

**PERCEIVED FACTORS INFLUENCING ADOPTION OF
ELECTRONIC DATA CAPTURE TECHNOLOGIES IN
HEALTH RESEARCH INSTITUTIONS IN KISUMU COUNTY,
KENYA**

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the award of the Degree of Master of Arts in Project Planning and Management of
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DECLARATION

This is my original piece of work and has not been submitted to any other college, institution of higher learning or university other than University of Nairobi.

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DEDICATION

I dedicate this piece of work to my dear mother Mrs. Mary Atieno Ojwang and my late dad Mr. Michael Ojwang Yogo.

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My appreciation goes to my supervisor, Dr. Naomi Gikonyo whose continuous guidance and mentorship was very instrumental in the production of this final piece.

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TABLE OF CONTENT

DECLARATION.....	ii
DEDICATION.....	iii
TABLE OF CONTENT.....	v
LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
ABBREVIATIONS AND ACRONYMS.....	x
ABSTRACT.....	xi
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background of the Study.....	1
1.2 Statement of the Problem.....	3
1.3 Purpose of the Study.....	4
1.4 Objectives of the Study.....	4
1.5 Research Questions.....	5
1.6 Research Hypothesis.....	5
1.7 Significance of the Study.....	6
1.8 Limitations of the Study.....	6
1.9 Delimitation of the Study.....	7
1.10 Assumptions of the Study.....	7
1.11 Definition of significant Terms.....	8
1.12 Organization of the Study.....	9
CHAPTER TWO: LITERATURE REVIEW.....	10
2.1 Introduction.....	10
2.2 Adoption of Electronic Data Capture Technologiesin Health Research Institutions ..	10
2.2.1 Common features of EDC Systems.....	11
2.2.2 Electronic Data capture technologies.....	12
2.3 Access to EDC devices and adoption of EDC technologies.....	15
2.4 Start-up Cost and Adoption of EDC technologies in health research Institutions.....	16
2.5 Institutional Leadership and Adoption of EDC technologies in health research Institutions.....	17

2.6 Privacy, Security and Adoption of EDC technologies in Health Research Institutions.....	19
2.7 User-Friendliness or Usability and adoption of EDC technologies in Health research Institutions.....	20
2.8 Theoretical Framework.....	21
2.8.1 Performance Expectancy (PE).....	22
2.8.2 Effort Expectancy (EE).....	22
2.8.3 Social Influence (SI).....	22
2.8.4 Facilitating Conditions (FC).....	23
2.8.5 Hedonic Motivation (HM).....	23
2.8.6 Habit (HB).....	23
2.7 Summary.....	26
CHAPTER THREE: RESEARCH METHODOLOGY.....	27
3.1 Introduction.....	27
3.2 Research Design.....	27
3.3 Target Population.....	27
3.4 Sample Size Determination and Sampling Procedure.....	28
3.4.1 Sample Size.....	28
3.4.2 Sampling Procedure.....	28
3.5 Research Instruments.....	30
3.5.1 Pilot Testing.....	30
3.5.2 Validity of Research Instrument.....	30
3.5.3 Reliability of Research Instrument.....	31
3.6 Data Collection Procedure.....	31
3.7 Data Analysis Techniques.....	31
3.8 Ethical Considerations.....	32
3.9 Operational of Variables.....	32
CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATION.....	36
4.1 Introduction.....	36
4.2 Questionnaire Response Rate.....	36

4.3 Socio-demographic Characteristics of the Respondents.....	37
4.4 EDC access factors and adoption of electronic data capture technologies.....	39
4.5 Initial Start-Up Cost and Adoption of electronic data capture technologies	43
4.6 Institutional Leadership and Adoption of electronic data capture technologies.....	45
4.7 Privacy and Confidentiality of EDC tools and its Adoption in selected Health Research Institutions.....	47
4.8 User-Friendliness or Usability of EDC technologies and its adoption in Health Research.....	49
4.9 Adoption of EDC technologies in Health Research Institutions in Kisumu County ...	51
CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.....	54
5.1 Introduction.....	54
5.2 Summary of Findings.....	54
5.3 Discussion of Findings.....	55
5.3.1 EDC access factors and adoption of electronic data capture technologies.....	56
5.3.2 Initial start-up cost and adoption of electronic data capture technologies.....	56
5.3.3 Institutional leadership and adoption of electronic data capture technologies	57
5.3.4 Privacy and confidentiality of EDC tools and adoption of electronic data capture technologies	58
5.3.5 User-Friendliness or Usability of EDC technologies and its adoption in Health Research.....	59
5.4 Conclusions.....	59
5.5 Recommendations.....	60
5.6 Suggestions for Future Research	60
REFERENCES.....	62
APPENDICES.....	67
APPENDIX I: LETTER OF TRANSMITTAL	67
APPENDIX II: QUESTIONNAIRE.....	68
APPENDIX III: RESEARCH AUTHORIZATION LETTER	77
APPENDIX IV: NACOSTI RESEARCH PERMIT.....	78
APPENDIX V: NACOSTI RESEARCH IDENTIFICATION CARD	79

LIST OF TABLES

Table 3.1: Operational of Variables.....	33
Table 4.1 Questionnaire Response Rate.....	36
Table 4.2: Socio-demographic characteristics of respondents	37
Table 4.3: Electronic data capture technologies known by respondents	40
Table 4.4: Devices used to capture electronic data.....	40
Table 4.5: Method of data capture used	41
Table 4.6 access of electronic data capture technologies and its influence on its adoption.....	41
Table 4.7: Test of Hypothesis 1.....	42
Table 4.8: initial start-up cost and its influence on its adoption	43
Table 4.9: Test of Hypothesis 2.....	44
Table 4.10 institutional leadership and its influence on its adoption?	45
Table 4.11: Test of Hypothesis 3	46
Table 4.12: on privacy and security of EDC technologies and its influence on its adoption	47
Table 4.13: Test of Hypothesis 4	48
Table 4.14: user-friendliness or usability of EDC technologies and its influence on its adoption.....	49
Table 4.15: Test of Hypothesis 5	50
Table 4.16: adoption of EDC technologies.....	51
Table 4.17: Model Summary	52
Table 4.18: ANOVA ^b	52
Table 4.19: Coefficients ^a	53
Table 5.1 Contributions to the Body of Knowledge.....	61

LIST OF FIGURES

Figure 1: Unified Theory of Acceptance and Use of Technology (Venkatesh, 2003).....	24
Figure 2 Conceptual Framework.....	25

ABBREVIATIONS AND ACRONYMS

BI:	Behavioral Intention
CAS:	Computer administered Surveys
CDMA:	Code Division Multiple Access
EC:	European Commission
eCRF:	Electronic Case Report Form
EDC:	Electronic Data Capture
EDGE:	Enhanced Data Rates for GSM Evolution
EE:	Effort Expectancy
EHR:	Electronic Health Records
EMRs:	Electronic Medical Records
FC:	Facilitating Conditions
GoK:	Government of Kenya
GPRS:	General Packet Radio Service
GPS:	Geographical Positioning System
GSM:	Global Positioning for Mobile
HM:	Hedonic Motivation
ICT:	Information Communication Technology
ODK:	Open Data Kit
OS:	Operating System
PCs:	Personal Computers
PDA:	Personal Digital Assistant
PE:	Performance Expectancy
RTI:	Research Triangle International
SI:	Social Influence
SMS:	Short Messaging Services

ABSTRACT

With the advent of Information and Communication Technologies (ICTs) and the legislative ICT policy guidelines and targets, researchers in the Health Sector are inclined to adopt electronic data capture technologies. This study entitled “Perceived factors influencing adoption of electronic data capture technologies in selected health research institutions in Kisumu County” sought to enumerate those factors that lead to reluctance by such institutions to adopt such promising technologies. The study was guided by five objectives namely: to establish the influence of initial start-up cost, user friendliness, privacy, security, and institutional leadership in adoption of electronic data capture technologies in health research institutions in Kisumu County. The study adopted a cross-sectional survey design and mixed methods concurrent approaches to gather responses from 216 respondents purposively selected from health research institutions in the study population. A semi-structured questionnaire with a 5-point Likert scale was used. Data was then entered using a statistical package Statistical Package for Social Scientists (SPSS v20) software with appropriate codes and variable specifications and counter-checked for possible erroneous entries. Data analyzed based on the themes of research objectives. The specific effects of independent variables vis-à-vis dependent variable were tested through multivariate analysis. The test of hypotheses to determine the level of significance of an independent variable against the dependent variable were tested through multiple regression analysis and correlation. The significance level was set at probability $p < 0.05$ for every statistical set. For the parametric data, Pearson’s product Moment Correlation Coefficient (r) and regression R^2 analysis was used. The influence of moderating variable on the relationship between the independent and dependent variables were derived by using Regression R^2 . Pilot testing to ascertain the validity and reliability of research instrument was done prior to the study. The respondent rate stood at 88% with more females 118(54.6%) than males participating in this survey. No significant relationship exists for the EDC start-up cost and adoption of EDC technologies. A linear relationship $F(5, 20) = 12.20, p < 0.05$ exists between adoption of EDC technologies and factors influencing its adoption in the study setting. Three of the predictors, access to EDC technologies ($\beta = 0.072$), institutional leadership ($\beta = 0.193$), privacy and security of EDC technologies ($\beta = 0.139$) and user-friendliness of EDC technologies ($\beta = 0.339$) have positive influence on the adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya. However, initial start-up cost of EDC technologies ($\beta = -0.011$) had negative coefficients. The conclusion of the study is that institutional leadership, user friendliness of EDC technologies and data security have strong influence on adoption of EDC technologies in health research institutions in Kisumu County. There is need for further research on financial modelling on either electronic and paper based methods of data collection or a combination of both.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Health research has made a considerable contribution to the development and advancement of a number of disciplines all aimed at improving populations' wellbeing and quality of life. Such research has led to immense understanding of the epidemiology of various ailments, development of vaccines, seat belt use, identification of various risk factors and development of sustainable interventions(Blumenberg & Barros, 2016). It is important to note that such studies involve use of a considerable large numbers of human participants, complex designs and high costs. With this in mind, there comes another problem of increasing complexity in modern research. This is putting additional demand and pressure on researchers to do more in less time with high level of efficiency and effectiveness(Packington & Beardon, 2015). Included in these demands is the need to stay on budget, maintain compliance and at the same time generate quality results in research activities(Fitzgerald & Fitzgibbon, 2014). It is imperative to note that there are a number of strategies being employed by many health research institutions to enable them keep abreast with such research demands(Kush, 2006). It is on this basis that many research organizations have come to realize the substantial contribution of electronic data capture (EDC) as a promising technology as opposed to the traditional paper-based methods of data collection.

Data collection forms an integral component of public health systems research(Packington & Beardon, 2015). Worth mentioning is that decision makers, researchers, policy makers and health service providers have always demanded for accurate and timely data to support their decisions in developing strategies geared towards quality service(s) delivery(Shao & Shao, 2012). There are two broadly classified methods of data collection and management in health research. These include the traditional paper-based and the ICT-based electronic data capture methods also referred to as electronic data capture methods in this particular study.

Hard copies commonly referred to as paper-based technologies have always been the norm in research. Paper –based questionnaires are gradually being phased out in most large and advanced clinical research studies (Packington & Beardon, 2015). The shortcomings of paper-based data capture technologies have included but not limited to the challenges of delivering lengthy questionnaires where many subjects are to be enrolled, difficulty in performing timely data quality checks and reduction of errors to maintain data integrity among others (Blumenberg & Barros, 2016). Besides, there is a longer period between data collection and analysis with paper-based data capture technologies(Fitzgerald & Fitzgibbon, 2014). In addition, paper-based methods of data collection and management consume a lot of time, relatively costly and are susceptible to human errors(Anokwa, Hartung, Lerer, Derenzi, & Borriello, 2007). Another flaw with the paper-based system of data collection can be the longevity in the time taken to complete the study all the way from research conceptualization, design through piloting and data collection, data entry and analysis up to dissemination of findings(Fitzgerald & Fitzgibbon, 2014). The paper further indicates that the output of such studies can be met with delays to the extent that they can be released at a time when validity of such information may be questionable(Bruland et al., 2016).

An EDC is a web based software specifically designed to capture and store health research participant data collected in health research studies(Gray & Gilbert, 2017). Such technologies focus on data acquisition aspect of a clinical research and therefore embraces the use of technology and controlled movement of the captured electronic data throughout the process(Pavlović, and Miklavčič 2009). The technologies provide the needed automated and real-time Tool for data collection, query resolution, reporting and validation are among other attributes in health research(Schobel, Schickler, Pryss, & Reichert, 2014). There is a recognized trend in adoption of EDC in health research(Kush, 2006). What remains unclear is the extent of use of EDC in health research. Capabilities of the automated system vary from the simplest basic stand-alone Technologies basically used for data entry in small studies to an elaborate complex or systems designed for sophisticated studies like large multi-site clinical trials. In these sophisticated systems, entry and validation of data is done over the web(Packington & Beardon, 2015).There are

few documented studies showing that the use of EDC technologies can speed up clinical research initiation, reduce the duration of study implementation and at the same time reduce data errors. EDC has provided health researchers with a rare opportunity to help check and identify missing data, control questions being posed and at the same time check for invalid answers to questions posed in real time thereby reducing survey and analysis time(Schobel et al., 2014). With EDC in use, it is possible to track the enrollment process in real time.

Having highlighted the attributes of EDC systems, it is equally imperative to discuss some of the flaws with the EDC systems. Several reports have indicated that EDC adoption has been met with failure rates of up to 70% with only 20% of trials being documented to be using EDC systems(Bart, 2003). This translates to the fact that EDC systems are met with high failure rates with low adoption rates. This poses a handful of questions to EDC developers and implementers(Arora, Yttri, Ph, Nilsen, & Ph, 2014). Derived from the above mentioned motivation, this study intends to identify the factors that influence the adoption of EDC Technologies among selected health research institutions in Kisumu County, western Kenya a county characterized with a lot of health research activities to contain the escalating HIV/AIDS pandemic, malaria and other communicable diseases as a promising investment to overcome the flaws of paper-based methods of data collection. Could it be that the technology is quite sophisticated or are there some obstacles being faced in changing the systems in health research to accommodate EDC data capture systems. It is this that the basis of this that the primary objective of this study is founded to investigate the factors that influence adoption of electronic data capture technologies in selected research organizations in Kisumu County, western Kenya.

1.2 Statement of the Problem

EDC Technologies have the capability to speed up health research initiation, reduce the duration of study implementation and at the same time reduce data errors. In addition to this, EDC systems have provided health researchers with the opportunity to help check and identify missing data, control questions being posed and at the same time check for invalid answers to questions posed in real time thereby reducing survey and analysis time. With

EDC in use, it is possible to track participant enrollment process in real time and at the same-time generate preliminary data analysis on ad hoc basis(Fitzgerald & Fitzgibbon, 2014). EDC Technologies like those embedded in tablets and smartphones offer an array of applications for data collection across the world with health research being no exception. These applications commonly referred to as “Apps” allow researchers to share digital questionnaires to data collectors who then collect responses on real-time basis and upload them on to the server. This has led to efficiency, accuracy and quality of data(Packington & Beardon, 2015).

Despite the benefits provided by EDC technologies and further recommendations by leading research institutions like the American based Research Triangle International (RTI) for research partners to embrace electronic data collection technologies, it still remains unclear and is being hypothesized that many health research institutions are still reluctant to fully embrace electronic data capture technologies. Instead, they continue using the traditional paper-based data capture systems(Blumenberg & Barros, 2016). Worse still, the respondents are burdened in time, inconvenience and privacy given that there is a face to face interaction with the interviewer when revealing some information out of which some content may be confidential(Harjumaa et al., 2016).Failure to adopt the EDC technologies in data collection would slow down research and development processes and at the same time increase lead-time in conducting research activities.

1.3 Purpose of the Study

The purpose of this study was to establish factors that influence adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya

1.4 Objectives of the Study

- i) To determine the extent to which access to EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya
- ii) To establish the extent to which initial start-up cost of EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya

- iii) To investigate the extent to which institutional leadership influence adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya
- iv) To verify the extent to which privacy and security of EDC technologies influence its adoption in selected health research institutions in Kisumu County, Western Kenya
- v) To determine the extent to which user-friendliness of EDC technologies influence their adoption in selected health research institutions in Kisumu County, western Kenya

1.5 Research Questions

- i) To what extent does access to EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya
- ii) To what extent does initial start-up cost of EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya
- iii) To what extent does institutional leadership influence adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya
- iv) To what extent does privacy and security of EDC technologies influence its adoption in selected health research institutions in Kisumu County, Western Kenya
- v) To what extent does user-friendliness of EDC technologies influence their adoption in selected health research institutions in Kisumu County, western Kenya

1.6 Research Hypothesis

The study sought to test the following hypothesis:

1. There is no significant relationship between access to EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.
2. There is no significant relationship between initial start-up cost of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.
3. There is no significant relationship between institutional leadership and its adoption in selected health research institutions in Kisumu County, western Kenya.

4. There is no significant relationship between privacy and security of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.
5. There is no significant relationship between user-friendliness of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

1.7 Significance of the Study

This study sought to generate data, on among others, the extent to which EDC has been embraced by the different research institutions in Kisumu County. Such findings will be disaggregated by nature of organization and eventually determine whether there exist relationships in addition to enumerating the most commonly used electronic data capture technologies. Such findings will be key to relevant authorities and stakeholders including program managers, researchers, software developers and academic institutions. To the program managers, researchers and decision makers, it will identify existing gaps and opportunities necessary for ensuring efficiency and effectiveness in services delivery when ICT-based data collection technologies are employed. The findings will be key to software developers by aiding their informed decisions when developing the data collection kits, which are less sophisticated, and user friendly. Lastly, to the academic fraternity, the findings will identify ICT knowledge gaps and opportunities for embracement of EDC technologies for quality research. This proposed research therefore intended to identify the factors that influence the adoption of EDC systems among selected health research institutions in Kisumu County, western Kenya as a promising investment to overcome the flaws of paper-based methods of data collection.

1.8 Limitations of the Study

The study focused on respondents who have attained post-secondary level of education. Such informed populations are in most cases inclined to modify their behaviour and responses to fit the context of the subject under investigation; phenomenon commonly referred to as the Hawthorne effect in research. Since most people especially those in researches do not want to have a feeling that they have been left behind in technological aspects, they gave dishonest responses. To overcome this, the research assistants

emphasized the essence of research and assured participants of data confidentiality measures put in place.

Another aspect is that of respondent being affiliated to more than one institution in which case they were at cross roads to identify with one particular institution. Take for instance case of Part-time Lecturers and other researchers engaged by different institutions on part-time basis. To overcome this, the researcher intended to ask respondents to identify with those institutions where they have been for a much longer duration of time.

1.9 Delimitation of the Study

This study is entitled “Perceived factors influencing adoption of electronic data capture Technologies in health research institutions in Kisumu County, Western Kenya”. The study was only focused on the views and responses from those researchers in the health setting as the primary unit of analysis thereby excluding those from other fields like Agriculture, economics among others that largely are also involved in human subjects’ research. Secondly, there is an array of electronic data capture and management technologies including the use of scanners but this study was particularly focused on those used in health research. Lastly, this study was not intended to profile the various institutions by names and type of data collection system being used but will basically group the institutions broadly as either those that are government, NGO, Company and or privately governed.

1.10 Assumptions of the Study

This study was guided by two major assumptions. The first one being that concerned with the readiness of the respondents to spare their time and participate in the study following their consent. This fear was attributed to the busy schedule that the study population has bearing in mind that most of these were researchers with deadlines and timelines to beat. The second assumption is a concern brought about by the Hawthorne effect. It is expected that the high level of knowledge, experience and fear of the unknown did not necessitate respondents to modify their behaviour and their perception during the time of interview.

1.11 Definition of Terms

Access: Availability or capacity to have a given technology within reach. In this case to develop, prototype or use any EDC technologies

Adoption of electronic data capture technologies: The use and or non-use of the available electronic data capture technologies in health research institutions.

Application(s): An information technology or computer based program or software designed to perform a set of coordinated functions, tasks or activities for the benefit of the user. In this case, application refers to that technology developed to perform data capture, real time reporting query functions and processing.

Confidentiality: The extent to which an EDC technology guarantees study participant or subject that their personal information or identifiers are not captured by the EDC technology

Clinical Research: A systematic and well-designed investigation aimed at determining the safety and effectiveness of medicines, devices and associated treatment regimens intended to improve the health and wellbeing of human populations.

Data Security: Refers to those measures in place to ensure that electronically collected data are accessed or manipulated by authorized persons only.

EDC technologies: web based advancements specifically designed to capture, organize, synchronize and securely store health research participant data collected in health research studies

Institution(s): any organization or organizations, establishments, foundations or anything of that sort primarily devoted to the advancement of a particular cause in this case health research especially that of either public, educational or anything of the sort

Institutional Leadership: Refers to the structures and people involved in decision making and controlling resources in health research institutions

Initial Start-up Cost: Refers to the amount of resources required to start the whole process of building and establishing a reliable and effective EDC system

Privacy and security of EDC technologies: Activities that clearly defines and restricts who accesses, modifies or deletes any data captured by the EDC technologies

Protocol: Agreed upon procedure or system of rules guiding development of an electronic Data Capture system

Validation: Refers to the process of checking for those values, which are out of range or any unrealistic data or variable combinations.

User-friendliness of EDC technologies: Extent to which the end-users of an EDC technology finds it easy to maneuver and manipulate the EDC technologies with little or no challenges

1.12 Organization of the Study

The final study is organized into five major chapters with various sub-headings under each of the five chapters. Chapter one of the study is focused on the background of the study, statement of the problem, purpose of the study, study objectives, research questions, hypothesis, significance of the study all through study assumptions, limitations and delimitations before summarizing with definitions of key terminologies. Chapter two commonly referred to as the literature review section will immediately follow this. Chapter two reviews existing literature, identify gaps, and at the same time illustrate the frameworks of the study. Chapter three, also referred to as methodology section highlights and describes the design of the study, target population, sample size and estimations, sampling procedure, reliability and validity of research instruments, types of analysis through definition of variables before ending with ethical considerations. Chapter four presents the presents from analysis, interpretation and discussion before ending with chapter five that deals with summary of key findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section presents reviewed literature on the major conceptualized variables in this study related to adoption of electronic data capture Technologies in Health Research Institutions in Kisumu County. Also presented is the overview of electronic data capture Technologies, EDC technology and access related factors, start-up and EDC systems maintenance capacity cost, privacy and security factors before concluding with the theoretical as well as the conceptual frameworks.

2.2 Adoption of Electronic Data Capture Technologies in Health Research Institutions

Urgent need for a variety of effective technologies has become a priority to address the challenges with data collection in health research settings. The much needed reliable data is essential for decision-making and research purposes(FrÃ, en et al., 2016). Due to the rapid advancement in technology, there is great excitement arising from the use of such technologies and devices in the health sector(Schobel et al., 2014). Such devices like smartphones and Personal Digital Assistants (PDAs) are much faster and accurate than the traditional paper-based methods of data collection(Anokwa et al., 2007). They can even be more accurate and less expensive(Roberts, Hine, Morey, Snee, & Watson, 2013).

Paper and pencil has in the past formed part and parcel of the traditional form of data collection in health research(Hanaka, 2006). This approach is time consuming as it involves physically visiting the respondents, questionnaires fill out and data recording(Satterlee, McCullough, Dawson, & Cheung, 2015). Worse still, the respondents are burdened in time, inconvenience and privacy given that there is a face to face interaction with the interviewer when revealing some information out of which some content may be confidential(Harjumaa et al., 2016).

Electronic data collection technologies can take different forms including computer administered Surveys (CAS) and internet survey(Tuten,1997). There are many benefits associated with electronic data collection so are the obstacles(Bruland et al., 2016).

2.2.1 Common features of EDC Systems

According to Forte Research systems Inc., EDC systems are created differently depending on the interest and the capability of the user and the developer respectively. Most EDC systems have slight variations in features but any other general EDC software is aimed at streamlining data collection and review(Arora et al., 2014). The common features of EDC systems include:

Cloud hosting. A good number of electronic data capture systems are cloud-hosted and data entry is conducted on a web-based interface. Being hosted in the cloud guarantees easy access of data from anywhere with any browser for as long as there is internet connectivity. This also offers additional data storage, protection and back up. Another aspect is user-permissions. Controlled access to data is of extreme importance more so on issues pertaining to participant's confidentiality and integrity of the data in the databases.

With effective EDC systems, each authorized user is identified with a unique username, which is, password protected and with designated permission boundaries. In this way, it is possible to limit what respective users have access to and clearly defines the actions they can perform within the system. Electronic Case Report Form (eCRF) is incorporated with a number of options to allow for selection and optimization of the developed forms for data entry, export and replication of assessments like in questionnaires. This also gives an additional option of saving eCRFs in a shared library and ends with the programming of edit checks to aid in prevention of data errors(Arora et al., 2014). Successful installation of the data collection instrument into the EDC system also allows for data entry into the appropriate eCRF followed by performance of real-time checks on data as it is entered into the system(Anokwa et al., 2007). All these activities are controlled by regular checks pre-programmed into the eCRFs. Query management allows for well-coordinated communication between investigators, research monitors, data officials and study

coordinators(Roberts et al., 2013). In most systems, auto-generated queries exist. All queries are supposed to be responded to before data is locked. Also built into an EDC system is an audit trail function to support validation and compliance with the controls in place. An audit trail tracks history of eCRFs; functions which include the details of the person who made the change, date and time change was effected, both old and new values added as well as reasons for modifications(Satterlee et al., 2015). Lastly, a data export capability allows for data retrieval out of the system. In addition, there are some EDC systems with in-built metrics reporting that offer an indication of study progress.

2.2.2 Electronic Data capture technologies

Computer Assisted Surveys (CAS) are program designed and work to administer the questions and at the same time gather the responses as chosen by the respondents. The CAS survey may be administered in several ways including by gathering participants in a central location and asking them to respond to the questions, installation on organization's network and lastly, the program can be installed on an individual's computer(Tuten, 1997).

The benefits of CAS include reduced levels of social desirability, respondents' perception of the survey as being less time consuming and enjoyable, no need for data entry and there is additional room for prompting of questions(Harjumaa et al., 2016). Computer Administered surveys were also found to have a significant reduction in project costs compared to the traditional paper based method(Cobb et al., 2016). CAS is also associated with a number of shortcomings including its expensive nature, incompatibility of the software with other Technologies and some researchers may not be comfortable with computers(Fraser et al., 2012)

With electronic mails, the surveys are electronically sent to respondent's email address where they are expected to read, respond and send back the survey to the sender. Another option for respondents is to print out the survey, and answer as if a printed questionnaire scan and send back to the sender. Electronic mail offer an array of benefits including ease of sending questionnaire and responses, reduced implementation cost compared to phone interview or face to face interview and at the same time eliminates time zone challenges of

implementing study as with telephone interview(Fraser et al., 2012). Drawbacks with electronic mail may include: additional data entry needed, different Technologies used by different email subscribers may be incompatible meaning the email may not function properly. Another drawback with electronic mails is the tendency of individuals to delete mails which are not of interest to them(Harjumaa et al., 2016). Tendency of individuals to disregard questionnaire design is witnessed with electronic mails where respondents opt to rewrite, modify and delete their own questions(Gray & Gilbert, 2017).

A web survey typically involves conducting surveys on websites. As much as a good number of firms have adopted web as the main tool for conducting market research, it remains unclear whether web technologies will be acceptable for scientific researchers. Among the many drawbacks with web surveys is that individuals who can gain access to webs are fewer compared to those undergoing either mail or telephone interviews(Fraser et al., 2012). Secondly, the population is in most cases widely unknown making it completely difficult to contact the respondents for clarifications.

Mobile devices are those computing devices that are portable. They include smartphones, tablet computers among other devices of the same nature. Being mobile, these devices are highly susceptible to theft and losses and if used for collecting data on participant identifiers, the Principal Investigators (PI) must ensure that participants' subject data are encrypted and data erased in any event of theft. Mobile applications also known as Mobile Apps are software programs that are designed to collect data that can be remotely stored or sent to other remotely stored locations. Mobile Apps, in health have the capacity to collect data either in passive or active forms(Cobb et al., 2016). Active data collection is the most commonly used mode of data collection in health research and always involves participant consent. Use of mobile technologies to perform various data collection tasks has significantly increased in the recent past. Rapid use of handheld devices like smartphones has led to creation of demand for ICT based data collection solutions, which is expected to narrow the information gap in health research. Usability of mobile data capture technologies is measured in terms of effectiveness, efficiency and user satisfaction(Onoka, 2017).

Production of more hand held devices is to a large extent attributed to rapid advancement in communication and information technologies(Fojtik & Habiballa, 2006). Hand held devices are suitable for data capture and transfers. Mobile devices cannot work in isolation; they also need a well-established support and reliable connection infrastructure to communication networks(Bruland et al., 2016). The most commonly used data communication systems include but not limited to GSM technologies like EDGE, CDMA and GPRS(Fojtik & Habiballa, 2006).

PDA's have been in existence for as early as 1990 where they have been used in medical research. However, use of PDA's has been associated with high cost, power outages, accidental data loss as well as slow speed of data download in various formats(Onoka, 2017). PDA's have better mobility are use Pocket PC, Symbian, windows mobile and Palm OS as the main operating systems(Fojtik & Habiballa, 2006). They are relatively small in dimensions, instant response to commands as well as software and hardware extensibilities. These small handheld computers have an in-built calendar, contacts, notes applications, a web browser, keyboards and pen-based input systems that act as data input systems. The smartphone is another technology that is promising and increasing health care research, quality, expansion of access to services, reduction in costs as well as public health research. Adolescents and youth have embraced smartphones and digital data connections are now becoming more frequent than voice calls(Onoka, 2017). These benefits can only be guaranteed if individuals have confidence in the privacy aspects of their personal information and if researchers are also assured of the security and integrity of the collected data(Arora et al., 2014). Smartphones are mobile telephones with applications similar to those of PDA's(Roberts et al., 2013). A wireless smartphone with text and internet connectivity does wireless calls, send and receive data, access information on the internet and also have the capabilities of faxing transmissions(Osoti et al. 2015). They use various operating systems including android, iOS, windows, blackberry OS, Palm OS, and Symbian. Smartphones have the capabilities to communicate with PCs, databases and servers(Fojtik & Habiballa, 2006). Smartphones have internal sensors that capture data from the environment including location. They also have a transportation or carrier mode, sound mode and interactions. These phones also have the capabilities of assessing the

various parameters upon an individual's interaction with the device e.g. by taking photos, touching screen and both video and audio recordings(Gray & Gilbert, 2017).

Notebooks are portable personal computers that can be designed to have wireless networking in the forms of Wi-Fi, Infra port and Bluetooth alongside a mobile processor(Wong et al., 2017). They belong to the family of those machines that enable users to work from home. Notebooks are tipped for replacement by tablet personal computers due to the additional added functions of mobility, touch display and ease of connectivity embedded on tablet computers(Fojtik & Habiballa, 2006). Tablet computers are wireless PCs that allow users to do note taking using a stylus, digital pen or touch screen(Wong et al., 2017). Tablet computers are similar to paper notepads in size and thickness. Tablet computers are of two types: the slate type with a removable keyboard and the second type being the convertible model with an in-built keyboard and display that rotates and can be folded over the keyboard(Fojtik & Habiballa, 2006). The handwritten notes can be edited and indexed and shared via electronic mail or phone(Wong et al., 2017).

2.3 Access to EDC devices and adoption of EDC technologies

Maganjo (2017) defines ICT as a term that includes any communication devices or applications that may include mobile phones, computer network hardware as well as services and applications like videoconferencing. Availability of different communication technologies at manageable prices is very crucial in adoption of EDC technologies in health research institutions. This implies that lack of access to these devices impose obstacles in the adoption of EDC technologies and in addition, a good number of devices may not be compatible with the existing ICT strategies in health research institutions. All these put together may lead to sheer reluctance by various health research institutions to embrace the EDC technologies. ICT based data collection technologies has been seen as a means of overcoming such barriers related to time and distance. Codified information can be exchanged between different users regardless of distance. This is only possible if EDC systems of data capture are embraced. As much as information may be transmitted across geographical boundaries, geographical location of study population may influence adoption of EDC technologies adoption in health research institutions.

2.4 Start-up Cost and Adoption of EDC technologies in health research Institutions

Worldwide, the cost of installing ICT based systems is very high; probably one of the main reasons why most health institutions adopt paper-based or manual systems of data collection. These installation costs include employee-training costs, consultancies to trainers and service providers. In contrast, the benefits provided by a well-designed and implemented EDC system to a health institution exceeds the costs incurred during installation.

According to Maganjo (2017), economic resources have adverse effects on the adoption of EDC technologies in health research organizations. Financial resources are documented to play a major role in embracement of decisions, as high costs of acquiring technologies have been found to be a barrier in adoption of ICT based technologies in the health sector. Resources are needed not only for procurement of ICT devices but also for installations, maintenance of the technology as well as its future enhancements. Use and maintenance of EDC systems involve costs that come not only comes from the purchase of the devices but also emanates from staff training, information technology support, system upgrades, migration costs and governance among others. Such costs accumulate and in turn becomes a barrier to adoption of electronic digital capture technology. It is well documented that the initial startup cost of designing and testing survey instruments are quite higher than that of designing the traditional paper-based questionnaires(Onoka, 2017). Additionally, there may be need to procure an additional back-end technology and hire the necessary expertise to ensure the required system is in place(Iwaya, 2016).

The same study conducted by Maganjo (2017) reports yet another finding that provision of training to the ICT based end users significantly increases technology adoption in organizations. The same study goes ahead and indicates that those systems that are perceived by researchers as user friendly have increased chances of being adopted by potential users. In addition, significant costs incurred in transition from paper to electronic systems poses a hindrance to work productivity and management of staff costs which may include hiring data clerks, data cleaning and hiring a system administrator to manage technical issues that may arise(Khan, Shahid, Hedstrom, & Andersson, 2013). Availability

of affordable and reliable internet connectivity plays a key role in adoption of EDC systems in Public Health research settings. Transmission of research data and other health research information is greatly hindered if communications and internet coverage and connectivity are unreliable. Health research institutions that are better equipped with good managerial and high levels of ICT infrastructures are more likely to adopt EDC technologies. Rapid and growing interest in EDC systems adoption has a lot to do with the growth of internet users worldwide with a larger percentage of the users reported to be residing in developing world with countries with high literacy rates and established telecommunication infrastructure enjoying a higher internet dispersion.

Poor and underdeveloped internet connectivity in developing countries hinders EDC technologies adoption in health research institutions. Additionally, among the developing countries, those with reliable internet connectivity still have challenges with bandwidth. Embracement of any EDC technologies varies greatly depending on the available resources to the program or institution. Research has it that digitally data collection enabled technologies has a huge potential in reducing both research and healthcare costs (Fleischmann, Decker, Kraft, Mai, & Schmidt, 2017). Nearly 1.5 billion people in the world do not have access to electricity. Electricity access problem is well pronounced in sub-Saharan Africa where almost half of the population is documented to be lacking access to electricity. According to Maganjo (2017), the urban electrification rate in most countries in sub-Saharan Africa stands at 57% with only 12% of the people documented to have access to electricity in rural settings. Many remote settings in Kenya are without access to electricity though the government, through its rural electrification program is trying to scale up electricity connections in rural areas. Important to note is that without reliable electricity connection, it will be almost impossible for health research institutions to adopt electronic data capture technologies unless other reliable sources of energy are adopted.

2.5 Institutional Leadership and Adoption of EDC technologies in health research

Institutions

Health institutions can only increase their commitment to ICT based data capture systems if there is existence of strong leadership and a focused vision. Essential for successful

implementation of EDC systems are: a shared ICT frameworks adoption vision and a well-articulated institutional leadership and governance structures. Also crucial is a well-financed and well-coordinated efforts in resource development and among others a favourable regulatory and or policy infrastructure(Delikostidis, 2007). Mobilization of organizational support is necessary for wide introduction and sustainability of EDC systems.

An institution's previous experience with any EDC system greatly determines the adoption or non-adoption of any ICT based data collection technologies. According to Maganjo (2017), good corporate governance is key in successful implementation and subsequent embracement of ICT based data capture technologies. Good corporate governance includes good practices and a clear management structure that establishes good relationship between the managers, researchers and field staff. Effective delivery of any strategy becomes smooth if the institution assigns the right personnel to oversee the exercise. Good leadership is essential in improving EDC technologies adoption in health research institutions as it boosts employees' morale and at the same time leads to improvement in the working environment. Different leadership styles exist and the most important bit is the understanding between leaders and followers. Effective leadership also increases health research institution's operations and leads to empowered employees. There should be no discrimination of employees as this leads to feeling of demoralization and isolation. A section of employees sidelined by their supervisors has great temptation to interfere or sabotage systems including ICT based systems. This is made possible if senior management is in place to drive the ICT policy, conduct sustainability champions and at the same time effectively communicate its importance to every level of the organization. There is also need for such EDC systems that lead to effective internal controls. Good financial information systems at the institution level help in timely error detection. Proper training of employees directly translates to positive results to the research institution. This may be in the forms of good reputation and wealth maximization. It is interesting to note that most research organizations are reluctant to invest heavily in their employees for fear of losing them out to their competitors.

2.6 Privacy, Security and Adoption of EDC technologies in Health Research

Institutions

According to a report published in April 2014 by the European Commission (EC), the use of digital devices in health setting is hampered by among other factors including lack of regulations and standards for data protection, privacy and security concerns on both data and the digital devices themselves(Harjumaa et al., 2016). EDC demands a very high level of network security, availability, reliability and adequate transmission capacity. Security and reliability of the EDC networks is a key factor in their adoption. It is therefore important to guarantee integrity, confidentiality and security of sensitive data of research participants if ICT based EDC are to be embraced(Iwaya, 2016). To be able to derive the needed clinical and research benefits from EDC technologies, there is need for technical standardization of the technologies with existing hardware(Street, 2004). Privacy of research participants' information is worth considering should any health research institution think of adopting any electronic method of data capture. Security flaws exist in medical and research information control systems. Unlike most countries in developing countries, privacy of personal information especially with research data is taken seriously and the law protects personal information in health research. Non-adopters of EDCs like Electronic Medical Records (EMRs) have a belief that such EDC platforms compromises patient or research participant's privacy(Christodoulakis and Easterbrook 2017).

System reliability is another issue worth consideration. There is always that fear of loss of already collected data in any event that such electronic system crashes(Sevtsuk, & Ratti, 2007).Health researchers should always ensure that secure data is obtained if mobile technologies are to be used. There are a number of means of securing data and these include: App protection or encryption of data storage and transmission whereby the mechanisms to be used must comply with the policies of the institution and at the same time provide the App user with the required protection(Delikostidis, 2007). Although other challenges related to adoption of ICT based technologies exist, security and privacy of research participant's information from either accidental or malicious use remain the two most important challenges.

2.7 User-Friendliness or Usability and adoption of EDC technologies in Health research Institutions

Researchers are often reluctant to embrace technology in data collection due to a number of factors including but are not limited to the scale, pace and speed of proliferation of the technology(Wentzel, P., Lammeren, R. V., Molendijk, M., Bruin, S. D., & Wagtendonk, 2005). This is further characterized by lack of education and needed training in deploying EDC technologies in health research. Research staff also lack adequate training and skills to confidently and effectively use the technologies(Osoti et al. 2015). Concerns are also raised about reliability, data overload, security and privacy of such technologies(Gray & Gilbert, 2017). Human resources play a key role in setting up an effective EDC system in health research. Education for health research staff is key for success in EDC platforms' adoption. Education can take different forms including continuing education in health related areas as well as their integration with ICT related capacity building initiatives. Training of health researchers in ICT is a prerequisite to demystification of EDC technologies and e-health in general and its adoption by researchers and other healthcare professionals(Street, 2004). It is also proposed that medical curriculum and other related training programs to be included in the normal day-to-day training for researchers. Consumers or clients should also be informed, as well-informed consumers are powerful enough to create sufficient pull in adoption of EDC technologies.

According to a utilization of health portal research conducted in Portugal, the users of electronic data capture portals like Electronic Health Records (EHR) consist of populations younger than the average with a higher level of education(Tavares & Oliveira, 2017). Human social influence also play a role in adoption of electronic platforms as this influence may originate from support groups and social media.

Lack of proper training to the staff can hamper electronic data capture technologies adoption. A point in case is when participants fail to remember to switch off their phones when not in use which eventually leads to failure to submit data in real time. Possibility of data fabrication by data collectors has been reported with mobile based household survey in addition to theft of mobile devices(Onoka, 2017).

Cost of training researchers and data collectors is yet another factor that has been an obstacle in the adoption of EDC technologies in health research institutions. In most health research institutions, as much as the employers are concerned about the quality of work from the various research activities, there is that panic that they may lose their skilled staff upon their completion of such trainings.

Installation of a new system in any health research institution urgently calls for training of the end users on how to operate the system effectively. Without the knowledge and skills, it becomes practically impossible to use the system.

2.8 Theoretical Framework

This study employed the Unified Theory of Acceptance and Use of Technology (UTAUT) theoretical model. This model is driven by the fact that both practitioners and academicians are more than interested in enriching their understanding on the main influences and human behaviour that lead to adoption of a given proposed technology (Mutlu & Der, 2017). UTAUT is more than a decade old and has found its extensive use in information systems (IS) and other ICT technology based fields. It focuses on the key individual level factors that have great influence in technology acceptance and at the same time aids in identification of the factors or contingences that may affect technology adoption (Venkatesh, Thong, Statistics, Xu, & Acceptance, 2016) vis. UTAUT model of acceptance was accepted following review of the eight prominent models in user acceptance of technology (Venkatesh et al., 2016). The eight models include: The Technology Acceptance Model (TAM) by Davis, The Theory of Planned Behaviour (TPB) by Ajzen, The Theory of Reasoned Action (TRA) by Fischbein and Ajzen, Model combining TAM and TPB by Taylor AND Todd, The Motivational Model by Davis and Bagozzi, The PC utilization model by Thompson and Higgins, The Social Cognitive Theory (SCT) by Bandura as well as The diffusion of Innovation Theory (DOI) by Rogers (Mutlu & Der, 2017). The UTAUT model is grounded, applied to the adoption of electronic data capture technologies, and may involve the following components:

2.8.1 Performance Expectancy (PE)

Refers to the extent to which EDC technologies would be beneficial to their job performance(Venkatesh et al., 2016). Performance expectancy in this case is expected to influence the use and acceptance of electronic data capture technologies(Lai, 2017). Several studies have indicated PE to be having very high explanatory powers on various variables on behavioral intention (BI). PE also has a significant influence on BI on use of digital applications(Taiwo & Downe, 2013). In the adoption of electronic data capture technologies, researchers handle and manage large volumes of data collection tools of which EDC tools play a great role in reducing the labourious and tiresome work of filing large volumes of work hence performance expectancy.

2.8.2 Effort Expectancy (EE)

Refers to the extent or ease of use of the proposed technology which in this case is the electronic data capture technologies like tablet computers(Lai, 2017). There exists a direct positive relationship between EE and BI. Results from other studies indicate that PE, EE and SI are great determinants of BI on technology adoption on trainee teachers. Technologies are intended to simplify the burden of manual work processing by increasing the speed of data collection. Increased speed ultimately leads to faster data collection and timely submission of health related research data.

2.8.3 Social Influence (SI)

Defined as the extent to which individual perceive that how important others (fellow researchers, donors or friends) believe they should use the new system, which in this case are the EDC technologies. It literally means others peoples' recommendation considered important for the new technology to be used. SI assumes that other peoples' influence will positively determine the adoption of the new technology(Venkatesh et al., 2016). UTAUT emphasizes direct effect of SI on behavioral intention moderated by age, gender, experience and voluntariness(Taiwo & Downe, 2013). The effect of SI on behaviour of individuals is through three mechanisms including compliance. Internalization as well as identification(Venkatesh et al., 2016). The effect of compliance is better pronounced in mandatory settings like research institutions which are governed by policies and

guidelines(Venkatesh et al., 2016). The effect of internalization and identification on the other hand are better well pronounced in voluntary settings for example a situation when an individual wants to conduct his on research. Additionally, women are said to be more sensitive to other people's opinions and views. Older and mature researchers have a much stronger desire for affiliation needs and are in-turn most likely to be affected by other people's views on adoption of technology(Taiwo & Downe, 2013). Health research is not left behind. researchers are networked and will always strive to learn and get to know what other organizations are using in data collection. That is social influence.

2.8.4 Facilitating Conditions (FC)

Is the degree of having a belief that a person's organizational and or technical infrastructural capacity is suited to support effective and efficient use of the innovation (EDC). It affects BI and its use. This may involve structures and departments in various health research institutions. For instance, proper coordination and definition of roles of various departments will ultimately lead to adoption of EDC technologies in health research organizations.

2.8.5 Hedonic Motivation (HM)

Refers to the fun or enjoyment associated with use of the innovation. It is that happiness derived from use of the technology. It plays a key role in ensuring that individuals accept the BI for embracement of technology. In this case, cost and pricing of the proposed innovation (EDC) may have a significant role to play in acceptance of the technology(Mutlu & Der, 2017). The speed of real time data processing and analysis is associated with the joy or fun in various health research institutions.

2.8.6 Habit (HB)

The degree to which individuals tend to perform behaviors automatically for the sake of learning(Taiwo & Downe, 2013). HB is normally regarded as a prior behaviour and measured as that extent to which people believe that behaviour can be automated(Lai, 2017). That fear or automation of individual's behaviour may be a barrier in adoption of EDC technologies in health research institutions.

Figure 1: Unified Theory of Acceptance and Use of Technology (Venkatesh, 2003)

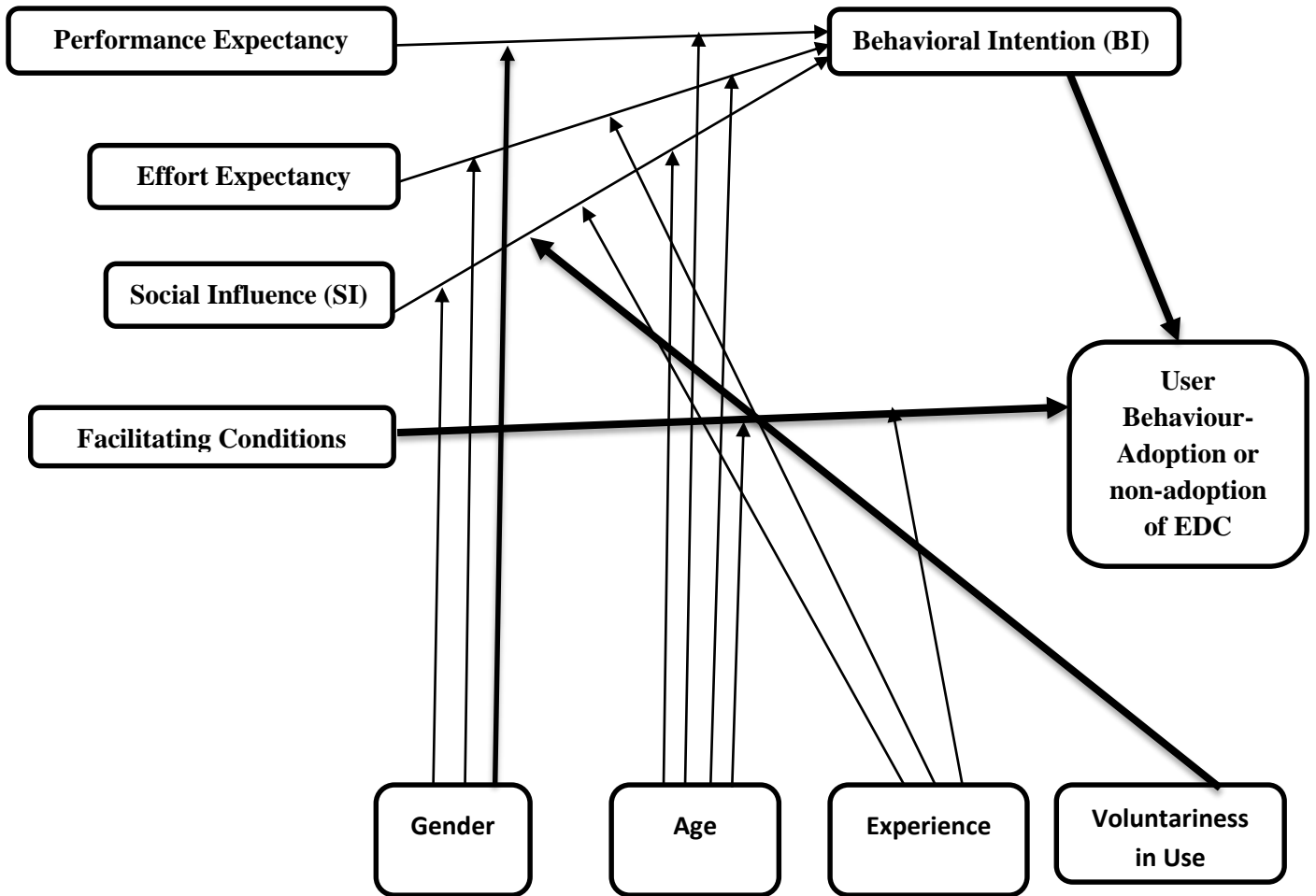
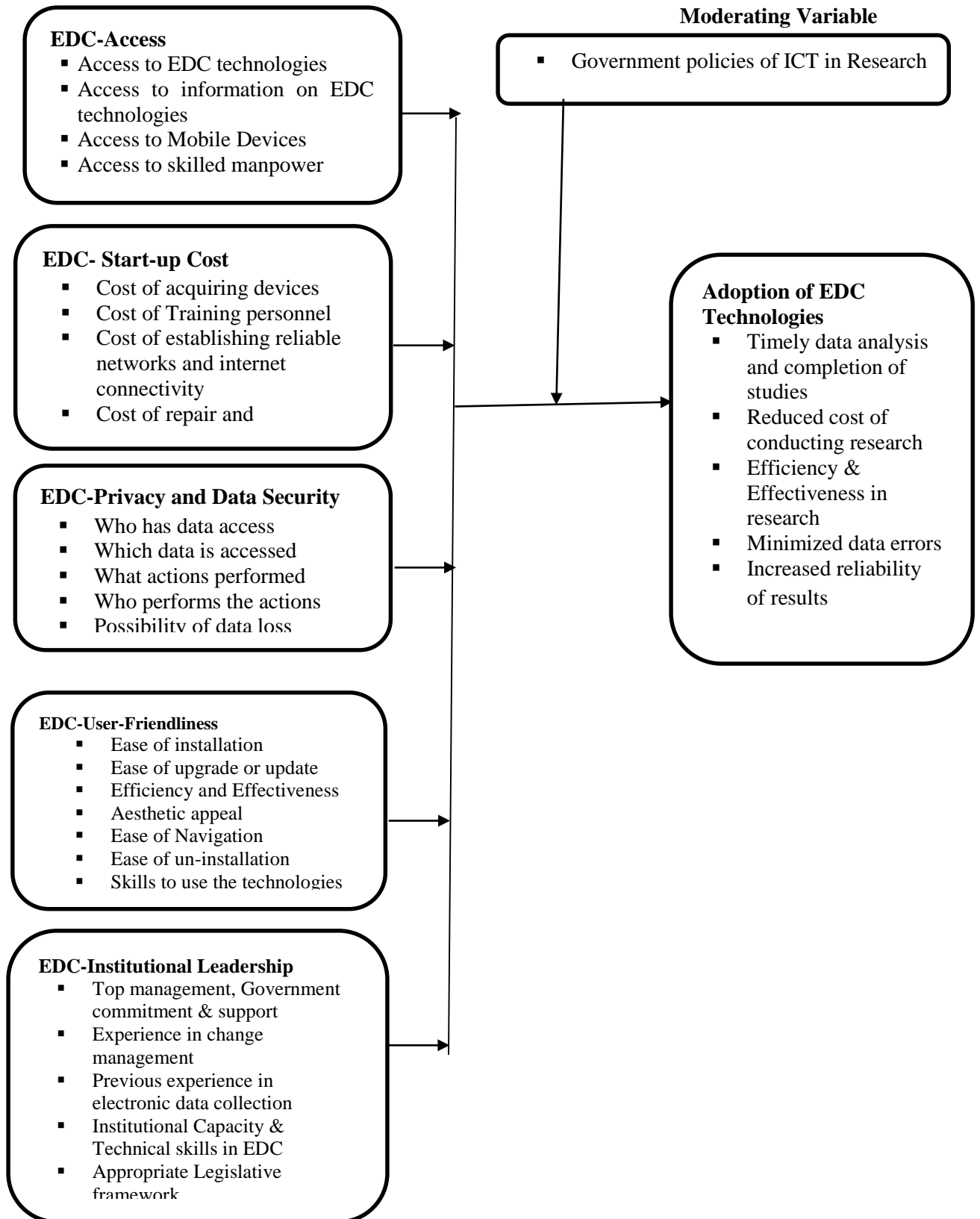


Figure 2: Conceptual Framework



As clearly denoted in the conceptual framework in figure 2 above, there are five main independent factors may influence adoption of electronic data capture technologies in health research institutions. These include access to EDC technologies, initial start-up cost of EDC technologies, privacy and data security, user friendliness of EDC technologies as well as institutional leadership.

2.7 Summary and knowledge gap

Previous studies reviewed largely concentrated on factors influencing adoption of electronic medical records in various hospital settings with a handful of studies and research focusing on factors influencing adoption and integration of ICT based technologies in Health Information Management systems. No single study has focused on factors influencing adoption of electronic data capture and management technologies in general save for health research institutions. This study therefore intends to go to the next level and investigate factors influencing adoption of electronic data capture technologies within health research settings. In order to ensure that EDC technologies are adopted in health research, effective EDC systems must not only provide researchers with reliable connectivity but must also see to it that such technologies are predictable, efficient and sensitive to the safety of research participants. Health Research Institutions are under obligation to evaluate the potential implications of EDC and optimize them to adopt to local conditions while at the same time being prepared to minimize risks associated with EDC technologies service delivery. In chapter two, we reviewed literature on the works of different authors on the variables under investigation. A considerable number of authors agree that electronic data capture technologies can increase the speed and accuracy of conducting research. However, there is lack of documented evidence on factors that may have influence on adoption of electronic data capture technologies in research settings leave alone health research set up. Secondly, there is no documented evidence on comparison of paper-based versus electronic methods of data capture.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Chapter three presents research design, target population, sample size determination and sampling procedure, data collection instruments and procedures, validity and reliability of the instruments, pretesting of the instruments, data analysis techniques, ethical considerations before ending with operational definitions of the major study variables.

3.2 Research Design

A Descriptive cross-sectional survey was conducted in understanding of the perceived factors influencing adoption of electronic data capture technologies among selected health research institutions in Kisumu County. A descriptive survey by nature is applicable when a researcher is interested in collecting data from a given predefined population in relation to one or more variables (Grimes & Schulz, 2002). According to Simiyu (2009), descriptive studies are employed to describe the existing conditions to explore existing relationship(s) between independent variables and that of the outcome dependent variable (Wiens, 1996).

3.3 Target Population

Target population by definition refers to those individuals, elements, subjects or groups to be studied (Roncalli, & Weisang, 2013). The target population for this research who were actively involved in health research at the time of interviews or those who took part in health related research for period not exceeding twelve months. They included Principal Investigators, study coordinators, Study Monitors, Data Officers, Data entry clerks, ICT professionals, Clinicians, Nurses, Laboratory personnel Biostatisticians, Health Records Officers, Research Assistants, and Data Collectors among others. These were derived from private research institutions, NGOs and Public Health facilities in Kisumu County. The population was categorized by the nature of institutions that ranged from private, MoH, NGO, Faith-based, Company, Parastatal health institutions provided they were involved in health research. According to the Ministry of Health (MoH) fact file for Kisumu County published in 2015, there were a total of 216 registered health institutions or facilities in Kisumu County disaggregated as 122 MoH, 44 private, 19 Non-Governmental

Organizations (NGO), 11 Local Authorities (LA), 2 Company owned, 17 faith-based institutions and 1 academic institution in Kisumu County.

3.4 Sample Size and Sampling Procedure

Sample size for this study was derived from the various institutions involved in human health related research in Kisumu County. For representativeness, the samples were derived from the health staff currently involved or ever participated in health research data collection. Since it is not cost effective to compute the total number of staff employed and at the same time engaged in health research institutions (Private, NGOs, government, faith-based , parastatal and local), purposive sampling was also used for this study.

3.4.1 Sample Size

The sample size (n) was calculated using the formula adapted from Mugenda & Mugenda (2003) and Charan & Biswas (2013) for cross-sectional studies.

$$n = \frac{Z^2 PQ}{d^2}$$

Whereby:

- Z = 1.96 (the standard nominal variate at 5% type 1 error, p<0.05).
- P =20%, the proportion of clinical trials that have fully adopted electronic data collection technologies in health research institutions
- Q = 1-p, and d= 0.05 at 95% level of significance or precision. This gives a sample size of 245 respondents as study participants.

3.4.2 Sampling Procedure

The health research institutions from which the respondents was drawn were divided into five (5) major categories namely MoH facilities, NGOs, Private Health facilities, Faith based Organizations and institutions of higher learning. The above-mentioned categories of institutions are located in the seven (7) sub-counties or clusters within Kisumu County namely Kisumu West, Kisumu Central, Kisumu East, Seme, Muhoroni, Nyando and Nyakach.

Each cluster or sub-county was treated as a representative of subset of the study population (Amin, 2005), which comprised of five categories of respondents; investigator, research assistants, study coordinators, data persons and administrators were selected purposively with only those who had participated or actively be participating in research at the time of interview selected for interviewing purposes. This approach, highly recognized by other authors (Kothari, 2004; Amin, 2005) due to its ability to help reduce on the cost and time of data collection.

To arrive at the number of clusters to which to concentrate the study, first, the average size of the clusters (24.5 healthcare authorities) was determined by dividing the total number of healthcare authorities in Kisumu County, which is 860 according to Kenya Health Sector Human Resources Strategy 2014-18. This was divided by 7, the number of clusters (sub-counties) in the study area [$860/7 = 122$]. The study sample size was then divided by average cluster size [$245/122 = \text{two}$], thereby giving at least two (2) sub counties as required number of clusters. Next, was to consider how to scientifically select the two clusters (sub-counties) from the seven clusters in Kisumu County with minimal bias. This was done by the simple lottery random sampling method described by Amin (2005) and bearing in mind that Kisumu Central was the hub of all research activities hence considered as the first cluster by default.

At cluster level, the purposive sampling method described by Kothari (2004) and Amin (2005) was used. The method involved selecting respondents from each sampled cluster based on known roles i.e. currently participating or having participated in health research data collection activities. The purposive sampling allowed a fair representation (Amin, 2005) of all categories of healthcare authorities that constituted in the study population.

In purposive sampling, the subjects are selected with a purpose in mind (MacDonald & Headlam, 1999). With this non- probability-sampling method, the investigator in most cases has predefined participant categories to form part of the study. In this study, those who are either currently involved in health research activities or have ever participated in health research were purposively form the inclusion criteria. Purposive sampling is useful

in situations where the researcher needs to reach the targeted sample quickly and where proportionality in sampling is not a main concern or is not easy to determine. When purposive sampling is employed, the researcher gets opinions or views of the targeted population with a likelihood of reaching those populations who are easily accessible (convenience approach). The human resources departments and reception desks for respective institutions will act as the initial point of entry for research assistants to obtain a complete listing of relevant departments for the study.

3.5 Research Instruments

Given the high literacy levels of the study population, self-administered semi-structured questionnaires were employed, as this enabled concurrent collection of both quantitative and qualitative data. A five-point Likert scale was used with meanings as shown: (1) Strongly Disagree (SD), (2) Disagree (D), (3) Uncertain (UN) (4) Agree (A) and (5) Strongly Agree (SA). The strongly agreed responses was scored at five (5) for direct positive responses while those of strongly disagreed responses was scored at one (1).

3.5.1 Pilot Testing

Pilot testing was necessary to determine the relevance, wording and ambiguous questions based on the types of responses elicited (MacDonald & Headlam, 1999). The semi-structured questionnaires were administered to a handful of research participants in Muhoroni Health Center/Dispensary where 8 respondents were targeted for this preliminary assessment of the research instruments.

3.5.2 Validity of Research Instruments

Validity has been defined as the ability of the data collection technologies to measure what it purports to measure. It can also be defined to the degree to which the results obtained from the study are representative of the phenomenon under investigation (MacDonald & Headlam, 1999). The instrument was evaluated for the wording, vocabulary, sentence structuring and ambiguity. This was done through various ways including mock pre-testing with the peers, piloting and through scrutiny by my supervisor and other experts in the field of study.

3.5.3 Reliability of Research Instrument

Reliability is defined as the degree to which research instruments yield consistent results after repeated experiments (Kimberlin & Winterstein, 2008). Reliability of the semi-structured questionnaire was ascertained by piloting in a sample group similar in characteristics to the population under investigation. This is necessary to determine the faults and deficiencies in content and corrective measures taken prior to conducting the study. This was followed by preliminary analysis of the piloted data to ascertain whether the gathered data answered the research questions. To test for the reliability of the research instruments, a section of non-research respondents were randomly selected at Migosi health Centre and questionnaires administered to them. The filled questionnaires were later scrutinized for the responses that were generated and consistency of the results observed over time.

3.6 Data Collection Procedure

Upon successful proposal defense, a Research Clearance letter was obtained from the University of Nairobi's Department of Open Learning. This was used to obtain a Research Permit from the National Commission for Science, Technology and Innovation (NACOSTI) followed by seeking relevant approvals from the purposively selected health research institutions to conduct research in their institutions. Informed consent was also obtained from potential study participants prior to administration of questionnaires. Trained research assistants to the respondents based on the eligibility criteria distributed the questionnaires. The respondents went around collecting filled questionnaires and at the same time made constant call reminders to schedule collection dates with the respondents. The filled questionnaires were checked for completeness before data entry.

3.7 Data Analysis Techniques

Data analysis followed four phases and these included data cleaning, reduction, differentiation and explanation. Data cleaning involved editing, coding and tabulation in order to detect anomalies. Data was then entered on pre-designed Ms Access database, which was later exported, to STATA for statistical computations.

The exported data was later analyzed based on the themes of research objectives. The specific effects of independent variables vis-à-vis dependent variable were tested through multivariate analysis. The test of hypotheses to determine the level of significance of an independent variable against the dependent variable were tested through multiple regression analysis and correlation. The significance level was set at probability $p < 0.05$ for every statistical set. For the parametric data, Pearson's product Moment Correlation Coefficient (r) and regression R^2 analysis was used. The influence of moderating variable on the relationship between the independent and dependent variables were derived by using Regression R^2 . This regression model involves mathematical modelling, as postulated by Larry (2013) that such models are used where variables are deliberately chosen without necessarily being backed by theory. Since the influence on the moderating variable was deliberate for this study, then the requirement for the use of Regression R^2 to analyze parametric data is justified.

3.8 Ethical Considerations

All ethical approval processes and procedures were sought from the relevant authorities ranging from University of Nairobi Ethics Committee, NACOSTI and Kisumu County Ministry of Health as well as other relevant authorities. Informed consent will be sought from all participants prior to administration of self-administered questionnaire. All the relevant aspects of the research were explained to the participants. They were assured of confidentiality, right to withdrawal and the benefits of taking part in this study.

3.9 Operational of Variables

The study variables were operationalized definition of study variables is as shown in Table 3.1 below

Table 3.1: Operational of Variables

Independent Variables	Indicators	Scale of Measurement	Statistical Analysis
<p>1. Access to EDC Technology factors and its adoption</p>	<ul style="list-style-type: none"> ▪ No. of those with information on EDC technologies ▪ No. and types of EDC technologies in us ▪ No. and types of electronic gadgets and devices ▪ No. of available EDC technologies ▪ Speed and accuracy with EDC technologies 	<p>Ordinal</p>	<p>Chi-Square and Regression Analysis</p>
<p>2. User-friendliness or Usability of EDC technologies and its adoption</p>	<ul style="list-style-type: none"> ▪ Ease of installation ▪ Ease of upgrade or update ▪ Efficiency and Effectiveness ▪ Aesthetic appeal ▪ Ease of Navigation ▪ Ease of un-installation 	<p>Ordinal</p>	<p>Chi-Square Correlation and regression analysis</p>
<p>3. Start-up cost of EDC technologies and its adoption</p>	<ul style="list-style-type: none"> ▪ Cost of purchase and installation of EDC technologies ▪ Cost of hiring and retaining ICT skilled personnel ▪ Cost of Training and Building capacity of research staff 	<p>Ordinal</p>	<p>Chi-Square and regression analysis</p>

	<ul style="list-style-type: none"> ▪ Cost of establishing reliable internet connectivity ▪ Cost of repair and maintenance of EDC technologies 		
<p>4. Institution related factors and adoption of EDC technologies in health research</p>	<ul style="list-style-type: none"> ▪ Top management support and commitment ▪ Availability of Institution's policy and frameworks ▪ Institution's past experience in change management ▪ Institutions past experience with EDC technologies ▪ Availability of ICT infrastructure at the institution ▪ Access to intra/internet 	Ordinal	Chi-square, regression analysis
<p>5. Privacy and Security factors and adoption of EDC technologies in health research</p>	<ul style="list-style-type: none"> ▪ Those with data access ▪ Type of data is accessed ▪ Actions performed on accessed data ▪ Persons who performed actions ▪ Possibility or chances of data loss 	Ordinal	Chi-square, regression analysis

Dependent Variable	Indicator	Scale of Measurement	Statistical Analysis
6. Adoption of EDC technologies in health research institutions	<ul style="list-style-type: none"> ▪ Timely transmission of research results ▪ Reduced errors in data gathered ▪ Real-time response to data queries ▪ Increased accuracy in research data ▪ Reduction in cost and time of conducting health 	Ordinal	Chi-square tests and regression analysis

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents findings on factors influencing adoption of electronic data capture technologies in selected health research institutions in Kisumu County. The findings are presented as per study objectives: the extent to which access to EDC technologies influence its adoption, the extent to which initial start-up cost of EDC technologies influence its adoption, the extent to which institutional leadership influence adoption of EDC technologies, the extent to which privacy and security of EDC technologies influence its adoption and the extent to which user-friendliness of EDC technologies influence their adoption in selected health research institutions in Kisumu County, western Kenya. The results are based on a response rate of 88.2% (n=216).

4.2 Questionnaire Return Rate

This study targeted a sample size of 245 respondents out of which 216 filled in and returned the questionnaires, making a total response rate of 88.2% as shown on Table 4.1.

Table 4.1 Questionnaire Response Rate

Category	Frequency	Percentage (%)
Investigator	4	1.6
Research Assistant	84	34.3
Study Coordinator	16	6.5
Administrator	14	5.7
Data Clerk/Manager	60	24.5
Other	38	15.5
Total	216	88.2

The response rate of 88.2% was good enough and in conformity with Mugenda and Mugenda (2003) who stipulated that a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good while a response rate above 70% is excellent. It is therefore true that the response rate obtained from this study was excellent and representative of the target population. This response rate was reliable in producing useful results and make meaningful conclusions.

4.3 Socio-demographic Characteristics of the Respondents

The study captured the socio-demographic characteristics of the respondents and these included gender, level of education, age, position held in the institution, length of work, organization life, and type of institution and source of funding of the institution. The results are presented in Table 4.2 below.

Table 4.2: Socio-demographic characteristics of respondents

		Frequency	Percent (%)
Gender	Male	98	45.4
	Female	118	54.6
	Total	216	100.0
Level of education	Certificate	8	3.7
	Diploma	106	49.1
	Degree	88	40.7
	Postgraduate	14	6.5
	Total	216	100.0
Age	Less than 20	2	0.9
	20-25	28	13.0
	26-30	52	24.1
	31-35	54	25.0
	36-40	62	28.7
	41 and above	18	8.3
	Total	216	100.0
Years spent in institution	Less than 1 year	56	25.9

	2-3 years	68	31.5
	4 years and above	92	42.6
	Total	216	100.0
Type of institution	Academic	8	3.7
	Faith Based Institutions	8	3.7
	MOH facility	60	27.8
	NGO	116	53.7
	Private Health Facility	12	5.6
	Other	12	5.6
	Total	216	100.0
Source of funding	Institution budget	22	10.2
	Sponsors	146	67.6
	Government allocation	36	16.7
	Other	12	5.7
	Total	216	100.0

From Table 4.2 above, it was showed that gender distribution out of the 216 respondents who participated in the study, 98 (45.4%) were males and 118 (54.6%) were females. This finding conforms to the Kenya government affirmative action policy that at least 30% representation should be of either gender .This showed that all gender was well represented in the study with females being the majority.

Out of 216 respondents, 8 (3.7%) had attained certificate, 106 (49.1%) close to average had diploma qualifications as their highest level of education, 88 (40.7%) had attained degree as their highest level of education whereas 14 (6.5%) had postgraduate as their highest level of education. This shows that the target population for this study comprised of people who are learned; typical of a health research setting.

Results show that out of the 216 respondents, majority 136 (63.0%) are 35 years and below compared to 80 (37%) who were above 35 years. This shows that majority of the respondents were youths and this could attributed to the fact that the young people are technology receptive.

Out of the 216 respondents 56 (25.9%) of the respondents have worked for less than one year, 68 (31.5%) between 2 and 3 years and 92 (42.6%) had over four years of experience. This shows that majority 74.1% had worked for more than two years. This shows that majority of the respondents had experience in EDC technologies.

Findings show that 8 (3.7%) of the respondents were from the academic field and Faith based institutions respectively, 60 (27.8%) were from Ministry of health facilities, 116 (53.7%) were from NGOs, 12 (5.6%) were from private health facilities and from other institutions respectively. This implied that majority of the respondents were from institutions that massively use electronic devices in capturing data. It was also showed that majority 146 (67.6%) revealed that their institutions are funded by sponsors followed by 36 (16.7%) who mentioned that their institutions are funded by government.

4.4 EDC Access factors and adoption of electronic data capture technologies

The first objective of the study was to determine the extent to which access to EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya. Firstly, the respondents were asked to state the electronic data capture technologies that they know and the findings are presented in table 4.3 below.

Table 4.3: Electronic data capture technologies known by respondents

Category	Frequency (n=216)	Percentage (100%)
Open Data Kit (ODK)	148	68.5
SurveyCTO	74	34.3
Blaise	14	6.5
SurveyBe	10	4.6
SurveyToGo	16	7.4
Survey Solutions	20	9.3
Other	44	20.4

Majority 148 (68.5%) of the respondents mentioned that the electronic data capture technologies known and used by their institution was Open Data Kit (ODK), 74 (34.3%) SurveyCTO, 14 (6.5%) Blaise, 10 (4.6%) Survey Be, 16 (7.4%) Survey To Go and 44 (20.4%) knew of other electronic data capture technologies. ODK and Survey CTO are the most known and used electronic data capture technologies because they are user friendly. Respondents were also asked to indicate the devices used by their institutions to capture electronic data and the results are presented in Table 4.4 below.

Table 4.4: Devices used to capture electronic data

Category	Frequency (n=216)	Percentage (100%)
Mobile phones	38	17.6
Smartphones	84	38.9
Tablet Computers	138	63.9
Personal Digital Assistants (PDAs)	62	28.7
Other	46	21.3

Out of the 216 respondents 38(17.6%) reported using mobile phones in electronic data capture, 84 (38.9%) mentioned smart phones, 136 (63.9%) reported using tablet computers, 62 (28.7%) use PDAs and 46 (21.3%) use other devices to capture electronic data. Majority

136 (63.9%) use tablet computers to capture electronic data because data is mostly captured from offices and therefore a convenient device in capturing desk data as compared to field data. Respondents were further tasked to give the methods used in capturing electronic data and the results are presented in Table 4.5 below.

Table 4.5: Method of data capture used

Category	Frequency	Percentage
Electronic	14	6.7
Paper-Based Methods	14	6.7
Both Electronic and Paper	182	86.6
Total	210	100.0

Out of the 216 respondents 14(6.7%) reported that they use only electronic and paper based methods respectively to capture data while 182 (86.6%) are using both paper and electronic systems. From the results, it can be seen that there is a high adoption of EDC technologies in the health research institutions in Kisumu County, Western Kenya.

The respondents were asked to state their perceptions on the degree to access of electronic data capture technologies influenced adoption of EDC technology. Their responses ranged from 1-Strongly disagree to 5-Strongly Agree. The results are presented in Table 4.6.

Table 4.6: Influence of access to electronic data capture technologies on its adoption in health Research Institutions in Kisumu County

Perception	N	Mean	Std. Deviation
I have enough information concerning available/commonly used electronic data capture technologies/tools	216	3.8704	0.97497
I use electronic data capture technologies in my everyday life in my institution	216	3.8333	1.05213
Electronic data capture tools are available at my place of work	216	4.0926	0.85766
Different types of electronic data capture methods are available in my institution	216	3.8657	1.02323
Valid N (Listwise)	216	3.9182	0.63336

Composite scores shows that respondents agreed (M=3.91; SD=0.63) on the contribution of access of electronic data capture technologies on adoption of EDC technology. It is not possible to adopt a system without first having access to it. Access involves having in place computer hardware and software like the internet services. The respondents ranked first availability of electronic data capture tools (M=4.09 and SD=0.86). This shows that access to these devices aid in the adoption of EDC technologies so long as the devices are compatible with the existing ICT strategies in health research institutions.

The second ranked item was the availability of information. The respondents agreed (M=3.87; SD=0.97) to the notion that they had enough information concerning available/commonly used electronic data capture technologies/tools. Thirdly, they also agreed (M=3.87 and SD=1.02) on the statement that different types of electronic data capture methods were available in their institutions. Finally, the respondents were also in conformity (M=3.83 and SD=1.05) with the statement that they interface with electronic data capture technologies in their everyday life in their institution.

The first hypothesis stated that:

H_{1:1} There is no significant relationship between access to EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

A bivariate correlation was computed at 0.05 significance level involving variables for access to EDC technologies against adoption of EDC. The results are presented in Table 4.7 below.

Table 4.7: Test of Hypothesis 1

		EDC Access	EDC Adoption
EDC Access	Pearson Correlation	1	0.2377*
	Sig. (2-tailed)		0.000
	N	216	216
EDC Adoption	Pearson Correlation	0.2377*	1
	Sig. (2-tailed)	0.000	
	N	216	216

*. Correlation is significant at the 0.05 level (2-tailed).

At 0.05 significance level, the first hypothesis is accepted ($p < 0.05$). The conclusion is that there is a significant relationship between access to EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

4.5 Initial Start-Up Cost and Adoption of electronic data capture technologies

The second objective was to establish the extent to which initial start-up cost of EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya. To ascertain this, the respondents were asked to give their perception on the initial start-up cost and adoption of electronic data capture technologies on the following scale; Strongly disagree (1), Disagree (2), Uncertain (3), Agree (4) and Strongly agree (5). The results are presented in Table 4.8.

Table 4.8: influence of initial start-up cost on its adoption in Health research institutions in Kisumu County

Perception	N	Mean	Std. Deviation
Cost of purchasing and installing electronic data capture technologies influences its adoption in my institution	216	3.9259	1.01800
Cost of hiring and retaining ICT skilled staff influences adoption of EDC technologies at my institution	216	3.7500	0.97528
Cost of continuously training staff in EDC technologies influences its adoption in my institution	216	3.7037	0.96698
Cost of establishing reliable internet connectivity influences its adoption in my institution	216	3.9630	0.92436
Cost of establishing reliable electrical connectivity and its maintenance influences adoption of electronic data technologies in my institution	216	3.8056	1.06057
Costs related to repair and maintenance of EDC technologies influences its adoption in my institution	216	3.9028	1.07608
Valid N (Listwise)	216	3.8418	0.71964

Results from Table 4.8 above show that majority of respondents agreed that initial start-up cost of EDC technologies influences its adoption in their institution (M=3.84; SD=0.72). It was also mentioned that the following costs influence adoption of EDC technologies in their institutions; cost of purchasing and installing electronic data capture technologies (M=3.92; SD=1.02), cost of hiring and retaining ICT skilled staff (M=3.75; SD=0.98), cost of continuously training staff in EDC technologies (M=3.70; SD=0.97), cost of establishing reliable internet connectivity (M=3.96; SD=0.92), cost of establishing reliable electrical connectivity and its maintenance (M=3.81; SD=1.06), costs related to repair and maintenance of EDC technologies (M=3.90; SD=1.08).

The second hypothesis stated that:

H_{1:2} There is no significant relationship between initial start-up cost of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

A bivariate correlation was computed at 0.05 significance level involving variables for initial start-up cost of EDC technologies against adoption of EDC. The results are presented in Table 4.9 below.

Table 4.9: Test of Hypothesis 2

			Start-up cost of EDC	EDC Adoption
Start-up cost of EDC	Pearson Correlation		1	0.0862
	Sig. (2-tailed)			0.207
	n		216	216
EDC Adoption	Pearson Correlation		0.0862	1
	Sig. (2-tailed)		0.207	
	n		216	216

At 0.05 significance level, the second hypothesis is rejected ($p > 0.05$). The conclusion is that there is no significant relationship between initial start-up cost of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

4.6 Institutional Leadership and Adoption of electronic data capture technologies

The third objective was to investigate the extent to which institutional leadership influence adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya. To ascertain this, the respondents were asked to give their perception on institutional leadership and adoption of electronic data capture technologies on the following scale; Strongly disagree (1), Disagree (2), Uncertain (3), Agree (4) and Strongly agree (5). The results are presented in Table 4.10.

Table 4.10 Institutional leadership and its influence on its adoption of EDC technologies in health research institutions in Kisumu County

Perception	N	Mean	Std. Deviation
Top management support and commitment has influenced adoption of EDC technologies in my institution	216	3.9954	1.01385
Governance structures has influenced adoption of EDC technologies in my institution	216	3.6620	0.93592
Changes in leadership has influenced adoption of electronic data capture technologies in my institution	216	3.6435	0.98725
Institution's ICT/EDC related policy and legislative frameworks has influenced adoption of EDC technologies in my institution	216	3.76639	0.89171
My institution's past experience with EDC technologies has influenced its adoption	216	3.7639	0.98112
Valid N (Listwise)	216	3.7657	0.570438

Findings from Table 4.10 above show that majority of respondents agreed that institutional leadership influences its adoption in their institution (M=3.77; SD=0.57). It was mentioned that the following institutional leadership influence adoption of EDC technologies in their

institutions; top management support and commitment (M=4.00; SD=1.01), governance structures (M=3.66; SD=0.94), changes in leadership (M=3.64; SD=0.99), institution's ICT/EDC related policy and legislative frameworks (M=3.77; SD=0.89) and institution's past experience with EDC technologies (M=3.76; SD=0.98).

The third hypothesis stated that:

H_{1:3} There is no significant relationship between institutional leadership and its adoption in selected health research institutions in Kisumu County, western Kenya

A bivariate correlation was computed at 0.05 significance level involving variables for institutional leadership against adoption of EDC. The results are presented in Table 4.11 below.

Table 4.11: Test of Hypothesis 3

		Institutional leadership	EDC Adoption
Institutional leadership	Pearson Correlation	1	0.0031*
	Sig. (2-tailed)		0.000
	N	216	216
EDC Adoption	Pearson Correlation	0.3031*	1
	Sig. (2-tailed)	0.000	
	N	216	216

*. Correlation is significant at the 0.05 level (2-tailed).

At 0.05 significance level, the third hypothesis is accepted ($p < 0.05$). The conclusion is that there is a significant relationship between institutional leadership and EDC technologies adoption in selected health research institutions in Kisumu County, western Kenya.

4.7 Privacy and Confidentiality of EDC tools and its Adoption in selected Health Research Institutions

The fourth objective was to verify the extent to which privacy and security of EDC technologies influence its adoption in selected health research institutions in Kisumu County, Western Kenya. To ascertain this, the respondents were asked to give their perception on privacy and confidentiality of EDC tools and adoption of electronic data capture technologies on the following scale; strongly disagree (1), Disagree (2), Uncertain (3), Agree (4) and Strongly agree (5). The results are presented in Table 4.12.

Table 4.12: Descriptive Statistics on privacy and security of EDC technologies and its influence on its adoption

Perception	N	Mean	Std. Deviation
Risks of unauthorized access to electronically collected data influences adoption of electronic data capture tools in my organization	216	3.8148	1.12599
Research participants data safety and privacy issues influences adoption of electronic data capture technologies in my institution	216	4.3056	0.85680
Nature or type of participant data collected influences adoption of electronic data capture technologies in my institution	216	4.2278	0.74501
Potential risks of data loss with EDC technologies influences its adoption in my institution	216	3.9769	1.142660
Valid N (Listwise)	216	4.0938	0.75533

Findings from Table 4.12 above show that majority of respondents agreed that privacy and security of EDC technologies influences its adoption in their institution (M=4.09; SD=0.76). It was mentioned that the following privacy and security of EDC technologies influence adoption of EDC technologies in their institutions; risks of unauthorized access to electronically collected data (M=3.81; SD=1.13), research participants data safety and

privacy issues (M=4.31; SD=0.86), nature or type of participant data collected (M=4.23; SD=0.75) and Potential risks of data loss with EDC technologies (M=3.98; SD=0.76).

The fourth hypothesis stated that:

H_{1:3} There is no significant relationship between privacy and security of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya

A bivariate correlation was computed at 0.05 significance level involving variables for privacy and security of EDC technologies against adoption of EDC. The results are presented in Table 4.13 below.

Table 4.13: Test of Hypothesis 4

		Privacy and security of EDC technologies	EDC Adoption
Privacy and security of EDC technologies	Pearson Correlation	1	0.0021*
	Sig. (2-tailed)		0.000
	N	216	216
EDC Adoption	Pearson Correlation	0.3121*	1
	Sig. (2-tailed)	0.000	
	N	216	216

*. Correlation is significant at the 0.05 level (2-tailed).

At 0.05 significance level, the fourth hypothesis is accepted ($p < 0.05$). The conclusion is that there is a significant relationship between privacy and security of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

4.8 User-Friendliness or Usability of EDC technologies and its adoption in Health Research

The fifth objective was to verify the extent to which user-friendliness or usability of EDC technologies influence its adoption in selected health research institutions in Kisumu County, Western Kenya. To ascertain this, the respondents were asked to give their perception on user-friendliness or usability of EDC technologies and adoption of electronic data capture technologies on the following scale; Strongly disagree (1), Disagree (2), Uncertain (3), Agree (4) and Strongly agree (5). The results are presented in Table 4.14.

Table 4.14: Descriptive Statistics on user-friendliness or usability of EDC technologies and its influence on its adoption

Perception	n	Mean	Std. Deviation
Electronic data capture technologies that can be easily installed are likely to be adopted in my institution	216	4.3056	0.66063
Electronic data capture technologies that can be easily be upgraded or updated are likely to be adopted in my institution	216	4.3704	0.52105
Electronic data capture technologies with high level of efficiency and effectiveness are likely to be adopted in my institution	216	4.4074	0.59513
Aesthetic value of a user interface influences the type of electronic data capture technologies in my institution	216	4.0926	0.82447
Valid N (Listwise)	216	4.2939	0.4585

The results show that the respondents agreed (M=4.29; SD=0.46) on the influence of user-friendliness or usability of EDC technologies on the adoption and use of EMR technology in public health facilities in Nairobi. The respondents ranked first that electronic data capture technologies with high level of efficiency and effectiveness are likely to be adopted in their institution (M=4.41; SD=0.60). Secondly, the respondents agreed to the notion that electronic data capture technologies that can be easily be upgraded or updated are likely

to be adopted in my institution (M=4.37; SD=0.52). Thirdly, they also seemed to agree (M=4.31; SD=0.66) that electronic data capture technologies that can be easily installed are likely to be adopted in their institution. Lastly, also tended to agree (M=4.09; SD=0.82) that aesthetic value of a user interface influences the type of electronic data capture technologies in their institution.

The fifth hypothesis stated that:

H_{1:3} There is no significant relationship between user-friendliness of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya

A bivariate correlation was computed at 0.05 significance level involving variables for user-friendliness of EDC technologies against adoption of EDC. The results are presented in Table 4.15 below.

Table 4.15: Test of Hypothesis 5

		User-friendliness of EDC technologies	EDC Adoption
User-friendliness of EDC technologies	Pearson Correlation	1	0.000641*
	Sig. (2-tailed)		0.000
	N	216	216
EDC Adoption	Pearson Correlation	0.3641*	1
	Sig. (2-tailed)	0.000	
	N	216	216

*. Correlation is significant at the 0.05 level (2-tailed).

At 0.05 significance level, the fifth hypothesis is accepted ($p < 0.05$). The conclusion is that there is a significant relationship between user-friendliness of EDC technologies and its adoption in selected health research institutions in Kisumu County, western Kenya.

4.9 Adoption of EDC technologies in Health Research Institutions in Kisumu County

Table 4.16: Descriptive Statistics on adoption of EDC technologies

Perception	n	Mean	Std. Deviation
Adoption of electronic data capture technologies in my institution leads to transmission of research findings in time	216	4.3889	0.75739
Adoption of electronic data capture technologies in my institution leads to reduction in errors in the data we collect	216	4.1574	0.91663
Adoption of electronic data capture technologies in my institution leads to real-time data querying and response	216	4.4074	0.70923
Adoption of electronic data capture technologies in my institution leads to reduction in cost of conducting research	216	4.0648	1.02320
Adoption of electronic data capture technologies in my institution leads to reduction in overall time of conducting	216	4.2222	0.84445
Adoption of electronic data capture technologies in my institution leads to increased accuracy in the data we collect	216	4.3704	0.89018
Valid N (Listwise)	216	4.2685	0.56277

The descriptive statistics show that the respondents seemed to have a common opinion (M=4.27; SD=0.56) on adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya. The respondents agreed that; adoption of electronic data capture technologies lead to transmission of research findings in time in their institutions (M=4.39; SD=0.76), lead to reduction in errors in the data we collect (M=4.16; SD=0.92), lead to real-time data querying and response (M=4.41; SD=0.71), lead to reduction in cost of conducting research (M=4.06; SD=1.02), lead to reduction in overall time of conducting (M=4.22; SD=0.84) and lead to increased accuracy in the data we collect. A multiple linear regression analysis was computed at 0.05 significance level and the results are presented in Table 4.20, 21 and 22.

Table 4.17: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.501 ^a	0.225	0.207	.372875

a. Predictors: (Constant), AEDC, ISC, IL, PS, UF

The model summary shows that the correlation coefficient for the five predictors is average (R=0.501) which suggest that there exist an average degree of relationship between the predictors and indicators. Moreover, the adjusted R square is 0.225, which suggests that 22.5% of variation in adoption of EDC technologies and usage is explained by the five independent variables studied. To check the linearity of the quotation, an ANOVA goodness of fit test was computed. The results are presented in Table 4.18 below.

Table 4.18: ANOVA^b

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	15.3303478	5	3.06606955	12.20	0.0000
Residual	52.762245	210	.251248786		
Total	68.0925927	215			

a. Predictors: (Constant), AEDC, ISC, IL, PS, UF
b. Dependent Variable: EDC

The ANOVA statistics that there exist a significant regression equation, $F(5, 210) = 12.20$, $p < 0.05$. This implies that there is likely a linear relationship between adoption of EDC technologies and factors influencing its adoption and usage in selected health research institutions in Kisumu County, western Kenya. This means that at least one of the population partial regression coefficients of the predictors is not 0 and the population value for the multiple R squared coefficients of the analysis are presented in Table 4.19 below.

Table 4.19: Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 AEDC	0.0721744	0.0598351	0.0809441	1.21	0.229	-.04578	.1901288
ISC	-.01072598	0.0538122	-0.1371587	-1.99	0.048	-.213341	-.0011785
IL	0.1925801	0.0715769	0.1951841	2.69	0.008	.0514788	.3336815
PS	0.1387681	0.0515947	0.1862509	2.69	0.008	.0370582	.240478
UF	0.3385797	0.0804739	0.2758765	4.21	0.000	.1799394	.49722
(Constant)	1.650848	0.3728745		4.48	0.000	.9157917	2.385905

a. Dependent Variable: EDC

Key: AEDC- Access to EDC technologies, ISC- Initial start-up cost of EDC technologies, IL- Institutional Leadership, PS- Privacy and security of EDC technologies, UF- User-friendliness of EDC technologies and EDC – Electronic Data Capture.

Using the constant and β coefficients of access to EDC technologies (x_1), initial start-up cost of EDC technologies (x_2), institutional leadership (x_3), privacy and security of EDC technologies (x_4) and user-friendliness of EDC technologies (x_5), an estimated prediction (regression) equation for the model can be written as:

$$y = 1.651 + 0.072x_1 - 0.011x_2 + 0.193x_3 + 0.139x_4 + 0.339x_5$$

Three of the predictors, access to EDC technologies ($\beta=0.072$), institutional leadership ($\beta=0.193$), privacy and security of EDC technologies ($\beta=0.139$) and user-friendliness of EDC technologies ($\beta=0.339$) have positive influence on the adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya. However, initial start-up cost of EDC technologies ($\beta=-0.011$) had negative coefficients. Moreover the statistics reveal that initial start-up cost of EDC technologies, institutional leadership, privacy and security of EDC technologies and user-friendliness of EDC technologies factor had significant ($p<0.05$) effect on adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings of the study, discussions, conclusions and recommendations based on the study findings. The findings are summarized in line with study objectives; extent to which access to EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya; extent to which initial start-up cost of EDC technologies influence its adoption in selected health research institutions in Kisumu County, western Kenya, extent to which institutional leadership influence adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya, extent to which privacy and security of EDC technologies influence its adoption in selected health research institutions in Kisumu County, Western Kenya and extent to which user-friendliness of EDC technologies influence their adoption in selected health research institutions in Kisumu County, western Kenya. These are aimed at documenting factors that influence adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya.

5.2 Summary of Findings

The purpose of conducting this research study was to establish factors that influence adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya. The respondents for the study-involved investigators, research assistants, study coordinators, administrators and data clerks/managers. The study relied on researcher-administered questionnaires to determine their perceptions on probable factors likely to influence the adoption of EDC technologies in selected health research institutions. Data collected was analyzed using descriptive and inferential statistics. Conclusions were made based on the study findings.

Significant findings that were established from the study on the factors influencing the adoption of electronic data capture technologies in selected health research institutions were:

Influence of EDC access factors on adoption of electronic data capture technologies: The study established that there exists a significant positive relationship ($r=0.2377$; $p=0.000$) between EDC access factors and adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya.

Influence of institutional leadership on adoption of electronic data capture technologies: The study established that there exists a significant positive relationship ($r=0.3031$; $p=0.000$) between institutional leadership and adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya.

Influence of privacy and security of EDC technologies on adoption of electronic data capture technologies: The study established that there exists a significant positive relationship ($r=0.3121$; $p=0.000$) between privacy and security of EDC technologies and adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya.

Influence of user-friendliness or usability of EDC technologies on adoption of electronic data capture technologies: The study established that there exists a significant positive relationship ($r=0.3641$; $p=0.000$) between user-friendliness or usability of EDC technologies and adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya.

However, the study established that there existed no significant relationship ($r=0.0862$; $p=0.207$) between initial start up cost and adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya.

5.3 Discussion of Findings

Study results showed that there is high adoption of EDC technologies ($M=4.27$; $SD=0.56$) in selected health research institutions in Kisumu County, Western Kenya. The most EDC electronic data capture technologies known and used by the institution was Open Data Kit (ODK). ODK and Survey CTO are the most known and used electronic data capture

technologies because they are user friendly. There is high use of tablet computers to capture electronic data because data is mostly captured from offices and therefore a convenient device in capturing desk data as compared to field data. This finding is supported by (Bruland et al., 2016) and (Tuten,1997) who contend that electronic data collection technologies can take different forms including computer administered Surveys (CAS) and internet survey (Tuten,1997). There are many benefits associated with electronic data collection so are the obstacles (Bruland et al., 2016).

5.3.1 EDC access factors and adoption of electronic data capture technologies

Results of the study showed availability of electronic data capture tools (M=4.09 and SD=0.86).

This implies that this may lead to various health research institutions embracing EDC technologies. Maganjo (2017) established that EDC access factors were a primary and major barrier to EDC adoption. He reveals that availability of different communication technologies at manageable prices is very crucial in adoption of EDC technologies in health research institutions. This implies that lack of access to these devices imposes obstacles in the adoption of EDC technologies and in addition, a good number of devices may not be compatible with the existing ICT strategies in health research institutions. EDC access factors include availability of electronic data capture tools and availability of information. The study obtained positive coefficient ($\beta=0.072$). This therefore implied that increase in EDC access would improve the adoption and usage of EDC technologies. Therefore, the inadequacy of basic facilities needed to support EDC implementation blocks the widespread adoption of EDC technologies in health research institutions in Kisumu County, Western Kenya.

5.3.2 Initial start-up cost and adoption of electronic data capture technologies

On the influence of initial start-up cost, study results showed that initial start-up cost of EDC technologies influences its adoption in their institution (M=3.84; SD=0.72). The respondents reported that cost of purchasing and installing electronic data capture technologies, cost of hiring and retaining ICT skilled staff, cost of continuously training staff in EDC technologies, cost of establishing reliable internet connectivity, cost of

establishing reliable electrical connectivity and its maintenance and costs related to repair and maintenance of EDC technologies affect adoption of EDC technologies. The finding agrees with (Onoka, 2017) who established that the initial startup cost of designing and testing survey instruments are quite higher than that of designing the traditional paper-based questionnaires. There may be need to procure an additional back-end technology and hire the necessary expertise to ensure the required system is in place and this was cited as one of the factors to improve adoption of EDC technologies (Iwaya, 2016).

Coefficient results showed that among the five independent predictors studied, initial start-up cost had significant negative effect ($\beta=-0.011$, $t=-1.99$ and $p=0.048$) on the adoption EDC technologies in selected health research institutions in Kisumu County, western Kenya. This shows that as the initial cost increase the level of adoption of EDC technologies reduce. It was further revealed that the cost of purchasing and installing electronic data capture technologies, cost of hiring and retaining ICT skilled staff, cost of continuously training staff in EDC technologies, cost of establishing reliable internet connectivity, cost of establishing reliable electrical connectivity and its maintenance and costs related to repair and maintenance of EDC technologies influence adoption of EDC technologies. In addition, significant costs incurred in transition from paper to electronic systems poses a hindrance to work productivity and management of staff costs which may include hiring data clerks, data cleaning and hiring a system administrator to manage technical issues that may arise (Khan, Shahid, Hedstrom, & Andersson, 2013).

5.3.3 Institutional leadership and adoption of electronic data capture technologies

On the influence of institutional leadership on the adoption of electronic data capture technologies. It is showed from previous studies that institution's previous experience with any EDC system greatly determines the adoption or non-adoption of any ICT based data collection technologies. However, findings from this study revealed that institutional leadership on adoption of electronic data capture technologies in selected health research institutions in Kisumu County, western Kenya. Most of the respondents indicated that institutional leadership influences its adoption in their institution ($M=3.77$; $SD=0.57$). Health institutions can only increase their commitment to ICT based data capture systems

if there is existence of strong leadership and a focused vision. Essential for successful implementation of EDC systems are: top management support and commitment, governance structures, changes in leadership, institution's ICT/EDC related policy and legislative frameworks and institution's past experience with EDC technologies.

Good corporate governance is key in successful implementation and subsequent embracement of ICT based data capture technologies. Good corporate governance includes good practices and a clear management structure that establishes good relationship between the managers, researchers and field staff. Effective delivery of any strategy becomes smooth if the institution assigns the right personnel to oversee the exercise. The findings coincides with Maganjo (2017) research study that showed good leadership is essential in improving EDC technologies adoption in health research institutions.

5.3.4 Privacy and confidentiality of EDC tools and adoption of electronic data capture technologies

From the study, it shown that a higher percentage of researchers find the systems complex to use. This agrees a report published in April 2014 by the European Commission (EC), that the use of digital devices in health setting is hampered by among other factors including lack of regulations and standards for data protection, privacy and security concerns on both data and the digital devices themselves(Harjumaa et al., 2016).

The findings show that that privacy and security of EDC technologies influences its adoption in their institution (M=4.09; SD=0.76). This is in line with (Sevtsuk, & Ratti, 2007) who revealed that there is always fear of loss of already collected data in any event that such electronic system crashes (Sevtsuk, & Ratti, 2007). It was further mentioned that the following privacy and security of EDC technologies influence adoption of EDC technologies in their institutions; risks of unauthorized access to electronically collected data, research participants data safety and privacy issues, nature or type of participant data collected and Potential risks of data loss with EDC technologies. The obtained coefficient result was positive ($\beta=0.3121$) which suggests a positive relationship between privacy and confidentiality of EDC tools.

5.3.5 User-Friendliness or Usability of EDC technologies and its adoption in Health Research

User friendliness or usability of EDC technologies is one of the key factors for its adoption in health research. Study findings revealed that majority 86.6% use both paper and electronic systems. The method of data capture combines both paper and electronic systems under one common platform. Therefore, staff or health workers have to possess required competencies to work with the systems. Lack of proper training to the staff can hamper electronic data capture technologies adoption. A point in case is when participants fail to remember to switch off their phones when not in use which eventually leads to failure to submit data in real time. Statistics computed revealed that user-friendliness of EDC technologies had positive coefficient ($\beta=0.339$) on the adoption of EDC technologies in selected health research institutions in Kisumu County, western Kenya.

The findings are in conformity with a number of researchers (Wentzel, P., Lammeren, R. V., Molendijk, M., Bruin, S. D., & Wagtendonk, 2005) who agree that researchers are often reluctant to embrace technology in data collection due to a number of factors including but are not limited to the scale, pace and speed of proliferation of the technology. This is further characterized by lack of education and needed training in deploying EDC technologies in health research. Research staff also lack adequate training and skills to confidently and effectively use the technologies (Osoti et al. 2015).

5.4 Conclusion of the Study

The study has established that the obtained regression coefficient was $R=0.501$ which suggests that there exist an average degree of relationship between the five factors studied; access to EDC technologies, initial start-up cost of EDC technologies, institutional leadership, privacy and security of EDC technologies and user-friendliness of EDC technologies on adoption of EDC technologies in research institutions in Kisumu County, western Kenya. The adjusted R square was 0.207, which indicated that at least 20.7% of adoption of EDC technologies in research institutions in Kisumu County, western Kenya was related to the five predictors.

Four hypotheses were accepted on access to EDC technologies, institutional leadership, privacy and security of EDC technologies and user-friendliness of EDC technologies while the hypothesis on initial start-up cost of EDC technologies was rejected. Access to EDC technologies, institutional leadership, privacy and security of EDC technologies and user-friendliness of EDC technologies had positive beta coefficients while initial start-up cost of EDC technologies had negative beta coefficient. The study results showed that for the EDC technologies to be fully used, there is need for increased access to EDC technologies, reduced cost of installing ICT based systems, regular training and awareness is needed to ensure that employees accept and use the change and improved privacy of personal information.

5.5 Recommendations

The findings of this study are crucial and have raised a number of issues which need to immediate attention by various health research institutions .Therefore, the following recommendations are key in determining whether a given health research institution would consider embracing EDC technologies:

1. To scale up adoption of EDC technologies in health research institutions, research institutions should consider developing user friendly, secure and accessible EDC technologies in the relevant departments
2. To catch up with the continuous evolving EDC technologies, health research institutions should consider continuous capacity building of staff to promote user friendliness and better technology interface interaction with the users
3. Health Research institutions in Kisumu county should refrain from the expensive EDC technology notion as being a hindrance to adoption of EDC technologies.

5.6 Suggestions for Future Research

The findings of this study suggest the need for future research in the following areas:

1. Need to find out why most health research institutions opt for a combination of both electronic and paper-based methods of data collection instead of selection one option
2. Need to roll out a replica of this study in other sampled regions of Kenya with a bigger sample size to give a clear basis for making inferences that are applicable to the entire country

3. Need to conduct an independent research on the government policy environments and adoption of EDC technologies in health research institutions
4. Need to ascertain the key determinants of adoption and non-adoption of EDC technologies in all research institutions in general
5. Need to conduct economic modelling to ascertain the cost of paper-based versus electronic data capture technologies in health research settings

5.7 Contributions to the Body of Knowledge

The Table 5.1 highlights the contribution of knowledge generated from this study to the body of knowledge.

Table 5.1 Contributions to the Body of Knowledge

Objective	Contribution
EDC Access Factors	Availability of mobile devices including smartphones, tablets as well as skilled work force are all essential for adoption of EDC technologies in Health Research Institutions in the study setting.
EDC Start-Up Cost	There was no relationship between the start-up cost (procurement of devices, initial installation and system configuration and adoption of EDC technologies among health research institutions in the study setting.
EDC Privacy and Confidentiality	Data security and access rights play a key role in adoption of the EDC technologies in selected health research institutions in the study population
EDC User-friendliness	The ease of interacting with the interface and its aesthetic value play an important role in its adoption. Most end users are not comfortable with operating sophisticated interfaces
EDC Institution Leadership	Top management support, good leadership and favourable organizational policies paves way to adoption of EDC technologies

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APPENDICES
APPENDIX I: LETTER OF TRANSMITTAL

Kennedy Odhiambo Ojwang
P.O Box 36293-00200,
Nairobi.

Date.....

Dear Respondent,

**RE: FACTORS INFLUENCING ADOPTION OF ELECTRONIC DATA
CAPTURE TECHNOLOGIES IN SELECTED HEALTH RESEARCH
ORGANIZATIONS IN KISUMU COUNTY,
WESTERN KENYA**

I am a University of Nairobi student pursuing a Master of Arts in Project Planning and Management. I am currently investigating the *“factors influencing adoption of electronic data capture technologies in selected Health h research Institutions in Kisumu County”* as a partial requirement for the award of the above master’s degree.

This humble communication therefore seeks to bring to your attention that you are one of those selected to assist in providing the needed information to help fulfil the purpose of this research. I kindly request you to spare some few minutes and respond to the semi-structured questionnaire attached. All the information you will provide will be solely used for academic purposes and will be treated with high level of confidentiality. I kindly request you not to write your name or name of your institution anywhere on the questionnaire.

I hereby request you to respond to the questions with utmost honesty.

Yours Sincerely,
Kennedy Odhiambo Ojwang
Department-Extra Mural Studies
University of Nairobi

APPENDIX II: QUESTIONNAIRE

This semi-structured questionnaire is aimed to gather research information on the topic entitled “*factors influencing adoption of electronic data capture technologies in selected health research institutions in Kisumu County*” The questionnaire has various sections. For each question, please respond by ticking or marking [X] or filling the blanks where appropriate. Your honest and timely response will be highly appreciated.

Eligibility Screening:

Are you currently involved in or have ever participated in any health research activities?

Yes

If yes, continue with the interview.

No

If no, STOP and look for the next respondent

SECTION A: Socio-demographic Characteristics

1. Which is the main source of funding for research activities within your institution?

1. Institution budget

2. Sponsors (USAID, CDC e.t.c)

3. Government Allocation

4. Commercial Loans

5. Others please

specify.....

2. How do you classify the institution you work for?

1. MoH facility

2. NGO

3. Private Health Facility

4. Faith-based Institution

5. Academic

6. Others please specify.....

3. What is your position or Designation in this Institution?

1. Investigator []

2. Research Assistant []

3. Study Coordinator []

4. Administrator []

5. Data Clerk/Manager []

6. Others please specify.....

4. Your Gender

1. Female []

2. Male []

5. Highest level of Education Attained

1. Certificate []

2. Diploma []

3. Higher Diploma []

4. Bachelor's Degree []

5. Master's Degree []

6. PhD []

6. Please specify your age bracket

1. Below 20 []

2. 20-25 []

3. 26-30 []

4. 31-35 []

5. 36-40 []

6. 41 years and above []

7. How long have you worked for this organization or institution?
 1. 1 year and below []
 2. 2-3 years []
 3. 3 years and above []

SECTION B: EDC Access Factors and Adoption in selected Health Research

Institutions

8. Can you please tell us any electronic data capture technologies you know of? [Do not read responses, explain what technologies are and differentiate from devices or gadgets]
 1. Open Data Kit (ODK) []
 2. SurveyCTO []
 3. Blaise []
 4. SurveyBe []
 5. SurveyToGo []
 6. Survey Solutions []
 7. Others please specify.....
9. Which devices or gadgets have you heard of or ever used for electronic data capture(Multiple response Question)
 1. Mobile phones []
 2. Smartphones []
 3. Tablet Computers []
 4. Personal Digital Assistants (PDAs) []
 5. Others please specify.....
10. Which method of data capture do you use in this institution?
 1. Electronic (e.g use of smart phones) []
 2. Paper-Based Methods (e.g use of paper and pen) []
 3. Both Electronic and Paper []
11. In your opinion, why do you think the method you have mentioned above is most commonly used?

.....

12. To what extent do you agree with the following statements relating to access of electronic data capture technologies and its influence on its adoption in your institution?

Please tick or put “X” against the selected category.

Variable	Definition/statement	Level of agreement	Mark Here
1. Information on EDC technologies	I have enough information concerning available/commonly used electronic data capture technologies/tools	1. Strongly disagree	
		2. Disagree	
		3. Uncertain	
		4. Agree	
		5. Strongly agree	
2. Usage	I use electronic data capture technologies in my everyday life in my institution	1. Strongly disagree	
		2. Disagree	
		3. Uncertain	
		4. Agree	
		5. Strongly agree	
3. Availability of EDC tools	Electronic data capture tools are available at my place of work	1. Strongly disagree	
		2. Disagree	
		3. Uncertain	
		4. Agree	
		5. Strongly agree	
4. Data capture method	Different types of electronic data capture methods are available in my institution.	1. Strongly disagree	
		2. Disagree	
		3. Uncertain	
		4. Agree	
		5. Strongly agree	

SECTION C: Initial Start-Up Cost and Adoption of electronic data capture technologies

13. To what extent do you agree with the following statements relating to access of electronic data capture technologies and its influence on its adoption in your institution?

Please tick or put “X” against the selected category

Variable	Definition/statement	Level of agreement	Mark Here
1. Purchase and installation of EDC	Cost of purchasing and installing electronic data capture technologies	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
2. Hiring and retaining ICT Skilled Staff	Cost of hiring and retaining ICT skilled staff influences adoption of EDC technologies at my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
3. Capacity Building	Cost of continuously training staff in EDC technologies influences its adoption in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
4. Internet Connectivity	Cost of establishing reliable internet connectivity influences its adoption in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
5. Electrical Connectivity	Cost of establishing reliable electrical connectivity and its maintenance influences adoption of electronic data	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
6. Repair and Maintenance	Costs related to repair and maintenance of EDC technologies influences its adoption in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	

SECTION D: Institutional Leadership and Adoption of electronic data capture Technologies

14. To what extent do you agree with the following statements relating to institutional leadership and adoption of electronic data capture technologies in your institution.

Please tick or indicate “X” against the selected category

Variable	Definition/statement	Level of agreement	
1. Top Management Support	Top management support and commitment has influenced adoption of EDC technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
2. Governance structures	Governance structures has influenced adoption of EDC technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
3. Leadership Changes	Changes in leadership has influenced adoption of electronic data capture technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
4. ICT/EDC Policy and Regulatory frameworks	Institution’s ICT/EDC related policy and legislative frameworks has influenced adoption of EDC technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
5. Experience with EDC technologies	My institution’s past experience with EDC technologies has influenced its adoption	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	

SECTION E: Privacy and Confidentiality of EDC tools and its Adoption in selected Health Research Institutions

15. To what extent do you agree with the following statements relating to Privacy, Confidentiality and adoption of electronic data capture technologies in your institution.

Please tick or indicate “X” against the selected category

Variable	Definition/statement	Level of agreement	Mark Here
1. Authorization Access	Risks of unauthorized access to electronically collected data influences adoption of electronic data capture tools in my organization	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
2. Privacy	Research participants data safety and privacy issues influences adoption of electronic data capture technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
3. Data Type	Nature or type of participant data collected influences adoption of electronic data capture technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
4. Data Loss Risks	Potential risks of data loss with EDC technologies influences its adoption in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	

SECTION F: User-Friendliness or Usability of EDC technologies and its adoption in Health Research

16. To what extent do you agree with the following statements relating to user-friendliness or usability and adoption of electronic data capture technologies in your institution

Please tick or indicate “X” against the selected category

Variable	Definition/statement	Level of agreement	Mark Here
1. Installation	Electronic data capture technologies that can be easily installed are likely to be adopted in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
2. Upgrade/Update	Electronic data capture technologies that can be easily be upgraded or updated are likely to be adopted in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
3. Efficiency and Effectiveness	Electronic data capture technologies with high level of efficiency and effectiveness are likely to be adopted in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
4. Aesthetic value	Aesthetic value of a user interface influences the type of electronic data capture technologies in my institution	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	

SECTION G: Adoption of EDC technologies in Health Research Institutions in Kisumu County

17. To what extent do you agree with the following statements relating adoption of electronic data capture technologies in your institution

Please tick or indicate “X” against the selected category

Variable	Definition/statement	Level of agreement	
1. Transmission of results	Adoption of electronic data capture technologies in my institution leads to transmission of research findings in time	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
2. Errors in Data Collected	Adoption of electronic data capture technologies in my institution leads to reduction in errors in the data we collect	1. Strongly disagree	
		2. Disagree	
		3. Neutral	
		4. Agree	
		5. Strongly agree	
3. Queries	Adoption of electronic data capture technologies in my institution leads to real-time data querying and response	1. Strongly disagree	
		2. Disagree	
		3. Neither agree or	
		4. Agree	
		5. Strongly agree	
4. Cost of conducting research	Adoption of electronic data capture technologies in my institution leads to reduction in cost of conducting research	1. Strongly disagree	
		2. Disagree	
		3. Neither agree or	
		4. Agree	
		5. Strongly agree	
5. Time of conducting research	Adoption of electronic data capture technologies in my institution leads to reduction in overall time of conducting research	1. Strongly disagree	
		2. Disagree	
		3. Neither agree or	
		4. Agree	
		5. Strongly agree	
6. Data Accuracy	Adoption of electronic data capture technologies in my institution leads to increased accuracy in the data we collect	1. Strongly disagree	
		2. Disagree	
		3. Neither agree or	
		4. Agree	
		5. Strongly agree	

APPENDIX III: RESEARCH AUTHORIZATION LETTER



UNIVERSITY OF NAIROBI
OPEN DISTANCE AND e- LEARNING CAMPUS
SCHOOL OF OPEN AND DISTANCE LEARNING
DEPARTMENT OF OPEN LEARNING
NAIROBI LEARNING CENTRE

Your Ref:

Our Ref:

Telephone: 318262 Ext. 120

Main Campus
Gandhi Wing, Ground Floor
P.O. Box 30197
NAIROBI

1st August, 2018

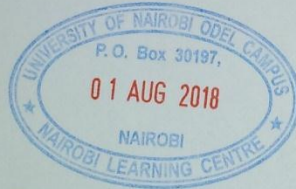
REF: UON/ODeL/NLC/29/076


RE: KENNEDY ODHIAMBO OJWANG - REG NO.L50/84576/2016

The above named is a student at the University of Nairobi Open, Distance and e-Learning Campus, School of Open and Distance Learning, Department of Open Learning pursuing Master of Arts in Project Planning and Management.

He is proceeding for research entitled, "factors influencing adoption of electronic data capture technologies in selected health research institutions in kisumu county, western kenya."

Any assistance given to him will be appreciated.




CAREN AWILLY
CENTRE ORGANIZER
NAIROBI LEARNING CENTRE

APPENDIX IV: NACOSTI RESEARCH PERMIT



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 3310571, 2219420
Fax: +254-20-318245, 318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/30214/24626**

Date: **20th August, 2018**

Kennedy Odhiambo Ojwang
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "*Factors influencing adoption of electronic data capture technologies in selected health research institutions in Kisumu County, Western Kenya,*" I am pleased to inform you that you have been authorized to undertake research in **Kisumu County** for the period ending **17th August, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Kisumu County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit a **copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.


BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kisumu County.

The County Director of Education
Kisumu County.



APPENDIX V: NACOSTI RESEARCH IDENTIFICATION CARD

THIS IS TO CERTIFY THAT: **Permit No : NACOSTI/P/18/30214/24626**
MR. KENNEDY ODHIAMBO OJWANG **Date Of Issue : 20th August,2018**
of UNIVERSITY OF NAIROBI, 36293-200 **Fee Received :Ksh 1000**
Nairobi,has been permitted to conduct
research in Kisumu County

on the topic: FACTORS INFLUENCING
ADOPTION OF ELECTRONIC DATA
CAPTURE TECHNOLOGIES IN SELECTED
HEALTH RESEARCH INSTITUTIONS IN
KISUMU COUNTY, WESTERN KENYA

for the period ending:
17th August,2019

.....
Applicant's
Signature



Director General
National Commission for Science,
Technology & Innovation