ABSTRACT

Over the past decades, there have been many rural initiatives towards healthcare delivery services, yet the health needs of many communities are still not adequately met. Residents of rural communities have poorer health facilities than residents in urban centres.

In the Kwahu South District of Ghana, there are 222 communities with a total of 18 health facilities, 10 Chip compounds, 6 health centres and a private maternity home catering for a population of about 79,021. Data available at the District Health Management Team (DHMT) indicates that more than 50% of the residents are beyond the stipulated 3 kilometres away from a health facility. The road networks within these communities are very poor. The cost of treatment is also very high, these communities experience difficulties in recruiting and retaining trained medical and health workers.

Due to the challenges facing the residents in these communities, this research work has examined how feasible the use of IP cameras will bridge the barrier between the rural and urban setting. The study made used of IP cameras to provide healthcare treatment to patients in rural communities by providing brighter, sharper and clearer live video images of patients to healthcare providers. These video signals are transmitted online through internet networks to an Expert outside the community irrespective of the location. The Expert then provides professional medical advice to the health worker. This study hopes to facilitate proper diagnosis and treatment on conditions of a patient beyond the knowledge of the health worker at the remote facility. Though initial cost of implementing the proposed system by this study may be high, the challenges facing the rural communities in accessing good healthcare will be overcome.

This research integrates the use of ICTs' into the health facilities thereby adding value to the use of telemedicine to solve a lot of problems in healthcare. The study findings recommend the implementation of this system into the health facilities in Ghana (ie GHS) to reduce the challenges faced by people leaving in rural communities in accessing healthcare.

BRIDGING THE BARRIER OF ACCESS TO QUALITY HEALTHCARE;THE APPLICATION OF INTERNET PROTOCOL CAMERAS. (CASESTUDY: KWAHU GOVERNMENT HOSPITAL)

by Jonathan Kissi

BRIDGING THE BARRIER OF ACCESS TO QUALITY HEALTHCARE;

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BY

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JONATHAN KISSI
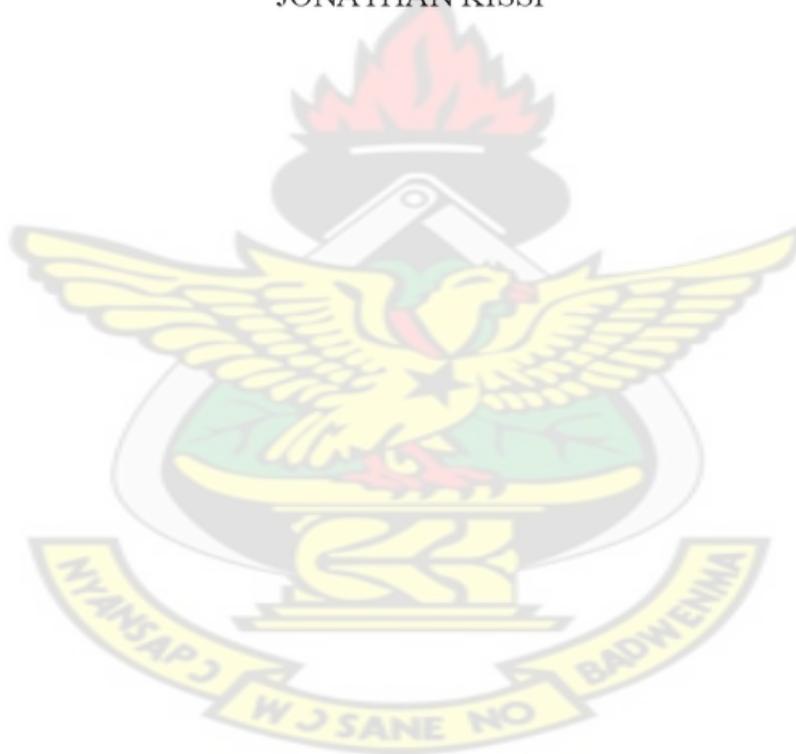
CHAPTER ONE

1.1 Introduction

In middle income countries, preventable diseases and premature demise still inflict a high toll. Inequity of access to basic healthcare services affects distinct regions, communities, and social groups (Infodev, 2006).

Ghana as a developing country is coupled with high rates of morbidity and mortality with a distinguished difference between rural and urban settings. The distribution of health care service workers is skewed towards urban areas in the Ghanaian communities. (Kwansah et al, 2011).

The health sector has always relied on technologies. According to WHO (2004), they form the backbone of the services to diagnose, treat illness and prevent diseases. One category of the vast array of technologies that may be useful is Information and Communication Technologies (ICT's). Given the right policies, organization, resources, and institutions, ICTs can be an influential tool to those working to improve health care services (Daly, 2003).

Mobile telephony, electronic mail and videoconferencing has changed the techniques people use to interact with each other and this has provided an option for sharing perspectives. Digital technologies are making visual images and the voices of people more accessible through radio, television, video, portable disk players and the internet, which changes the opportunities people use to share ideas, experiences, and knowledge (Infodev, 2006).

Effective communication and credible information are crucial elements in public health practices. The use of appropriate technologies can improve the quality of both information and communication. Accurate information helps people to improve upon their own health. At the same time, social organization helps people to achieve good health condition through

health care services and public health processes. The ability of impoverished communities to access services and engage with the services demands a health sector that responds to their priorities and needs. This is influenced by wider information and communication processes mediated by Information and Communication Technologies (ICT's). (Infodev, 2006).

1.2 Problem Statement

Globally, West Africa is the region with the highest mortality in its rural areas in the World. Preventable morbidity among children explains much of the excess mortality (GHS, 2002)

There is a great disparity in health status between urban and rural areas. As Ghana entered the 21st century, it records 60 percent infant mortality rate in rural areas higher than the prevailing rates in the urban areas (MOH-Ghana, 2001).

In Ghana, access to geographical areas is a major impediment to health care services and childhood mortality is increased due to service inaccessibility. Seventy percent of the population resides in communities that are over five kilometres away from the nearest health care facility. Childhood mortality is forty percent higher in this communities than in communities located within five kilometres of health care facilities (GHS, 2002). Coupled with the above, is the challenge of staffing in rural health care facilities. According to Deville et al, (2010), the difficulty of motivating and retaining highly qualified health professionals to deprived areas of Ghana still poses a challenge.

Staff turnover and the "brain drain" are impeding health care delivery, particularly in rural areas. There is therefore the need for strategies that improve the efficiency and coverage of health services in these areas. (GHS, 2002).

Health care services and systems are made more effective and efficient with the use of vital ICT gadgets in promoting individual health, spreading health information (including information about health-promoting and disease-preventing individual behaviour), combating diseases, monitoring the outbreak and spread of diseases, providing training, information and long-distance support to health care practitioners (Afarikumah, 2014).

In a review of eHealth projects in Ghana, Afarikumah, (2014) identified 22 different projects. These were however found to be relatively new, with insufficient studies to establish their relevance. Some of the projects have also wind up.

The challenges bedevilling most of the eHealth projects usually have to do with the cost of implementation of these projects, as well as the inability of healthcare staff to fully understand and utilize these interventions. The need therefore exists to design new pragmatic, cheap and easy to use technologies.

1.3 Objectives of the Study

The objectives of the research will be segmented into the following categories:

1) To investigate into the types of telemedicine systems that are currently used in Ghana.

2) To investigate into the challenges that are encountered when patients are referred from a lower Health facility to a higher Health facility.

3) To determine the views of the Participant on the use of telemedicine as a treatment method.

4) To install Internet Protocol Cameras in a remote healthcare facility in the Kwahu West Municipality that will connect Health Service Providers to a Specialist at the District / Municipal Hospital.

1.4 Significance of the Project

This project aims to provide the following significances:

- Enables remote consultation, diagnosis and treatment through telemedicine (by the application of IP Cameras).
- Facilitate collaboration and cooperation among health workers, including sharing of information, learning and training approaches.
- Support more effective health care research and access to health care research findings.

1.5 Scope of Study

The System will be used for patients with conditions that are beyond the knowledge of the Community Health Officers or Community Health Nurses in the remote areas.

1.6 Participants of the Study.

In this regard, detailed, in-depth data collection through questionnaires will be conducted among Municipal/District Medical Doctors, Community Health Officers, Midwives, Community Health Nurses and other health workers in the community. Researched documents of study in this area and other jurisdictions will also be examined to ascertain the best acceptable method of implementation.

1.7 Research Questions

This system will be used to address questions like:

- ➢ What types of Telemedicine systems are available in Ghana?
- ➢ What challenges do Health Workers face in referring patients to high Hospital for continuation of their treatment?

- What factors affects referrals of clients from a remote Community Health Centers to an urban Health Hospital?
- How do patients feel when they are treated using a telemedicine method?
- How feasible is the use of Internet Protocol Cameras in providing primary Health Care in remote Health Care Settings?

1.8 Organization of the Study.

The study is structured into six chapters as follows:

Chapter One;

Examines the focus of the whole research study; this includes the introduction of the study, statement of the research problem, objectives of the research study, research questions and significance of the research study.

Chapter Two;

Presents a review of literature on researchers on the use of IP cameras as a telemedicine method in Ghana, Africa and beyond. Both theoretical and pragmatic literatures relating to the research is conferred in this chapter.

Chapter Three;

Demonstrates the methodology that was accepted for the research.

Chapter Four;

Demonstrates the analysis of data collected with respect to the objectives of the research.

Chapter Five;

Presents detail of development, implementation and testing of the prototype.

Chapter Six;

Discusses the research findings, conclusion and recommendations of the research as a contribution to new knowledge, and provides impetus for further and continuing research in this realm.

1.9 Research Design Methodology Diagram

The diagram below shows the various steps that will be carried out during the research process.


Figure 1.1: Research Methodology Diagram

CHAPTER TWO

LITERATURE REVIEW

2.1 The Health And Healthcare Of Africans'

The average life of an African is 14years lower than the average world citizen and 21years lower than the average European. The maternal and under five (5) child mortality rate are higher than the world's average. There are only 2.3 doctors per 1,000 clients in Africa, lesser than one-tenth of the number in Europe and lesser than half the number in South-East Asia.

Selected health indicators				
INDICATOR	WORLD	AFRICA	EASTERN MEDITER-RANEAN	EUROPE
Life expectancy at birth, 2009	68	54	66	75
Physicians per 1,000 people, 2010	14.0	2.3	11.0	33.3
Under-5 mortality per 1,000 live births, 2011	51	107	58	13
Maternal mortality ratio, per 100,000 live births, 2008	260	620	240	21
Source: WHO, UNICEF. 'Eastern Mediterranean' includes North Africa except Algeria				

Figure 2.1 : Selected Health Indicators.

The absolute levels of all indicators in Africa are not only lower but have a slower progressive rate in other region. Over the past 2 decades, maternal mortality in Africa has

significantly decreased by 27% which is certainly a satisfactory results, however, the global percentage over the same era was 35% and in South-East Asia it was recorded 58%. In Africa, under five child mortality is diminishing by 25% per year as compared to Europe and the world as a whole with 5.6% and 2.7% respectively. Maternal mortality in Africa is diminishing at a rate of 1.7% per year, in opposition to 2.3% worldwide and 5% in South-East Asia. Consequently, Africa will delay behind the rest of the world in health indicators for many years ahead. (KPMG,2012).

Lastly, most systems that rely on out-of-pocket spending in a deprived region fail. The low number of trained doctors and the small size of the domestic pharmaceutical industry are the cause of the aforementioned problems.

It is possible to triumph over the limitations above since Africa's healthcare has a number of recorded triumph stories. Those triumphs have all been as a result of dedicated organisations overcoming structural limitations by doing things in an unfamiliar ways. Health care in Africa will demand a different strategy of delivery. (KPMG,2012).

2.2 The Use of Internet Protocol Cameras In Remote Areas For Healthcare Systems.

Healthcare applications of mobile phones are progressively gaining recognition over the last few years. With the increasing penetration of mobile networks in remote villages, mobile phones are becoming an important tool for enhancing effective communication between Doctor and Patients. The mobile technology is gradually enhancing the functionalities of handheld devices, PDAs and smart phones, which are substituting the traditional consultation while enhancing mobility needs of patients and medical practitioners. (KPMG,2012).

Mobile technology stands out as a strong and sustainable options when put side by side with the traditional consultation by Doctor's in rural villages nowadays, However, the technology

becomes a powerful transformational tool if it is applied as an enabler of a synergistic system. (Tiwari, 2010)

Research shows that there are no structured models capable of servicing the health needs of many rural communities. Furthermore, many small rural communities require different approaches to health care and models of health service delivery which is different to those customarily established systems/models. The most essential component is that service models must differ in order to take account of the specific cultural, geographical, social and economic contexts that differentiate the many remote communities scattered across. (NHHRC, 2008).

2.3 Why Telemedicine Uptake Is Low In Africa?

Despite the substantial benefits of telemedicine in Africa, its effectiveness has been limited. The limitations are the inadequacy of doctors and the unfortunate reality is that most telemedicine activities add additional steps into the routines of the clinical workflow, adding burden to already hackneyed nurses and doctors. To maintain and support a telemedicine system information and communication infrastructures, people and supply of electricity are required. Currently, 6.7% of households in Africa have Internet access at home, 16.3% of people use the Internet, and fixed broadband penetration is 0.3%. Internet penetration in Africa is half that of Asia and is the lowest of any middle income country in the world.

In poor communities people mostly use the web based solutions software's for patient centric healthcare which are largely irrelevant because few of the over 2000 African languages are available on the internet.

Mobile phone penetration is reported to be 64%, a figure which is slanted due to the number of subscriptions, that is the number of SIM cards in circulation and not the number of people

using mobile phones. In Africa, 14 of the 20 most expensive countries experiences high toll in telecommunication when expressed as a percentage in gross national product.

The poorest of the poor in rural regions in Africa needs telemedicine most, but insufficient infrastructure and high connectivity cost affects this reality. Moreover, there is a narrow knowledge by both healthcare workers and the patient community on telemedicine as well as insufficient government willingness to support telemedicine. It is within this background that, education of telemedicine in Africa must be considered. (Nelson R. Mandela, 2013)

2.4 Challenges Of Using Telemedicine In Africa (Uganda)

The success of telemedicine which has a high benefit to the health sector is sometimes marred by challenges and contradictions in developing countries. This includes the level of awareness and skills of the potential users, policy provisions, workable conditions, technology compatibilities and costs of ICT equipment, amongst others.

Currently, in Uganda the ICT infrastructure status is very poor which has lead to poor support of telemedicine benefit in the health sector. Very few hospitals are computerized with limited internet access. Mulago hospital in Uganda, which is a national hospital still operates within the manual environment for recording and storing patient information.

Costs of installing internet facilities, Cost of accessing the internet, maintaining the internet equipment and buying new ones poses a challenge for poor countries like Uganda because of the higher cost of the equipments. (Huston, T. and Huston, J. 2000)

Consequently, several hospitals in Uganda are faced up with interoperability issues for equipment and software. The availability of experts in real time also poses a challenge. In cases where consultations have to be made across continents, there is also the issue of time difference and the availability of experts when they are required.

There is a language barrier to the respondents of Uganda on most of the information available on the internet since most are English languages or in languages not accessible to the wider segments of the population. The understanding of the medical jargon is also a challenge for people who understands the English language when they access them over the internet but are not medical practitioners. (Huston, T. and Huston, J. 2000).

2.5 Problems with Service Delivery, And Health Outcomes In Rural Areas Of Ghana.

Existing rural health dissimilarities and discriminations are intolerable because it implies that the residents in rural areas are disadvantaged in terms of their diagnosis, treatment and chance for economic and social wellbeing (rights and equity). Health discrimination includes higher rates of many diseases, life expectancy, and their underlying risk factors – including obesity, the use of tobacco, sedentary lifestyle, and excessive alcohol consumption – relating to social status, but amenable to preventative and health promotion strategies. (Veitch, 2008).

Most of this are specific to remote areas, including injury motor vehicle accidents and accidents from farming activities which results from long distance, poor roads, and excessive speeding (Veitch, 2008). Understanding how these risk factors determine the health needs and status helps bring up to date appropriate health service planning and service provision.

Remote environments (including socioeconomic status, lifestyles, and indignity) and remote geographical settings (accessibility to and availability of appropriate health services) are unquestionably the hallmark characteristics of rural areas in Ghana. There are a lot of confirmations about how rural settings shape the nature of practice and service delivery (Wakerman, 2004; Wakerman & Humphreys, 2002).

The lack of transportation and tyranny of distance are the major obstacles to accessing health care for many Ghanaians living in the remote areas. The only way a Ghanaian in the rural environment enjoys healthcare services are either by transporting services to the client or the client moving for the services needed at a health center. Health transport may be required at different points within the health care system (Humphreys, 2002) - where continuation of care for patient access is required (rehabilitation, care of the chronically ill); at the interface of diverse parts of the health care system (including transferring patients between institutions); at the entry point (like facilitating attendance at primary medical care); and for the maintenance of social and psychological health (including access to social, cultural and recreational amenities).

Distance still remains the single most important impediment for rural people in accessing healthcare despite the dramatic advances in transport and communications technology. The provision of real time delivery of health care services and medical services at a distance between two or more locations using technology-assisted communications have been widely used in recent years as a means of overcoming challenges associated with the accessibility to health care and the deficiency in health professionals in rural settings . (Humphreys & Wakerman, 2002).

APPLICATIONS OF TELEMEDICINE IN GHANA

CASE STUDY 1

2.6   MoTeCH Ghana Limited

MoTeCH is a telemedicine application used by the Ghana Health Service, this technology is under the piloting stage and if it becomes successful it will be used by the Ghana Health Service on a large scale. However its technology infrastructure was being designed to be portable and replicable in other countries. It operates low cost hand held phones and "open source" software that will be freely available and flexible, this system may have widespread use in Africa and beyond.

MoTeCH utilizes a versatile platform that is not specific to maternal or child health care needs. It uses the three different software's namely: OpenMRS, OpenXData and IntelliIVR. The software's are used for maintaining the individual level client data, data collection on low-cost hand held mobile phones and application for Interactive Response (IVR) messages to patients respectively.

The OpenMRS software is an open source medical record software used for the medical records management. The "rules engine" and other components enables the system to process both inbound and outbound text and voice messages.

The MoTeCH program provides expectant mothers and new born mothers with valuable information including:

- Accurate health education reminds them of upcoming clinic checkups for themselves or their babies.
- The voice and SMS options respectively.

- The Nankam, Kassim, and English languages as a preferred language of choice.

- The notifications and alerts of upcoming appointments at the clinic. This helps to reduce the number of patients overdue for checkups. (www. ghsmotech.org)

MoTeCH also provides some important benefits to Nurses which includes:

➢ Generation of the nurses' monthly reports which saves the nurses valuable time and improves report accuracy.

➢ The system allows nurses to search for information about groups of patients with their vicinity.

➢ The system enhances team work among the Nurses and increase effective planning towards noted deliveries.

The diagram below shows how the client receives and sends data in the MoTeCH application. (www. ghsmotech.org)
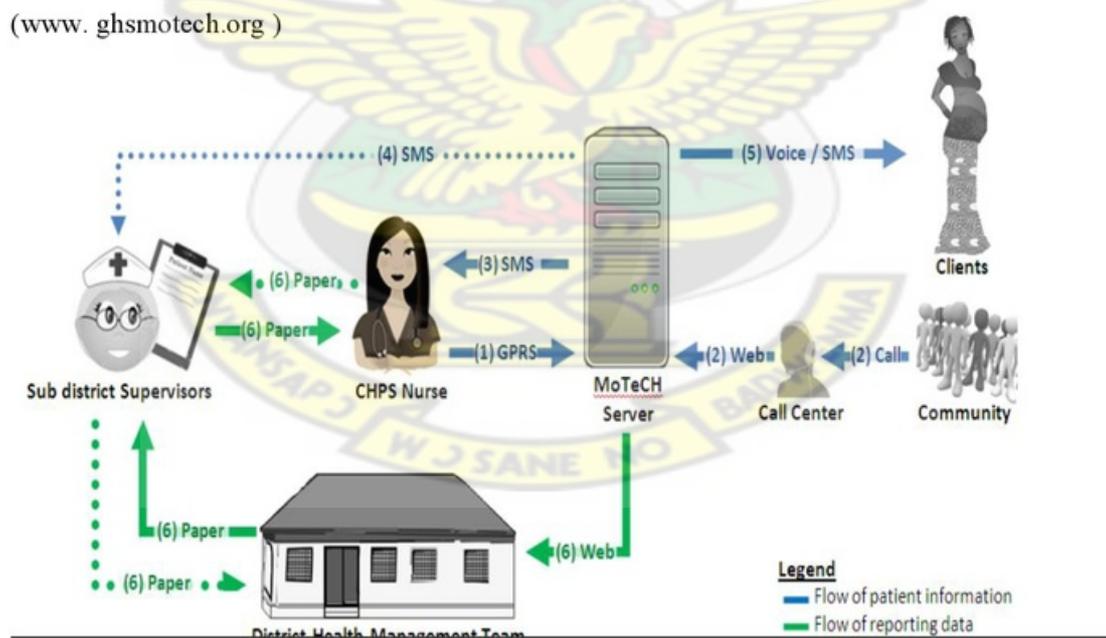
Figure 2.2: The Flow of Data In MoTeCH application.

2.7 Problems With The Use Of Motech As Telemedicine In Ghana.

- The Community Health Officers perceive the system as "extra work" rather than a time-saving tool.

- Most of the clients are not familiar with the use of mobile phones so it limits their ability to access the text message they receive.

- The sending of text messages on client health information to clients from the health worker becomes difficult when the networks are congested.

- The new born mothers or expectant mothers do not receive their text message when they are in areas that are out of service or when they misplace their mobile phones.

- The new born mothers or expectant mothers phones do not respond to calls when their phones are turned off to save electricity or because the battery is drained. (Awoonor-Williams et al.)

CASE STUDY 2

2.8 Perception Of Healthcare Personnel's Working In Rural Communities (Amansie-West District of Ghana).

Method

A qualitative study was adopted for the research study. The studies used semi-structured in-depth interviews with eleven (11) health care service workers. The interviews provided a chance for field notes to be captured which enlighten added questions and ensured that relevant information on telemedicine usage in Ghana was gathered based on the research (Perecman and Curran, 2006; Marshall, 1996).

A purposive sampling technique was employed to select participants for the study. The availability of the health care personnel's and their experience with the use of telemedicine within the remote communities in Amansie-West district of Ghana was taken into consideration. The participants were made up of eight (8) community health nurses from the various remote communities, one midwife, one general registered nurse and one doctor in the Amansie-West district. The consultants at the teleconsultation centre (TCC) in the district hospital were General Nurse, Midwife and a Doctor.

2.9 Perceived Challenges of Healthcare Personnel's working in rural communities of Amansie- West District of Ghana.

The health workers who participated in the programme noted out that the following are the challenges coupled with the use of the telemedicine programme; limited resources, inaccurate diagnosis, incomplete scope of application, extra workload, no motivation as well as the lack of supporting will among stakeholders, and technical difficulties.

The nurses, midwives and Doctors at the TCC identified that they mainly depend on the information given to them by the community health workers for diagnosis and treatment of diseases. This information are sometimes inaccurate to fully assess and prescribe appropriate diagnosis to their clients. Generally, there is no straight interaction between the healthcare professionals at the TCC during teleconsultation and patients. They indicated that, they often do not have direct feeling of the patients.

The community health nurses indicated that, it can be burdensom when managing cases at times like delivery but when dealing with diseases like malaria, the application of telemedicine is very supportive.

The health care service workers also mentioned that, taking up assignments at the telemedicine centre was primarily paying attention to all the in-coming calls from the various health centres, an additional workload to their usual clinical duties and therefore they have short resting time.

Despite the stress among the health care workers telemedicine application enables them to solve most challenges but they are poorly paid. (ICEHTM, 2014).
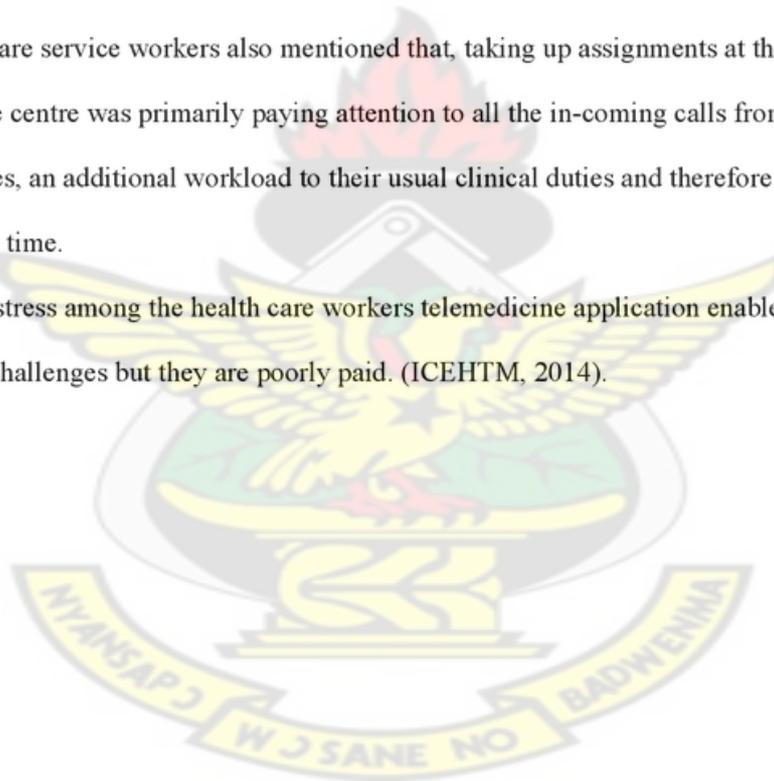
CASE STUDY III

2.10   A Review of Tenvis Internet Protocol Cameras At A Health Center

How IP Cameras Offer at Healthcare Centers.

Some healthcare industries with the help of IP cameras are able to deal with wide range of security issues they encounter nowadays. The hospital not only has the duty to cure diseases, but also shoulders the responsibilities of ensuring the safety of their patients. Risks like falling, wandering, pulling out tubes or other forms of self-injury will frequently need medical staff to visually monitor, thus making them have a heavy workload. The TENVIS surveillance system can totally solve the current situations and significantly lower staff costs without compromising patient safety.

Video surveillance in hospitals plays a critical role to the support of security professionals as they provide a secure, safe and conducive atmosphere which supports the goals of the healthcare organization. There are many tangential advantages that healthcare providers can realize by implementing Internet Protocol cameras, this are reflected in the following: (www.tenvis.com)

2.11 Benefit Of Using Internet Protocol Cameras To Healthcare Providers.

> **Function as Patient Sitter**

The camera surveillance system can make patient observation centralized. Instead of sitting in or just outside the patient's room, trained staff can work in an operation center, monitoring multiple high-risk patients over the existing network at the facility, alerting medical personnel just as quickly as they could if they were physically present. Thus patient sitters will not be hired in great numbers which can reduce economic burdens of both families and the health care facilities. The diagram below shows some Healthcare providers using IP cameras remotely.

Figure 2.3: Health Care Providers Using IP Cameras remotely.

➢ **Ensuring Newborn and Infant Security.**

In hospital nursery, the IP camera surveillance system can provide instant, actionable information in the event of a newborn kidnap, thus baby switching or stealing things can be effectively prevented and brings peace of mind to parents. The picture below shows how IP cameras are used for infant security checks in a hospital.

Figure 2.3: Using IP Camera For Infant Security Checks In A Hospital.

➢ **Law Enforcement for Visual Evidence**

The ability to record and capture videos on large capacity storage devices gives healthcare facilities and law enforcement a powerful tool to examine criminal and eradicate fraudulent insurance claims.

Besides, the surveillance system can also improve staff productivity, ensure their safety and work as a deterrent to criminals. (xiaojun , 2013).

CASE STUDY IV

2.12   A Review of Allied Telesis Solutions for Healthcare With IP Cameras.

Video Surveillance with IP Cameras for Healthcare

In health care organization, ensuring the security of the employees and patients is very paramount.

The use of video surveillance and high definition technologies is now the most effective strategic tool in protecting the properties and the people in the organization, further more the video surveillance system is use in investigating incidents to resolve the cause and avoid repeating the situations again.

The modern Internet Protocol Cameras are built with technologies which uses high-megapixel, high-definition and high-quality lenses to produce full-motion and real-time video. The ability to obtain a high-resolution, clear, real-time video, demands a higher broadband IP to ensure uninterrupted quality images.

An Internet Protocol camera video supervision system consists of series of cameras connected to a video storage server which records and processes the video streams, with an operations center or hub where video is displayed and monitored on a real-time basis. Most IP security cameras rotate 360 degree pan-and-tilt capabilities which are remotely controlled from an operations center. To maintain the IP video network and enable remote camera control and operation, a high-speed IP or Ethernet infrastructure is required with its designs and modified to IP video applications.

Internet Protocol security cameras are used in almost every type of facility and application for example on building exteriors, streets, hallways, inside buildings and, in parking lots. There are many types of fixed or adjustable cameras suited for many applications. In order to serve the wide variety of needs and applications, whether indoor or outdoor, a reliable broadband IP network is needed to connect the cameras to the servers, and the other operation centers where monitoring occurs, whether on atop of a roof, inside a building or a traffic light.

 The variety of applications, locations, and even the brand of cameras used in the operation all determines the need for adaptive IP or Ethernet networking infrastructure which is scalable to and optimized for the specific purpose. (www.alliedtelesis.com). The diagram below shows Allied Telesis network topology.
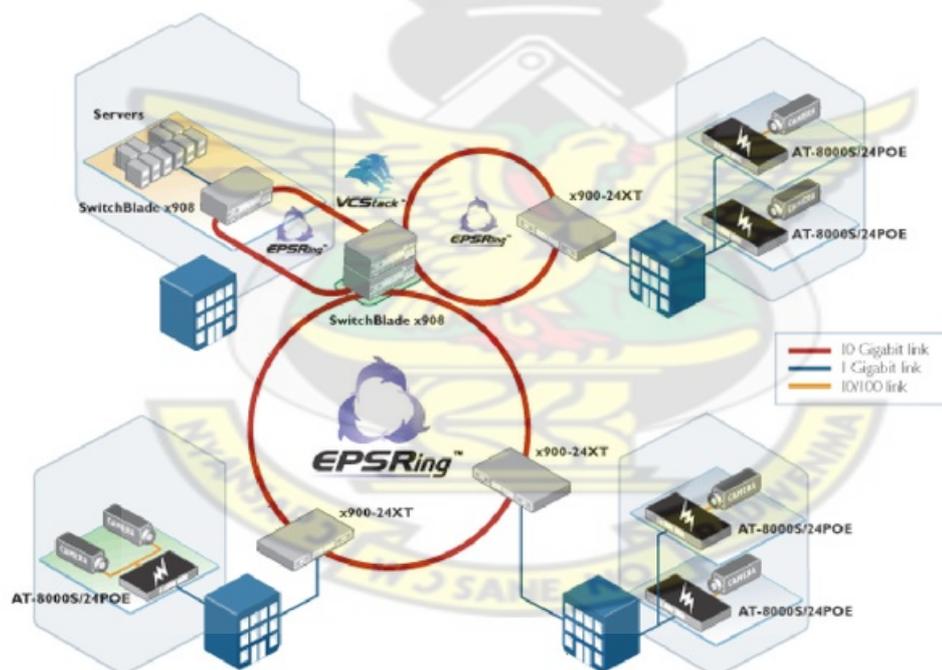
Figure 2.5: A Network Topology of Allied Telesis.

CASE STUDY V

2.13   A Review of Unreal Streaming Technologies with the Use of IP Cameras.

In some healthcare and hospital organizations, Unreal Streaming Technologies offers constant streaming solution and cost effective video

They also develop real-time streaming video software, market low latency, and develop hardware that permits any hospital or consulting rooms to install various telemedicine applications such as diagnosis and remote clinical assessment, real-time broadcast and recording from operating, and consulting rooms. The diagram below shows the workflow of data in Unreal Streaming Technologies.
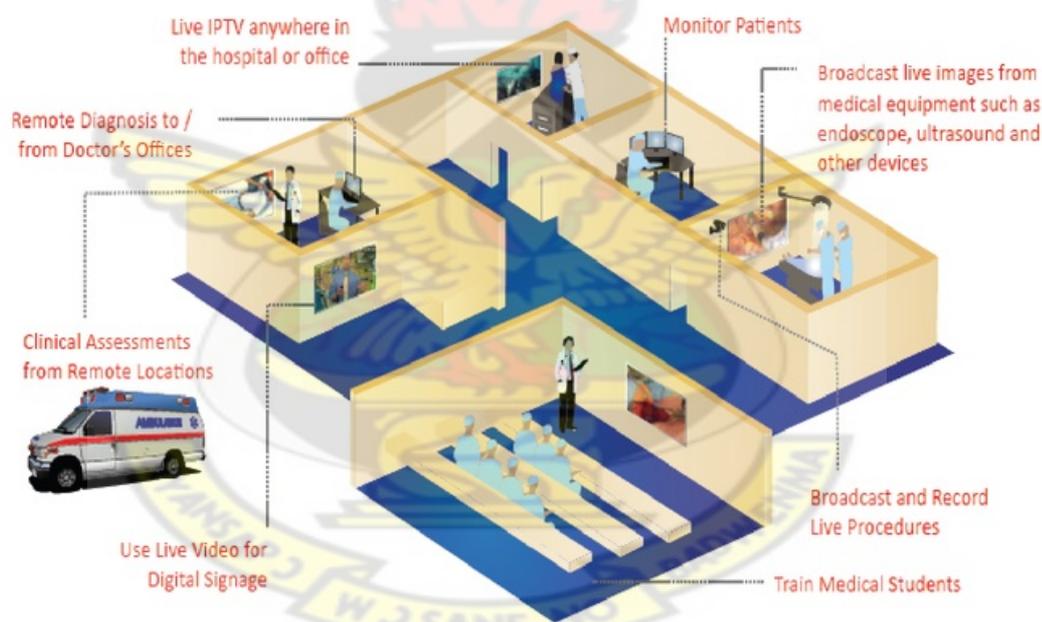
Figure 2.6: A Workflow of Unreal Streaming Technologies.

The Unreal Streaming technology works by projecting all the live activities performed by an experienced surgeon in a surgical ward, whilst a surgeon accesses it remotely and discusses the progress of activities with other medical students in the lecture hall, this is done by

showing real images from the diagnostic procedures (laparoscopic, ultrasound) and operating theatres to the lecture hall.

The system can achieve similar quality of teaching like with direct presence of students in the operating room. The system has the possibility of actively using the e-learning for teaching students in separate medical training centres by the application of the e-learning models, a high-speed internet connection of about 3Mb can render the internet connection accessible at home for surgical broadcasting and lectures. The figure below shows the network topology of Unreal Streaming Technologies.
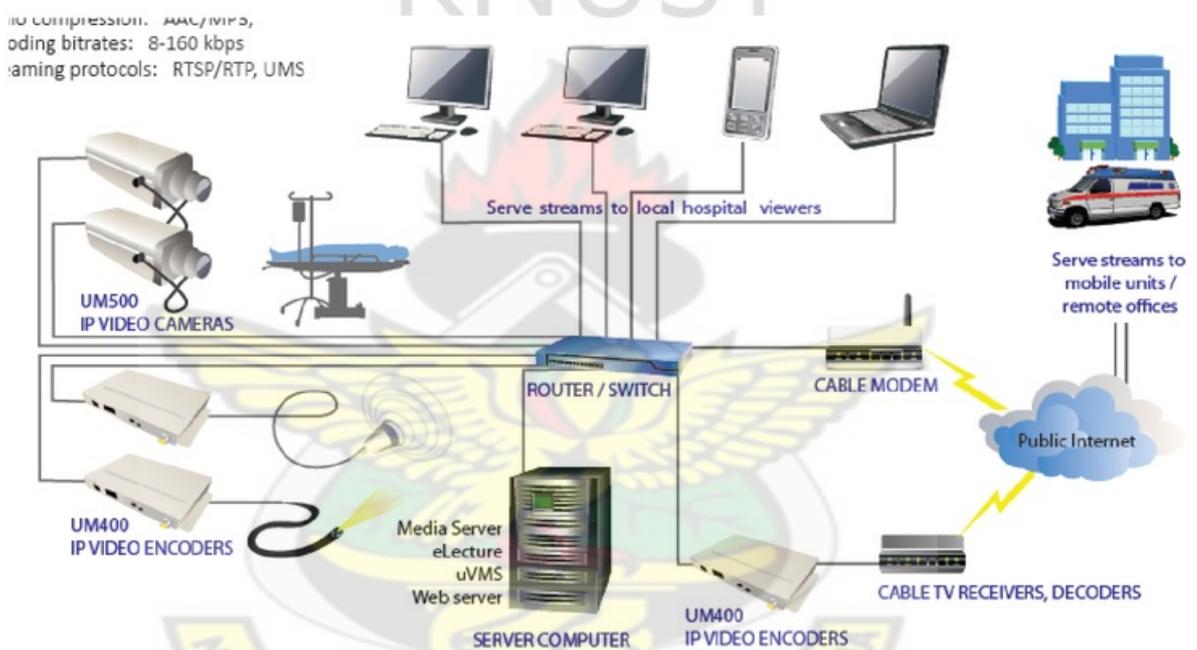
Figure 2.7: The Network Topology of Unreal Streaming Technologies

The merits of Unreal Streaming Technologies solution in comparison with other vendors are hardware and software systems with low network traffic data stream, streaming from existing analog devices including endoscopes and other medical optical instruments." Other merits from the Unreal Streaming Technologies includes:

> **Broadcasting and Recording operating room procedures.**

Recording and broadcasting is easy, flexible and transparent for medical practitioners to manipulate whether a remote specialist, student or lecturer is available or not. Recording can be scheduled and the cameras can be prevented or allowed from streaming in the operating room.

> **Video monitoring.**

There is an effective monitoring in consulting rooms, maternity units, patient rooms, and other important locations within the hospital or in remote or mobile locations. This live streaming videos can also be viewed on some sophisticated mobile devices.

> **Remote Assessment and Diagnosis**

Doctor-to-Doctor remote collaboration and Doctor-to-Patient remote interaction can be possible in areas with internet or private IP network connections.

▪ **Train Nurses and Students**

Local or remote student groups can be connected together with real time streaming through simulated procedures during training sessions or classes.

▪ **Production of Live TV within the hospital.**

Live TV programs can be distributed over the IP connections to patient rooms which saves resources on expensive TV cable infrastructure. (www.umediaserver.net)

2.14   Why IP Camera Surveillance Is Critical To Healthcare Security.

➤ **Monitoring of Remote and Centralized Areas.**

Providing effective and efficient video supervision over an entire hospital facility is an intimidating assignment.

With the application IP-based surveillance systems, healthcare facilities can assemble a centralized operation center that will allow security personnel's to watch live events from multiple cameras while at the same time reviewing recorded images from specific incidents. IP-enabled devices are able to transfer video data wirelessly, allowing authorized security officials to view video footage via mobile computers and wireless tablets, and providing video feed access of their facilities anywhere, at any time.

➤ **Video Analytics.**

Video analytics are yet another benefit offered by IP-based security solutions. With the application of the analytics software, triggers are set to notify personnel about potential threats that occur and the security system is automated to provide alerts to particular events in real time. By deploying these emerging technologies, hospitals gain the ability to proactively monitor their activities and ensure that the hospital policies are properly adhered to.

➤ **Patient Privacy.**

Patient privacy is a critical consideration for hospitals. Some of the latest IP-enabled cameras are equipped with eyelids that allow healthcare staff to turn cameras on remotely in the event of an incident or emergency, while providing patient privacy. Ultimately, these benefits help hospital administrators to ensure that their facilities are safe and secure while complying with state and federal privacy laws.

2.15   The Use of Internet Protocol Cameras In Other Organizations.

➢ **Monitoring of Project.**

Mining and construction industries use web-based camera systems to monitor the continuous progress of the projects either remotely or locally and to generate high quality image for journals and time lapse films.

➢ **Process Control.**

IP cameras are mostly used to monitor the production lines, processes and quality control in the manufacturing industries. In control rooms the video analytics cameras are used to trigger alerts.

➢ **Retail Market.**

Network IP cameras are used to analyze the effects on in-store and off-store promotions on customers, analyze store presentation and oversee the performance of sales personnel.

➢ **Online Marketing and Advertising**

Live video content are broadcast over the internet with the help of IP cameras to promote product from shops, this increases the customer base of most organizations since it is a form of advertizing to the companies.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

Nowadays, the coming of multiple experts to focus on a single Patient is a terrifying organisational and logistical difficulty. Discussions among broad range of experts on multiple number of patients are possible with the use of Internet protocol cameras. This has made it possible for experts to communicate over vast distance at a cost otherwise not possible and thereby increasing the quality of access to healthcare.

Multidisciplinary teams improve communication, coordination, and decision-making among health care members, patients and optimistically more positive findings will be produced. Communication at different levels of healthcare services are improved with the use of internet protocol cameras; (World Journal of Surgery; 2009)

This chapter emphasizes on the research methods that were selected for the study. It entails the Introduction, History of Case Study (Kwahu Government Hospital), research design, case study approach, population, sample size and sampling technique, research instrument, methods of analysis, ethical consideration, data analysis, reliability and validity, feasibility study of operations of cases at the lower health facility, and the proposed system to be developed.

3.2 Study Area

The study will be conducted in three Hospitals and one health center which are in Kwahu South District, Kwahu East District and Kwahu West Municipality all in the Eastern Region. But majority of the respondents will be from Kwahu Government Hospital. This hospital was established in 1974. The Kwahu Government Hospital serves the populations of the Kwahu South and Kwahu East Districts. It is the only referral point for the over 30 health centres and

clinics in the two districts. In addition, it serves as a referral point for some health facilities in the Kwahu West Municipality. The map below shows the areas in Eastern region serviced by the Kwahu Government Hospital.
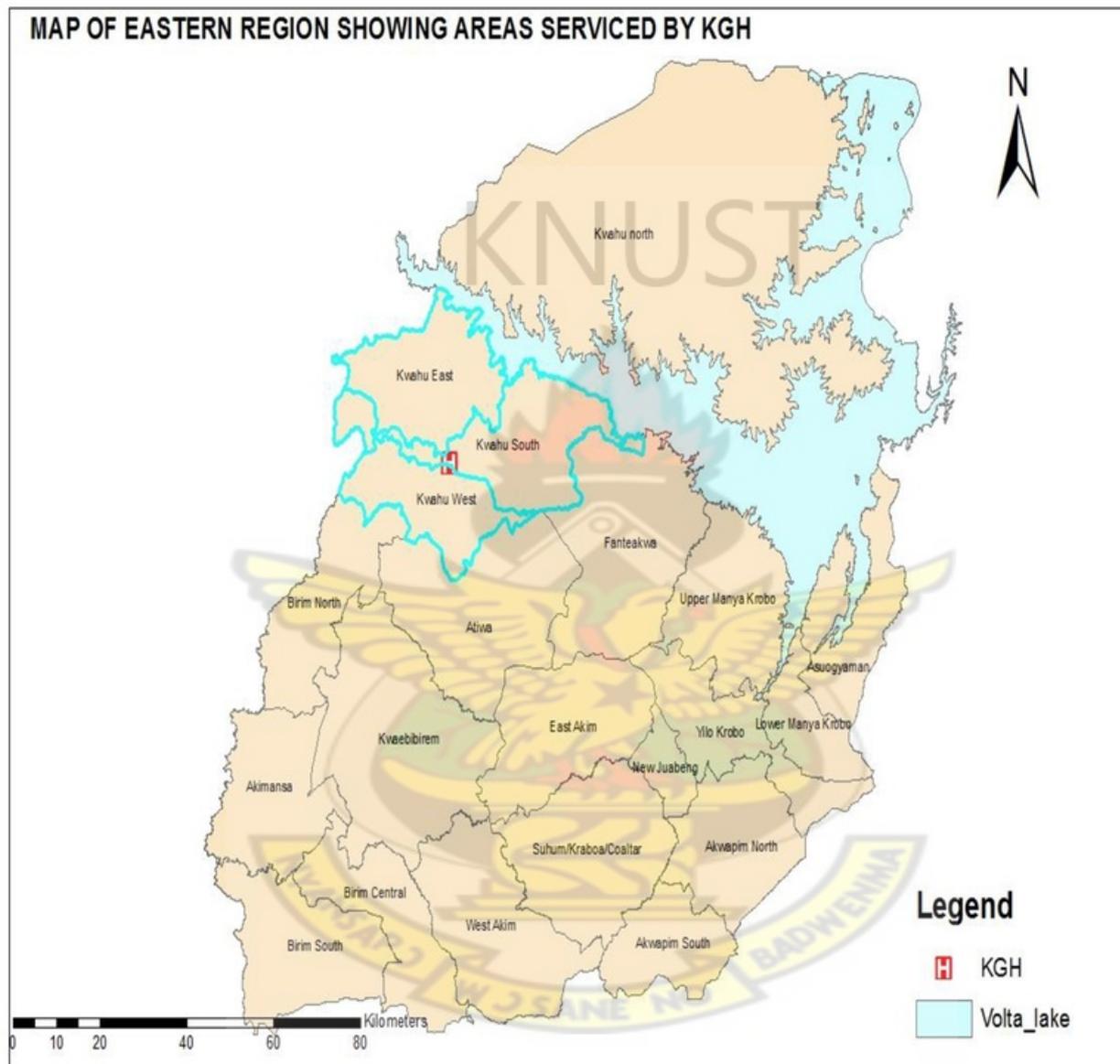
Figure 3.1: Map of Eastern Region showing areas serviced by KGH.

Figure 3.2 : Map of Kwahu South District showing areas with health facilities.

In the year 2014, the Kwahu Government hospital had 78,753 OPD attendances. The main causes of OPD attendance recorded in the hospital were Malaria, Upper Respiratory tract

infections and diarrheal diseases. Diabetes Mellitus is among the top causes of admissions and its resultant complications are the leading causes of mortality in the hospital.

3.3 Research Design.

Research design is typically the framework for collecting appropriate data. Aina (2004). It is generally, a plan for obtaining response from respondents based on the research questions under study.

3.4 Case Study Research Approach.

Yin (1984), describes a case study research design as an empirical investigation to situations found in real-life condition when contiguity between phenomenon and context are evidently not clear, especially when different sources of evidence are used.

In addition, case study is an orderly method of investigation into an occurrence or a set of such events aimed at describing or explaining an event of interest. Bromley(1990). "How", "why" or 'when' are generally used to answer case study research questions. A limited number of events or conditions and their inter-relationships are targeted with a case study research questions. To assist in formulating and targeting the questions in a case study, a literature review is conducted which establishes the perfidiously conducted research and it leads to an insightful questions about the problem. Large amounts of data for analysis are produce since it may include multiple cases within a study.

The methodology use in case study by Researchers from multi-disciplines are used to build upon theory, dispute or challenge theory, produce new theory, describe an object or phenomenon, explain a situation, or to explore. The significance of the case study methodology is its applicability to real-life situation such as human situations, contemporary issues and its public accessibility through written reports. The results of case study are

directly related to the common readers experience and make easy understanding of complex real-life situations.

3.5 Population.

According to Fraenkel and Wallen (2003) the population is the large group to which one hopes to apply the results. The population for the study were the 50 respondents comprising of 10 respondents from the Pepease Health Centres, 10 respondents from the Agyarkwa Hospital Limited, 10 respondents from the Holy Family Hospital and 20 respondents from the Kwahu Government Hospital.

3.6 Sample Size and Sampling Techniques.

Kumekpor (2002) explains sampling as is a process or a method that allows a researcher to make assumption about a population based on the nature of the sample. Sample size is the subset of the population under study. A random sampling method was use in the selection of Staff from different unit in the hospitals. The sampling technique was used to sample One (1) Medical Doctor, Six (6) Medical Assistants, Two (2) Midwives, Thirty-One (31) Nurses and Ten (10) Student Nurses. All categories of the health professionals were taken into consideration and their views reported.

3.7 Study Variables

The study variables will include:

1. Level of Education.

2. Level of Qualification.

3. Nature of Duties performed at the Hospital.

4. Level of Knowledge on the System to be used.

5. Level of knowledge of accessibility of other Health Care facilities.

6. Determination of distance of health facilities.

7. The financial status of the Patient.

3.8 Source of Data.

The acquired data for the research was obtained from both secondary and primary source.

3.9 Primary Sources of Data Collection.

3.9.1 Questionnaire Administration

The questionnaire was used to provide a meaningful picture of events that would explain how the use of Internet Protocol Cameras will bridge the barrier of access to quality health care with regard to the data gathered. The questionnaires were answered by all 50 respondents chosen from the various hospitals and health centers.

Asante (2000) also explains questionnaires to be a valuable tool used for eliciting useful information on a specific issue from knowledgeable respondents. The first part was used to gather information on the challenges that are encountered when patient are referred to different health facility for quality health care and the second part comprised questions directly relating to how feasible the use of Internet Protocol Cameras are in bridging the barriers of access to quality health care in remote settings. (see *appendix*)

3.10 Secondary Sources of Data Collection

The secondary source of data collection was based on documents relating to bridging the barrier of access to quality health care with the use of Internet protocol cameras. The data was obtained from institutional archival records. These included information from Pepease

Health Centre, Agyakwah Hospital Limited, Holy Family Hospital and Kwahu Government Hospital morbidity and mortality reports, articles, journals, publications and the internet.

3.11 Ethical consideration

Respondents were informed that they have the right to withdraw from the study at any time, and they were assured also of the confidentiality of the data they submit. Numbers (codes) were used rather than names to assure the Respondents anonymity. However the respondents were assured that whatever they said as part of the research was meant for academic purposes and completely confidential and would in no way be divulge to another person. Moreover, all respondents were encouraged not to answer any question that made them uncomfortable.

3.12 Method of Analysis.

Frequencies and percentages which are descriptive statistics were used to interpret the results. The statements were ranked by the Respondents and their results analyzed.

3.13 Analysis of Data.

Silvia and Skilling (2006) explains data analysis as the process of examining all the information and appraising the important information that can be supportive in better decision making. The answered questionnaires retrieved were edited and checked for discrepancies. Qualitative and quantitative techniques were used to examine the data. Tables and charts were use to present the data.

3.14 Reliability.

Reliability means that there would be uniformity in the event of another researcher undertaking the same study with similar category of persons for same period of time, the result should be alike (Cooper & Schindler, 1998). A test-retest process was used to test the reliability of the questionnaire. The simple percentage method was used to calculate and compared the results in each occurrence. The results were alike and therefore the questionnaire had high test-retest to promote reliability.

3.15 Validity.

Validity can be explained as the degree to which an instrument is able to measure what it is intended to measure. Data validity is examined to ensue whether the collected or gathered data is relevant to the issue under investigation, and whether the survey undertaken provided the solution. Golafashani (2003), explains that validity is how the Researcher truly assess what it is expected to access, or how accurately the study results are. To assess the validity of this study, questions for the respondents were taken from a standardised questionnaire that addressed the research questions of the study.

3.16   Feasibility Study Of Existing Health Operations In Rural Areas.

Middle income countries have chosen village-level primary care facilities mostly called dispensaries, maternities or health centers-as the main point of care for uncomplicated health conditions (Barnum and Kutzin 1993; Sanders et al. 1998; Campbell et al. 2006). These are often run by non-physician, clinicians, such as clinical officers, nurse or midwives who are trained to attend to deliveries and to refer patients with complications to hospitals (Mullan

and Frehywot 2007). This structure of health care delivery, with many primary-care facilities close to communities and district hospitals designated as referral centres, is seen as an efficient way to expand service coverage in resource-constrained countries with few hospitals and doctor shortages (Koblinsky et al. 2006). Though designate facilities for referring complication, the nature of roads, financial constraints, distance and many other factors reduce the percentage of patients with complicated conditions who adhere to this referrals. In most situations these patients resort to over the counter medications obtain from drug stores, prayer camps and traditional medical practitioners to help in solving this conditions (Survey, 2015). Likely requisites for successful referral systems include: A referral strategy informed by the assessment of population needs and health system capabilities, an adequately resourced referral center, active collaboration between referral levels and across sectors, formalized communication and transport arrangements, agreed setting-specific protocols for referrer and receiver; supervision and accountability for providers' performance, affordable service costs, the capacity to monitor effectiveness and policy support.
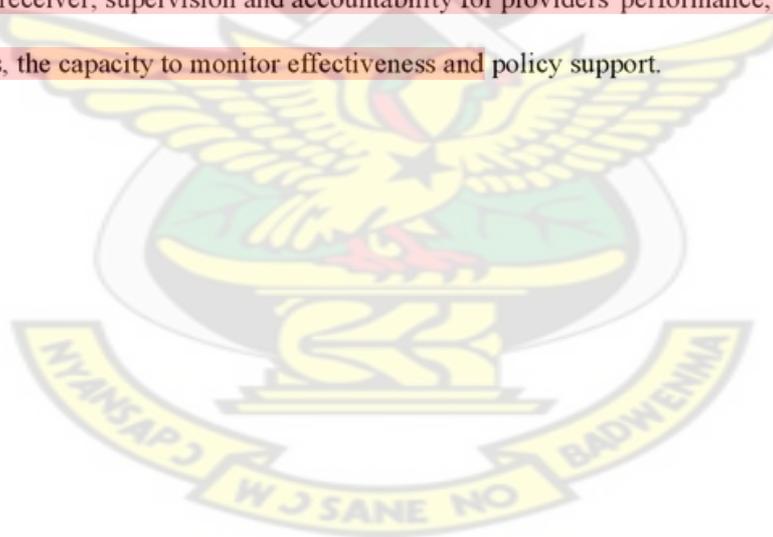
The diagram below explains the flow of information in the existing referral system when a complicated case arrives at the remote health facility.
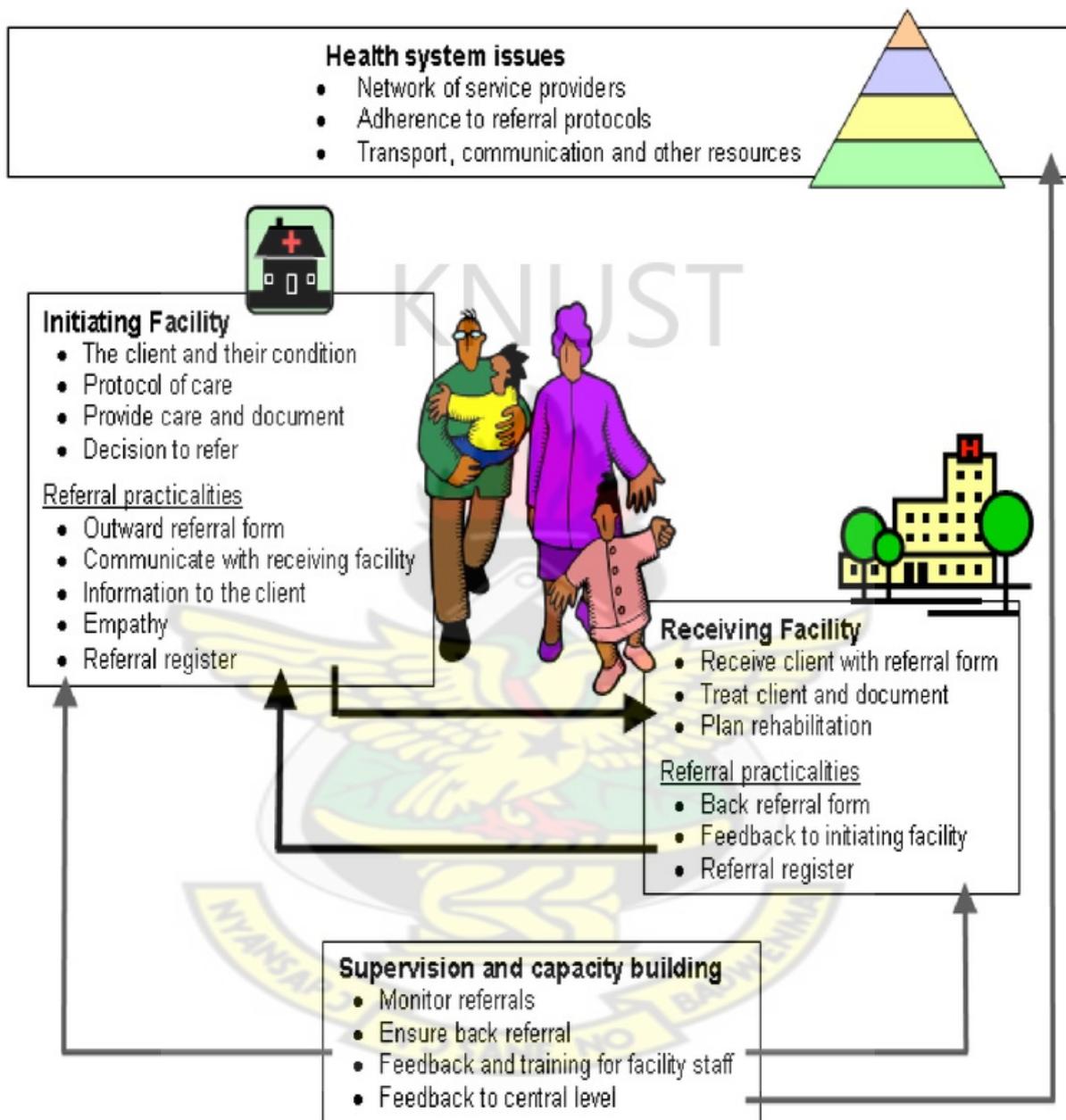
Figure 3.3   Information Flow In A Referral System.

Source: (Bossyns P and Van Lerberghe W, 2004)

The flow chart below shows the flow of information in the existing referral system.
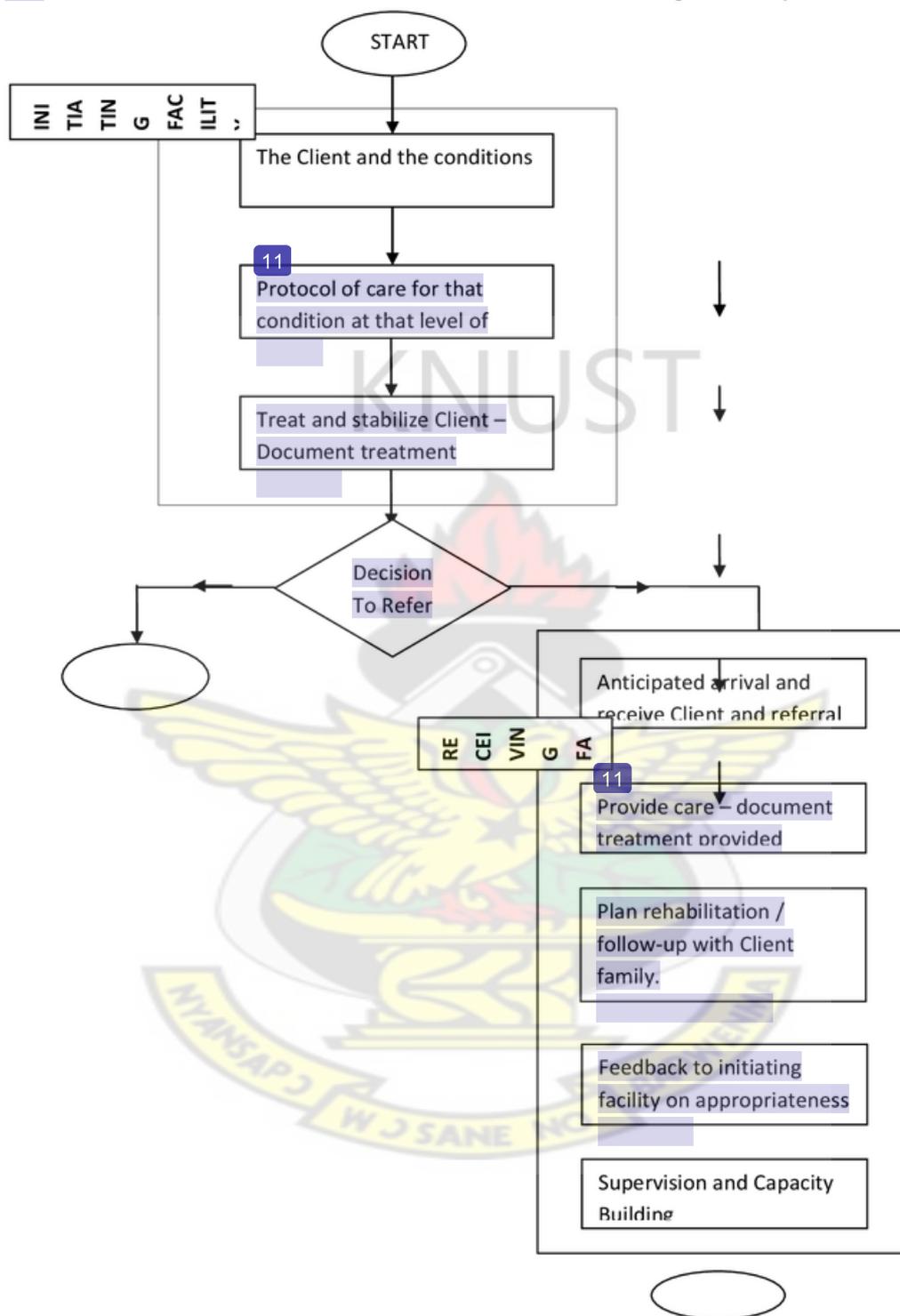
Figure 3.5: Flow chart of existing referral system in a remote health facility.

3.17 Propose System Requirement

This requirement is divided into functional and non-functional requirement and the MoSCoW principle was applied.

3.18 Functional Requirement

The functional requirement describes what the system is intended to do.

a) User Login Page (User Authentication)

b) User Login details (Administrative Function)

c) User account (Administrative Function)

d) Basic System Operation – update, add, view, delete and search (Administrative, User functions)

e) Record live streaming case (User Function)

f) Generate Report (User Function)

g) Logout (User Authentication)

3.19 Non-Functional Requirement

Non-functional requirement is used to indicate the criteria that judges the operation of the system, other than precise performance of the system.

A. **Performance**: The system should perform within the scope.

B. **Usability:** The system should be user friendly and must be used by an average computer literate.

C. **Accessibility:** The system should be accessible at any point in time.

D. **Security:** The system should provide access to only authorized users and reject wrong login credentials (incorrect username / incorrect password).

E. **Recoverability**: The system should be capable of recovering from errors and be accessible after error recovery.

3.20 Description of the Proposed System.

A Computer or Laptop will be connected to a router and configured by assigning a static IP address to the computer with the help of an RJ45 cable in a Local Area Network (LAN) configuration depending on the network topology of the healthcare facility.

The software which will be used to capture the personal Information, the vital statistics and the diagnosis of the patient will be installed on this machine. This will capture the Name, Sex, Age, Address, Temperature, Weight, Height, Blood Pressure, Diagnosis, Treatment and Recommendations by the Doctor. The captured data will enable the Doctor to take a decision when the system is accessed.

Two different IP addresses will be obtained from any recognized or registered internet service provider, One of the IP addresses will be configured to the router that will make it possible for the Doctor to view the system from outside the location of the facility through the principle of port forwarding between the router and IP camera and the other IP address configured between the computer and the router using LAN configuration. The IP camera, the router and the computer will be connected together by using RJ45 network cables.

The router and the IP Camera will be installed on the computer by installing their software's from their manufacturers.

The IP addresses obtained from the internet service provider will be embedded into the programing codes. This will make it easy to access through the hypertext transfer protocol. There will be two separate links on the main page of the system, one of the links will be to access the database and the other link to access the live video of the patient.

For a Doctor to access the database at his location, the Doctor will just click on the database button which is already link to the database software by the system developer on the main page and the link will directs him to access the database, after entering the correct credentials (Username and Password) assigned to him, the database will open for him and he can now view the reports on the patient.

To access the live video of the patient, the Doctor will click on the view live video button on the main page of the system and it will link him to the live video of the patient, this will enable him to make any recommendations. The memory disk in the camera will be used to store the live recording videos for future references.

There must always be an internet connection so that the router can transmit its data out and the Doctor who accesses the system must also have an internet connection in other for him to access the web pages.

It is always important for the Doctor/Specialist to view the vital report of the patient before proceeding to view the live video but under emergency condition it can be the other way round. This system can run on any smart phone, tablet or a computer.

The flowchart below shows the flow of information in the proposed System.
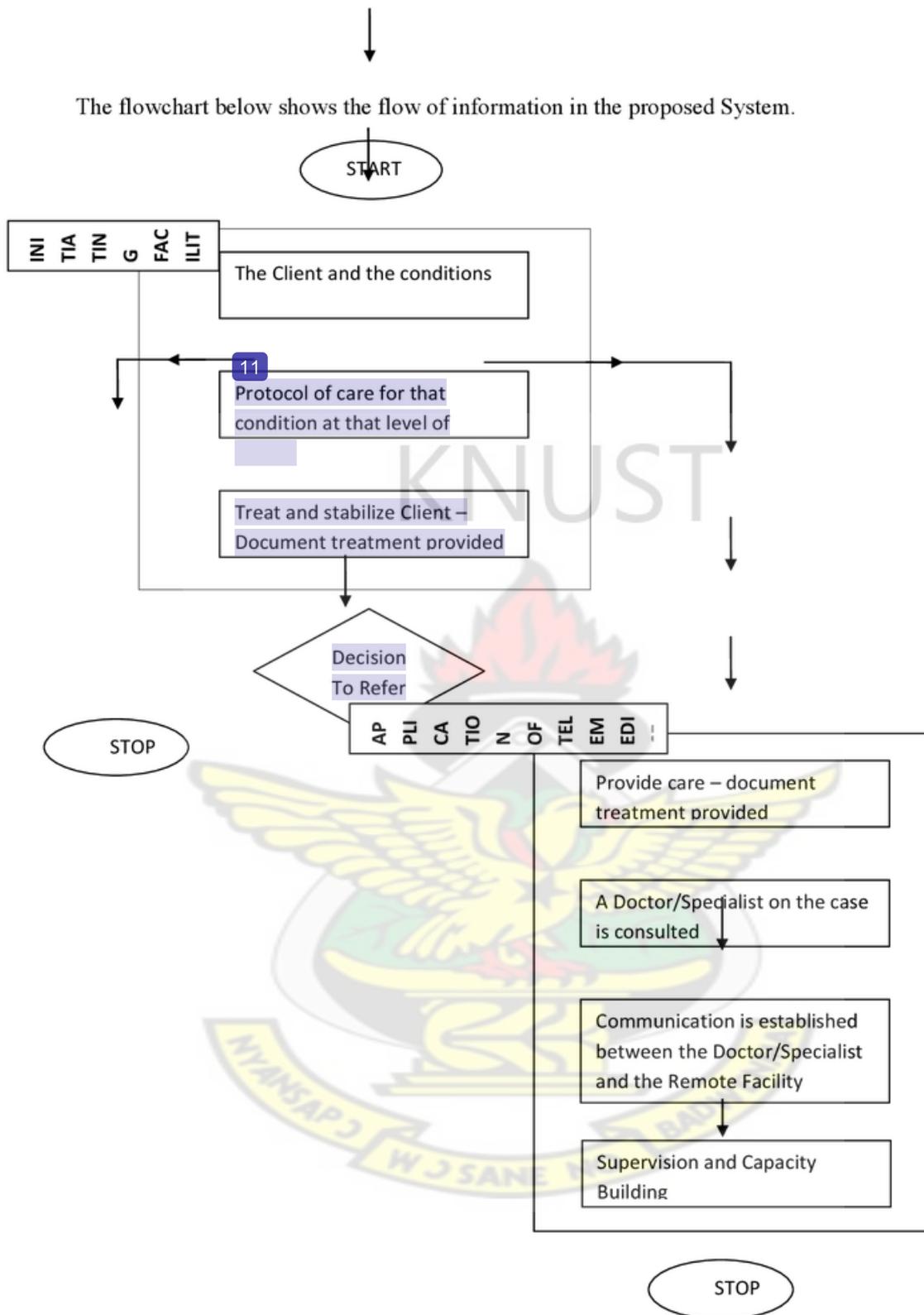
Figure 3.6: Flow chart of the proposed system.

The diagram below describes the proposed system.

Figure 3.7: Diagram of the Proposed System

CHAPTER FOUR

FINDINGS AND DISCUSSIONS OF RESULT

4.1 Introduction.

This chapter presents the result of the study.

4.2 Sex of the Respondents.

As shown in figure 4.1 below, 70% which is the majority of the population of the respondents are females and the remaining 30% are males. This shows that, the category of staff (Student Nurse, Nurses, Midwives, Medical Assistants and Medical Doctors) of the Health Service interviewed, females dominate with males in the minority. The gender distribution proposes that there was adequate depiction of male views in the study although the females were more than the males. This can be concluded that the results of the study reflect the views of all sexes.
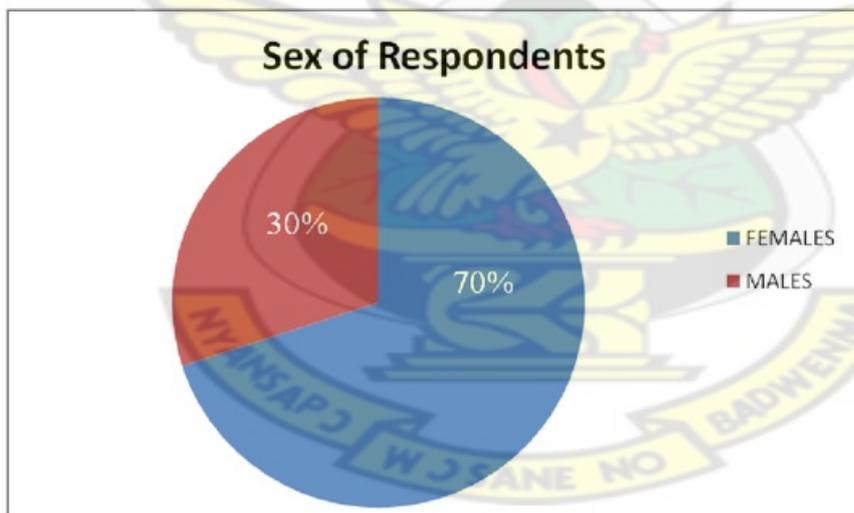
Figure 4.1 Sex Of the Respondents.

Source: Authors Field Data (2015).

The result above shows that generally, there are more female than males in the general nursing field. Many have asked the reasons for the preferences. The idea that to be a 'good nurse' was to be a 'good woman' (Gamarnikow, 1978:77-121), has influenced this factor.

Docia Kisseih, the first Ghanaian Chief Nursing Officer states: "The care of the sick had been the prerogative of the elderly female members of the community before the advent of the professional nurse. Their skill was not acquired in any school of nursing but through long years of housekeeping and child-bearing and practical experience gained in the care of former sick relatives." (Kisseih 1968).

Florence Nightingale believed that men's 'hard and horny' hands were not fitted 'to touch, bathe and dress the wounded' (Summers, 1988). It is thus not surprising that most male nurses are seen in orthopaedics, obstetrics, gynaecology, psychiatry, mental health care and in the theatre (most specialised in anaesthesia). Moreover, this research was carried out for general nurses in the Out Patient Department and some wards in the various health facilities.

4.3 Age Groups of Respondents.

As shown in figure 4.2 below, 56% of the respondents are within the age group of 26-35years, followed by 26% in the age group 18-25years, followed by 16% in the age group 36-46years and lastly, 2% were 47years above. The age distribution reflects all categories of ages for the study, this indicates that there was adequate representation of all age group view on telemedicine.

There were more Nurses between the age groups of 18years to 35years because most of the respondents were Student Nurses and General Nurses who were not specialized in any field.

The number of general nursing staff declined from ages 36years above because in Ghana, The Human Resource Policy of the Ministry of Health (MOH, 2010) allows nurses who have worked for at least three to four years for further studies and most of these Nurses do not return to 'Bed Side Nursing' again after the studies but rather branch to a different specialized field.
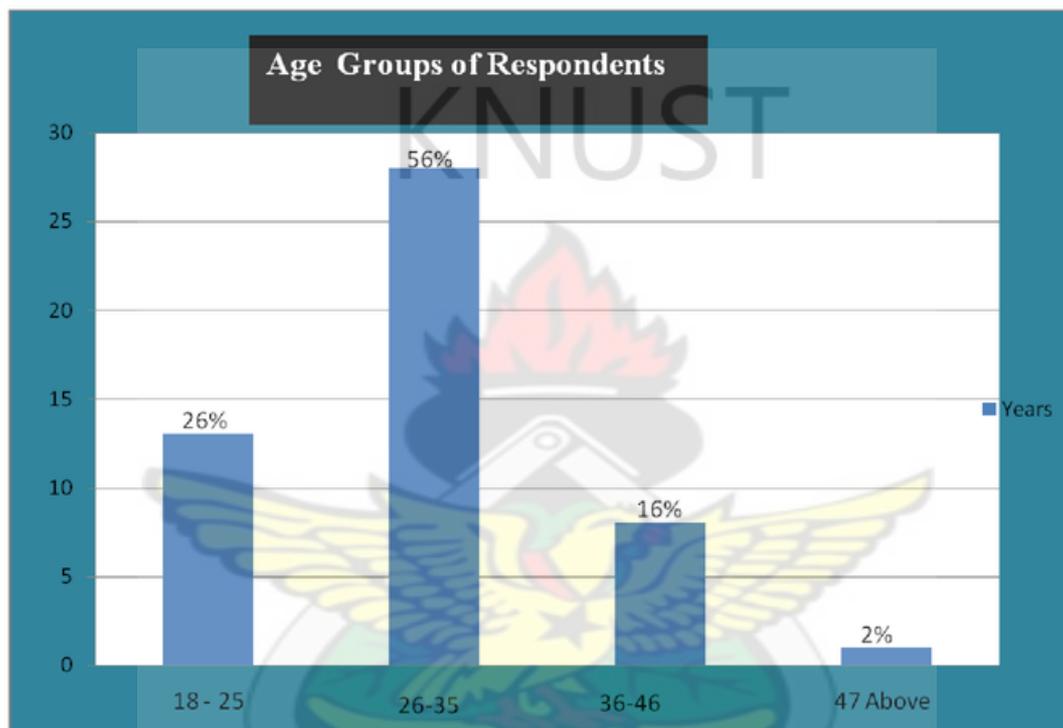
Figure 4.2: Age Groups of Respondents.

Source: Authors Field Data (2015)

4.4 Educational Qualification of Respondents.

The Figure 4.3 below represents the level of education of the respondents. All the respondents have had Post-Secondary/ Tertiary education. However 80% of the respondents have obtain Diplomas and Higher National Diplomas in their various fields of study and 20% of the respondents   have obtain First Degrees and above in their various fields of study. From the research, majority 80% of the respondents have a Diplomas / Certificate as compared to 20% with University Degree. This is supported by the work category of the respondent in (figure 4.4) the basic requirement for nursing and midwifery 86% of respondent is a diploma certificate as compare to a degree for Doctors and Medical Assistance 14%. In a study of the impact of HIV on health sector in South Africa by Shishana et al (2002), only a few 13.5% of nurses and midwives had obtain University Degrees as compare to 100% of the medical Practitioner group.

This depicts that the respondents have had a substantial level of formal education and should be able to critically manage telemedicine applications at their various health care centres.
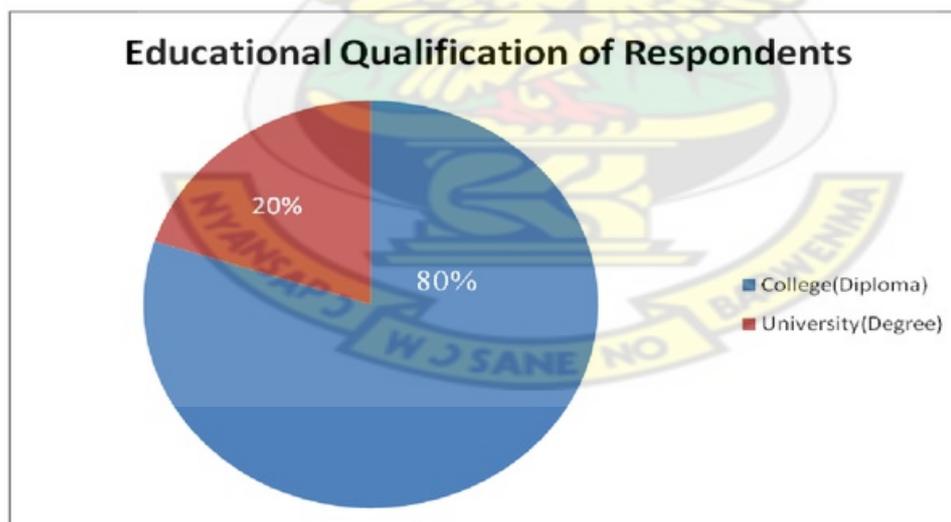
Figure 4.3: Educational Qualification Of Respondents.

4.5 Rank In Organisation.
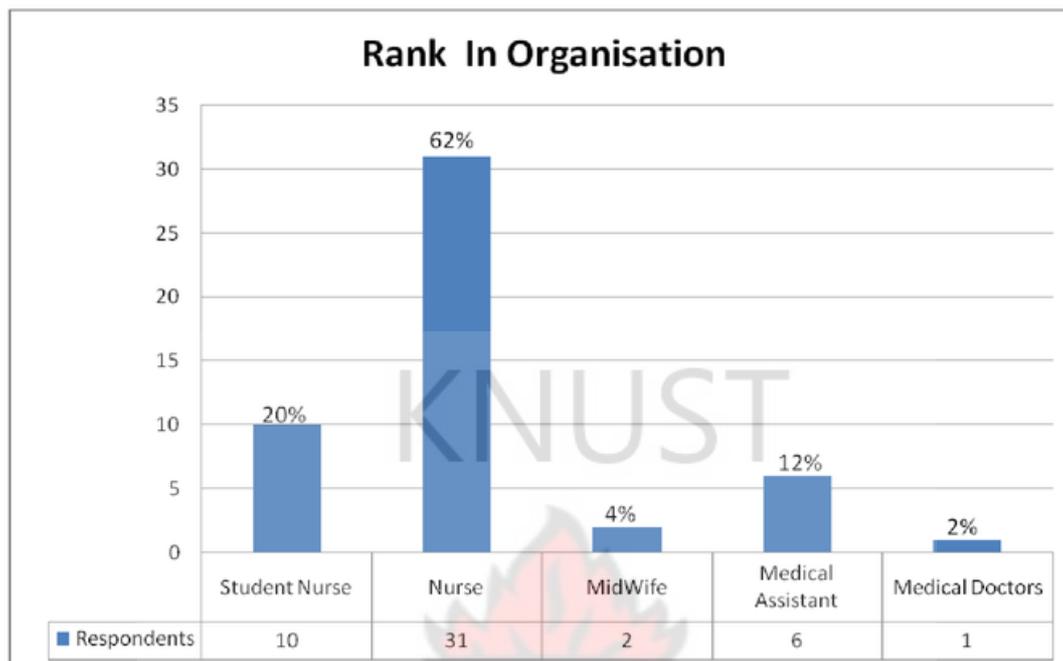
Figure 4.4: Rank In Organisation.

Source: Authors Field Data (2015).

As shown in Figure 4.4 above, 20% of the respondent were Student Nurses, A vast majority of the Staff 62% were Nurses, however 4% of the respondents were Midwives, 12% were Medical Assistants and 2% were Medical Doctors. All categories of the health professionals answered the questionnaires and their views well reported. The results of the study are a reflection of all staffs that were represented in the study.

The results above are in tan den with findings in a similar study conducted by WHO (2006) in which a majority of health workers 30.8% were females to be nurses whilst Medical Doctors 6.3% and Midwives 3.1%. This could be attributed to various factors such as availability of training institutions in which nurses training institutions are more in number than those that train Medical Doctors and Midwives, in addition the number of the work

carried out by this groups is another factor. Nurses have a generalized role which runs from taking patients vital statistics, to recording information in consulting rooms through to assisting patients with their medication, all these make their numbers in the healthcare industry large. In comparison Medical Doctors and Midwives have a more specialized role which requires specialized training.

4.6 Length of Service at the Health Facility

Figure 4.5 below indicates that 16% of the respondents have toiled with their health facilities for not more than 1 year, 42% have worked in the health facilities between 1 to 3 years, 26% of the respondents have worked in the health facilities between 3 to 7 years, 10% of the respondents have worked in the health facilities between 7 to 10 years and lastly about 6% of the respondents have worked in the health facilities for 10 years above.

In Ghana, The Human Resource Policy of the Ministry of Health (MOH, 2010) allows nurses who have worked for at least three years and above to go for study leave. This makes most of the Nurses divert into more specialized areas such as Midwifery, Anaesthesia , ENT , Medical Assistants etc after their study leave and do not return back to' bed side' nursing again. This leads to the fact that most of the respondents that were studied were nurses 62%, it stand to reason that they have not gone for further studies and this could be attributed to their length of stay (1-3years) at the facility which might not have qualified them for the study leave.

Length of Service at the facility

	Below 1year	1-3years	3-7years	7-10years	Above 10years
Respodents	8	21	13	5	3
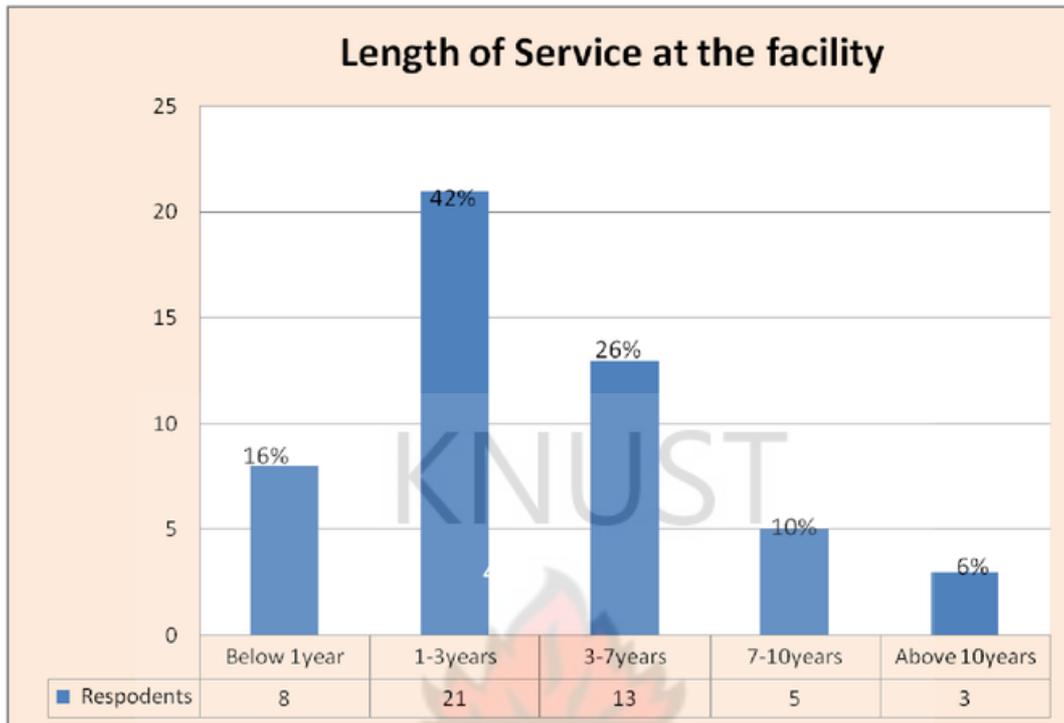
Figure 4.5: Length of Service at the Health Facility

Source: Authors Field Data (2015)

4.7 Health Workers Views on Referrals.

Health Workers Views on Referrals
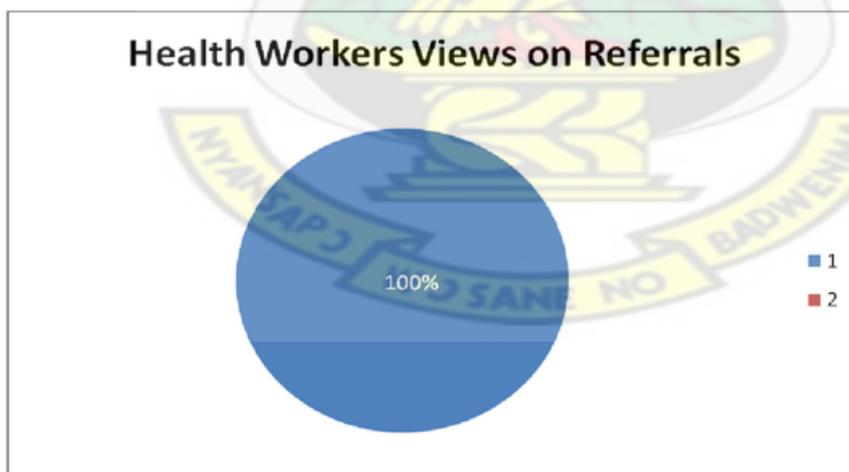
Figure 4.6: Health Workers Views on Referrals.

Figure 4.6 above indicates that all respondents answered yes to the question on whether they have ever referred a client from their health facility to another health facility for a service or services that they could not handle. In all situations, clients were referred to facilities that were deemed to be higher than where the respondents were stationed.

4.8 Common Challenges Encountered When Referring Patients.

The table below shows some of the common challenges that health personnel face when referring patients for treatment.

Table 4.1: Common Challenges Encountered When Referring Patients

	Extremely Affected	Very Affected	Averagely Affected	Slightly Affected	Not Affected at All
I) Availability of service	4 (8%)	6 (12%)	25 (50%)	9 (18%)	6 (12%)
II) Distance	8 (16%)	32 (64%)	4 (8%)	4 (8%)	2 (4%)
III) Poor Road Network	18 (36%)	13 (26%)	11 (22%)	3 (6%)	3 (6%)
IV) Time to be wasted at the receiving facility before your patient will be attended to:	20 (40%)	9 (18%)	18 (36%)	3 (6%)	3 (6%)

V) Cost Involved (Transportation)	32 (62%)	10 (20%)	6 (12%)	3 (6%)	0

Source: Authors Field Data (2015)

From Table 4.1 above, respondents were asked to grade the challenges encountered when referring clients from their facilities to other facilities. The grading was in the form of ' Extremely Affected',' Very Affected',' Averagely Affected' , 'Slightly Affected' and "Not Affected At All".

The first challenge was Availability of service at the receiving facilities. Majority of respondents 50% indicated that availability of service at the receiving facilities was an averagely affected challenge encountered whilst 8% were extremely affected by this challenge.

Distance was another major challenge that was identified by the respondents. The Distance from the referring facility to the receiving facility was a challenge with 64% of the respondents saying that they were 'very affected' as compared to only 4% who said they were 'not affected at all'.

The third challenge identified among the respondents was' Poor Road Network'. On this challenge, 36% of the respondents supported the idea that they were 'Extremely Affected', 26% supported 'Very Affected' and 22% and 6% were 'Averagely and 'Slightly Affected' respectively. However, 6% of the respondents said they were Not Affected at All.

In addition, the time wasted by the referred patient at the receiving facility before being attended to was also identified as a challenge. From the respondents 40% were 'Extremely Affected', 36% said they were 'Averagely Affected', 18% were 'Very Affected' whiles 6%

said they were 'Slightly Affected'. Notwithstanding this, 6% of the respondents said they were 'Not Affected At All'.

The last but obviously not the least challenge is the Cost Involved (Transportation). This was established as a very huge challenge because most of the referring facilities don't even have the means (vehicles) to convey the referred patient to the receiving facility. Majority 62% of the respondents supported 'Extremely Affected', 20% supported 'Very Affected' followed by 12% and 6% for 'averagely and 'Slightly Affected' respectively with no respondent supporting 'Not Affected at All'.

4.9 Why Patients Do Not Adhere To Referrals.
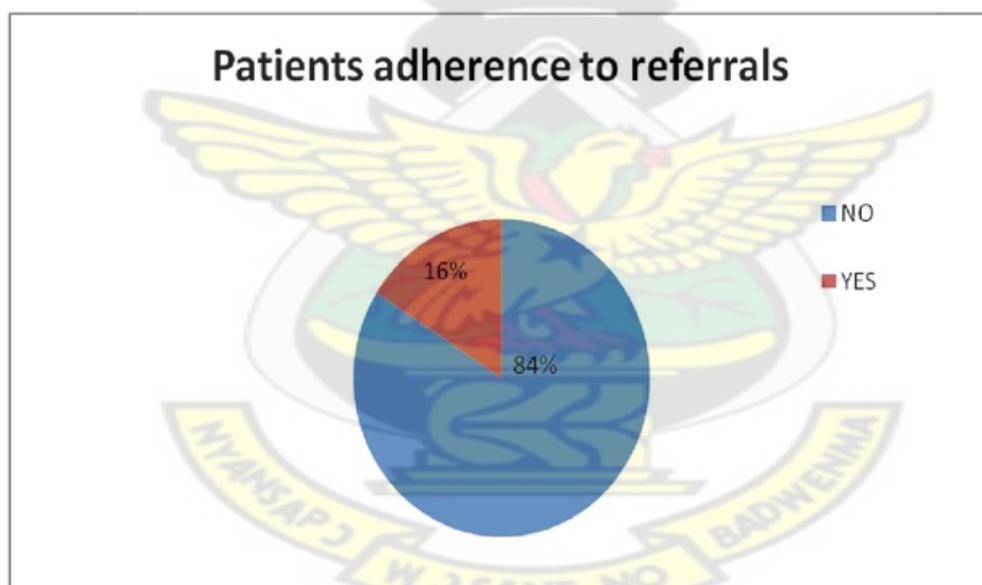
Figure 4.7: Why Patients Do Not Adhere To Referrals.

Source: Authors Field Data (2015)

The results from figure 4.7 above indicate that 16% of the patients do comply with referrals and 84% of the patients do not adhere to referrals when they are referred.

Some of the reasons why patients do not adhere to referrals where based on Cost of transportation, Financial constraints, The nature of the road, patients attitude, family negligence, cost of treatment and the addiction to the use of traditional herbal medicines by the patients. The results can be represented in the figure below.
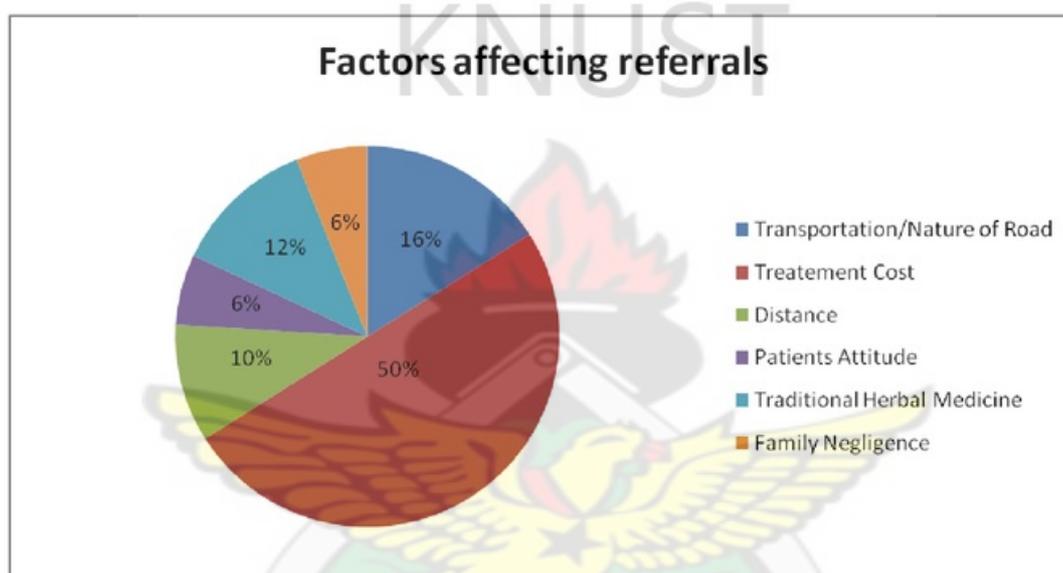
Figure 4.8 : Factors affecting referrals.

Source: Authors Field Data (2015).

4.10 How To Improve The System Of Referral

Figure 4.9 below indicates that the system of referral can be improved by providing modern equipments at the various health facility, Providing free or available transport (Ambulance) at the various health facility, Establishing proper and better communication between the

referring facility and the receiving facilities and finally educating patients on the need for their referrals and their relatives too. The views of the respondents are represented in the figure below.
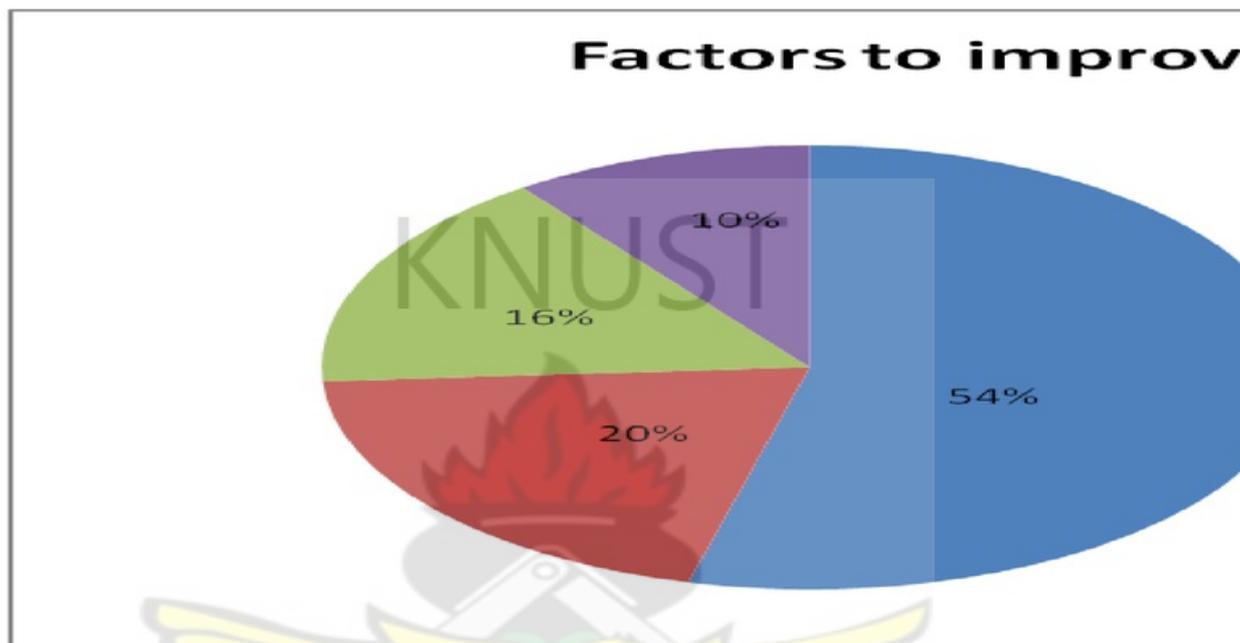
Figure 4.9: Factors to improve the system of referrals.

Source: Authors Field Data (2015)

4.11 Knowledge On The Use Of Telemedicine.

Respondents were asked whether they have ever used telemedicine in patient care. From figure 4.10, it is observed that a greater majority 80% of the respondents said they have used one or more telemedicine system in patients care as opposed to 20% who have never used telemedicine in handling patients. The implication therefore is that if a permanent and well structured telemedicine system is implemented in these facilities, there is a greater chance of acceptance and the benefaction among the staff will be very high. The figure below shows how the health personnel use telemedicine in their health facilities.
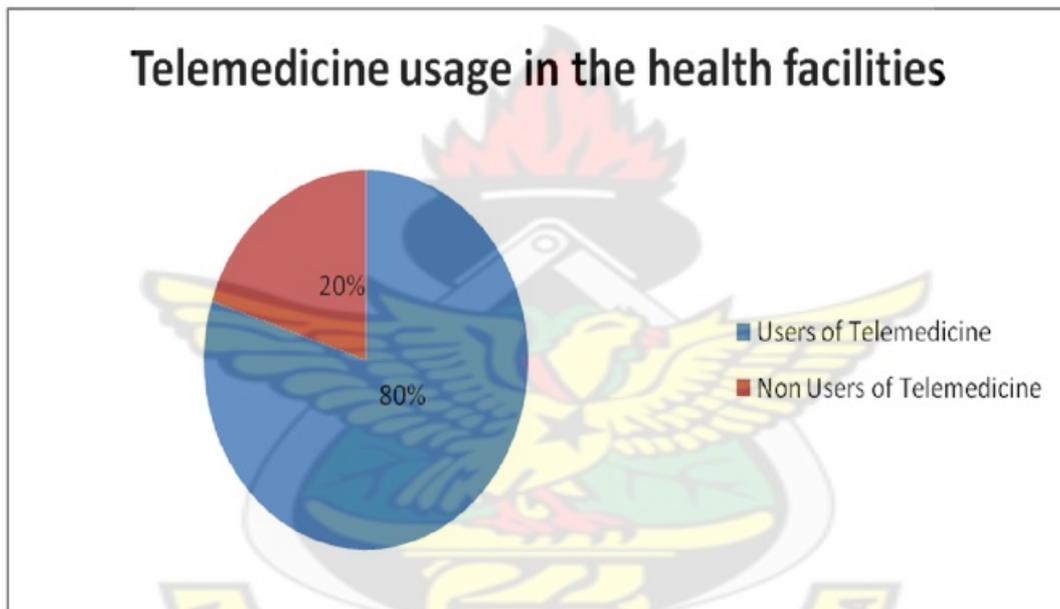
Figure 4.10: Knowledge On The Use Of Telemedicine.

4.12 Types of Telemedicine Systems Used In the Facilities.

The table below shows the type of telemedicine systems that are used at the various health facilities

Table 4.2: Types of telemedicine systems used in the facilities.

	TYPES		PERCENTAGES
1	Telephone calls		50%
2	Skype		11%
3	WhatsApp		12%
4	SMS	INTERNET	8%
5	Viber	APPLICATIONS	8%
6	Telegram		3%
7	Facebook		5%
8	Imo		3%

Source: Authors Field Data (2015)

4.13 The rate of use of telemedicine in the facilities.

The results from figure 4.12 below indicates that 12% of the respondents use telemedicine very often at their various facilities, 24% of the respondents seldom use telemedicine at their various facilities, 48% of the respondents rarely use telemedicine at their various facilities which is the majority, 16% of the respondents have never used telemedicine before . The results indicates that majority of the respondents rarely use telemedicine at the various health facilities and that they may be conversant with the use of Internet Protocol Cameras as a telemedicine method when implemented.
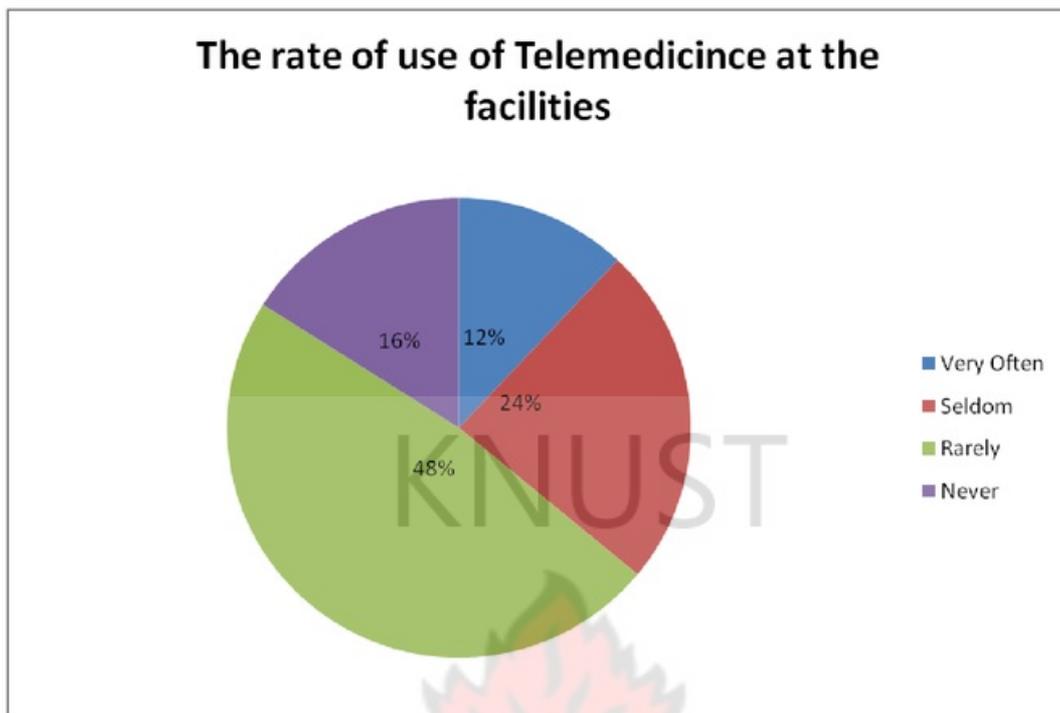
Figure 4.12: The rate of use of telemedicine at the health facilities.

Source: Authors Field Data (2015).

4.14 Importance of the Integration of Telemedicine In The Health Facility.

The table below shows some of the importance as elaborated by the respondents that the integration of telemedicine will lead to: first and foremost, Doctors were of the view that the integration of the system will help them to acquire a lot of knowledge from other Doctors which will help them to deal with certain challenges. The Medical Assistants were of the view that, the case that makes them to refer a patients can now be handled and in difficult times makes consultation from other doctors using the application.

The Nurses also supported the point that the time they waste sometimes in waiting for Doctors to attend to them due to several factors will now be reduced since they can now consult them remotely. This is illustrated in the table below.

Table 4.3: Importance of the integration of telemedicine stated by Health Personnel's

Doctors	Transfer of Knowledge
Medical Assistants	Reduction in number of referrals
Student Nurse, HAC & Nurses	Early treatment of patients
	Help with the provision of first aid to patients
	Health facilities will be equipped with modern ICT equipments.

4.15 Benefits Of Telemedicine To Patient Care.

The results in the table below indicate how beneficial telemedicine is to Patient care in the various facilities. Based on the questionnaires answered, Doctors were in support of the first point which is of more importance to them because the difficulty they face in research findings will be reduced to the diminutive minimal. Medical Assistants were in very much support of the second and third points because the system will allow them to tap a lot of knowledge from other health workers and also facilitate collaboration among them. The Nurses who answered the question strongly supported the fourth and fifth points because the system will boost the confidence of their patients and the idea of patients also willing to see a

Doctor will be reduced because they can handle some of the minor cases. This is illustrated in the table below.

Table 4.4 : Importance of telemedicine to patient care as stated by Health Personnel's

Doctors	Support more efficient health research and access to research results.
Medical Assistants	Enable remote consultation, diagnosis and treatment.
	Promote collaboration and cooperation among health workers.
Student Nurse, HAC & Nurses	Boosts patients' confidence in the facility.
	Reduce the number of referrals to other health facilities.
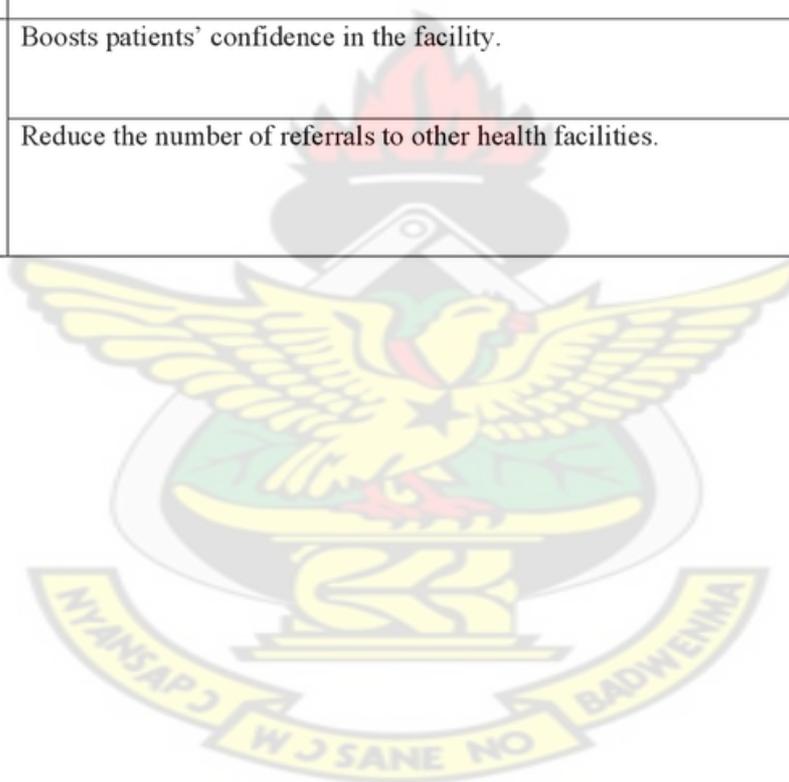
CHAPTER FIVE

DEVELOPMENT, IMPLEMENTATION AND TESTING OF PROTOTYPE

5.1 Introduction

This chapter presents the system development phase. The designs to develop the system including all the layouts, contents, screen designs, user level authentications are all emphasized and laid out for the development.

The database which comprises all records on the various users of the system, patient information will first be developed. This database is the essential part of the system where all information on the users will be stored and will be retrieved upon request by the user whenever it is needed.

This system will be divided into two phases;

Phase One will cover the development of the software to capture the information on the patient and the system users.

Phase Two will concentrate on how to connect the Internet Protocol camera remotely from the facility to the service provider.

The system has a main page interface which links the two web pages together. It helps to easily access a page by clicking on the link below without specifying the web address of the page that the user wants to access.

The figure below shows the main page interface of the system.
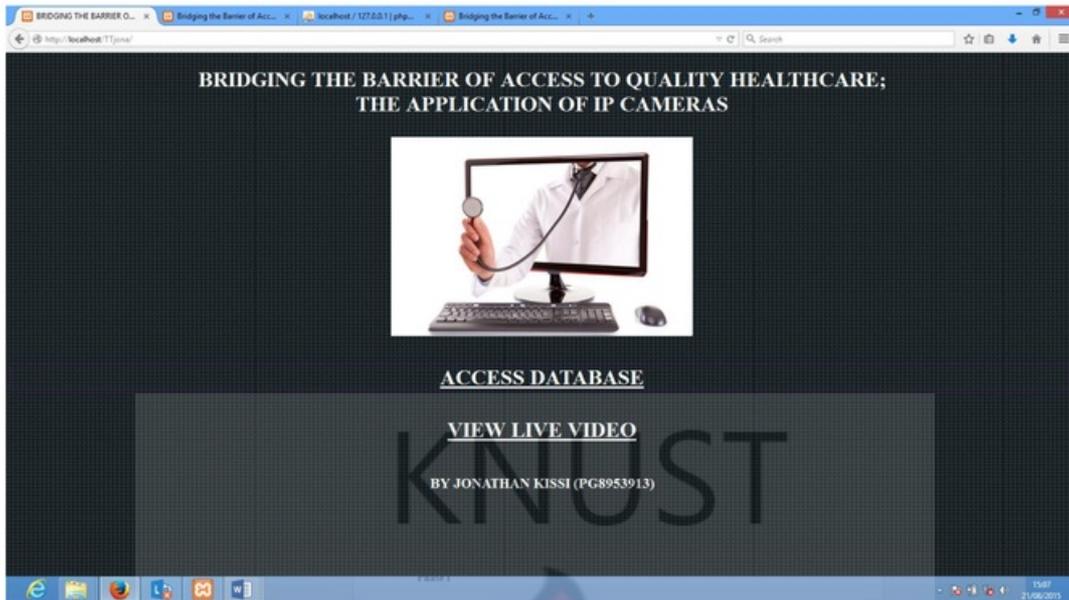
Figure 5.0 Main Page Interface

Phase 1

5.2 Database Development (PhpMyAdmin)

The database of this system will be developed with MySQL using PhpMyAdmin including all the database connection. Below is the screen capture of the database.
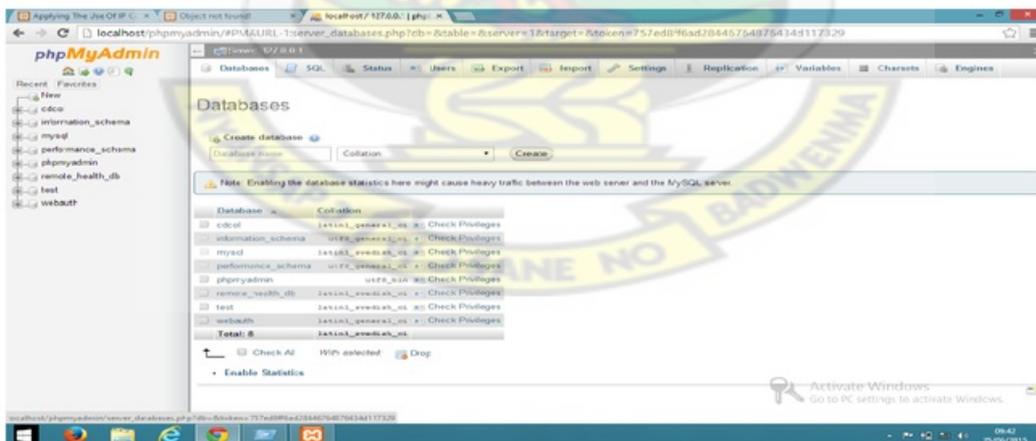
Figure 5.1 Screen capture of the MySQL database using PhpMyAdmin:

5.3 System Interface Development.

The database system login interface or web page will be developed after the database has been successfully developed. This login interface allows the user to key his credentials assigned to by the Administrator. The Administrator and the system users log into the system using the same interface but with different credentials. Below is the screen shot.

Figure 5.2 login Interface

5.4 New User Creation

The Administrator has all the privileges in the system to create all the other users of the system. After creating a user, the user is given the credentials to access the system, the User has the right to change the initial password assigned by the Administrator but the username becomes unchanged.

Below is a screen shot of the New User Creation interface.

Figure 5.3 New User Registration Form

5.5 User Level Permissions

The level to which a system user can use the system is determined by the Administrator who grants the various permissions to the user. Each User in the system is given more than one permission. The permission granted to a User by the Administrator determines what the User can perform and vice versa. Below is a screen shot of the User Level Permission form.
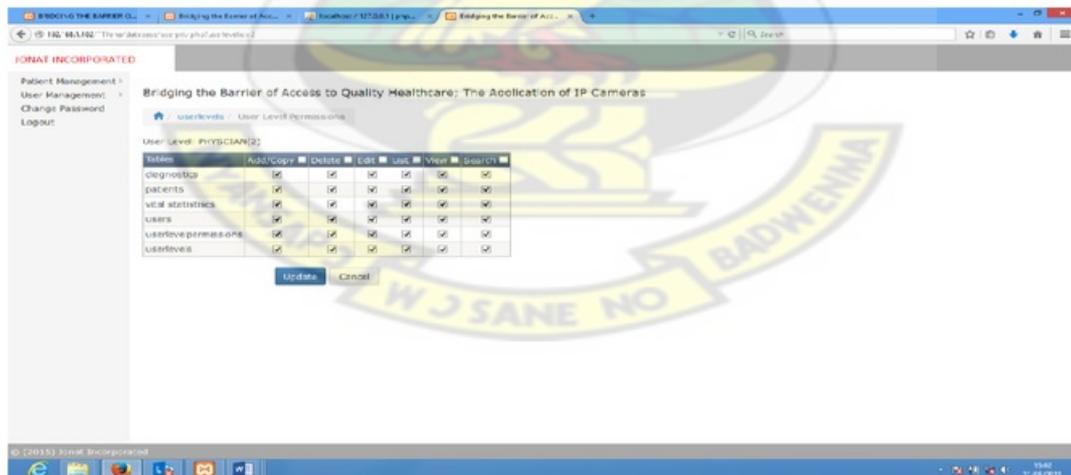
Figure 5.4 User level Permissions Interface.

5.6 New Patient Registration.

The screen shot below enables the system users to capture the details of a new patient into the system.

Figure 5.5 New Patient Registration Form

The detailed reports of patients registered into the system can be seen below.

Figure 5.6 Report of Registered Patients in the system

5.7 Vital Statistic Forms.

This form allows the system user to capture the vital signs of the patient into the system.

Figure 5.7 Vital Signs Forms

The report on the vital sign of a patient captured into the system is shown below.

Figure 5.8: Report on Vital Signs of patient.

5.8 Diagnosis Form

This form below allows the system user to enter the diagnosis and treatment of a patient that has been administered by the Physician. The record is stored in the database and can be recalled at any time.
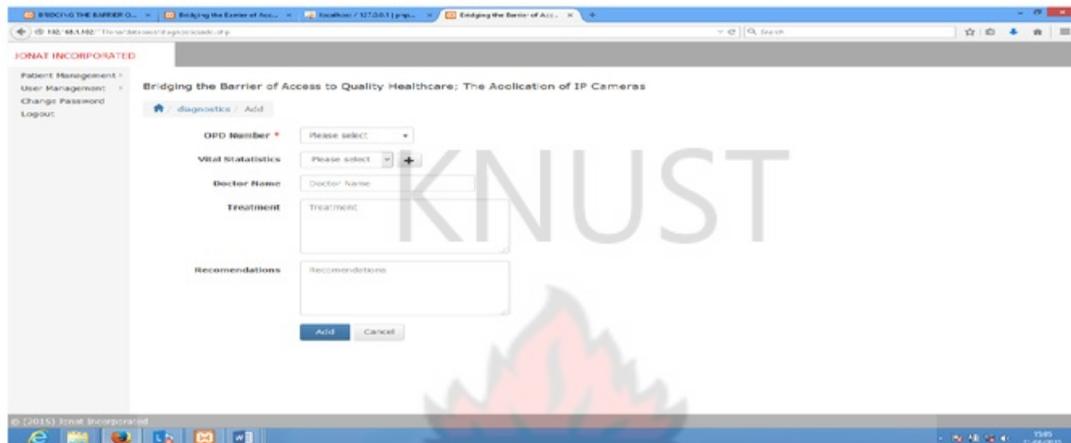
Figure 5.9 Diagnostics Forms

The report on the diagnosis and treatment of a patient captured into the system can be displayed below.

Figure 5.10: Report on the diagnosis and treatment of a patient

Phase II

This is where an Internet Protocol camera is used to remotely connect from the health facility to the service provider.

5.9 Internet Protocol Camera Installation

The camera is packed with all of its installation drivers from the manufacturers; this must be installed onto the local computer at the initiating facility.

There are two ways of installing the camera; The camera can be installed by using either a DHCP (Dynamic Host Computer Protocol) address or a static Internet Protocol client address provided by the internet Service Provider. When a user wants to install the camera by using a static IP address provided by the Service Provider then the address will be entered into the network setup by the user otherwise the IP camera will generate a DHCP address which will enable the installation of the camera to proceed. The interface through which the static IP client address from the Service Provider will be entered is shown.
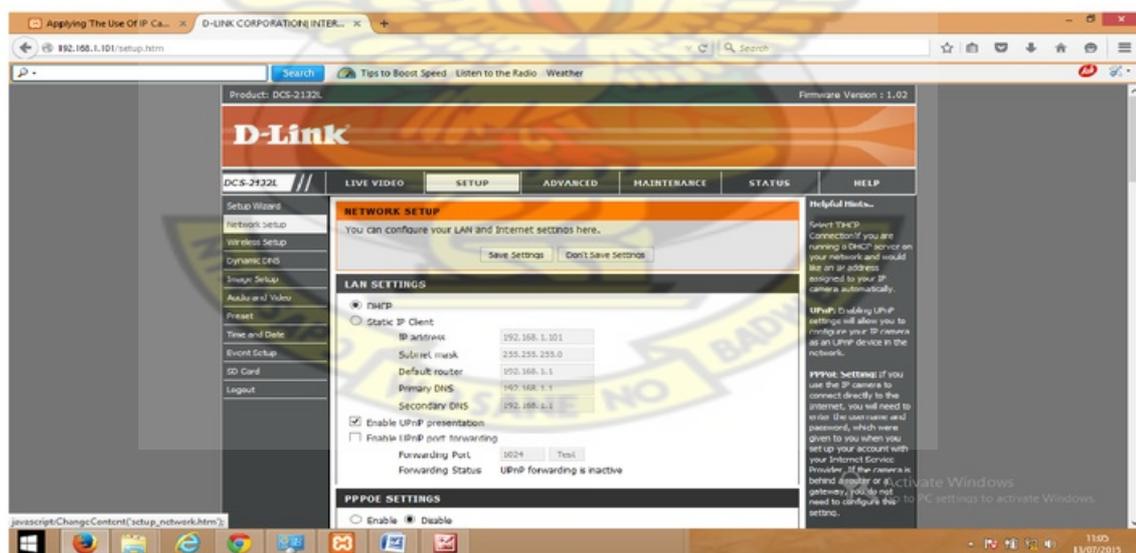

Figure 5.11 Screen capture of the network Setup Interface

After a successful installation of the camera and its accessories, the camera will record all the event that takes place as soon as a Service Provider is connected and stores the live streaming records on its local disk. This video can be played later.

Below is an image viewed remotely after a successful installation of the camera.
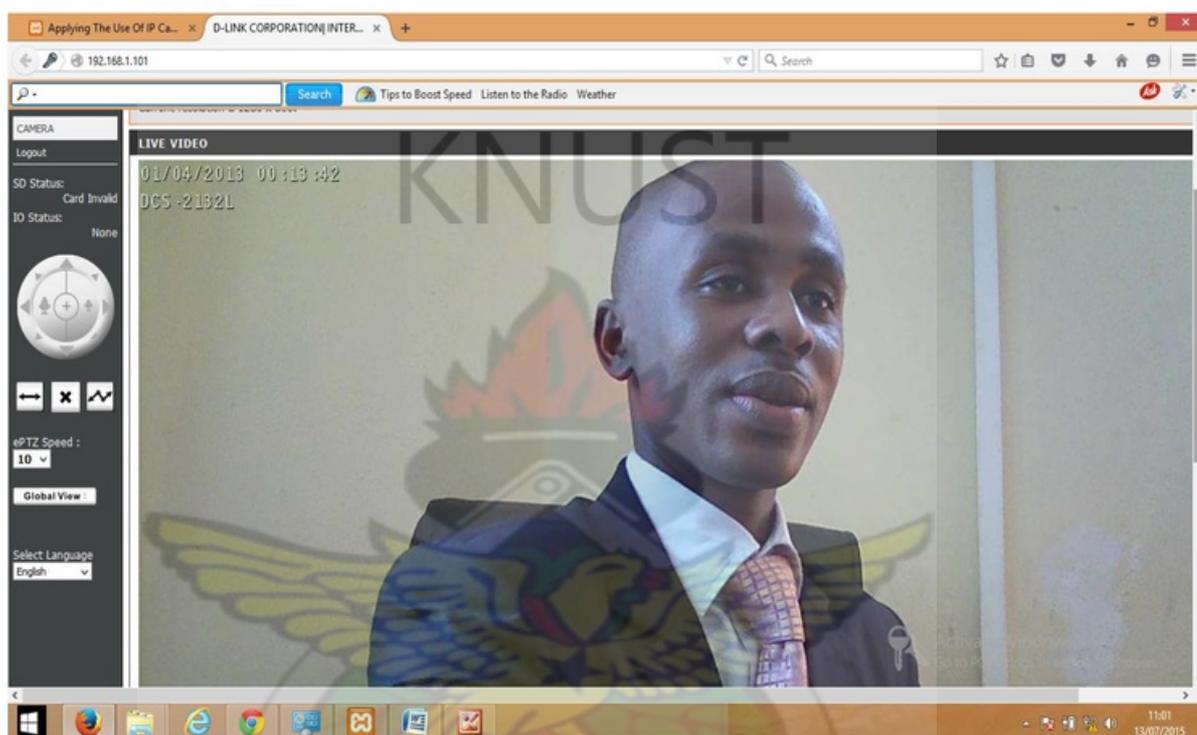
Figure 5.12   Snap shot of an image viewed remotely.

5.10 System Installation

The system installation involves using the DCHP (Dynamic Host Computer Protocol) provided by the camera or by obtaining a static Internet Protocol (IP) client address from a recognized internet service provider which will be configured to the camera. However, the recognized Internet Protocol client addresses has not been obtained yet because this work is for academic research and dissertation.

The database which contains the details of the system users and the patient information will be installed locally on a centralized server. The system will run on any machine that has an operating system above the windows XP, a memory size of 1GB and a hard disk space of about 50GB. The system will be implemented by the health facility and a series of testing will also be carried out.

5.11 User Training

The implementation of this system will lead to a new method of activities into the health sector, and it is obvious that there will be some complications in the effective usage of this system, in view of this, the system will be made user friendly. Moreover there will a series of training organized for staffs who will not be part of the initial implementation phase to equip them with the necessary skills.

5.12 User Manual

It is therefore anticipated that not all members of Staff will be present at the training hence user manuals which contains the systematic guidelines and instructions for the system will be created, documented and will be given to the health facility to enable them deal with the problems and errors that will arise as a result of using the system.

5.13 Testing

Testing is a critical element of Software Quality Assurance (SQA), this portrays that a program or software meets what it is planned for and to reveal all errors in the software or program ahead of its implementation.

There are two distinct goal for testing as stated by Sommerville(2001:p206) this includes

1. To illustrate to the developer and customer that the system meet its requirements.

2. To discover situations in which the behavior of the software is undesirable, incorrect and does not confirm to the system specification.

5.14 Test Case

The objective of testing is to measure the effectiveness of the system, to look into the software carefully and see if it meets the business and user requirement and to uncover errors early in the development.

The following categories of testing will be used in this phase

➢ User Acceptance Testing

Table 5.1: User Acceptance Testing

TEST CASE	OBJECTIVE	EXPECTED RESULT
Page links	Checking if the page links work properly by clicking on the page it should take you to that particular page.	The requested page should be open on clicking at the respective page link.
Hyperlinks	Checking if the hyperlinks on the system are working by taking you to the page on clicking	The hyperlinks should enable users to navigate to another page in the system on clicking the hyperlinks.
Form links	Checking if the form links on the system are working by taking you to the page on clicking	The forms should open and enable users to add to records in the database and also should open on clicking the form link

➢ **Security Testing**

Table 5.2: Security Testing

Admin Login : Correct Credentials	Checking if the system will allow access to the user when the correct credential (username and password) are used.	Allows user to access the system with full access or system privileges.
Admin Login: Wrong Credentials	Checking if the system will restrict access to the user if wrong credentials (username and password) are used.	Restrict user to access the system.
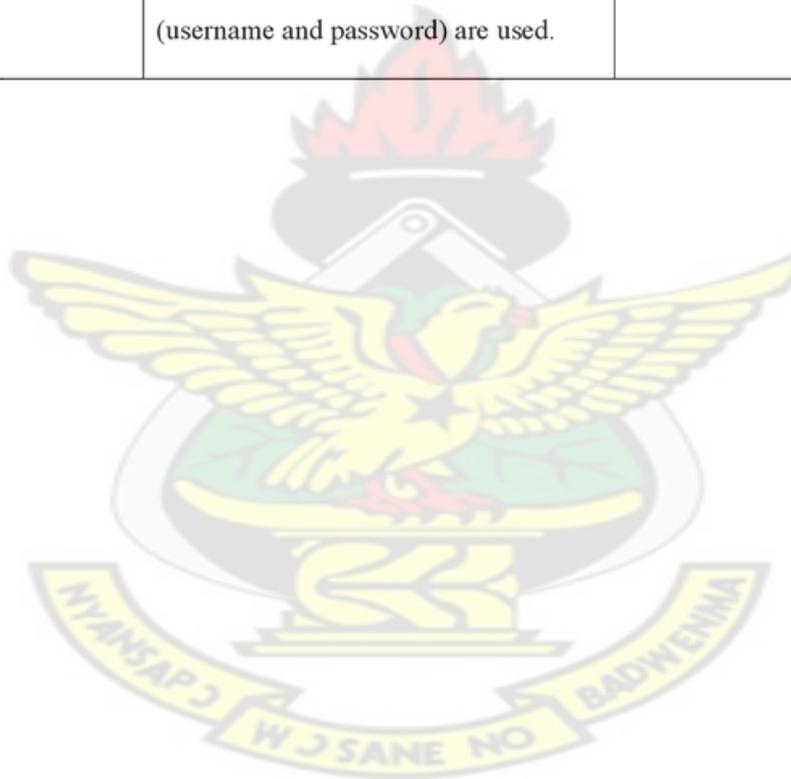
CHAPTER SIX

FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

6.1 Introduction.

This chapter presents the findings of the research process. Suggestions for future research and conclusions that were arrived at on the basis of the research objectives and recommendations based on the important result of the research.

6.2 Findings.

The findings of this research are group into two parts:

➢ This first part is the findings from the survey that was conducted: from the survey,

1. A lot of patients do not adhere to their referrals when they are referred for further treatment. From the research it revealed that (84%) of the patients did not adhere to their referrals.

2. There were several challenges that affect the referrals of patients but the greatest challenge was the cost of treatment which stood at (50%) from the research conducted.

3. Most of the health service persons at the health centers are diploma certificate holders.

4. Most nurses do not come back to 'bed side' nursing after their study leave but rather divert to a more specialized fields like Midwifery, Anaesthesia, ENT, Medical Assistants. etc

5. The knowledge on Information and Communication Technology (ICT's) is low among the health workers and it will require some days of training before they can effectively use the system.

6. Patients are deeply affected by these challenges among the rest when they referred for further treatment. Distance, Poor road network, time to be wasted at the receiving facility before they are attended to and the cost of transportation.

7. A lot of health personnel wants to use telemedicine system but the only system available at their facilities now is the use of the telephone, this implies that when the system is introduce most health personnel's will patronize it.

➢ The second part of the findings of the research was after a successful testing of the system at the health facilities, the following were critically observed.

1. The internet connectivity at the initiating facility must be very strong.

2. The internet protocol cameras that are use must be of higher resolution to give clearer, sharper and brighter images.

3. There must be user training for the staff that will be operating the system.

4. Since the system travels over the satellites, under sunny days the internet connectivity is very strong but on cloudy days the internet connectivity becomes very low.

6.3 Recommendation.

It is at this stage recommended that health facilities/institutions yearning to adopt the use of Internet protocol cameras as an information technology solution request for:

➢ Higher data transmission bandwidth from their internet service providers. This will speed up data delivery times and strong data internet connectivity.

➢ Health Service Administrators should incorporate the use of ICT's in their operations so that much emphasis can be placed on telemedicine as a means to support the health

system rather than the manual ways of always referring patients from one facility to the other.

➤ In any security system, tampering is a risk. The video signals can be lost if the system is tampered with. This can be avoided by installing the cameras in areas out of reach by intruders and putting physical protection in place.

➤ Security procedures such as the use of passwords and biometric finger print techniques should be cooperated into the system so that only authorized users will have access to the system.

6.4 Future Project.

This research project only considered the application of Internet Protocol Cameras in remote settings but did not consider the security risk implication of the system when implemented; a future project will consider the following:

I.   Adding a strong security encryption codes to the system so that intruders cannot interfere with the system.

II. A Global Positioning Service (GPS) system should be included in the system to ensure easy access to the facility and the service provider.

6.5 Conclusion.

The rampant changes in the development, design, use and application of computing resource or applications (hardware and Software) has come with many attendant security risk issues which must be properly assessed, critically analysed and practically evaluated. A properly designed network infrastructure is a way of keeping hackers, and attackers away from these computing resources or applications. As shown in this research work, the application of Internet Protocol Camera as an outsourcing information technology solution to health facilities has its security vulnerabilities as identified. It is therefore imperative for Health Service facilities to completely deploy the use of Internet Protocol Cameras in its operations to enjoy the benefits that comes with it. Once Health Service Administrators shows commitment in this direction telemedicine will be enhanced and a lot of lives will be saved.

BRIDGING THE BARRIER OF ACCESS TO QUALITY HEALTHCARE;THE APPLICATION OF INTERNET PROTOCOL CAMERAS.(CASESTUDY: KWAHU GOVERNMENT HOSPITAL)

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