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The Main Challenges of Transitioning from a Paper-based to an e-Health System: The Case of Cameroon

Master's Thesis

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Paberipõhiselt tervisesüsteemilt e-tervise süsteemile üleminekuga seotud peamised väljakutsed: Kameruni juhtum

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Author's Declaration of Originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature, and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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Abstract

It can be said that the technology to design and implement an e-health system in Cameroon can be adopted from other countries that have a mature e-health system like Estonia, Finland, and Denmark. Despite the availability of technology in other countries, and increased use of internet usage in Cameroon in general, certain factors are hindering the implementation or use of an e-health system in Cameroon. The study aims to find out the barriers that Cameroon is facing in transitioning from a paper-based health system to an e-health system. One of the important components of this research will be to discuss some recommendations that could apply in Cameroon or certain factors the government should consider in their quest to transition to a digital health system. A qualitative methodology will be used in this study focusing on a case study approach. Data for the case study will be collected using a semi-structured interview and the data from the different respondents will be presented or analyzed using a thematic technique.

Keywords: Implementation, e-health system, obstacles, data, and barriers.

List of abbreviations and terms

OECD	The Organization for Economic Cooperation and Development
UN	United Nations
Covid-19	Coronavirus Disease of 2019
ICT	Information and Communication Technology
E-health	Electronic health
CDC	Centre for Disease Control
NDHSP	National Digital Health Strategic Plan
IT	Information Technology
EU	European Union
e-Prescription	Electronic Prescription
e-ID	Electronic Identification
ID	Identification
USA	United States of America
WHO	World Health Organization
MOH	Ministry of Health
INTERPOL	The International Criminal Police Organization
COPD	Chronic Obstructive Pulmonary Disease
GDPR	General Data Protection Regulation
MRI	Magnetic resonance Imaging
EHIS	The Estonian Nationwide Health Information System
EHR	Electronic Health Record
PACS	Picture Archiving and Communication System

Table of contents

List of Figures

List of tables

1 Introduction

In the scramble for natural resources, oil is often referred to as “black gold”. It is without a doubt that oil sales can generate huge profits. Hence, why it is often compared with gold or something precious. Nowadays, there is another type of black gold known in the field of information systems known as data or big data. Big data can be characterized amongst which include; volume, velocity, variety, extensionality, and value (Kitchin, 2016). It is this data which constitutes a significant aspect of the e-healthcare system. In the field of medicine, research, and data are two integral that work alongside each other. Medicine relies typically on data that has been collected either from the past or currently. As such, the storage of past medical data cannot be over-emphasized as it is a crucial part of the medical field. The accumulation of medical data over the years is one of the contributing factors that promulgated the necessity for the design and implementation of an e-health system (Perera, 2012). For example, during the heart of the Covid-19 pandemic, the Estonian Center for Health and Welfare Information Systems launched the “HOIA” application. This e-health application provided useful data when coming in contact with another user who has tested positive for the Covid-19 virus (Karopoulos, 2021).

From a layman’s perspective, e-health refers to the use of electronic devices to offer or carry out healthcare services. The term e-health has been used for quite a while as far back as the late 1990s when the use of the internet started gaining ground and marketers promoting e-commerce, or e-business, e-health also became a new field to explore. The term e-health does not have a fixed definition, however, for the purpose of academics, some sought of definition is necessary. According to (Eysenbach, 2001), “*e-health is an emerging field in the intersection of medical informatics, public health, and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state of mind, a way of thinking, an attitude, and a commitment to networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology”* This definition is useful as it covers relevant aspects of e-health such as ICT, the intersection of public and private

health (e-health is also used in both sectors), the use of the internet to deliver medical services. Another author (Neuhauser, 2003), discussed that "e-health involves the use of emerging ICT to improve health and health care services" Even though the definition seems short, it covers vital aspects like the use of ICT to provide health care services.

The focus of this research is not to elaborate or examine a detailed discussion of the definition of e-health. However, since e-health is not a relatively new concept, its importance in the medical field cannot be ignored. In (Perera, 2012), certain relevance of e-health can be identified. Firstly, the use of ICT and the internet in health care services bring about efficiency and thereby reduces cost. Cost can be increased by duplicate and or unnecessary diagnostic, non-reusable information collection techniques. For instance, a single computer can be used to record multiple patients' data, whereas, in Cameroon, each patient is required to purchase a medical booklet. Secondly, e-health can significantly improve education in the use of ICT equipment for medical personnel and digital literacy for its users. Also, e-health can ensure the delivery of quality medical services such as online appointments as opposed to waiting in a physical queue which is time-consuming and can result in time wastage if the patient is not finally attended to or if it takes an unnecessarily long time, online video calls with medical staff, and e-prescription.

The few importance of e-health highlighted above is a daunting adventure to implement in Cameroon. Even though the use of e-health is not new to the medical field, more emphasis on its use was heightened during the early phases of the Covid-19 pandemic (Affairs, 2022). The UN e-government survey of 2022 reveals that most member states were not prepared to offer services online but tried implementing steps directed towards online services, especially to those living in remote areas. The UN survey reported that there was an increase in internet usage from 4.1 billion people in 2019 to about 5.2 billion people in 2022. At the heart of the Covid-19 pandemic which shifted the delivery of some public and private sector services to seek digital solutions, was a lesson to start designing and implementing digital services. As such, the Ministry of Health in Cameroon designed the National Digital Health Strategic Plan (NDHSP) in collaboration with the CDC. The NDHSP discussed the issues related to health care. This topic will be covered in detail in the subsequent chapters of this research.

Despite a well-detailed e-health plan put in place by the Ministry of Health in Cameroon, this research will investigate further the barriers Cameroon is facing from transitioning from a paper-based system of health to an e-healthcare system.

1.1 Problem Statement

The UN e-Government survey of 2020 outlined aspects that characterize a successful e-government state. Amongst these threads, e-health was not excluded as one of the services both the public and private sectors can deliver which adds up to an important aspect of e-governance. It is relevant to note that public and private health care can also be in the form of electronic or e-healthcare systems. The delivery of e-healthcare services has to be seamless (Estevez, 2007) to ensure that users and medical professionals can access medical data for real-time diagnosis and treatment. That is, doctors and medical staff should be able to securely store patient's data which can be used as soon it is needed. Especially when a patient is at the hospital and there is a need to understand their previous medical history to make informed medical decisions. Countries all over the world are in the digital era (Shepherd, 2004) where access to information is vital for the delivery of services.

Unlike most African countries (Kiberu, 2017), the healthcare system in Cameroon is mainly paper-based. In any IT-related service, data is an important aspect (Ubaldi, 2020) of a successful e-healthcare system. This is not the case in Cameroon where every patient has to purchase a hospital booklet before going in for a consultation. To acquire more insight into the research, the researcher communicated in an informal pre-interview via an unrecorded phone call on the 11th of November 2022 with two medical personnel's from Cameroon working as laboratory technicians. During the short conversation, they disclosed that all the laboratory results, past and current medical history, and prescriptions are written in a patient's hospital booklet. The hospital booklet can easily be destroyed by rain, flood, and fire or even get missing. A paper-based healthcare system cannot guarantee that the data recorded in hospital books or hospital patient registers can last for a longer period. Therefore, the longevity and usability of medical data on these patient booklets and hospital medical registers are highly questionable. Paper base health care system cannot seamlessly facilitate the duties of medical personnel (Gurley, 2004) because, without a patient's hospital booklet during a consultation, the attending nurse or doctor may not have the accurate past medical history of that patient. It can be said that

entering medical records just on paper or hospital booklets cannot serve long-term medical purposes and it is also not sustainable for the environment. Deforestation is a significant problem in Cameroon where one of the reasons trees are cut down is to produce papers that are used as files, booklets, and registers in medical institutions. Deforestation results in other problems like floods, and climate change. Even though switching to an electronic system of health does not completely solve the problem of deforestation, at least it is a step in the right direction to mitigate the problem. The benefits of a digitalized health system (Fitzgerald, 2008) can help give medical staff a better working experience, and a more organized work life, access to patients' health history all in one place.

A patient's data can be accessed with just a few clicks using an electronic system with the help of ICT tools like computers, the internet, and other electronic medical devices. Health records can last for a long period and can be used interoperable by other sectors such as the Transport Administration, the Judicial Administration, and the Police. Also, looking at the e-health benefits for example Estonia (Habicht, 2018), an e-health system can significantly reduce the cost of printing papers. Transitioning to an e-health system will help preserve medical data and better deliveries of health services in Cameroon.

1.2 Research Questions and Goals

Research question

The goal of the research is to investigate the barriers preventing Cameroon from transitioning to an e-health system. Also, the researcher is interested to find out the factors that can contribute to the successful implementation of an e-health system. Examples will be taken from some countries like Estonia, Denmark, and Finland. To achieve these goals, this paper will have to answer two main research questions that will be further broken down into sub-research questions to more insight into a particular research question:

Research question 1

What are the characteristics of an e-health system?

Sub-question 1: What features/models have been used by countries with a mature e-health system?

Research question 2

What is the status quo of Cameroon's healthcare system?

Sub-question 1: What are the current processes healthcare professionals and patients in Cameroon go through for delivering and receiving medical services?
Sub-question 2: What are the barriers or obstacles to transitioning to an e-health system in Cameroon?
Sub-question 3: What recommendations can be given for Cameroon to transition to an e-health system?

1.3 Motivation to carry out the research

The researcher moved to Estonia in the fall of 2018 and has lived here ever since. One of the main reasons for moving here was the IT incline culture of Estonia. The country has a population of about 1.3 million people according to the population world meter. Even with its small size, Estonia ranks second amongst the ten EU member states with a more than 70% success rate in the provision of e-health services (Fitri, 2022). After a few visits to some hospitals in Estonia, the delivery of medical services such as patient registration, consultation, and prescriptions were carried out with the use of ICT tools or with the use of e-health systems. For e-prescription, the researcher bought the e-prescribed medication with the use of their Estonian identification card that has some digital or electronic features which can be used for e-prescriptions. The status quo is different in Cameroon where a patient's registration, consultation, and prescription of medication are entered into a patient's hospital booklet and recorded in the hospital patient register.

The 2022 UN e-Government survey reveals that digital solutions were implemented to ensure the continuation and seamless delivery of services during the Covid-19 pandemic. It is without a doubt that the Covid-19 pandemic is a motivating factor to encourage the use of digital services as one can never tell exactly when another disaster or pandemic will force nations the world over to go into lockdown. One of the six steps proposed by the OECD for a nation to move to full digital transformation is being proactive (OECD, 2019). It is on this bedrock that the researcher is interested to investigate why despite all the positive impact an e-health system can bring, why Cameroon's health system is still primarily paper-based. What could be the challenges Cameroon faces in transitioning to an e-health system? What could Cameroon do to transition to an e-health system? These are core questions the research intends to investigate in the course of this work.

1.4 Structure of the Research

To carry out this research to meet the requirements of a scientific approach, the research will be divided into different chapters. Each chapter will try to bring more light surrounding the transition of Cameroon to an e-health system and try to answer the different research questions.

The First chapter will focus on the introduction. The introduction will define what e-health is. It will also give a background to the study.

Chapter Two will focus on the literature review of this research. The researcher will take a look at different scientific papers or peer-reviewed papers, and books in the area of e-Governance and e-health systems. These different scientific references will contribute a particular role to the successful development of the research. The theoretical framework will also be analyzed in this section of the research. The theoretical framework shall be selected so it aligns with the problem statement of this research.

Chapter Three will examine the research methodology of this work. This constitutes an essential part of this research as it will outline the research approach the researcher will use and the reasons for choosing that particular approach. It will present a clear understanding of how the author will collect and analyze data.

Chapter Four will focus on the research findings and the results from the semi-structured interviews. The researcher will present the data gathered from analyzing mainly the responses interviewees will generate from the semi-structured interviews. The findings and results will be presented in a thematic approach. This will help to better understand research question two and the research goals.

Chapter Five will discuss the recommendation that could help Cameroon better design and implement a successful e-health system.

The conclusion and limitations, and future research will be looked at in chapter five. This will be the last chapter of this research.

2 Literature review

2.1 Introduction

This chapter will be structured into different sections so that the ideas can be presented in an orderly and presentable manner. The theoretical framework will be examined as it discusses the challenges to transitioning to an e-health system in Africa and proposed solutions to these problems from which Cameroon as an African nation facing similar problems could benefit. As such, the highlights of this theory will be a relevant contribution to this research. Some general characteristics will be discussed and some features which have helped certain countries transition to a mature e-health system. Some general barriers and benefits will also be discussed.

2.2 Theoretical framework

Activity theory framework will be used in this work as it explains the basis for e-health readiness assessment in health institutions (Coleman, 2013). The theory is relevant as it focuses mainly on Africa. It can be said that the health system in Cameroon and most African nations are paper-based. A significant number of people especially those living in rural areas do not have access to adequate healthcare services. To improve quality health care services, information and communication technology (ICT) tools need to be adopted amongst the other activities or changes like competence in ICT education, data protection laws, and cybersecurity infrastructures. The use of ICT in health services can bring about a successful e-health system. The theory discusses four main areas that can be used to ascertain the common problems faced in the delivery of healthcare services and how the design and implementation of an e-health system could alleviate these problems or result in better healthcare service deliveries.

Firstly, there is a need for change. It was discovered that those in the rural areas who manage to make it to the hospitals usually meet a long queue and shortage of medical staff, and long waiting time. As such, some of these services, like e-appointment, e-consultation, and e-prescriptions can help save time, and reduce the cost of hiring more

medical staff (Coleman, 2013). Not all medical cases may need a patient to necessarily come to the hospital. Certain cases can be attained online and a patient could get their prescription online. This approach could help save time for both the medical staff and the patients. The medical staff can focus on more severe life-threatening cases. The idea is not to prevent or stop patients from coming to the hospital but more of they should only come if it is really necessary.

Secondly, it is imperative for medical staff like doctors and nurses to be willing to engage and support the adoption and implementation of an e-health system, as the system will also be used by them and if they are not willing or engage in such changes, then it could be difficult to successfully implement an e-health system (Coleman, 2013).

Thirdly, society needs to also be ready to use e-health services and their different platforms (Coleman, 2013). Society is considered as the end user and if they do not use the service then there is no need to design and implement an e-health service.

Lastly, technology is an important aspect of designing and implementing an e-health system. There is a need for experienced IT experts to help support the design and implementation process of an electronic healthcare system.

The theory will help guide the researcher to understand the challenges faced by Cameroon's health system, the current state, and how an e-heath system could better help the current state.

It is relevant to also assess the current state of Cameroon's health system and if it is possible to transition from a paper base medical health system to an e-health system using the factors which have led to a successful e-health systems in some countries like Estonia, Finland, and Denmark. The Digital Health Strategic Plan which is supported and promoted by the Centers for Disease Control and Prevention (CDC) and I-Tech university in Washington is a project aimed at introducing an e-health system in Cameroon by 2024. The initial research has shown that even though the internet is accessible, the country does not have the tools and required capacities to successfully implement an e-health system (Manaouda, 2020).

2.3 Characteristics of an e-health system

This study cannot be completed without looking at some common attributes or features of an e-health system. Electronic or digital health system is not a new phenomenon but its implementation and use have seen an increase in most countries. This significant show

of interest or increased implementation of e-health systems can be attributed to the growth of the internet, digital systems of recording data, and the use of ICT technologies (Putteeraj, 2022). The characteristics of an e-health system can either be a barrier or a factor promoting the successful transition from a paper-based system of health to a digital healthcare system.

Quality of the information

Information or data is a key component of an e-health system and the quality to which this information is available for the end-user and medical personnel is crucial. The quality of the information should include aspects like seamlessness, consistency, relevance, and usability. These elements of information quality will give a better user experience and delivery of e-healthcare services (Alazzam, 2021). Poor information quality will result in an undesired quality of e-healthcare services. As with any field or research, information plays a significant role and can determine how a service will be used. The idea of implementing or transitioning from a paper-based healthcare system to an e-health system relies on the availability of not just a wide range of information but this information should ensure that it will result in a positive outcome such as increased usability, and facilitate the flow of medical information when necessary.

Security and user authentication

Just having an e-health system is not enough. One of the most significant issues with an e-health system amongst other things is the aspect of continuously making sure the various e-health platforms or applications and the different infrastures that support their functionality are adequately secured. In 2020, INTERPOL posted on its website highlighting concerns about amplified or increased cyberattacks targeting medical facilities. These attacks were mostly ransomware attacks where the attackers who gained unauthorized access to medical data encrypt the data and request monetary compensation before they can decrypt the data. These payments are usually made to crypto wallets which are difficult to trace. Such attacks were common in hospitals and institutions such as Brno University Hospital in the Czech Republic, the WHO, United States Health and Human Services Department, and Paris Hospital Authority (Muthuppalaniappan, 2021). According to (Metsallik, 2018) countries like Estonia have designed and implemented the use of e-IDs, and Smart-ID to ensure some robust form of security and to prevent unauthorized access to medical information. Security and authentication remain a big

concern when it comes to electronic health systems. Countries also need to put in place standard regulations in line with data privacy to ensure the security of patient data (Kovac, 2014).

Interoperability

According to the Oxford English Dictionary, interoperability is "*the ability of computer systems or software to exchange and make use of information*". Another author (Iroju, 2013) defines interoperability as "*the ability of different information and communications technology systems and software applications to communicate, to exchange data accurately, effectively, and consistently, and to use the information that has been exchanged*". The aspect of interoperability is a significant factor for any hospital or medical institution that uses an e-health system. One of the main reasons for adopting an e-health system is to facilitate the transfer of data securely within the different ICT systems, and even possibly different institutions like between the health authority and the transport department. The smooth or seamless exchange of medical data is critical with e-health. It is not enough to have computers, e-health platforms, and applications that are connected to the internet but there should be a system that makes all these infrastructure to be able to connect to one another. As such, at the point of consultation, a medical doctor can already have access to a patient's data even before they get to meet a doctor.

Stakeholders

According to the Oxford Learner's Dictionaries, a stakeholder could be a person or an entity that has a vested interest in a project. The design and implementation of an e-health system can be best established with the help of relevant stakeholders. These stakeholders could differ from county to county but the stakeholders could come from different IT backgrounds, policy reviewers, and government institutions (Gregory, 2017). It is beneficial to have contractual agreements (Hage, 2013) with stakeholders in an e-health system as these contracts motivate the stakeholders to deliver better services as agreed in their contracts. According to the NDHSP in Cameroon, stakeholders can significantly help evaluate the development and maturity of e-health.

2.4 Lessons from some selected countries with a successful transition to an e-health system

This part of the thesis will look at examples from Estonia, Finland, and Denmark. The question of why these countries have been selected will be explained when examing each country in the proceeding sub-chapters. It is relevant to note that an African country was not selected by the researcher because e-health design and implementation or transition from a paper-based healthcare system to an e-health system is a new phenomenon. A majority of African countries are still at the design or building stage (Bedeley, 2014) and (Iradukunda, 2021). One of the goals of this research is to look at some countries that already have a mature or successful e-health system or have successfully transitioned from a paper-based to an e-health system. Cameroon can learn a lesson or two from these countries. The idea is not to prove that a particular method used in one country can or must be implemented in its entirety in Cameroon as that may be of course almost impossible. However, certain aspects must be put in place like authentication and logging into the e-health platform, data privacy, interoperability, standardization, and national insurance plan.

Estonia

According to the population world meter, Estonia has a population of about 1.3 million people. The small nation has an impressive and if not one of the nations that offer more online services in the world. According to the e-Estonia website, 99% of all public services are online. One of the services not online is divorce as the parties involved have to be physically present. Digital health is one of the e-services that has improved over the years in Estonia. The main source surrounding the discussion about the e-health system in Estonia is mainly the work of (Janek et al, 2018). The work gives an understanding of what Estonia has built over the years. It is important to stress that what Estonia has built over the years to transition to an e-health system cannot be “copy and paste” or implemented in the same manner 100% in Cameroon. The idea is to look at or discuss some of the features/factors that have contributed to Estonia’s successful transition to an e-health state and what lessons can Cameroon take out from Estonia’s e-health journey.

The EHIS manages the e-health system. Every citizen and resident has an e-ID number which helps to facilitate a patient identification process at medical facilities or when logging into various e-health platforms or applications. Estonia's health system is based

on health insurance plans which can be paid by employers or privately for unemployed individuals. The Estonian e-health system is based on three layers. The first is the data layer which is made up of repositories for medical storage. Data transfer is the second layer for secured internet data exchange and the last is the application layer to provide services to different users such as healthcare providers, citizens, government agencies, and decision-makers. Another landmark feature of the health system in Estonia is the nationwide EHR system which is an interoperable platform for the exchange of health data in a standardized approach. The nation also has a standardized imagery-sharing platform known as the PACS. With this platform, medical providers do not need to worry about looking for specific software any time they want to access a specific medical image like an MRI. The e-health system in Estonia is also made up of a nationwide register for family doctors, pharmacies, and school nurses. This helps to facilitate interaction between the different stakeholders. Finally, the nation has the Health Services Organization Act and chapter five of that act is dedicated to also draw attention to the EHIS. This research will not dive into an in-depth analysis of the act, but it is relevant to point out that with such legal clarity on the rights and duties of the different stakeholders in Estonia's e-health system, it brings a sense of clarity of the different responsibilities of the health stakeholders. Legal clarity, an integrated digital ecosystem, a national health insurance plan, rules on authentication and secured login, and standardization are some of the factors that have contributed to a mature e-health system in Estonia. In the context of Cameroon, this could already be an indicator to have a system that best works for the nation. What is important is that, for instance, if having legal clarity or a properly outlined insurance plan that has contributed to a successful transition e-health system in Estonia, then the lesson for Cameroon could be to also have something of that nature but in the context of the nation that is feasible to work.

Finland

Finland also features as one of the top five countries in Europe with a successful implementation of an e-health system (Afiq, 2022). The implementation of the Finnish e-health system is divided into the regional and national levels. The regional levels or structures form a network of integrated information systems while the national structures ensure standardization and clarity on the EHR. One of the very first aspects of Finland's e-health system is standardization (Doupi, 2004). Finland has a body that monitors the e-health system called the National Institute for Health and Welfare under the Ministry of

Social Affairs to ensure health care and welfare services are in accordance with the national strategic plan for the implementation of an e-health system. One of the most relevant things which the Finnish government did before embarking on implementing an e-health system was to carry out a survey to help decision-makers support the transition to an e-health system (Vehko, 2019). This gives an idea that when making such a landmark decision to implement an e-health system in Cameroon, then it is, of course, necessary to carry out a study with a significant number of respondents to understand the need and demand for such services. Finland is among the first countries in 2012 to encourage digital health competence education for its health professionals. It allowed health professionals to enroll in a two years study on issues related to digital health (Staelraeve, 2022). Another interesting feature of the Finnish e-health service is the Kanta platform which is the main platform for the exchange of medical data. This has supported the creation of a telemedicine consultation network that allows healthcare professionals to communicate in a secured video consultation with patients. This is useful for older patients and patients from remote areas where the distance to urban hospitals may be long and problematic. Telemedicine or video call consultation can be used for common medical issues such as; family planning, headaches, prescription, cough, and allergies (Staelraeve, 2022). This can save time for patients who will not need to travel to hospitals if they can get treatment online. Transitioning and implementing a successful e-health system takes years of planning, design, actual implementation, and monitoring to put the blueprint on paper into action.

Denmark

In analyzing the Danish e-health system, one of the very first features the researcher picked out was that every Dane is issued an e-ID number from birth. According to the population world meter, as of 2023, Denmark has a population of about 5.8 million people and 3.3 million people are aware of the health portal. One of the successes of the e-health system in Denmark has been embedded in trust. It is without a doubt that users should trust the system which handles their medical information and this information should not be abused. Just like the Estonian health system, users can see who accessed their data and have the right to request more information as to why their data was accessed, and what was it used for. This to an extent creates a foundation of trust for more people to use the portal. 24% of those who are aware of the portal reported having convenient treatment and a better understanding of their medical history as they could access and see their

medical data (Keutel, 2018). Another relevant feature that could have contributed to a successful transition to an e-health system is the education of health professionals on the use of ICT tools to facilitate digitalization in health. In line with this, users are also encouraged or educated to use the platform through workshops where they are taught how to use the portal (Norgaard, 2015). Denmark also uses an audio-visual communication system to communicate with the aging population or those who may find it difficult to travel to the hospital. This helps to save time and is less stressful for patients (Wynn, 2020).

2.5 Benefits of an e-health system

The electronic or e-health system has revolutionized the health sector and the way services are delivered (Wickramasinghe, 2006). Even though e-health still faces several barriers, the benefits derived from designing and implementing an e-health system can be overwhelming. The researcher will examine a few of the e-health benefits which are relevant to achieve the goals of this thesis.

Improves communications

In most cases, the traditional healthcare system will require patients to physically meet with their doctors. Patients have to queue for several hours just for consultation and even wait long hours to get laboratory results. Also, before patients finally meet face-to-face with their doctors, it takes longer time and these meetings can last just for a few minutes (Harrison, 2006). However, the e-health system is a game changer in the medical field. Healthcare providers, patients, and medical staff could all use a single platform for communication. For instance, a patient may be asked to get an MRI from another medical institution. After the imaging is completed, with an e-health system, the patient's doctor can just access the MRI from an online platform. This can save time for patients rather than coming to the hospital and spending hours, they can have planned communication with their doctors using platforms that support different means of communication like messaging, and video or audio calls.

Improves efficiency

In a study carried out in Pakistan which also uses a paper-based health system, the author found out that an e-health system will improve efficiency in the delivery of healthcare services. Efficiency can help to reduce costs related to providing medical services. For instance, with the paper-based method, tons of paper and more personnel are needed in the delivery of services, whereas with an e-health system, just a handful of papers like consultation forms and manpower are needed as most of the services can be delivered online. A digital record of the services can also be tracked online This helps to improve the delivery of concise and precise information. Also, with the e-health system, a patient's basic information like name, date of birth, emergency contacts, and any allergies is usually collected once which safe time each time a patient visits the hospital. An e-health system generates a great deal of data about a patient such as previous and or ongoing diagnosis, treatment, and prescription (Naseem, 2014). This information can be used to provide or facilitate quality and timely delivery of medical services to a patient.

Data preservation

An e-health system can be used to preserve a patient’s data which can be reused for medical purposes. The data can be digitally preserved using services like cloud storage. Digital preservation relates to several activities carried out to ensure access to data over time (Caplan, What is digital preservation?, 2008). It cannot be disputed or out rolled that providing services online does not come with associated risks such as cyberattacks (Barateiro, 2010). However, preserving data to be used and reused over a long period can save time for both the patient and medical staff. The data generated by patients can also be used for medical research.

Digital innovations

There are a couple of countries with a successful e-health syste m such as Estonia, Finland, and Denmark. Looking at innovation from both countries, it is clear that implementing an e-health system can bring about other digital medical innovations or solutions. For instance, added to the e-prescription service under the Estonian healthcare system, they also have software which indicates to doctors when prescribing medication to patients of any recorded allergies, or any drug which a patient is already taking that can pose health risks to the patient (Halim, 2021). In Denmark, they also developed an e-health service for COPD. The system allows patients to enter their health data into a

mobile application and can get medical assistance. The patients only go to the hospital only when necessary (Alcimed, 2022). Therefore, the implementation of an e-health system is fertile ground for other technological innovations.

2.6 Barriers or challenges to an e-health system

The attitude of the user

One of the reasons for designing and implementing an e-health system is to provide the delivery of seamless healthcare services conveniently even in the comfort of a user's home. That is, it is not all medical cases where a patient needs to physically visit a medical facility or physically meet a doctor. E-health systems usually have self-services where users can book online appointments, and renew prescriptions without meeting face-to-face with their doctors. One of the goals of this research is to look at the transition from a paper-based health system to an e-health system. According to the NDHSP 2019, in Cameroon, one of the major challenges was the resistance to change especially by the user. It can be seen from the NDHSP that the low demand for e-health services is strongly tied to resistance to change. Most users may not see it necessary to change from the status quo there are already used to. According to (Bangert, 2003), if the leader encouraging the transition to an e-health system does not share the vision convincingly enough to the users as to why the transition is necessary, the users can be resistant to such changes. The author also highlighted that the issue of resistance could be linked to the willingness to accept technological changes which are also influenced by cultural values. The NDHSP in Cameroon also forecast that one of the challenges they could face is the aspect of acceptability of a new healthcare system with the use of digital technology.

Legal challenges

Some of the issues associated with legal challenges could be data privacy, legal procedures for abusing a patient's data, legal proceedings for cybersecurity issues such as cyberattacks, and the absence of standardized regulations or laws on issues related to data privacy violation. Legal barriers could be one of the most significant barriers to designing and implementing an e-health system and cannot just be overlooked or ignored. The EU for instance has legal guidelines such as the GDPR, the Directive 95/46/EC on Data Protection (Callens, 2008). Whereas in Cameroon, according to the NDHSP, there are legal gaps concerning legal issues on health, and also there are weak national laws in

line with cyberattacks issue. It can be said that there is an absence of a standardized legal framework that could support the implementation of e-health at the moment in Cameroon.

Interoperability

Interoperability is like a double edge sword in the field of e-healthcare. It can be considered a benefit and at the same time a barrier to the successful transition to an e-health system. When trying to solve the issue of interoperability, the issue of standardization becomes a challenging task. Different departments, medical institutions, and MOH may use different systems and data formatting styles. Let us take an example adapted from (Masud, 2012), if a family doctor trying to analyze an MRI from a laboratory, it becomes an issue if there is no standardized file format for accessing the MRI especially if the family doctor's hospital software for reading MRIs is not the same with the laboratory where the MRI was produced. It is however vital to have a standardized interoperability guideline about the design and implementation of an e-health system (Adebesin, 2013). Looking at the findings from the NDHSP in Cameroon, the aspect of interoperability was another concern because they were no laid down framework on the topic. An interconnected system where medical information can be exchanged and understood clearly without interruption is necessary for the successful implementation of an e-health system.

Technology Literacy

Technological literacy is relevant for the survival or successful implementation of an e-health system. It may backfire even if an effective and efficient e-health system is implemented in a country if the healthcare professionals and the users do not have sufficient knowledge of how to use the technology or make use of ICT tools. Those with experience or those who have been trained with ICT tools and IT are more comfortable and inclined to use technological tools in healthcare services (Zayyad, 2018). Without proper education not just for healthcare professionals but also for users can impede the development or progress of implementing an e-health system.

3 Methodology

3.1 Introduction

This chapter is dedicated to giving an understanding of how the researcher will gather relevant data to present ideas in a scientific approach. The researcher will make use of a qualitative research approach to answer the research questions highlighted in chapter one of this research. As discussed by the author (Gerring, 2017), qualitative research is best used when using a case study like in the case of this thesis that will focus on the challenges of transitioning from a paper-based system of health to an e-health system in Cameroon. It involves little or no significant statistical analysis and the sample of the study is usually small. This approach is preferable to a quantitative research technique as the data that will be gathered will come mostly from sources with little or no quantifiable sources. It is without a doubt that using this approach, the researcher may have difficulty organizing the collected data (Jervis, 2014). To tackle this problem, the author will make use of a thematic presentation or analysis of the collected data which will help to scientifically present the findings or results. A drawback of the qualitative research methodology is that the sample size is usually small, and the findings may not be a thorough representation of the barriers related to the successful transition to an e-health system in Cameroon (Vanderstoep, 2008). Secondary sources or literature will also be used to gather more data and answer the research questions.

The approach and tool to be used to gather data and analyze data respectively will be discussed in this section. This chapter will look at the case study approach to collect qualitative data. Semi-structured interviews will be used to collect data, and the responses from the semi-structured interviews will be thematically presented.

3.2 Case study approach

A qualitative research methodology will be used in this research. This methodology mainly deals with non-numeric data. In chapter two of this research, relevant documents have already been discussed to give a wide understanding of the main ideas. Reviewing those documents or secondary sources of data will not be enough to conclude the findings to answer the research questions. As such, a case study will be used to gather primary data. The researcher finds the definition used by (Flyvbjerg, 2011) useful and relevant

"*an intensive analysis of an individual unit or a community stressing on developmental factors…*" The stress on community and development in the author's definition is an important aspect of using the case study approach. The focus will be on interviewing a small number of people such as medical staff and patients. Their responses will contribute to the developmental aspect of the challenges Cameroon faces in transitioning to an e-health system. The author further argues that case studies alone cannot provide sufficient data for a broader group but it can at least lay the foundation to answer research questions which in this case the focus is on barriers to transition to an e-health system in Cameroon.

3.3 Data collection

Semi-structured interviews

A semi-structured interview is a method used to collect data in research using open-ended questions in a predetermined thematic approach. This type of data collection method gives more flexibility, and it also allows the respondents to give detailed responses as the responses of each respondent can be tailored to get more answers from each interviewee. (George, 2022). Certainly, two interviewees will have different responses.

The primary source of data collection will be a semi-interview (Wilson, 2012) most especially a semi-structured interview (Aksu, 2009) from a random sample of about five medical professionals and about five individuals who have once been patients. The semi-structured interviews will be recorded and transcribed. Since the researcher has not been living in Cameroon for the last five years, the researcher asks a friend to contact doctors and patients who will participate in the interview. A semi-structured interview was more suited for this research as the respondent can give their responses in an open end format and dig dive to explain their answers in detail (Blake Jackson, 2021). The interview will be carried out through Zoom and would not last more than 20 minutes. Interviews seem to be the most preferable source of data collection as there's little or no available academic literature on the e-health system in Cameroon. However, some interviewees may be reluctant to disclose sensitive or personal information (Aksu, 2009). To analyze the information, gathered from the interviews, a thematic analysis (Alhojailan, 2012) will be used to present the data in a meaningful form.

Thematic analysis

The responses gathered from the semi-structured interviews will be presented using thematic analysis. This approach of data analysis is commonly used by qualitative researchers and it gives flexibility when organizing the findings from the semi-structured interviews. Thematic analysis "*... is a method for analyzing qualitative data that entails searching across a data set to identify, analyze, and report repeated patterns*" (Kiger, 2020). Some of the responses of the interviewees will be repetitive and this approach is convenient and flexible to arrange those repetitive data or responses into themes (Braun, 2006). This method is most applicable as one of the research questions seeks to answer the problems to transition from a paper-based health system to an e-health system in Cameroon. To give a good picture of the issues surrounding the health environment in Cameroon, it is worth presenting the findings into themes.

In the works of (Kiger, 2000) they present that (Braun and Clark, 2006) argue that this approach may be as rigorous as using a quantitative methodology in general. More interesting, they present that using an effective theory that applies to this data analysis method can prove effective. The Activity theory used in this research focuses on the challenges Africa faces to transition from a paper-based health system to an e-health system. Also, the authors argued that the nature of this approach is flexible. Semi-structured interviews which will be used to gather responses from interviewees itself is flexible and the researcher can ask follow-up questions which may generate more flexible data. Analyzing this kind of data can be problematic, as with flexible responses, the researcher can be deterred from the research question(s) they are trying to answer. The researcher will try to ensure that the research questions are specific in answering only parts of the general research questions. The time per interview will not be more than 20 minutes to avoid unnecessary responses and large data from the respondents. This method of analysis helps the researcher to easily summarised their findings and present relevant aspects to address the research questions (Kiger, 2000). This approach helps to filter out meaningful data from irrelevant information generated by the respondents.

Ethical issues and commitment

The university has outlined guidelines for writing a thesis. These guidelines are explicit and cover all the necessary aspects a researcher should follow when writing a paper. In that regard, the researcher shall follow these guidelines to be compliant. Non-compliance

with these guidelines, the thesis may not be considered scientific and may be disqualified. Most especially referencing and formatting styles will be strictly followed. All sources will be referenced properly according to American Psychological Association (APA) standards. This will give some credibility and eliminate any doubt of unethical issues.

It is without a doubt that academic research of this nature will be carried out with some ethical considerations in terms of personal, sensitive confidential information. One of the methods used in this research to gather information will be a semi-structured interview through Zoom. The researcher anticipates that some interviewees may not want to disclose any information which is personal like their complete names, addresses, ages, previous medical history, work titles, and where they work exactly. To tackle these concerns, the researcher shall explain to the interviewees that their names, work titles, where they work, and the information they provide will be solely for this research. The interviewees themselves shall remain anonymous.

Document review

The secondary form of data collection will be a literature review (Gunasekare, 2015) of scientific documents, reports, and surveys on some countries with successful e-health systems. At the moment, there is insufficient literature on the subject of e-health in Cameroon. As such, the research may use literature on the subject matter from other African countries. Also, literature from outside the continent – of Africa, will also be used to complete this thesis.

4 Presentation of results

The chapter will begin by looking into Cameroon's National Digital Health Strategic Plan (NDHSP). The NDHSP is a blueprint that examines Cameroon's transition to an e-health system. Issues like the current state of Cameroon's health system could be looked at under the NDHSP. The second part will focus on the results from the semi-structured interviews.

4.1 Cameroon's National Digital Health Strategic Plan

The drafting of the NDHSP (Health, 2019) commenced in 2019 with the help of the following stakeholders:

- The CDC in the United States of America
- The University of Washington
- The Ministry of Public Health in Cameroon
- Public and Private actors in the field of ICT in Cameroon

It is acknowledged in the NDHSP that Cameroon's strategy for an e-health system is in line with the WHO resolution on e-health system. The resolution WHA58.28 was approved in 2018 by the member states of the WHO (Al-Shorbaji, 2013) and encouraged its 192 member states to promote the design and implementation of an e-health system in their respective countries.

The NDHSP serves as Cameroon's blueprint which can be used by both the public and private sectors for the transition from a paper-based health system to an e-health system. It is hoped that by 2024, Cameroon should already have an effective framework for the implementation of an e-health system and a functioning e-health system which should be in line with the WHO digital health resolution. In this light, the following financial estimations were carried out to finance the NDHSP. This financial distribution is shown in Table 1 below.

Table 1: Financial Distribution for the NDHSP

Areas	Departments	Activities	Amount in USD
1	Leadership and Governance	Creation of the National Committee for the Supervision and Coordination of e-health	466,555
2	Legislation, Policy, and Compliance	Develop policies and ethics in e-health	126,050
3	Human Resources	Training of health personnel to use ICT tools	391,597
4	Strategy and Investment	Develop an e-health Annual Financing Plan	1681
5	Services and Application	Develop IT tools, e-medical record system, set up an integrated national management system, set up a tele/mobile medicine platform	10,125,496
6	Infrastructure	Ensure the availability of technological infrastructure, availability of cloud-based services	808,235
7	Standards and interoperability	Improve the collection and exchange of data	7,118,319
TOTAL			**19,037,933**

(Adopted from the NDHSP)

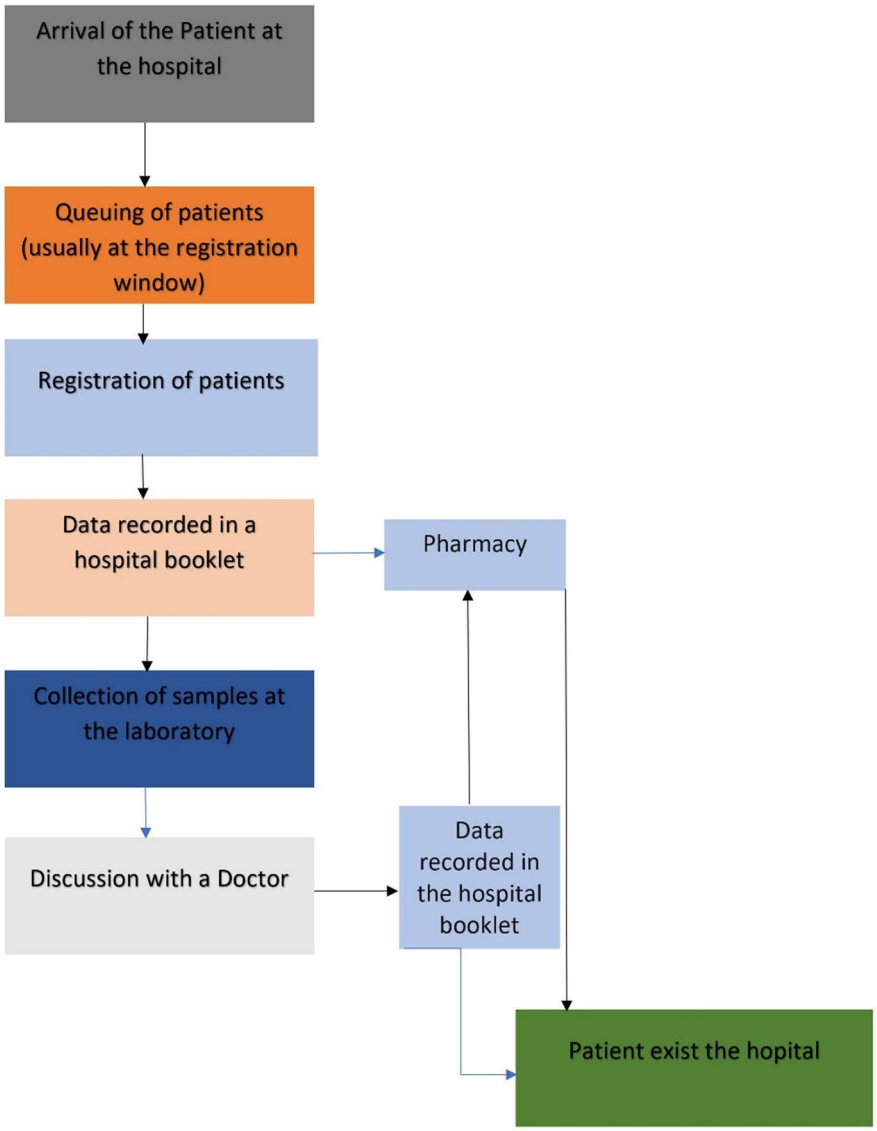
Cameroon Healthcare System

The description of the Cameroon health system will be analyzed from two main literature; NDHSP, and (Kamadjeu, 2005). The health system in Cameroon is divided into three

main sections; public, private, and traditional with the Ministry of Health at the center of providing guidelines and policies to regulate the delivery of healthcare services in Cameroon. The focus of this research will not include traditional health care because it is not possible to introduce an electronic health system in the traditional health sector. This will distort the originality of traditional medicine. According to (Kamadjeu, 2005), Cameroon does not have a standardized electronic blueprint for the collection, recording, and use of medical data. Just a few medical institutions in urban cities like Douala and Yaounde have incomplete standards with some degree of data collection. In Estonia for example, a user can see who has accessed their medical data with relevant information like date and time stamp, and name of the person who accessed their information (Metsallik, 2018). Whereas in Cameroon, due to the absence of a legal standardized e-health system, an individual may never be aware of who has accessed their data, and for what reasons was their data accessed. There is no change log to keep track of who has accessed a patient's data. To implement an e-health system, an application known as MEDCAB was launched in 2003 which provided patient registration, patient report, e-appointment, patient data generator, and hospital administration management. Only doctors and some medical personnel had access to the application. The application was only used by a limited number of medical institutions in some urban areas due to a lack of interest in the application. The application was short-lived as few of the trained medical staff moved to other hospitals that did not use the application, insufficient provision or availability of computers to sustain the use of the application (Kamadjeu, 2005).

Figure 1 below illustrates a typical traditional health system in Cameroon which is paper-based. The idea was adopted by (Cao, 2011), which has a physical queuing system. This type of system results in time wastage which stems from registration, entry of data in the hospital booklet such as recording of lab results, and prescription. Also, information collected at one department may not completely get to the next department as some information may be lost in the recording process. The NDHSP has been designed to implement an efficient and effective e-health system in Cameroon which could tackle the shortcomings of a typical paper-based health system.

Figure 1: Traditional patient flow in Cameroon's paper-based health system



Source: Adopted from (Cao, 2011)

4.2 Results from the semi-structured interviews.

The author interviewed 10 respondents, five of whom were medical staff and the other 5 were individuals who have once in their lifetime or recently been to a medical institution or hospital. The idea was to understand the problems faced by those who are actually working in the medical field and also by those who have used medical services. Table 2 below shows the title of the different respondents. To give a better understanding or present the responses from the interviewees in a scientific nature, the transcribed data or results from the recorded semi-structured interviews will be presented using thematic analyses. The thematic analyses or structure will help to give a scientific understanding of the barriers preventing Cameroon to transition from a paper-based health system to an e-health system.

Table 2: Distribution of respondents and their titles

Interviewee Number	**Position or Titles**
Respondent 1	Medical Doctor
Respondent 2	Nurse
Respondent 3	Medical Laboratory Technician
Respondent 4	Medical Laboratory Technician
Respondent 5	Medical Doctor
Respondent 6	Has once been a patient
Respondent 7	Has once been a patient
Respondent 8	Has once been a patient
Respondent 9	Has once been a patient
Respondent 10	Has once been a patient

Competence training

One of the questions asked or posed to health workers or staff was their educational level. The reason for this question is that those who have attained some level of tertiary or university education should have at least used computers and the Internet to complete a certain academic task. In that regard, they are not completely blank about using ICT tools. All the five healthcare workers interviewed responded that they have not had any competent ICT training on how to inculcate digital tools in their professional work to facilitate their day-to-day tasks. Respondent number five who is a medical said "*I am not confident to use digital tools in my daily work not because I do not want to but because I have not been trained. I am sure with proper training, using ICT tools will not be a problem*" Another respondent – respondent number one highlighted that "*I can use ICT tools because I did some training/education on my own, but I am not sure for my colleagues. As such, being the only one who can use ICT tools will not be a good idea if a large proportion of the healthcare staff cannot use them*" In Finland, a special digital competence two years training program was introduced in 2012 to upskill healthcare physicians on how to use digital tools in the healthcare system. By 2016, about 62 healthcare professionals graduated from the program (Reponen, 2017). Therefore, the lack of any sponsored government or sponsorship by the healthcare institution themselves is without a doubt a barrier for Cameroon to transition from a traditional paper-based health system to a digital health system.

Insignificant use of digital tools in hospitals/medical institutions

The medical staff response on whether they use any type of digital tools in their day-to-day work was confirmed by respondents who have once been patients and have experienced the delivery of medical services. The respondents mentioned there is little or no use of ICT tools in medical facilities. It is relevant to note that having digital tools like computers connected to the internet does necessarily mean there is an e-health system. The digital tools should be connected to a system without which the tools themselves cannot be relevant to the subject matter of digitalization in e-health. A practical example is the Taltech Moodle system where possession of computers by both the staff of the institution and her students without the actual Moodle system itself, will be meaningless when talking about the digitalization of education. The use of these tools even without an e-health system is a step in the right direction towards digitalization of the healthcare sector. Medical staff can already acquaint themselves with the use of computers to

facilitate their day-to-day work and make use of online work calendars. The fact the incorporation of digital tools is not significantly used is a mild problem for Cameroon to transition to an e-health system.

Awareness of the National Health Digital Strategic Plan

The respondents were asked if they are aware of any plans by the government or medical institutions to implement an e-health system in Cameroon. They all said they have not heard of such plans. The details of the NHDSP have already been discussed in Chapter 4.1 of this work. Even the best or well-suited digital plan may not be successfully implemented if attention is not given to well-planned strategies (Desveaux, 2019) and also if awareness is not considered in this plan (Anderson, 2002). Digitalizing the healthcare sector in any country, not just Cameroon is beneficial as discussed in previous chapters, what is important is that if the healthcare providers and users are not aware of such changes, even after its implementation those who are to use the service may not welcome it. It is therefore fair to assume that awareness is crucial when certain significant changes are to be implemented nationwide. The mere fact that people are not aware of the NHDSP can be considered a barrier to transition to an e-health system.

Interoperability

Some of the respondents for medical staff disclosed that they will want a situation where whilst a patient is in the consultation or laboratory room, they can already have access to a patient chart even before they meet the doctor face-to-face. The traditional procedure is that the patients are handed their medical booklets with information about the consultation and lab results which they present to the doctor attending to them. It is only at that moment that the doctor can be aware of the patient medical situation. The doctors who were interviewed in this research highlighted that the traditional method is not time effective and slows down the process of making informed decisions. Having access to a patient medical file before meeting their doctors seems to be an effective foundation in the implementation of an e-health system.

Data protection law

According to Article 12 of the Universal Declaration of Human Rights, everyone is entitled to the right to privacy. It is on this backbone that the EU has outlined a set of data protection laws enshrined in the GDPR to protect the data of its citizen which constitutes

part of their privacy or private life. The GDPR helps to protect a private or natural person's data from abuse. The medical staff respondents noted that the laws they follow that are even close to data protection of patient information their the usual ethical code where for example a doctor is not allowed to disclose patient information to a third party without due process. Respondent number five even agreed that "it is just normal common sense not to share a patient's data without concern rather than following a set of laws" That is, if a third party requests a patient's data even for research purposes, certain information should not be disclosed without contacting the patient. For instance, it will not be ethical to publish a list of patients names with certain diseases like tuberculosis, Human Immunodeficiency Virus, and Acquired Immunodeficiency Syndrome. Therefore, the absence of clear data protection laws is already a barrier to the transition to a digital healthcare system in Cameroon. Implementing a healthcare system without proper data protection laws already seems like a failure from the beginning.

Absence of digitalization in preserving medical files

Both sets of respondents disclosed that all medical data are written in a patient medical or hospital booklet. This data include; a patient's name, age, height, weight, consultation, lab results and diagnosis, and doctor's prescription. The doctors interviewed in this research agreed that having access to this information in a timely fashion or manner can help them make informed decisions. The doctors also disclosed that the hospital uses a register where patients' data are entered. It is time-consuming and strenuous to manually search for these medical files stored in the archive room. They noted that they do not use well-structured or sorting archiving techniques to easily retrieve the files. One of the medical doctors mentioned that "*having a digital system where we can store these medical data will help us*" The five respondents who have once been patients all responded that they cannot find their medical booklet from about two years ago and even if they do, they do not think the ink on it will still be readable. As such, having a digitalized preservation system for medical data is an idle way to ease and facilitate the job of medical staff.

No adequate plan by medical institutions to transition to an in-house e-health system

Just respondent one for medical staff mentioned that their institution is making an in-house plan to introduce some degree of digitalization with the use of computers with the help of the internet. Patients can book online appointments, doctors can already see

patients' consultations when they are at the consultation desk. This will encourage the development of interoperability within the different departments of the hospital. Also accessing a patient's medical file will be effortless and within reach. That lack of interest to transition from a paper-based healthcare system to an e-health system is problematic.

The political environment in Cameroon

The average age of the National Assembly in Cameron is 55 years (Union, 2023) and coupled with the fact the country itself it's not technologically inclined. As such, when the respondents were asked about their perception of the political environment in Cameroon. That is, if they think politicians will favor or vote to adopt an e-health system, they all were skeptical and some mentioned that since they are mostly older people in the National Assembly, they may not see the need for such drastic changes. Figure two below shows an estimated cost for a five-year plan beginning in 2020 – 2024 on the implementation of e-health. The cost is also something that is still a doubt whether politicians will vote on a bill to grant such an amount of money for such a project.

Figure 2: Five-Year Budget for Implementation of the National eHealth Strategic Plan

	ANNUAL COST						
Strategic Objective	**2020**	**2021**	**2022**	**2023**	**2024**	**Total (XAF)**	**Total (USD)**
1. By 2024, improve governance and leadership in digital health.	135,500,000	62,900,000	28,400,000	28,400,000	22,400,000	**277,600,000**	**$466,555**
2. By 2024, strengthen the legal and regulatory framework for digital health.	3000,000	36,000,000	13,000,000	13,000,000	10,000,000	**75,000,000**	**$126,050**
3. By 2024, develop the quantity and quality of human resources needed to implement digital health.	46,000,000	113,000,000	11,000,000	55,000,000	8,000,000	**233,000,000**	**$391,597**
4. By 2024, strengthen investment and funding for digital health.	200,000	200,000	200,000	200,000	200,000	**1,000,000**	**$1,681**
5. By 2024, develop services and applications to meet the needs of individuals, healthcare providers, managers and administrators of health structures.	610,025,000	1,322,762,500	1,065,862,500	622,800,000	613,950,000	**4,235,400,000**	**$7,118,319**
6. By 2024, develop health information processing and sharing infrastructures between health structures and communities at national and international levels.	1,686,750,000	2,000,680,000	1,738,280,000	384,180,000	214,780,000	**6,024,670,000**	**$10,125,496**
7. By 2024, develop standards and interoperability components to improve the collection and exchange of consistent and accurate health information across geographical and sectoral boundaries.	197,800,000	175,600,000	40,833,333	48,833,333	17,833,333	**480,900,000**	**$808,235**
TOTAL	**2,679,275,000**	**3,711,142,500**	**2,897,575,833**	**1,152,413,333**	**887,163,333**	**11,327,570,000**	**$19,037,933**

Source: From Cameroon's NHDSP

5 Discussion

The data collected from the semi-structured interviews and having analyzed the results, it is clear that a set of recommendations can be suggested that the government of Cameroon should consider in its quest to implement an e-health system. This chapter will simultaneously focus on the discussion of the interview results and at the same time focus on recommendations to implement e-health.

5.1 Awareness

It was clear from the interview data that the respondents had no idea about the NHDSP. It could be argued that the number of respondents was small and to an extent may not represent the real situation in Cameroon. However, the NHDSP was scheduled to be effective in the fourth quarter of 2024, but it is not one of the major news in the country. There are several social media and news platforms like Facebook, Instagram, Twitter, the Cameroon Radio and Television station, and Tiktok that the government can use to spread awareness for the nationwide e-health system. It is relevant for healthcare providers and users of such a service to be aware to make acceptance easy. To an extent, it is easy for users to resist what they are not aware of than what they have some degree of knowledge about (Scholkmann, 2021) and (Marcon, 2019). On this note, it is relevant for the government to look for the most effective and efficient ways to make the intended users of this service aware of the service.

5.2 Digital tools competence training

Some of the respondents mentioned that they have had some ICT training and are comfortable using digital tools because they had some training will in schools. ICT was taught as a subject and also, and these respondents were just in their early 20s. Meaning that ICT was recently introduced, as such, those who are already working in the medical field might or did not have the opportunity to study ICT in school. The medical staff who responded mentioned that with the right digital training, they will be comfortable using digital tools in the health system. In this regard, the government can partner with ICT institutions and encourage healthcare workers to sign up with a carefully designed method that will not disrupt the day-to-day of the medical staff or slow down hospital activities

due to a shortage of staff. Such training will not only help facilitate the use of e-health but will also promote technological literacy. Also, it was realized from the interviews that the medical staff has attained some level of University education. As such, the government could encourage one semester or one full academic year dedicated to education related to ICT or IT. Before they graduate, they should have had some knowledge about using digital tools.

5.3 Partnering with State-owned Universities

This part is a continuation of 5.2 focusing on the aspect that the Ministry of Health in Cameroon could partner with state-owned universities to train or educate medical staff on the use of ICT tools in the delivery of healthcare services. Figure 3 will show the map of Cameroon and its 10 regions or states which constitutes or make up the Republic of Cameroon. The government of Cameroon has ensured that each of these 10 regions has at least one state university. This is interesting because it is from these same universities where some of the medical staff like doctors, lab technicians, and nurses graduate from. Table 3 will demonstrate the distribution of relevant faculties in the different regional universities which could train medical staff to be competent enough to use digital tools to facilitate their day-to-day work (NOBIS, 2016). It is evident that these state or regional universities have infrastructures that could support the education of medical staff in the use of digital tools. As such, the Ministry of Health will not necessarily need to invest resources since manpower like lecturers is already available, these universities already have computer labs. For example, the University of Buea has the following relevant faculties such as; the Faculty of Technology and the Faculty of Engineering and Technology which could offer or modify some of their courses to tailor the need for competent ICT training for medical staff. What could be difficult is designing a suitable curriculum for medical staff. In theory, it can be said that it is possible if an academic program or curriculum is designed for medical staff in partnership with regional universities.

Figure 3: The 10 Regions of Cameroon

Source: National Institute of Statistics, Cameroon

Table 3: Distribution of relevant faculties in the Regional Universities in Cameroon

NO:	Regions	Name of Universities	Relevant Faculties
1	Far or Extreme North	University of Maroua	-Faculty of Sciences -Faculty of Advanced School of Engineering
2	North	University of Garoua	Faculty of Sciences
3	Adamawa	University of Ngaoundere	Institute of Technology
4	North West	University of Bamenda	-Faculty of Sciences

			-Faculty of Health Sciences -Faculty of Technology
5	South West	University of Buea	-Faculty of Engineering -College of Technology
6	West	University of Dschang	-Faculty of Sciences -Faculty of Technology -Faculty of Medicine and Pharmaceutical Sciences
7	Centre	University of Yaounde 1 and 2	-Faculty of Sciences -School of Information and Communication Sciences
8	Littoral	University of Douala	-Faculty of Sciences -Institute of Technology -Faculty of Medicine and Pharmaceutical Sciences
9	East	University of Bertoua	-Faculty of Sciences
10	South	University of Ebolowa	-Faculty of Sciences -Faculty of Medicine and Pharmaceutical Sciences

5.4 Data protection

Cameroon does not currently have clear patient data protection laws. The medical staff responded that they follow or use just the medical ethical code. For example, medical personnel cannot share a patient's data without concern. Generally, that's more common sense than following applicable laws and traditional practice of not sharing a customer's data without their knowledge. Looking at the case of Estonia, Under the Health Services Organisation Act, chapter five which focuses on Health Information Systems (Estonian Health Services Organization Act, 2018) clearly outlines or covers issues related to e-health. This clarity in the legal aspect of e-health makes it to allocate rights and

responsibility and also facilitates the legal process if should in case there is a default by a party either by the health providers or the users of healthcare services. The government of Cameroon could copy the GDPR and apply those principles which apply to Cameroon.

5.5 Encourage the use of digital tools in hospitals or medical institutions

The medical staff responded that they do not use tools like computers which was backed up by those who have been patients, during their encounter with the hospital, and they did not witness the use of digital in the delivery of medical services. The government can get computers from international bodies that donate or sell computers at low costs like Computer Aid, PCs for People, and Electronic Access Foundation. These tools will be the foundation of implementing an e-health system. Even if an e-health platform is designed, it needs tools especially computers to make it work. This will also go a long way to improving the technical skills of medical staff.

5.6 Digital preservation

This is a set of activities aimed towards ensuring access to digital material over time" (Caplan, 2008). The medical staff interviewed by the researcher highlighted that the hospital file they keep for each patient is recorded in a register which is stored in an archive room. In the case of a fire breakout, or any natural disaster like a flood, earthquakes it can be assumed that those data will forever be lost. With the use of computers, patients' data may be recorded and preserved over a long period. Alternatively, the hospitals could scan each patient's medical booklet, and the scanned images stored in a computer device. This second option seems more strenuous and time-consuming rather than using a computer to compute any patient's data from the time they arrive at the hospital. Preserving medical data can be used for long-term purposes and understanding how to respond to certain outbreaks like the Covid-19 pandemic. Countries use such data to proactively respond to future unforeseen events. It is without a doubt that data is very important in any field of research as it guides the researcher(s) on their path as they carry out their research. Even in the field of academic research, the absence of adequate literature can be a nightmare to researchers.

6 Conclusion

Transitioning from a paper-based system of health to a digitalized system of healthcare is not just a trend country like Cameroon should follow, but more of the benefit it offers. Countries with mature e-health systems did not just get there overnight and that should be a lesson to countries trying to digitalize their healthcare system. The idea is not to build the entire e-health infrastructure in one go and it may be difficult to mitigate certain challenges that may arise. Rather the goal is to gradually move towards an effective and efficient e-health system. A good practice can be for countries to set Key Performance Indicators (KPIs) and categorize these KPIs into groups or stages. For example, the first group could be Data Protection laws, and group two could be cybersecurity infrastructure. Whenever each group is archived then the next phase can commence. Countries that have had a mature e-health system over a long period still face challenges and strife for better healthcare service delivery. Cameroon should be proactive in anticipating problems that may arise with an e-health system. It will be dangerous not to anticipate future unforeseen challenges as designing and implementing a digital healthcare system does not mean every healthcare service delivery will be solved.

This research was aimed at understanding some of the challenges Cameroon could be facing which presents as a barrier for the country to transition to an e-health system. This main objective was achieved after interviewing a set of respondents. The research will not be completed without looking at some of the relevance of this study. There are several works of literature on the topic of e-health systems. In the context of Cameroon, the literature on the subject matter is limited as researchers are still exploring the topic. This is also coupled with the fact that the e-health system is not quite mature in Cameroon. This work will help to contribute to the literature on the e-health system in Cameroon. The work research made some interesting discoveries about the challenge Cameroon faces preventing her to transition to an e-health system. From these findings, a set of recommendations were suggested that could mitigate the challenges faced to transition to an e-health system. The study looked at the benefits of implementing a digital health system. These benefits could be realized in Cameroon if such a digital healthcare system is used. Furthermore, this research has abled the researchers to learn and improve their skills in how to carry how a scientific interview. The researcher has not had the

opportunity to conduct such a scientific interview with such a serious and more technical method. It was an opportunity for the researcher to be able to acquire

It is clear that countries the world over are striving to digitalize their economies and Cameroon is taking a leap forward. From 2016 and 2021, the Cameroon government digitalized the application for National ID and Passport respectively. This nationwide digitalization could be exported to other vital public and private services like health, banking, water supply, natural disaster warning, and electricity.

If the NHDSP is implemented gradually, it is sure that the country could move steadily toward achieving its goal. The project also needs strong political backing for it to be embedded in Cameroon's constitution. If the implementation of an e-health system becomes successful, then it will be a lamp light for other digital projects to be designed and implemented.

6.1 Limitations of the study

One of the major limitations was time constraints. The researcher had to limit the number of respondents for the semi-structured interview. 10 interviewees may not be a true representation of the situation in Cameroon. Secondly, it was raised by the interviewees that some medical institutions have computers but the researcher did not focus on investigating further what is the use of the computer in the delivery of medical services if it is not linked to a computer system. Some aspects of the research made assumed a generalized explanation rather than looking at the issue in detail. For instance, when analyzing the benefits of an e-health system, the researcher failed to further give details and in-depth explanations of certain points such as on the issue of data preservation.

6.2 Future research

So many interviewees showed interest in the topic as they think implementing a digital health system in Cameroon will bring about significant benefits for medical care providers and users of medical care services. Due to limitations and the timeframe for carrying out and submitting the final research, there are some future topics that the researcher finds worth researching.

The researcher's main focus was to investigate the barriers to transition from a paper-based healthcare system to a digital healthcare system but a very important aspect that was not investigated in depth was the KPIs used to design and implement an e-health system. Designing and implementing such a relevant healthcare service delivery system is vital to set KPIs. Also, researchers can investigate whether these set KPIs are mature enough or sufficient enough to be used to measure the growth of success of the design and implementation of an e-health system. Just having KPIs may not be enough, but understanding their relevance to a specific country, and the type of e-health system to be used is crucial. This is because a set of KPIs that are relevant in the case of Estonia may not be the same set of KPIs needed in Cameroon.

Another relevant area that future researchers may explore is designing an e-health system that is suitable for the context or environment of Cameroon. This research was more focused on the theoretical or qualitative aspects of e-health in Cameroon. It will be great to see a researcher who will design an e-health system.

Furthermore, a study of user perception is another area that should be investigated. Such changes or the transition from a paper-based healthcare system to a digital health system can be resisted to be used by users. Therefore, a study on how users will react will be an interesting research area.

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Appendix 2 – Financial Distribution for the NDHSP

Areas	Departments	Activities	Amount in USD
1	Leadership and Governance	Creation of the National Committee for the Supervision and Coordination of e-health	466,555
2	Legislation, Policy, and Compliance	Develop policies and ethics in e-health	126,050
3	Human Resources	Training of health personnel to use ICT tools	391,597
4	Strategy and Investment	Develop an e-health Annual Financing Plan	1681
5	Services and Application	Develop IT tools, e-medical record system, set up an integrated national management system, set up a tele/mobile medicine platform	10,125,496
6	Infrastructure	Ensure the availability of technological infrastructure, availability of cloud-based services	808,235
7	Standards and interoperability	Improve the collection and exchange of data	7,118,319
TOTAL			**19,037,933**

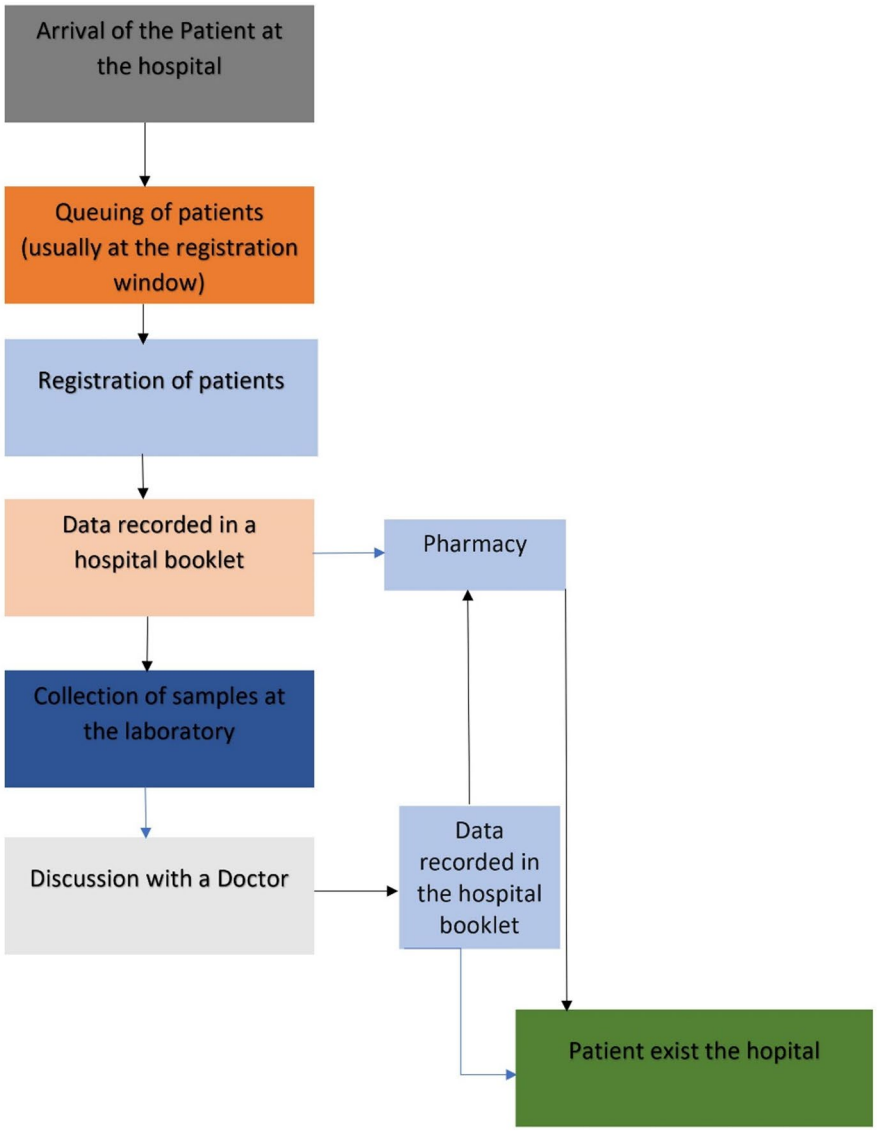
Appendix 3 - Distribution of respondents and their titles

Interviewee Number	Position or Titles
Respondent 1	Medical Doctor
Respondent 2	Nurse
Respondent 3	Medical Laboratory Technician
Respondent 4	Medical Laboratory Technician
Respondent 5	Medical Doctor
Respondent 6	Has once been a patient
Respondent 7	Has once been a patient
Respondent 8	Has once been a patient
Respondent 9	Has once been a patient
Respondent 10	Has once been a patient

Appendix 4 - Distribution of relevant faculties in the Regional Universities in Cameroon

NO:	Regions	Name of Universities	Relevant Faculties
1	Far or Extreme North	University of Maroua	-Faculty of Sciences -Faculty of Advanced School of Engineering
2	North	University of Garoua	Faculty of Sciences
3	Adamawa	University of Ngaoundere	Institute of Technology
4	North West	University of Bamenda	-Faculty of Sciences -Faculty of Health Sciences -Faculty of Technology
5	South West	University of Buea	-Faculty of Engineering -College of Technology
6	West	University of Dschang	-Faculty of Sciences -Faculty of Technology -Faculty of Medicine and Pharmaceutical Sciences
7	Centre	University of Yaounde 1 and 2	-Faculty of Sciences -School of Information and Communication Sciences
8	Littoral	University of Douala	-Faculty of Sciences -Institute of Technology -Faculty of Medicine and Pharmaceutical Sciences
9	East	University of Bertoua	-Faculty of Sciences
10	South	University of Ebolowa	-Faculty of Sciences -Faculty of Medicine and Pharmaceutical Sciences

Appendix 5 - Traditional patient flow in Cameroon's paper-based health system



Appendix 6 - Five-Year Budget for Implementation of the National eHealth Strategic Plan

	ANNUAL COST						
Strategic Objective	**2020**	**2021**	**2022**	**2023**	**2024**	**Total (XAF)**	**Total (USD)**
1. By 2024, improve governance and leadership in digital health.	135,500,000	62,900,000	28,400,000	28,400,000	22,400,000	**277,600,000**	**$466,555**
2. By 2024, strengthen the legal and regulatory framework for digital health.	3000,000	36,000,000	13,000,000	13,000,000	10,000,000	**75,000,000**	**$126,050**
3. By 2024, develop the quantity and quality of human resources needed to implement digital health.	46,000,000	113,000,000	11,000,000	55,000,000	8,000,000	**233,000,000**	**$391,597**
4. By 2024, strengthen investment and funding for digital health.	200,000	200,000	200,000	200,000	200,000	**1,000,000**	**$1,681**
5. By 2024, develop services and applications to meet the needs of individuals, healthcare providers, managers and administrators of health structures.	610,025,000	1,322,762,500	1,065,862,500	622,800,000	613,950,000	**4,235,400,000**	**$7,118,319**
6. By 2024, develop health information processing and sharing infrastructures between health structures and communities at national and international levels.	1,686,750,000	2,000,680,000	1,738,280,000	384,180,000	214,780,000	**6,024,670,000**	**$10,125,496**
7. By 2024, develop standards and interoperability components to improve the collection and exchange of consistent and accurate health information across geographical and sectoral boundaries.	197,800,000	175,600,000	40,833,333	48,833,333	17,833,333	**480,900,000**	**$808,235**
TOTAL	**2,679,275,000**	**3,711,142,500**	**2,897,575,833**	**1,152,413,333**	**887,163,333**	**11,327,570,000**	**$19,037,933**

Appendix 7 – The 10 Regions of Cameroon

Appendix 8 – Interview questions to healthcare workers

1. What is your official title or position in the medical field?
    a. What is your highest level of education?
2. Do you use any ICT (maybe digital instead?) tools like computers or the internet for your day-to-day tasks in the medical field?
    i. If yes, to the previous question can you list some of the ICT tools you use?
    ii. Have you ever had any competence training on how to use ICT tools in the medical field?
    iii. How conformable/confident are you using ICT tools in your field?
3. What is the current process for identifying patients? Do they have any kind of ID number? Is it manually input into a binder or ICT tool?
    a. Similar to the above question, how do you store patients' medical data?
    b. How long can you store/keep a patient's file?
    c. How do you follow up with patients? Email? In-person? Video call?
4. Where do you enter the medical consultations, diagnoses, and prescriptions of your patients?
5. What are some of the medical standardization concerning the file format for medical images like MRI? Or how do you access medical images (soft or hard copy)
    i. Is it currently possible to receive, open, and understand a medical file from another hospital?
6. Describe any plan the institution you're working on has to transition or use digitalization in that institution.
7. What kind of digital tools do you think will facilitate your work in the future?
8. Does your institution have an in-house digital system for facilitating administrative and healthcare delivery processes?
9. Do you feel the political environment in your institution or in general, impacts the implementation or transition of using digital tools for your day-to-day work?

Appendix 9 – Interview questions to individuals who have once been patients

1. How conformable/confident are you using digital tools?
    a. Have you ever received any digital training from the government, educational institutions, NGOs, or family members?
2. How do you usually pay for healthcare services? Cash, card, insurance?
3. Describe an encounter when you went to the hospital by highlighting the following:
    i. Booking/appointment (was it online)
    ii. Consultation (did you use a medical booklet?)
    iii. Was there any use of digital tools like computers during your encounter with the hospital?
    iv. Where do the diagnostics, prescription, and lab results enter or written? Was it accessible for you? If so, how was it accessible?
4. Have you ever been asked to get a medical image or a scan of yourself from another hospital and how was this image transferred to your doctor?
5. Assuming you've your medical booklet from 15 years ago, do you still have a copy of it and if possible, can it be readable?
6. Let's take for example an email you sent 5 years ago, it is still possible to access that email and know the exact contents. What's your opinion on having a digital health system where all your medical data can be accessed even over a long period
7. Are you aware of how your medical data is stored, accessed, and processed by your hospital, or medical institution?
8. In an ideal world, what would be your opinion on Cameroon's healthcare system going fully digital?