CONTEXT, PROCESS AND CONTENT DIMENSION TO FULL INTEGRATION OF ICT IN DELIVERY OF HEALTH CARE SERVICES IN SELECTED PUBLIC HEALTH FACILITIES OF MACHAKOS, TURKANA AND NAIROBI COUNTIES IN KENYA

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Context, Process and Content Dimension To Full Integration of ICT in Delivery of Health Care Services in Selected Public Health Facilities of Machakos, Turkana and Nairobi Counties in Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university

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This thesis has been submitted for examination with our approval as the University Supervisors.

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DEDICATION

This thesis is dedicated to my loving parents Mr. and Mrs. Joseph Ngorett for the love, strength, support and inspiration I drew from them during the entire course of my study.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

AMRS	AMPATH Medical Record System
CD-ROM	Compact Disk- Read Only Memory
EHR	Electronic Health Records
ERC	Ethical Review committee
GOe	Global Observatory for eHealth
HIV	Human Immunodeficiency Virus
HMIS	Hospital Management Information System
ICT	Information and Communication Technologies
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KEMRI	Kenya Medical Research Institute
KIIs	Key Informant Interviews
KNH	Kenyatta National Hospital
LIMS	Laboratory Information Management System
MMS & MPHS	Ministry of Medical Services and Ministry of Public Health and Sanitation
MS	Microsoft

OS	Operating Systems
PC	Personal Computer
PGH	Provincial General Hospital
PI	Principal Investigator
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
SSA	Sub Saharan Africa
UN	United Nation
UNICEF	United Nations International Children's Emergency Fund
UoN	University of Nairobi
WHO	World Health Organization

DEFINITION OF TERMS

Context: External context refers to the social, economic, political, and competitive environments in which an organization operates. Internal context refers to the structure, culture, resources, capabilities, and politics of an organization. (Pettigrew, 2012).

Content: The specific areas of the transformation under examination. Covers the hardware, software and the work processes (Pettigrew, 2012)

Computerized routine operation: A day to day operation that a computer is designed and built to perform.

Computer literacy: The knowledge and ability to use computers and related technology efficiently.

ICT in health care: Use of computers, mobile phones, satellites, software, information systems and digital platforms, etc. – to enable, support and deliver health services to patients and populations. This involves use of mobile phone-based health (mHealth) applications, telemedicine systems, or eLearning programs, including digitization of a country's Health Management Information System (HMIS) or Health Information System (HIS). (Word Bank, 2012)

Institutional induction training: Formal training to employees on ICT at facility level to introduce them to use of computers and other related technologies to facilitate their work.

On job training: Training done to employee while he or she is engaged in productive work to provide knowledge and skills essential to the full and adequate performance on the job in this case on utilization of ICT.

Process: The processes of change, made up plans, actions, reactions, and

interactions

of the stakeholders, rather than work processes in general. (Pettigrew, 2012)

Replacement protocol: A system in place that ensures whenever there is a breakdown in the ICT equipment, there is a guide on what needs to be done.

Training sponsorship: Health facility paying for the staff to undertake training in ICT related course to support their routine operation.

ABSTRACT

Use of Information and Communications Technologies (ICTs) helps in improving delivery of health care services. However, despite heavy investment by Kenyan government in ICT infrastructures, the efficiency and benefits of ICT has not been achieved as health care system continue to suffer compromised quality of care due to disjointed patient management systems and poor management of resources. Therefore, the need to establish the barriers to full integration and utilization of ICT in the delivery of health care in Kenya which is key in the realization of universal health care and sustainable development goal number three in health (SDG#3) as that data would aid in increasing efficiency and ensure evidence based health system management. Broad objective of the study was to determine the ICT Process, Content and Context dimension to full integration of ICT in health care delivery in public health facilities of Machakos (semi-urban), Turkana (rural) and Nairobi (urban) Counties in Kenya. A cross-sectional quantitative study was used. The three counties were selected from the 47 counties using simple random sampling with replacement technique from the three clusters (rural, semi urban and urban). A total of 172 health facilities (Level 2-5) were selected using proportionate and simple random sampling with replacement in the three counties. A total of 369 study respondents (health care professionals) were selected from the various departments using stratified sampling technique and proportionately divided across the counties where the health care workers were randomly selected. A pretested self-administered questionnaire and observation sheet was used to collect data. Odds ratio at 95% Confidence Interval (CI) was used to determine association between dependent and independent variables. Data was analysed using Statistical Package for Social Sciences (SPSS^{TM}) analytical software version 25 for windows. Univariate analysis was carried out based on frequencies and testing for association using bivariate analysis by use of Chi square test at 95% Confidence Interval while strength of the association was determined using Phi and Cramer's V tests. Dependent variable was ICT utilization and independent variales were context, process and content dimensions. This study demonstrated that content and process dimensions were the most critical success factors associated with uptake of ICT utilization in public health facilities. In the rural county, the major limitation in the use of ICT was lack of ICT infrastructure (hardware and software) in the lower level facilities and level 5 facility at 50% and 21.9% respectively. In the semi urban county, the major limitation in the use of ICT in the lower level facilities was lack of ICT infrastructure at 33.3% while for the level 5 facility lack of computers was the major limitation at 36.4%. In the urban county the major limitation in use of ICT in the lower level facilities and level 5 facility was lack of ICT infrastructure at 46.8% and 30.4% respectively. The specific key attributes to ensure utilization of ICT was found to be Strong management involvement in ICT related matters and Availability and implementation of an ICT policy especially among the lower level facilities (Level2 -4) (process dimensions), Presence of an institutional induction training program on ICT (context dimension), Type of ICT support provided and its reliability and Level of services operations computerized (content dimensions)

CHAPTER ONE

INTRODUCTION

1.1: Background

An information communication technology (ICT) driven health care system presents the most logical approach to enhancing efficient, accessible cost-effective and sustainable health care service (World Bank, 2012). The availability of ICT, its ease in use and the numerous immediate need it can meet has turned into a key player in advancing efficiency and cutting down on cost. (Ansah, 2013). Therefore, use of ICT application in health services delivery entails evaluating the types of ICT soft wares being applied, the ICT servers in use, the existing upgrade system, levels of healthcare staff preparedness and their levels in use of ICT in their duties which is key to determining barriers hindering full realization of ICT benefits in the delivery of health care systems (Saleem *et.al*, 2013).

Africa remains among the under-developed continents in the world with major problems in access to healthcare due to compromised quality of health care service delivery process from patient management which includes in efficiencies in diagnosis, treatment, lack of essential medicines, equipment and supplies, high cost of treatment among others and this translates to poor health outcomes as evidenced by the health indicators. (Durokifa and Ijeoma, 2018).

Integration of ICT in the health sector have well-known advantages. They can promote patient-centered healthcare, improve quality of care, and educate health professionals and patients. However, implementation of ICTs remains difficult and involves changes at different levels i.e. patients, healthcare providers, and healthcare organizations among other stakeholders (Rowleau *et.al*.,2015). There is therefore need for all relevant stakeholders to be involved as ICTs present a large, unexploited potential for transforming the health sector in Africa to achieve more thereby improving efficiency in

service delivery processes and management of resources in health care (World Bank, 2012).

1.2 Statement of the problem

Lack of functioning ICT health care infrastructure in Kenya has been associated with inefficiencies that are currently observed in most of the public hospitals in Kenya. The health care system in Kenya and Africa in general suffers greater inefficiencies in use of resources and service delivery. In Kenya, the health care system continues to be dogged with compromised quality of care, lack of infrastructures, poor management of resources and data including patients' records, lack of essential equipment for diagnosis and treatment, shortages of drugs, accessibility and presence of unqualified staffs. Information and communication technologies (ICTs) have the potential to transform the delivery of health services across the continent to address the challenges. Across Kenya and Africa, there are many ongoing projects that attempt to improve the health sector through use of ICTs, most remain as pilots, few are evaluated and fewer are designed or assessed for scalability (World Bank, 2012). Despite this huge investment of ICT, these gains have not yet benefitted the health sector in a systematic way that could be attributed to ICT related content, context and process dimension that affect utilization of ICT in the health sector. This study therefore aims at determining barriers to full realization of ICT benefits in delivery of health care system in selected public health facilities in Machakos, Turkana and Nairobi counties.

1.3 Justification

The use of Information and Communications Technologies (ICTs) provides great potential for saving human lives by improving delivery of health care from admission, diagnostics, treatment, pharmaceutical and management of patient bills that captures all accruing expenses per patient. The absence of full ICT integration that provides end to end flow of patient information across all the hospital department could be the major contributor to the inefficiencies and delays in delivery of health care services in the

Kenyan health care system and therefore important to look into the integration of ICT in the three categories of Kenyan Counties (Urban, Semi-urban and rural). Such delays in the flow of patient information culminates in increasing cost of health care services and poor patient treatment outcomes (Simon *et.al*., 2013). The ICT infrastructure integration components that entail context dimensions i.e. knowledge and skills in use of ICT by end users and level of preparedness in terms of infrastructure which includes trainings and ICT literacy, would affect the technology capabilities of the health facility and the nature of health services provided, further the content dimension that entails the nature of interaction with ICT e.g. routine operation, use of ICT equipment, replacement protocol and efficiency in use of ICT would affect delivery of services and decision-making in the health facility. In addition the process dimension that entail access to ICT equipment, made up plans which include resource allocation and control, presence of an ICT policy, and interactions of the stakeholders in system design, rather than work processes in general will continue to affect management of patient data and resources, shortages of drugs, equipment and supplies.With process dimension in place, promotion, influence and encouragement of the development and implementation of ICT would exert a positive influence on increased clinical improvement, quality of care and improved collaboration among physicians.

1.4 Significance of the study

The findings of this study will help in improving the integration of ICT health care identified from this study, the result will provide insights to policy makers and heads of health institutions on implementation of ICT projects that will ensure full realization of ICT benefits in delivery of health care system. Through use of ICT, healthcare workers with poor skills will be solved through e-Learning (electronic learning) and telemedicine to extend expertise to remote areas. Lack of health information systems could be resolved through data collection and surveillance m-Health (mobile health) applications that can monitor and track health indicators in real time, providing insight to policymakers on true challenges and providing valuable data enabling health workers to better serve and patients to be more proactive in their own health. The problem of

shortage and expiry of drugs, shortage of equipment and supplies could be addressed through Supply Chain Management m-Health applications so as to decrease stock-out frequency, increase efficacy and decrease or avoid wastages and properly manage resources.

1.5 Objectives

1.5.1 Broad objective

To determine the Context, Process and Content dimension to full integration of ICT in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi Counties in Kenya.

1.5.2 Specific objectives

This study had three specific objectives as stated below: -

1. To establish the ICT context dimensions that influence full integration in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi counties.
2. To identify the ICT process dimensions that influence full integration in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi counties.
3. To establish the ICT content dimensions that influence full integration in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi counties.
4. To determine the ICT challenges hindering utilization of ICT in public health facilities of Machakos, Turkana and Nairobi counties.

1.5.3 Research questions

This study attempts to answer the following research questions; -

1. What are the context dimensions that influence full integration of ICT in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi counties?
2. What are the process dimensions that influence full integration of ICT in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi counties?
3. What are the content dimensions that influence full integration of ICT in delivery of health care services in public health facilities of Machakos, Turkana and Nairobi counties?

CHAPTER TWO

LITERATURE REVIEW

2.1: Background

Trends and challenges related to health care system

Globally, many low- and middle-income countries' health systems lack sufficient technology to enable communication between households, care providers, and eventually, policy makers. The absence of these infrastructure elements increases the possibility of morbidity and mortality owing to the "third delay", i.e. the delay in receiving adequate service after reaching a healthcare facility. The impact is felt most by people in rural areas, where delays are more extreme. Shortages of drugs, equipment and supplies: Without medical equipment and supplies it is difficult for health workers to provide the care they have been trained to provide. Sometimes, supply shortages even lead to health center shutdowns (World bank, 2012)

In 2010 in Uganda, for example, eight rural health centers closed because of lack of supplies, leaving people in the Amuru district without healthcare, and an additional twelve recently-built health centers have not opened for the same reason. Integration of ICT into supply chain management could be one of the steps towards addressing stock outs. Inadequate public information about preventable diseases where simple preventive solutions can save lives could be propelled to reach masses with use of ICT. For example, while HIV testing services may be highly available, without encouragement and clear communication about the details of the service they may go underutilized. Or alternatively, if the general public was able to receive information about contaminated water sources – in the form of alerts about diarrhea or malaria outbreaks – households could protect themselves from disease (World Bank, 2012)

There is some progress in healthcare across Africa towards achieving the health-related Sustainable Development Goals (SDGs). Sub-Saharan Africa (SSA) has experienced a reduction in child mortality from 180 to 129 deaths per 1,000 live births however certain countries with high under-five mortality, like Madagascar, Malawi, Eritrea, Liberia, Niger, and Tanzania, have already more than halved their rates of child mortality between 1990 and 2010 (Dufokira and Ijeoma, 2018). Similarly, while the entire region requires more progress to reducing maternal mortality by three quarters, Eritrea, Ethiopia, Cape Verde, Rwanda, Equatorial Guinea and Mauritius have already more than halved their rates since 1990. Progress is seen in countries like Botswana, Rwanda, Namibia, and Zambia, where over 55% of people living with advanced HIV have access to antiretroviral therapy. Despite progress being made, a majority of Africa countries are falling behind on their SDGs commitments and existing strategies will not be sufficient as there is need for new approaches. The main opportunities for ICTs to positively impact the health sector reflect the remaining core challenges countries face in pursuit of SDG targets, and implementation of ICTs to assist in resolving micro level challenges will only be successful if macro-challenges do not obstruct ICT capabilities. (World Bank, 2012)

According to report by UNICEF, Kenya's infant mortality rate stands at 48%, (under 1 year olds) with the country's life expectancy at birth being 58 %. This is significantly lower than the global average of 68 %, mainly due to contribution of communicable diseases to the health of most individuals after the age of 42. In fact, it is estimated that 82% of health is lost to communicable diseases every year (UNICEF, 2012). In addition, the mortality rate for children under the age of five is significantly high at 73%, while neonatal mortality rate is approximately 27 %. The above figures are indications of serious problems in the healthcare sector.

Healthcare is one of the most essential human requirements, and its disbursement should be addressed with the requisite sensitivity to prevent loss of life and decrease in human capital. Governments, healthcare agencies and non-governmental organizations have collegial and tremendous opportunity and have addressed quality healthcare in a bid to

transform the sector for enhanced efficiency and sustainability (Piotrowicz and Cianciara, 2013).

However, sub-Saharan Africa has had numerous problems that have maimed and compromised the quality of health care service delivery process, availability, accessibility and affordability. Some of the issues affecting healthcare in the Sub-Saharan Africa includes lack of infrastructures, poor management of healthcare facilities, lack of essential equipment, shortages of drugs, affordability, accessibility and unqualified staffs.

Under development in this region has led to poor infrastructures few hospitals and healthcare centers translates to high patient burden at hospitals that are supposed to be only referral hospitals (Tilya, 2018).

The mortality rates have been increasing each year due to lack of apposite protection strategies by the government and other concerned agencies. Lack of proper infrastructures and healthcare policies has therefore compromised the quality of healthcare service delivery. Infant mortality has been on the increase, ranging between 57-74 deaths per every 1000 live births. This is a very huge margin, which has mainly been influenced by poor funding and lack of facilities and equipment to cater for prenatal and postnatal care (Moran *et. al*, 2013)

Lack of adequate facilities to carry out correct diagnosis on patients are also prevalent problems and challenges in the health sector across the Sub-Saharan region. Due to this problem, most patients do not receive diagnostic services. This challenge, coupled by the fact that most individuals are poor, increases chances of death, and deteriorated health. Some vital equipment like x-ray machines, diagnostics ultrasounds, monitors, fetal monitor and chemistry analyzers among others are not available in most health facilities, with only a few being available in bigger hospitals. For this reason, healthcare delivery process has been compromised, with health professionals relying on conventional diagnostics, thereby affecting the health of patients, which translates to higher chances

of poor medical outcomes. The issue of drugs and facilities has been mainly influenced by lack of effective policies to counter drug shortage and endowment of hospitals with contemporary technology. Most countries in Sub-Saharan Africa are yet to establish effective healthcare policies that are meant to subvert the existing problem through establishment of stable cost guidelines that would ensure access to healthcare for all (Tilya, 2018).

Despite poor health care system and its outcome, the Kenyan government has been at the forefront to address the healthcare concerns. Recently there has been collaboration with developed countries like Japan, European countries and USA on bringing the state of art technology. One great thing that Kenya has learned as a nation is that systems are complex but are adaptable and change will ultimate endure. For the system to be adaptable, integration of ICT into the health care should be more of a process and not a product. It should be part of daily routine to support the various type of interaction in the health care. The process also should be interactive and seamless for it to be effective to support provision of health care services (MMS & MPHS, 2011).

2.2 ICT as a game changer in health sector

It is assumed that use of ICTs will lead to greater efficiencies in use of resources and greater efficiency in service delivery, a significant matter when the 2010 WHO World Health Report revealed that 20 to 40 per cent of all health spending was wasted due to inefficiencies. Investment in ICT has the potential to reform health systems, extend services to underserved areas, and reduce waste and redundancy. Data from the 2011 Global Observatory for eHealth (GOe) survey showed that some 83 per cent of 112 surveyed countries identified at least one ongoing mHealth programme, and 33 per cent identified at least one telemedicine programme within their country. Of the 31 African countries who responded to the survey, SSA nations were least likely to have established, institutionalized eHealth programmes in mHealth, telemedicine or eLearning. When these programmes exist, they are in either the pilot or informal stages of development. Yet the fact that over 67 per cent of the African WHO members

responded to the survey is encouraging, indicating willingness to “mainstream” eHealth as a component of their health strategies. (World Bank 2012)

2.3 ICT related content, context and process dimension

The outcome of an organizational change in relation to ICT projects will be determined by the context, content, and process of that change (Pettigrew, 2012).

2.3.1 ICT Context dimension

ICT Context dimension refers to knowledge and skills in use of ICT by end users and level of preparedness in terms of infrastructure which includes trainings and ICT literacy. This is measured by the type of previous training undertaken, whether the facility conducts on job training on ICT to staff, types of ICT training sponsorship offered by the facility, whether the institution have an induction training program on ICT and the type of health facility one worked for previously and whether they used ICT platforms during the routine operations. The level of ICT infrastructure and the nature of the country's health services sector impact the technology capabilities of that country. Moreover, e- health seems to be more valued in regions where resources for health-services provision are scarce, and its value tends to diminish as the resources become abundant. However, e-health seems unable to thrive where ICT infrastructure is scarce. This is an indication that the value of e-health to SSA is leveraged by leveraging ICT infrastructure in general and ICT for e-health, in particular. Access to ICT infrastructure with subsequent training has one of the strongest influence on utilization of ICT, (Simon *et.al*., 2013).

In a study done in building capacity for information and communication technology use in global health research and training, illiteracy and poor infrastructure, limited full application of ICT services. Although the knowledge of the health professionals on e-health and ICT was poor, majority of them were in support of the services. There is therefore the need to intensify training workshops for health professionals (Wang *et.al*., 2017)

2.3.2 ICT Process dimension

The process dimension are processes of change including access to ICT equipment, made up plans which include resource allocation and control, presence of an ICT policy, and interactions of the stakeholders in system design, rather than work processes in general. This includes the strategic change not only as a rational analytical process but rather as an interactive, continuous, multilevel process, (Pettigrew, 2012). This is measured by whether the participants were involved in the initial set up of ICT in the health facility.

ICT policies have strong relation to e-health capabilities, implying that governmental promotion, influence and encouragement of the development and implementation of ICT would exert a positive influence on increased clinical improvement, quality of care and improved collaboration among physicians. In institutionalizing these policies and making decision on the direction to take, there has to be an intention and desire to achieve something from the top management (Barcus, 2014). The direction has to be strategic, fundamental and should have a means to achieve it (Rapp, 2012). Therefore, the more reason why the top management has to be at the forefront for any new changes to be effected as organization decision making process is conceived to be an essential function of management and therefore important to have a buy in from leadership of the organization who are part of the stakeholders. Management will have to influence key decisions e.g. finances that have an implication in full application of ICT services (Barcus,2014). Enthusiastic and visionary leadership has a positive impact on the users' attitudes and behaviour. It will influence their usability of ICT (Simon *et.al*., 2013).

Decision making is key as time and resources will go into the anticipated change in this case adoption and utilization of ICT in a health facility. The management should make strategic directions and effect strategic responses. Through their response, their juniors

will either be motivated or demotivated to be part of the change being initiated (Rapp, 2012).

User-centered design approaches are important in effecting change as one gets to incorporate users' perspective into the design of new systems through an iterative approach (Subramanian *et.al*.,2010; Devi *et.al*., 2012); these methods have been found to improve user adoption, acceptance, and satisfaction with new systems and can also contribute to improved implementation overall (Chan *et.al*., 2011). User-centered design works well when existing work processes are effective and require little change; however, when practices require more drastic alteration, other, more disruptive approaches to design and implementation may be required.

Currently users are adopting electronic habits hence increasing use of new ICT, therefore seeking their opinion in what they require in terms of accessing information and the types of ICT facilities they require to carry out their work would enhance user satisfaction and therefore promote utilization of ICT in their work (Saleem *et.al*, 2013). Poor staff initiation into use of ICT and lack of involvement was cited as one of the challenges to poor utilization of ICT by health care professional (Asemahagn, 2015; Anwar &Shamim, 2011).

2.3.3 ICT Content dimension

This is the nature of interaction with ICT e.g. routine operation, use of ICT equipment, replacement protocol and efficiency in use of ICT. this is measured by purpose of a computer at a health facility, difference in performance with and without ICT and lastly patient outcome when ICT is used and when it is not used. It also includes specific areas of the transformation in this case it covers the hardware and software (Pettigrew, 2012). Providing wireless Connectivity within and between health facilities that supports the transmission of health knowledge and management information provides an entry-level health information infrastructure. Over such a health facility-based wireless infrastructure it then becomes possible to build workforce Capacity as well as support

Community development, via the delivery of information to enable better individual and community decision-making in health and other development issues. Poor electric power supply and internet services, limited full application of ICT services therefore need to improve electricity and Electronic communications (Drury, 2015).

2.4 ICT application in Health Care in Sub Saharan Africa and Kenya

The results from various studies done in Sub Saharan Africa show that policies specific to the advancement of ICT influence the country's advancement in information systems (IS) infrastructure capabilities. Likewise, the level of ICT infrastructure and the nature of the country's health services sector impact the technology capabilities of that country Moreover, e- health seems to be more valued in regions where resources for health-services provision are scarce, and its value tends to diminish as the resources become abundant. However, e-health seems unable to thrive where ICT infrastructure is scarce. This is an indication that the value of e-health to SSA is leveraged by leveraging ICT infrastructure in general and ICT for e-health, in particular (Tilya, 2018). Another study showed that ICT policies have strong relation to e-health capabilities, implying that governmental promotion, influence and encouragement of the development, implement of ICT would exert a positive influence on increased clinical improvement, quality of care and improved collaboration among physicians (Barcus, 2014).

A research done on eHealth: A Model for Developing Countries sited the following five elements (5 Cs) that influence application and use of ICT. First is Context in meeting the Millennium Development Goals and the role ICT can play to support health workers. Then, there is the Content of health information provided to health workers and how it can be migrated from being paper-based to a digital format. Providing wireless connectivity within and between health facilities that supports the transmission of health knowledge and management information provides an entry-level health information infrastructure. Over such a health facility-based wireless infrastructure it then becomes possible to build workforce capacity as well as support Community development, via the

delivery of information to enable better individual and community decision-making in health and other development issues (Drury, 2015).

In a study done in support of introduction of e-health practice, financial implication, illiteracy and poor infrastructure, such as electric power supply and internet services, limited full application of ICT services. Although the knowledge of the health professionals on e-health and ICT was poor, majority of them were in support of the services. There is therefore the need to intensify training workshops for health professionals and improve electricity and Electronic communications (Siender *et. al*.,2012).

According to Kenya National e- Health Strategy 2011- 2017 by the Ministry of Medical Services and Ministry of Public Health and Sanitation report of April 2011, The Kenyan health system is currently struggling to cope with the rising cost and demand for quality health care services, against the backdrop of a shortage of skilled health care professionals. There is therefore a compelling need to devise ways and means of closing the gap between vision and reality. This e-Health strategy seeks to set in motion the process of closing this gap by harnessing ICT for improved healthcare delivery in addition to other ongoing efforts.

In order to have a strategy that is holistic and inclusive, the development of the strategy used a participatory process that started in October 2008 and concluded in February 2011 with stakeholder workshop where the implementation framework was developed. The Vision is to develop efficient, accessible, equitable, secure and consumer friendly healthcare services enabled by ICT. The Mission is to promote and deliver efficient healthcare services to Kenyans and consumers beyond our borders, using ICT (MMS & MPHS, 2011).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Design

This study adopted a cross-sectional descriptive research design. A descriptive survey highlights an accurate quantitative or numeric description and depiction of the respondents' opinion, beliefs and abilities (Cooper and Schindler, 2008). The purpose of descriptive research is to determine and report the way things are happening thus helping to establish the status of the population under study (Mugenda and Mugenda, 2003). Descriptive survey is used in preliminary studies to enable researchers gather information and interpret data for clarification. This design is appropriate for this study because it is less expensive and facilitates collection of snapshot of the features of a phenomenon within a specific time (Bernard, 2006).

3.2 Study Site

In carrying out the study, a cross-sectional quantitative study was done in Machakos, Nairobi and Turkana counties. The study was conducted in selected urban, semi urban and rural counties in Kenya in selected level 2-5 public health facilities in Nairobi, Machakos and Turkana counties.

3.2.1 Classification of study counties as rural, semi urban and urban

In selecting the counties, the 47 counties were clustered into three study categories (urban, semi urban and rural) based on the following criteria: population, surface area and density, poverty rate, urban population, health data, education data, constituency development fund, local authority transfer fund (LATF), Road Maintenance, Levy Fund (RMLF), single business permit (SBP), Rural Electrification Program Levy Fund (REPLF),access to clean water, , improved sanitation and electricity, road network,

service delivery, population and proportion of nationally registered voters in each constituency.(Commission on revenue allocation- Kenya, 2011; World Bank, 2016). On average any county that had a score of 50% and above was considered an urban county, 25-50% was considered a semi urban county while below 25% was considered as a rural county. Based on the scoring, 4 counties were classified as urban, 12 were classified as semi urban and 31 as rural counties. The counties were scored as shown in table 3.1 below.

Table 3.1: classification of study counties as rural, semi urban and urban

Urban	**Semi- urban**	**Rural**
	Characteristic features	
Has a population of at least 600,000 residents	Has a population of at least 260,000 residents	Has a population of at least less than 100,000 residents
More than 50% of integrated urban area or city development plan	Has 25-50% of integrated urban area or city development plan	Has less than 25% of integrated urban area or city development plan
Has more than 50% capacity to generate sufficient revenue to sustain its operation	Has 25- 50% capacity to generate sufficient revenue to sustain its operation	Has less than 25% capacity to generate sufficient revenue to sustain its operation
More than 50% good system and records of prudent management	Has 25-50% good system and records of prudent management	Has less than 25% good system and records of prudent management
More than 50% capacity to effectively and efficiently deliver essential services to its residents	Has 25-50% capacity to effectively and efficiently deliver essential services to its residents	Has less than 25% capacity to effectively and efficiently deliver essential services to its residents
Has institutionalized on average 50% active participation by its residents in the management of its affairs	Has institutionalized on average 25-50% active participation by its residents in the management of its affairs	Has institutionalized less than 25% active participation by its residents in the management of its affairs
Has atleast 50% infrastructural facilities, including but not limited to roads, street lighting, markets and fire stations, and an adequate capacity for disaster management	Has 25-50% infrastructural facilities, including but not limited to roads, street lighting, markets and fire stations, and an adequate capacity for disaster management	Has less than 25% infrastructural facilities, including but not limited to roads, street lighting, markets and fire stations, and an adequate capacity for disaster management
	County classification based on the above scoring	
Kisumu, Kiambu Mombasa, and Nairobi	Nakuru, Machakos, Isiolo, Kajiado, Uasin Gishu, Migori, Vihiga, Kericho, Kilifi, Laikipia, Nyeri and Garissa	Taita Taveta, Bungoma, Kisii, Trans Nzoia, Lamu, Nyandarua, Bomet, Kwale, Mandera, Samburu, Busia, Muranga, Embu, Kirinyaga, Kakamega, Tana River,Wajir, Elgeyo Marakwet, Homabay, Nyamira,

	Kitui, Nandi, Meru, Makueni, Baringo, Siaya, West Pokot, Narok, Tharaka Nithi, Marsabit and Turkana.

Source: *Kenya urbanization review report, World Bank 2016*

3.2.2: Selection of the three study counties (Turkana, Machakos and Nairobi)

From the cluster of the counties as rural, semi urban and urban, all the counties were given equal chance in their respective cluster. Using simple random sampling with replacement in the three different clusters, the three counties were selected with Machakos representing semi urban county, Nairobi representing urban county and Turkana representing a rural county.

Machakos County

Nairobi County

Turkana

Figure 3.1: A map showing administrative boundaries of Machakos, Nairobi and Turkana counties.

Source: https://opencounty.org/county-about.php?com=8&cid=16

3.2.3: Selection of study health facilities (Public health facilities level 2-5) in Nairobi, Machakos and Turkana counties

The health facilities were selected using proportionate sampling from the three different counties as shown in table 3.2 below.

Table 3.2: Selection of study health facilities (Public health facilities level 2-5) in Nairobi, Machakos and Turkana counties

County	**Nairobi**			**Machakos**			**Turkana**		
Facility Level	Total	Proportion	Selected	Total	Proportion	Selected	Total	Proportion	Selected
Level 2	48	0.143	7	140	0.418	58	147	0.439	64
Level 3	36	0.419	15	38	0.442	17	12	0.140	2
Level 4	6	0.375	2	5	0.313	2	5	0.313	2
Level 5	1	0.333	1	1	0.333	1	1	0.333	1
Total	91		25	184		78	165		69

A total of 172 health facilities were selected in Machakos (78), Turkana (69) and Nairobi (25).

3.3 Study Population

A population is the entire individuals, events or objects under a given study. The study population in this case was all the 4,805 health care professionals working in all the 440 level 2-5 public health facilities in Nairobi, Machakos and Turkana Counties.

3.4 Sample Size and Sampling techniques

3.4.1 Sample size determination

Sample size for the respondent was determined using *Yamane 1967*, Sample size calculation formulae;

$$n = \frac{N}{1 + N\,(e)2}$$

Where;

n = sample size required

e = Acceptable sampling error (0.05)

N= Population size

Level of significance at 95% confidence interval (5%)

Therefore, $n = \frac{4805}{1+4805\ (0.05)\ 2} \approx 369$

Hence the sample size is approximately 369 health care professionals.

3.4.2 Sampling Procedure

The study utilized a stratified sampling strategy to divide the 369 health care professionals across the public health facilities in the three counties under study. First, the population was divided into 3 strata (counties) namely Nairobi (Urban), Machakos (Semi-Urban) and Turkana (Rural). The sample was then proportionately divided across the groups where health care professionals were randomly selected. The selected professionals were from 172 different health facilities (Level 2 to 5).

Table 3.3 shows the sample size and how it has been divided across the 3 groups.

Table 3.3: Sample size determination

County	Total number of Health Care workers in Level 2-5 Public Health Facilities	Proportion	Sample size
Turkana (Rural)	929	0.193	71
Machakos (Semi Urban)	1062	0.221	82
Nairobi (Urban)	2814	0.586	216
Total	**4805**	**1.000**	**369**

Source: *Ihris data (2019)*

3.4.3: Distribution of the different cadres of study participant in the different facility level in the different counties.

From the ihris data proportion for the different staffing across the counties is as shown in table 3.4 below. This estimate was used to determine the number of staffing in the different cadres across the different facilities and county classification from the sample size calculated of 369.

Table 3.4: Sample size determination for different cadres in the different facility levels across the counties as per the proportion estimate.

Participants per cadre across facility level	Turkana Proportion 19.3% Sample size 71 Level 2-5		Machakos Sample size selected 369 Proportion 22.1% Sample size 82 Level 2-5		Nairobi Proportion 58.6% Sample size 216 Level 2-5		Total sample size for different facility level across the different counties
	Proportion per cadre	Sample size per cadre	Proportion per cadre	Sample size per cadre	Proportion per cadre	Sample size per cadre	
Pharm tech	0.25	3	0.33	4	0.42	5	12
Lab tech	0.2	3	0.27	4	0.53	8	15
Doctors	0.21	5	0.25	6	0.54	13	24
Nutritionist	0.26	5	0.32	6	0.42	8	19
Consultant	0.16	5	0.19	6	0.65	20	31
Radiologist	0.14	2	0.14	2	0.71	10	14
HRIO	0.17	3	0.22	4	0.61	11	18
Biomed	0.13	2	0.2	3	0.67	10	15
Clinicians	.02	8	0.2	8	0.6	24	40
ICT officers	0.13	2	0.2	3	0.67	10	15
Support staff	0.19	3	0.25	4	0.56	9	16
Nurses	0.22	20	0.23	21	0.55	51	92
Managers/ Admin/	0.15	3	0.15	3	0.7	14	20
HR	0.17	3	0.17	3	0.67	12	18
Cash/ Finance	0.23	3	0.23	3	0.54	7	13
Public Health Officer	0.14	1	0.29	2	0.57	4	7

3.5 Data Collection

Data Collection Tools

A pretested self-administered questionnaire and observation sheet was used to collect data on different variables. ICT context variables studied were computer literacy, previous computer training, on-job ICT training, ICT training sponsorship by the facility, presence of an institutional induction program on ICT, external assistance to promote implementation of ICT, type of facility one previously worked and previous use of ICT. ICT process related variables were access to computer at work, involvement in initial set up of ICT and availability of ICT policy. The ICT content variables included

percentage of routine operations computerized, use of the computers at the health facility, replacement protocol in case of a breakdown, difference in performance with or without use of ICT and difference in patient outcome with or without use of ICT.

3.6 Data management and analysis

All field questionnaires were checked for completeness before leaving field. All the questionnaires were serialized from 001-369. The filled questionnaires were filed in a box file. Data was entered into the computer using excel software. Backup of the database was done using flash disk and CD-ROM.

Unit of analysis were the health care workers in the selected health facility levels. Data was presented in form of tables and the conclusions drawn from the finding while analysis was done using Statistical Package for Social Sciences (SPSS^{TM}) analytical software version 25 for windows.

Univariate analysis was carried out based on frequencies. Testing for association was carried out using bivariate analysis by use of Chi square test at 95% Confidence Interval while determining the strength of the association was done using Phi and Cramers V tests. This have been discussed below.

Chi-square test of Independence

Chi-Square test of independence was used to determine if there was a significant relationship between two nominal (categorical) variables.

First, the expected values of the two variables are calculated as follows:

$$E_{i,j} = \frac{\sum_{k=1}^{c} O_{i,j} \sum_{k=1}^{r} O_{k,j}}{N}$$

Where

$E_{i,j}$ = expected value

$\sum_{k=1}^{c} O_{i,j}$ = Sum of the i^{th} column

$\sum_{k=1}^{r} O_{k,j}$ = Sum of the k^{th} row

N = total number

Next, after calculation of the expected values, the following formula was applied to calculate the value of the Chi-Square test of Independence:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{i,j} - E_{i,j})^2}{E_{i,j}}$$

Where,

χ^2 = Chi-Square test of Independence

$O_{i,j}$ = Observed value of two nominal variables

$E_{i,j}$ = Expected value of two nominal variables

The test states its hypothesis as follows:

Null hypothesis: Assumes that there is no association between the two variables.

Alternative hypothesis: Assumes that there is an association between the two variables.

Hypothesis testing: Hypothesis testing for the chi-square test of independence as it is for other tests like ANOVA, where a test statistic is computed and compared to a critical value. The critical value for the chi-square statistic is determined by the level of significance (typically .05) and the degrees of freedom. The degrees of freedom for the chi-square are calculated using the following formula: df = (r-1) (c-1) where r is the

number of rows and c is the number of columns. If the observed chi-square test statistic is greater than the critical value, the null hypothesis can be rejected.

Degree of freedom was calculated using the following formula:

$$df = (r-1)*(c-1)$$

Where:

df = Degree of freedom
r = number of rows
c = number of columns

Strength of the relationship: Phi and Cramer's V were used to investigate the strength of the relationship between two categorical variables under study. Cramer's V is a way of calculating correlation in tables which have more than 2x2 rows and columns while Phi is for 2X2 tables. They are used as post-test to determine strengths of association after chi-square has determined significance.

Phi and Cramer's V are calculated by first calculating chi-square, then using the following calculation:

$$SQRT (\chi^2 / (n (k - 1)))$$

Where χ^2 is chi-square and k is the number of rows or columns in the table.

Phi and Cramer's V values varies between 0 and 1. Close to 0 it shows little association between variables. Close to 1, it indicates a strong association.

3.7 Variables of the study

3.7.1 Dependent variable

The dependent variable in this study was ICT utilization. This was indicated by 5 indicators namely: Computer literacy, access to computer at work, presence of ICT policy at the health facility, percentage of routine operation computerized and replacement protocol in case of a breakdown.

3.7.2 Independent variables

This study had three independent variables namely context dimension, process dimension and content dimension. Context dimension was indicated by 6 indicators namely: type of previous training undertaken, whether the facility conducts on job training on ICT to staff, types of ICT training sponsorship offered by the facility, whether the institution have an induction training program on ICT and the type of health facility one worked for previously and whether they used ICT platforms during the routine operations. Process dimension was indicated by one construct on whether the participants were involved in the initial set up of ICT in the health facility. Lastly, content dimension was indicated by three main indicators namely; purpose of a computer at a health facility, difference in performance with and without ICT and lastly patient outcome when ICT is used and when it is not used.

3.8 Conceptual Framework

Figure 3.2 shows the conceptual framework of this study.

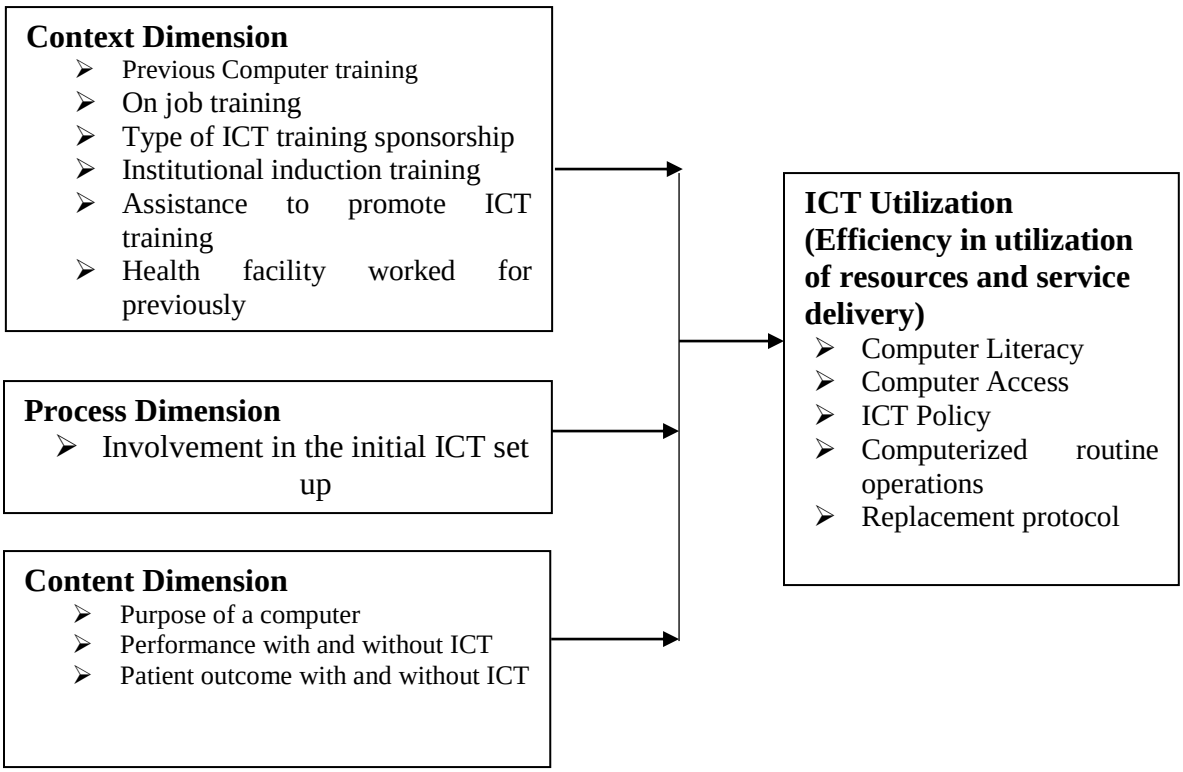

Figure 3.2: Conceptual Framework

3.9 Ethical Considerations

Clearance to carry out the study was obtained from Kenya Medical Research Institute, Kenyatta National Hospital (KNH)/ University of Nairobi (UoN) Ethics Review Committee (KNH-ERC/A/150) (Appendix 4). Approval to carry out the research was also obtained from the selected health facilities. Informed consent was also obtained

from the participants in the study. To ensure confidentiality was observed, no names or identification was used in the process of data collection and the study participants were assured of the same.

CHAPTER FOUR

RESULTS AND INTERPRETATION

4.1 Introduction

This chapter presents the results of the study. This has been based on the information obtained from the field. The aim of this study was to determine barriers to full realization of ICT benefits in delivery of health care system in public health facilities in Machakos, Turkana and Nairobi counties. The data collected was analyzed and reported where the results obtained were presented in form of frequency tables, followed by a brief interpretation and a discussion on research findings. Data analysis has been based and guided by the research objectives.

4.2 Response Rate

This study targeted all the 4805 health care workers in Nairobi, Machakos and Turkana Counties in Kenya. A sample of 369 health care workers was obtained. A total number of 369 questionnaires were administered and a total of 343 questionnaires were returned for analysis. This indicated a 93% response rate. Saunders *et al*, (2003) and Mugenda and Mugenda (2003) argued that a response rate of a 50% and above is considered acceptable in a survey research and therefore, sufficient to power the analysis presented herein.

Table 4.1: Table showing study participants' response rate

County	Sample size	Response Rate	%
Turkana (Rural)	71	71	100.0
Machakos (Semi Urban)	82	81	98.8
Nairobi (Urban)	216	191	88.4
Total	**369**	**343**	**93.0**

4.3 Demographic Information

This section gives the demographic information of the health care workers from Nairobi, Machakos and Turkana Counties in Kenya. These information was on the facility level, their gender, age and the highest Education level. This has been presented in Table 4.2 below.

Table 4.2: Demographic Information of health care workers in rural, semi-urban and urban health facilities

Demographic Information	**Facility level**	**Rural**		**Semi-Urban**		**Urban**	
		f	%	f	%	f	%
Hospital Category	Level 2	7	10.0	8	9.8	33	17.3
	Level 3	5	7.1	17	20.7	36	18.8
	Level 4	15	21.4	18	22.0	35	18.3
	Level 5	43	61.4	39	47.6	87	45.5
	Total	70	100.0	82	100.0	191	100.0
Gender	Male	39	55.7	29	35.8	80	41.9
	Female	31	44.3	52	64.2	111	58.1
	Total	70	100.0	81	100.0	191	100.0
Age	20-30	40	57.1	43	53.1	86	45.0
	31-40	22	31.4	27	33.3	71	37.2
	>40	8	11.4	11	13.6	34	17.8
	Total	70	100.0	81	100.0	191	100.0
Education Level	Diploma	55	79.7	55	67.9	121	63.4
	Degree and above	13	18.8	26	32.1	68	35.6
	Higher Diploma	0	0.0	0	0.0	2	1.0
	Certificate	1	1.4	0	0.0	0	0.0
	Total	69	100.0	81	100.0	191	100.0

Note: f refers to frequency

Out of all the 70 participants in the rural county (Turkana), majority were male 55.7% (n=39) while the rest were female at 44.3% (n=31). For semi urban (Machakos) and

urban (Nairobi) counties, majority were female 64.2% (n=52) and 58.1% (n=111) while the male were 35.8% (n=29) and 41.9% (n=80) respectively.

Majority of the respondents were from level 5 across the three counties with the highest being rural county (Turkana) at 61.4% (n=43) and urban county (Nairobi) the least at 45.5% (n=87). Majority of the respondents were young ages 20-30 across the three counties with the highest being from facilities in the rural county (Turkana) 57.1% (n=400 and the least being from facilities in the urban county (Nairobi) 45% (n=86). Under the level of education majority of the respondents in the facilities across the three counties were Diploma holders with the rural county (Turkana) being the highest at 79.7% (n=55) and the least being from the urban county (Nairobi) 63.4% (n=121).

4.4 ICT Utilization in rural, semi-urban and urban health care facilities

The study aimed at finding out whether ICT had been well adopted in rural, semi-urban and urban health care facilities. ICT utilization was indicated by 5 indicators namely: computer literacy, computer access at work/office, existence of policy regarding ICT, computerized routine operations and replacement protocol of ICT equipment. The results are as presented in Table 4.3 below.

Table 4.3: ICT Utilization in rural, semi-urban and urban health facilities

ICT Utilization	Response	Rural		Semi-Urban		Urban	
		f	%	f	%	f	%
Computer Literacy	Yes	61	87.1	80	98.8	173	90.6
	No	9	12.9	1	1.2	18	9.4
	Total	70	100.0	81	100.0	191	100.0
Computer access at work/office	Yes	30	42.9	41	50.0	95	49.7
	No	40	57.1	39	47.6	95	49.7
	Total	70	100.0	80	97.6	190	99.5
Policy Regarding ICT	Yes	14	20.3	27	34.2	57	30.3
	No	55	79.7	52	65.8	131	69.7
	Total	69	100.0	79	100.0	188	100.0
Computerized routine operations	<50%	32	45.7	48	60.0	104	54.7
	≥50%	8	11.4	11	13.8	34	17.9
	None	30	42.9	21	26.3	52	27.4
	Total	70	100.0	80	100.0	190	100.0
Replacement protocol of ICT equipment	Maintenance	44	62.9	53	66.3	133	70.7
	Disposal	3	4.3	2	2.5	3	1.6
	None	23	32.9	25	31.3	52	27.7
	Total	70	100.0	80	100.0	188	100.0

Note: f refers to frequency

Of the 81 health care workers in the semi urban county, majority were computer literate 98.8% (n=80) compared to the rural county that had a total of 70 health care workers with the least being computer literate 87.15 (n=61). Half of the health care workers in the semi urban county had access to computer at work 50% (n=41) compared to the rural county with the least where less than half 42.9% (n=30) had access to computer at work. As the highest, only 34.2% (n=27) of the respondents from semi urban county acknowledged presence of an ICT policy in the facility compared to the rural county with the least 20.3 (n=14). Majority of computerized routine operation was less than 50% across all the three counties with the highest response in urban county (Nairobi) 54.7% (n=104) and the least in rural county (Turkana) 45.7% (n=32). Maintenance was sighted as the highest replacement protocol in case of a breakdown in ICT equipment

with the urban county as the highest 70.7% (n=133) with the least as rural county 62.9% (n=44).

4.5 Context Dimension in relation to ICT Utilization

The first objective aimed at establishing the effect of ICT context dimensions in Utilization of ICT in public health facilities in Machakos, Turkana and Nairobi counties.

4.5.1 Descriptive analysis of context dimension in relation to ICT utilization

First descriptive analysis was performed to summarize the findings on context dimension in relation to ICT utilization and the results are as presented in Table 4.4.

Table 4.4: Descriptive analysis of context dimension in relation to ICT utilization

Context dimension	Response	Rural		Semi-Urban		Urban	
		f	%	f	%	f	%
Previous Computer Training	Trained	56	80.0	79	97.5	169	88.5
	Not Trained	14	20.0	2	2.5	22	11.5
	Total	70	100.0	81	100.0	191	100.0
On job ICT training to staff	Yes	6	8.6	15	18.5	30	15.7
	No	64	91.4	66	81.5	161	84.3
	Total	70	100.0	81	100.0	191	100.0
ICT sponsorship offered by the facility	None	63	90.0	64	79.0	163	85.8
	Basic application package	6	8.6	17	21.0	19	10.0
	Specialized courses	1	1.4	0	0.0	8	4.2
	Total	70	100.0	81	100.0	190	100.0
Facility Institutional ICT induction program	Yes	9	12.9	14	17.3	20	10.5
	No	61	87.1	67	82.7	170	89.5
	Total	70	100.0	81	100.0	190	100.0
External assistance to implement ICT	Partner	27	38.6	19	23.8	57	30.0
	County	5	7.1	18	22.5	38	20.0
	None	38	54.3	43	53.8	95	50.0
	Total	70	100.0	80	100.0	190	100.0
Type of health facility worked previously	Government Facility	23	32.9	24	30.0	80	42.3
	Private Facility	21	30.0	40	50.0	61	32.3
	Faith based facility	11	15.7	7	8.8	25	13.2
	Never work	15	21.4	9	11.3	23	12.2
	Total	70	100.0	80	100.0	189	100.0
Use of ICT in previous work place	Yes	29	42.6	46	57.5	87	47.5
	No	39	57.4	34	42.5	96	52.5
	Total	68	100.0	80	100.0	183	100.0

Note: f refers to frequency

Majority of the health care workers in the urban county (Nairobi) had training in ICT 88.5% (n=169). The highest percentage of those not trained in ICT were from the rural county (Turkana) 20% (n=14). Across the three counties absence on job training on ICT for the staff was reported to be highest in the rural county (Turkana) 91.4% (n=64) and the least in semi urban county (Machakos) 81.5% (n=66). A greater percentage of health

care workers indicated lack of ICT sponsorship by the facility with the highest being rural county (Turkana) 90% (n=63) and the lowest semi urban county (Machakos) 79% (n=64). Across the three counties a greater percentage indicated lack of external support to implement ICT in the facilities with the highest being the rural county (Turkana) 54.3 (n=38) and the lowest urban county (Nairobi) 50% (n=95), followed by support from the partner with the highest being the rural county (Turkana) 38.6% (n=27) and the least being semi urban 23.8% (n=19) and the least support was from the county with the highest being semi urban county (Machakos) 22.5% (n=18) and the least being rural county (Turkana) 7.1% (n=5). Across the rural (Turkana) and urban (Nairobi) counties, majority had previously worked in government health facilities at 32.9% (n=23) and 42.3% (n=80) respectively. In the semi urban county (Machakos) majority had previously worked in a private health facility 50% (n=40). In rural (Turkana) and urban (Nairobi) counties, majority indicated they did not ICT in their previous work place 57.4% (n=39) and 52.5% (n=96) while majority of the health care workers in the semi urban county (Machakos) indicated they had used ICT in their previous work places 57.5% (n=46).

4.5.2 Association between Context dimension and ICT utilization

Objective one aimed at examining an association between context dimension and ICT utilization. A chi-square test of independence was used as the variables were categorical in nature. Context dimension was taken to be whether the respondents had a previous computer training or not and whether there was an on job training at their health facility. ICT utilization was characterized by computer literacy of the respondents, computer access, ICT policy and computerized operations. The results are as presented in Table 4.5and Table 4.6.

Table 4.5: Test of association between Context dimension (Previous Computer training) and ICT utilization

ICT Utilization	Facility Level	Rural				Semi-Urban				Urban			
		χ^2	Df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V
Computer Literacy	Others	6.20	1	0.013*	0.678	4.62	1	0.032*	0.698	67.47	1	<0.01*	0.854
	Level 5	7.89	1	0.005*	0.503	-	-	-	-	20.86	1	<0.01*	0.556
Computer Access	Others	0.113	1	0.737	0.199	1.641	1	0.200	0.316	2.443	1	0.118	0.185
	Level 5	0.019	1	0.892	0.021	-	-	-	-	2.89	1	0.090	0.219
ICT policy	Others	0.587	1	0.444	0.147	4.264	1	0.039*	0.461	0.452	1	0.501	0.100
	Level 5	0.010	1	0.922	0.079	-	-	-	-	0.239	1	0.625	0.092
Computerized operations	Others	0.378	2	0.828	0.118	2.872	2	0.238	0.262	4.781	2	0.092	0.215
	Level 5	0.246	2	0.884	0.076	-	-	-	-	29.001	2	<0.01*	0.531

*Note: χ^2 is the chi-square statistic, df refer to degrees of freedom, p is the probability value. * indicates that the association is significant at 5% level of significance, others refers to level 2-4 health facilities*

Previous computer training was found to be strongly associated with computer literacy for below level 5 rural facilities, $\chi^2 = 6.20$, p=0.013, rural level 5 hospitals, $\chi^2 = 7.89$, p=0.005, semi-urban level 4 and below facilities, $\chi^2 = 4.62$, p=0.032, urban level 4 and below health centres, $\chi^2 = 67.47$, p= <0.01 and lastly urban level 5 facilities, $\chi^2 = 20.86$, p=<0.01. Having been trained previously leads to computer literacy hence ICT utilization at health facilities across the board.

Across all categories of health facilities, previous computer training was not associated with computer access indicating they are not related. This was so as the Chi-square statistics and their resultant p-values were statistically insignificant. This shows that

having been trained previously does not guarantee access of a computer at the health facilities.

Previous computer training was seen to be associated with ICT policy at semi-urban levels 4 and below hospitals, $\chi^2 = 4.264$, p=0.039 but was not in other health facilities. This shows that in semi-urban facilities, having a previous computer training indicated that there exists a working ICT policy at the health facilities however, this was not the case in other health facilities where the respondents worked.

In urban level 5 health facilities, previous computer training was associated with computerized operations, $\chi^2 = 29.001$, p=<0.001. The more the health workers were trained, the more the operations were computerized indicating good utilization of ICT. However, this was not the case in other health facilities as previous computer training was not associated with computerized operations.

Table 4.6: Test of association between Context dimension (On job training of staff) and ICT utilization

ICT Utilization	Facility Level	Rural				Semi-Urban				Urban			
		χ^2	Df	P	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V
Computer Literacy	Others	-	-	-	-	0.138		0.710	0.057			0.492	0.118
	Level 5			0.570	0.178	-	1 -	-	-	0.473	1	0.326	0.156
		0.323	1							0.963	1		
Computer Access	Others	-	-	-	-	8.201		0.004*	0.520	10.08	1	0.001*	0.345
	Level 5	0.814	-	0.367	0.206	0.865	1 1	0.352	0.219	7.41	1	0.006*	0.320
ICT policy	Others	-	-	-	-	3.533	1 1	0.06	0.383	9.10	1	0.003*	0.332
	Level 5	0.867	1	0.352	0.221	3.563		0.056	0.380	10.871	1	0.001*	0.389
Computerized operations	Others	-	-	-	-	5.198	2	0.074	0.352	29.01	2	<0.001*	0.531
	Level 5	8.403	2	0.015*	0.442	5.034	2	0.081	0.364	12.902	2	0.002*	0.385

*Note: χ^2 is the chi-square statistic, df refer to degrees of freedom, p is the probability value. * indicates that the association is significant at 5% level of significance, others refers to level 2-4 health facilities*

On job training of staff was not associated with computer literacy across all health facilities in rural, semi-urban and urban counties. This means whether there was an on job training or not did not guarantee computer literacy of health workers in those facilities. However, there was a significant relation between on job training of staff and computer access at semi-urban level 4 and below hospitals, $\chi^2 = 8.201$, p=0.004, urban level 4 and below facilities, $\chi^2 = 10.08$, p=0.001 and urban level 5 health facilities. This shows that on job trainings were conducted to staff with computer access at the health facilities.

Existence of ICT policy was seen to be related significantly to on job training at urban below level 5 health facilities, $\chi^2 = 9.10$, p=0.003 and urban level 5 hospitals, $\chi^2 = 10.87$, p=0.001. Therefore, in urban health facilities, on job training indicated existence of an ICT policy which was unlike health facilities in semi-urban and rural counties.

Lastly, computerized operations was seen to be related significantly to on job training at urban below level 5 health facilities, $\chi^2 = 29.01$, p= <0.001 and urban level 5 hospitals, $\chi^2 = 12.902$, p=0.002. Therefore, in urban health facilities, on job training indicated computerization of operations which was unlike health facilities in semi-urban and rural counties.

4.6 Process Dimension in relation to ICT Utilization

The second objective aimed at establishing the effect of ICT process dimensions in Utilization of ICT in public health facilities in Machakos, Turkana and Nairobi counties.

4.6.1 Descriptive analysis of process dimension in relation to ICT utilization

To start with, descriptive analysis was performed to summarize the findings on process dimension in relation to ICT utilization and the results are as presented in Table 4.7.

Table 4.7: Descriptive analysis of process dimension in relation to ICT utilization

Facility classification	Involvement in initial ICT setup	Rural		Semi-Urban		Urban	
		f	%	f	%	f	%
Below Level 5	Yes	3	11.1	3	7.1	11	10.7
	No	24	88.9	39	92.9	92	89.3
	Total	27	100.0	42	100.0	103	100.0
Level 5	Yes	5	11.6	5	13.2	12	13.8
	No	38	88.4	33	86.8	75	86.2
	Total	43	100.0	38	100.0	87	100.0

Note: f refers to frequency

Majority of the respondents at level 5 and below level 5 health facilities across the three counties had not been involved in the initial set up of ICT in their respective facilities.

4.6.2 Association between process dimension and ICT utilization

Objective two aimed at examining an association between process dimension and ICT utilization. A chi-square test of independence was used as the variables were categorical in nature. Process dimension was taken to be involvement in the initial set-up of ICT while ICT utilization was characterized by computer literacy of the respondents, computer access, ICT policy, computerized operations and replacement protocol. The results are as presented in Table 4.8.

Table 4.8: Test of association between process dimension (involvement in the initial set up of ICT) and ICT utilization

Variable	Facility Level	Rural				Semi-Urban				Urban			
		χ^2	Df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V	χ^2	Df	p	Phi & Cramer's V
Computer Literacy	Others	0.270	1	0.603	0.100	0.079	1	0.779	0.043	0.033	1	0.857	0.018
	Level 5	0.164	1	0.686	0.160	-	-	-	-	0.373	1	0.541	0.127
Computer Access	Others	9.40	1	0.001*	0.742	3.64	1	0.057	0.392	10.08	1	0.001*	0.345
	Level 5	2.36	1	0.124	0.308	0.224	1	0.636	0.077	7.53	1	0.006*	0.328
ICT policy	Others	0.105	1	0.194	0.250	2.01	1	0.157	0.336	5.36	1	0.021*	0.263
	Level 5	1.66	1	0.197	0.283	0.173	1	0.677	0.068	1.28	1	0.259	0.159
Computerized routine operations	Others	3.36	2	0.186	0.380	2.46	2	0.293	0.242	5.25	2	0.072	0.226
	Level 5	8.49	2	0.014*	0.493	1.79	2	0.409	0.217	19.66	2	0.001*	0.475
Replacement protocol	Others	4.22	2	0.121	0.395	7.66	2	0.022*	0.427	2.23	2	0.328	0.149
	Level 5	1.95	2	0.378	0.213	1.16	1	0.281	0.175	2.88	2	0.237	0.183

*Note: χ^2 is the chi-square statistic, df refer to degrees of freedom, p is the probability value. * indicates that the association is significant at 5% level of significance*

A chi-square test of independence was performed to examine the association between process dimension (involvement in the initial setup of ICT facility in the hospital) and ICT utilization in rural, semi-urban and urban hospitals in Kenya. There was a significant association between involvement in ICT initial setup and computer access in rural levels 4 and below facilities, χ^2 (1) = 9.40, $p < 0.001$, urban levels 4 and below, χ^2 (1) = 10.08 $p<0.001$ and urban levels 5, χ^2 (1) = 7.53, $p=0.006$. Phi and Cramer's V indicated that the strength of the association were strong (0.742) and moderate (0.345 and 0.328) respectively. This means that in rural levels 4 and below hospitals and urban

health facilities, health practitioners who were involved in the initial setup of ICT in the health facility were more likely to have computer access.

In urban levels 4 and below hospitals, there was a significant relation between involvement and existence of an ICT policy at the facility, χ^2 (1) = 5.36, p=0.021. This means that in those facilities where the health practitioners were involved in the initial set up of the ICT facility/equipment it was more likely to have an ICT policy in the facility. The results showed that this was not the case in other facilities as there was no significant relationship. This was indicated by an insignificant p-value greater than 5% level of significance. The results goes ahead to show that there exist a significant association between involvement and computerized routine operations in rural levels 5 hospitals, χ^2 (2) = 8.49, p=0.014 and urban levels 5 hospitals, χ^2 (2) = 19.66, p<0.001. Lastly, there was a significant relation between involvement and replacement protocol in semi-urban levels 4 and below hospitals, χ^2 (2) = 7.66, p=0.022. In those health facilities who involved their health practitioners in the initial setup of the facility were more likely to have a maintenance department for repair.

4.7 Content Dimension in relation to ICT Utilization

The third objective aimed at establishing the effect of ICT content dimensions in Utilization of ICT in public health facilities in Machakos, Turkana and Nairobi counties.

4.7.1 Descriptive analysis of content dimension in relation to ICT utilization

First, descriptive analysis was performed to summarize the findings on content dimension in relation to ICT utilization and the results are as presented in Table 4.9.

Table 4.9: Descriptive analysis of content dimension in relation to ICT utilization

Variable			Rural		Semi-Urban		Urban	
			f	%	f	%	f	%
Difference in performance with and without ICT	Below Level 5	Yes	21	77.8	33	78.6	75	73.5
		No	6	22.2	9	21.4	27	26.5

		Total	27	100.0	42	100.0	102	100.0
	Level 5	Yes	38	88.4	38	100.0	65	75.6
		No	5	11.6	0	0.0	21	24.4
		Total	43	100.0	38	100.0	86	100.0
Patient outcome with and without ICT	Below Level 5	Poor	2	7.4	1	2.3	5	4.8
		Average	9	33.3	15	34.9	42	40.4
		Good	14	51.9	19	44.2	48	46.2
		Not sure	2	7.4	6	14.0	7	6.7
		Total	27	100.0	41	95.3	102	98.1
	Level 5	Poor	0	0.0	1	2.6	3	3.4
		Average	16	37.2	18	46.2	29	33.3
		Good	26	60.5	19	48.7	50	57.5
		Not sure	1	2.3	0	0.0	2	2.3
		Total	43	100.0	38	97.4	84	96.6

Note: f refers to frequency

Across the three counties they reported difference in performance with use of ICT. Semi urban county (Machakos) reported the highest 78.6% (n=33) with the least being urban county 73.5% (n=75) in the facilities below level 5 (Level 2, 3 & 4). Among the level 5 facilities the semi urban county (Machakos) reported the highest at 100% (n=38) with the least being urban county (Nairobi) at 75.6% (n=65)

Under patient outcome with use of ICT, majority of the facilities below level 5 across the counties indicated good outcome with the facilities in the rural county (Turkana) reporting the highest at 51.9% (n=14) and the least being semi- urban county (Machakos) at 44.2% (n=19).Among the level 5 facilities across the three counties, majority indicated good patient outcome with the use of ICT with the facility in rural county (Turkana) reporting the highest at 60.5% (n=260 and the least being facility in semi urban county (Machakos) at 48.7% (n=19).

4.7.2 Association between content dimension and ICT utilization

Objective three aimed at examining an association between content dimension and ICT utilization. A chi-square test of independence was used as the variables were categorical

in nature. content dimension was indicated by two variables namely: Difference in performance with and without ICT, and patient outcome with and without ICT. ICT utilization was characterized by computer literacy of the respondents, computer access, ICT policy and computerized operations. The results are as presented in Table 4.10 and Table 4.11.

Table 4.10: Test of association between Content dimension (difference in performance with and without ICT) and ICT utilization

ICT Utilization	Facility Level	Rural				Semi-Urban				Urban			
		χ^2	Df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V
Computer Literacy	Others	3.480	1	0.062	0.529	0.279	1	0.597	0.082	13.42	1	0.000*	0.400
	Level 5	2.345	1	0.126	0.233	-	-	-	-	6.56	1	0.010*	0.326
Computer Access	Others	0.530	1	0.466	0.255	3.98	1	0.046*	0.369	6.83	1	0.009*	0.283
	Level 5	1.84	1	0.175	0.280	-	1	-	-	12.62	1	0.000*	0.411
ICT policy	Others	0.060	1	0.806	0.189	1.35	1	0.245	0.253	2.61	1	0.106	0.186
	Level 5	0.770	1	0.380	0.219	-	1	-	-	3.08	1	0.080	0.221
Computerized operations	Others	0.863	2	0.650	0.179	2.28	2	0.320	0.233	4.59	2	0.101	0.213
	Level 5	3.801	2	0.149	0.297	-	2	-	-	12.94	2	0.001*	0.408
Replacement protocol	Others	8.31	2	0.016*	0.555	6.15	2	0.046*	0.383	13.25	2	0.001*	0.362
	Level 5	0.972	2	0.615	0.150	-	-	-	-	9.16	2	0.010*	0.328

*Note: χ^2 is the chi-square statistic, df refer to degrees of freedom, p is the probability value. * indicates that the association is significant at 5% level of significance*

To test association between aspects of content dimension and ICT utilization, a chi-square test of independence was performed. The results show that there was a moderate significant relationship between performance with and without ICT and computer literacy in urban levels 4 and below hospitals, χ^2 (1) = 13.42, p=0.000 and urban level 5 hospitals, χ^2 (2) = 6.56, p=0.010. This means that those health workers who indicated that there was a difference in performance when ICT is used were more likely to be computer literate. There was a moderate significant relationship between performance

with and without ICT and computer access in semi-urban levels 4 and below hospitals, χ^2 (1) = 3.98, p=0.046, urban levels 4 and below hospitals, χ^2 (1) = 6.83, p=0.009 and urban level 5 hospitals, χ^2 (2) = 6.56, p=0.010. This means that those health workers who indicated that there was a difference in performance when ICT is used were more likely to be computer literate

Table 4.11: Test of association between Content dimension (patient outcome with and without ICT) and ICT utilization

ICT Utilization	Facility Level	Rural				Semi-Urban				Urban			
		χ^2	Df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V	χ^2	df	p	Phi & Cramer's V
Computer Literacy	Others	12.42	3	0.006*	0.678	1.78	3	0.620	0.208	3.45	3	0.327	0.184
	Level 5	0.528	2	0.768	0.111	-	-	-	-	12.26	3	0.007*	0.382
Computer Access	Others	2.38	3	0.497	0.297	4.74	3	0.192	0.340	6.06	3	0.109	0.245
	Level 5	2.64	2	0.267	0.248	1.38	2	0.502	0.190	4.90	3	0.179	0.242
ICT policy	Others	0.643	3	0.887	0.154	3.69	3	0.297	0.300	9.43	3	0.024*	0.250
	Level 5	5.18	2	0.075	0.351	1.20	2	0.550	0.180	3.45	3	0.327	0.205
Computerized operations	Others	5.93	6	0.432	0.331	3.77	6	0.708	0.214	6.04	6	0.419	0.173
	Level 5	1.64	4	0.802	0.138	2.10	4	0.718	0.166	11.33	6	0.079	0.260
Replacement protocol	Others	6.39	6	0.381	0.344	13.33	6	0.038*	0.354	7.65	6	0.265	0.195
	Level 5	1.46	4	0.834	0.130	8.20	2	0.017*	0.594	3.28	6	0.774	0.140

*Note: χ^2 is the chi-square statistic, df refer to degrees of freedom, p is the probability value. * indicates that the association is significant at 5% level of significance*

A chi-square test of independence was performed to examine the relation between content dimension and ICT utilization in rural, semi-urban and urban hospitals in Kenya. ICT utilization was measured using 5 aspects namely computer literacy, computer access, ICT policy, computerized operations and replacement protocol. Content dimension was measured in terms of the patient outcome with and without ICT. From the results, the relation between patient outcome with and without the use of ICT and computer literacy was significant in below level 4 hospital facilities in the rural county (Turkana) , χ^2 (3)= 12.42, p=0.006 and urban level 5 hospital facilities, χ^2 (3)= 12.26,

p=0.007. The association in both relationships were strong and moderate respectively as indicated by 0.678 and 0.382 values of Cramer's V test. This means that health care practitioners in rural levels 4 and below who said that patient outcome was good with use of ICT were more likely to have been computer literate.

There was no significant association between patient outcome with and without the use of ICT and computer access in rural levels 4 and below, χ^2 (3) = 0.643, p=0.887, rural level 5, χ^2 (2) = 2.64, p=0.267, semi-urban levels 4 and below, χ^2 (3) = 1.78, p=0.620 and urban levels 4 and below, χ^2 (3) = 3.45, p=0.327.

The association between existence of an ICT policy and computer literacy was found to be statistically significant in urban levels 4 and below hospitals, χ^2 (3) = 9.43, p=0.024. Those staff in urban level 4 and below hospitals who rated patient outcome as good were more likely to have a policy regarding the use of ICT as compared to the others. There was no statistically significant relation between a patient outcome was good with use of ICT and the percentage of computerized operations.

Lastly, there was a significant association between patient outcome with use of ICT (content dimension) and the replacement protocol in Semi-urban level 5 hospitals, χ^2 (2) = 8.20, p=0.017 and levels 4 and below, χ^2 (6) = 13.33, p=0.038. the patient outcome was good. Those who rated patient outcome to be good when ICT facilities are used other than the manual way of doing things, were more likely to have a maintenance department for repair as a replacement protocol in their facility.

4.8 Context, content and process challenges in utilization of ICT in public health facilities

The last objective aimed at determining the content, context and process challenges in utilization of ICT in public health facilities in Machakos, Turkana and Nairobi counties. The results are as presented below in tables 4.12, 4.19 and 4.20.

Table 4.12: Context dimension Challenges in utilization of ICT in public health facilities

Facility		Rural		Semi-urban		Urban	
Level	**Challenges**	**f**	**Percent**	**f**	**Percent**	**f**	**Percent**
Others	Computer illiteracy/ lack of ICT skills	5	17.2%	11	16.7%	37	27.4%
	Lack of ICT infrastructure	21	72.4%	37	56.1%	72	53.3%
	Resistance to change	3	10.3%	13	19.7%	19	14.1%
	Job dissatisfaction	0	0.0%	5	7.6%	7	5.2%
	Total	29	100.0%	66	100.0%	135	100.0%
Level 5	Computer illiteracy/ lack of ICT skills	11	25.0%	6	12.5%	32	32.0%
	Lack of ICT infrastructure	29	65.9%	30	62.5%	58	58.0%
	Resistance to change	2	4.5%	10	20.8%	7	7.0%
	Job dissatisfaction	2	4.5%	2	4.2%	3	3.0%
	Total	44	100.0%	48	100.0%	100	100.0%

Note: f refers to frequency

Among the ICT context related challenges, lack of ICT infrastructure was cited as the highest challenge among the lower level facilities (level 2, 3 &4) across the counties and job dissatisfaction the least. Lack of ICT infrastructure was reported the highest in the rural county (Turkana) 72.4% (n=21) and the least in the urban county (Nairobi) 53.3% (n=72). Job dissatisfaction reported as the least challenge was reported the highest in semi urban county (Machakos) 7.6% (n=5) and the least in rural county (Turkana) 0% (n=0).

Among the level 5 facilities in the three counties, lack of ICT infrastructure was also indicated as the main challenge and job dissatisfaction as the least. Lack of ICT infrastructure was highest in the rural county (Turkana) 65.9% (n=29) and the least in the urban county (Nairobi) 58% (n=58). Job dissatisfaction was highest cited in the rural county (Turkana) 4.5% (n=2) and the least in the urban county (Nairobi) 3.0% (n=3).

Table 4.13: Availability and numbers of computers located by Level 5 health facilities

Variable	County Classification		Others		Level 5	
			f	Percent	f	Percent
Computer Availability	Rural	Yes	21	80.8	21	50.0
		No	5	19.2	21	50.0
		Total	26	100.0	42	100.0
	Semi-Urban	Yes	12	29.3	21	58.3
		No	29	70.7	15	41.7
		Total	41	100.0	36	100.0
	Urban	Yes	56	60.9	38	44.2
		No	36	39.1	48	55.8
		Total	92	100.0	86	100.0
Number Available computers	ofRural	1-10	17	70.8	21	75.0
		11-20	3	12.5	0	0.0
		>50	1	4.2	0	0.0
		None	3	12.5	7	25.0
		Total	24	100.0	28	100.0
	Semi-Urban	1-10	9	42.9	9	100.0
		None	12	57.1	0	0.0
		Total	21	100.0	9	100.0
	Urban	1-10	34	65.4	28	50.9
		11-20	3	5.8	0	0.0
		21-30	1	1.9	0	0.0
		41-50	1	1.9	1	1.8
		>50	3	5.8	3	5.5
		None	10	19.2	23	41.8
		Total	52	100.0	55	100.0

Note: f refers to frequency, others refer to level 2-4 health facilities

In the rural county 80.8% of the health facilities below level 5 (level 2-level 4) indicated availability of computers while 19.2% did not have computers. Availability of computers within the level 5 facility in the rural county was at 50%. Within the semi urban county 29.3% of the facilities below level 5 indicated having computers in the facility while 70.7% of the facilities did not have computers in the facilities. Comparing with the level 5 facility in the semi urban county computer availability within the health facility was at 58.3%. Under the urban county 60.9% of the facilities below level 5 had computers available in the facilities while 39.1% of the health facilities did not have computers in the facilities. Availability of computers within the level 5 facility in the urban county was at 44.2%.

Among the rural counties 70.8% of the facilities that reported availability of computers had a total of 1-10 computers and with the least 4.2% having more than 50 computers while the level 5 facility had 1-10 computers within the various departments (75%) in the facility. Within the semi urban county 42.9% of the facilities reported having 1-10 computers on the highest while the level 5 facility reported having 1-10 computers on the highest in the departments at 100%. In the urban county 65.4% of the facilities below level five reported availability of 1-10 computers within the facility while the level 5 facility also reported having 1-10 computers on the highest within the departments at 50.9%.

Table 4.14: Computer models

County classification	Computer model	Others		Level 5	
		f	Percent	f	Percent
Rural	HP	16	61.5	14	56.0
	Lenovo	2	7.7	2	8.0
	Philips	4	15.4	0	0.0
	Dell	0	0.0	3	12.0
	Acer	0	0.0	1	4.0
	None	4	15.4	5	20.0
	Total	26	100.0	25	100.0
Semi-Urban	HP	6	23.1	7	35.0
	Lenovo	1	3.8	0	0.0
	Philips	1	3.8	0	0.0
	Toshiba	1	3.8	0	0.0
	Dell	0	0.0	3	15.0
	Sony	0	0.0	1	5.0
	None	17	65.4	9	45.0
	Total	26	100.0	20	100.0
Urban	HP	18	26.9	12	21.1
	Lenovo	1	1.5	1	1.8
	Dell	20	29.9	12	21.1
	Toshiba	1	1.5	0	0.0
	Compaq	1	1.5	0	0.0
	Sony	0	0.0	1	1.8
	None	26	38.8	31	54.4
	Total	67	100.0	57	100.0

Note: f refers for frequency, others refers to level 2-4 health facilities

The most reported computer model in the rural county among the lower level facilities (level 2-4) and level 5 facility was HP at 61.5% and 56% respectively. In the semi urban county HP was also the highest reported computer model available in the lower level facilities and level 5 facility at 23.1% and 35% respectively. In the urban county among the lower level facilities (level 2-4) and level 5 facility Dell was the highest reported computer model at 29.9% and 21.1% respectively.

Table 4.15: Presence of server for storage, type of server and the status of the server

Variable	County Classification		Others		Level 5	
			f	Percent	f	Percent
Presence of Server for storage	Rural	Yes	12	46.2	12	42.9
		No	14	53.8	16	57.1
		Total	26	100.0	28	100.0
	Semi-Urban	Yes	7	21.9	17	56.7
		No	25	78.1	13	43.3
		Total	32	100.0	30	100.0
	Urban	Yes	29	40.3	21	31.3
		No	43	59.7	46	68.7
		Total	72	100.0	67	100.0
Type and model server	Rural	ARNET	2	25.0		
		EMR	1	12.5		
		Adobe Flash			1	8.3
		None	5	62.5	10	83.3
		Don't know			1	8.3
		Total	8	100.0	12	100.0
	Semi-Urban	None	21	100.0	10	83.3
		Don't Know			2	16.7
		Total	21	100.0	12	100.0
	Urban	Server R12	1	2.3	1	2.2
		HP Proliant	1	2.3	1	2.2
		Dormax	8	18.6	6	13.3
		None	26	60.5	33	73.3
		Dont know	7	16.3	4	8.9
		Total	43	100.0	45	100.0
Status of the server	Rural	Current	8	53.3	10	45.5
		Old	2	13.3	3	13.6
		None	4	26.7	8	36.4
		Don't know	1	6.7	1	4.5
		Total	15	100.0	22	100.0
	Semi-Urban	Current	5	19.2	12	57.1
		Old	2	7.7		
		None	19	73.1	9	42.9
		Total	26	100.0	21	100.0
	Urban	Current	21	39.6	12	23.5
		Old	1	1.9	2	3.9
		None	23	43.4	33	64.7
		Don't know	8	15.1	4	7.8
		Total	53	100.0	51	100.0

Note: f refers to frequency, others refers to level 2-4 facilities

Majority (53.8%) of the lower level facilities (level 2-4) in the rural county had no server for storage which was also the case in the level 5 facility where absence of server was reported at 57.1%. this was also the case in the semi urban county where absence of server was reported at 78.1% in the lower level facilities and 43.3 in the level 5 facility. Majority of the facilities across the three counties indicated lack of servers both at the lower level facility and at the level 5 facilities. This was reported at 62.5% among the lower level facilities in the rural county and 83.3% in the level 5 facility. In the semi urban county this was reported at 1005 in the lower level facility and 83.3% in the level 5 facility. In the urban county this was reported at 60.5% in the lower level facility and 73.3% in the level 5 facility. In the rural county the server model that was mostly reported in the lower level facility was ARNET at 25% and Adobe flash at 8.3% in the level 5 facility. In the urban facility, the most reported server model in the lower level facility was Dormax at 18.6% and 13.3% in the level 5 facility. 8.3% of the respondent in the level 5 facility in the rural county indicated they were not aware of the server model. 16.7% in the level 5 facility in the semi urban county indicated they were not aware of the server model. In the urban county 16.3% and 8.9% of the respondents in the lower level facility and level 5 facility respectively indicated they were not aware of the server model. Across the three counties majority of the respondents both from the lower level facilities and the level 5 facilities indicated the server that were present were current and not old version. In the rural county among the lower level facilities 53.3% indicated presence of current servers while in the level 5 facility 45.5% indicated presence of current server.

In the semi urban county, 19.2% indicated presence of current server while in the level 5 facility 57.1% indicated presence of current server. In the urban facility among the lower level facility 39.6% indicated presence of current server while in the level 5 facility 23.5% indicated presence of current server.

Table 4.16: Type of software being used

County Classification	Software being used	Others		Level 5	
		f	Percent	f	Percent
Rural	Microsoft (Windows)	2	18.2	1	5.6
	Labware LIMS	2	18.2		
	Ubuntu	3	27.3	2	11.1
	Stone EHMIS			3	16.7
	HMIS/Medboss			1	5.6
	ADT Version 3.3			2	11.1
	None	4	36.4	9	50.0
	Total	11	100.0	18	100.0
Semi-Urban	Adobe Acrobat	2	8.0		
	ERP			3	20.0
	None	22	88.0	9	60.0
	Don't know	1	4.0	3	20.0
	Total	25	100.0	15	100.0
Urban	Microsoft (Windows)	5	11.6	2	4.5
	Labware LIMS	3	7.0	2	4.5
	HMIS/Medboss	5	11.6	2	4.5
	EMR/ IQ Care	3	7.0	1	2.3
	None	22	51.2	33	75.0
	Don't know	5	11.6	4	9.1
	Total	43	100.0	44	100.0

Note: f refers to frequency, others refers to level 2-4 facilities

The major software being use in the rural county among the lower level facilities was Ubuntu at 27.3% and Stone EHMIS at 16.7%.

Table 4.17: Training of staff on the software use

County Classification	Training of staff on the software	Others f	Others Percent	Level 5 f	Level 5 Percent
Rural	Yes	11	45.8	10	37.0
	No	10	41.7	15	55.6
	Not applicable	3	12.5	2	7.4
	Total	24	100.0	27	100.0
Semi-Urban	Yes	5	15.6	11	44.0
	No	23	71.9	13	52.0
	Not applicable	4	12.5	1	4.0
	Total	32	100.0	25	100.0
Urban	Yes	28	37.3	21	30.9
	No	43	57.3	44	64.7
	Some trained	3	4.0	2	2.9
	Not applicable	1	1.3	1	1.5
	Total	75	100.0	68	100.0

Note: f refers to frequency, others refers to level 2-4 facilities

In the rural county among the lower level facilities majority 45.8% indicated having undergone training on the software use while majority 55.6% in the level 5 facility indicated not being trained on software use. In the semi urban county majority in the lower level facility (71.9%) and level 5 facility (52%) indicated they have not been trained on software use. In the urban county majority in the lower level facility (57.3%) and 64.7% in the level 5 facility indicated not having been trained in software use.

Table 4.18: Table showing if there are trainings conducted after an upgrade to HCWs at the health facilities

County Classification	Training after upgrade	Others		Level 5	
		f	Percent	f	Percent
Rural	Yes	3	13.0	6	21.4
	No	16	69.6	21	75.0
	Not applicable	4	17.4	1	3.6
	Total	23	100.0	28	100.0
Semi-Urban	Yes	4	12.9	5	20.0
	No	20	64.5	19	76.0
	Not applicable	6	19.4		
	Don't know	1	3.2	1	4.0
	Total	31	100.0	25	100.0
Urban	Yes	17	23.9	11	16.7
	No	51	71.8	52	78.8
	Not applicable	1	1.4	1	1.5
	Don't know	2	2.8	2	3.0
	Total	71	100.0	66	100.0

Note: f refers to frequency, others refers to level 2-4 facilities

In the rural county majority of the lower level facilities and the level 5 facility indicated there was no training after upgrade of hardware and software at 69.6% and 75% respectively. This was also similar for the semi urban county where there was no training after upgrade at 64.5% for the lower level facilities and 76% in the level 5 facility. 3.2% in the lower level facilities and 4% in the level 5 facility indicated they were not aware of any training conducted after upgrade of hardware and software. In the urban county 71.8% and 78.8% indicated there were no training after upgrade of hardware and software while 2.8% and 3% in the lower level facility and level 5 facility indicated they were not aware of any training after upgrade of software and hardware respectively

Table 4.19: Process dimension Challenges in utilization of ICT in public health facilities

Facility		Rural		Semi-urban		Urban	
Level	**Challenges**	**f**	**Percent**	**f**	**Percent**	**f**	**Percent**
Others	Work Overload	4	15.4%	13	24.5%	28	25.2%
	Preference to manual way of doing things	7	26.9%	13	24.5%	42	37.8%
	Not Prioritized During budget allocation	15	57.7%	27	50.9%	41	36.9%
	Total	26	100.0%	53	100.0%	111	100.0%
Level 5	Work Overload	8	17.8%	22	51.2%	29	31.9%
	Preference to manual way of doing things	10	22.2%	10	23.3%	27	29.7%
	Not Prioritized During budget allocation	27	60.0%	11	25.6%	35	38.5%
	Total	45	100.0%	43	100.0%	91	100.0%

Note: f refers to frequency, others refers to level 2-4 health facilities

Under the ICT process related challenges in the lower level facilities (Level 2,3, &4), rural (Turkana) and semi urban (Machakos) counties reported ICT not prioritized during budget allocation as the main challenge at 57.7% (n=15) and 50.9% (n=27) while the urban county (Nairobi) reported preference to manual way of doing things as the main challenge respectively. The least reported process related challenge among the lower level facilities across the three counties was work over load with the highest reported in the urban county (Nairobi) 25.2% (n=28) and the least in the rural county (Turkana) 15.4% (n=4).

Across the level 5 facilities in the three counties, ICT not prioritized during budget allocation was cited as the main challenge in the rural (Turkana) 60.0% (n=27) and

urban (Nairobi) 38.5% (n=35) counties while work overload was cited as the main process related challenge in the semi urban (Machakos) county 51.2% (n=22). Preference to the manual way of doing things was cited as the least process related challenge in the semi urban (Machakos) 23.3% (n=10) and urban (Nairobi) 29.7% (n=27). Work overload was cited as the least process related challenge in the rural county (Turkana) 17.8% (n=8).

Table 4.20: Content dimension Challenges in utilization of ICT in public health facilities

		Rural		Semi-urban		Urban	
Facility Level	**Challenges**	**f**	**Percent**	**f**	**Percent**	**f**	**Percent**
Others	Power Supply	6	18.8%	17	27.4%	27	20.1%
	Internet Connectivity/System down time	9	28.1%	17	27.4%	36	26.9%
	Inadequacy of ICT infrastructure	15	46.9%	26	41.9%	69	51.5%
	None	2	6.3%	2	3.2%	2	1.5%
	Total	32	100.0%	62	100.0%	134	100.0%
Level 5	Power Supply	6	10.7%	2	4.2%	6	5.7%
	Internet Connectivity/System down time	23	41.1%	21	43.8%	46	43.4%
	Inadequacy of ICT infrastructure	27	48.2%	25	52.1%	54	50.9%
	None	0	0.0%	0	0.0%	0	0.0%
	Total	56	100.0%	48	100.0%	106	100.0%

Note: f refers to frequency, others refer to level 2-4 health facilities

Among the ICT content related challenges in the lower level facilities (level 2, 3, & 4) inadequacy of ICT infrastructure was reported as the highest challenge across the three counties. This was reported the highest in the urban (Nairobi) county 51.5% (n=69) and the least in the semi urban (Machakos) county 41.9% (n=26).

Among the level 5 facilities across the three counties, inadequacy of ICT infrastructure was reported as the main challenge with the highest in the semi urban (Machakos) 52.1% (n=250 and the least in the rural (Turkana) 48.2% (n=27) counties. The least reported challenge was power supply with the highest reported in the rural (Turkana) 10.7% (6) and the least in the semi urban (Machakos) 4.2% (n=2).

Utilization of ICT in the different facility levels and cadre of health care personnel

The overall utilization of ICT was greatly seen in the level five facilities compared to the lower level facilities (Level 2-4) with the highest being computer literacy at 91.7% and 91.9% in the level 5 and lower level facilities respectively and lowest being presence of an ICT policy at the health facility at 34.8% and 23.8% for level 5 facilities and lower level facilities respectively as shown in the table below under the different categories of ICT utilization.

Table 4.21: ICT Utilization in the different facility levels (Level 5 and others)

		Level 5		Others	
ICT Utilization	**Response**	**f**	**%**	**f**	**%**
Computer Literacy	Yes	155	91.7	159	91.9
	No	14	8.3	14	9.1
	Total	169	100.0	173	100.0
Computer access at work/office	Yes	104	61.9	62	36.0
	No	64	38.1	110	64.0
	Total	168	100.0	172	100.0
Policy Regarding ICT	Yes	57	34.8	41	23.8
	No	107	65.2	131	76.2
	Total	164	100.0	172	100.0
Computerized routine operations	<50%	108	64.3	76	44.2
	≥50%	28	16.7	25	14.5
	None	32	19.0	71	41.3
	Total	168	100.0	172	100.0
Replacement protocol of ICT equipment	Maintenance	137	82.0	93	54.4
	Disposal	2	1.2	6	3.5
	None	28	16.8	72	42.1
	Total	167	100.0	171	100.0

Note: f refers to frequency, others refer to level 2-4 health facilities

ICT Utilization defined as Computer literacy, computer access, policy regarding ICT in the different Cadre

Under ICT Utilization defined as Computer literacy, computer access and policy regarding ICT in the different cadres, majority of the cadre at the health facility indicated despite having computer literacy and access to computers at their departments, there was limited or no access to policy regarding ICT at the health facilities and as such it affected utilization of ICT as shown in the table below.

Table 4.22: ICT Utilization defined as Computer literacy, computer access, policy regarding ICT in the different Cadre

		Computer Literacy		Computer access at work/office		Policy Regarding ICT	
Cadre		**f**	**%**	**f**	**%**	**f**	**%**
Laboratory technicians	Yes	15	100.0	10	66.7	3	20.0
	No	0	0.0	5	33.3	12	80.0
	Total	15	100.0	15	100.0	15	100.0
Doctors	Yes	22	91.7	11	45.8	6	25.0
	No	2	8.3	13	54.2	18	75.0
	Total	24	100.0	24	100.0	24	100.0
Nutritionist	Yes	12	63.2	4	21.1	2	10.5
	No	7	36.8	15	78.9	17	89.5
	Total	19	100.0	19	100.0	19	100.0
Consultants	Yes	24	96.0	12	48.0	5	20.0
	No	1	4.0	13	52.0	20	80.0
	Total	25	100.0	25	100.0	25	100.0
Radiologist	Yes	8	72.7	5	45.5	3	27.3
	No	3	27.3	6	54.5	8	72.7
	Total	11	100.0	11	100.0	11	100.0
Health Record information officers	Yes	17	94.4	8	44.4	9	50.0
	No	1	5.6	10	55.6	9	50.0
	Total	18	100.0	18	100.0	18	100.0
Biomedical Engineers	Yes	10	66.7	9	60.0	7	46.7
	No	5	33.3	6	40.0	8	53.3
	Total	15	100.0	15	100.0	15	100.0
Clinicians	Yes	30	90.9	14	42.4	9	27.3
	No	3	9.1	19	57.6	24	72.7
	Total	33	100.0	33	100.0	33	100.0
ICT officers	Yes	15	100.0	11	73.3	11	73.3
	No	0	0.0	4	26.7	4	26.7
	Total	15	100.0	15	100.0	15	100.0
Public health officers	Yes	6	85.7	4	57.1	2	28.6
	No	1	14.3	3	42.9	5	71.4
	Total	7	100.0	7	100.0	7	100.0
Support staff (Social work, stores, tailoring, kitchen)	Yes	15	93.8	6	37.5	6	37.5
	No	1	6.3	10	62.5	10	62.5
	Total	16	100.0	16	100.0	16	100.0
Nurses	Yes	71	86.6	47	57.3	23	28.0
	No	11	13.4	35	42.7	59	72.0
	Total	82	100.0	82	100.0	82	100.0
Managers and Administrators	Yes	20	100.0	20	100.0	20	100.0
	No	0	0.0	0	0.0	0	0.0
	Total	20	100.0	20	100.0	20	100.0
Cash/ Finance	Yes	13	100.0	4	30.8	2	15.4
	No	0	0.0	9	69.2	11	84.6
	Total	13	100.0	13	100.0	13	100.0
Human Resources	Yes	18	100.0	15	83.3	0	0.0
	No	0	0.0	3	16.7	18	100.0
	Total	18	100.0	18	100.0	18	100.0
Pharmacists/ pharm techs	Yes	12	100.0	7	58.3	5	41.7
	No	0	0.0	5	41.7	7	58.3
	Total	12	100.0	12	100.0	12	100.0

Note: f refers to frequency

ICT Utilization defined as computerized routine operation in the different Cadre

Under ICT Utilization defined as computerized routine operation, majority of the cadre indicated less than 50% of their routine operations were computerized or not computerized at all with the Biomed engineers having the highest percentage of their computerized operation (50-100%) at 42.9% and the least nutritionist at Zero (0%). Failure to having the routine operations computerized and none being computerized affected utilization of ICT as shown in the table below.

Table 4.23: ICT Utilization defined as computerized routine operation in the different Cadre

Computerized routine operation				
Cadre		Frequency	Percent	Cumulative Percent
Laboratory technicians	<50	10	50.0	50.0
	50-100	4	20.0	70.0
	None	6	30.0	100.0
	Total	20	100.0	
Nutritionists	<50	5	55.6	55.6
	None	4	44.4	100.0
	Total	9	100.0	
Doctors	<50	20	60.6	60.6
	50-100	4	12.1	72.7
	None	9	27.3	100
	Total	33		
Consultants	<50	12	68.0	68.0
	50-100	2	4.0	72.0
	None	6	28.0	100.0
	Total	25	100.0	
Radiologists	<50	4	36.4	36.4
	50-100	2	18.2	54.5
	None	5	45.5	100.0
	Total	11	100.0	
Health Record and information Officers	<50	6	50.0	50.0
	50-100	1	8.3	58.3
	None	5	41.7	100.0
	Total	12	100.0	
Biomedical Engineers	<50	2	28.6	28.6
	50-100	3	42.9	71.4
	None	2	28.6	100.0
	Total	7	100.0	
Clinicians	<50	15	66.7	66.7
	50-100	4	16.7	83.3
	None	11	16.7	100.0
	Total	6	100.0	
ICT officers	<50	1	20.0	20.0
	50-100	1	20.0	40.0
	None	3	60.0	100.0
	Total	5	100.0	
Public health officers	<50	5	71.4	71.4

	50-100	1	14.3	85.7
	None	1	14.3	100.0
	Total	7	100.0	
Support staff (Social work, stores, tailoring, kitchen)	<50	8	50.0	50.0
	50-100	3	18.8	68.8
	None	5	31.3	100.0
	Total	16	100.0	
Nurses	<50	57	58.0	58.0
	50-100	13	14.0	72.0
	None	30	28.0	100.0
	Total	50	100.0	
Managers and Administrators	<50	4	80.0	80.0
	50-100	1	20.0	100.0
	Total	5	100.0	
Cash/Finance	<50	6	44.4	44.4
	50-100	1		
	None	6	55.6	100.0
	Total	9	100.0	
Human Resources	<50	3	75.0	75.0
	None	1	25.0	100.0
	Total	4	100.0	
Pharmacists/ pharm technicians	<50	6	50.0	50.0
	50-100	4	33.3	83.3
	None	2	16.7	100.0
	Total	12	100.0	

ICT Utilization defined as availability of replacement protocol on ICT equipment in the different Cadre

Under ICT Utilization defined as availability of replacement protocol on ICT equipment in the different cadre, majority of the cadre indicated availability of maintenance at above 50%. This was critical in utilization of ICT as wherever there was a breakdown, there was a replacement protocol that ensured maintenance is carried out on the ICT equipment so that there is no interruption of services the highest being biomed engineers and pharmacists at 83.3% for both cadres as shown in the table below.

Table 4.24: ICT Utilization defined as availability of replacement protocol on ICT equipment in the different Cadre

		Replacement protocol on ICT equipment		
Cadre		**Frequency**	**Percent**	**Cumulative Percent**
Doctors	Maintenance	28	82.4	82.4
	None	6	17.6	100.0
	Total	34	100.0	
Laboratory technicians	Maintenance	12	60.0	60.0
	None	8	40.0	100.0
	Total	20	100.0	
Nutritionists	Maintenance	5	55.6	55.6
	None	4	44.4	100.0
	Total	9	100.0	
Consultants	Maintenance	19	76.0	76.0
	None	6	24.0	100.0
	Total	25	100.0	
Radiologist	Maintenance	6	54.5	54.5
	Disposal	1	9.1	63.6
	None	4	36.4	100.0
	Total	11	100.0	
Health Record and information Officers	Maintenance	8	61.5	61.5
	None	5	38.5	100.0
	Total	13	100.0	
Biomedical Engineers	Maintenance	5	83.3	83.3
	None	1	16.7	100.0
	Total	6	100.0	
Clinicians	Maintenance	23	66.7	66.7
	Disposal	3	16.7	83.3
	None	11	16.7	100.0
	Total	6	100.0	
ICT officers	Maintenance	2	40.0	40.0
	None	3	60.0	100.0
	Total	5	100.0	
Public health officers	Maintenance	4	57.1	57.1
	None	3	42.9	100.0
	Total	7	100.0	
Support staff (Social work, stores, tailoring, kitchen)	Maintenance	8	53.3	53.3
	Disposal	1	6.7	60.0
	None	6	40.0	100.0
	Total	15	100.0	
Nurses	Maintenance	82	64.0	64.0
	Disposal	3	2.0	66.0
	None	37	34.0	100.0
	Total	50	100.0	
Managers and Administrators	Maintenance	5	100.0	100.0
Cash/Finance	Maintenance	9	55.6	55.6
	None	4	44.4	100.0
	Total	9	100.0	
Human Resources	Maintenance	4	100.0	100.0
Pharmacist/Pharm technicians	Maintenance	10	83.3	83.3
	None	2	16.7	100.0
	Total	12	100.0	

Table 4.25: If the computers are connected to others in other department

		Others		Level 5	
County Classification	**Computers connected to other departments**	**f**	**Percent**	**f**	**Percent**
Rural	Yes	4	16.0	11	39.3
	No	21	84.0	17	60.7
	Total	25	100.0	28	100.0
Semi-Urban	Yes	5	15.6	7	26.9
	No	27	84.4	18	69.2
	I don't know			1	3.8
	Total	32	100.0	26	100.0
Urban	Yes	19	27.9	12	18.8
	No	49	72.1	52	81.3
	Total	68	100.0	64	100.0

Note: f refers to frequency, others refers to level 2-4 health facilities

In the rural county majority of the computers (84% and 60.7%) were not connected to other departments in both the lower level facilities 84%and level 5 facility respectively. In the semi urban facility, 84.4% indicated the computers were not connected to other departments in the lower level facilities while 69.2% indicated computers were not connected to other departments in the level 5 facility. 3.8% indicated they were not aware if the computers were connected to other departments in the level 5 facility. In the urban county 72.1% in the lower level facilities indicated the computers were not connected to other departments in the facility while 81.3% indicated the computers were not connected to other departments in the level 5 facility.

Availability of ICT equipment

Table 4.26: If the connection is local or via internet

County Classification	Connection	Others f	Others Percent	Level 5 f	Level 5 Percent
Rural	Internet	2	15.4	4	19.0
	Local	5	38.5	8	38.1
	No connection	6	46.2	7	33.3
	Don't know			1	4.8
	Total	13	100.0	21	100.0
Semi-Urban	Internet	2	9.5	7	35.0
	Local	4	19.0	2	10.0
	No connection	15	71.4	9	45.0
	Don't know			2	10.0
	Total	21	100.0	20	100.0
Urban	Internet	17	30.4	14	25.9
	Local	8	14.3	5	9.3
	Both local and internet	3	5.4	2	3.7
	No connection	26	46.4	32	59.3
	Don't know	2	3.6	1	1.9
	Total	56	100.0	54	100.0

Note: f refers to frequency, others refers to level 2-4 health facilities

In the rural county, 38.1% of the connectivity in the lower level facilities were local and 38.1% in the level 5 facility was local connectivity while 46.2% of the computers had no connectivity in the lower level facility and 33.3% in the level 5 facility. In the semi urban county 71.4% of the facilities had not connectivity and 195 was local connection while 45% in the level 5 had no connectivity and 35% was through internet connectivity. In the urban county majority of the computers had no connectivity at 46.4% in the lower level facilities and 59.3% in the level 5 facility. 30.4% in the lower level facilities were

connected through internet while 25.9% in the level 5 facilities were connected through internet. 4.8% in the level 5 facility in the rural county and 10% in the semi urban county indicated they were not aware if there was any connectivity. In the urban county 3.6% in the lower level facility and 1.9% in the level 5 facility indicated they were not aware if there was any connectivity.

Table 4.27: Reasons for none connectivity to internet by health facility level

County Classification	If local why not internet?	Others f	Others Percent	Level 5 f	Level 5 Percent
Rural	Financial challenges	2	18.2	1	6.7
	Not applicable	6	54.5	7	46.7
	Lack of network boosters	3	27.3	2	13.3
	Poor strength of network			3	20.0
	Computer infrastructure			1	6.7
	Don't know			1	6.7
	Total	11	100.0	15	100.0
Semi-Urban	Not applicable	17	94.4	9	75.0
	Poor strength of network	1	5.6	3	25.0
	Total	18	100.0	12	100.0
Urban	Financial challenges	2	5.7	2	5.1
	Not applicable	29	82.9	34	87.2
	Poor strength of network	2	5.7	1	2.6
	Management issues	1	2.9	1	2.6
	Don't know	1	2.9	1	2.6
	Total	35	100.0	39	100.0

Note: f refers to frequency, others refers to level 2-4 health facilities

In the rural county the major reason why the connection was not through internet was lack of network boosters at 27.3% in the lower level facilities and 13.3% in the level 5 facility. In the semi urban county, the major reason was poor strength of network at 5.6% in the lower level facilities and 25% in the level 5 facility. In the urban counties

the main reason was financial challenges in the lower level facilities at 5.7% and 5.1% in the level 5 facility.

Table 4.28: Availability of software in the health facilities

		Others		Level 5	
County Classification	Use of the available soft ware	f	Percent	f	Percent
Rural	Laboratory Management Information System	2	16.7		
	Storage of patient information and retrieval	3	25.0	5	17.9
	Prescription writing	1	8.3		
	Tracking treatment processes	1	8.3	3	10.7
	Financial management			1	3.6
	Report writing			1	3.6
	Pharmaceutical management			3	10.7
	Prescription writing			4	14.3
	Not applicable	4	33.3	10	35.7
	Manage applications	1	8.3		
	Don't know			1	3.6
	Total	12	100.0	28	100.0
Semi-Urban	Storage of patient information and retrieval	3	12.0	5	25.0
	Financial management	3	12.0	2	10.0
	Not applicable	18	72.0	9	45.0
	Manage applications	1	4.0	4	20.0
	Total	25	100.0	20	100.0
Urban	Storage of patient information and retrieval	18	34.0	11	22.4
	Financial management	1	1.9	1	2.0
	Report writing	3	5.7		
	Pharmaceutical management	2	3.8	2	4.1
	Prescription writing	1	1.9		
	Tracking treatment processes	2	3.8		
	Don't know	2	3.8	1	2.0
	Not applicable	22	41.5	32	65.3
	Manage applications	2	3.8	2	4.1
	Total	53	100.0	49	100.0

Note: f refers to frequency, others refers to level 2-4 health facilities

Across the three counties the software was majorly used for Storage of patient information and retrieval. In the rural county among the lower level facilities this was reported at 25% and 17.9% in the level 5 facility. In the semi urban county this was reported at 12% and also financial management at 12%. In the level 5 facility storage of patient information and retrieval was majorly reported at 25%. In the urban county storage of patient information and retrieval was reported majorly at 34% in the lower level facilities and 22.4% in the level 5 facility.

Table 4.29: Frequency of upgrading software

County Classification	Frequency of upgrading the software	Others		Level 5	
		f	Percent	f	Percent
Rural	No upgrading	6	40.0	10	43.5
	Not sure	1	6.7	1	4.3
	Once a year	4	26.7	1	4.3
	Twice a year	2	13.3		
	Severally	1	6.7	1	4.3
	Every end month	1	6.7		
	Quarterly			2	8.7
	Rarely			4	17.4
	I don't know			4	17.4
	Total	15	100.0	23	100.0
Semi-Urban	No upgrading	19	73.1	8	47.1
	Once a year			1	5.9
	Twice a year			1	5.9
	Not sure	1	3.8	5	29.4
	In case of malfunction	2	7.7		
	Rarely	4	15.4	2	11.8
	Total	26	100.0	17	100.0
Urban	No upgrading	26	52.0	33	66.0
	Not sure	3	6.0	4	8.0
	Once a year	4	8.0	3	6.0
	Twice a year	2	4.0		
	Severally	2	4.0	2	4.0
	Every end month	2	4.0	1	2.0
	Quarterly	1	2.0	1	2.0
	In case of malfunction	1	2.0	1	2.0
	Don't know	8	16.0	3	6.0
	Rarely	1	2.0	2	4.0
	Total	50	100.0	50	100.0

Note: f refers to frequency, others refer to level 2-4 health facilities

Majority of the facilities across the three counties in both the lower level facilities and the level 5 facilities indicated there was no upgrade of software and hardware.

In the rural county, the major limitation in the use of ICT was Lack of ICT infrastructure (hardware and software) in the lower level facilities and level 5 facility at 50% and 21.9% respectively with the least challenge being work related factor (overload) at 6.3% and 6.3% respectively in the lower level facilities and the level 5 facility. In the semi urban county, the major limitation in the use of ICT in the lower level facilities was Lack of ICT infrastructure (hardware and software) at 33.3% while for the level 5 facility lack of computers was the major limitation at 36.4% while the least limitation was faulty computers, old generation, poor maintenance at 0% in both the lower level facilities and level 5 facility. In the urban county the major limitation in use of ICT in the lower level facilities and level 5 facility was Lack of ICT infrastructure (hardware and software) at 46.8% and 30.4% respectively while the least limitation was work related factors (overload) at 4.8% for the lower level facilities and 0% for the level 5 facility.

Table 4.30: Limitations in Utilization of ICT in the departments

County classification	Limitation in utilization of ICT in the departments	Others		Level 5	
		f	Percent	f	Percent
Rural	Lack of ICT infrastructure (hardware and software)	8	50.0%	7	21.9%
	No computers	2	12.5%	6	18.8%
	Lack of internet	1	6.3%	5	15.6%
	Lack of commitment from management (Planning/Budgeting/ funding)			3	9.4%
	Work related factors (overload)	1	6.3%	2	6.3%
	Faulty computers, old generation, poor maintenance	1	6.3%	3	9.4%
	Lack of training/ illiteracy	3	18.8%	6	18.8%
	Total	16	100.0%	32	100.0%
Semi-Urban	Lack of ICT infrastructure (hardware and software)	8	33.3%	6	27.3%
	No computers	5	20.8%	8	36.4%
	Lack of internet	2	8.3%	3	13.6%
	Lack of commitment from management (Planning/Budgeting/ funding)	4	16.7%	1	4.5%
	Work related factors (overload)	3	12.5%		
	Faulty computers, old generation, poor maintenance				
	Lack of training/ illiteracy	2	8.3%	4	18.2%
	Total	24	100.0%	22	100.0%
Urban	Lack of ICT infrastructure (hardware and software)	29	46.8%	14	30.4%
	No computers	7	11.3%	14	30.4%
	Lack of internet	5	8.1%	6	13.0%
	Lack of commitment from management (Planning/Budgeting/ funding)	4	6.5%	4	8.7%
	Work related factors (overload)	3	4.8%		
	Faulty computers, old generation, poor maintenance			2	4.3%
	Lack of training/ illiteracy	14	22.6%	6	13.0%
	Total	62	100.0%	46	100.0%

Note: f refers to frequency, others refers to level 2-4 health facilities

Across the three counties, Training of staff (OJT, Induction, updates, short courses) was the highest recommendation for improvement to ensure use of ICT in the lower level facility and the level 5 facilities. In the rural county this was recommended at 38.5% in the lower level facilities and 37.9% in the level 5 facility. In the semi urban county this was recommended at 29.3% in the lower level facilities and 32.7% in the level 5 facility. In the urban county, this was recommended at 32.3% in the lower level facilities and 31.7% in the level 5 facility. The least recommended was employment of more personnel at 0% in the lower level facility and 1.5% in the level 5 in the rural county. This was also the least recommended in the semi urban county at 4.9% in the lower level facilities and 1.9% in the level 5 facility. The least recommended in the urban county among the lower level facilities was planned preventive maintenance (PPM) schedule for ICT equipment at 3.1% and employment of more personnel at 2.4% in the level 5 facility.

Table 4.31: Recommendations for improvement to ensure utilization of ICT

County classification	Recommendation for improvement	Others		Level 5	
		f	Percent	f	Percent
Rural	Infrastructural development and improvement (upgrade)	6	23.1%	10	15.2%
	Purchase of computers, installation and connection to other departments	6	23.1%	10	15.2%
	Provision of internet connectivity and speed upgrade			8	12.1%
	Support from management (proper planning, budgeting, funding and staff motivation)	1	3.8%	2	3.0%
	Employment of more personnel			1	1.5%
	Planned preventive maintenance (PPM) schedule for ICT equipment	2	7.7%	4	6.1%
	Training of staff (OJT, Induction, updates, short courses)	10	38.5%	25	37.9%
	Stable power supply and backup	1	3.8%	6	9.1%
	Total	26	100.0%	66	100.0%
Semi-Urban	Infrastructural development and improvement (upgrade)	9	22.0%	10	19.2%
	Purchase of computers, installation and connection to other departments	5	12.2%	12	23.1%
	Provision of internet connectivity and speed upgrade			7	13.5%
	Support from management (proper planning, budgeting, funding and staff motivation)	10	24.4%	2	3.8%
	Employment of more personnel	2	4.9%	1	1.9%
	Planned preventive maintenance (PPM) schedule for ICT equipment			2	3.8%
	Training of staff (OJT, Induction, updates, short courses)	12	29.3%	17	32.7%
	Stable power supply and backup	3	7.3%	1	1.9%
	Total	41	100.0%	52	100.0%
Urban	Infrastructural development and improvement (upgrade)	33	20.5%	28	22.8%
	Purchase of computers, installation and connection to other departments	24	14.9%	26	21.1%
	Provision of internet connectivity and speed upgrade	14	8.7%	13	10.6%
	Support from management (proper planning, budgeting, funding and staff motivation)	12	7.5%	8	6.5%
	Employment of more personnel	8	5.0%	3	2.4%
	Planned preventive maintenance (PPM) schedule for ICT equipment	5	3.1%	5	4.1%
	Training of staff (OJT, Induction, updates, short courses)	52	32.3%	39	31.7%
	Stable power supply and backup	13	8.1%	1	0.8%
	Total	161	100.0%	123	100.0%

Note: f refers to frequency, others refer to level 2-4 health facilities

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the discussion, conclusion and recommendations of the study.

5.1 Context Dimension in relation to ICT Utilization

Context dimensions were taken to be whether the respondents had a previous computer training or not and whether there was an on job training at their health facility. ICT utilization was characterized by computer literacy of the respondents, computer access, ICT policy and computerized operations.

Majority of the health care workers in the urban County (Nairobi) had training in ICT. The highest percentage of those not trained in ICT were from the rural County (Turkana). Across the three counties absence on job training on ICT for the staff was reported to be highest in the rural County and the least in semi urban County (Machakos). A greater percentage of health care workers indicated lack of ICT sponsorship by the facility with the highest being rural County and the lowest semi urban County. This is consistent with findings from previous studies that demonstrated that lack of induction training program and trainings on ICT was major challenge for many African health systems that were implementing ICT platforms for effective and efficient service delivery (Siender *et. al*.,2012; Azfar *et.al*., 2011). Another study finding also showed the lack of utilization or under-utilization of ICT may be as a result of the unavailability of the ICT facilities and tools. Also, the lack of knowledge by the users in the use of these ICT facilities. This lack of utilization or under-utilization is because they do not possess the fundamental and required skills in ICT and its use. (Ugo & Aliyu, 2017).

Across the three counties a greater percentage indicated lack of external support to implement ICT in the facilities with the highest being the rural County and the lowest urban County, followed by support from the partner with the highest being the rural

County and the least being semi urban County and the least support was from the county with the highest being semi urban County and the least being rural County. Across the rural and urban counties, majority had previously worked in government health facilities. In the semi urban County majority had previously worked in a private health facility. In rural and urban counties, majority indicated they did not use ICT in their previous work place while majority of the health care workers in the semi urban county indicated they had used ICT in their previous work places.

Previous computer training was found to be strongly associated with computer literacy for below level 5 rural facilities, rural level 5 hospitals, semi-urban level 4 and below facilities, urban level 4 and below health centres, and lastly urban level 5 facilities. In summary, having been trained previously leads to computer literacy hence ICT utilization at health facilities across the board. This is suggestive that the importance of training program is often ignored by the low facility levels, and inadequate induction training or absence of it usually leads to laxity in utilization of ICT in comparison to a study done that argued for appropriate adequate induction training on ICT to all end-users at the right times and location in terms of quantity and quality (Simon *et.al*.,2013).

Across all categories of health facilities, previous computer training was not associated with computer access indicating they are not related. This was so as the Chi-square statistics and their resultant p-values were statistically insignificant. This shows that having been trained previously does not guarantee access of a computer at the health facilities.

Previous computer training was seen to be associated with ICT policy at semi-urban levels 4 and below hospitals, but was not in other health facilities. This shows that in semi-urban facilities, having a previous computer training indicated that there exists a working ICT policy at the health facilities however, this was not the case in other health facilities where the respondents worked.

In urban level 5 health facilities, previous computer training was associated with computerized operations. The more the health workers were trained, the more the operations were computerized indicating good utilization of ICT. However, this was not the case in other health facilities as previous computer training was not associated with computerized operations.

On job training of staff was not associated with computer literacy across all health facilities in rural, semi-urban and urban counties. This means whether there was an on job training or not did not guarantee computer literacy of health workers in those facilities. However, there was a significant relation between on job training of staff and computer access at semi-urban level 4 and below hospitals, urban level 4 and below facilities, and urban level 5 health facilities. This shows that on job trainings were conducted to staff with computer access at the health facilities.

Existence of ICT policy was seen to be related significantly to on job training at urban below level 5 health facilities, and urban level 5 hospitals. Therefore, in urban health facilities, on job training indicated existence of an ICT policy which was unlike health facilities in semi-urban and rural counties.

Lastly, computerized operations was seen to be related significantly to on job training at urban below level 5 health facilities, and urban level 5 hospitals. Therefore, in urban health facilities, on job training indicated computerization of operations which was unlike health facilities in semi-urban and rural counties.

5.2 Process Dimension in relation to ICT Utilization

Process dimension was taken to be involvement in the initial set-up of ICT while ICT utilization was characterized by computer literacy of the respondents, computer access, ICT policy, computerized operations and replacement protocol.

Majority of the respondents at level 5 and below level 5 health facilities across the three counties had not been involved in the initial set up of ICT in their respective facilities.

There was a significant association between involvement in ICT initial setup and computer access in rural levels 4 and below facilities, urban levels 4 and below, and urban levels 5. Phi and Cramer's V indicated that the strength of the association were strong and moderate respectively. This means that in rural levels 4 and below hospitals and urban health facilities, health practitioners who were involved in the initial setup of ICT in the health facility were more likely to have computer access.

In urban levels 4 and below hospitals, there was a significant relation between involvement and existence of an ICT policy at the facility. This means that in those facilities where the health practitioners were involved in the initial set up of the ICT facility/equipment it was more likely to have an ICT policy in the facility. The results showed that this was not the case in other facilities as there was no significant relationship. This was indicated by an insignificant p-value greater than 5% level of significance. The results goes ahead to show that there exist a significant association between involvement and computerized routine operations in rural levels 5 hospitals, and urban levels 5 hospitals. Lastly, there was a significant relation between involvement and replacement protocol in semi-urban levels 4 and below hospitals. In those health facilities who involved their health practitioners in the initial setup of the facility were more likely to have a maintenance department for repair. The findings of this this study has similar findings to the results from a study done that showed policies specific to the advancement of ICT influence the country's advancement in ICT infrastructure capabilities. (Roztocki *et.al*., 2019; Ansah, 2013).

5.3 Content Dimension in relation to ICT Utilization

Content dimension was indicated by two variables namely: difference in performance with and without ICT, and patient outcome with and without ICT. ICT utilization was characterized by computer literacy of the respondents, computer access, ICT policy and computerized operations.

Across the three counties they reported difference in performance with use of ICT. Semi urban county reported the highest with the least being urban county in the facilities below level 5 (Level 2, 3 & 4). Among the level 5 facilities the semi urban county reported the highest at with the least being urban county.

Under patient outcome with use of ICT, majority of the facilities below level 5 across the counties indicated good outcome with the facilities in the rural county reporting the highest and the least being semi- urban county. Among the level 5 facilities across the three counties, majority indicated good patient outcome with the use of ICT with the facility in rural county (Turkana) reporting the highest and the least being facility in semi urban county.

5.3.1 Association between Content dimension (difference in performance with and without ICT) and ICT utilization

The results show that there was a moderate significant relationship between performance with and without ICT and computer literacy in urban levels 4 and below hospitals, and urban level 5 hospitals. This means that those health workers who indicated that there was a difference in performance when ICT is used were more likely to be computer literate. There was a moderate significant relationship between performance with and without ICT and computer access in semi-urban levels 4 and below hospitals, urban levels 4 and below hospitals, and urban level 5 hospitals. This means that those health workers who indicated that there was a difference in performance when ICT is used were more likely to be computer literate. This is in line with the findings of a study that analyzed key implementation factors to helps us understand why there is a convergence around some ICT-enabled activities over others and the characteristic of an individual strongly influenced the utilization of ICT and in this case it was individual ‘s literacy in ICT (Gray *et.al*., 2018)

5.3.2 Association between Content dimension (patient outcome with and without ICT) and ICT utilization

ICT utilization was measured using 5 aspects namely computer literacy, computer access, ICT policy, computerized operations and replacement protocol. Content dimension was measured in terms of the patient outcome with and without ICT. From the results, the relation between patient outcome with and without the use of ICT and computer literacy was significant in below level 4 hospital facilities in the rural county, and urban level 5 hospital facilities. The association in both relationships were strong and moderate respectively. This means that health care practitioners in rural levels 4 and below who said that patient outcome was good with use of ICT were more likely to have been computer literate.

There was no significant association between patient outcome with and without the use of ICT and computer access in rural levels 4 and below, rural level 5, semi-urban levels 4 and below, and urban levels 4 and below.

The association between existence of an ICT policy and computer literacy was found to be statistically significant in urban levels 4 and below hospitals. Those staff in urban level 4 and below hospitals who rated patient outcome as good were more likely to have a policy regarding the use of ICT as compared to the others. There was no statistically significant relation between a patient outcome was good with use of ICT and the percentage of computerized operations.

Lastly, there was a significant association between patient outcome with use of ICT (content dimension) and the replacement protocol in Semi-urban level 5 hospitals, and levels 4 and below. the patient outcome was good. Those who rated patient outcome to be good when ICT facilities are used other than the manual way of doing things, were more likely to have a maintenance department for repair as a replacement protocol in their facility. This is in agreement with the studies done by various authors that have argued that creating a balance between technology and daily work practices is an

essential factor in the implementation and up scaling of ICT usage. (Cresswell *et.al*., 2012; Takian *et.al*.,2012).

5.4 Context, content and process challenges in utilization of ICT in public health facilities

The last objective aimed at determining the content, context and process challenges in utilization of ICT in public health facilities in Machakos, Turkana and Nairobi counties.

5.4.1 Context dimension Challenges in utilization of ICT in public health facilities

Among the ICT context related challenges, lack of ICT infrastructure was cited as the highest challenge among the lower level facilities (level 2, 3 &4) across the counties and job dissatisfaction the least. Lack of ICT infrastructure was reported the highest in the rural county and the least in the urban county. Job dissatisfaction reported as the least challenge was reported the highest in semi urban County and the least in rural county.

Among the level 5 facilities in the three counties, lack of ICT infrastructure was also indicated as the main challenge and job dissatisfaction as the least. Lack of ICT infrastructure was highest in the rural County and the least in the urban County. Job dissatisfaction was highest cited in the rural County and the least in the urban County.

5.4.2 Process dimension Challenges in utilization of ICT in public health facilities

Process factor related challenges also had major impact on up scaling of ICT i.e. less up scaling of ICT that was attributed to lack of support from hospital top management team.

Under the ICT process related challenges in the lower level facilities (Level 2,3, &4), rural and semi urban counties reported ICT not prioritized during budget allocation as the main challenge while the urban county (Nairobi) reported preference to manual way of doing things as the main challenge respectively. The least reported process related

challenge among the lower level facilities across the three counties was work over load with the highest reported in the urban county and the least in the rural county.

Across the level 5 facilities in the three counties, ICT not prioritized during budget allocation was cited as the main challenge in the rural and urban counties while work overload was cited as the main process related challenge in the semi urban County. Preference to the manual way of doing things was cited as the least process related challenge in the semi urban and urban Counties. Work overload was cited as the least process related challenge in the rural County.

This is suggestive that the benefits that accrue from using ICT is not well understood and implemented by the hospitals top management teams. This could be a possible reason of the low support extended to the end-users by management resulting to low levels of computerization of service operations in their respective facilities. This is consistent with studies that have shown that supportive leadership, strong and active management involvement is positively associated with ICT implementation. The study argues that senior management should repeatedly declare that ICT implementation is the highest organization priority and thus they should support it with sufficient financial and human resources and also by working with organizations decision makers to mitigate policy and regulatory barriers to implementation of ICT. (Gray *et. al*., 2018)

5.4.3 Content dimension Challenges in utilization of ICT in public health facilities

Among the ICT content related challenges in the lower level facilities (level 2, 3, & 4) inadequacy of ICT infrastructure was reported as the highest challenge across the three counties. This was reported the highest in the urban County and the least in the semi urban County.

Among the level 5 facilities across the three counties, inadequacy of ICT infrastructure was reported as the main challenge with the highest in the semi urban and the least in the rural Counties. The least reported challenge was power supply with the highest reported

in the rural and the least in the semi urban County. This implies that although sharing of ICT resources are in place in most facilities, they are likely not to be used as they are either down as a result of either network connectivity, breakdown or not available to end users. This concurs with a study that argues that hardware and software must be available and reliable at all times for utilization of ICT to be effective (Gray *et.al*., 2018).

5.5 Conclusion

Content and process dimensions were the most critical success factors associated with uptake of ICT utilization in public health facilities. These factors are setting-dependent on the classification of the facility levels and majorly influenced by; Strong management involvement in ICT related matters (process dimensions); availability and implementation of an ICT policy especially among lower level facilities; Level 2-4(process dimension); presence of an institutional induction training program on ICT (context dimension); type of ICT support provided and its reliability (content dimension); level of services operations computerized (content); limited or no access to policy regarding ICT in the facility affects utilization of ICT in as much as one may have computer literacy and access to computer at work; having a higher percentage of computerized routine operation is related to ICT utilization while failure to having the routine operations computerized and none being computerized affected utilization of ICT. availability of replacement protocol on ICT equipment is critical in utilization of ICT, this will avoid service interruption whenever there is a breakdown.

5.6 Recommendation

Across the three counties, to ensure utilization of ICT, Training of staff (OJT, Induction, updates, short courses) was the highest recommendation for improvement to ensure use of ICT in the lower level facility and the level 5 facilities followed by planned preventive maintenance (PPM) schedule for ICT equipment. Employment of more personnel does not guarantee utilization of ICT in delivery of health care.

It is with this in mind that a recommendation for training of staff (OJT, Induction, updates, short courses) to ensure use of ICT in the health facilities is key. The study also further recommends availability of enough ICT infrastructure as part of the challenges in ICT integration was majorly affected by lack or insufficient ICT infrastructure.

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APPENDICES

Appendix I: Consent Form

Part A: Informed Consent Form and explanation.

Date……...

Title of the study: Context, Process and Content dimension to full integration of ICT in health care delivery in selected public health facilities of Machakos, Turkana and Nairobi counties in Kenya.

Investigators: PI, Faith Chesang' Ngorett, ITROMID/ JKUAT

Study location: Level 2-5 Public health facilities in Machakos, Turkana and Nairobi counties.

Introduction

My name is Faith Chesang' Ngorett, a Masters student at Jomo Kenyatta University of Agriculture and Technology. I am the principle investigator in this study that aims at assessing Context, Process and Content dimension to full integration of ICT in delivery of health care services in selected public health facilities of Machakos, Turkana and Nairobi counties in Kenya.

PURPOSE OF THE STUDY

The aim of this study is to Context, Process and Content dimension to full integration of ICT in health care delivery in selected public health facilities of Machakos, Turkana and Nairobi counties in Kenya. At the end of this study, the findings will contribute to the existing knowledge to enable suggestion for the implementation of ICT services in the public health sector that will render delivery of health services easier.

PROCEDURES

I would like you to participate in this study. If you agree to participate, you will be asked questions to give any relevant information about application of various information communication technologies (ICT) in health facilities, factors that influence ICT application in public health facilities and strategic direction towards ICT application in public health facilities.

If therefore, you wish to participate, the principle investigator request that you give permission by signing the consent form. The interview will take approximately twenty minutes.

POTENTIAL HARM OR RISKS

There is no harm or risks associated with participation in the study.

BENEFITS

This research is purely academic and there are no direct benefits to the participants. The findings will benefit science by adding information to solve health challenges in our society.

COMPENSATION

If you agree to participate, you will not be paid for any study procedures to be carried out.

CONFIDENTIALITY

All information relating to your participation in this study will remain private. Your name will not be used; instead, a unique code for each informant will be used. The information will be locked up for information security.

ALTERNATIVE TO PARTICIPATION

Your participation in this study is voluntary. If you do not want to participate there will be no penalty. You may stop your participation at any time without penalty or loss of benefits.

CONTACT PERSON'S

In case of any queries or concerns, please contact the following: The Director; Institute of Tropical Medicine and Infectious Diseases, Email erc-secretariat@kemri.org or Jomo Kenyatta university of Agriculture and technology P. O. Box 62200-00200, Nairobi; Tel No 2722541- 2713349- 072220590. or Faith Chesang' Ngorett, Principle Investigator cell No: 0711484477; Email fngorett@yahoo.com

Part B: Participant Consent Form

PARTICIPANT STATEMENT

The study you are about to participate in is aimed at assessing Context, Process and Content dimension to full integration of ICT in health care delivery in selected public health facilities of Machakos, Turkana and Nairobi counties in Kenya.

Should you agree to participate in the study, you will be asked to give relevant information about application of various information communication technologies (ICT) in health facilities, factors that influence ICT application in public health facilities and strategic direction towards ICT application in public health facilities.

Any additional information about the study will be provided to you including the final study results.

The methods and means by which the study will be conducted have been explained to me by the researcher. All questions have been answered to my full satisfaction and I fully understand my role. I also understand that withdrawal from the study at any point is voluntary and not subject to penalty. I agree to participate in this study.

Participant signature……

Date ……

Researcher's signature……

Date……

Appendix II : Questionnaire

Name of Health facility: _____Respondent's initials _____

Questionnaire NO._____ Date: _____

Section A

General Information (Tick the Appropriate)

1) Gender
   a) Male b) Female

2) Age
   a) 20-30
   b) 31-40
   c) <40

3) Education level
   a) Diploma
   b) Degree and above

Section B

B.1: Context dimension

4) Computer literacy

a) Yes

b) No

5) Previous computer training

a) Short course
b) Certificate course
c) Diploma course
d) Degree course
e) No training

6) Does your facility conduct on job training on ICT to staff?

a) Yes
b) No

7) What types of ICT training sponsorship are offered by facility?

a) None
b) Basic application package
c) Specialized courses

8) Does your facility have an institutional induction training program on ICT?

a) Yes
b) No

9) What are some of the assistance that you get from outside that promote implementation of ICT as staff?

a) Partner support

b) County support

c) None

10) Challenges in use of ICT

a) Computer illiteracy/ lack of ICT skills
b) Lack of ICT infrastructure
c) Resistance to change
d) Job dissatisfaction

11) Which type of health facility did you work in before this one?

a) Government facility
b) Private facility
c) Faith based facility
d) Never work

1. If yes, did you use ICT platforms during the routine operations?
    a) Yes
    b) No

B.2: Process dimension

12) Do you have access to computer at office/ work?

a) Yes
b) No

13) Were you involved in the initial set up of ICT in this health facility?

a) Yes
b) No

14) Is there a policy in place regarding ICT in this health facility?
a) Yes
b) No

15) What are some of the things that make you not use ICTs/ ICT infrastructure?
a) Work overload
b) Preference to manual way of doing things i.e. paper work
c) Not prioritized during budget allocation

B.3: Content dimension

16) How much of your routine operations have been computerized

a) <50%
b) 50-100%
c) None

17) Purpose of computer at the health facility
a) Patient management (diagnosis and treatment)
b) Financial management
c) Storing information and report writing
d) Internet services and learning

18) What is the replacement protocol in case of a breakdown in any of the ICT equipment?

a) Maintenance department for repair
b) Disposal

c) None

19) Is there a difference in performance when you use ICT facilities compared to manual way of doing things?

a) Yes
b) No
c) Don't know

20) How can you rate patient outcome when you use ICT facilities to the manual way of doing things?

a) Poor
b) Average
c) Good

21) What are the content challenges experienced while using ICTs in this facility?

a) Power supply
b) Internet connectivity/ system down time
c) Inadequacy of ICT infrastructure (hardware and software)

22) What is your department?

23) Are the following ICT infrastructures available in your department?

a) Computers Yes/ No if yes, how many: _
b) What is the models of the computers?
c) Is there any server for information storage and sharing? Yes /No
d) If present, what type and model server.....
e) Is it current or old generation.....?
f) What is the type of software being used in this department?
g) What is the software used for?
h) Are the computers connected to other departments? Yes/ No
i) If connected is it by use of internet or local connection?

j) If local connections, why not internet?

k) If neither local nor internet what are the reasons?

l) Are the staff trained on the software? Yes/No

m) How often are the soft wares and hardware upgraded?

n) Are there trainings after every upgrade? Yes/ No

o) What are the limitations in the utilization of ICT in your department?

24) What are the main things that need to be improved so as to ensure utilization of ICT is embrace in the health facilities

Appendix III: Observation Sheet

Type of ICT hardware and software available in the facility **Name of Facility**……

Category	**Description**	**Availability** **(Tick if available)**	**Number**	**Department**	**Status (functional / non-functional**
Hardware	Desktop PCs				
	Camera				
	Laptops				
	Printers				
	Photocopy machines				
	CT scan machine				
	X ray machine				
	Ultrasound machine				
	Full Hemogram machine				
	MRI machine				
	CD4 Count machine				
	Gene expert machine				
	Ventilator machine				
	Patient monitors				
	Resuscitaires				
	Nebulizers				
	Intravenous infusion pumps				
	Incubators				
	Others				
Communication	Mobile Phones				
	Landlines				
	Connection to internet (fiber / modem				
	Others				
Software	Operating Systems (Windows OS / Apple)				
	Internet patient database				
	Laboratory database (LIMS)				
	Staff database				
	Enterprise management software				
	Electronic Medical Record System (EMR)				
	Hospital Management System e.g. Epic				
	Word Processor (MS Word)				
	Excel				
	Customized software				
	Others				

Appendix IV: Ethical clearance

Approval Letter from Ethical Review Committee (KNH/UoN)

KENYATTA NATIONAL HOSPITAL APPROVED 02 APR 2015 KNH/UoN-ERC P.O Box 20723-00202 NAIROBI

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P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/150

2nd April, 2015

Faith Chesang'Ngorett
TM310-1044/2013
JKUAT

Dear Faith

Research Proposal: Assessment of Application of Information Communication Technology in Major (level 3 to 6 Health Facilities, a Case Study of Nairobi County (P7/01/2015)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 2nd April 2015 to 1st April 2016.

This approval is subject to compliance with the following requirements.

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **www.erc.uonbi.ac.ke**

Yours sincerely

PROF. M. L. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director CS, KNH
The Chair, KNH/UoN-ERC
Supervisors: Mr. James N. Kariuki, Dr. Joseph K. Kariuki

Appendix V: Approval letter for modification of study site from Ethical Review Committee (KNH/UoN)

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KENYATTA NATIONAL HOSPITAL
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Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/ SAE/167

19th May, 2015

Faith Chesang' Ngorett
TM310-1044/2013
JKUAT

Dear Faith

Re: Approval of modifications –Assessment t of the application of information communication Technology in selected level 3 to 6 health facilities in Machakos and Nairobi counties (P7/01/2015)

Your communication received on 15th May 2015 refers.

The KNH/UoN-ERC has reviewed and approved your request to modify your study site to include selected health facilities in Machakos county in order to acquire the required sample size for the above study.

Yours sincerely

PROF. M. L. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director CS
The Chairperson, KNH/UoN-ERC

Protect to discover