FACTORS INFLUENCING UTILIZATION OF INTERNATIONAL QUALITY CARE SYSTEM FOR CLINICAL DECISION SUPPORT IN HIV CARE CLINICS IN NAKURU COUNTY, KENYA

BY

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DECLARATION

I declare that this thesis is my original work and has not been submitted in part or whole in any university or institution of higher learning for the award of academic degree.

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DEDICATION

I dedicate this work to the almighty God for giving me the opportunity, to wife Maclean Nyakoe whose moral support has been sufficient, to my children Brenda Kaptuya, Bryan Rotich, and Precious Nyambati, with the hope that this will inspire them to aim higher in their studies. I thank my friends and colleagues, and University fraternity for making this research a success.

ABSTRACT

Electronic medical records (EMR) are computerized medical information systems that are used to collect, store, and display patient information. EMR systems can strengthen pathways of care and close gaps in patient tracking, care, and management of chronic diseases such as HIV&AIDS. Conventionally, health care workers (HCWs) face difficulties in locating, sorting, and identifying key information in paper records. To counter these challenges, in the year 2010 the Ministry of Health in Kenya approved the use of two EMR platforms, namely the International Quality Care (IQCare) system and the Kenya EMR. These systems were initially set to support HIV&AIDS clinical decision making. In 2014, Nakuru County was among the first counties to roll out the utilization of IQCare system for clinical decision support (CDS). In its implementation, appropriate support was provided, which included human resource and ICT infrastructure. Despite the substantial investment in IQCare in Nakuru County, its utilization for CDS remained low. As such, the main aim of this study was to investigate the factors that influence the utilization of the IQCare system for CDS in HIV care clinics in Nakuru County. Specifically, the study set out to determine the influence of human resource availability, ICT infrastructure and HCWs perspective on the utilization of IQCare for CDS in the provision of HIV&AIDS care services in health facilities in Nakuru County. This cross-sectional study was conducted in 13 health facilities where IQCare had been deployed since January 2014 and enrolled 81 HCWs. Data was collected using questionnaires and focus group discussions. The results from the study revealed a significant association between human resource availability and utilization of IQCare for CDS; with IQCare training *(p*=0.023) and mentorship support (*p*=0.049) being significantly associated with use of IQCare for CDS. A binary regression analysis revealed linking of computers via local area network (LAN) (*p*=0.012), and internet connectivity (*p*=0.026) influenced the utilization of IQCare for CDS. Further, IQCare simplifying the work of HCWs (*p*=0.023), clinicians having control in decision making (*p*=0.008) and protecting patient confidentiality (*p*=0.005) are some of the HCWs perspectives which showed significance to utilization of the IQCare for CDS. The results presented showed that training of staff on IQCare, mentorship support, Computers linked via LAN and internet connectivity are drivers to utilization of IQCare for CDS in Nakuru County. The study recommends that decision-makers at facility, County and national level should invest in HCWs training, mentorship support, avail computer networking and internet connectivity devices to guarantee optimal utilization of IQCare systems for CDS.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AMPATH	Academic Model Providing Access to Healthcare
ART	Anti-retroviral treatment
CPAD	Comprehensive Patient Application Database
CDS	Clinical Decision Support
DQA	Data Quality Audit
EMR	Electronic Medical Records
FBO	Faith-Based Organization
FGD	Focus Group Discussion
HCWs	Health Care Workers
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
ICT	Information Communication Technology
IQCare	International Quality Care
IREC	Institutional Research and Ethics Committee
LAN	Local Area Network
MeSH	Measurement and Surveillance of HIV Epidemics
M&E	Monitoring and Evaluation
MOH	Ministry of Health
NASCOP	National AIDS STDS Control Program
NGO	Non-governmental Organization
SOP	Standard Operating Procedure
SPSS	Statistical Package for Social Scientists
SSA	Sub-Saharan Africa
STI	Sexually Transmitted Infection
TAM	Technology Acceptance Model
TB	Tuberculosis
UNAIDS	United Nations Program on HIV&AIDS
WHO	World Health Organization

OPERATIONAL DEFINITIONOF TERMS

AIDS-Acquired Immune Deficiency Syndrome is the late stage of HIV disease characterized by a group of symptoms and signs caused by the Human Immunodeficiency Virus (HIV) that cause a deterioration of the immune system (Weiss, 1993).

Clinical decision support system is a computerized procedure for delivery of alerts/reminders, client-specific content resulting from the comparison of client information against a set of knowledge 'rules' or procedures and delivery of alerts or prompts at the point of care (Bryan et al., 2008).

Electronic medical record is a computerized clinical information system that medical data is entered, stored, and patient information is displayed. Electronic medical record systems are generally intended to safeguard and present patient information longitudinally all through their many encounters with a healthcare provider system (Udo & Davis, 1992).

Implementation is the process of putting a decision or plan into effect, it is the realization of a technical specification.

Infrastructure is the basic equipment and structures that are required for an organization to function appropriately. In this study, infrastructure was quantified as computer hardware devices which includes computers networking via LAN, internet connection, servers and power back-up that facilitates communication, storage and allows access to patient information.

International Quality Care is an EMR system for patient management and monitoring that informs decision-making at the clinician level and it is designed to measure patient outcomes.

System is a collection of modules that work together to achieve a common objective. In this study is the combination of hardware, software, and data knowledge connected through networks.

Health care workers perspective is the angle from which a person perceives, based on their point of view, it goes to the visual and by extension, the point of view. In this study, HCWs perspective was operationalized a show HCWs opinions on their preference between using an EMR over paper records and the effect on EMR on quality of HIV care services.

Human resource availability is access to the right human resources for a given project with necessary knowledge and skill sets. Human resource availability was quantified as HCWs trained on IQCare system, mentorship, and availability of technical personnel to install and operate EMR technology resources

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CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

HIV remains a major public health problem in Sub-Saharan Africa (SSA), which is home to25.7 million (15.9 million women vs 9.8 million men) people living with HIV by 2020, 73% (18.8 million) of whom receive antiretroviral therapy [ART](UNAIDS, 2020).In Kenya, about 1.6 million HIV-infected persons in 2020 with 86% coverage of adults and children receiving ART(UNAIDS, 2020). Along the HIV and AIDS care cascade, medical errors have been discovered to be both more costly and harmful when documentation is not readily accessible(Jao & Hier, 2010).

Electronic medical record (EMR) is an organized assortment of health information by electronic means about a particular patient (Boonstra et al., 2010).There are many EMR systems that have been developed and utilized globally, in 2017 more than 85% of hospitals in both the United States and European Union countries had adopted EMR systems(Lee T et.,al 2018). The most widely used EMRs by physicians according to Medscape's EHR report are Epic with 23%, Cerner with 9%, Allscripts 10%, eClinical Works with 6% and Next Gen with 6% (Holroyd-Leduc JM et al., 2011). In Kenya, there were 17 EMR systems that had been registered by the Government in 2009(MOH, 2011). Out of the 17 systems three systems which includes Academic Model for the Prevention and Treatment of HIV (AMPATH) Medical Record System (AMRS), the International Quality Care (IQCare) system and Comprehensive Patient Application Database*(*C-PAD) which were mostly in use(MOH, 2011).

A survey conducted by the World Health Organization (WHO) in 2012 indicated 45% of the countries used EMR systems for patients' data management. In addition, 30% of the countries have been collecting and communicating patient information via electronic systems (WHO, 2012). The health information system is one of the WHO building block number three that provides an alert and early warning capability, supporting patient and health facility management, enabling planning, supporting and stimulating research, supporting global reporting, and underpinning health challenges to diverse users(Manyazewal, 2017).According to WHO, health facilities where HCWs are using EMRs with CDS fall in the 4thadvanced level where there is use of computerized data with the ability to electronically transmit it to multiple

users in multiple locations (WHO, 2012). Lack of a comprehensive legal policy framework in Kenya on adoption and use of eHealth systems and services may expose patients and healthcare providers to unlawful and unethical practices (Ministry of Health Kenya, 2016). A study in Kenya identified gaps in standard operating procedures on data security and confidentiality, which affects HCWs perspective on data quality and utilization of EMRs (MeSH Consortium, 2016).In establishing a regulatory framework favorable for the adoption of eHealth in Kenya. The Ministry of Health in Kenya launched standards and guidelines for EMR as mandated under the Kenya Communications Act of 2012, in line with the ICT policy of 2016 and implemented under the eHealth Strategic Plan (2011-2017)(Ministry of Health, 2017).These developments were expected to support the management of patients with chronic conditions such as HIV and AIDS(Ministry of Health, 2017).

Fruitful usage of an EMR system requires a complete comprehension of existing frameworks, a committed well-trained and mentored inter-disciplinary team to support implementation (Boonstra et al., 2010). A study done in Japan found out that the diagnostic error rate was 2% for HCWs trained and mentored on an updated computer-based clinical system, while the error rate for those not trained nor mentored was 24% (Shimizu et al., 2018). A cross-sectional study in the United States to assess utilization of EMR for CDS found out that it is limited when clinicians do not interact with EMR during patient visits, the results revealed that 24% of the primary care clinicians and 39% of the non-clinicians never or sometimes used any EMR functionality during clinic visits(Linder et al., 2006).EMR-based CDSS are well-thought-out solution to excellence of HIV care (Oluoch et al., 2012). This indicates that staff training and mentorship lead to reduction in diagnostic errors among HCWs.

Findings from Ghana where EMR was used, reported that hospitals had sufficient preparations in terms of provision of network connections (Essuman et al., 2020).A recent study done in Ethiopia showed that successful adoption and use of e-health systems depends on good ICT infrastructure (Biruk et al., 2014).Inadequate use of EMR for CDS is characterized by lack of connectivity of computers via LAN or internet and the non-involvement of users in the design and configuration of the system and unstable power supply (Muthee et al., 2018). Furthermore, the study revealed that HCWs in places with good ICT infrastructure were four times more likely to use the system as compared to those without good infrastructure (Biruk et al., 2014). In order

to maintain complete and accurate data in EMRs to facilitate data for clinical decision making there is need to address the challenge of unreliable electricity and internet connectivity (MeSH Consortium, 2016).These studies suggest that ICT infrastructure is a facilitator to utilization of IQCare for CDS.

A study done in Sub-Saharan African countries, showed that the major challenge on EMR utilization is attributed to HCWs perspectives (Odekunle et al., 2017). Results from a study in Malawi in 2017 also indicated that 76% of health workers preferred to work in health-care facilities which had installed the EMR system, justifying that the system is fast and easy to use. Additionally, 77.8% of respondents supported that the EMR system was more accurate, and as a result, the patients were served more quickly (Msiska et al., 2017). Despite the positive effects of EMR usage in medical practices, the adoption rate of such systems is still low and meets resistance from physicians (Boonstra et al., 2010). Seeking staff buy-in leads to motivation and readiness to use an innovation is the main determinants of innovation's success(Castaneda et al., 2015).HCWs perspective towards CDS features depends on its usefulness and ease of use (Granlien & Hertzum, 2012). This study addresses the extent to which HCWs perspectives is factor that influences utilization of IQCare for CDS hence worth studying.

In 2009, National AIDS and STI Control Program (NASCOP) and Health Information Systems (HIS) commissioned an assessment on the functionality of existing EMR systems implemented in Kenya. Three *(CPAD,* Open MRS-*AMPATH and IQCare)* out of these 17 systems incorporated clinical decision guidelines and could generate alerts or provide reports that could support clinical decisions (Kang'a et al., 2017).Of the 17 systems, three had an average score above 77%, the three were Open MRS-AMPATH(95.2%), IQCare (90.3%), and C-PAD (77.1%)(MOH, 2011).In 2013 after the national assessment, the MOH selected the two top ranked *(Open MRS-AMPATH and IQCare)* EMR systems for roll-out in Kenya.

Clinical decision support (CDS) system is one of the features of the IQCare system that is primarily used at point-of-care to assist clinicians access past and current electronic patient information to aid in clinical management. CDS features have been useful in reducing medical errors, adverse drug reactions, guarantee all-inclusive treatment of patient illnesses and reduce patient waiting time (Catalani et al., 2014). In addition, the CDS system has been shown to increase compliance with clinical guidelines and improve patient safety in hospital settings by

standardizing the decision-making process (Kawamoto et al., 2005). Despite the benefits of CDS system, results from a national assessment conducted in 2009 on the functionality of EMRs used in Kenya rated CDS system among the lowest-performing indicators at 17.6% compared to a mean score of 71.8% for health information and reporting functionality(Kang'a et al., 2017).This study addresses the existent research gap by analyzing the factors contributing to low utilization of IQCare for CDS in Nakuru County.

The two selected EMRs in Kenya offered clinicians a longitudinal source of patient data including diagnostic history, prior encounter history, drug allergies, and additional pertinent information(Jao & Hier, 2010). The two EMR systems are freely available; IQCare (http://fgiqcare.codeplex.com), and Open MRS (http://openmrs.org/).These two systems being open source could offer some relief to hospital managers/users from the high costs of proprietary software, which is a well-documented as a barrier to adoption of EMRs (Muinga et al., 2018). Open source software is also often associated with online supporting communities that constantly help in improving the software (Muinga et al., 2018).

In 2011, another Open MRS system called Kenya EMR was developed by International Training & Education Center for Health (I-TECH) Kenya for roll out in 381 facilities which were assessed (Muthee et al., 2018). By June 2014, the Kenya EMR system had been rolled out to 233 (61%) sites set up to implement point of care, while 148 (39%) were set up for retrospective data entry. (Muthee et al., 2018; MeSH Consortium, 2016).

The IQCare system was being used in 324 facilities in Kenya by 2014 (MeSH Consortium, 2016). IQCare was implemented in Kenya through the support of the Palladium Group (formerly Futures Group) and was donor-funded through AIDS Relief (Muinga et al., 2018).In Kenya the IQCare system was implemented in South Rift valley, Nairobi, coastal and eastern regions of Kenya. By 2014, Nakuru County located in South Rift Valley had the highest number of health facilities implementing the IQCare system (Muthee et al., 2018). This system offered a variety of features for clinical care management, primarily for HIV&AIDS patients(Jao & Hier, 2010). The IQCare system adhered to the national EMR standards with the existence of a comprehensive CDS component (MOH, 2010, Muinga et al., 2018), factors that led to its approval for use in Kenya by the Ministry of Health.

A Routine Data Quality Assessment (RDQA) on EMRs usagein Kenya was conducted by NASCOP in June 2017 to assess the usage of EMRs at point of care. In Nakuru County and neighboring Counties such as Baringo and Kajiado, which implemented the Kenya EMR and IQCare systems respectively. Results from the RDQA showed that usage of the IQCare system for CDSin Nakuru County was 15%, compared to Baringo and Kajiado counties that reported 80% and 65% respectively(NASCOP, 2017).It is however, not known whether resource availability and ICT infrastructure and healthcare workers perspective, account for the low utilization of IQCare system for clinical decision support in HIV clinics in Nakuru County, Kenya.

1.2 Statement of the Problem

Despite the rigorous implementation of IQCare system for patient information in HIV care clinics in Nakuru County, there was still low utilization of IQCare system for CDS. IQCare system has been designed to enable clinicians access longitudinal and previous clinic visits data for monitoring patient viral load suppression, drug dosing, lab test ordering, defaulter tracing, and manage referral of patients from one health facility or provider to another. While with paper systems clinicians encounter challenges accessing patient information from previous clinic visits and historical data to ascertain treatment progress and management of chronic conditions such as HIV&AIDS.

According to NASCOP 2018 DQA report in Nakuru County, IQCare system has been in use from 2013 to 2017 where data entry is done retrospectively and accessed mostly by data clerks as opposed to the clinicians at point of care which leads to duplication of tasks. Despite the benefits of CDS, results from a national assessment conducted in 2009 on the functionality of EMRs used in Kenya rated CDS among the lowest-performing indicators at 17.6% compared to a mean score of 71.8% for health information and reporting functionality. This is quite low as compared to the utilization situations in the United Kingdom and the Netherlands which is 96% and 99% respectively.The public health problem in Nakuru is inaccessibility of information by clinicians for CDS. Previous studies have shown that acceptance rate of such systems like CDS has been quite low and has encountered opposition from clinicians. Knowledge gaps exist in the literature on the utilization of IQCare system for CDS. This study therefore becomes useful in

investigating the factors influencing utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County.

1.3 Objectives of the Study

1.3.1 Main Objective

To investigate factors influencing utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya.

1.3.2 Specific Objectives

i. To determine the association between human resource availability and utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya.

ii. To determine how ICT infrastructure influence utilization of the IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya.

iii. To determine health care workers perspectives on utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya

1.3.3 Research Questions

i. What is the association between human resource availability on utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya?
ii. How does ICT infrastructure influence the utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya?
iii. What are the perspectives of health care workers on utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya?

1.4 Significance of the Study

It was anticipated that this study shall be a critical contribution to the practice, research and theory of EMR systems utilization and implementation.HCWs and Ministry of Health stakeholders are key beneficiaries of success in utilization of IQCare for CDS. IQCare EMR systems have shown to improve accessibility to health records and quality of patient information. The study will also provide health practitioners and the academia with facts and data that will lead to scholarly publications and reference material. Scholars and researchers will therefore find

information and data from this study as a basis for further research. This study shall also contribute immensely to the theory and body of knowledge of public health and health systems management discipline. It is also expected that this study will make insightful contribution to university teaching. New knowledge generated through this study shall benefit funding agencies, hospital administrators, policy makers and health practitioners. The study also ascertained that much needs to be undertaken by the Ministry of Health to develop policies and sustainability strategies for EMR use to realize full utilization of EMR for CDS. The findings and knowledge acquired through this study is helpful to Ministry of Health in supporting the scale-up and strengthening EMR use. The study also revealed areas that require change of approach in implementation to realize full utilization of IQCare system. The study findings shall be beneficial to strengthen the utilization and implementation of EMR systems in health facilities under study, health professional and health facilities in other similar settings as important evidence to plan and make interventions on how to utilize EMR systems for clinical decision making.

1.5 Scope of the Study

Geographically, this study was confined to health facilities in Nakuru County. The study employed a cross-sectional research design that targeted health care workers from whom data were collected using questionnaires and Focus Group Discussion (FGD) over a period one and a half months beginning December 2019 and ending mid-January 2020.The research study focused on the factors influencing utilization of the IQCare system for HIV care clinical decision support in HIV care clinics in facilities where the system was rolled out about 5 years ago from the time of the study.

1.6 Limitations of the Study

The study banked on the accuracy of the information provided by the health care workers, such information sometimes may not necessarily be accurate. This was be overcome by using both individual-participant based as well as group-based data collection instruments to allow for verification of information from study participants. Secondly, challenges of cooperation are expected from the respondents, however, this was overcome by ensuring that the respondents understand the importance of the study to their situation and focus group discussions (FGDs)done in the afternoon hours when staff are not too busy.

CHAPTER TWO
LITERATURE REVIEW

2.1Electronic Medical Records (EMR)

Electronic medical record (EMR) isan organized assortment of health information by electronic means about a particular patient (Boonstra et al., 2010).There are many EMRs systems that have been developed and utilized globally (Lee T et.,al 2018).The most widely used EMRs by physicians according to Medscape's EHR report are Epic with 23%, Cerner with 9%, Allscripts 10%, eClinical Works with 6% and Next Gen with 6% (Holroyd-Leduc JM et al., 2011).The first EMR system to be used in sub-Saharan African was Academic Model for the Prevention and Treatment of HIV (AMPATH) Medical Record System (AMRS)for comprehensive and clinical care of patients infected with HIV (Noormohammad et al., 2010).In Kenya, there were 17 EMR systems that had been registered by the Government (Table 2.1).

2.2Utilization of EMR and CDS Systems globally and in Kenya

Despite available evidence to strengthen EMR for CDS, its utilization remains low. Results from the 2008 nationwide ambulatory medical care assessment in the United States of America (USA), revealed that out of the 38% of clinicians used an EMR, only 4% used an EMR with CDS system capabilities (Eichner & Das, 2010).Although most nations in Europe and the United States of America (USA) are progressively using EMRs to help improve the quality of healthcare (Williams & Boren, 2008). The levels of EMR use in primary health care in Canada and the United States are relatively low, estimated at 37% and 46% respectively in contrasts to its adoption and utilization in the United Kingdom (96%) and the Netherlands (99%)(Terry et al., 2012).

A study done in Japan revealed that patient information in electronic format should be assimilated with computerized reminders and decision support systems as good practice by HCWs based on observations (Moja et al., 2016).The US National Academy of Medicine has identified CDS as a key element of a learning healthcare system (Odekunle et al., 2017). Despite the progressive usage of EMRs in medical practices, the adoption rate of such systems remains low and encounters resistance from medical practitioners (Ajami & Tadi, 2013). A study carried out in Japan revealed that government policy has been effective in promoting successful EMR initiatives as well as solving pressing social issues regarding healthcare delivery (Abraham et al.,

2011). Results from a study done in Ethiopia revealed that EMR systems face resistance from users which leads to more than 50% of EMRs fail to be properly utilized (Biruk et al., 2014).

In Kenya, the Ministry of Health assessed all the 17 EMR systems in the year 2009 (Table 2.1)(MOH, 2011). Out of the 17 systems targeted, 3 had an average score above 70%, these three were Academic Model for the Prevention and Treatment of HIV (AMPATH) Medical Record System (AMRS; 95.2%), the International Quality Care (IQCare; 90.3%), and Comprehensive Patient Application Database (C-PAD; 77.1%) (table 2.1)(MOH, 2011). After the national assessment, the MOH selected the two top ranked, 1). AMRS and 2). IQCare systems for rolled out for comprehensive and clinical care of patients infected with HIV (Noormohammad et al., 2010).

Table 2.1: Overall Scores for EMR Systems in Kenya by Functional area

EMR System	**Functional Area**							**Average score (%)**
	System details and standards (%)	Basic demographic and clinical Health information (%)	Order entry & prescribing (%)	Clinical decision support (%)	Health information and reporting (%)	Security and confidentiality (%)	Exchange of electronic information (%)	
AMRS-AMPATH	100	95.2	100	100	100	100	71.4	**95.2**
IQ CARE	100	85.7	100	100	100	75	71.4	**90.3**
C-PAD	71.4	80.9	100	100	100	87.5	0	**77.1**
FUNSOFT	100	66.7	100	0	100	62.5	28.6	**65.4**
Ehospital	71.4	66.7	50	0	100	75	42.9	**58.0**
COMPACT	71.4	47.6	100	0	80	75	0	**53.4**
MEDBOSS	71.4	61.9	100	0	100	37.5	0	**53.0**
HEALTH SOFT	71.4	71.4	100	0	40	62.5	0	**49.3**
OPENMRS FACES	57.1	76.2	0	0	100	50	14.3	**42.5**
Access Based system	42.9	42.9	0	0	100	100	0	**40.8**
CARE 2000	28.6	47.6	100	0	40	50	0	**38.0**
EDARP HMIS	28.6	47.6	50	0	40	37.5	14.3	**31.1**
KEMRI/Welcome Trust	42.9	38.1	50	0	40	37.5	0	**29.8**
BOMU	28.6	61.9	0	0	60	37.5	0	**26.9**
AMS 2000	42.9	52.4	0	0	40	25	0	**22.9**
EPICENTRE FUCHIA	28.6	19	0	0	80	0	0	**18.2**
TRIMED	14.3	0	0	0	0	75	0	**12.8**

The bold represents an overall score for each system which is the average for various domain score. Data Source: Report on the review of EMR systems towards standardization by the Kenya Ministry of Health in September 2011 (MOH, 2011).

In addition IQCare and Kenya EMR are the other two EMR systems which were approved in 2010 for adoption and roll-out in Kenya to support monitoring and management of HIV Care services (Muthee et al., 2018).

2.3 International Quality Care (IQCare) system

International Quality Care (IQCare) system is a freely available Windows-based EHR application system that offers a variety of features for managing clinical care for primary HIV&AIDS patients (Muinga et al., 2018). IQCare is one of the EMR systems rolled out in Kenya for HIVCare patient management. As early as 2010, IQCare system was used in 622 sites in 10 countries that included Nigeria, Kenya, Uganda, Tanzania, Rwanda, Zambia, South Africa, Haiti, Guyana and Ethiopia (Fraser et al., 2010). By May 2019 there were 678 HIV Care sites in Kenya using IQCare system *(Appendix II).* IQCare was implemented in Kenya through the support of the Palladium Group (formerly Futures Group) and is donor-funded through AIDS Relief (Muinga et al., 2018).In Kenya the IQCare system was implemented in the South Rift valley, Nairobi, coastal and eastern regions of Kenya. By 2014, Nakuru County located in South Rift Valley had the highest number of health facilities implementing the IQCare system (Muthee et al., 2018).

2.4 Clinical decision support (CDS) systems

Clinical decision support (CDS) systems is defined as ‘an automated process that compares patient-specific characteristics against a computerized knowledge base with resulting recommendations or reminders presented to the service provider at the time of clinical decision making (Kong et al., 2008). CDS system supports decision making for instance in health facility it processes clinical data and presents to users for clinical decision making(MOH, 2010). The WHO has formulated a health systems policy framework that describes health information systems(World Health Organization, 2012).The IQCare system utilizes google maps to track geographical drug adherence patterns and provides decision support regarding which geographic regions to target for future drug adherence related interventions (Fraser et al., 2010).

2.5 Role of clinical decision support (CDS) systems in IQCare systems

CDS systems has been shown to significantly improve the quality of healthcare through improved accessibility of high-quality data for clinical decision making (Casimir, 2015).This concurs with Kawamoto et al., who found out that CDS systems has shown evidence of decreased medication errors, improves efficiency and quality of care (Kawamoto et al., 2005).CDS systems offer solutions to many frequently asked questions in evidence-based practice such as time constraints and difficulties in traversing complex information systems and interpreting results (Kortteisto et al., 2012).

Use of CDS systems aids in improving judgment accuracy of HCPsby combining CDS information with their first-hand knowledge so that an independent conclusion can be established (Tomines et al., 2015;Wagholikar et al., 2013; Bonney, 2016). Results from a study done in the United States found that use of CDS in EMRs is associated with improved quality of care among national primary care outpatient visits from 2006 to 2009 (Mishuris et al., 2014). Errors involving drug-drug interactions are cited as common and preventable, with up to 65% of inpatients being exposed to one or more potentially harmful combinations (Kawamoto et al., 2005). Much still needs to be done to create awareness on the need for EMR systems with CDS to reduce medical errors drastically.

An operational CDS system can support users of an EMR to considerably reduce medical mistakes and thus making healthcare extra effective and promoting the quality of healthcare (Sambasivan et al., 2012)(Ajami & Tadi, 2013). Previous studies conducted in the United States, showed that meaningful use standards that consist of CDS have a substantial positive effect on some national quality of care indicators and health outcomes (Mishuris et al., 2014). A study in Ghana revealed that the delay in healthcare access, misdiagnosis and loss of patients' vital information, reduced system coordination has led to poor service delivery hence the need for integration of CDS in EMR systems (Essuman et al., 2020).

A good clinical decision support (CDS) system is one that has the provision for clinicians to access patients' information promptly (Berner, 2009). CDS system is a powerful tool that can help in detecting errors that need prevention but are time-consuming with current possibilities (Noormohammad et al., 2010, Essuman et al., 2020). The use of EMRs also enabled clinicians to assess more patients within a shorter period of time reduced (Msiska et al., 2017).

2.6 Components of Clinical Decision Support in IQCare Systems

There are three main modules of CDS system that are recognizable in nearly all EMR systems. These modules are automated procedures for sending warnings or reminders, patient-specific content obtained from the evaluation of patient information in contrast to a set of knowledge 'rules' (Bryan et al., 2008).Figure 2.1 shows the overview of CDS systems, the data module seeks patient information from the IQCare and holds the information in a form that is amendable to the guideline engine and depends on the free-text processor to interpret reports (Wagholikar et al., 2013).

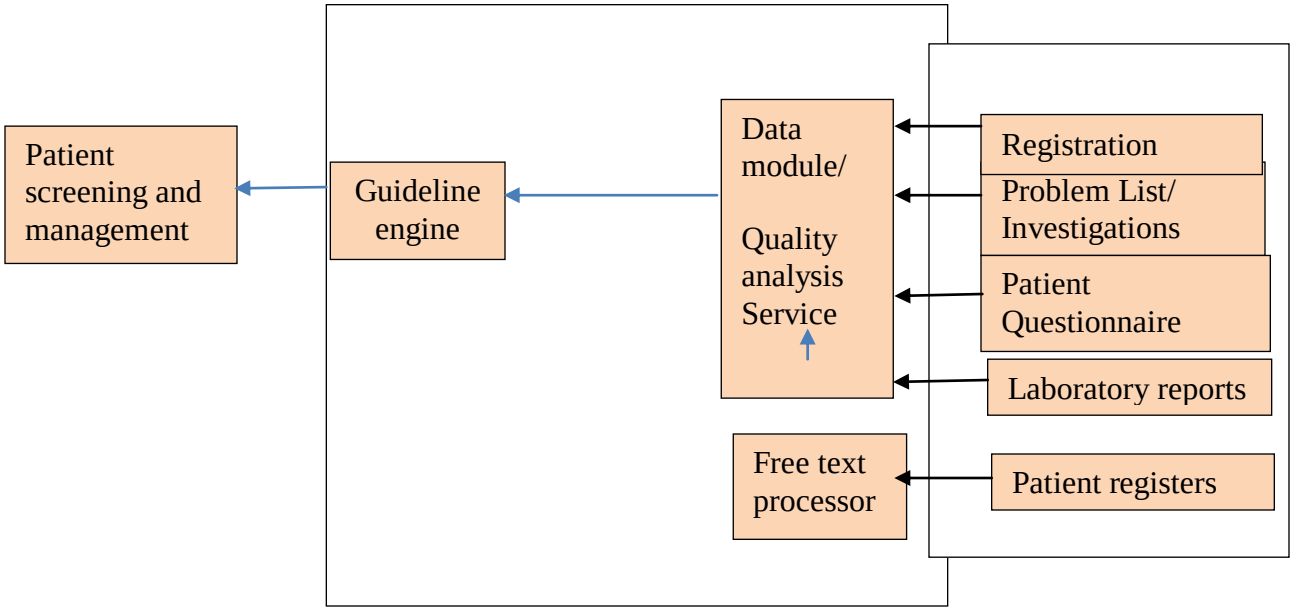

Figure 2.1: Contextual relevance of the CDS-RM reference model.

Source: (Wagholikar et al., 2013)

IQCare systems users work interactively using CDS system by selectively entering clinical signs, symptoms, and laboratory tests using the CDS systems(Kong et al., 2008).CDS systems are integrated into IQCare system, HCWs selects the appropriate treatment plan and corresponding order sets from a reference list, once selected, these processes or tasks can be performed (Castelnuovo et al., 2012).In addition, CDS provide quality control standards as references which is displayed each time a process is being carried out (Castaneda et al., 2015).

2.7 Factors influencing to utilization of Clinical Decision Support in IQCare systems

Numerous reasons for the low usage of CDS systems have been documented. The literature available describes EMR systems in other Countries and not IQCare system. In this section, literature reviewed analyses factors influencing utilization of IQCare for CDS.

2.7.1 Influence of human resource availability on utilization of IQCare for CDS

Human resource component is key to any EMR system, personnel are needed to expedite the planning, implementation, and maintenance of the EMR system(Aguirre et al., 2019).Inadequate and poorly trained health workers are a key challenge to the enactment of e-health in developing countries (Msiska et al., 2017).A study done in Japan found out that the diagnostic error rate was 2% for HCWs trained and mentored on an updated computer-based clinical system, while the error rate for those not trained nor mentored was 24% (Shimizu et al., 2018).

Among the 57 Countries classified by WHO as having an acute shortage of health workers, 36 are in sub-Saharan Africa and Kenya was one of them (Oluoch & De Keizer, 2016). In addition, little evidence exists on the adoption of EMR-based CDSS on quality of HIV care and treatment in sub-Saharan Africa (Oluoch et al., 2012).In 2014 some facilities were discontinued from using IQCare system in Kenya due to the lack of trained staff to support the use of EMR system (MeSH Consortium, 2016).Having an in-house support system technician brings full comprehension of existing frameworks and the abilities to fully utilize the EMR (Boonstra et al., 2010). Designers of clinical summaries/reports are required to be in constant communication with the HCWs to understand their training requirements(Were et.al, 2011). The role of the troubleshooter is to provide technical support to maintain the server and network, which is crucial to smooth operation (Trivedi et al., 2009).For instance, beginners require the support of an EMR champion to help in understanding the EMR system features(Williams & Boren, 2008).Some selected super users can also be deployed per site to provide mentorship to health care workers. Indeed, a certain level of computer skills by EMR users (clinicians) is required to allow them to use the system as a point of care (Boonstra et al., 2010).

Regardless of cost, there is need to maintain investment in EMR training which is critical to maximizing competence and the quality of patient care(Lopez et al., 2018).The use of mentors to build the skills of HCWs in decision-making is encouraged for sustainability (Aguirre et al., 2019). When using EMR systems an increase in productivity depends on the provision of quality

training and organizational support(Udo & Davis, 1992).EMR training helps HCWs to gain a better understanding of the system by introducing features and functions with which they may not be familiar with(Dhillon et al., 2018).

A study conducted in Saudi Arabia revealed that 48% of the core EMR features were not utilized by physicians because they were unaware of their availability in the EMR system hence the need for training and mentorship (Msiska et al., 2017). Other previous studies showed that training was a critical component that would improve HCWs competence and ultimately lead to high quality of patient care (Lopez et al., 2018; Essuman et al., 2020).A study conducted in Tanzania, revealed that out of the 77 HCWs who were trained on EMR only 40.7% were using EMR in their clinics, this is a much lower proportion as compared to the results in Ireland where 63.5% of the 150 HCWs who were found to be using computers two year after the training (Kortteisto et al., 2012). Productive usage of an EMR system requires comprehension of existing frameworks and a committed interdisciplinary team that supports EMR implementation (Boonstra et al., 2010).

According to a study in Massachusetts General Hospital to evaluate EHR use in ambulatory appointments, it was found that 24% of the respondents had never used any EHR functionality throughout patient appointments (Marie et al., 2011).Furthermore, it is intuitive that human resource constraints may limit utilization of EMR such as IQCare. However, there is need to study influence of training, mentorship, and availability of a trouble-shooter in light to low utilization of IQCare system for CDS along the HIV&AIDS care cascade.

2.7.2 Influence of ICT infrastructure on utilization of IQCare for CDS

Technology has continued to have a positive impact in healthcare, which has resulted in reduced costs and increased work efficiencies (Ajami & Tadi, 2013).Many studies that have been conducted on general EMR systems which are like IQCare system. Information and communications technology (ICT) infrastructure is characterized by availability of internet connection and linkage of computers via LAN are adequate to facilitate utilization of EMR CDS features (Busagala & Kawono, 2013).Previous studies have shown that connectivity of computers leads to utilization of EMR systems for CDS because it facilitates flow of data and information within the different departments *(reception, clinician rooms, Lab and pharmacy)* within the HIV care clinic(Essuman et al., 2020; Msiska et al., 2017;Howland, 2013).

Results from a study done in Netherlands found out that the low utilization of CDS features was associated with lack of integration of computers and internet connectivity with host systems to fully utilize EMR for CDS (Arts et al., 2018).Study findings from Western Region of Ghana where EMR usage was low reported that hospitals had sufficient preparations in terms of provision of network connections (Essuman et al., 2020). Furthermore, another study done in Ethiopia showed that successful adoption and use of EMR systems depends on good ICT infrastructure (Biruk et al., 2014).The study also revealed that HCWs in places with good ICT infrastructure were four times more likely to use the system as compared to those without good infrastructure (Biruk et al., 2014).

A survey conducted at the QECH Antiretroviral Therapy (ART) Clinic in Malawi revealed that 70% of respondents preferred using the paper-based records over EMR system due to lack of power back-up systems (Msiska et al., 2017). Another study done in Kenya found out that inadequate use of EMR for CDS is characterized by lack of connectivity of computers via LAN or internet and the non-involvement of users in the design and configuration of the system and unstable power supply (Muthee et al., 2018). In many resource-limited settings, some EMR systems are not well-matched with requisite electronic devices and structures (Davidson & Heslinga, 2006; Kemper, Uren, & Clark, 2006).

In Kenya 30 health facilities with EMR installed were discontinued in 2014 due to electric power challenges (MeSH Consortium, 2016). Implementing EMR systems entails extensive financial resources obligation for deployment, system management, control, maintenance, and support to retain it working effectively (Davidson & Heslinga 2006).Some web-based systems like Kenya EMR were problematic when connectivity is down or slow (MeSH Consortium, 2016).Most developing countries like Kenya face many challenges such as lack of robust healthcare infrastructure in the form ICT to ensures continuity of patient care (Williams & Boren, 2008).From the above review, ICT infrastructure which includes network connectivity via LAN and internet seems to be a significant factor in utilization of IQCare for CDS in Nakuru County.

2.7.3 Influence of health care workers perspective on utilization of IQCare for CDS

Globally studies have been done on EMRS and not focusing on IQCare. CDS system is perceived as encroaching on medical practitioners' and clinicians' competency and jurisdiction rather than useful support to their practice and a potential hindrance to the exercise of clinicians'

judgment and critical thinking (Marie et al., 2011). Therefore, physicians are concerned about the loss of their control of patient information and working processes by the implementation of EMR systems, since these data will be assessed by others (Kortteisto et al., 2012). Clinicians seem to be left with two conflicting options: either rejection or unconditioned adherence (Liberati et al., 2017).Low ICT literacy amongst users and possible violation of patients' privacy and confidentiality is a factor that hinders the utilization of EMR system (MOH, 2010).HCWs perspective towards EMR systems depends on system usefulness and ease of use CDS features (Granlien & Hertzum, 2012).

A study conducted in the United States ofAmerica reported 75% of physicians used patient information for clinical decision making because they acknowledged that EMRs assures security of patient information, readily available information, and easy to retrieval hence improved continuity of patient care services (Kong et al., 2008).In Japan majority of the health information system development was initiated by the medical institutions and medical schools in universities which served to lessen the risks, such as inadequate buying-in from physicians to use the applications (Shimizu et al., 2018).Main determinants of innovation's success are adopting strategies that facilitate staff to accept and buy-in into the technology, (Biruk et al., 2014) which leads to motivation and readiness to use innovation (Castaneda et al., 2015). Although EMR is perceived as an approach to improve quality of care (Granlien & Hertzum, 2012), the acceptance rate of such systems is quite low and encounters opposition from clinicians (Ajami & Tadi, 2013). Studies have showed that for health care workers (HCWs)to embrace technological systems, there is need to strengthen EMR system usefulness (Granlien & Hertzum, 2012). Opposition to implementation is intensified by lack of proper support to users of EMR systems (Oluoch et al., 2015).

HCWs perspective domains investigated in this study were selected from a meta-analysis study that investigated emerging themes from 78 articles from various studies, with an aim of understanding the global perspective of EMR and its implementation in healthcare setups (Dhillon et al., 2018).The HCWs perception on EMR arises from a variety of issues, Linder (2006) found that perceived obstacles to using EMR during patient clinic visits led to the loss of eye contact with patients (62%), falling behind schedule (52%), computers being too slow (49%), inability to type fast (32%), sensing that use of computers in front of the patient is

impolite (31%), and desire to write long prose notes (28%) (Linder et al., 2006). In contrast, a study in Malawi in 2017 indicated that 76% of health workers preferred to work in healthcare facilities which had installed the EMR system, justifying that the system is fast and easy to use (Msiska et al., 2017). Consistent capacity building of health care workers in Kenya can fast-track the clinician`s acceptance and increase the rate of adoption and utilization of CDS (Oluoch et al., 2015) systems. This might be the case in Nakuru County as the above studies show challenges that are similar with the situation in Kenya.

A study in Kenya identified gaps in policies and standard operating procedures regarding data security and confidentiality, which affects HCWs perspective on data quality and utilization of EMRs (MeSH Consortium, 2016). From the above review of literature, HCWs perspective seems to be a significant factor influencing utilization of IQCare for clinical decision support.CDS systems is based on reliable clinical guidelines that play a critical role in addressing problematic issues by providing new evidence, and help manage perceptions, assumptions, and uncertainty amongst HCWs and patients (Odekunle et al., 2017).From a previous study, more than half (58.1%) of the physicians have doubts that EMRs improving clinical outcomes (Kemper, Uren, & Clark, 2006). However, a study in the united states found out that some HCWs were not convinced that the EMR systems will successfully improve the quality of medical practices (Ancker et.al, 2015). Ultimately, such perspectives translate into resistance to the wide adoption of EMR systems for CDS(Ancker et.al, 2015).Whether HCWs perspectives is associated with the low level of IQCare system utilization in Nakuru County is also not known.

2.8 Theoretical Framework

This study is grounded on two interrelated theories namely: Innovation diffusion theory and technology acceptance model.

2.8.1 Innovation Diffusion Theory (IDT)

This study is grounded in the diffusion of knowledge theory Everett Rogers' diffusion of innovations concept affords an appropriate situation on the adoption of EMR for clinical decision support(Rogers, 1995). Diffusion theory recognizes that people are on average risk-averse, the uncertainty will often result in a postponement of the decision until further evidence can be gathered. Five adopter categories are (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards (Helitzer et al., 2003). The rate of adoption commonly follows a

predictable curve, reflecting the relative degree of conventionality or resistance to modification of individuals within the system. The IQCare system has undergone various stages of implementation starting with initial training done in 2011 to 2013 coupled with system deployment, configuration, and use of the system in the HIV Care clinics. During the implementation different facilities was at different stages depending on the staff readiness to adopt the system as opposed to the paper-based systems. The diffusion of innovations approach was used to expand understanding of reasons for utilization, usage patterns, and adoption technology in developing countries (Rogers, 1995). Some facilities adopted and started using the IQCare system immediately, while others lacked behind because of lack of resources while others were not ready to impress change.

2.8.2 Technology Acceptance Model (TAM)

The second theory considered in this study was Technology Acceptance Model (TAM) which has been used as the guiding theoretical framework to provide insight into two key determinants that influence utilization of IQCare system on perceived usefulness and ease of use(Davis, 1989).This model contends that a strong relationship exists between one's intention to use technology and their actual usage behavior(Terry et al., 2012). Perceived usefulness is characterized by an individual's belief that engaging a technology improves their job performance while perceived ease of use refers to their belief that using a technology requires minimal effort (Davis, 1989).

Perceived usefulness is the factor that indicates the degree that the person believes the information system will assist them in the performance of their job(Davis, 1989).

Perceived ease of use is the second factor, which is used to indicate how difficult the person believes the proposed system would be to use. These constructs are based in the theory of reasoned action, which noted that a person`s behavioral intention is determined by the person`s attitude as well as a subjective norm as estimated by regression. While the TAM has been utilized in a number of studies dealing with a wide array of information technologies, a review of the literature shows very few studies in the healthcare field and even fewer related to health information technology. A series of studies found that TAM is the best model in examining Physicians‟ acceptance of telemedicine technology because it is specialized in information

technology, it is well researched, it uses psychometric measurements, and it is a dominant model for investigating user technology acceptance(Terry et al., 2012).

2.9 Conceptual Framework

A conceptual framework is a hypothesized model that shows the relationship between the independent and dependent variables in the study. As indicated in Figure 2.2, human resource availability, the ICT infrastructure and HCWs perspective potentially influence utilization of IQCare for CDS.

The interrelationships between study variables are conceptualized as shown in Figure 2.2.

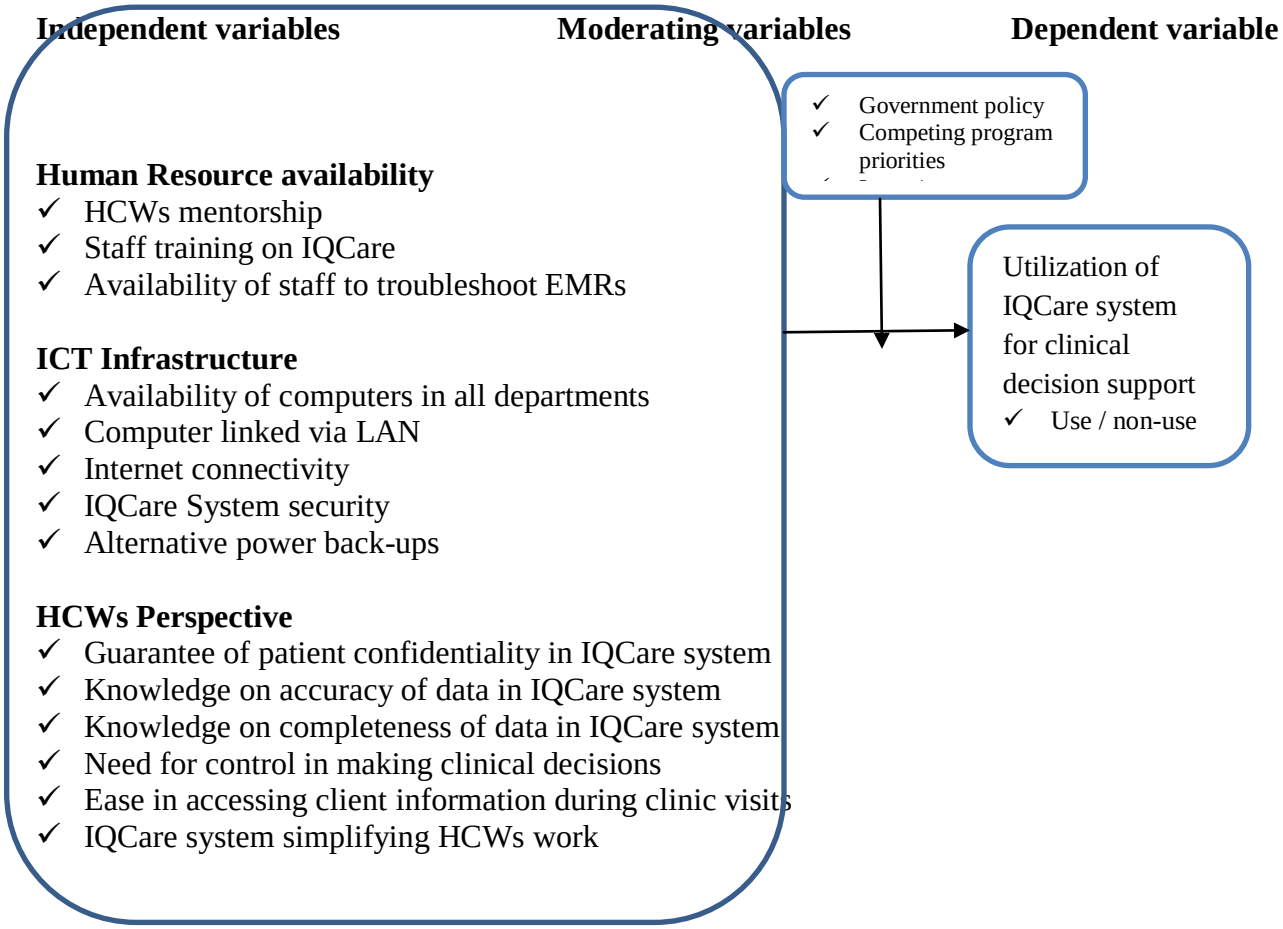

Figure 2.2: Conceptual framework showing the relationship between variables of the study.

The above conceptual framework illustrates that to realize utilization of IQCare for clinical decision support which was the expected outcome(dependent), it depends on how much of the three main independent variables*(human resource availability, ICT Infrastructure and HCWs*

*perspectives)*have been supported. In the conceptual framework human resource availability was quantified as HCWs trained on IQCare system, mentorship, and availability of technical personnel to install and operate EMR technology resources. ICT infrastructure was quantified as having computer hardware devices which includes computers networking via LAN, internet connection, servers and power back-up that facilitates communication, storage and allows access to patient information. Lastly, is how HCWs perspectives which includes their opinions/ preference led to use or non-use of IQCare for CDS.

This study shall contribute immensely to the theory and body of knowledge of public health and health systems management discipline. The findings and knowledge acquired through this study is helpful to Ministry of Health in supporting the scale-up and strengthening IQCare use. The conceptual framework is in line with the Kenya Health Sector Strategic and Investment plan (KHSSP1) 2013-2017 outlines the above as part priority factors to attain better access to services, improved quality of care and higher demand for health services(Ministry of Health Kenya, 2014).

The conceptual framework uses both the Roger`s innovation diffusion theory and Technology acceptance Model because the assumption is that the availability of trained and mentored HCWs with proper ICT infrastructure will improve HCWs attitude hence use of IQCare for CDS is realized. Innovation research has tried to define the variables that impact how and why users embrace new technology, such as EMR for CDS (Dhillon et al., 2018). Gaps exist on the factors that influences the utilization of IQCare for CDS in Nakuru County and the extent of the relationship of these three variables are not clear.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter focuses on the processes that were followed to arrive at the study findings, starts by describing the study setting, study design, study population, and sampling. The chapter also describes the data collection tools and measurement and data collection procedures. It closes with a description of the data analysis plan, ethical considerations, and expected study outcomes.

3.2 Study Setting

The study was conducted in Nakuru County located in the southeastern part of the Rift Valley Province. Nakuru County borders 7 counties with Nyandarua to the east, Kajiado to the south, Narok to the southwest, Baringo to the north, Laikipia to the northeast, Bomet and Kericho to the west. Nakuru County has an estimated population of 2,176,581 people, female (1,110,056) and Male (1,066,525) as per KNBS 2018 report. It is served by a total of 541 Health facilities, of which 41 are hospitals and 500 primary care facilities. The figure 3.1 shows the map of Nakuru County with the 11Sub-Counties and the study sites.

Nakuru County contributes 3.4% of the total number of people living with HIV in Kenya and is ranked ninth nationally. The county has an ART coverage of 82% and viral suppression of 83% according to the routine program data (National AIDS Control Council, 2018).The thirteen (13) facilities selected for this study have IQCare EMR system deployed since 2014.

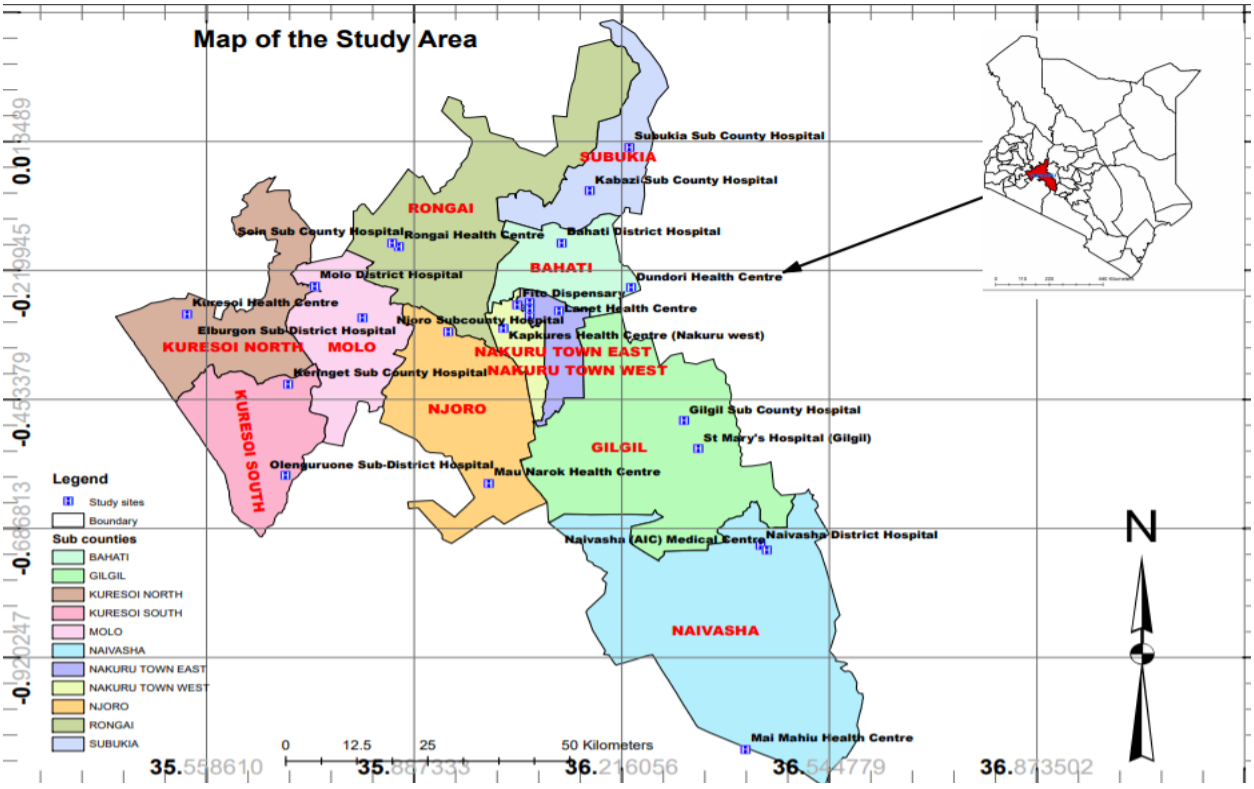

Figure 3.1: Map of Nakuru County showing the study sites

3.3 Study Design

A cross-sectional research design was used in this study. This particular design was ideal since the research entailed collecting and comparing data at the same time of the study so as to explicate association or relationships between key variables in the study. According to (Mugenda, 2003), the purpose of descriptive research is to define and report the way things are and it helps in establishing the status of the population in the study, which was in line with the component of the study on perspectives of HCWs.

3.4 Target Population

The study assessed the experiences of health care workers in the HIV care clinics using IQCare system. The health care workers included: HTS Counselors, Health Records and information officers/data clerks, Nurses, Nutritionists Pharmacists and Clinical officers.

3.5 Study Population

The study population included112 healthcare workers (HCWs), working in 13health facilities where 10 were public, 2 faith-based, and 1 private*(Appendix 1)*HIV care clinics that had IQCare EMR system deployed by January 2014out of the total 39 current HIV Care clinics in Nakuru County. Staff registers maintained by the human resources department with 112 HCWs. These 13 health facilities ranged from levels three and four according to the MOH ranking.

3.5.1 Inclusion Criteria

This study focused on the facilities offering HIV Care services which has been using IQCare system continuously since 2014. Within these facilities, all cadres of healthcare workers in the HIV care clinic were also targeted and recruited to participate in the study. Lastly, participants who consented through the detailed consenting process were included in the study.

3.5.2 Exclusion Criteria

The HCWs who were not on duty at the time of study were excluded from this study.

3.6 Sample Size Determination

This involved selecting respondent from the human resource register for the list of staff in the HIVcare clinic to be representative of the whole population. Each of the facilities consists of an average of 3–11 health care workers assigned to the HIV care clinics. The sample size was determined using the Krejcie and Morgan's sample size determination table *(Appendix III)*(Krejcie & Morgan, 1970).

$$\text{Size} = \frac{X^2NP(1-P)}{d^2(N-1) + X^2P(1-P)}$$

$n=X^2NP\ (1-P) \div [d^2\ (N-1) + X^2\ P\ (1-P)]$.

where,

n =required sample size.

χ^2 =the table value of chi-square for 1 degree of freedom at the desired confidence level (0.05 = 3.841.

N= the population size.

P= the population proportion (assumed to be 0.50 since this would provide the maximum sample size.

D = the degree of accuracy expressed as proportion (0.05).

n = 3.841 x112 x 0.5 (1 – 0.5) ÷ [0.05 2 (112 −1) + 3.841 x0.5 (1 – 0.5)]

= 3.841 x112 x 0.5 (0.5) ÷ [0.05 2 (111) + 3.841 x0.5 (0.5)]

= 107.548 ÷ [0.2775+1.083614]

= 107.548 ÷ [1.361114]

= 79

10% (7) of the sample was included as shown below for non-respondents. Study findings by Suresh KP (2012) applied 10% non-response rate in calculation of their study sample size to cater for incomplete and non-responses.

79+7=**86**

Therefore, the sample size was 86 HCWs.

3.7 Sampling Procedure

Random selection of 13 health facilities across Nakuru County that have been using IQCare system in their HIV care clinics since 2014 without interruption. From the 13 facilities, health care workers working in HIV Care clinics were sampled. The health care workers were sampled proportionately by staff cadre to have each cadre proportionately represented in the overall sample size of HCWs, Table 3.1.

A sample size of 86 health care workers was determined as per Krejcie and Morgan's formula.

Table 3.1: Sampling size allocation across cadres of healthcare workers

Group	Target Population	Sample Size	Distribution of the sample
Counselors	15	12	14%
Health records and information officers	13	10	12%
Nurses	43	35	41%
Nutritionists	6	4	5%
Pharmacists	10	6	7%
Clinical officers	25	19	21%
Total	**112**	**86**	**100%**

The distribution of health care workers across facilities is as shown in Table 3.2.

Table 3.2: Distribution of participants by health facility

Sub-County	Health Facility	Total Population	Number of respondents	Sample representation
Gilgil	Gilgil Sub-County Hospital	14	11	13%
Gilgil	St Mary's Hospital (Naivasha)	7	5	6%
Nakuru West	Nakuru West Health Centre	8	6	7%
Molo	Elburgon Sub-County Hospital	8	6	7%
Molo	Molo Sub-County Hospital	11	9	10%
Naivasha	Naivasha Sub-County Hospital	14	11	13%
Nakuru East	Langa Langa Sub-County Hospital	11	9	11%
Nakuru North	Bahati Sub-County Hospital	8	6	7%
Nakuru West	Nakuru West (PCEA) Health Centre	4	3	3%
Nakuru West	Sunrise Evans Hospital	4	3	3%
Njoro	NjoroSub-County Hospital	10	8	9%
Kuresoi South	Olenguruone Sub-County Hospital	7	5	6%
Subukia	Subukia Sub-County Hospital	6	4	5%
		112	**86**	**100%**

For the above selected facilities focus group discussions were administered started in 5 facilities with the highest number of clients and staff working in the HIVCare clinics in different sub-counties of Nakuru County based on purposive sampling strategy. In each Sub-County, one facility was sampled using the following criteria:

1. Facilities sampled were those linked to the health facilities where the questionnaire of the research was being conducted.
2. Services offered, and distance to health facilities to ensure balanced representation as guided by the master facility list.

All participants were reminded of the voluntary nature of the study. All FGDs were conducted in the language most appropriate to the participants and at venues that were mutually convenient to both the participant and the interviewer, the FGDs lasted 45–60 minutes.

3.8 Study variables

Table 3.3 summarizes the key variables in the study. The outcome variable in this study was utilization of the IQCare system for HIV care clinical decision support.

Table 3.3: Measurement of variables

Independent variable	Indicator(s)	Measurement	Scale	Tools of analysis	Type of analysis
Human Resource availability	EMR Training	- Proportion of health care Workers who have been trained on the IQCare system	Ordinal and nominal	Descriptive (Frequencies, percentages), chi-square test, binary logistic regression	Quantitative and Qualitative
	Mentorship and supervision	-Follow-up mentorship done after the initial training on EMR software. -Availability of mentors to help EMR users			
	Staff to troubleshoot the IQCare system	Staff who have the knowledge and skills for upgrading and troubleshooting the IQCare system.			
ICT infrastructure	Computer connectivityInternet & LAN	Availability of internet, software and hardware interconnectivity of computers with IQCare system	Ordinal and nominal	Descriptive (Frequencies, percentages) binary logistic regression	Quantitative and Qualitative
	Computer hardware	- Availability of computers at workstation/ points of use. -Computer hardware replacement and repair.			
	IQCare software security	Availability of secured IQCare software Security password to restrict access			
	Alternative Power back-up	Availability of alternative power back-up			
Health care workers Perspective on EMR	Need for control	-The EMR system taking control of patient information and working processes.	Ordinal and nominal	Descriptive (Frequencies, percentages), binary logistic regression	Quantitative and Qualitative
	HCWs knowledge on accuracy and completeness of EMR data	-Health care workers knowledge to access Knowledge on the Quality of data and how helpful are they in execution of the CDS tasks.			
	Accessibility of patient information in IQCare systems	How HCWs utilize IQCare system CDS features during clinic visits -How the HCWs use the EMR system to improve quality of care.			
	HCWs understanding of IQCare Usefulness	- Health care workers perspective of in IQCare system in terms of job performance.			

3.9 Data Collection Tools

This study used qualitative and Quantitative data collection tools.

3.9.1 Quantitative data collection tools

This study utilized Semi-structured questionnaires *(appendix VIII)* as a tool for data collection. The questionnaire contained four sections containing use of closed and open-ended questions. Section A captured questions on demographic characteristics of respondents; Section B had

questions on human resource availability. Section C of the questionnaire captured questions on ICT infrastructure, while section D contained questions onHCWs perspectives. Lastly, section entailed questions on utilization of IQCare system for CDS in HIV Care clinics. For closed-ended questions, a five-point Likert scale were used with meanings as shown*: (1) Strongly Agree (SA), (2) Agree (A), (3) Disagree (DA) and (4) Strongly Disagree (SD). Another set of closed-ended questions had these sets (1) Never (2) Rarely, (3) Sometimes, (4) Often and (5)Always.* The *Strongly Agreed or Always* responses were scored at the highest (4 and 5) for direct positive responses while those of *Strongly Disagreed or Never* responses were scored at 1.

3.9.2 Qualitative data collection tools

Focus group discussion (FGD) guides*(appendix-IX)*were used to collect data from all cadre of HCWs. A focus group discussion (FGD) is an in-depth field method that brings together a small homogeneous group (usually six to twelve persons) to discuss topics on a study agenda.Five focus group discussions were carried out at Njoro Sub-County Hospital, Langa Langa Sub-County Hospital, Molo Sub-County Hospital, Gilgil Sub-County Hospital, and Naivasha Sub-County Hospital being the high-volume facilities with more than nine staff that can avail 6 to 8 staff to participate in the FGD. FGD guides targeted 6 to 8 staff per facility, data was collected through FGDs focused on three main areas: Human resource availability, ICT Infrastructure and the HCWs perspective. This explored to get HCWs motivation use EMRs; if EMRs facilitates service delivery linkages and referrals; experiences, challenges and recommendations of implementing the EMR system.

3.9.3 Validity and Reliability

Pre-testing of questionnaires and focus group discussion guides was done in Forest Institute Training Centre (FITC) Dispensary and Rongai Sub-County Hospitalbefore the actual study to assess the clarity of the questions, the instructions and the format in order to do any modification**.** Responses from the focus group discussions were recorded using audio recorders. These were reviewed and questions that were found not clear revised according.

Face validity of the two instruments were ensured through review by public health experts. Cronbach's alpha was used to measure internal consistency resulting to an alpha of 0.754, suggesting that the items have relatively high internal consistency which is good and stable.

3.9.4 Research assistants

Two research assistants were recruited and trained for two days on data collection and interviewing techniques. The training included familiarizing the research assistants with the purpose of the research, the study instruments, how to administer the questionnaires, ethical issues, and how to interact with respondents. To ensure quality control, meetings were held with the research assistants every day after data collection to avoid inter-research variability and adherence to research ethics.

3.10 Data analysis

3.10.1 Data entry, coding, and storage

Filled questionnaires were reviewed daily to check on completeness and appropriateness check by the research assistants with guidance from the researcher. Debriefing sessions were held to wrap-up each day and to sort out any problems or difficulties that may have been encountered by research assistants, thereby improving the quality of data collected.

Data entry and coding to facilitate analysis were done where a code sheet was used to transfer only numerical numbers representing responses from the questionnaires and focus group discussion guide. Before any analysis was done, the data was cleaned to remove errors and mistakes made during data entry.

3.10.2 Quantitative data analysis

Quantitative data were analyzed using SPSS Version 21. Association between human resource availability, ICT Infrastructure and HCWs perspective on the utilization of IQCare for CDS was determined using the chi-square test. In addition, binary regression was used to assess the relationship between human resource availability, ICT Infrastructure, HCWs perspective and utilization of IQCare and for independent variables that showed significant association with utilization of IQCare for CDS. A *p*-value of $P \leq 0.05$ was considered statistically significant. To verify the results from the quantitative data analysis, one focus group discussion (FGD) was conducted each of the 5 high volume study sites, each comprising 6-8 members.

3.10.3 Qualitative Analysis

Qualitative data from the FGDs extracted from audio recordings and transcribed thematically. Preliminary analysis entailed open coding and progressive categorization of issues based on

inductive approaches in which analytical categories are derived gradually from the data. Data was analyzed using the *Nvivo*version12 to generate sub-themes that emerged. These categories and themes were further refined as findings emerged from the data. We analyzed the data using an inductive thematic analysis approach. To manage the data analysis a codebook was developed to guide the data analysis. Fifty-three codes were identified, using an inductive approach, the researcher identified themes from the codes. The coding process was a journey that started with the immersion of the data based on the FGD guides, which generated 12 sub-themes which covering the three specific objectives.

3.11 Ethical Considerations

Ethical approval was obtained Maseno University Ethics Review Committee,*(Appendix IV)* whereas authorization to conduct the research was obtained from Nakuru County Director of Public Health and Sanitation*(Appendix VI)* and research permit issued by the National Commission for Science, Technology and Innovation (NACOSTI) to carry out the study*(Appendix VI).*The approval letter from Nakuru County Director of Public Health and Sanitation was presented to the study sites before data collection commenced.

Respondents were provided with a consent form *(Appendix VII)*, which contained an information sheet detailing all information about the research process clearly and concisely. Only eligible individuals who consented to participate in the study was enrolled. The respondents were informed that participation in the study was voluntary. The participants were informed that even after consenting to participate and cooperate, they had a right to opt-out of the study if they deemed so.

To ensure confidentiality was adhered to, research assistants were trained in research ethics and the protection of human subjects. Data collected throughout the study was kept private and confidential under lock and key. Consent forms, semi-structured questionnaires, focus group discussions(FGDs) and other research material that were used in this study remained under lock and key with only the researcher having access to ensure data protection. To further ensure confidentiality, the respondent ‘s identities and responses were protected from the public domain through the assignment of codes in data analysis and presentation. Digitized data was preserved in a password-protected folder that was accessed by persons authorized by the researcher.

The participants were informed that the study had no direct effect to them other than to improve health care delivery to society at large. Feedback of the findings shall be communicated to the Nakuru County team and health facility in-charges.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents results of the study as set out in the objectives. In total, 81HCWsresponded which represents 100% of the expected responses after accounting for the non-respondents.

4.2 Socio-Demographic Characteristics of the Study Participants

Table 4.1summarizes data on the socio-demographic characteristics of study participants. The study results revealed that nurses constituted the highest proportion of study participants 30 (37.0%) followed by clinical officers at 18 (22.2%). The health records and information officers were 12(14.8%), counselors were 11 (13.6%) while pharmacists were 6 (7.4%); the other cadres were nutritionists and data clerks who accounted for 2 (2.5%) each. Regarding their gender, female were51(63.0 %) while male were 30 (37.0%). Results on their highest level of education revealed that holders of diplomas were 66 (81.5%),holders of certificates were 9 (11.1%) and holders of degrees were 6 (7.4%). Majority of the respondents were aged between 26-30 years, while those over the age of 45 years were only 2 (2.5%; Table 4.1).The p-values in the table 4.1 shows the proportion distribution of social-demographic characteristics and utilization of IQCare system for CDS. There was no difference in the proportion distribution of the social-demographic characteristics between users and non-users of IQCare Table 4.1.

Table 4.1: Socio-demographic Characteristics of the Respondents (n=81)

Characteristics	**Category**	*Total number of participants* ***n (%)***	***Use n (%)***	***Non-use n (%)***	***P-value***
	N	81***(100)***	66 ***(81.5)***	15***(18.5)***	
Job title/Cadre	Clinical officer	18 *(22.2)*	17*(94.4)*	1*(5.6)*	*0.092*
	Nurse	30 *(37.0)*	20*(66.7)*	10*(33.3)*	
	Pharmacist	6 *(7.4)*	5*(83.3)*	1*(16.7)*	
	Counselor	11 *(13.6)*	9*(81.8)*	2*(18.2)*	
	HRIO	12 *(14.8)*	12*(100.0)*	0*(0.0)*	
	Data Clerk	2 *(2.5)*	2*(100.0)*	0*(0.0)*	
	Nutritionist	2 *(2.5)*	1*(50.0)*	1*(50.0)*	
Gender	Male	30 *(37.0)*	26*(86.7)*	4*(13.3)*	*0.357*
	Female	51 *(63.0)*	40*(78.4)*	11*(21.6)*	
Education level	Certificate	9 *(11.1)*	8*(88.9)*	1*(11.I)*	*0.818*
	Diploma	66 *(81.5)*	53*(80.3)*	13*(19.7)*	

Characteristics	Category	*Total number of participants* ***n (%)***	***Use n (%)***	***Non-use n (%)***	***P-value***
	Degree	6 *(7.4)*	5*(83.3)*	1*(16.7)*	
Age in years	20- 25	15 *(18.5)*	12*(80.0)*	3*(20.0)*	*0.824*
	26-30	27 *(33.3)*	22*(81.5)*	5*(18.5)*	
	31-35	21 *(25.9)*	17*(81.0)*	4*(19.0)*	
	36-40	11 *(13.6)*	8*(72.7)*	3*(27.3)*	
	41-45	5 *(6.2)*	5*(100.0)*	0*(0.0)*	
	over 45	2 *(2.5)*	2*(100.0)*	0*(0.0)*	

Data is presented as number and proportions (%) of subjects. Statistical analysis was performed using chi-square (χ^2) test. Abbreviations: HRIO-Health Records and Information Officer, Statistical significance was set at $P<0.050$. Significant *P*-values are indicated in bold.

4.3 Association between human resource availability and utilization of IQCare for CDS

The study sought to establish how human resource availability factors like training, mentorship and those who had staff to support troubleshooting in their health facilities lead to utilization of IQCare for CDS. Table 4.2 outlines the frequency distribution of the human resource availability and its utilization for CDS among HCWs in Nakuru County. Furthermore, a binary logistic regression analysis was performed to determine the influence of human resource on utilization of IQCare system for CDS (Table 4.3).

4.3.1 Distribution of human resource availability and utilization of IQCare system for CDS

Table 4.2 showed the distribution of human resources availability characteristics and utilization of IQCare system for CDS among HCWs in Nakuru County. Out of 82.7% (n=67) respondents who received training, 88.1% (n=59) respondents reported using IQCare for CDS as compared to 11.9% (n=8) respondents who reported non-use. For those 17.3% (n=14) who were not trained, 50.0% (n=7) respondents reported using IQCare for CDS while, 50.0% (n=7) reported non-use (Table 4.2). Of the81.5% (n=66) respondents who received mentorship, 87.9% (n=58) reported using the IQCare for CDS While,12.1% (n=8)respondents reported non-use. Regarding the 18.5% (n=15) who did not receive any mentorship, 53.3% (n=8) utilized the IQCare for CDS as compared to 46.7% (n=7) (Table 4.2).

Most of the respondents 82.7%(n=67) reported having personnel capable of trouble shooting EMR within their health facility. Out of this,77.6% (n=52) were using IQCare for CDS, while

22.4% (n=15) who reported non-use. From the 17.3% (n=14) who did not have personnel capable of trouble shooting EMR, 100.0% (n=14) were using IQCare for CDS. The table 4.2 shows the proportion distribution of human resource availability characteristics and utilization of IQCare system for CDS. The results of the P≤ 0.05 implies that use of IQCare for CDS is dependent on the trainings done, mentorship provided to HCWs and availability of a troubleshooter to identify and resolve faults in case it arises in the system.

Table 4.2: Frequency of human resource availability and utilization of IQCare for CDS

Human Resource Availability Characteristics		**Total respondents**	**Use**	**Non-use**	***P* value**
		n(%)	n (%)	n (%)	
Staff training on IQCare	Yes	67 *(82.7)*	59 *(88.1)*	8 *(11.9)*	**0.001**
	No	14 *(17.3)*	7 *(50.0)*	7 *(50.0)*	
Mentorship support	Yes	66 *(81.5)*	58 *(87.9)*	8 *(12.1)*	**0.002**
	No	15 *(18.5)*	8 *(53.3)*	7 *(46.7)*	
Availability of troubleshooter	Yes	67 *(82.7)*	52 *(77.6)*	15 *(22.4)*	**0.050**
	No	14 *(17.3)*	14 *(100.0)*	0 *(0.0)*	

Data are presented as numbers and proportions (%) of subjects, unless otherwise indicated. Statistical analysis was performed using chi-square (χ^2) test. Statistical significance was set at $P \leq 0.050$. Significant *P*-values are indicated in bold.

4.3.2 Association between human resource availability and utilization of IQCare system

In order to determine the relationship between availability of human resource characteristics and utilization of IQCare for CDS in Nakuru County, binary regression analysis, was performed in a model that weighted the human characteristics equally (Table 4.3).The results showed that HCWs trained on the use of the IQCare system had 5.4 times more likely of using the IQCare for CDS (Odds ratio, OR=5.475, 95% confidence interval, CI=1.261-23.775, *P*=0.023) compared to those not trained. Further, health care workers who received mentorship support were 4.2 times more likely to use the IQCare for CDS (OR=4.261, 95% CI=1.005-18.067, *P*=0.049), relative to participants without mentorship support. There was no significant difference in utilization of the IQCare for CDS and availability of personnel to perform trouble shooting (*P*=0.998) (Table 4.3).

Table 4.3: Association between human resource availability and utilization of IQCare system for CDS

Characteristics	Odds Ratio	95% C.I.		*P* Value
		Lower	**Upper**	
Staff training on IQCare	5.475	1.261	23.775	**0.023**
Mentorship support	4.261	1.005	18.067	**0.049**
Availability of troubleshooter	0.000	0.000	.	0.998
Constant	2253934.835			0.999

Binary logistic regression analysis was performed to assess the association between human resources availability and utilization of IQCare for clinical decision support. Health care workers were grouped into those using the IQCare system (n=66) and non-use (n=15). Data are presented as odds ratios and 95% confidence interval (CI). Statistical significance was set at $P \leq 0.050$. Significant *P* values are shown in bold.

4.3.3 Emerging themes on human resource availability from focus group discussion

Thematic analysis revealed four sub-themes surrounding human resource availability and usage of IQCare for CDS (Table 4.4).Results showed that majority of the respondents cited training as the most important component towards the utilization of the IQCare for CDS, followed by the frequency of mentorship support received (Table 4.4).

Table 4.4: Emerging sub-themes human resource availability from FGD

Category/themes	Sub-themes	Quote
Human Resource Availability	Training received on the EMR	*"Proper training of HCWs on judicious usage of IQCare CDS functionalities is required for maximum benefit. These can introduce a considerable number of medical errors, which results in poor patients' treatment outcomes".F1*
	Frequency of mentorship support	*"By 2015 our facility was using both paper and EMR which meant double work, with refresher training and continuous mentorship we are now running a paperless system in all departments in this HIV Care clinic".F5*
	Availability of technical personnel to install and operate IQCare system.	*"One of our clinicians who has been well trained in IQCare has helped in trouble shooting some IQCare system we had last year hence troubleshooting can be performed by any other staff who has been well trained or mentored". F2*

Results from the FGDs conducted in five facilities to understand the participant's views on how availability of human resources impacts on use of the IQCare system in their HIV care clinics. Each FGD was composed of 6-8 members of different cadres of healthcare workers drawn from the HIV care clinics they worked. Information was extracted from the FGD transcripts for sub-themes on human resource availability. Data was analyzed using the *Nvivo*12 software to generate sub-themes that emerged.

4.4 Influence of ICT infrastructure on utilization of IQCare system for CDS

The study also set out to determine whether the presence of ICT infrastructure influences the utilization of IQCare systems for CDS. The frequency distribution of ICT infrastructure and the utilization of IQCare for CDS among HCWs in Nakuru County were determined (Table 4.5). In addition, binary regression analysis modeling was used to determine the influence of ICT infrastructure on utilization of IQCare system for CDS (Table 4.6).

4.4.1 Distribution of ICT infrastructure and utilization of IQCare system for CDS

Table 4.5 shows the distribution of ICT infrastructure characteristics and utilization of IQCare system for CDS among HCWs in Nakuru County. Assessment of availability of computers in all departments showed that 54.3% (n=44) had computers in all rooms, while 45.7% (n=37) did not have computers in all departments. For those with computers in their departments, 86.4% (n=38) reported using IQCare for CDS and 13.6% (n=6) were not using IQCare for CDS. For the 45.7% (n=37) who did not have computers in their departments, 75.7% (n=28) reported using IQCare for CDS using a centralized computer as compared to 24.3% (n=9) who were not using IQCare for CDS, (Table 4.5).

Regarding linking of computers via the local area network (LAN), 70.4% (n=57) of the respond-entsreported linkages, of which 91.2% (n=52) reported using IQCare for CDS as compared to 8.8% (n=5) who reported non-use of IQCare for CDS. For the 29.6% (n=24) respondents who reported having no linkage of computers via LAN, 58.3% (n=14) reported use of IQCare for CDS compared to 41.7% (n=10) who indicated non-use of IQCare system (Table 4.5).

The respondents who had internet connectivity were 51.9% (n=42), while 48.1% (n=39) had no internet connectivity. For those respondents with internet connectivity, 92.9% (n=39) reported

using IQCare for CDS compared to 7.1% (n=3) who reported non-use. For respondents without internet connectivity, 69.2% (n=27) reported use of IQCare for CDS compared to 30.8% who reported non-use(Table 4.5).

About a third, 29% (n=24) of the respondents had IQCare system security in place while majority,70.4% (n=57) had no IQCare system security*(computers having passwords and HCWs having their individual passwords to provide access to only authorized staff to the IQCare system).* For those respondents with IQCare system security, 83.3% (n=20) reported use of IQCare system for CDS compared to 16.7% (n=4) who reported non-use. Furthermore, forthose who did not have IQCare system security, 80.7% (n=46) reported using IQCare for CDS while 19.3% (n=11) reported non-use (Table 4.5).

Less than half,48.1% (n=39) of the respondents were found to have alternative power back-up,84.6% (n=33) of the respondents reported using IQCare for CDS while 15.4% (n=6) were not using the IQCare for CDS. Of the51.9% (n=42) respondents in HIV clinics without alternative power back-up,78.6% (n=33)reported using IQCare for CDS compared to 21.4% (n=9) who reported non-use (Table 4.5).

Table 4.5: Distribution of ICT infrastructure and utilization of IQCare system for CDS

ICT infrastructure Characteristics	**Availability**	**Total Respondents** *n (%)*	**Use** *n (%)*	**Non-use** *n (%)*	***P*Value**
Computers available in all departments	Yes	44 *(54.3)*	38 *(86.4)*	6 *(13.6)*	0.217
	No	37 *(45.7)*	28 *(75.7)*	9 *(24.3)*	
Computers linked via local area network (LAN)	Yes	57 *(70.4)*	52 *(91.2)*	5 *(8.8)*	**0.001**
	No	24 *(29.6)*	14 *(58.3)*	10 *(41.7)*	
Internet connectivity	Yes	42 *(51.9)*	39 *(92.9)*	3 *(7.1)*	**0.006**
	No	39 *(48.1)*	27 *(69.2)*	12 *(30.8)*	
IQCare system Security	Yes	24 *(29.6)*	20 *(83.3)*	4 *(16.7)*	0.781
	No	57 *(70.4)*	46 *(80.7)*	11 *(19.3)*	
Alternative Power back-up	Yes	39 *(48.1)*	33 *(84.6)*	6 *(15.4)*	0.484
	No	42 *(51.9)*	33 *(78.6)*	9 *(21.4)*	

Data are presented as number and proportions (%) of subjects, unless otherwise indicated. Statistical analysis was performed using chi square (χ) test. Statistical significance was set at $P \leq 0.050$.Significant *P* values are indicated in bold.

4.4.2 Influence of ICT infrastructure on the utilization of IQCare system

To determine the influence of ICT infrastructure on utilization of IQCare for CDS in Nakuru County, we performed a binary regression analysis, in a model that weighted ICT infrastructure characteristics respectively (Table 4.6).

The results showed that staff in HIV clinics where computers were linked via LAN had 8.6 higher odds of using the IQCare for CDS (OR=8.646, 95% CI=1.591-46.981, *P*=0.012), compared to those HCWs in HIVcare clinics where computers were not linked via LAN. Furthermore, HCWs in HIVcare clinics with internet connectivity were 5.3higher odds of using IQCare for CDS (OR=5.353, 95% CI=1.226-23.377, *P*=0.026), compared to HCWs in HIV care clinics without internet connectivity. This shows that connectivity of computers via either LAN and internet connectivity has a positive influence on utilization of IQCare system for CDS (Table 4.6).

There was no influence of availability of computers in departments (OR=0.695, 95% CI=0.131-3.682, *P*=0.669), alternative power back-up (OR=1.359, 95% CI=0.362-5.097, *P*=0.649) and IQCare system security (OR=0.538, 95% CI=0.120-2.414, *P*=0.419) on utilization of the IQCare for CDS. The results from the P-values in Table 4.6 shows that connectivity of computers via either LAN (P=0.012) and internet connectivity (P=0.026) has a positive influence to utilization of IQCare system for CDS as shown in table 4.6.

Table 4.6: Influence of ICT infrastructure and utilization of IQCare system for CDS

			95% C.I.		
Characteristics	B	Odds Ratio	**Lower**	**Upper**	*P* Value
Availability of Computers in departments	-0.364	0.695	0.131	3.682	0.669
Computer linked via the LAN	2.157	8.646	1.591	46.981	**0.012**
Internet Connectivity	1.678	5.353	1.226	23.377	**0.026**
Alternative Power back-up	-0.620	1.359	0.362	5.097	0.649
IQCare system Security	0.307	0.538	0.120	2.414	0.419
Constant	-6.151	0.002			0.005

Binary logistic regression analysis was performed to assess the influence of ICT infrastructure on utilization (use, n=66 or non-use, n=15) of IQCare for clinical decision support. Data are presented as odds ratios and 95% confidence interval (CI). Abbreviations; LAN – Local area network. Significant *P* values are shown in bold.

4.4.3 Themes on Influence of ICT infrastructure from focus group discussion (FGD)

Thematic analysis revealed four sub-themes on ICT infrastructure key to facilitate utilization of IQCare system for CDS (Table 4.7).These results from the FGD correlate with the questionnaire results which showed that internet connectivity and computers linked via LAN were the main drivers to full utilization of IQCare system for CDS.

Table 4.7: Emerging Sub-themes on ICT infrastructure from the FGD

Category/themes	Sub-themes	Quote
ICT infrastructure	Availability of computers in all departments	*"We were delighted to have computer installed in all departments of the HIV Care clinic because two years ago we use to document on paper then the HRIO enters the data into the EMR. This led to a lot of transcription errors".**F3***
	Local Area Network to connect computers between departments	*"Since computers were connected to one another via LAN workload has been reduced because there is division of tasks and hence reduced clients waiting time". **F4***
	Availability of internet to facilitate exchange of data and information.	*"We always wanted to go paperless in 2016, but none of our computers were connected to one another to facilitate data and information exchange between departments". **F5***
	Power back-up and IQCare system security	*"Having used IQCare for 4 years we wanted to go paperless, but when there is power outage, you revert to paper.This has made it hard to let go paper system hence continuous use of hybrid system in our facility hence increased workload."**F1***

Information was extracted from the FGD transcripts for sub-themes on ICT infrastructure. Data was analyzed using the *Nvivo* 12 software. F-refers to the study site where the FGD tool was administered.

4.5 Health care workers perspective son utilization of the IQCare system for CDS

The third objective sought to find out the influence of HCWs` perspectives on utilization of the IQCare system for CDS. The respondents were asked to rate the level of knowledge on their perspective and how it influences utilization of IQCare system for CDS (Table 4.8). A binary regression analysis modeling was performed to determine the influence of HCWs` perspectives on utilization of IQCare system for CDS (Table 4.9).

4.5.1 Distribution of HCWs Perspective on IQCare system utilization for CDS

Perspectives of HCWs on utilization of IQCare systems are summarized in Table 4.8 using the likert scale. Majority of respondents 82.7% (n =67) indicated that IQCare systems has simplified their work because IQCare allows easier access to patient records compared paper-based records. Similarly, 82.7% (n=67) have confidence in IQCare systems hence they have control in making clinical decisions using CDS features. IQCare use and exposure instills confidence in the usage of the EMRs among users, 80.3% (n=65) respondents stated that IQCare enabled them to generate more accurate reports than paper. From the analysis88.9% (n=72) indicated that the IQCare system maintain privacy and security of patient information (Table 4.8).The p-values in the table 4.8 shows the proportion distribution of the HCWs perspective characteristics and utilization of IQCare system for CDS.

Table 4.8: HCWs Perspective use of IQCare system for CDS

Characteristics	**Strongly Disagree** n (%)	**Disagree** n (%)	**Sum (Disagree** n (%)**)**	**Agree** n (%)	**Strongly Agree** n (%)	***Sum (Agree*** n (%)***)***	***P*** **Value**
IQCare system has simplified HCWs work	2*(2.5)*	12*(14.8)*	14(17.3)	32*(39.5)*	35*(43.2)*	67(82.7)	**0.005**
Clinicians have control to make clinical decisions with the help of CDS feature.	8*(9.9)*	6*(7.4)*	14(17.3)	22*(27.2)*	45*(55.5)*	67(82.7)	**0.001**
Patient confidentiality is guaranteed with the use of the IQCare system.	2*(2.5)*	7*(8.6)*	9(11.1)	30*(37.0)*	42*(51.9)*	72(88.9)	**0.001**
IQCare system records are easily accessible during clinics visits.	3*(3.7)*	15*(18.5)*	18(22.2)	30*(37.0)*	33*(40.8)*	63(77.8)	**0.005**
IQCare system reports are more accurate than paper.	0*(0.0)*	16*(19.7)*	16(19.7)	26*(32.1)*	39*(48.2)*	65(80.3)	**0.001**
Paper reports are more accurate than IQCaresystem.	18*(22.2)*	42*(51.9)*	60(74.1)	17*(21.0)*	4*(4.9)*	21(25.9)	0.051
Paper records are more complete than IQCaresystem.	22*(27.2)*	43*(53.1)*	65(80.3)	11*(13.6)*	5*(6.2)*	16(19.7)	0.081

The healthcare workers views on the utilization of the IQCare for clinical decision support in their facilities were determined. Data are presented as number and proportions (%) of subjects, unless otherwise indicated. *Likert scale: 1=strongly agree, 2=agree, 3=disagree and4=strongly disagree. In addition, Sum (disagree n (%)) is a summation of number and percent of strongly disagree and disagree, Sum (agree n (%)) is a summation of number and percent of strongly agree and agree. Statistical* analysis was performed using chi square (χ^2) test. Statistical significance was set at $P \leq 0.050$.Significant *P* values are indicated in bold.

4.4.2 Influence of HCWs perspectives and utilization of IQCare system for CDS

To determine the influence of HCWs perspectives and utilization of IQCare for CDS in Nakuru County, we performed a binary regression analysis, in a model that weighted HCWs perspectives characteristics equally (Table 4.9).Results shows that out of the seven HCWs perspective characteristics, three showed significances towards utilization of IQCare system for CDS. These were, (i)IQCare system simplified their work (OR=0.038, 95% CI=0.002-0.636; *P*= 0.023), (ii) Providing clinicians control in making clinical decisions (OR=6.262, 95% CI=1.613-24.308; *P*=0.008), (iii) Guaranteed confidentiality of patient information (OR=44.130, 95% CI=3.207-607.166; *P*=0.005), had a positive influence on utilization of IQCare system for CDS (Table 4.9).

The other four HCWs perspective characteristics were insignificant to utilization of IQCare system for CDS, and they included (i) IQCare system records accessibility during clinic visits (OR=0.867, 95% CI=0.136-5.511; *P*=0.879), (ii) IQCare system reports are more accurate than paper (OR=4.005, 95% CI=0.463-34.633;*P*=0.207), (iii)Paper reports are more accurate than IQCare system (OR=0.636, 95% CI=0.111-3.657; *P*=0.612) and, (iv)Paper records are more complete than IQCare system(OR=0.515, 95% CI=0.072-3.671; *P*=0.507);Table 4.9).

Table 4.9 Influence of HCWs perspectives and utilization of IQCare system for CDS

Characteristics	B	Odds Ratio	95% C.I.		*P*Value
			Lower	Upper	
IQCare system has simplified HCWs work	-3.271	0.038	0.002	0.636	**0.023**
Clinicians have control to make clinical decisions with the help of CDS feature	1.834	6.262	1.613	24.308	**0.008**
Patient confidentiality is guaranteed with the use of the IQCare system	3.787	44.130	3.207	607.166	**0.005**
IQCare system records are easily accessible during clinic visits	-.143	0.867	0.136	5.511	0.879
IQCare system reports are more accurate than paper	1.387	4.005	0.463	34.633	0.207
Paper reports are more accurate than IQCare system	-.452	0.636	0.111	3.657	0.612
Paper records are more complete than IQCare system	-.664	0.515	0.072	3.671	0.507
Constant	-5.559	0.004			0.249

Binary logistic regression analyses were performed to assess influence of HCWs perspectives on the likelihood that it will lead to utilization of IQCare system for CDS. Data are presented as odds ratios (OR) and 95% confidence interval (CI). Abbreviations; EMR– Electronic medical records, CDS-Clinical decision support. Significant *P* values are shown in bold.

4.5.3 Results for qualitative data on influence of HCWs perspectives on utilization of IQCare system

Thematic analysis revealed five sub-themes on HCWs perspective that were thought to influence utilization of IQCare system for CDS. Results from the FGDhave been summarized as shown in table 4.10 which includes HCWs quotes on their perspectives on utilization of IQCare system for CDS.

Table 4.10: Emerging Sub-themes from FGD on influence of HCWs perspectives on utilization of IQCare system

Category/themes	Sub-themes	Quote
User Perspective	IQCare system usefulness	"*IQCare CDS features areuser-friendly, and the charts shows data trends over time. HCWs can identify abnormal trends, this gives us the opportunity to discuss the results in detail with our clients during support adherence counselling process." **F4***
	IQCare tracks patient quality of care	*"Since I started using IQCare system I am able to interact with clients by reviewing their viral loads over time which has helped improve viral load suppression among the clients with high viral load"**F2***
	Increased Job satisfaction/uncertainty reduced	*"Use of IQCare CDS feature has enabled me improve my clinical judgment accuracy by combining CDS information with their MOH guidelines to make an independent clinical decision in the shortest time possible". **F3*** *"Our clinicians are more comfortable using IQCare because they can validate patients' information quick, thorough manner including trends over time". **F1***
	Easier generating reports using IQCarethan paper	*"At the end of each month with the help of IQCare system we are able to generate reports accurately and faster, within one hour as compared to using paper records which used to take 7-8 hours". **F4***
	Need for control in decision making	*"IQCare has reduced the pressure on HCWs working in the HIV care clinics because clinicians can retrieve client data and information with a clique of a button thereby freeing more time for patient management". **F5***

Information was extracted from the FGD transcripts for sub-themes on HCWs perspectives. Data was analyzed using the Nvivo 12 software. F refers to the study site where the FGD tool was administered.

4.5.4 Use of CDS functions by HCWs in HIV care clinics

To validate the results obtained from the perspectives of HCWs on utilization of IQCare for CDS, the respondents were requested to demonstrate the CDS features they access and their

frequency of use when offering services to HIV care clients. The results are as summarized in Table 4.11. The most used functions were capturing data trend charts 79.0% (n=64), followed by ordering lab/repeat tests 78.0% (n =63),generation of output reports 71.0% (n=58), clinical reminders 63.0% (n =51),and drug reaction alerts 44.3.0% (n =36).Short message service (SMS)9.0% (n=7), and email alerts 7.0% (n=6), were CDS functions that were rated lowest in the utilization of IQCare for CDS (Table 4.11).

Table 4.11: Use of CDS functions by HCWs in HIV care clinics in the study sites

CDS features/Frequency	***Never*** *n (%)*	***Rarely*** ***n****(%)*	***Sometimes****n (%)*	***Often*** *n (%)*	***Always*** ***n****(%)*	***P-Value***
Generation of output reports ***(e.g. defaulter lists, Clients due for Viral Load)***	**10** *(13.0)*	**4***(5.0)*	**9***(11.0)*	**10***(12.0)*	**48***(59.0)*	**0.001**
Clinical reminders	**27***(33.0)*	**3***(4.0)*	**7** *(9.0)*	**8***(10.0)*	**36***(44.0)*	**0.001**
Drug reaction alerts	**33** *(40.1)*	**12** *(15.0)*	**5** *(6.0)*	**9***(11.1)*	**22***(27.2)*	**0.020**
Order lab/repeat tests	**11***(13.0)*	**7** *(9.0)*	**0***(0.0)*	**13***(16.0)*	**50***(62.0)*	**0.001**
Access to trend charts/Dashboards ***(viral load, BMI, etc.)***	**7** *(9.0)*	**6***(7.0)*	**4***(5.0)*	**14***(17.0)*	**50***(62.0)*	**0.000**
Short message service ***(SMS)***	**64** *(79.0)*	**9***(11.0)*	**1***(1.0)*	**2** *(3.0)*	**5***(6.0)*	0.886
Email alerts	**63***(78.0)*	**10***(12.0)*	**2***(3.0)*	**0***(0.0)*	**6** *(7.0)*	0.768

The respondents were required to document IQCare functions and the frequency of using CDS features. Data is presented as number and proportions (%) of subjects. Likert scale: 1=never, 2=rarely, 3=sometimes, 4=often and 5=Always. Abbreviations; BMI=Body mass index. Significant *P* values were set at ≤0.050 and are indicated in bold.

CHAPTER FIVE
DISCUSSION

5.1 Introduction

In this chapter, the findings of the study are discussed, giving possible reasons for the findings and comparing with findings from other relevant studies. Each part of the discussion addresses the three specific objectives which included how human resource availability, ICT infrastructure and HCWs perspectives influence utilization of IQCare system for clinical decision support in HIV care clinics within Nakuru County, Kenya.

5.2 Association between human resource availability and utilization of IQCare for CDS

The study set out to determine if training and mentorship of staff on the utilization of IQCare system had any influence on its utilization for CDS. The results indicated that there was a significant association between trained *(P*=0.023)and mentored *(P*=0.049)HCWs and utilization of the IQCare for CDS. These results are consistent with other previous studies showed that EMR training was a critical component that would improve HCWs competence and ultimately lead to high quality of patient care (Lopez et al., 2018; Essuman et al., 2020). In concurrence consistent capacity building of HCWs in Kenya can fast-track the clinicians acceptance and increase the rate of adoption and utilization of CDS systems (Oluoch et al., 2015).In addition other studies found out that inadequate and poorly trained health workers were a key challenge to the implementation of e-health in developing countries(Msiska et al., 2017; Essuman et al., 2020).

In this study, 87.9% HCWs received mentorship support on the utilization of IQCare for CDS. This finding was in line with other study findings by Essuman and Edwards which showed that HCWs need continuous support for them to utilize the clinical decision support features in the EMR system (Essuman et al., 2020; Edwards et.al, 2012). These findings also concurs with another study which found out that mentors are selected super-users who support peer-to-peer approach, which facilitates training as peers communicate and speak the same language(Aguirre et al., 2019). Mentorship enables HCWs with similar roles to share their knowledge and experience on the IQCare system, rapidly increasing the level of EMR proficiency. Roger's diffusion of innovations theory was key in this study as it describes the pattern and speed at which new ideas, practices, or products spread through a population (Helitzer et al., 2003).hence

in line with this study on determining if training and mentorship has resulted to utilization of IQCare for CDS. The study revealed no association between having someone to troubleshoot and the utilization of the IQCare system for HIV care CDS(*P*=0.998) which concurred withFGD results showed that trouble shooting roles can be performed by any other staff who has been trained or mentored. These results are quite different compared to other studies by(Edwards et.al, 2012,Msiska et al., 2017) who found out that maximum utilization of EMR system is dependent on availability of an in-house problem solver (troubleshooter) who play a key role in aiding beginners to move forward on realizing the benefits of EMR.

These findings are highly supported by another study done in Japan found out that the diagnostic error rate was 2% for HCWs trained and mentored on an updated computer-based clinical system, while the error rate for those not trained nor mentored was 24% (Shimizu et al., 2018).Taken together, findings from this study revealed concurrence of qualitative and quantitative results and that training and mentorship influences utilization of IQCare for CDS in HIV Clinics in Nakuru County, Kenya.

5.3 Availabilityof ICT Infrastructure forutilization of IQCare for CDS

The study sought to find out if presence of ICT infrastructure influences utilization of IQCarefor CDS. This study relied of Rogers' theory of diffusion on the attributes that support use of EMR innovations (Helitzer et al., 2003)and the ICT infrastructures which depends on how fast HCWs are ready to use IQCare for CDS.

Key drivers to ICT infrastructure are computers linked via LAN and internet connectivity which were 8.6 and 5.3 times more likely of using the IQCare for CDS. This concurs with previous studies which indicated that connectivity of computers leads to utilization of EMR systems ((Essuman et al., 2020; Msiska et al., 2017;Howland, 2013).Connectivity facilitates flow of data and information exchange within the various departments within the HIV Clinic. Similar findings have been reported by other studies which indicated that ICT infrastructure is characterized by availability of internet connection and linkage of computers via LAN are adequate to facilitate utilization of EMR CDS features (Busagala & Kawono, 2013). In addition, another study found out that the low utilization of CDS features was associated with lack of integration of computers and internet connectivity with host systems to fully utilize EMR for CDS (Arts et al., 2018).

The study results revealed that low utilization of IQCare for CDS was not attributed to absence of alternative power back-up. The Study is in line with a survey conducted in Malawi which found that 70% of HCWs preferred using the paper-based records over EMR system due to lack of power back-up systems (Msiska et al., 2017).

5.4 Health care workers perspectives on theutilization of IQCare system for CDS

The study investigated both quantitative and qualitative aspects of HCWs perspective son utilization of IQCare for CDS. To determine what characteristics to examine regarding EMRs, the study relied on both Technology Acceptance Model (TAM) with Diffusion Theory on the perceived ease of use or perceived usefulness. In this context, HCWs perspective domains investigated here were selected from a meta-analysis study that investigated emerging themes from 78 articles from various studies, with an aim of understanding the global perspective of EMR and its implementation in healthcare setups (Dhillon et al., 2018).

In this study, most (82.7%) (P=0.023) respondents acknowledge that IQCare systems have simplified their work and allowed easier access to patient information compared paper-based records. These results concur with previous studies found out that EMR CDS functions designed in consideration of clinical flow during onset are easily accessible and simplifies HCWs tasks hence highly correlated with better utilization(Ancker et al., 2015; Castaneda et al., 2015; Granlien & Hertzum, 2012; McLane, 2005).As such IQCare system allows clinicians to make quick clinical decisions based on evidence by reviewing trends of client performance over time.
In addition, study findings revealed that most (82.7%), (P=0.008) respondents acknowledge that IQCare systems supported clinicians to have more control in making clinical decisions using CDS features. These results resonate with a study done in United States of America which reported 75% of physicians used patient information for clinical decision making (Kong et al., 2008). In addition another study acknowledges that patient records being secure, readily available and easy to retrieve for continuity of care improved with consistent use of the EMR system (Kong et al., 2008). This implies that HCWs perspective is dependent on consistent use of IQCare system which builds the HCWs competence.

From the study, majority of the respondents (88.9%), (P=0.005)were assured of the protection of confidentiality of patient information. These results are consistent with other studies, which found out that with restricted access to EMR systems helps to build staff confidence that the

information in EMR are safe and cannot be manipulated hence proper utilization of EMR (Evans,2016; Udo &Davis, 1992). As such, data stored in IQCare systems were considered very secure and free from malicious damage and manipulation by unauthorized people.

This study showed that the four HCWs perspective domains were insignificant to utilization of IQCare system for CDS, and they included (i) IQCare system records accessibility during clinic visits (P=0.879), (ii)IQCare system reports are more accurate than paper (P=0.207), (iii) Paper reports are more accurate than IQCare system (P=0.612) and, (iv) Paper records are more complete than IQCare system (P=0.507). This concurs with another study carried out in Saudi Arabia which revealed that 83% of healthcare professionals preferred use EMR system than paper-based system (Biruk et al., 2014).

The findings on the availability and use of CDS features during clinic visits collected through observation. The results showed that majority (>80%) of the respondents used CDS features to aid in clinical decision support. These findings implied that the HCWs perspective is dependent on their capability to use the EMR system in running clinic operations.This is similar to study findings which reported that use of IQCare systems reduced access time to patient records, reduced costs related to paper consumption, reduced the pressure on the already limited number of health staff (Msiska et al., 2017).Moreover, CDS features inbuilt in IQCare system provides clinicians with synthesized information adequate for HIV Care management.

Majority (>80%) HCWs had a positive perspective on use of IQCare for CDS. HCWs acknowledged IQCare gives them more control in making clinical decisions, assures protection of confidentiality and easy access to patient information. Integrating the TAM model with Roger's diffusion theory were applicable to this study since it determined whether the nature of the task is related to perceived ease of use or perceived usefulness (Terry et al., 2012)to utilization of IQCare for CDS and the supportive structures (CDS features).

Data from the focus group discussions showed that HCWs still found EMRs to be quicker, more secure, and more accurate in aiding patient management compared to paper-based records. Electronic record-keeping enabled clinicians to consult more patients within a short period compared to paper records. Participants stated that IQCare clinical decision support features helped reduce healthcare workers workload, as less time was spent retrieving patient records.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this chapter, the research summary of the findings, conclusions and recommendations to the study are drawn. Research gaps have been identified for future studies, as this study was aimed at determining factors influencing the utilization of the IQCare system for clinical decision support in HIV Care clinic in Nakuru County.

6.2 Summary of study findings

The following is a summary of the findings based on the study results.

1. Training staff on IQCare system (P=0.023) and mentorship support (P=0.049) were found to be associated with the utilization of IQCare for CDS. With well trained and well mentored staff on the IQCare system they can fully utilize IQCare system features for CDS.
2. There is a significant relationship between the use of EMR for CDS and linking of computers via LAN (P=0.012) and internet connectivity (P=0.026) to allow data and information exchange with the use of LAN and internet. Strong ICT Infrastructure has a positive influence on utilization of IQCare for CDS.
3. The HCWs perspective is dependent on previous level of interaction with IQCare system. The study findings showed that three HCWs perspective domains were significant to utilization of IQCare system for CDS, and they included (i) IQCare system makes the work of HCWs easier (P=0.023)when searching for patients results and information, (ii) IQCare system led to clinicians having control in making clinical decisions (P=0.008), and (iii) IQCare system assuring of patient confidentiality (P=0.005) compared to paper records.

6.3 Conclusions

1. Training staff on IQCare and mentorship support are drivers to utilization of IQCare for CDS under human resource availability.
2. Computers linked via local area network (LAN) and internet connectivity are the ICT infrastructure domains that facilitates utilization of IQCare for CDS.
3. IQCare system makes the work of HCWs easier, enabling them have control in making clinical decisions and maintaining patient confidentiality, these are the three key drivers for utilization of IQCare for CDS under HCWs perspective.

6.4 Recommendations

There is need:

1. The Ministry of Health at facility, county and national level to invest in HCWs training and mentorship support on EMR to guarantee optimal utilization of IQCare systems for CDS.
2. Avail computer networking and internet connectivity devices to facilitate utilization of IQCare system for CDS.
3. Orient HCWs on the IQCare system CDS features that would lead to simplification of their, assure control in making clinical decisions and maintain patient confidentiality.

6.5 Suggestions for further research

The following areas emerged as a key for further investigation:

1. Effective EMR training and mentorship packages to facilitate utilization of CDS features in EMR systems.
2. A comparative study on the recommended ICT infrastructure suitable for supporting other EMR systems in Kenya for provision of HIV Care services at point of care.
3. Evaluation on how to improve HCWs perception towards clinical decision support alerts.
4. Study on effectiveness of a clinical decision support features on adherence to e-prescribing.

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APPENDICES

AppendixI: List of ART Sites that have used IQCare System consistently from 2014

	Health Facility Name	MFL Code	Sub-County	Facility Type	Status
1	Gilgil Sub-County Hospital	14510	Gilgil	Public	Active
2	St Mary's Hospital (Naivasha)	15654	Gilgil	Faith-based	Active
3	Olenguruone Sub-County Hospital	15398	Kuresoi South	Public	Active
4	Elburgon Sub-County Hospital	14431	Molo	Public	Active
5	Molo Sub-County Hospital	15212	Molo	Public	Active
6	Naivasha Sub-County Hospital	15280	Naivasha	Public	Active
7	Langa Langa Sub-County Hospital	15009	Nakuru East	Public	Active
8	Bahati Sub-County Hospital	14224	Nakuru North	Public	Active
9	Nakuru West Health Centre	15290	Nakuru West	Public	Active
10	Sunrise Evans Hospital	15686	Nakuru West	Private	Active
11	Njoro Sub-County Hospital	15358	Njoro	Public	Active
12	Nakuru West (PCEA) Health Centre	15290	Nakuru West	Faith based	Active
13	Subukia Sub-County Hospital	15678	Subukia	Public	Active

***Data Source**: EMR implementing partner reports May 2019*

AppendixII: Distribution of ART Sites using IQCare System by County

S/No	Name of County	Region	Number of IQCare sites
1	Kiambu	Central	13
2	Kirinyaga	Central	6
3	Murang'a	Central	25
4	Nyandarua	Central	19
5	Nyeri	Central	23
6	Tharaka-Nithi	Central	13
7	Kilifi	Coast	15
8	Kwale	Coast	16
9	Mombasa	Coast	28
10	Taita Taveta	Coast	18
11	Embu	Eastern	21
12	Kitui	Eastern	23
13	Machakos	Eastern	31
14	Makueni	Eastern	25
15	Meru	Eastern	25
16	Nairobi	Nairobi	88
17	Nandi	North Rift	23
18	Homa Bay	Nyanza	15
19	Kisii	Nyanza	24
20	Kisumu	Nyanza	18
21	Migori	Nyanza	24
22	Siaya	Nyanza	55
23	Bomet	South Rift Valley	23
24	Kajiado	South Rift Valley	17
25	Kericho	South Rift Valley	15
26	Laikipia	South Rift Valley	16
27	Nakuru	South Rift Valley	27
28	Narok	South Rift Valley	20
29	Samburu	South Rift Valley	6
30	Bungoma	Western	2
31	Kakamega	Western	4
	Total IQCare sites		**678**

Data Source*:* National data warehouse**,** https**.** *May 2019*

Appendix III: Krejcie and Morgan's Sample Size Determination

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note. —*N* is population size.
S is sample size.

Appendix IV: Research Authorization letter -Maseno University

MASENO UNIVERSITY ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221
Private Bag – 40105, Maseno, Kenya
Email: muerc-secretariate@maseno.ac.ke

FROM: Secretary - MUERC

DATE: 17th September, 2019

TO: Christopher Cherutich Komen
EL/ESM/00493/2013
Department of Public Health
School of Public Health and Community Development
Maseno University
P. O. Box, Private Bag, Maseno, Kenya

REF: MSU/DRPI/MUERC/00756/19

RE: Factors Influencing Utilization of IQCare System for Clinical Decision Support in HIV Care Clinics in Nakuru County, Kenya. Proposal Reference Number MSU/DRPI/MUERC/00756/19

This is to inform you that the Maseno University Ethics Review Committee (MUERC) determined that the ethics issues raised at the initial review were adequately addressed in the revised proposal. Consequently, the study is granted approval for implementation effective this 17th day of September, 2019 for a period of one (1) year. This is subject to getting approvals from NACOSTI and other relevant authorities.

Please note that authorization to conduct this study will automatically expire on 16th September, 2020. If you plan to continue with the study beyond this date, please submit an application for continuation approval to the MUERC Secretariat by 15th August, 2020.

Approval for continuation of the study will be subject to successful submission of an annual progress report that is to reach the MUERC Secretariat by 15th August, 2020.

Please note that any unanticipated problems resulting from the conduct of this study must be reported to MUERC. You are required to submit any proposed changes to this study to MUERC for review and approval prior to initiation. Please advice MUERC when the study is completed or discontinued.

Thank you.

MASENO UNIVERSITY SECRETARY 17 SEP 2019 ETHICS REVIEW COMMITTEE

Dr. Bernard Guyah
Ag. Secretary,
Maseno University Ethics Review Committee

Cc: Chairman,
Maseno University Ethics Review Committee.

MASENO UNIVERSITY IS ISO 9001:2008 CERTIFIED

Appendix V:Research Permit- NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **937247**

Date of Issue: **06/November/2019**

RESEARCH LICENSE

This is to Certify that Mr.. Christopher Komen of Maseno University, has been licensed to conduct research in Nakuru on the topic: FACTORS INFLUENCING UTILIZATION OF IQCARE SYSTEM FOR CLINICAL DECISION SUPPORT IN HIV CARE CLINICS IN NAKURU COUNTY, KENYA for the period ending : 06/November/2020.

License No: **NACOSTI/P/19/2526**

937247

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

AppendixVI:letter from Nakuru County Health department authorizing the data collection

DEPARTMENT OF HEALTH SERVICES

NAKURU COUNTY

DIRECTOR ADMIN & PLANNING
NAKURU COUNTY
P.O BOX 2600-20100
NAKURU
2nd December, 2019

Ref No. NCG/CDMS/GEN.VOL.1/306

TO
CHRISTOPHER CHERUTICH KOMEN
DEPARTMENT OF PUBLIC HEALTH
MASENO UNIVERSITY
P.O. PRIVATE BAG
MASENO

RE: RESEARCH AUTHORIZATION

This letter serves as an authorization from the Department of Health Services Nakuru for you to conduct research on ***"Factors influencing utilization of IQCare System for Clinical Decision Support in HIV Care Clinics in Nakuru County, Kenya".***

The study is in line with the County Research priorities in the county research agenda and therefore the researcher is expected to present and submit the final report to the County Research and Development Unit.

COUNTY DIRECTOR OF PLANNING & ADMINISTRATION HEALTH SERVICES
03 DEC 2019
P.O. BOX 2060-20100
NAKURU-KENYA

for **ELIZABETH KIPTOO**
FOR/COUNTY DIRECTOR ADMIN & PLANNING
NAKURU

CC:

- All Medical Superintendents, Nakuru
- All Sub County Team Leads, Nakuru
- All Facility In charges, Nakuru

Appendix VII: Letter of Transmittal(consent letter)

Christopher Cherutich Komen,
P.O. Box Private Bag,
Maseno,
30th Nov, 2019,

Dear Respondent,

RE: FACTORS INFLUENCING UTILIZATION OF IQCARE SYSTEM FOR CLINICAL DECISION SUPPORT IN HIV CARE CLINICS IN NAKURU COUNTY, KENYA.

I am a Master`s of Public Health student specializing in Management of Health Systems and Services at Maseno University currently conducting a research study entitled as above.

You have been selected as one of the respondents to assist in providing the requisitedata and information for this research. I kindly request you to spare a few minutes andanswer questions in the attached questionnaire. The information you give will be used foracademic purposes only, will be treated with utmost confidentiality and will not beshared with anyone whatsoever. Do not write your name anywhere on thequestionnaire.

On this basis i request you to respond to all questions with utmost honesty.
Thank you for your participation and effort in completing the questionnaire.

Yours Sincerely,

Christopher Cherutich Komen,
Maseno University
Department of Public Health and Community development

Appendix VIII: Questionnaire

Christopher Cherutich Komen *(ADM No. EL/ESM/00493/2013)*

Instructions

Please kindly complete the following questions in the spaces provided.

Type of facility: GOK_____FBO/NGO_____Private_____

Facility Name……

A) BACKGROUND INFORMATION(*Tick on the (√) text box)*

1. **Please indicate your gender.**□ *Male* □*Female* □*Intersex*
2. **Please indicate your age group in years**
   □*20- 25Yrs* □ *26-30Yrs* □ *31-35Yrs*
   □ *36-40 Yrs*□ *41-45 Yrs*□ *over 45 Yrs*
3. **What is your job title/Cadre**
   □ *Clinician officer* □ *Nurse* □ *Pharmacist* □ *Counselor*
   □ *Health Records and information officer* □ *Data Clerk* □ *Nutritionist*
   □ *Other Specify …….*

4. **Please indicate the highest completed formal qualification you hold?**
   □*Certificate* □*Diploma* □ *Degree* □*Master's Degree* □*PhD*

B) HUMAN RESOURCE AVAILABILITY

5. **Please indicate if you received any form of training on how to use an IQCare system?**

Yes □ *No* □

6. **If yes in 5 above, who trained you to use of EMR system?**
   □ *By EMR support partner staff*
   □ *By other CCC Clinic staff* □ *By other ……..*

7. **Kindly indicate how adequate the training prepared you on how to use the IQCare system**

   □ *fully prepared* □*mostly prepared* □ *somewhat prepared*
   □*I was never trained Degree* □*Not at all prepared*

8. **How often does this facility receive Mentorship support on IQCare systems for their staff?**

Monthly	Quarterly	Bi-annual	Annually	None

9. How can you rank your computer proficiency/ typing skills/ability?

Low	Average	High	Very high

10. Kindly indicate how adequate the funding available to support healthcare services as per standards and implement the usage of the IQCare system?

□*Always adequate* □*sometimes adequate* □ *Inadequate*
□*Always inadequate*

11. Do you have any in-house staff (within the hospital) to troubleshoot an IQCare system in case there is any system challenge?

Yes □ *No* □

If No where do you get support from?

1. ……..……
2. …… ……..
3. ……

12. What does the troubleshooting support entail?

□ *Data Cleaning* □ *System repair* □ *System upgrade*
□ *All above* ……..
……

13. Is your facility using IQCare system for Clinical Decision support?

Yes □ *No* □

14. What is your frequency of using the IQCare system for Clinical Decision support?

□*Always/Daily* □ *weekly* □ *monthly*
□ *Quarterly* □ *I have never used*

D) ICT INFRASTRUCTURE

15. Do you have access to the IQCare system at your workstation?

Yes [ ] No [ ]

16. Is the information for every patient who comes to this clinic in the EMR database system?

Yes [ ] No [ ]

If No, record where it is stored? ……

17. How have EMR medical alerts changed the quality of care to your patients?

Decreased significantly □ *Decreased a little* □ *Not changed* □

Improved a little □ *Improved significantly* □

If there is no change above please clarify

……

18. Indicate if the IQCare system in your facility can perform the following functions.
(*Observe if there is the existence of any of the features)*

Characteristics/processes	***Never***	***Rarely***	***Sometimes***	***Often***	***Always***
Generation of output reports ***(e.g defaulter lists, Clients due for Viral Load)***					
Clinical reminders					
Drug reaction alerts					
Order tests/repeat tests					
Access to trend charts/Dashboards ***(viral load, BMI, MUAC etc.)***					
Short message service (SMS)					
Email alerts					

19. Kindly review if the following ICT infrastructure factors have/can contribute to the utilization of EMR for CDS in this health facility?

Characteristics	**Yes**	**No**
Availability of computers in all departments		
Computers linked via local area network (LAN)		
Availability of Internet connectivity		
IQCare system Security/*restricted access by use of password*		
Alternative power back-up/source		

C) HCWs PERSPECTIVES

20. How long have you worked in this facility?

□ *Less than 6 Months* □ *6-12 Months* □*1-2 years*

□ *2-5 years* □ *above 5years*

21. Which system of recording and maintaining patient details does this facility use/maintain□ *Paper-based* □ *computerized* □ *Both Paper & computerized* (Hybrid)

22. Is there a routine system for tracking implementation of quality improvement or corrective actions after reviews of HIV patients?

□ *Yes* □ *No*

If ***yes****please specify*……..

23. Do the following factors influence the utilization of IQCare system for point of care in this facility? Indicate your response using the following scale.

Characteristics	Strongly agree (SA)	Agree(A)	disagree (DA)	Strongly Disagree (SD)
The fear of using EMR technology				
Lack of knowledge about IQCare system influence its utilization				
Lack of using IQCare systems technology hinders its usage				
Lack of proper computer skills				

Any other factor not mentioned above? ----------

---

24. How long does it take you to extract reports required by the hospital management from the IQCare system while attending to the patients?

<10 minutes □ *11-15 minutes* □ *15-20 minutes* □
21-30 minutes □*>30 minutes* □

25. Kindly rate the following statements by putting a tick (√) regarding your preference between using an IQCare system and paper records.

Characteristics	Strongly agree (SA)	Agree (A)	disagree (DA)	Strongly Disagree (SD)
IQCare system has simplified HCWs job/workload				
I have control to make clinical decision with the help of CDS feature				
Paper records are more accessible during clinics visits				
It is easier reporting on Paper than IQCare system				
Paper reports are more accurate than IQCare system				
Paper records are more complete than IQCare system				
Patient confidentiality is protected with the use of the IQCare system				
IQCare system reports are more accurate than paper				

26. Please indicate to what extent you use the IQCare system for each of the following tasks?

Usefulness of EMR Characteristics	Never	Rarely	Sometimes	Often	Always
Review of Patient History					
Follow the result of particular Test					
Obtain the result from a new test or investigation (e.gViral load)					
Follow investigation of a particular client					
Prescribe for drugs to the client to pick from the pharmacy or Order the X-ray					
Review previous medication for any switch in case of non-adherence/non-suppression.					

27. Do you have any other suggestions on how to improve EMR use for CDS?

i. ……..
ii. ……..
iii. ……..

Thank you for taking the time to participate in this study

Appendix IX: Focus Group Discussion (Consent letter)

Dear Respondents,

FACTORS INFLUENCING UTILIZATION OF IQCARE SYSTEM FOR CLINICAL DECISION SUPPORT IN HIVCARE CLINICS IN NAKURU COUNTY, KENYA

I am Christopher Cherutich Komen a Master's student at Maseno University. I am conducting a study on "Factors influencing utilization of International Quality Care system for clinical decision support in HIV care clinics in Nakuru County, Kenya". This research thesis is a requirement for the award of Master of Public Health Degree in Management of Health Systems and Services of Maseno University.

I know you hold important positions in this hospital and would have liked you to participate in this study. If you agree to participate in this study, you will be expected to sign a consent form after which i will take you through the FGD where i will ask you afew questions which will take about twenty (20) minutes of your time.

Voluntary participation: you have the freedom to decline participation or withdraw from the study at any time.

Privacy:the interview will be general and the information you provide will be respected and everyone the feedback will be used for only the purposes of the study. Your views are very important to this research.

Confidentiality: no name will be written on the FGD. Collected data will be kept in a lockable cabinet where no one else can have access to it apart from the researcher and research team.

Benefits: there will be no direct benefit to you asan individual, but results obtained will help in the improvement of service delivery in the hospital and purely for academic purposes. Study results and conclusions will be available if you wish.

Harm: no potential harm will arise from participation in this study.

If you have any questions regarding this study, you can contact me on this mobile number 0720-582-387 or this email address Christopher.komen@gmail.com.

You can also contact Maseno University Ethical Review Committee, contact address P.O. Box Private Bag, Maseno Tel. +254057351622 Ext. 3050 or email address www.maseno.ac.ke

(Allow participants to ask any question they have and respond satisfactorily)

I have read the consent form and/or explained it to, describing the nature of the study and the benefits. I have had a chance to ask all questions regarding this study. I voluntarily agree to participate.

Signature of the Participant..... Date.....

Signature of the person obtaining Consent..... Date.....

Appendix X: Focus Group Discussion Guide

To be conducted to a groupof6-8 EMR users at each selected sites

Code number…….
Date of interview: ……. /……./2019
Time start……..End time……...
Number of participants……Location…….

Introductory Questions

- Tell us your names and how long you have been using the EMR system?
- Think back to when you first became involved with EMR. What were your first impressions?

1) In what way is your work and performance different since the introduction of IQCare system?
2) What features or functionality do you find in the IQCare system that are particularly helpful for your practice?
3) What human resources availability factors have contributed to the utilization of IQCare for CDS?
4) What kind of training is helpful during the introduction of IQCare system at Point of care?

   -Explain your answer.
5) What is the role of the in-house staff (within the hospital) to troubleshoot an EMR system in case there is any system challenge? Are they helpful?
6) What is your opinion on e-prescriptions? Do you envisage any challenges if integrated to IQCare system?
7) In your perspective what factors led to utilization or none-utilization of IQCare for clinical decision support?
8) What do you think could be the major ICT infrastructure factor that facilitate CDS for IQCare system?
9) Are there any changes or recommendations you have in terms of the IQCare CDS? Do you have any advice onsite that are just going to start adopting IQCare CDS now?
10) Is there anything we should have talked about, but we didn't?

Bring the meeting to a close-by summarizing the main points