

**ACCESS AND USE OF CLINICAL INFORMATICS AMONG MEDICAL DOCTORS
IN SELECTED TEACHING HOSPITALS IN NIGERIA AND SOUTH AFRICA**

BY

KEHINDE ABAYOMI OWOLABI

NCE, BA. (EDU), MLS

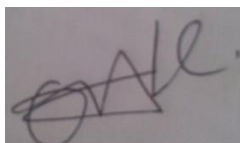
(Student No: 201451451)

**This thesis is submitted in fulfilment of the requirements for the award of the Degree of
Doctor of Philosophy in Library and Information Science at the Department of
Information Studies, University of Zululand, KwaDlangezwa, South Africa**

2016

DECLARATION

I declare that this study, '**Access and use of clinical informatics among medical doctors in selected teaching hospitals in Nigeria and South Africa**' is my original research work. This thesis has not been submitted to any other university for the award of any other degree. All data and information used in this research work has been duly acknowledged in the text, references and appendixes.



Owolabi, Kehinde Abayomi

31- 03- 2017

Date



Dr. Evans Neil

Promoter/ Supervisor

Department of Information Studies,

University of Zululand, Kwadlangezwa

31- 03- 2017

Date



Prof. D, N. Ocholla

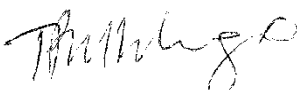
Co- Supervisor

Department of Information Studies,

University of Zululand, Kwadlangezwa

31-03-2017

Date



Prof. T.P. Mhlongo

Co-Supervisor,

Department of Nursing Sciences

University of Zululand, Kwadlangezwa

31-03-2017

Date

DEDICATION

This thesis is dedicated to God Almighty for His immeasurable love, support and grace, and to every member of my family. Despite my rough beginning in life, He enabled me to commence this doctoral journey at the University of Zululand in KwaDlangezwa, South Africa, and complete the programme in good health.

To my jewel of inestimable value - my love, my pride, my rose, a woman with whom I share my heart and the mother of my beautiful children - Olajumoke Hafisat Alake Owolabi, and to my lovely children, Oluwabunkunmi Sharon Owolabi and Oluwabusayo Gideon Owolabi.

To Dr. Mulik Olawanle Salaam, the University Librarian at the Federal University of Agriculture in Abeokuta, Nigeria, who through God, made this journey a worthwhile experience

ACKNOWLEDGEMENTS

My special thanks go to my amiable supervisors, Dr. N.D. Evans, Professor D. N. Ocholla and Professor T. P. Mhlongo, for their invaluable guidance, suggestions, mentorship, encouragement, and their interest in this study. I am also grateful to the members of staff at the Department of Information Studies in the University of Zululand - Professor J.B. Mostert, Dr. T. Kalisopa, Mr. N. Nkomo and Mr. M. M. Shongwe. I will not forget the assistance of Mr. and Mrs. R .P. Bennert and Mr. N.L.M. Thembu during my stay at the university.

I am very grateful to the University of Zululand for funding this research. I also need to thank all the staff at the Teaching and Learning Centre for giving me the opportunity to serve as a tutorial assistant. My thanks go to Mrs., B. Marovatsanga, Dr., L. Marhanya, Miss, K. Eslin and Dr., N. J. Mashiya.

I cannot forget to thank the acting Chief Executive Officer at King Edward VIII Hospital and all the members of staff at the hospital, particularly Mr, S. Aderibigbe, and Ms .R. K. Sibiya. Also, my thanks go out to all the medical doctors at the University College Hospital in Ibadan, Nigeria. I thank the President of the Resident Doctors Association at UCH, who vacated his office for me to use as my research office during the fieldwork. Special thanks to Dr. T. Adewunmi, Dr. W. Olufajo, Dr. B. Sariyan and Dr. C.Izuka who were my students, and in the course of this work, decided to be my research assistants. I would also like to thank the Chief Medical Advisory Board at UCH in Ibadan (CMAN) for giving me the necessary assistance. I also thank Dr. T. Omitade, Dr. A. Salaam, and Dr. O. O. Daniel for their cooperation and assistance during the course of my fieldwork at Ibadan.

I am indebted to the following teachers for encouraging me to pursue a career in academics when I was a student at Obafemi Awolowo University in Ile Ife: Professor C.U. Manus, Department of Religious studies, OAU, Ile-Ife, Nigeria, Professor A. Kehinde, Professor J.K. Ayantayo, Dr. A. Tella, Dr .K. Olayode, Department of International Studies, OAU, Ile-Ife, Nigeria and Dr R. O. Attama, the Polytechnic Librarian, Akanu-Ibiam Federal Polytechnic Unwana- Afikpo, Ebonyi State, Nigeria.

I appreciate all the members of staff at the University of Zululand Library, particularly Mrs Ocholla, for all the training they organised. My friend, Miss Z. Hadebe - I really appreciate your love, care and encouragement, and the release of your office for my research when the need arose. Likewise, I thank all the members of staff at Nimbe Adedipe Library, Federal

University of Agriculture, and Abeokuta, Nigeria: Messers, I. Amusa, W.O. Lawal, B. Bamigboye, T.A Bello, O.O. Omotosho, J.O. Fatokun, Mrs I. Agboola, Mrs. B. Olude, Mrs. A. Labulo, Mrs. K.M. Alawiye and Mrs. N. Okorie. Moreover, I thank all my friends at the University of Zululand: Dr. Y. Olorunfemi; Dr. R. Enakire; Mr. W. Durodolu Mr. N. A. Aderibigbe, Mr. M.O. Ayoola; Mr. A. Ajayi; Mrs. D. Eneya; Mrs. E. Ovawasa and Miss T.Olugbile.

I am highly indebted to my friends in South Africa – Miss. S. Belethushi, Miss. N. Mhlongo, Miss. T. Mkhwanazi, Miss. B. Zulu, and Miss Ntuli-Mabongi. My thanks go to my mother, grandmother and my lovely friends: Mr. and Mrs. A. Adefemi, Mr. and Mrs. B. Babayanju, Mr. and Mrs. B. Akintomide, Mrs. N. Ayoola and Mrs. T. Fijabi and Mr. K. Oyewunmi, thank you for being a wonderful friend since our days at St Patricks' Grammar School in Ibadan. Finally, my special thanks to the Nigerian community at the University of Zululand, T. A. Adekiya, and C. Uleya, S. Olaniran, K. Ilesanmi, and A.Young. I will not forget C. Ocholla and Professor N. Akinjobi of English Department, University of Ibadan, Nigeria that created time to editing my work despite her tight schedule.

ABSTRACT

This study examined access and use of clinical informatics among medical doctors at University College Hospital, Nigeria and King Edward VIII Hospital, South Africa. The specific objectives of the study were to explain the purposes of using clinical informatics; determine the benefits of using clinical informatics in the selected teaching hospitals; ascertain the availability of clinical informatics infrastructure in the selected teaching hospitals; identify the clinical informatics facilities that are accessible to medical doctors in the selected teaching hospitals; determine the factors that influence the behavioural intention to use clinical informatics by medical doctors in the selected teaching hospitals; determine the policies that guide the effective accessibility and utilisation of clinical informatics among medical doctors in the selected teaching hospitals; and investigate the challenges that faced both the access to and the use of clinical informatics among medical doctors in the selected teaching hospitals.

The study adopted the post-positivist paradigm which combines both qualitative and quantitative research methods. The study largely used a survey design. The sample for the study was drawn from medical doctors in two purposively selected teaching hospitals in Nigeria and South Africa. The teaching hospitals were King Edward V111 hospital, Durban, South Africa and University College Hospital, Ibadan, Nigeria. The two teaching hospitals were selected because they belong to the first generation of teaching hospitals in Nigeria and South Africa, among other reasons. It was believed that they would be well established in terms of funding towards infrastructure and human development in their respective countries.

Convenience sampling was used to select the respondents for the study. The questionnaire was administered to 413 medical doctors, 258 (63%) of whom returned the questionnaire. Interviews were also conducted with the heads of the ICT units at the University College Hospital in Ibadan, Nigeria, and King Edward VIII Hospital in Durban, South Africa. The quantitative data aspect of the study was analysed using descriptive statistics and Statistical Package for Social Sciences (SPSS), while the qualitative aspect of the data was analysed through the use of qualitative contents analysis.

The study was guided by the Unified theory of acceptance and use of technology (UTAUT). The essence of using this theory is to identify the factors that influence the use of clinical informatics.

The finding of the study reveals that there was an association between the demographic variables and the use of clinical informatics. It was established that there was a significant association between the medical department and the use of electronic medical records. An assessment of the socio-demographic characteristics and the use of the Clinical Decision Support System revealed that there was a significant association between the years of medical practice and the use of Clinical Decision Support System. The finding also revealed that social demographic variables such as age, years of practice and position were all significant related with the use of diagnostic image archiving. Furthermore, the surveyed medical doctors stated that their main purpose of using clinical informatics is for medical diagnosis. It was also discovered that there is association between the teaching hospitals and the use of clinical informatics for knowledge sharing. In addition, clinical informatics was found to influence the spirit of team work amongst the medical doctors through knowledge sharing with their professional colleagues and their medical students. Similarly, there were association between the teaching hospitals treatment of patients and effective healthcare delivery. In addition, the major benefit of using clinical informatics in the two hospitals was to reduce medical errors.

The most available clinical informatics tools in the selected teaching hospitals were the Diagnosis Image Archiving and Clinical Decision Support System. Performance expectancy and effort expectancy were identified as the factors from the UTAUT that influenced the medical doctors' behavioural intention to use clinical informatics resources in the selected teaching hospitals. The non-availability of clinical informatics resources was identified as the main challenge facing the effective access to and use of clinical informatics. In addition, the two hospitals relied on the ICT policies of other institutions and did not have their own ICT policies, which was problematic.

The study concluded that the clinical informatics environments in the two teaching hospitals are inadequate and there is poor access to clinical informatics resources among medical doctors in the selected teaching hospitals.

Major recommendations of the study include the need to establish ICT policies and increase investment in clinical informatics resources at the surveyed teaching hospitals in order to promote effective and value-based healthcare delivery.

In addition, the hospital management should create awareness on the importance and benefits of clinical informatics particularly for the medical doctors through informal and continuing

education and training such as workshops and short courses. Moreover, the hospital managements need to partner with relevant stakeholders such as government, corporate bodies, and departments of health. This is for the provision of adequate and suitable environment to support the access and use of clinical informatics.

Further studies on the various types of health informatics such as nursing informatics, pharmacy informatics and veterinary informatics are recommended. It is also suggested that the study should be extended to other regions of Africa. The study is significant and makes tangible contributions to technology acceptance and use in clinical medicine from developing country contexts such as Nigeria and South Africa giving the increasing role of information and communication technology in diagnosis, prescription, treatment, monitoring and overall management of patient care in an environment characterized by complex diseases. The study has the potential to inform policy, practises, and also contribute to this research in the general area of social information in Africa.

Key words: Clinical informatics, health informatics, social informatics, teaching hospitals, Nigeria and South Africa.

TABLE OF CONTENTS

TITLE PAGE.....	i
DECLARATION.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENTS.....	iv
ABSTRACT.....	vi
TABLE OF CONTENTS.....	ix
ACKNOWLEDGEMENTS.....	v
ABSTRACT.....	vii
TABLE OF CONTENTS.....	x
LIST OF TABLES.....	xviii
LIST OF FIGURES.....	xxi
LIST OF ABBREVIATIONS.....	xxiii
CHAPTER ONE: INTRODUCTION.....	2
1.1 Background to the study.....	2
1.2 Contextual setting.....	7
1.3 Theoretical model.....	9
1.4 Statement of the problem.....	9
1.5 Aim of the study.....	11
1.6 Research objectives.....	11
1.7 Research questions.....	11
1.8 Intended contribution to knowledge.....	12
1.9 Scope and limitations of the study.....	12
1.9.1 Subject coverage.....	13
1.9.2 Methodological scope.....	13
1.9.3 Literature scope.....	13
1.10 Ethical considerations.....	14
1.11 Knowledge dissemination.....	14
1.12 Structure of the thesis.....	15
1.13 Summary.....	16
CHAPTER TWO: CONTEXT OF THE STUDY.....	20
2.1 Introduction.....	20

2.2	Status of, access to, and the use of clinical informatics in Nigeria's health care sectors.....	20
2.2.1	Policy and legislation.....	20
2.2.2	Health care facilities and equipment	21
2.2.3	Human resources development.....	23
2.2.4	Health financing in Nigeria	24
2.3	ICT access and use in Nigeria's health care sector	25
2.4	ICT opportunities in Nigeria's health care sector	27
2.4.1	Guiding innovation in the health care system	27
2.4.2	Supporting ICT infrastructure development.....	27
2.4.3	Promoting health care intervention.....	27
2.4.4	Promoting capacity building.....	28
2.5	Challenges of ICT access and use in Nigeria's health care sector	28
2.5.1	Policy issues	28
2.5.2	Paucity of ICT infrastructure	29
2.5.3	Funding problems	30
2.5.4	Poor maintenance culture	30
2.5.5	Shortage of medical doctors	30
2.5.6	Poor attitude toward ICTs.....	31
2.5.7	Poor power supply	31
2.5.8	Telecommunication problems	31
2.6	Status of, access to, and use of clinical informatics in South Africa healthcare sector	32
2.6.1	Policy and Legislation	32
2.6.2	Healthcare facilities and equipment	33
2.6.3	Human resources development.....	34
2.6.4	Financing of health in South Africa	35
2.7	ICT access and use in South Africa's health care sector.....	36
2.8	ICT opportunities in South African health care sector.....	38
2.8.1	Transformation of the health system	38
2.8.2	ICT capacity building	39
2.8.3	Building collaboration	39
2.8.4	Promoting infrastructural development	40
2.8.5	ICT infrastructure development.....	40
2.8.6	Policy framework	40
2.9	Challenges of ICT access and use in South African healthcare sector	41

2.9.1	Low bandwidth	41
2.9.2	Inadequate funding of ICT in healthcare	41
2.9.3	Poor ICT skills.....	42
2.10	Summary	42
CHAPTER THREE: LITERATURE REVIEW		47
3.1	Introduction	47
3.2	Influence of demographic variables on the use of clinical informatics.....	48
3.2.1	Age.....	49
3.2.2	Medical departments.....	50
3.2.3	Gender	51
3.2.4	Years of experience	52
3.3	Purposes of using clinical informatics	53
3.3.1	Provision of access to clinical information.....	54
3.3.2	Knowledge sharing	55
3.3.3	Improvement of effective healthcare delivery	56
3.3.4	Management of diseases	57
3.4	Type of clinical informatics	58
3.4.1	Computerised physician order entry (CPOE).....	59
3.4.2	Computerised decision support system	60
3.4.3	Diagnosis image archiving	62
3.4.4	Electronic medical record (EMR).....	63
3.5	The benefits of clinical informatics.....	65
3.5.1	Reduction in medical errors.....	66
3.5.2	Time economy	67
3.5.3	Improvement in efficiency.....	68
3.5.4	Reduction of cost	68
3.5.5	Increasing performance	69
3.6	Availability of clinical informatics	69
3.7	Accessibility to clinical informatics	71
3.7.1	The digital divide and clinical informatics	79
3.8	Challenges to access and use of clinical informatics	81
3.8.1	Poor access to telecommunication.....	81
3.8.2	Resistance to new technology.....	82
3.8.3	Poor ICT skills.....	82
3.9	Summary	83
CHAPTER FOUR: THEORETICAL FRAMEWORK		84

4.1	Introduction	84
4.2	Theoretical framework	85
4.3	Technology acceptance theories.....	86
4.4	Factors that influence the use of clinical informatics by medical doctors	92
4.4.1	Performance expectancy.....	92
4.4.2	Effort expectancy.....	93
4.4.3	Social Influence	95
4.4.4	Facilitating conditions	96
4.5	Implications and applications of the theory	97
4.6	Criticisms of the theory	101
4.7	Summary	102
CHAPTER 5: RESEARCH METHODOLOGY		103
5.1	Introduction	103
5.2	Philosophical paradigm	104
5.3	Research method/Research approach.....	109
5.4	Research design.....	115
5.4.1	Survey research.....	117
5.5	Target population	118
5.5.1	Accessible population.....	119
5.6	Sampling procedures and methods.....	119
5.6.1	Sampling techniques.....	119
5.6.2	Purposive sampling	120
5.6.3	Convenience sampling.....	124
5.6.4	Sampling frame.....	124
5.6.5	Sample Size	125
5.7	Data collection methods	126
5.7.1	Questionnaire.....	126
5.7.1.1	Questionnaire construction	127
5.7.2	Interview	128
5.7.3	Triangulation	130
5.8	Pilot study.....	131
5.8.1	Validity of instruments	131
5.8.2	Reliability of survey instruments.....	132
5.9	Data analysis	133
5.9.1	Descriptive statistics	134
5.9.2	Inferential Statistics	134

5.10	Ethical considerations	135
5.11	Summary	135
CHAPTER 6: DATA PRESENTATION AND ANALYSIS OF THE SURVEY		
QUESTIONNAIRE		137
6.1.	Introduction	137
6.2.	Demographic characteristics of the respondents	137
6.2.1	Distribution of respondents according to teaching hospitals.....	137
6.2.2	Gender of the respondents	138
6.2.3	Age of the respondents	138
6.2.4	Medical practice experience of the respondents.....	139
6.2.5	Distribution of the respondents by job status	139
6.2.6	Distribution of respondents by medical department.....	140
6.2.7	Educational qualifications of the respondents	141
6.2.8	The association between socio-demographic variables and the use of clinical informatics tools.....	142
6.2.8.1.	The socio-demographic characteristics and the use of Electronic Medical Records	144
6.2.8.2.	Association between socio-demographic characteristics and the use of the clinical decision support system	146
6.2.8.3:	Association between socio-demographic characteristics and the use of diagnostics image archiving.....	148
6.3:	Objective 2: The purposes of using clinical informatics.....	150
6.3.1	Association between the selected teaching hospitals and the use of clinical informatics for medical diagnosis	152
6.3.2	Association between the teaching hospital and the use of clinical informatics for disease management.....	152
6.3.3	Association between the teaching hospital and the use of clinical informatics for research purposes	152
6.3.4	Association between the teaching hospital and the use of clinical informatics for decision making.....	153
6.3.5	Association between the teaching hospital and the use of clinical informatics to share knowledge with professional colleagues and medical students.....	153
6.3.6	Association between the teaching hospital and the use of clinical informatics for communication purposes with patients on their treatments	153
6.3.7	Association between the teaching hospital and the use of clinical informatics for the treatment of patients	154
6.3.8	Association between the teaching hospital and the use of clinical informatics to promote effective healthcare delivery.	154
6.4.	Comparison of responses from KEH and UCH on the purposes of using clinical informatics.....	155

6.5	Objective 3: Benefits of using clinical informatics	157
6.6	Objective 4: To ascertain the availability of clinical informatics infrastructure in the selected teaching hospitals	158
6.7	Objective 5: To identify the clinical informatics facilities that are accessible to the medical doctors	159
6.7.1	Accessibility of clinical informatics	159
6.8	Objective 5: The factors that influence the behavioural intention to use clinical informatics tools.....	160
6.8.1	Correlation analysis between independent and dependent variables at KEH	163
6.8.2	Relationship between use behaviour and behavioural intention to use at KEH...	165
6.8.3	Relationship between use behaviour and facilitating condition to use: KEH	166
6.8.4	Correlation analysis between independent and dependent variables at UCH.....	167
6.8.5	Relationship between use behaviour and behavioural intention to use at UCH	170
6.8.6	Relationship between use behaviour and facilitating condition at UCH	171
6.9	Objective 8: Challenges facing the use of clinical informatics	172
6.10	Summary	173
CHAPTER 7: DATA PRESENTATION AND ANALYSIS INTERVIEWS		176
7.1	Introduction	176
7.2	What are the demographic characteristics of the respondents?.....	178
7.3	What are the purposes of using clinical informatics tools?.....	179
7.4	What are the benefits of clinical informatics to medical doctors in your hospital? .	180
7.5	Are clinical informatics resources available in your hospital?	180
7.5.1	How do you acquire clinical informatics tools?	181
7.5.2	Do you have a committee that recommends clinical informatics tools to you? ...	181
7.5.3	Do you have maintenance department for repairing clinical informatics resources?.....	182
7.6	What clinical informatics resources are available in your hospital?.....	182
7.6.1	What are the sources of finance for acquiring clinical informatics resources?	183
7.7	Which of the clinical informatics resources are accessible to the medical doctors in your hospital?	183
7.7.1	Where are the access points for the use of clinical informatics?.....	184
7.7.2	Are you satisfied with the clinical informatics resources that are available in the hospital?... ..	186
7.8	What are the various factors that can promote clinical informatics' access and use in the two hospitals?.....	186
7.8.1	How often do you organise the training of medical doctors on the use of clinical informatics?.....	187
7.8.2	Do they consult your office before using clinical informatics tools?.....	187

7.9 Do you have an ICT policy in your hospital?	188
7.10 What are the challenges facing the use of clinical informatics resources?	188
7.11 Summary	189
CHAPTER 8: DISCUSSION OF THE FINDINGS	189
8.1. Introduction	190
8.2. Characteristics of the respondents in the selected teaching hospitals.	190
8.3. Association of socio-demographic variables and the use of clinical informatics tools	194
8.3.1 Association between socio-demographic variables and the clinical decision support system.....	194
8.3.2 Association between socio-demographic variables and the use of Electronic Medical Records.....	194
8.3.3 Association between socio-demographic variables and the use of diagnostic image archiving.....	195
8.4. Purposes of using clinical informatics among medical doctors in the selected teaching hospitals.....	196
8.5 Benefits of using clinical informatics in selected teaching hospitals.....	198
8.6 Availability of clinical informatics in the selected teaching hospitals.....	201
8.7 Clinical informatics facilities that is accessible to medical doctors in selected hospitals	202
8.8 Factors that influence medical doctors' behavioural intention to use clinical informatics tools in the selected hospitals.....	205
8.9 The ICT policies that are in place towards effective accessibility and utilisation of clinical informatics tools in the selected teaching hospitals	206
8.10. Challenges facing the use of clinical informatics by medical doctors in the selected teaching hospitals.	207
8.11 Summary	208
CHAPTER 9: SUMMARY, CONCLUSION AND RECOMMENDATIONS.....	210
9.1. Introduction	210
9.2 Summary of findings.....	210
9.2.1. Objective 1: To determine the association between social demographic variables and the use of clinical informatics	211
9.2.2. Objective 2: To explain the purposes for using clinical informatics among medical doctors in the two teaching hospitals	211
9.2.3. Objective 3: To find out the benefits of using clinical informatics in the two teaching hospitals.....	212
9.2.4. Objective 4: To ascertain the availability of clinical informatics infrastructures in the selected teaching two hospitals	213
9.2.5. Objective 5: To identify the clinical informatics facilities that are accessible to medical doctors in South Africa and Nigeria teaching hospitals.	214

9.2.6. Objective 6: To determine the factors that influence behavioural intention to the use of clinical informatics by medical doctors in the two teaching hospitals	215
9.2.7. To find out about policies that guides the use of clinical informatics in the two teaching hospitals.	216
9.2.8. Objective 8: To investigate the challenges facing both access and use of clinical informatics among medical doctors in the selected teaching hospitals.....	217
9.3. Conclusion.....	218
9.4 Originality and contribution of the study	219
9.5. Recommendations	221
9.5.1. Objective 1: Association between social demographic variables and the use of clinical informatics.....	221
9.5.2. Objective 2: The purposes for using clinical informatics by medical doctors in the two teaching hospitals	221
9.5.3. Objective 3: The benefits of using clinical informatics in the two teaching hospitals	222
9.5.4. Objective 4: The availability of clinical informatics infrastructures in the two selected teaching hospitals	222
9.5.5. Objective 5: Clinical informatics facilities that is accessible to medical doctors in South African and Nigerian teaching hospitals.....	223
9.5.6. Objective 6: The factors that influence behavioural intention towards the use of clinical informatics by medical doctors in the two teaching hospitals.....	223
9.5.7. Objective 7: Institutional ICT policies that are put in place toward effective accessibility and utilisation of clinical informatics among medical doctors in the two hospitals.....	224
9.5.8. Objective 8: Challenges facing both the access and use of clinical informatics among medical doctors in the selected teaching hospitals	224
9.6. Recommendations for further research	225
REFERENCES	331
Appendix 1: Questionnaire for medical doctors	430
Appendix 2 : University of Zululand clearance	442

LIST OF TABLES

Table 1. 1: Summary of research research objectives, research questions, sources of data and data collection methods.....	17
Table 4. 1: Studies on factors that influence behavioural intention to use clinical informatics	97
Table 4. 2: Researchers that have applied the UTAUT to inform their studies in South Africa and Nigeria between 2010 and 2015.....	99
Table 4. 3: Analysis of UTAUT based on publication types, countries and subject areas.....	100
Table 5. 1: Research paradigm.....	109
Table 5. 2: Characteristics of quantitative and qualitative research	113
Table 5. 3: List of medical departments in the two hospitals	123
Table 5. 4: Reliability of the instruments.....	133
Table 6. 1: Gender representation of medical doctors	138
Table 6. 2: Age range of the doctors.....	139
Table 6. 3: Medical practice experience of the respondents.....	139
Table 6. 4: Distribution of the respondents by job status	140
Table 6. 5: Distribution of respondents by medical department.....	141
Table 6. 6: Distribution of respondents by educational qualification.....	142
Table 6. 7: Descriptive statistics of use and non-use of clinical informatics.....	143
Table 6. 8: Use and non –use of clinical informatics.....	144
Table 6. 9: Association between social-demographic characteristics and the use of Electronic Medical Records	145
Table 6. 10: Social- demographic characteristics and the use of the clinical decision support system	147
Table 6. 11: Association between social-demographic characteristics and the use of diagnostic image archiving.....	148
Table 6. 12: Purposes of using clinical informatics	151
Table 6. 13: Association between the teaching hospitals and the use of clinical informatics for medical diagnosis.....	152

Table 6. 14: Association between the teaching hospital and clinical informatics' use for disease management.....	152
Table 6. 15: Association between the teaching hospital and the use of clinical informatics for research	152
Table 6. 16: Association between the teaching hospital and the use of clinical informatics for decision making	153
Table 6. 17: Association between the teaching hospital and the use of clinical informatics to share knowledge with professional colleagues and medical students	153
Table 6. 18: Association between the teaching hospital and the use of clinical informatics for communication purposes with patients.....	154
Table 6. 19: Association between the teaching hospital and the use of clinical informatics for the treatment of patients.....	154
Table 6. 20: Association between the teaching hospital and the use of clinical informatics to promote effective healthcare delivery.....	154
Table 6. 21: Mean ranks of purposes of using clinical informatics	155
Table 6. 22: Mann-Whitney test	157
Table 6. 23: Benefits of using clinical informatics	158
Table 6. 24: Availability of clinical informatics tools in the teaching hospitals	159
Table 6. 25: Accessible clinical informatics tools	160
Table 6. 26: Descriptive statistics of the factors that influence the behavioural intention to use CI.....	163
Table 6. 27: Correlation analysis between the independent and the dependent variables: KEH	163
Table 6. 28: Model fitting information: KEH.....	164
Table 6. 29: Pseudo R-Square.....	164
Table 6. 30: Parameters estimates.....	165
Table 6. 31: Model fitting information	166
Table 6. 32: Pseudo R-Square.....	166
Table 6. 33: Parameter estimates	166
Table 6. 34: Model fitting information	167
Table 6. 35: Pseudo R-Square.....	167
Table 6. 36: Parameter estimates	167
Table 6. 37: Correlation between behavioural intention and SI, FC, EE, FC, EE, PE at UCH	168

Table 6. 38: Model fitting information	169
Table 6. 39: Pseudo R-Square.....	169
Table 6. 40: Parameters estimates.....	169
Table 6. 41: Model fitting information	170
Table 6. 42: Pseudo R-Square.....	170
Table 6. 43: Parameter estimates	171
Table 6. 44: Model fitting information	171
Table 6. 45: Pseudo R-Square.....	172
Table 6. 46: Parameter estimate.....	172
Table 6. 47: Challenges facing the use of clinical informatics among medical doctors.....	173
Table 7 1: Allignment of research questions and interview questions	177
Table 7 2: Characteristics of the participants from the teaching hospitals	179
Table 7. 3: The purposes of using clinical informatics tools	179
Table 7. 4: Usefulness of clinical informatics in medical practice	180
Table 7. 5: Availability of clinical informatics	180
Table 7. 6: Acquisition of clinical informatics	181
Table 7. 7: Committee that recommends clinical informatics tools	181
Table 7. 8: Availability of maintenance department.....	182
Table 7. 9: Available clinical informatics tools in the hospitals.....	182
Table 7. 10: Sources of fianance for acquiring clinical informatics resources.....	183
Table 7. 11: Accessible clinical informatics tools	183
Table 7. 12: Access points for the use of clinical informatics	184
Table 7. 13: Satisfaction of medical doctors with clinical informatics resources	186
Table 7. 14: Factor that can promote the use of clinical informatics in the hospitals	186
Table 7. 15: Frequency of training in the use of clinical informatics	187
Table 7. 16: Consulting the ICT units for assistance concerning the use of ICT	187
Table 7. 17: ICT policy in the two teaching hospitals	188
Table 7. 18: Challenges facing the use of clinical informatics	188
Table 7. 19: Strategies to promote the use of clinical informatics resources among medical doctors.....	189

LIST OF FIGURES

Figure 4.1: UTAUT diagram.....	90
Figure 6.2: Distribution of medical doctors according to teaching hospitals.....	136

LIST OF APPENDICES

APPENDIX 1: Questionnaire for medical doctors.....	429
APPENDIX 2: Interview guide for heads of ICT in the selected hospitals.....	438
APPENDIX 3: University of Zululand ethical clearance approval.....	441
APPENDIX 4: Approval letter 1.....	443
APPENDIX 5: Approval letter 2.....	444
APPENDIX 6: Approval to administer questionnaire.....	445
APPENDIX 7: Letter from the editor	446

LIST OF ABBREVIATIONS

CI	Clinical informatics
CDSS	Computerised Decision Support Systems
CPOE	Computerised Physicians Order Entry
DIA	Diagnosis Imagery Archives
DoH	Department of Health
DoL	Department of Labour
UCH	University College Hospital
EE	Effort Expectancy
EMR	Electronic Medical Record
FC	Facilitating Conditions
FGN	Federal Government of Nigeria
FMH	Federal Ministry of Education
ICT	Information and Communication Technology
KEH	King Edward VIII Hospital
KZN	KwaZulu Natal
NHLS	National Health Laboratories Service
PE	Performance Expectancy
PPP	Public Private Partnership
SPSS	Statistical Package for Social Sciences
SI	Social Influence
US	United States
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
UNF	Unified Nation Foundation
WHO	World Health Organisation

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Effective healthcare services are the most noticeable part of any health system, particularly to healthcare users and the general public. Adequate health services can be in various forms such as promotion, prevention, treatment, diagnosis and rehabilitation which may be delivery in health facilities or in any other places. However, the World Health Organisation (2007) observes that effective healthcare service delivery depends on various key resources, particularly, availability of information and communication technology for the use of medical doctors in performing their job functions. They go further to say that good healthcare services are those which deliver effective, safe and good quality healthcare to users and with minimal waste.

The need to strengthen healthcare services through the use of clinical informatics is a key to achieve the Sustainable Development Goals (SDG), reduce child mortality, maternal mortality, the burden of HIV/AIDS, tuberculosis and malaria which is very common in many Africa countries. Effective healthcare is at the center of SDGs. This was based on the fact that health is fundamental to the global agenda of reducing poverty and a major way of promoting human development in both developed and underdeveloped countries (World Health Organisation, 2005).

Safeguarding health lives and promoting the well-being of citizens all over the world are very important for sustainable development. It is in line with this that new Sustainable Development Goals came to existence to replace MGDs with the mandate to end poverty (SDG 1), hunger (SDG 2), universal health coverage (SDG 3) and host of others. The goals were created through agreement between the United Nation Development Programme and the United Development Group (United Nation, 2016). The integration of ICT in health is vital to the achievement of the Sustainable Development Goals (SDGs) (United Nation, 2016).

World Bank (2015) states the importance of ICT in meeting the SDGs, particularly in health care, in both developed and underdeveloped countries to include: Building medical evidence. The adoption of ICT will provide better healthcare which in turn will assist in achieving SDGs in the relations to specific goals in terms of health (World Bank, 2015). This indicates that availability and accessibility of ICT in effective healthcare delivery provide strong evidence-based information that can assist medical doctors in taken clinical decision.

Supporting the use of ICT in health, The World Summit on the Information Society Plan of Action identifies ten targets to be achieved by 2015 which include effective healthcare delivery, as stated in Action Lines 3 and 7. Action Line C3 is basically on the importance of access to information in promoting effective healthcare while Action C7 is explaining the relevance of ICT application in e-health (ITU, 2010). The two action lines argue that ICT is necessary equipment for effective healthcare.

One of the basic goals of every government is to provide adequate and effective healthcare delivery to their citizenry. Access to adequate medical information is imperative for successful healthcare delivery, particularly, for medical doctors all over the world. Moon, Hossain and Shin (2012) admit that access to accurate medical information, in various health care facilities, is very necessary for medical doctors to take effective medical decision. Attama and Ezema (2005) argue that access and use of information are necessary for medical doctors ‘for problem solving and decision making’.

The availability of accurate, timely, reliable and relevant clinical information is most essential for medical practices because it has tremendous benefits of improving the efficiency and increasing the quality of medical care. WHO (2005) opines that a well-functioning healthcare system is one in which medical doctors adopt the use of clinical informatics for reliable and timely health information and decision making.

Also, clinical informatics use, in healthcare, will lead to improved service delivery and enhanced access to effective healthcare because availability and access to healthcare services are the basic functions of a good healthcare system. An increased ICT adoption is a necessary prerequisite to improved effective healthcare service delivery and enhanced access to health services. WHO (2007) notes that the service delivery, in healthcare, is concerned with how services are organised and managed to ensure access, quality, safety and continuity of care across health conditions and across the globe. WHO goes further to say that, there are no universal models for good health service delivery but noted that, access to and use of clinical informatics, by medical doctors, will improve their job output because it will assist them in taking decision and saving their time.

Clinical informatics is developed, to find remedy to various health challenges and at the same time, improve quality of life. They are very useful in the prevention, diagnosis and treatment of diseases. The influence and pervasiveness of clinical informatics, in the field of medicine, has significantly increased as a result of the benefits of the Information and Communication Technologies (ICTs). Clinical informatics is the use of ICT in the field of medicine. It gives

the opportunity to medical doctors and other healthcare workers to diagnose and provide effective medical services to patients, at distance locations, thorough ICT resources. Medical doctors can also access information, by using clinical informatics to update their knowledge, with up-to-date medical information or sharing information with their professional colleagues, in order to obtain more accurate and timely information, for effective diagnosis and treatment of patients.

Okiy (2010) notes that ICTs encompass all forms of technology used to create, store and exchange information in various formats such as voice, still-images, animation and multimedia as well as retrieving and disseminating information. Similarly, Attama and Esema (2005) define ICT as a range of technologies for gathering, storing, processing, analysing and disseminating information. This implies that ICT has served as a solution to a high number of problems, especially in the health sector in developing countries where the awareness and use still remains low, regardless of the fact that the knowledge of ICT gives the competitive advantage that is needed to face the challenges of the new emerging health development.

Health informatics is the application of information and communication technology in the health system for collection, storing, and evaluating health data, and its advent has brought a great transformation to the health sector (Idowu, Cornford and Batin, 2008). Its use enhances the promotion of healthcare delivery and leads to improvement in evidence based medicine that will assist medical doctors in making decisions (Straggler and Thompson, 2002).

University of Southampton (2014) describes health informatics as the knowledge, skills and tools that enable health information to be collected, managed, used and shared to support the delivery of healthcare and promote the development of healthcare system. It is concerned with assessment of methods and systems for acquisition, processing and interpretation of patients' data, with the help of knowledge from scientific research (Imhoff, Webb and Goldschmidt, 2001). From these foregoing, it can be deduced that health informatics is the use of ICTs tools, in the healthcare system, with the aim of supporting clinical decisions that will have positive impacts on the health of individuals as well as the health sector generally.

Healthcare informatics is a broad term for all fields using technology. Healthcare informatics is the application of computers, communications and information technology systems to all fields of healthcare, healthcare education and healthcare research. Healthcare informatics has a significant effect on the delivery and management of healthcare, in the current environment.

Bardan and Thouin (2013) categorise Health Informatics into seven groups which include: clinical informatics, nursing informatics, veterinary informatics, dental informatics, Bioinformatics, Imagery informatics and public health informatics. This implies that clinical informatics is the sub-component of informatics pertaining to clinical care.

Clinical informatics is the application of information and communication technology (ICT) in all facets of medicine and healthcare system (Polasek and Kern, 2012). Polasek and Kern further explain that clinical informatics assists the medical doctors in improving their clinical practices. According to the Agency for Health Care Research and Quality (2001), clinical information could be categorised into the following: Electronic Medical Record, Computerised Physician Order Entry, Computerised Decision Support Systems and Diagnosis Imagery Archive. These and other examples of clinical informatics will be discussed at length in Chapter 3.

The objective of clinical informatics, in effective healthcare delivery, as observed by Staggers et al. (2002), is to improve the health condition of the people through adequate use of ICT resources in the direct diagnosis, treatment and evidence based medicine for the care of patients. The contributions of clinical informatics to a medical professional include the following: promotion of knowledge sharing, adequate health monitoring, statistics gathering analysis, and the delivery of effective healthcare services (Olatokun and Adeboyejo, 2009). Daniel and Oyetunji (2013) identify various purposes in which medical doctors utilise clinical informatics. Examples of such utilization are the provision of adequate access to professional colleagues through instant transmission/receipt of mail message, electronic file system, and power search utilities to locate information stored in millions of computers around the world and effective communication through the use of internet, and diagnosis of patients.

The application of clinical informatics, by medical doctors, has different goals in developed and developing countries. In developed countries, the main objective of clinical informatics is to reduce healthcare costs and budget as well as to provide effective healthcare delivery to people irrespective of their origins and colours (European Commission, 2010). In developing countries, on the other hand, the main objective of clinical informatics is to provide improved access to medical care to people due to already limited access to effective healthcare resources (Haluza and Jungwith, 2014).

Nuq (2012) indicates that there is a shortage of 4.3 million doctors and other health workers all over the world. He argues further that, third world countries are the worst hit, particularly African countries which have 24% of the global burden of diseases with only 3% of the

world's medical doctors and less than 1% of the world's health expenditure. Wooton, Patil, Scott and Ho (2009) identify various reasons for the need to instil clinical informatics in developing countries. These include expensive costs of traditional healthcare services, shortage of medical doctors in developing countries, lack of qualified personnel in healthcare sectors and absence of ICT innovation. Clinical informatics also provides a window of opportunity to the health sector, particularly in developing countries, through the introduction of ICT resources, aimed at reducing epidemics and disease surveillance (Dawaon, 2007).

Medical professions are information intense and there is a need for adequate information sources that will assist medical doctors in clinical decision and at the same time promote evidence based medicine. Kilbridge, David and Classen (2008) note that clinical informatics is a cornerstone of the promotion of effective healthcare system in the continent. In order to understand and realise the potentials of clinical informatics in the health sector, however, there is a need for qualified medical doctors that have sound knowledge about ICTs and their application in healthcare. AbouZair and Boerma (2005) agree that reliable, efficient and accurate ICT skills are essential, for medical doctors, in the operation and monitoring of clinical informatics resources. This implies that clinical informatics and its applications have revolutionised healthcare service delivery. In another dimension, access and use of clinical informatics can contribute and address the challenges of cost reduction and improvements in equity and quality of care (De Rosis and Seghieri, 2015).

Lewis, Synowiec, Lagomarison and Chweiter (2013) observe that health system, in low and middle income countries, continues to face serious challenges in providing effective healthcare delivery which will be of high quality, affordable and accessible to the people. They recommended the need for adequate policies to promote the use of clinical informatics. Other authors such as De Rosis and Seghieri (2015) recommend the use of information and communication technology in low-and middle-income countries such as Nigeria and South Africa.

Clinical informatics has the ability to raise the standard of healthcare service delivery, in teaching hospitals, in Nigeria and South Africa, particularly, among the medical doctors, if they are properly utilised. In this study, it is argued that enormous potentials lie in the access and use of clinical informatics, in teaching hospitals, in Nigeria and South Africa. The level of the access to and use of clinical informatics is not readily known. Thus, the focus of this study is on the degree of access to and the use of clinical informatics among medical doctors, in University College Hospital, Ibadan, Nigeria and King Edward VIII Hospital, Durban,

South Africa. The selection of the two teaching hospitals allowed for the comprehensive and comparative study of the accessibility and utilisation of clinical informatics among medical doctors.

1.2 Contextual setting

Nigeria and South Africa are two of the eminent countries on the continent of Africa. Nigeria has a population of 170 million (National Agency for Control of Aids, 2014), with thirty-six states which are divided into six geo-political regions. They are North East, North Central, North-West and South West, South East and South-South. There are twenty-six teaching hospitals and twenty-five federal medical centres in the country (Federal Ministry of Health, 2004). However, there is no available data about the total number of general hospitals which are being handled by various state governments in Nigeria. South Africa, on the other hand, has eight teaching hospitals. The country is divided into nine provinces, namely the Eastern Cape, Free State, Gauteng, Limpopo, Mpumalanga, Northern Cape, North West, Western Cape and KwaZulu-Natal. The estimated population of South Africa in 2013 was 52.98 million (Statistics South Africa, 2013). There are 4,200 public health facilities in South Africa with a total of 165,371 qualified doctors in the country (South Africa Infor, 2012).

Nigeria has three tiers of medical care: primary, secondary and tertiary healthcare (National Strategic Health Development Plans Framework 2010). South Africa has five structures of healthcare system which are primary healthcare (clinics), district hospitals, regional hospitals, tertiary (academic hospitals) and central hospitals (academic). The two countries face the same health challenges, which include high levels of HIV/AIDS, tuberculosis, and low expectancy rate (Chikotie, 2013; Onu and Agbo, 2013).

The governments of the two countries have made various attempts, in the past, to promote clinical informatics in their countries. The Nigerian government embarked on the promotion of clinical informatics in 1980 through a research project championed by the Computer Center of Obafemi Awolowo University Teaching Hospital, Ile-Ife and University of Kuopio, Finland (Idowu, Cornford and Batin, 2008). It also introduced a software package called State Hospital Network (SHONET) which is used for sharing hospital resources over computer network (Idowu et al., 2008). The Ministry of Health in South Africa, on its part, inaugurated a committee to look at the effective ways of promoting clinical informatics in public hospitals across the country with the aim of developing clinical informatics practices (National Service Delivery Agreement, 2012).

Two teaching hospitals, the University College Hospital in Ibadan, Nigeria and King Edward VIII Hospital in Durban, South Africa were selected for this study. The University College Hospital, Ibadan was founded in 1952 and is affiliated to University of Ibadan as its teaching hospital. The hospital was established in response to the need for the training of medical personnel and other healthcare professionals for both the country and the West African sub regions (University College Hospital, 2011). The hospital runs courses at undergraduate and postgraduate residency training programmes in all specialities of internal medicine, surgery, obstetrics and gynaecology, etc. (UCH, 2011).

King Edward VIII Hospital was founded in the year 1950 (Ahamed, 2013). The hospital is the second largest hospital in the southern hemisphere, and provides regional health services to Kwa Zulu Natal (KZN) and the Eastern Cape (Department of Health Province of KZN, 2014). It is also the teaching hospital of the Nelson Mandela School of Medicine which is affiliated to University of KwaZulu- Natal. It offers courses in various fields of medicine such as obstetrics and gynaecology, general medicine, general surgery and paediatrics. (Department of Health, 2014).

The selection of teaching hospitals in Nigeria and South Africa was based on Ani's (2013) opinion that Nigeria and South Africa are two leading African countries in research productivity. Despite this, the countries have been ranked poorly in terms of healthcare delivery. For example, South Africa was 175th and Nigeria was ranked 187th by the World Health Organisation (WHO, 2000). Furthermore, Smart, Peace and Tonukari (2004) decry the poor state of ICT infrastructure in many countries, which include Nigeria and South Africa. According to them, the status of ICT development, in many teaching hospitals on the continent, does not support an effective and efficient healthcare delivery system.

The two teaching hospitals were selected for several reasons. The first is that, they belong to the first generation of teaching hospitals in the two countries and are therefore well established in terms of funding as regards infrastructural and human development. King Edward VIII is the only teaching hospital in the province of KwaZulu-Natal just as the University College Hospital, Ibadan, is the only federal teaching hospital, in Oyo State, Nigeria.

Furthermore, the affiliated universities of the hospitals were ranked high in 2014 by Webometrics ranking (2014) among the universities in Africa. King Edward VIII hospital was selected because University of Kwazulu-Natal in South Africa was ranked 6th while University College Hospital was selected because University of Ibadan, Nigeria, was ranked

19th out of 1417 universities that were listed in the assessment. The two hospitals selected are public teaching hospitals. Private teaching hospitals, were excluding from the study because there is no single private teaching hospital in the two countries.

1.3 Theoretical model

A number of theories are relevant to the access and use of clinical informatics and they generally fall into two categories. These include motivational theories and user acceptance of information technology theories. The motivational theories include Maslow's Hierarchy of Needs Theory and McClelland's Achievement Theory. The User Acceptance of Information Technology Theories, on the other hand, includes the Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), and Unified Theory of Acceptance and Use of Information Technology (UTAUT). This study opted to use Unified Theory of Acceptance and Use of Information Technology (UTAUT).

UTAUT condensed the eight other theories on users' acceptance, namely TRA, TAM, TPB, C-TAM-TPM, MM, SCT, MPCU and IDT. The theory has four main determinants of behavioural intention and actual utilization. These are performance expectancy, effort expectancy, social influence and facilitating condition (Ani, 2013). These primary constructs are further moderated by degrees of gender, age, experience and voluntariness of use (Al-Shafi and Weerakkody, 2009; Evans, 2013; and Olasina, 2014).

Venkatesh, Morris, Michael, Davis and Davis (2003), note that the theory has been empirically tested and validated, particularly for user acceptance. Although, Khechine, Lakhal and Ndjambou. (2016) have maintained that the theory is parsimonious in structure; Taiwo and Downe (2013) argue that it is more robust. Ghobakloo, Zulkifi and Aziz (2010) opine that UTAUT has a high predicting strength, particularly for technology acceptance behaviour up to 70% which is more effective than any of the known models. UTAUT was adopted for this study because it has overwhelming advantages; it has been validated; and it possesses the reliable instrument needed to measure users' behaviour towards information and communication technology. A detailed analysis of the UTAUT model is presented in Chapter four.

1.4 Statement of the problem

Access to effective clinical informatics is important as it increases healthcare delivery. Unfortunately, medical doctors' inadequate access to and use of clinical informatics prevent them from rendering effective and quality healthcare services to people through preventive,

diagnostic, restoration and rehabilitation cares. Ruxwana, Herselman and Conrate (2010) have earlier observed that clinical informatics tools are not being used in most teaching hospitals in Africa because of limited suitable resources.

Inadequate access to and use of clinical informatics among medical doctors have brought about medical errors and mis-diagnoses. Many people are casualties of medical doctors' inability to access and use informatics tools effectively. Medical errors could have been prevented if medical doctors have both access and the ability to use clinical informatics effectively (Idowu et al., 2008). Ushie, Salami and Jegede (2013) estimate that not less than 44,000 to 98,000 patients died annually from wrong diagnosis in the United State of America. In Nigeria, 13 to 43% of the instances where stroke has been misdiagnosed due to lack of access and use of clinical informatics tools have been reported (Imam and Olorufemi, 2006). Similarly, in South Africa, 40% of medical doctors admitted to have made medical errors due to lack of access and use of clinical informatics in the administration of drugs to the patients (Labusschagne et al., 2011).

There is evidence that access to and use of clinical informatics tools, in a hospital, can improve the quality of healthcare delivery. This can be achieved by adherence to guidelines, enhancing disease surveillance, promoting evidence based medicine and reducing medical errors.

There is a paucity of literature of literature in the domain of clinical informatics in Africa. For instance, a search on Scopus data base, which is the largest database in health sciences (Adelaide University, 2014), was employed to examine the number of articles that were published in peer review journals between the years 2005-2015 on clinical informatics in Nigeria and South Africa. The result revealed that between the aforementioned years only seven articles were published on clinical informatics in Nigeria, while twelve articles were published in South Africa.

This study seeks to extend the frontier of knowledge, by addressing the paucity of literature on accessibility and use of clinical informatics among medical doctors in teaching hospitals in Nigeria and South Africa. A review of literature revealed that no comprehensive study had been done on the use of clinical informatics in the two countries. Studies mainly focused on the Internet and computers used among medical doctors in the two countries (Cline and Luiz, 2013; Nwargu and Adio; 2013; Ruxwana et al., 2010; Idowu et al., 2008).

The study focuses on this gap, by providing insightful literature on the access to and use of clinical informatics among medical doctors in selected teaching hospitals in Nigeria and South Africa and providing new data on clinical informatics practices from this sample. It appears that there is no study on clinical informatics access and use among medical doctors in King Edward VIII, Durban, South Africa and the University College Hospital, Ibadan, Nigeria.

1.5 Aim of the study

The aim of the study is to investigate the access to and use of clinical informatics by medical doctors in selected teaching hospitals in Nigeria and South Africa, with the view to providing theoretical and practical knowledge for the improvement of the access and use of the clinical technology in the two countries.

1.6 Research objectives

In order to actualise the aforementioned aim, the study is designed to achieve the following objectives:

1. To determine the association between socio-demographic variables and the use of clinical informatics;
2. To explain the purposes of using clinical informatics among medical doctors in the selected teaching hospitals;
3. To find out the benefits of using clinical informatics in the selected teaching hospitals;
4. to ascertain the availability of clinical informatics infrastructure in the selected hospitals;
5. To identify the clinical informatics facilities that are accessible to medical doctors in the selected teaching hospitals;
6. To determine the factors that influence behavioural intention in the use of clinical informatics by medical doctors in the selected teaching hospitals;
7. To find out about policies that guide the use of clinical informatics in the two teaching hospitals;
8. To investigate the challenges facing the access to and use of clinical informatics among medical doctors in the selected teaching hospitals.

1.7 Research questions

The research questions are as follows:

1. Is there any association between the socio-demographic variables and the use of clinical informatics?
2. What are the purposes of using clinical informatics among medical doctors in the selected teaching hospitals?
3. What are the benefits of using clinical informatics in the selected teaching hospitals?
4. What clinical informatics infrastructure is available in the selected teaching hospitals?
5. Which of the clinical informatics tools are accessible to medical doctors in the two hospitals?
6. What are the factors that influence behavioural intention in the use of clinical informatics by medical doctors in the selected teaching hospitals?
7. What policies guide the use of clinical informatics in the selected teaching hospitals?
8. What are the challenges that medical doctors face in the access and use of clinical informatics tools in the selected teaching hospitals?

1.8 Intended contribution to knowledge

The study contributes to the practice of and the need to promote evidence-based medicine in clinical practices. In addition, the study contributes to knowledge by providing suggestions that could bring about policy changes. This is very important because policy changes, in organizations, entail long procedures and processes. The study creates opportunities for policy makers and hospital managements to argue for policy changes without having to face government bureaucracy bottlenecks. The study makes several recommendations aimed at promoting effective healthcare delivery and capacity building, in the hospitals in the two countries. Furthermore, the research contributes to knowledge through the research outcomes which will invariably and significantly contribute to the existing knowledge of clinical informatics. At the time of writing, four papers based on this research had been presented in conferences.

1.9 Scope and limitations of the study

The study is limited to medical doctors at King Edward Hospital, Durban, South Africa and the University College Hospital, Ibadan, Nigeria. The medical doctors, in the teaching hospitals, were chosen because of the important role they play in clinical care delivery.

The results of the study cannot be generalised to all the teaching hospitals in the two countries because of their different contextual settings which might lead to different approaches to access and use. Nevertheless the results of the research may be applied to

similar teaching hospitals (Tellis, 1997). Ngwelezane Hospital, South Africa was used for the pilot study of the research.

1.9.1 Subject coverage

The focus of the study is on access to and use of clinical informatics. Clinical informatics is a subfield of social informatics. Social informatics is an interdisciplinary field that examines the relationship between the use and impact of ICT on all human endeavours such as the health sciences, education, law, and other disciplines. It examines various ways in which ICT could be useful for human development, improving effective interaction between mankind and technology, and the interaction between society and ICT, at different levels, from the micro level of the economy to the macro level. The intention is to bring about changes in the use of ICT, particularly in this era of information society.

Due to the close relationship between studies on social informatics and clinical informatics, Kling (1999) argues that clinical informatics is not a new or independent discipline but a mere branch of social informatics. However, both social and clinical informatics are sub-categories of a more general field called “informatics”. Informatics is a discipline that covers various artificial intelligence, computer science and cognitive science that relate to ways of processing, managing, and retrieving information.

1.9.2 Methodological scope

The study employed both quantitative and qualitative research methodologies. The survey method was used to gather quantitative data while content analysis was used to analyse in-depth interviews and open-ended questions from the questionnaire. The details of the research methodology were discussed in Chapter 5.

1.9.3 Literature scope

The study explores current literature from published and unpublished work which included peer review articles, journals, conference proceedings, workshops papers, electronic database journals, and text books. The reasons for the review of literature, in this study, are to describe, explain, evaluate, and summarise what various scholars have done on the subject matter. The literature review, for this research, provides the theoretical basis for the study and access to existing body of knowledge.

The scope of the review focuses on the availability of clinical informatics in teaching hospitals, the clinical informatics facilities accessible to medical doctors, the factors that influence behavioural intention to use clinical informatics, clinical informatics challenges and

a host of others factors. The review of the model used for the study, UTAUT, revolves around access and use of clinical informatics: application of the theory in similar studies, limitations of the theory, and relevance of the theory to this study. In searching for literature, key words or phrases pertinent to the problems are identified and used to search for the relevant information.

The literature review for the study is informed by the global research trends in social informatics/clinical informatics whose value goes beyond the border of one country or region or location. Also, the analysis and the application of the research theory and models such as the globally known information systems/ICT4D/social informatics models like Unified Theory of Acceptance and Use of Technology (UTAUT) are done beyond the borders of one country/nation, for the benefit of all. Further details about literature review are at chapter three of the study.

1.10 Ethical considerations

The University of Zululand's ethical guidelines and policies regarding plagiarism and participation were given recognition in this research. Ethical requirements at national level for South Africa and Nigeria were also observed and complied with. The ethical clearance was granted by the two teachings hospitals before the research was carried out (See Appendix C). The issue of confidentiality was discussed with all the participants involved in the research. The confidentiality agreements were signed and proper acknowledgments were given to authors for using their materials.

1.11 Knowledge dissemination

The results of the study will be disseminated to the Department of Health, Kwa-Zulu Natal, and the library of King Edward VIII Hospital, Durban, and the library of the University College Hospital, Ibadan, Nigeria. A copy will be made available to the University of Agriculture in Abeokuta based on an agreement with the researcher and Nigerian Federal Ministry of Health. A copy will also be provided to the University of Zululand as contribution to the thesis collection in their institutional repository.

The findings of the study will also be disseminated through academic publications in academic journals and related conference proceedings. Thus far, the following papers have been presented in different conferences:

1. Owolabi, K.A. (2015) Access, use and challenge of clinical informatics among medical doctors in selected teaching hospitals in Nigeria and South Africa. Paper presented at the ProLISSA Conference - 9 to 13 March 2015, Pretoria, South Africa.
2. Owolabi, K.A. (2015). Access and use of clinical informatics among medical doctors in two African countries: a literature review. Paper presented at the University of Zululand, Faculty of Arts Annual Conference, 19 to 21 October, 2015, KwaDlangezwa, South Africa.
3. Owolabi, K.A. (2015). The status and development of access and use of clinical informatics among medical doctors in two selected teaching hospitals in Nigeria and South Africa. Paper presented at 16th Library and Information Conference, October, 14th to 15th, Richard Bay, South Africa.
4. Owolabi, K.A. (2016). Applying UTAUT in clinical informatics research. Paper presented at 17th Library and Information Conference, September, 6th-9th, Richard Bay, South Africa.
5. Owolabi, K.A. Mhlono, T.P. Evans, N. (2016). The status and challenges of clinical informatics development in South Africa. *Ikanyiso, Journal of Humanities and Social Sciences*. 8(2).125-135.
6. Owolabi K.A. Evans, D.N. and Mhlono, T.P. Applying UTAUT in clinical informatics research. Accepted for publication by *Library Philosophy and Practice*.

1.12 Structure of the thesis

Chapter One:	Introduction and background to the study
Chapter Two:	Contextual setting
Chapter Three:	Literature review
Chapter Four:	Theoretical framework
Chapter Five:	Research methodology
Chapter Six:	Data presentation and analysis of questionnaire responses
Chapter Seven:	Data presentation and analysis of interview responses
Chapter Eight:	Discussion of the findings
Chapter Nine:	Summary, conclusion and recommendations

1.13 Summary

The access to and use of ICT tools, among medical doctors in Nigerian and South African healthcare systems, minimises the risk of medical errors and helps in the early detection of health problems. ICTs have also been discovered to promote best practice, improve procedures, and motivate innovation and development in the healthcare sector. Investment in clinical informatics can promote more efficient healthcare services in the country. The governments of the two countries need to find lasting solutions to various challenges facing the development of the healthcare system, ranging from inadequate facilities to shortage of personnel and lack of electricity power, particularly in Nigeria. These and other challenges need to be overcome in order for the countries to enjoy the benefits of clinical informatics in promoting evidence-based medicine.

However, in order to ensure optimum use of clinical informatics, in the Nigerian and South African healthcare sectors, the governments, at all levels, must invest heavily in the acquisition of clinical informatics resources, which involve both hardware and software. Functional healthcare systems are likely to reduce emigration of health personnel, particularly medical doctors, to greener pastures and create a new revenue stream through those who will come to the country to seek solutions to their medical challenges. The need for commitments and proven healthcare models and adequate funding, to support clinical informatics projects in developing countries, is therefore very important.

Despite the rapid adoption of clinical informatics in developed countries, the effects of adoption of clinical informatics are very low. The low rate of adoption of clinical informatics is widening the digital divide between developed and developing countries. There is an urgent need for careful and nuanced methods to develop and establish the use of clinical informatics in poor countries. The application of clinical informatics is feasible in developing countries where there is a shortage of medical doctors, in both rural and urban areas. Integrating clinical informatics, in the healthcare sector of a country, would promote universal and effective healthcare coverage and strengthen the already weakened healthcare systems, especially in rural areas. In order for developing countries, particularly African countries, to be economically viable, politically vibrant and socially secure, there is a need for the effective adoption and utilisation of clinical informatics resources in their healthcare facilities.

Clinical informatics has enormous benefits as a tool to increase access to information for decision making and promote evidence-based medicine. Medical doctors in Africa are lagging behind in the use of clinical informatics. There is a need for more studies that would

establish the relevance, and usefulness of clinical informatics to medical doctors on the continent. Lack of research may be the reason why different governments on the continent have decided not to invest so much in clinical informatics development in healthcare. It can be deduced from the chapter that for the successful adoption of clinical informatics, it is not only technological factors that need to be considered, there must be an enabling environment, policy guidelines, good governance, and stakeholders' involvement.

It is hoped that the review of literature on the development of clinical informatics, in the two countries' healthcare systems, will inform medical doctors, hospital managements, healthcare providers and the government on processes of promoting clinical informatics in the Nigerian and South African health sectors. The chapter is also a general contribution to discussions and debates on clinical informatics development.

Table 1. 1: Summary of research research objectives, research questions, sources of data and data collection methods

Research objective	Research design	Source of data	Data collection instrument
To ascertain the availability of clinical informatics infrastructure in the selected teaching hospitals.	Survey / Qualitative Content analysis.	Medical doctors and heads of ICT respectively	Questionnaire and interview
To identify the clinical informatics facilities that are accessible to medical doctors in the selected teaching hospitals.	Survey / Qualitative Content analysis.	Medical doctors and heads of ICT respectively	Questionnaire and interview
To determine the factors that influence behavioural intention to use clinical informatics by medical	Survey / Qualitative Content analysis.	Medical doctors and heads of ICT respectively	Questionnaire and interview

doctors in the selected teaching hospitals.			
To explain the purposes for using clinical informatics among medical doctors in selected teaching hospitals.	Survey / Qualitative Content analysis.	Medical doctors and heads of ICT respectively	Questionnaire and interview
To find out the benefits of using clinical informatics in the selected teaching hospitals.	Survey / Qualitative Content analysis.	Medical doctors and heads of ICT.	Questionnaire and interview
To find out about policies that guide the use of clinical informatics in the two teaching hospitals;	Qualitative and content analysis.	Heads of ICT units.	Interview
To investigate the challenges medical doctors in the selected teaching hospitals face in both the access to and use of clinical informatics.	Survey / Qualitative Content analysis.	Medical doctors and heads of ICT respectively.	Questionnaire and interview

The next chapter discusses the status and development of clinical informatics in Nigeria's and South Africa's healthcare systems.

CHAPTER TWO: CONTEXT OF THE STUDY

2.1 Introduction

This chapter focuses on the institutional policies that are in place to promote the accessibility and utilisation of clinical informatics, in teaching hospitals in Nigeria and South Africa. The following sub themes are discussed in the chapter: status (policies, human resources, health finance, health facilities and equipment); issues relating to access and the use of ICT tools, in teaching hospitals, as well as opportunities and challenges in the Nigerian and South African contexts.

2.2 Status of, access to, and the use of clinical informatics in Nigeria's health care sectors

Health care facilities are necessary in all countries not only in African countries, where there is a rampant shortage of medical doctors (Nuq, 2012). The recent advancements, in ICT, provide the platform for innovative clinical informatics services and various opportunities for improving access to quality medical services. The status of access to and use of clinical informatics, in Nigeria's healthcare, can be examined through the following: policy and legislation, healthcare facilities and equipment, health finance and human resources development.

2.2.1 Policy and legislation

The National Health Equipment Policy for Nigeria (2005) states that access to information and communication technology is a prerequisite for a functional health care system. Consequently, there are various government policies, reports, bills, legislations, gazettes, and strategies that have been directed at the applicability of ICTs to health care delivery, in Nigeria. Among them are the Federal Ministry of Health Integrated Disease Surveillance and Response Policy (2005), National Policy on Health (2005), National Strategic Health Development Plan Framework 2009-2015 (2009), National Health Promotion Policy (2005), and National ICT Policy (2012).

The National Health Promotion Policy (2005) is highly relevant to this study. The policy was developed with the intention to create a positive outcome, in the health care system in Nigeria. This is particularly so, with respect to empowering medical doctors and other healthcare workers, with health improvement actions through the application of ICT tools in health care delivery. The objectives of the policy include strengthening the health promotion capacity of

the national health system and fulfilling the national health policy objectives of improving the health status of Nigerians, as well as, the achievement of health-related MGD goals (National Health Promotion Policy, 2005). The thrust of the policy indicates the need for urgent reform in the health sector, particularly, on the need to access and use ICT tools, in health care delivery (NHPP, 2005).

The Nigerian National Policy on Health (2005) emphasizes that the health care system of a country can be used to measure its productivity and level of poverty reduction. However, Nigeria's health indicators are among the worst in the world, with Nigeria alone carrying 10% of the global disease burden (National Strategic Health Development Plan, 2010 – 2015, (2010). The National Strategic Health Development Plan also underscores the fact that the country's healthcare delivery was rated 187th out of 190 countries in 2000 by the World Health Organisation.

2.2.2 Health care facilities and equipment

Nigeria has three levels of government; namely, federal, state and local. These three tiers of government are responsible for providing health care services to the people. The health care system is on a concurrent legislative list of the federal and state tiers as, in the country's constitution. Nigeria's health care facilities are administered by both private and public hospital managements. However, just as the roles of the three tiers of governments are not well defined, the functions and roles of the private sector, in the health care system in the country, are not also clearly stated (National Policy on Public Private Partnership for Health in Nigeria, 2005).

Public health care facilities are managed by federal, state and local governments. Other types of health care facilities are non-government hospitals, such as missionary hospitals and privately owned hospitals (National Human Resources for Strategic Health Plan, 2008 - 2012, and 2007). Primary health care facilities include clinics, dispensaries and health posts that provide general treatment (The National Human Resources for Strategic Health Plan, 2008 – 2012, and 2007). Primary facilities are staffed by nurses, community health workers, community health extension workers, and health officers. Primary facilities are under the control of local government authorities.

Secondary health facilities include general hospitals, which are mandated to provide general medical services as well as specialized health care services to the people. Services such as surgery, paediatrics, obstetrics and gynaecology are provided to health care users referred from the primary health care system (NHRHSP, 2012). The services of medical doctors,

nurses, and laboratory, pharmacy and health officers are always needed in secondary healthcare facilities. The secondary health care facilities are under the control of the state governments.

The National Strategic Health Development Framework, 2009 - 2015 (2009) notes that tertiary level facilities are the highest level of health care in the country. The facilities include teaching hospitals, federal medical centres, and specialist hospitals. Tertiary facilities are mandated to treat patients that are referred from primary health care and secondary health care. The facilities have various consultants from different medical fields, with special expertise and a variety of ICT tools for the diagnosis of patients (National Human Resources for Strategic Health Plan, 2008 – 2012, and 2007).

Oyinbocha et al. (2014) estimate that there are 23640 health care facilities in Nigeria. In which 85.8% of these facilities are primary health care centers, 14% are secondary health care centers, while 0.2% are tertiary hospitals. In addition, 38% of the total facilities are owned by the private sector, which provides 60% of the health care services in the country. Identifying this number would promote proper stewardship and help to develop human and material resources, within the functioning health care system (National Strategic Health Development Plan Framework, 2009 - 2015, 2009).

According to the National Health Policy (2014), adequate ICT tools should be provided to all the health care facilities, in the country, particularly, to teaching hospitals. In order to achieve this, the Nigerian government has agreed to create a special fund, referred to as the Basic Health Care Provision Fund, for the provision of ICT tools to all the teaching hospitals in the country. The National Health Bill (2014) indicates that 50% and 15% of the fund respectively are to be allocated to the provision and maintenance of ICT facilities, in the hospitals.

Furthermore, the Central Bank of Nigeria (2011) states that the Nigerian government signed an agreement with an Austrian firm, in a bid to provide ICT tools to all the federal teaching hospitals in the country. The project is known as the “Federal Government/ Vamed Engineering Teaching Hospital Equipment” Project. Nwakize and Kandal (2011) list some of the health facilities that the government has provided to teaching hospitals to include the following: linear accelerators, 64-slice cardiac computed tomography (CT) machines, world class echo, ECGs, digital cath lab, medical imagery and diagnostics equipment, infusion pumps, medical stainless, electrostatic dissipative, spectrophotometers, fluoroscopy machines, magnetic resonance imaging (MRI), and incubators. The hospital equipment initiative of the federal government of Nigeria seems to demonstrate its commitment to the improvement and

overhauling of the health sector by providing relevant ICT tools for improved medical procedures. Nevertheless, the Nigeria Project Agenda (2010) reveals that access to health care facilities in the country is very low, claiming that only 3 out of 5 Nigerians have access to adequate health care facilities.

2.2.3 Human resources development

Human resources are the fundamental elements of the health care system. The National Strategic Health Development Plan, 2010 - 2015 (2010) asserts, that healthcare delivery cannot flourish without an effective workforce. This workforce includes medical doctors and other support workers who enable the health system to function. The number of medical doctors determines health productivity and result drive (National Human Resources for Strategic Health Plan, 2008 – 2012, and 2007:14). Wakili (2013) observes that 71,740 medical doctors were registered with the medical regulatory body. About 27,000 were practicing within Nigeria, while 7,000 were working in public health institutions, in foreign countries like Britain and America. Others had left the profession for better working opportunities (Wakili, 2013).

Nigeria has 25 accredited medical colleges that are unequally distributed across the country. In which, 75% are located in the southern part of the country, while almost 17 states in the country do not have a medical college (National Strategic for Health Development Plan, Framework 2009 - 2015, 2009 Adindu and Asuquo, 2013). The National Human Resources for Strategic Health Plan, 2008 - 2012 (2008) reveals that there was an average of one doctor for every four primary health care facilities; an average of 6 doctors per secondary health facility; and an average of 65 medical doctors per teaching hospital. The National Strategic Health Development Plan Framework, 2009 - 2015 (2009) notes that the majority of the medical doctors in Nigeria were working in the private sector, while about 12% of the medical doctors, who were trained in the country, were working in foreign countries.

Other hand, health care providers, especially doctors, should be adequately trained to function in the health care system. Therefore, the National Health Bill (2014) states that, the government is mandated to ensure that there are adequate resources for the training and retraining of medical doctors and other health workers, working in the country. In order to meet the demand for medical doctors, in the health care sector, the federal government has mandated the Federal Ministry of Health to employ more medical doctors, from other countries and facilitate their training (National Health Bill, 2014).

2.2.4 Health financing in Nigeria

As mentioned earlier, the health sector is on the concurrent legislative list, in the Nigeria's Constitution. The implication of this is that, each tier of the government budgets for its own health care services. The federal government provides budgetary allocation to teaching hospitals, while state governments handle secondary health care facilities, such as general hospitals or comprehensive hospitals, and local government authorities handle the budgetary allocations to primary health care centres (National Human Resources for Health Strategy Policy, 2007).

National Human Resources for Health Strategy Plan (2007) highlights various health care functions that the government funded, in the year 2008. These include preventive measures against diseases, curative and rehabilitative services, occupational health and capital formation, research, and health development. The Health Worker Country Profile (2008) reports that, in 2008, curative care recorded the highest health care expenditure in the year 2005, accounting for 175.5 billion naira or 68.49% of the total health expenditure. Preventive care came second with 2.2 billion naira, accounting for 0.9% of the total health expenditure. Capital formation took up the rear with less than 0.31%, while 29.93% of the budget was grouped as 'other'.

The Human Resources for Health Country Profile Tanzania (2013) recommends that \$54 (2005 exchange rate) should be the minimum that the government should spend on health-related issues, per person. Soyinbo, Olaniyan and Lawanson (2009) estimate Nigeria's total government health expenditure as a proportion of the total health expenditure, which was put at 18.69% in the year 2003, 26.40% in 2004 and 26.02% in 2005.

Imoughele and Ismaila (2013) observe that the total government expenditure on the health sector in the years 1986, 1990, 2000 and 2010 was N360.4m, N 558.1m, N18181.8m and N149269.8m respectively. The capital expenditure, on the other hand, reveals the same continuous increase in the year 1986, 1990, 2000 and 2010 of N18.2m, N157.0m, N6569.2m and N46649.8m respectively. Similarly, the recurrent expenditure, on health, reveals continues increase in value in the year 1986, 1990, 2000 and 2010 of N279.2m, N401.1m, N11612.60m and N102.620m respectively.

However, Alabi, Adams, Chime and Aiguuomudu (2011) observe that less than 1% of the GDP was allocated to health care from 1986 to 2010. According to the Federal Ministry of Finance, the allocation to health was increased to 5.6% of the GDP in 2013 and 6.5% in 2015 (Federal Ministry of Finance, 2013; Federal Ministry of Finance, 2015).

Bhardj (2016) compares Nigeria's budgetary allocation to other countries in the region such as Sierra Leone, Mali, Niger, Burkina Faso, Senegal, Benin, Togo, Liberia, Ghana, Cape Verde and Gambia and he discovered that these countries budgetary allocations is higher compared to Nigeria's budgetary allocation to health. This is surprising, because Nigeria is one of the signatories of the Abuja Declaration in 2001, where African Heads of State agreed that 15% of the annual budget should be allocated to the health sector (United Nations Programme on HIV and AIDS, 2013). The implication is that although the budgetary allocation to the health sector has increased, a lot of consideration still needs to be given to the tools, manpower and facilities that could improve the health care sector and ensure that the best services are available to all.

In order to promote the adequate funding of health care delivery, the government recently introduced the National Health Insurance and National Health Bill to dedicate more funds to health care in the country (United Nation Foundation, 2014).

2.3 ICT access and use in Nigeria's health care sector

ICT, for health, refers to any tools that promote the processing of information by electronic means, for the purpose of improving health of the people. Gagnon, Desmartis, Car, Pagliari and Pluye (2012) observe that ICTs have become essential in medical practice because the amount and complexity of knowledge and information have outstripped the ability of medical doctors to function optimally without the support of relevant information and communication technology.

The National Strategic Health Development Plan Framework, 2009 - 2015 (2009) also notes that, over time, many donor agencies have donated computers and other ICT tools for use in the health care sector, particularly in the area of record and information management and the use of electronic-based ICT systems.

In listing various advantages of ICT access and use in health care delivery in Nigeria, the National Health Management Information System Policy Programme and Strategic Plan of Action (2007) states that ICTs lead to: better decision making by medical doctors; effective allocation of resources; effective disease management; and better quality of life. Oдини and Omuke (2014) likewise note some of the areas in which ICT can be applied in health care, citing decision making, provision of adequate medical information, and dissemination of health information for medical education and research. The provision of up-to-date

information and effective communication between professional colleagues, in the medical field, can only be successful, through the effective use and application of ICTs.

Nigeria's National Broadband Plan, 2013 - 2018 (2012) notes that ICT access and use by medical doctors can offer solutions to many medical problems, improve health care outcomes, reduce costs, and improve the efficiency of communication between medical doctors and their patients. The use of ICTs, in health care, gives patients, in many jurisdictions, the opportunity to communicate with their medical doctors via the e-mail, Internet, and video consultations rather than through traditional face-to-face consultations (NNBP 2013-2018, 2012). Various ICT applications, that can be very useful in health care delivery, as noted by Odiini and Omuoke (2014), include telecommunication, teleferrals, teleradiology, electronic health records, computerized physician orders, and imagery archive systems. The United Nations Foundation (2014) categorizes ICT initiatives in health to include SMS based applications, Internet based applications, Internet based interaction applications, and high speed Internet.

The WHO (2008) states that ICT is used, in health care delivery, to support health care by preventing diseases, diagnosing diseases, and managing diseases. Drury (2005) and Bukachi and Pankenham-Wash (2007) specify that ICTs are fundamental in modern healthcare because they can improve isolated communities' access to health care, provide support to medical doctors, assist in knowledge sharing, provide visual tools that can link the population for the dissemination of environmental information on disease outbreaks, as well as provide an effective electronic means for data capture, storage, interpretation, and management.

Afolayan and Oyekunle (2014) conducted a study on availability, accessibility, and the use of ICTs by health workers in Nigeria. In the study, 70% of the respondents stated that they used Internet resources and accessed the tools outside the hospital for the purpose of seeking information. Half of the respondents claimed that they had been using ICT tools over the last five years. Asagnasi, Adejoro, Farri and Makinde (2008), likewise, conducted a study on computer use among medical doctors, in a teaching hospital in Nigeria. The findings revealed that all the medical doctors had access to the Internet, but the predominant place of access was the cyber café. Only 51% of the respondents owned personal computers. When asked about challenges in accessing medical records, 41.4% of the respondents stated that computer-based recording systems are better than manual based recording systems. They also stated that they always had problems with checking patients' records, when using the manual-based recording system.

2.4 ICT opportunities in Nigeria's health care sector

There are many opportunities that ICTs can bring and have brought to Nigerian teaching hospitals. Among them are: guiding innovation in the health care system; supporting ICT infrastructure development; promoting health care intervention and promoting capacity building.

2.4.1 Guiding innovation in the health care system

ICT application in health care delivery also provides diverse opportunities for the development of reliable human resources, particularly among medical doctors who are able to expand their skills, increase their job satisfaction, and improve the efficiency of medical tasks (National Information Technology Policy, 2012).

The networking of all health care facilities, compulsory ICT training of medical doctors, and software development, are just some of the government initiatives motivated by the promotion of ICT, in health care in Nigeria (National Health Policy, 2005). Various innovative projects involving ICTs have also been implemented, in the health care sector in the country, such as the National Health Management of Information, Abiye Safe Motherhood, the Community Surveillance System, Clinical Pack 360, Mobile Health Applications, and the Distributed Electronic Clinical System (United Nation Foundation, 2014).

2.4.2 Supporting ICT infrastructure development

The provision of quality health care services, in a country, is guided by the level of access to and use of ICTs by medical personnel (Awopetu, Anhanje and Ocheibi, 2014; Olatokun and Adeboyejo, 2009). Following the push for ICT in health care delivery, quite a number of teaching hospitals have subsequently been provided with various ICTs, such as the Internet (Hassan, Siyanbola and Oyebisi, 2011).

The government has harnessed the opportunities of ICT, in health care delivery, by providing relevant infrastructure and upgrading the ICT equipment in teaching hospitals across the country. This demonstrates the commitment of the government towards overhauling the entire health sector, by equipping teaching hospitals with state-of-the-art medical equipment (Nwoko, 2011).

2.4.3 Promoting health care intervention

The government is partnering with various organizations on ways to reposition the health care sector. The Public Private Partnership (PPP) of the government has proved to be very effective in promoting a health care system where investors are encouraged to establish

and operate theatres, diagnostic units and ICT facilities within teaching hospitals on “build, operate and transfer” (BOT) terms (Ukwoma and Muracy, 2002). The authors go on to list some of the PPP/ICT projects at some of the teaching hospitals in Nigeria. Such hospitals include: Automated Open Heart Surgery at the University of Nigeria Teaching Hospital, Enugu, and University College Hospital (UCH), Ibadan, Nigeria.

2.4.4 Promoting capacity building

The National Policy on Public Private Partnership for Health in Nigeria (2005) observes that many doctors, in Nigeria, cannot operate various ICT tools in hospitals due to inadequate training and the inadequate medical curricula in medical schools. The federal government agreed to employ the service of private ICT firms to organize ICT training opportunities (National Policy on Public Private Partnership for Health in Nigeria, 2005). Recently, the government allocated 10% of its health allocation budget to the ICT training of medical doctors (National Health Bill, 2014) The National Information Technology Policy (2012) clearly states that ICT training has been made compulsory for medical doctors, working in all government hospitals (NNBP, 2012).

2.5 Challenges of ICT access and use in Nigeria’s health care sector

There are many issues facing ICT access and use in Nigerian hospitals. Such challenges include: policy issues, paucity of ICT infrastructure, funding problems, poor maintenance culture, a shortage of medical doctors, and a poor power supply.

2.5.1 Policy issues

A policy is a course or principle of action adopted or proposed by an organization or individual for bringing about a desired outcome (United Nations Foundation, 2014). Policy issues are a serious challenge to the implementation and development of ICTs in health care delivery. The National Policy on ICT (2012) observes that there are various uncoordinated policies and laws guiding different facets of ICT development in Nigeria, rendering them ineffective in providing adequate support for real ICT development in the country. The lack of clear government policies and strategies on ICT and health care delivery has led to the slow uptake of technology in the health sector. This has affected the adoption and implementation of ICTs for the advancement of health care services. Where the initiative has been implemented, there has not been adequate monitoring and evaluation (Ouman and Herselman, 2008). It is important for the government to provide adequate policy documents to support the use of ICTs, in health care delivery, particularly by medical doctors.

The United Nations Foundation (2014) observes that none of the existing policy documents in Nigeria pays serious attention to ICT access and use for effective health care delivery. The National Strategic Health Development Plan Framework 2009-2015 (2009), likewise, observed that while successive governments have strived to improve the health sector through a series of policies and reports, none of the reports has made adequate plans for ICT implementation and development. There has been policy inconsistency with respect to ICTs because different governments introduce different or new policies that do not correspond with existing ones, thus affecting the development of ICT in the Nigerian health sector (Oyegoke, 2013). The United Nations Foundation (2014) also notes that there is a need for an e-Health strategy policy plan or framework in Nigeria.

2.5.2 Paucity of ICT infrastructure

Ezeamalu (2010) opines that ICT access and use in hospitals is a panacea for developing new ways of providing better health care services. He attributes this to the massive innovations in ICTs, over the past 10 years, that have brought about significant changes to health care services. The quality of health care services, in a country, is measured by the level of ICT infrastructure possessed and used in the health care sector (Hassan, Siyanbola and Oyebisi, 2011). Therefore good ICT infrastructure in health care delivery is a requirement for promoting the wellbeing of a country.

The development of ICT infrastructure is essential to a modern and effective health care system. The United Nations Foundation (2014) describes ICT infrastructure development as concerned with all aspects of connectivity, electricity, hardware, and software that facilitate the use of ICTs in health care delivery (UNF, 2014). The paucity of ICT infrastructure, in Nigeria's health care system, has hampered the provision of efficient and affordable access to clinical informatics in the health sector, which has affected the quality of health care in the country (UNF, 2014).

According to Research ICT Africa (2012), Internet and broadband have been globally acknowledged as a strong foundation for transforming the health sector and promoting access to and the use of ICT in health care, particularly among medical doctors (National ICT Policy, 2012).

There are 167 million Internet subscribers in Africa, which is about 15% of total subscribers all over the globe. Nigeria reportedly has the highest number of users with 48.4 million recorded in the year 2012, leading Egypt (29.8 million), Morocco (16.5 million), Kenya (12 million) and South Africa (8.5 million)(Internet World Stats, 2012). Despite these numbers

only 7% of domestic households were reported to have Internet access (National ICT Policy Action, 2012). The broadband in Nigeria barely covers 20% of the population (Nigeria's National Broadband Plan, 2013 – 2018, 2012). Quality health care services and ICTs cannot be sustained in Nigeria without an adequate and pervasive power supply. This problem of power supply is discussed later.

2.5.3 Funding problems

Funding is a problem that all professions face, particularly with respect to ICT access and provision. Gbadamosi (2006) notes that inadequate funding is one of the main challenges militating against ICT access and use in Nigeria. The poor level of health funding in Nigeria and reduced budgetary allocation to the health sector has constrained the provision of ICTs. An examination of public expenditure on health in the country's budget indicates that, the allocation to health care has been rather low. The percentage of public health expenditure on total government expenditure, according to the World Health Organization, in 1995, 2000, 2005, and 2010 was 7.05%, 4.22%, 6.41% and 4.4% respectively (Imoughele and Ismaila, 2013). This implies that more provision should be made for the Nigerian health care system in terms of budget allocation.

2.5.4 Poor maintenance culture

Many hospitals and health institutions in Nigeria are facing maintenance challenges with their ICTs (National Health Equipment Policy for Nigeria, 2005). Obansa and Orimisan (2013) observe that good health services, in the country, depend on the availability of functional ICT tools for diagnostic and treatment purposes. The authors explain that most hospitals in Nigeria lack ICTs, and those that do have access to them, have them in short supply.

The National Health Equipment Policy for Nigeria (2005) reveals findings from a national survey of ICT use in government hospitals in Nigeria that showed that 5% of the ICT tools, in government hospitals, were not installed. Another 5% were installed but not formally put to use, while only 10% of the ICT tools in the government hospitals were fully functional. The research identified the factors that are responsible, in particular, the failure to comply with instructions on installation requirements, and time wasted between the time of procurement, installation, and formal declaration of use, leading to out dated tools.

2.5.5 Shortage of medical doctors

Human resources are the heartbeat of effective health care services in a country. The Nigerian health sector is facing a serious human resources challenge, most notably with regard to the

misdistribution of available medical doctors, within the health sector and the increase in brain drain which has resulted in a shortage of critically needed medical doctors. National Human Resources for Health (2006) affirms that adequate medical doctors are essential to the provision of quality and effective health care services in the country.

There were 39210 registered medical doctors in the country as at 2007. Despite the fact that the country has the largest pool of medical doctors in Africa, the 39210 doctors translate to 30 doctors per population of 100,000 (NHRHP, 2008 - 2012, 2007). This poor ratio of medical doctors to the population may be attributed to various factors, including but not limited to poor working conditions, lack of equipment, poor conditions of service, delays in promotion, poor placement after training, inadequate opportunities for professional advancement, and unfavourable civil service rules (NHRHP, 2008 - 2012, 2007).

2.5.6 Poor attitude toward ICTs

The government is committed to capacity building with ICTs in other ministries, but ICT skills training in the health sector, particularly for medical doctors, is lacking (United Nation Foundation, 2014). In their study, Olasina and Popoola (2014) argue that medical doctors in Nigeria have low perceptions about the use of ICT in health care delivery. They attributed this to poor ICT infrastructure and the inadequate training of medical doctors.

2.5.7 Poor power supply

The critical impact of the shortage of electricity on ICT projects has been expressed by Idowu, Ogunbodede and Idowu (2004), who note that the unstable power supply to hospitals in Nigeria can cause damage to ICTs in hospitals.

Nigeria's power generation capacity is estimated to be 6,000 megawatts, with an average working capacity of 2,000 megawatts for the provision of electricity to over 17s0 million people (FGN, 2013). Nigeria has been struggling to supply adequate power for over two decades, and the power supply, in the country, is characterized by frequent power cuts (Alawiye, 2011). The lack of a steady power supply, in the country, reduces the essential energy that is necessary for the operation of ICT tools in the health care sector.

2.5.8 Telecommunication problems

The Nigeria National Broadband Plan, 2013 - 2018 (2012) asserts that, while telecommunication is a very important pillar in the use of information and communication technology in the health sector, presently, there are a lot of challenges, such as the high cost of the right infrastructure, damage to fibre infrastructure, and cable theft. Idowu et al. (2008)

identify inadequate telecommunications facilities as one of the challenges facing ICT use in the health sector. The authors, further state that, despite the highly rated telecommunications sector in the country, the majority of health care facilities have no access to the Internet and operate on low bandwidth.

2.6 Status of, access to, and use of clinical informatics in South Africa healthcare sector

Achieving equitable and universal healthcare requires the provision of effective policy and legislation, available and accessible healthcare facilities and capacity building for human resources in the sector. There are many issues that address the access and use of ICT in health care in South Africa. These are discussed under the following sub-headings: Status of access to, and use of clinical informatics in South Africa healthcare sector, policy and legislation, healthcare facilities and equipment , human resources, finance of healthcare in South Africa, ICT access to and use of clinical informatics, opportunities and challenges of access and use of clinical informatics in South Africa.

Good and quality healthcare system are necessary components to improve clinical outcomes and to bring uplift to the health status of a country (Department of Health Annual Report, 2013). E-Health Strategies of South Africa (2012) states that an effective health care system is a function of an adequate and reliable health information system that assists in producing relevant and accurate information for decision making. It has been widely accepted that Information and Communication Technology is a critical resource for achieving this.

2.6.1 Policy and Legislation

There are many policies, strategies and legislations that support the development and implementation of ICT in health care delivery in South Africa. Among the policies are the White Paper on Health Care Reform (1997), Public Service Act (2001), Health Sector Strategies Framework (1999-2004), Strategic Priorities for the National Health System 2004-2009, Medical Scheme Act (Acts 131 of 1998), Public Financial Management Act (Act 1 of 1998), Statistics Act (Acts 6 of 1999) , National Health Acts (Act 61 of 2003). Medical Schemes (Acts 131 of 1998), and National Health Amendment Act (Act 12 of 2013).

This research was informed by South Africa e-Health Strategy Plan (2012). The e-Health Plan outlines the employment of ICT, for effective healthcare delivery, particularly, in the treatment of patients, research, training of medical students, tracking of diseases and monitoring of public health. The document outlines ten strategic priorities for ICT use in

healthcare delivery. Among these strategies are capacity building for medical doctors, standards and developing application to support health care delivery. Among the specific goals stated in the documents are adequate budgetary allocation and issues of affordability and sustainability of access and use of ICT tools in effective health care delivery, registration of all medical doctors with their professional body and professional accreditation of health informatics in the country (e-health Strategies Plan, 2012).

2.6.2 Healthcare facilities and equipment

The National Health Act, 2003 (Act 61 of 2003) states that there is a single health system for South Africa. It stipulates the rights and responsibilities of various healthcare facilities and health providers and ensures broader participation in healthcare delivery.

The National Health Care Facilities Baseline Audit (2012) and South Africa Year Book (2015) describe various forms of health care facilities in the country. For instance, a clinic is described as a permanent, well equipped, health facility, in which primary health care services are provided. It provides accident, emergency and midwifery services. The audit document defines a district hospital as a level 1 facility that provides outpatient and inpatient services. The services are offered with support from general medical doctors and the facilities can perform operations under general anaesthesia (NHCFBA, 2012). Cullan (2006) and Scott (2011) note that out of 388 hospitals in the country, 64 % are district hospitals, 16% are secondary and 4% are made of provincials and national hospitals.

A regional hospital is a (level 2) facility that caters for and requires the services of specialists and general medical doctors. These hospitals cater for the following seven basic specialities: surgery, medicine, orthopaedics, paediatrics, obstetrics, gynaecology and psychiatry, with the services of radiology and anaesthesia. Another level 2 hospital is the tertiary hospital. Level 3 health facilities comprise of the National Central Hospital which is mandated to provide tertiary hospital service and central referral services (NBHA, 2013). They are mandated to provide medical services such as heart and lung transplants, bone marrow transplants, liver transplants and cochlear implants. The facility provides training for medical students, conducts medical research and receives patients referred from regional hospitals. The facility is attached to a medical college as a teaching arm (NBHA, 2013).

The essence of the classification of the health care facilities in South Africa may be due to the need to redress social and economic injustices, to eliminate poverty, reduce waste, increase efficiency and promote access to quality health. It is also seen as part of improving the

healthcare system and ensuring that everybody has equitable access to essential and quality health care.

The Department of Health set up a committee to audit the health facilities, particularly to assess infrastructure and human resources. The finding of the committee revealed that essential medical facilities, which include ICT tools, have increased from 40% to 78% as of 2013 (Government of South Africa, 2015). This increase in medical facilities may be attributed to the South African's government's commitment to the improvement of ICT access and use in medical infrastructure, through the introduction of the National Health Insurance Scheme that makes funds available for the project. Furthermore, the recent introduction of the National Health Act (Act 12 of 2013), established the Office of Health Standards Compliance, which is mandated to inspect ICTs and other medical facilities in government and private hospitals, once every four years.

2.6.3 Human resources development

Bandiwala, Fonn, Osegbeagbe and Tollaman (2010) stress that human resources are very vital in the task of repositioning healthcare delivery in South Africa. In order to strengthen the capacity of human resources in the health sector, the Minister of Health, in 2013, launched the Albertina Sisulu Executive Leadership Programme in Health (ASELPH), in collaboration with the University of Pretoria, University of Fort Hare, Harvard University, Department of Public Health and South African Department of Health (South Africa Government, 2013). Part of training involves the use of ICT tools for effective healthcare delivery (South Africa Government, 2013).

However, a report by the Human Science Research Council (2009) determines that there were 5103 public sector vacancies for medical doctors in 2006. Erasmus (2008) likewise conducted a study on the shortage of medical doctors in public hospitals in South Africa. The study analysed the Department of Labours (DOL) database 112828 vacancies advertised in newspapers from April 2004 to March, 2007 and discovered 36% of the vacancies were for medical doctors. In the year 2012, there were 165,371 qualified health practitioners in both public and private sectors health facilities that were registered with the Health Professions Council of South Africa. This includes 38,236 doctors and 5,560 dentists. The doctor-to-population ratio is estimated to be 0.77 per 1000, and due to the vast number of practitioners (73%), the majority of medical doctors worked in the private sector. As at 2012, there was 1 practicing medical doctor per 4219 people (26 SA Medical Stats 2012; South Africa Info,

2012). The above illustrates that the medical doctor's to population ratio is very low (South Africa Info, 2012).

In addition, the basic medical equipment is not meeting the working standards of medical doctors and the work environment is not conducive (South Africa Infor, 2012). These factors may be responsible for the shortage of medical doctors and other allied worker, who may have left for greener pasture. South Africa Infor (2012) enumerates various steps that the government is taking to increase the number of medical doctors in the country. These included signing an agreement with the Cuban, Tunisian and Iranian governments on the training of medical students from South Africa, employment of Cuban medical doctors, one year compulsory community training, and the state policy to produce 1200 medical doctors from medical schools within South Africa annually.

2.6.4 Financing of health in South Africa

The National Planning Commission (2014) maintains that the South African health care system needs to be well funded in order to provide adequate health care to the people. The South African government has invested heavily, in the health sector. An average of 8.2 % of Gross Domestic Product (GDP) is spent annually on the health sector (Econex, 2013).

Econex (2013) provides the percentage of budgetary allocations to health from 2007-2012, indicating that it was 7.5% in 2007/2008, 8% in 2008/2009, 8.5% in 2009/10, 8% in 2010/11 and 8% in 2011/2012. %). The National Planning Commission (2014) notes that, the government of South Africa is spending large amounts of money on health, in order to achieve the health targets set out by the MGDs which include: increasing life expectancy to 70 years of age by the year 2030, reducing in the HIV /AIDS rate in the country, reducing maternal mortality from 500 to 100 for every 100,000 live birth, provision of treatment and the need to put preventive mechanisms in place to prevent the spread of diseases, the need to reduce the communicable diseases by 28%, and the provision of free access to equal and standardized health care services. The majority of the funds, spent on the health care sector in the country, come from the national treasury. The budget for the year 2012 was put at R121 billion, which was aimed at improving the hospitals and providing them with adequate ICT tools (NPC, 2012).

South Africa Infor (2014) states that in the 2014 budget; almost R19.3billion was allocated to the refurbishing and purchasing of ICT tools and other clinical equipment. Another R1.2 billion was allocated to vital equipment and ICT tools in 856 clinics, 66 hospitals, 17

specialised hospitals and 10 additional hospitals which formed the three metropolitan health complexes (Bateman, 2012).

In order to promote ICT use in hospitals, the government introduced a programme known as Hospital Infrastructures, Procurement of Necessary Equipment and Management Skills, which is mandated to equip all public hospital facilities with the latest ICT tools. This was mobilised with the sum of R 1.9 billion as a take-off grant (Medical Club of South Africa, 2013). In 2011/2012, the national government allocated a sum of R442 million to ICT development in the public health sector. Another R442 was allocated in the same year to teaching hospitals to procure relevant ICT tools in their different hospitals. The government also established 29 hi-tech (ICT) hospitals all around South Africa (Medical Club of South Africa, 2014)

Furthermore, National Health Insurance (2012) earmarked R125 billion for the provision of ICT tools in the public health sector from 2012 to 2020 and another R255 billion to be spent in the year 2025 for the same purpose. This represents an average annual increase of 4% in real value when compared to the average real increase in the public health expenditure of 6.6% over the last 10 years. Trevor (2007), the minister of finance, in his budget speech, observed that the national government had set aside 1billion Rand for ICT infrastructure development in the public health sector in that fiscal year and earmarked another 1 billion Rand for all the teaching hospitals, for automating their equipment.

It is therefore plausible to conclude that the South African government has been spending large amounts of funds on healthcare infrastructure development so that the citizens could have access to better healthcare facilities, as it is clearly stated in the Constitution.

2.7 ICT access and use in South Africa's health care sector

The history of ICT to public health care delivery in South Africa can be traced to the formation of the District Health Information (DHIS), which was launched in 1998, in all the provinces. This was the first systematic computer data gathering tool that was used to link all the primary health centres, in the country together, for the collection of information on various national health indicators. The programme was facilitated by the Health Information Systems Programme (HISP) and comprised of training on ICT, data handling processes, and software tools and design for health care delivery (Info Dev, 2006).

The computerised National Health Care Management Information System was introduced 1994 to cover medical records, registration of health care users, and to control the billing system, in selected hospitals, in the nine provinces (Littlejohns, Wyatt and Garvican, 2003).

The South African Department of Health, in collaboration with the Department of Home Affairs, also introduced an ICT project on healthcare named the HANIS Project, in which the data elements of every citizen would be stored and infused into a smart card which would contain their medical history, diagnoses, treatment, prescription and medical aid (Infor Dev, 2006).

According to the South African Constitution, particularly Clause 27, everyone has the right to enjoy and access good health care services, which includes reproductive health, sufficient food, shelter, water and social security, especially for individuals who are unable to care for themselves. Access to equitable health care is a basic human right. The Constitution and the Bill of Rights of the Republic of South Africa, Section 27 (1) (a), stipulates that: “everyone has the right to have access to health care services” and section 27 (2) states that the government must “take reasonable legislative and other measures to achieve the progressive realisation of the right” (Constitution of the Republic of South Africa, 1996). The DoH (2013) lists the strategic priorities that need to be attended to before there could be effective ICT leverage, in healthcare delivery, to include proper strategy and leadership, involvement of stakeholders, standards and interoperability, good governance and regulations, affordability, benefit gain, capacity and workforce.

Mars and Seebregts (2008) explain the role of the South African government in developing and promoting ICT access and use in healthcare delivery. They observed that the country is an active member of ISO/TC 46 (National Information Standards Technical Committee) which is tasked with harmonising standards in the world of information globally and facilitating access to knowledge and information (The Information, 2015). Furthermore, South Africa has made efforts to promote the interoperability and interchange of data. The country also employed ICD-10 as the national diagnosis standard and HL7 version 2.4 as the national messaging standard, particularly in the public sector (Council for Medical Scheme, 2014).

South Africa’s eHealth Strategies (2011) lists various initiatives that the government has adopted to promote the use of and access to ICT in the health sector. Such strategies include, telemedicine project undertaken by the Medical Research Council, Health’s Love Life project and the establishment of the Closed Health Broadcast Channel. The DoH (2013) examines the status of telemedicine in South Africa and discovered that telemedicine facilities had increased from 28 to 68 sites, with the highest number in the province of KwaZulu-Natal. These and other initiatives suggest that the government has realised the positive impact of

ICT, in the promotion and improvement of the country's healthcare system, particularly in remote areas.

The aim of all these initiatives is to create awareness and understanding of the benefits of clinical ICT tools as a mechanism for the promotion of better health care. These initiatives also aim to contribute to economic and social development, as well as support the building of a formidable ICT infrastructure in the health care system. The government's support for the promotion of the ICT use and access in the country is noted by Mars and Seebregts (2008), who claim that "the development of ICT use in health is a very important project in the mind of South Africa and as a result, the National Department of Health has presented many policy documents (which includes white paper, discussion documents and bills) which will promote the adoption of clinical informatics in the country."

The Department of Health (2013) states that, the major purpose of ICT use, in healthcare delivery, in South Africa, is to improve the health status of the people. South Africa's eHealth Strategies (2012) states that with ICT tools in place, the people will enjoy the following benefits: effective and standard management of healthcare institutions; access to repositories of knowledge; applications and literature; and education for public and access to formal education for health service professional. ICT tools also overcome distance in the diagnosis and treatment of patients.

2.8 ICT opportunities in South African health care sector

The opportunities of access to and the use of ICT in healthcare facilities shall be discussed under the following headings: transformation of the health system, ICT capacity building, and encouraging collaborations.

2.8.1 Transformation of the health system

ICT access and use has brought a lot of transformation into the health care sector through the introduction of innovations, such as electronic TB register which is being used in all the provinces, as well as the health care information system (PHCIS), electronic patients' administration, and billing system which are being used in Gauteng, North West and Mpumalanga (Gray and Varuda, 2014).

In addition, the use of ICT in health has brought innovation into the legislative instrument, in the country, through the introduction of ICT related laws that will promote the access and use of ICT in the health care system. Examples of such legislations are State Information

Technology Agency Act (88 of 1998) and Policy of Free and Open Source Software. (Department of Health, 2014).

2.8.2 ICT capacity building

As indicated earlier, improving the quality of health cares has been an important objective of the South African Department of Health, for a number of years (Department of Health, 2013). There has been a greater focus in South Africa on how ICT could strengthen and promote capacity building and improve the quality of health services, in the country.

As a result, the National Department of Health agreed to work with the Department of Education in developing an ICT skills curriculum for medical students (Education Labour Relations Council, 2003). Realising the importance of capacity building in ICT among medical doctors, the Universities of Kwa-Zulu Natal and Walter Sisulu introduced a new course called ‘health informatics’ that aim to keep medical doctors abreast of the relevance of ICT in health care delivery and to train medical doctors and allied health workers in the use of computers and other relevant clinical informatics tools. Coleman (2013) notes that ICT access and use in health care delivery, in South African hospitals, should promote efficiency, accountability and build confidence in the minds of the medical doctors and the patients.

2.8.3 Building collaboration

Healthcare, in South Africa, is undergoing far-reaching reforms to revitalise and restructure the system and to ensure access to quality healthcare for all. Ruxwana, Herselman and Contradie (2010) opine that the integration and incorporation of ICT into the healthcare sector will improve medical doctors’ competence. There are a lot of projects initiatives, companies and donor agencies that are collaborating in the promotion of ICT in health care delivery, in South Africa (Gray and Varda, 2014). The Department of Science and Technology (2014) lists some of the agencies that are working with the Department of Health, in promoting the ICT to include the South Africa Government National Research Network (SANReN) and National Nanotechnology Strategy Department.

In addition, the government has decided to provide Internet connectivity to all the academic hospitals through the SANReN programme, in which almost 173 research and educational institutions have been connected with high speed networks (Department of Science and Technology, 2014). This has resulted in the roll-out of high-speed broadband networks to all the teaching hospitals in the country. The National Health Laboratory service is another agency that is collaborating with the Department of Health, in promoting access to and the use

of ICT in health care, by providing laboratory diagnostic services (Department of Science and Technology, 2014).

2.8.4 Promoting infrastructural development

The South African government has realised the importance of promoting ICT infrastructure in the country. Netetha and Mostert (2011) state that the government has been promising effective service delivery in all the sectors, particularly the health sector, by providing a wide range of ICT infrastructure, for effective service delivery. To achieve this, the South African government has spent a lot on providing network infrastructure that will promote access and use of ICT, for effective healthcare service delivery. Department of Communication (2014) set a target of 13% broadband penetration for health facilities by the year 2013. This was to be increased to 50% of 10Mbps by the year 2016. By the year 2020, it is expected to have increased to 100% of 10 Mbs or 80% at 10MB.

Burger (2010) restates the need for adequate ICT infrastructure for effective healthcare delivery, particularly in providing evidence- based medicine and reduction in cost. Mutula and Mostert (2010) confirm that South Africa's government has plans towards the promotion of ICT infrastructure in the country, by launching various ICT projects for quality service delivery, with regulatory framework policies.

2.8.5 ICT infrastructure development

Adequate investment, in the growth of ICT infrastructure, contributes to the economic development and transformation of the healthcare sector (National Integrated ICT Policy Green Paper, 2014). The deployment of ICT tools, in healthcare services, is essential to improve the quality of healthcare, in the country. According to National eHealth Strategy South Africa (2012), the key issue that the South African government is facing is how to provide accessible, affordable and reliable ICT tools, to the healthcare sectors, as part of its economic development.

The South African government is also examining ways to include adequate access to broadband connectivity to various healthcare facilities in the country (National Integrated ICT Policy Green Paper, 2014).

2.8.6 Policy framework

Department of Health (2012) notes that, South African government has spent a lot of funds, to procure relevant ICT tools, for effective healthcare delivery. The available ICTs, within the healthcare system, have largely not met the requirements and support of the healthcare sector,

due to lack of regulations and policy frameworks, in relation to technology usage (Department of Health, 2012). The National Integrated ICT Policy Green Paper (2013) declares that South African policies and legislation on the access to and use of ICTs in healthcare have been slow in implementation. The need for right ICT policies, in healthcare delivery, is to ensure and maintain the growth brought about, by technology and translate it into effective healthcare service.

The National Integrated ICT Policy Green Paper, (2013) emphasises the necessity for policy review, in healthcare delivery, because of the speed of technological advancement and the advent of new media, such as the Internet. The policy process needs to recognise that the healthcare system is changing, and the policy interventions need to be evaluated and assessed against the changing objectives of the healthcare system.

2.9 Challenges of ICT access and use in South African healthcare sector

Some of the challenges facing ICT access and use among medical doctors in South African teaching hospitals were discussed below

2.9.1 Low bandwidth

Bandwidth is one of the challenges facing access and use of ICT, in healthcare facilities, in South Africa. Sharpey-Schafer and Suleman (2008) claim that uneven bandwidth availability on different segments and often a complete lack of bandwidth is a serious challenge facing many healthcare facilities in South Africa. The National Integrated ICT Policy (2014) confirms the lack of necessary high speed bandwidth networks for effective healthcare delivery in South Africa. Telkom (2015) identifies various challenges facing broadband plans in South Africa, to include: geographical and demographics, data explosion, changing consumption, low speed performance as well as coverage and affordability.

2.9.2 Inadequate funding of ICT in healthcare

The key enabler to access and use of ICTs in healthcare delivery is finance. However, there are limited investments in ICTs, for health, in most African countries (Agbele, Nyongeza and Adesina, 2010). Insufficient financial resources and structural reliance on foreign agencies, for the donation of ICT tools, are affecting ICT access and use in many hospitals in South Africa (Modiba and, 2011.) An audit assessment of ICT has revealed disparities in the treatment of ICT, as a strategic enabler for healthcare service delivery in the provinces (Department of Health, 2012). The disparity is reflected in the budgetary allocation, for health, in the year

2009; while Gauteng, Limpopo and KwaZulu- Natal's budget was R188.3m, R178.6m and R105m respectively in nominal terms, North West, Northern Cape and the Free State's budget was R15m, R20.4m and R32m respectively (e-health South Africa, 2012).

This implies that there has been poor funding and uncoordinated investment in ICT in healthcare delivery, which are the major key enablers to the access and use of ICTs for health care delivery across the country. Some hospitals may, therefore, find themselves at a disadvantage

2.9.3 Poor ICT skills

Lack of literacy and computing skills as well as support have been identified as significant factors that prevent many professionals, like medical doctors, from using the Internet and other forms of ICT (Buabeng –Andoh, 2012). Sukums, Mensak, Mpembeni, Kattschmidt, Haefeli, and Blank (2014) claim that computer usage, among medical doctors, in developing countries such as South Africa, is limited because of the lack of adequate skills to operate computers.

South Africa Infor (2014) reveals that the country is well rated in term of the availability of ICT in the health sector. However, Week (2013) notes that despite this high ranking, lack of ICT skills remains a significant barrier to the use of this resources by medical doctors and other professionals. Coleman (2013) agrees that despite the availability of ICT facilities in hospitals, many medical doctors in South Africa are unable to use them. Coleman (2013) conducted a study on computer skills among medical doctors in South Africa and determined that 46% of the medical doctors lacked the skills to operate computers. While, in the study, 42% admitted that they were averagely skilled in the use of computers, only 12% stated that they had the skills to operate computers.

In order to improve the quality of the clinical information that medical doctors can access, it is essential that they acquire relevant ICT skills, to access information from computers. In order to improve the quality of the healthcare sector in South Africa, there is an urgent need to train medical doctors on how to operate computers and access information, relating to their medical practice (Loveday, Smith and Monticeli, 2006).

2.10 Summary

Information and communication technology has brought positive changes to all human endeavours. This also applies to health care delivery. ICTs can be used to obtain information

and diagnoses, as well as for evidence-based medicine and clinical information support systems. Adequate access to clinical information is essential for effective health care services.

The political climate is one of the main determinants of social informatics development, in any society. Nigeria's and South Africa's political climates have a great influence on the prevailing ICT status in the two countries, particularly in the health sectors. In promoting the use of clinical informatics in the two countries' healthcare systems, the policy issue needs to be addressed. As noted earlier, there is apparent inconsistency in different governments' introduction of policies that do not align with existing ones. Specifically, the effective implementation and use of clinical informatics in healthcare service delivery needs to be anchored on policies that are adopted by all levels of government, private health providers, and allied workers. The policy documents should also indicate the role of the government and other stakeholders, in the effective implementation of ICTs in the healthcare sector.

Furthermore, the governments need to provide visionary leadership and strategic plans that promote the use of technology, in the country's healthcare system, in order to save the lives of people. The need for government policies on ICT use, in healthcare, is paramount because government policy documents would leverage the development of clinical informatics and improve ICT access and use in the countries' healthcare sectors.

Based on the literature reviewed for this paper, it is believed that, in designing the policy documents on ICT use in healthcare, the following must be taken into account:

- The policy documents need to consider the interests of healthcare users, medical doctors, and allied workers in the sector and describe the ways the government could provide interventions, with regard to ICT in healthcare delivery.
- The government policies on ICT and healthcare need to be supported with legal documents to ensure that the targets are met and to improve the quality of healthcare delivery.
- The policy needs to be tailored towards the development of clinical informatics.
- There must be a regulatory body that will ensure compliance with and the enforcement of the policy documents on ICT, in healthcare delivery.

This is necessary because poor leadership and ineffective monitoring have been the basis for the unsuccessful implementation of most government policy programmes on healthcare. Consequently, political stability and effective monitoring are very necessary in supporting the effective implementation and use of ICT, in healthcare service delivery, in

Nigeria and South Africa. Lastly, in order for clinical informatics to foster development in Nigerian and South African healthcare systems, there has to be political willingness on the part of the governments, to create an enabling environment for ICT adoption and application.

In order to effectively implement clinical informatics in Nigeria and South Africa, there is a need to consider the state of economic activities in both the short and the long term. This has become necessary, particularly when comparing the status of clinical informatics in the country to that of other nations. The economic benefits of ICT are enormous, both as a growing industry in its own right and in terms of its influence on economic development. Studies by Adomi (2006) and Anie (2011) confirm that there is a close relationship between ICT use and economic development, in the Nigerian and South African healthcare systems, and that ICT has contributed positively to the development of the healthcare sector in Nigeria and South Africa. The authors also found that, the impact of ICT, on health, contributes to the growth of the economy.

To promote access to and the use of clinical informatics in the two countries' healthcare sectors however, economic considerations, such as sufficient budgetary allocation and human resources development, need to be taken into account. The manner in which a country finances its healthcare system is a good indicator of the types of ICTs that will be available. A good health care financing strategy must strive to avail all the resources necessary to achieve an effective and quality healthcare system. The poor funding of the Nigerian and South African healthcare systems have resulted in the inadequate provision and non-maintenance of healthcare facilities, including ICT tools. Eneji, Dickson and Onabe (2013) suggest various ways by which the two governments could generate funds for the health sector. These include seeking external loans from other countries and grants from international donor agencies and non-governmental organizations (NGOs), a National Health Insurance Scheme and taxes from the private sector.

The migration of medical doctors to other countries, in search of greener pastures, has resulted in massive brain drain which has created a demand gap in these countries' healthcare sectors. The problem of brain drain is the fall-out of economic depression, and if not properly addressed, will continue to obstruct the development of effective healthcare services in Nigeria and South Africa. There is a need for motivation, in the form of better salaries and provision of a conducive environment as well as relevant resources, to encourage medical doctors and other health workers to stay and work.

An adequate power supply is also vital to the socio-economic development of any nation. A country that finds it hard, to provide constant power to its healthcare facilities, will definitely face challenges, in the deployment of ICT resources. An unsteady power supply can also cause damage to various ICTs. The Nigerian government needs to provide a steady power supply as a necessary prerequisite for effective healthcare delivery. This would also build confidence in the medical doctors' usage of clinical informatics. However, the challenges in the supply of electricity across various health facilities, particularly in Nigeria, are enormous. To resolve some of these challenges, the government needs to enter into a bilateral agreement with developed countries and multinational companies, on ways to improve the power supply.

In addition, the high cost of clinical informatics tools and other medical equipment contributes significantly to the cost of the healthcare system. To tackle these high costs, the government needs subsidiary healthcare equipment, particularly clinical informatics tools. Public Private Partnerships also need to be encouraged, in order to promote ICT use for effective healthcare delivery in both countries. The governments, at all levels, need to encourage private organizations to build a modern diagnostic centre under the auspices of 'build, operate and transfer'. This would enable more healthcare users to benefit from clinical informatics and other healthcare facilities.

The most prominent technological issue identified in the literature review was infrastructure development. The infrastructure aspect is concerned with various ICT components, such as connectivity, hardware and software. These components are essential to the effectiveness of clinical informatics in healthcare delivery.

Clinical informatics has barely taken a foothold in the Nigerian and South African healthcare sectors. Poor ICT training and lack of ICT infrastructure are widely recognized as increasingly insurmountable obstacles to the development of clinical informatics resources in Nigeria and South Africa. Therefore, it is very necessary to organize ICT training and ensure computer literacy, so that medical personnel can operate the relevant systems effectively and with ease. New technologies and changes in usage can affect attitudes and morale. While many medical doctors are familiar with old infrastructure, the need to change or upgrade the system can create problems and hamper technology adoption.

Effective healthcare service delivery, in Nigeria and South Africa, requires functional and adequate clinical informatics resources. Overall, there is a need for the governments and private organisations to collaborate on ways to improve clinical informatics infrastructure in the healthcare system.

The next chapter provides the literature review of the study.

CHAPTER THREE: LITERATURE REVIEW

3.1 Introduction

One of the crucial stages, in a research, is the literature review. Ridely (2012) defines a literature review as the selection of available documents from published and unpublished sources, which contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the research or topic and ways in which it will be investigated and the effective evaluation of these documents in relation to research being processed. Polit and Beck (2008), in their definition, refer to literature review as a critical summary of existing knowledge, on a topic of interest, for the proper placement of research problem. From this, literature review is a comprehensive review of the published and unpublished work of previous researchers, which provide opportunity for the researcher to focus on research problems based on certain aspects found to be relevant in the published research work.

The literature review explores and discusses various authors' ideas and research findings in relation to the topic or problem under investigation. Denney and Tewksburu (2013) observe that literature review, in a scholarly writing, forms a part of study which may be in dissertation or an independent study, in which the areas that other researchers have investigated are explored and in consequence, the missing gaps are identified in order to justify the reasons for the new study. Literature review is important for a researcher to identify the variables involved, the measurements applied, the methodology used and the expected findings in the studies reviewed. It can also be said that literature review is the crucial element of research process that provides in-depth knowledge that research needs to study the selected problem (Neuman, 2015).

The purposes of literature review as described by Brink, Walt, and Rensburg (2013:17) include the following:

- to conduct a critical analytical appraisal of the recent scholarly work on topic by determining what is already known about the topic;
- to identify the research problem and refine the research questions;
- to place the study in the context of the general body of knowledge. This minimises the possibility of unintentional duplication and increases the probability that the new study makes a valuable contribution;
- to obtain clues to the methodology and instruments;

- to refine certain parts of the study, specifically the problem statement, hypothesis, conceptual framework, design and data-analysis process;
- to compare the findings of existing studies with those of the study at hand.

Thus, a literature review evaluates and organises literature by providing the required inputs and solid foundation for a clear explanation of the essence of the new research, and expanding the perspective of the subject areas (Fari, 2015). Polit and Beck (2008) state that the following types of information should be included in a literature review: facts, statistics and research findings, theories or interpretation, methods and procedures, opinions, beliefs or points of view and narrations of incidents and situations.

This chapter reviews extant literature based on the objectives of the study. The chapter identifies and reviews relevant documents on the different types of clinical informatics including their accessibility, benefits, and purposes of use by medical doctors.

The next section focuses on the influence of socio-demographic variables on the use of clinical informatics.

3.2 Influence of demographic variables on the use of clinical informatics

Demographic variables are commonly used in behavioral research and they are contributing factors that influence the effective use of ICT. Tella and Mutula (2008) refer to demographic variables as “personal characteristics”. Mowday, Porter and Steer (1982) list various forms of demographic variables to include: education, tenure, age, gender and occupation.

Demographic variables influence the effective use of clinical informatics among medical doctors (Ajuwon, 2015; Okoro and Okoro, 2009). Burns and Grove (1993) and Sidani and Braden (1998) identify various demographic variables that may influence medical doctors’ use of clinical informatics. These include gender, academic qualification, salary, medical specialisation, skills, and age.

In addition, Ajuwon and Popoola (2014) note that demographic features such as age, sex, medical experience, and salary, among others, have been found to influence clinical informatics usage among medical doctors in Nigeria. The International Telecommunication Union (2003) observes that, there is digital divide concerning the use of ICT among various professionals, such as medical professionals in Africa. They attribute this to socio-cultural and economic factors, which include gender, income, age and education. They observe that there are gaps in the use of clinical informatics, among medical doctors. They attribute these gaps to

gender and sex, hospitals' locations and medical departments. They note that these demographic variables can affect the use of clinical informatics. To solve this, there is the need for academic research to find lasting solutions to all these gaps.

The use of clinical informatics is becoming noticeable among medical doctors in African hospitals (Nwargu and Adio, 2013). The awareness, on the use of clinical informatics for evidence-based medicine, effective diagnosis, assistance in getting accurate clinical information and understanding various factors that would encourage clinical informatics use among medical doctors, is becoming very important (Gatero, 2011). Ajuwon and Popoola (2014) and Asagasi, Adejoro, Fari and Makinde (2008), while commenting on the importance of the use of ICT by various professionals, such as medical doctors, affirm that medical doctors must have access to ICT which he describes as a necessary prerequisite for the effective utilisation of clinical informatics in healthcare delivery. They note that social demographic variables play a leading role, in determining the use of ICT. This implies that, demographic variables determine the successful use of clinical informatics among medical doctors.

3.2.1 Age

The influence of age, on the use of ICT, has been investigated by different scholars. Among such scholars are: Al-Ansari (2006), Al-Shanbari and Meadows (1995), Alao and Folunsho (2008), Deng (2010), Kaur and Verma (2009) and Kinenyere (2007).

Ajuwon and Popola (2014), Agangansi et al. (2008), Olok, Yagos, and Ovvuga (2015), and Figueredo de Oliverira (2014) affirm the influence of age on the use of clinical informatics among medical doctors. It was reported, in their studies, that, young medical doctors were found to be more interested in using clinical informatics, in their medical practices, than any other age groups. In Uganda, Olok, Yagos, and Ovuga (2015) examine the use of ICT among medical doctors and they discovered that the use of ICT is prominent among young medical doctors.

In another study, Sukumus et al. (2014) and Olasina and Popola (2014) state that age grades have influence on the use of ICT by medical doctors. According to the study, young professionals were discovered to be using ICT more than other age groups, in the profession. The reason for this may not be too far to seek, as young medical doctors could have been exposed to the use of ICT when they were in elementary and higher schools. Contributing to this, Weng, Kuo, Lo, Shin, Chen and Chiu (2013) examine the use of ICT among medical

doctors in the Taiwan and discovered that the use of ICT is prominent among younger medical doctors.

Nwagu and Adio (2013) conducted a study in Nigeria on the utilisation of ICT by medical doctors. Their finding reveals that the use of ICT reduces with age. This finding fits into what could be assumed as the pattern of ICT use and awareness among all professions. Younger people are expected to be more skilled in the use of ICT than older persons, although medical practitioners are generally believed to be technologically skilled across the board.

Ajuwon and Popoola (2014) conducted a study in Nigeria among resident doctors on the use of the internet. The study reveals that age has a significant influence on the utilisation of clinical informatics in the country. This supports the submission of Ani (2013) that “it has been part of computer mythology that younger people are happier using computers than older people”. It could also be argued that single persons might have freer time than those who are married, in respect of learning and using ICT. Moreover, most of the married medical practitioners are likely to be older persons who also probably completed their medical education a long time ago, when compared to the unmarried ones.

Deng (2010) conducted a survey on the use of ICT among university academic staff, which included the medical staff in the medical school. The results reveal that respondents who are less than 29 years old were the major users of ICT. This supports the view that younger doctors tend to use ICT more. Kinengyere (2007) attributes the poor use of clinical informatics by older doctors to the fact that many of them have a lower level of ICT literacy.

Overall, the trend in literature would appear to be that, the use of clinical informatics, by medical doctors, decreases as they grow older.

3.2.2 Medical departments

Heterck (2002) observes that, there is the influence of discipline on the use of ICT. He found that, researchers in the Humanities do not use ICT as much as those in the faculties of Science and Medicine. This may be attributed to the demands of each field. Burt and Sisk (2005) and Ehikamenor (2003) confirm that there is a significant use of ICT among academic staff in universities

Various researches have been carried out to investigate the extent of the use of clinical informatics in various medical departments around the world (Paul, Reedy, Abraham and Deflish, 2008; Olasina and Popoola 2015; and Progment, Georgious and Westbrook, 2009). Gund, Lindecrants, Schauerberger, Patel and Sqoquist (2012) reveal that the use of clinical

informatics, among medical doctors, greatly differs across different medical departments in the hospitals. They discovered that medical doctors, in clinical laboratories, such as haematology and radiology, were found to have a higher level of usage of clinical informatics. This implies that, the use of ICT, among medical doctors, depends on the relevance of ICT to their areas of specialization, which will determine the types of clinical informatics that will be useful and relevant to them.

Grund et al. (2012) conducted a study in Sweden on the attitude of healthcare professionals towards the use of ICTs and found that medical doctors in cardiology used clinical informatics more than doctors in other departments in the hospitals. This suggests that the discipline or medical areas of specialisation influence the use of clinical informatics among medical doctors.

3.2.3 Gender

Oghiagbephan and Asamaigo (2010) are of the opinion that gender refers to sets of relationships attributes, roles, beliefs and attitudes that define what being a man or a woman is within the society. It is a socially ascribed attribute as opposed to sex which is a biological attribute. Tella and Mutula (2008) note that issues of gender equity as related to the use of technology will continue to be a subject of discussion for a long period, especially in developing countries.

Kirk and Zanader (2004) argue that gender has a very significant influence on the use of clinical informatics, not only among medical doctors, but also with other clinicians while Mckenzie, Whitely and Weich (2002), Ojeniyi and Adetimirin (2013) observe that gender issues toward ICT use depends on individual's choice and attitude.

The issue of gender, in technology usage, is gaining ground and attracting the attention of academic researchers. Mckenzie et al. (2002) succinctly note that gender difference affects peoples' interest and attitude towards ICT. Aramide, Ladipo and Adebayo (2015) observe that men are more interested in ICT use, compared with women. The implication of this is that male medical doctors would be more interested in the use of clinical informatics than female medical doctors. Mistra Lenzmeier, Steffensmeier, Avon, Qu and Hasen (2001), Tezci (2009), Demirbilek (2014) and Butler (2000) in their various studies reveal gender gaps in the use of ICT among medical doctors. In addition, previous studies also reveal that there is a consistent gender difference, in Information and Communication Technology studies (Hashim and Mustapha, 2004). Ikolo (2010) states that gender digital divide are manifested in some female medical doctors' use of ICT, compared to male medical doctors.

Link and Marz (2006) and Poelmans, Truyen and Deslé (2009) conducted studies on computer usage among medical doctors and the results confirm that male medical doctors have a significant higher usage of computers when compared with the female doctors. Link and Marz (2006) examine computer literacy among medical doctors in South Africa where 94% of the medical doctors affirmed that they used computers. Out of this percentage only 26% were females while the remaining were male medical doctors.

Likewise, Ong, Lai, Luan, Aziz, Yunus, Sidek, Bakar, Meseran and Atan (2005) report that, male professionals have more positive attitudes towards ICTs, compared with females. Olatokun and Adebayo (2009), in a study among health workers in Nigeria, reveal that 95% of male workers use multimedia projector, compared with 77.2% among female workers. The use of email and video-conference technology followed similar trend. Ikolo and Okiy (2012) conducted a study in two medical schools in Nigeria on the use of ICT. The results indicate that, 50% of the male medical students had access to computers, while 36% of female medical students admitted that they had access to computers. Kay (2006) examines 36 studies related to the impact of gender and ICT use. He discovered that the male respondents have significantly high level of ICT usage, compared with the females.

Mckenzie, Whitley and Weich (2002) and Ojeniyi and Adetimirin (2003) agree that, gender behavior, towards ICT use, depends on the individual's choice and attitude. However, the overall suggestion is that, male medical doctors are more interested in the use of clinical informatics than female medical doctors.

3.2.4 Years of experience

Experience is another factor that can influence the use of clinical informatics among medical doctors (Schiller, 2003). Most academic researches indicate that the experiences of medical practitioners influence the successful use of clinical informatics in hospitals (Olasina and Poopola, 2014; and Mwangi, Namusgo and Sakwa, 2016).

It is clearly agreed that, the more years of experience of medical doctors, the more likely they will have experience in the use of the tools. In Demark, clinical informatics is widely used by the medical doctors. The medical doctors, in the country, are generally considered to have very good ICT skills due to the capacity and experience that they gained, in their use of ICTs from undergraduate level to post-graduate level (Protti and Johansen, 2010). This suggests that ICT training may influence the use of clinical informatics by medical doctors.

Morton and Widerdenberk (2010) conducted a study at the University of Mississippi Medical Hospital. The medical doctors admitted that they used Electronic Medical Record in Hospital (91%). They attribute this to their prior knowledge of computers. O'Connell et al. (2004) survey clinical informatics satisfaction among medical doctors in the departments of paediatric and general medicine. The result reveals that, the years of medical practice and computer experience did not correlate with clinical informatics satisfaction of the medical doctors. They attribute this to the late adoption of clinical informatics in the hospitals.

Gorder (2008) observes that, medical doctors' experience is one of the factors that influence them to use ICT, which implies that it significantly correlates with the actual use of ICT. In Finland, clinical informatics is widely used by medical doctors (Virtanen et al., 2011). The medical doctors, in the country, are generally considered to have very good ICT skills due to the capacity and experience they have built in the use of ICT from undergraduate level to postgraduate level (Virtanen, Hypponenb, Laaveri, Vanskard, Responene and Winblad, 2011). This implies that continued education in ICT training may influence the use of clinical informatics by medical doctors.

Similarly, U.S National Centre for Education Statistics (2000) notes that, professionals, with less experience in their fields of practice, are likely to use computers more than professionals with more experience on the job. The report goes further to say that educators that have 3 years of teaching experience claimed to spend 48% of their time using ICT; those with 4 to 9 years spent 45%; 10 to 19 years spent 47%; while educators with 20 years teaching experience claimed they spent 33% of their time on the computer. The implication of this is that fresh educators tend to use computers more. This may be due to the fact that they are young and are recent graduates.

Hsio and Chen (2016) recently examined various factors influencing physicians' intention to use computerised clinical practice in Taiwan. The results indicated that, medical doctors' years of experience is a significant factor that promotes the use of computers.

The next section discusses the purposes of clinical informatics.

3.3 Purposes of using clinical informatics

There are many reasons why medical doctors engage in the use of clinical informatics, in the hospitals. Olatokun and Adeboyejo (2009) and Verbeke, Karaka and Nyssen (2013) list the various reasons for using clinical informatics in healthcare delivery. These reasons include promoting access to information on health education, knowledge sharing among practitioners,

health monitoring, improving healthcare delivery and meeting the international acceptable standards. Some of the purposes are discussed below.

3.3.1 Provision of access to clinical information

Muhammed (2006) and Fari (2015) both describe the information as the act of informing. It can be viewed as a message that is conveyed and assimilated by a person who receives the message. Information conveyance usually results in some decision, action or behavioural change, or adds to the body of knowledge. Information is very important for individual and professional growth. An informed mind is an enriched mind; as a result, every individual needs information for his or her existence and wellbeing. Opara (2003) and Moahi (2007) argue that information is the life blood of every organisation and professional.

Deloitte (2014) maintains that access to information assists different professionals, in performing their jobs. It can be said that, access to information, by medical doctors, will enhance their performance, increase their research output, improve their treatment and communication as well as build trust in the minds of their patients. Salman and Ahmed (2013) note that information is an 'indispensable resource' for medical doctors. Shieferaw and Zolfo (2012) also note that, access to information, by medical doctors and other professionals, promotes the development of research activities. Therefore, access to information is very important to the medical profession, particularly, to medical doctors because they need reliable and accurate information in decision making, in the diagnosis and treatment of patients. This view is supported by Bates (2006) who believes that, access to information is necessary for medical doctors, in problem solving and decision making. Medical practice has always been described as information-intensive profession and the advent of ICT into the profession is to a great advantage, since there are many advances in clinical informatics to healthcare delivery. These advances include promotion of effective healthcare delivery system (Schoen and Osborn, Huynh, Zapert, Peugh and David 2005). In addition, access to medical information will provide the medical doctors new tools to work with and the opportunity to practice modern day medicine. Shabi, Kuteyi, Odewale and Shabi (2008) list various types of information that medical doctors need. They include: drug information, professional development information, government regulation on medicine, routine patient's care, practice organisation and management, diseases' specification information, and the new medical information.

Furthermore, Shabi et al. (2008) discuss various ways in which medical doctors seek information. They include, citing professional colleagues, medical texts, the Internet, medical

databases, printed journal, courses, conferences and libraries. Krueger (2010) reveals that, out of 8 million people that used the Internet in the USA, in 2004, 66% admitted to use the internet for online health information; while in 2009, 24 million Americans reported the same. Sandefer, Khairat, Pieczkiewwz and Speedie (2015) reported that over 50% of the hospitals have patient portals, which has promoted effective communication with doctors and increased patient-doctor relationship.

It was also reported that, over 50% of the patients that visited the hospitals, in U.S, had access to the email. The access to the email has promoted effective communication with their doctors and increased patient-doctor relationships (Chamdrasekhar and Ghosh, 2001). In Japan, over 50% of the medical doctors used internet tools to access medical information, for the effective diagnosis and treatment of their patients in the year 2005 (Simba, 2004). From this, it can be deduced that access to health information on the net has bridged the distance by providing access to clinical information knowledge and professional advice to patients at little or no cost. Reinstating the importance of access to information in healthcare delivery, particularly for medical doctors and patients, Eysenbach, Sa and Dieppen. (2002) inform that in 2002, there were over 100,000 health's related information sources that were available on the internet, for medical doctors and patients. However, Ozumba's (2002) research in Nigeria reveals that only 0.5% of the medical doctors use the internet to search for information relating to medical practices.

To surmise, one of the basic goals of healthcare facilities is to provide effective healthcare delivery services to patients. There is no gainsaying the fact that access to information is imperative to successful and efficient medical care. Clinical informatics provides access to information, through knowledge sharing, which is crucial to improved and effective healthcare delivery, and the effective management of diseases.

3.3.2 Knowledge sharing

The review of literature, on the concept of knowledge sharing, has revealed that the term has no universal acceptable definition. Various scholars define knowledge sharing from their professional points of view. Pauline and Sunesson (2012) define knowledge sharing as the exchange of knowledge between individuals, where one is communicating knowledge and the other is assimilating knowledge. The knowledge of information that is exchanged can be in the form of ideas, results, opinions, and discoveries. Medicine is a discipline that requires collaboration between various consultants, specialists and doctors in special areas for more effective outcome.

Medical doctors are knowledge-intensive professionals. As the most important group working in hospitals (Ryu, Ho and Han, 2003), their decisions are usually based on their knowledge and experience. Consequently, their practical and theoretical knowledge are very important in taking clinical decisions, about the care of the patients. Knowledge sharing, in the medical discipline, particularly the sharing of findings and results with young medical doctors, would improve the effectiveness and quality of healthcare and promote collaboration, encourage the easy and timely exchange of medical information and help to reduce medical errors. Udousoro (2014) states that access to clinical informatics tools by medical doctors assists them to disseminate and share knowledge across borders. With effective knowledge sharing, a medical doctor can send a medical report of his or her patient or to a leading expert in another country who can advise him/her. The medical doctor can also provide more information, and direct him or her on how to manage a disease (Hassan, Siyanbola and Oyebisi, 2011).

Knowledge sharing, among medical doctors, could bring improved healthcare delivery, exchange of experiences, ideas, and co-operation, in a knowledge intensive organisation like medicine. It is in support of this that Cooper, Gelb, Rim, Hawkin, Rodriguez and Prolonec (2012) note that knowledge sharing among medical doctors is very important for effective healthcare of patients, and that the quality of speciality-based clinical practices is a major determinant for patients' use of medical services. Teaching hospitals, as accredited hospitals for teaching medical doctors and at the same time being the most sophisticated form of hospital institutions, have a paramount need for knowledge sharing among their medical doctors because of the nature of their work which involves teaching, research and practice.

The importance of knowledge sharing in healthcare system is well documented in various works (Abidi, Cheah, and Curran, 2005; Engel 2008; Greenhalgh, Robert, Bate, Kyriakidou, Macfarlane and Peacock, 2006; Steiniger, Ruckel, Dannerer and Roithmayer, 2010 and Copper et al., 2012). Effective knowledge sharing, among medical doctors, is a crucial means of improving their competencies and assisting them in decision making. In addition, Lipshitz and Popper (2000) and Engel (2008) opine that knowledge sharing among medical doctors has a lot of benefits, particularly, towards improving the quality of healthcare delivery.

3.3.3 Improvement of effective healthcare delivery

The quality of healthcare delivery in a country is a function of the level of access to and use of clinical informatics tools, by the country's health system because they are necessary tools for effective diagnosis, treatment, monitoring and disease surveillance. Supporting this, Olatokun and Adeboye (2009) state that clinical informatics has become an indispensable tool for

reducing diseases and ailments and has provided the Nigerian healthcare system with unprecedented opportunities to meet vital developmental goals, such as poverty reduction and provision of effective medical services.

Clinical informatics is continually viewed as having the opportunity to provide solutions to challenges facing the health sector. Disease control and surveillance, disease prevention, patient management and diagnosis, and health information are some of the necessary components of healthcare delivery. Olatokun and Adeboye (2009) and Idowu, Ogunbodede and Idowu (2004) observe that the appropriate use of clinical informatics tools in hospitals will enhance the quality of research and promote better healthcare service delivery among medical doctors. It can be said that access to clinical informatics tools provide up-to-date information to support medical doctors' knowledge.

According to the National Prevention Health Promotion and Public Health Council (2011), the healthcare sector is one of the main beneficiaries of ICT use in the United States. The council claims that, clinical informatics has reduced 10% of all early deaths in the United States and prevented 70% of premature deaths. Clinical informatics can be used to educate and create awareness of various causes of early death and ways in which people, mostly patients with chronic diseases, can perform self-examination.

Linto (2010) observes that clinical informatics use, in the healthcare system, will provide adequate opportunities for medical doctors, in utilising the tools, to diagnose and treat patients. This confirms clinical informatics as a vital means through which doctors have access to relevant sources that aid them to get timely, reliable and accurate information for effective diagnosis and treatment. It has brought many positive changes to the treatment and diagnosis of patient and medical education due to its roles in the improvement of the quality of healthcare delivery, as a result of its far reaching capabilities.

3.3.4 Management of diseases

There are a lot of health challenges in Africa where diseases such as HIV/AIDS, malaria, cholera, typhoid, yellow fever, obesity and renal failure have been reported to have killed several people (Linto, 2010). According to the World Health Organisation (2015), in the year 2014, 70% of the people that are infected with HIV/AIDS were living in Africa. It becomes imperative to point out the fact that, clinical informatics has the potential to provide solutions, to some of these challenges, in the healthcare sectors in Africa. It needs to be noted that, many developed countries such as United State of America and United Kingdom have been employing the use of clinical informatics to manage and diagnose diseases for years.

Glden (2011) and Stocwell and Filks (2011) state various ways in which clinical informatics can be used to manage diseases which include: improve clinical outcomes, self-monitor health conditions encourage the use of vaccination and improve medication adherence. Udusaro (2014) notes that, the advent of clinical informatics has contributed immense benefits to effective healthcare delivery.

ICT use, in healthcare, has contributed tremendously to helping medical doctors to engage in distant consultation and diagnosis as well as gaining access to medical information for decision making. ICT tools, such as radio and television, have been very useful in disease prevention and control of epidemic in many African countries (Litho, 2007). He explains further that mobile phones, e-mail and Internet can be used for health alerts to the people and medical doctors. Likewise, Bowles Dykes and Demiris (2015) identify various ways in which clinical informatics can be used to manage diseases. These include telemedicine technologies, homecare monitoring health devices, and evidence based technologies.

Explaining, the importance of clinical informatics, Wang, Fau, Allgri, Brenner and Kalmus (2015) note that, 80% of healthcare expenditures, in Africa, is due to the management of chronic diseases. The report affirms that, clinical informatics tools will dramatically reduce the costs of disease management and improve the quality of healthcare delivery in Africa. Appropriate healthcare support and provision of adequate clinical informatics tools in healthcare services are cost effective and provide sustainable development to healthcare, not only in remote areas but also in cities. Clinical informatics also improves capacity building and quality of care as well as effective healthcare management.

The next discussion is on the various types of clinical informatics.

3.4 Type of clinical informatics

The American Association of Medical Informatics (2015) categorises clinical informatics into the following types: Clinical Documentation, Provider Order Entry, Clinical Decision Support and Visual Images. Felt-Lisk cited by Jung (2006) also lists Computerised Physicians Provider Order (CPOE), Electronic Lab Result, Electronic Clinical Note Systems, Electronic Images, Electronic Lab Orders and Electronic Reminder for Guideline Based Intervention as types of clinical informatics.

However, the disparity between American Association of Medical Informatics and the Felt-Lisk's categories of clinical informatics can be attributed to the breaking of Electronic Health Record into two clusters, which are Electronic Reminders for Guideline Intervention and

Electronic Clinical Note System (Felt-Lisk, 2006; Jung, 2006). Jung (2006:5) conducted a study to find out the percentage of healthcare facilities that are using Felt-Lisk's six categories of clinical informatics in Colombia. The findings reveal that, 90% of the hospitals used at least one of the six categories.

3.4.1 Computerised physician order entry (CPOE)

Jung (2006:10) describes Computerised Physician Order Entry (CPOE) as 'a prescription ordering system that allows physicians to enter an order for a medication and clinical laboratory or radiology test directly into a computer instead of handwriting, which can cause medication errors'. The Agency for Healthcare Research and Quality (2015) defines CPOE as 'the use of computers by medical doctors to directly make orders electronically for patients'. This method is to replace traditional ways of making orders which is through paper, pen, verbal communication, phones and fax.

Based on this, CPOE is the process by which medical doctors or other professionals in healthcare make direct orders of medication, from a computer, with the intention to reduce errors associated with bad handwriting. With CPOE, doctors can employ the use of computer technology in making orders directly for patients' medication. The order is documented in a digital format. From these definitions, there are some salient features that should be noted; in particular, that it is only the medical doctors that can make order. The order must be done through a computer interface and must be done in a standardised format.

Computerised Physician Order Entry (CPOE) has been contributing to the development of healthcare delivery, in the following ways: reduction of errors, paying attention to patients' safety, improving the quality of healthcare and bringing innovation to effective healthcare (Khanna and Yen 2014). Wess, Embi and Besier (2007) observe that CPOE has contributed to the improvement of medication ordering, particularly in teaching hospitals. From this, CPOE can be seen as a system basically designed, for medical doctors, to search information about drug usage and adverse interactions for the treatment of patients in hospitals.

Ash, Groma, Sesadri, and Hersh (2004) note that with the introduction of CPOE in healthcare facilities, the problem of illegible handwriting and transcription errors would be a thing of the past. They argue further that CPOE would also improve the response rate of medical doctors and there will be accuracy of information about the medical history of the patients.

Open Clinic (2013) identifies the following as the functions of CPOE:

- Enables medical doctors to enter prescription, laboratory test and other orders for patient care directly into hospital computer;
- Replaces hand-written orders (legibility, completeness, rapidly and quickly accessible);
- Accesses patients' information.
- Promotes safety and prevent medical errors and adverse drug effects by checking the dosage etc.;
- Promotes quality assurance and reporting error awareness;
- Promotes information sharing by integrating different units, such as laboratory, imaging and records units;
- Displays and show test and medication costs;
- Assists in decision support, such as medication check for patient and medical test recommendations;
- Monitors patients' treatment through the monitoring of administration of the right drug and the right time because it can issue alert or reminders and suggest a different course of treatment.

Minesh, Isha, Jongwaha and Rarus (2012) conducted a survey on the number of hospitals in United States of America that have adopted the implementation of CPOE. According to the survey, only 4% of the hospitals, used for the study, had fully adopted the use of CPOE in their operations, while 16% have plans to implement the use later. In another study conducted at Massachusetts Acute Care Hospitals, USA, the finding reveals that, only seven hospitals had CPOE system (Miseh et al., 2012). From the above, it can be inferred that, the adoption rate of CPOE systems in the USA is still low. This may be due to the high cost of the tools, lack of the technical knowledge on how to operate with them and inadequate training of medical doctors in its handling.

3.4.2 Computerised decision support system

Clinical informatics resources are designed to improve and assist medical doctors with making informed decisions about their patients (Tumamao, 2014). In an era that relies on accurate and timely information, one of the ICTs that assist medical doctors with decision making is the Computerised Decision Support System (CDSS). Kawamoto, Houlihan, Balas, and Lobach (2005:16) describe Computerised Decision Support System as 'any 'electronic system designed to aid directly with clinical decision making'. Payne (2000:47) likewise

states that CDSS is a computer application used by medical doctors, to assist them with diagnostic and therapeutic decision making in the management of patients' health.

Pope, Halford , Turnbull , Pirchard and May (2013) describe CDSS as a computer technology programme designed with the intention to assist clinical personnel, through the combination of professional knowledge, with the use of an algorithmic rule which directs medical doctors in their decision making. CDSS is a computer application that provides access to electronically stored medical knowledge through platforms such as the internet, local personnel computers, networked health electronic resources (HER), or handhelds (Eta, 2009). Kaushal, Shojania, and Bates (2003) list various examples of CDSS to include hand-held computer, computer, smart phone, barcode, and automated drug delivery systems. The technology is designed to improve the healthcare delivery system and reduce costs (Osherooff et al., 2007).

CDSS can be divided into two types: the knowledge based and the non-knowledge based. Eta (2007) notes that knowledge based CDSS can be classified into three forms, which are the knowledge base, the reasoning engine, and a mechanism which is used to communicate with the healthcare user. On the other hand, non-knowledge CDSS is in the form of artificial intelligence, which is also referred to as a learning machine because the information in a computer were learned by medical doctors through the past medical experiences (Tumamao, 2014).

Creswell, Bates and Sheikh (2012) summarise the usefulness of CDSS as preventive care, ordering investigations through the use of computer aided detector diagnostics, disease management, and public health surveillance. CDSS has been implemented in the following areas of medicine: pharmacy, pharmacology and pathology. CDSS is used to assess renal failure, pregnancy, drug allergy and other medication related conditions (Castanedo et al., 2015).

Uzoka, Osuji and Okure-Obot (2011) list various ways in which computer decision support systems have been found useful in medical practices. These are referral practices, managing clinical complexity, cost controls, supporting clinical diagnosis, evidence based medicine, standardisation of practices and generally improving healthcare efficiency. In the same vein, Dowdling (2013) notes various ways in which CDSS are useful for modern day medicine. These include the provision of support to medical doctors in diagnosis, diseases' management and prevention, and drug prescription.

From this, it can be summed up that, the major benefits of CDSS system is to support decision making for medical doctors and other allied workers, with various research evidence to inform their decisions.

3.4.3 Diagnosis image archiving

Diagnosis Image Archiving (DIA) has revolutionised the provision of radiological services, in healthcare service delivery, because these medical images are now converted from static paper formats to dynamic electronic formats. Diagnosis image archiving is a clinical informatics tool that can transport and store radiographic image such as Magnetic Resonance Imaging (MRI) and Computerised Axial Tomography Scan Electronically (Weatherburn, Brayan, Nichollas and Cock, 2000).

Fang and Yang (2006) describe DIA as a form of information and communication technology that can be purposely used, for a short or long period of time for storage, retrieval, management and distribution of medical images. In addition, it can be described as an electronic and filmless information system that is used for acquiring, sorting and displaying medical imageries electronically. The DIA has been used for archival, migration, and display of digital images, which have brought about expedite image-based work flow (Dandu, 2008).

The storage of DIA can be classified as online, near line and offline. Online storage is about data storage on magnetic discs and Redundant Array of Inexpensive Discs (RAID) systems which provide access to the data, in a few milliseconds. Images that do not require immediate access are stored in near line storage, while offline are storage devices used for long-term storage (Dandu, 2008). DIA is the only technology which provides a centralised repository for all imaging data and at the same time delivers diagnostics images such as x-rays, CT scans, MRI scans and radiology reports electronically to medical doctors at the point of care (Hains, Georgious and Westbrook, 2012).

The application of ICT, for purposes of storing, retrieval and distribution of medical images, will be useful for medical doctors to support clinical examinations before taking decisions. DIA machines are X-ray machines, computerised tomography, magnetic resonance and scanning machine. Devolder and Pynoo (2009) list various web applications that medical doctors can use to enlarge or reduce the images, which include desktop personal computer, Citrix Presentation Server environment and Pentium 111-class machines.

Aroja and Metha (2014) note that DIA consists of four major components, which are:

- Image modalities such as computer tomography (CT) and Magnetic Resonance Imaging (MRI)
- Network for the transmission of patients information
- Computers
- Archives for storage and retrieval of images and report.

Weatherbur, Bryan and Nicholas (2000) reveal the importance of DIA in teaching hospitals where radiographic images are commonly used to assist in the diagnosis, and management of patients in accident and emergency units. They note that, the failure of medical doctors to employ the use of DIA, in accident and emergency units, has brought about an increase in medical errors from 0.6% to 7%. Similarly, Hains, Georgious and Westbrook (2012) reported that, in the year 2008, over 76% of USA hospitals were using DIA.

Access to DIA assists patients in the proper management of their health conditions and in making decisions about the healthcare of their patients. Welter et al. (2011) affirm that the use of DIA will create the opportunity to bridge the knowledge-performance gap for medical doctors because it will give them access to various visual information sources that will assist them in making clinical decisions, increase their job performance, reduce medical errors, improve accuracy and provide opportunity for timely and reliable information. Hains et al. (2012) state the advantages of DIA to include the provision of reliable image storage, access to information as well as permanent storage of information.

3.4.4 Electronic medical record (EMR)

The review of literature on Electronic Medical Records (EMRs) has revealed a number of definitions arising from various scholars coming from different medical fields (Hayrinen et al., 2008). According to the report of e-health Stakeholder (2013), Electronic Medical Record (EMR) is a comprehensive medical record or similar documentation of the past and present physical and mental state of health of an individual, in electronic form, and providing for ready availability of these data for medical treatment and other closely related purposes.

Hochwaster, Cuong, Chuc and Lassen (2014) define EMR as a repository of health user data in digital form, which is stored and exchanged securely and accessible by multiple authorised users. It has retrospective, concurrent and prospective information and its primary purpose is to support effective healthcare.

From these definitions, it can be seen that, the major functions of EMR is to provide adequate information for medical doctors and other allied workers, in making medical decisions and

also for hospital management, in decision making policy. Haux (2006) points out that EMR will provide reliable information about patients to medical doctors and other healthcare workers in taking decisions. EMR is an enabling ICT technology that assists medical doctors to provide effective services. Lakbala and Dindarloo (2014) state that, the introduction of EMR system promotes an increase in effective healthcare delivery, improved quality of care as well as patients' and doctors' satisfaction.

Jha et al. (2009) conducted a study on the use of EMR in USA hospitals where 63.1% of the country hospitals responded to the survey. The findings revealed that, 1.5% of U.S. healthcare facilities had comprehensive electronic health records; that the facility was present in all the clinical departments; and that 7.6% had a partial EMR system.

In a similar study, Hillestad and Bigelow (2005) reveal that 4% of U.S. medical doctors were using EMR effectively, while between 15-20 % were using partial forms of computerised record-keeping. Hsiao and Hing (2014) reported on the findings of a study on the use of EMR in U.S in 2006. The results revealed that 17% of medical doctors used it in their offices; 31% claimed that they used it in emergency rooms; and 29% stated that they used it in outpatients departments. They further say that, in the year 2013, 78% of medical doctors used EMR in their hospitals. The reasons for this may not be far from the submission of Miller and Sim (2004) and Silow –Carrol, Edward and Rodin (2013) that, many medical doctors are ready to adopt EMR because they believe it will enhance their job descriptions.

Jha (2011) lists various types of EMR systems, which include electronic prescribing, electronic health information exchange, electronic reporting of data, electronic recording of patients' medical history and clinical decision support resources. Zaindieh et al. (2008) highlight the advantages of EMR to include the following: improved communication, provision of access to information about patients; and generating of funds for healthcare facilities. If properly adopted, EMR will bring improvement to the healthcare delivery and the quality of services in the hospitals.

However, Hubne, Liebe, Egbert and Frey (2012) claim that only 22.6% of German hospitals have implemented the Electronic Medical Record system. This poor adoption rate can be attributed to high cost of clinical informatics tools. However, for any meaningful advantage to come from the use of EMR in hospitals, the medical doctors are the deciding factors. Tierney et al. (2010) conducted a study on EMR in three East African countries: Kenya, Tanzania and Uganda using Open MRS. The results revealed that EMR implementations were successful in the three countries. South African government introduced the EMR project in 2002 as part of

its e-Health Strategy which was introduced by the National Department of South Africa (Kleynhans 2011).

The government of South Africa also launched EMR application to promote the system's use in the country (Chowles, 2015). South Africa, (the Department of Health (DoH), is committed to EMR as a way to improve health services in the country (DoH 2012). The department states that all health facilities need to migrate from the current predominantly paper-based system to Electronic Medical Records (DoH 2012). Mahony, Wright, Yogeswaran and Goverance (2013) conducted a study on EMR used among nursing in the rural areas of South Africa, in which 19 of the nurses admitted that they knew about the use of EMR and two nurses claimed that they had used the system before. Cline and Luiz (2013) in their study revealed that, majority of medical doctors in South Africa admitted that EMR will be useful to them because it will provide access to patients' record information and allow for more informed decision making.

Examining the need for EMR in Nigeria's healthcare system, Benson (2011) recommended the following: the need for adequate planning, the need for medical doctors to have adequate knowledge on how to operate the system and objectives of the introduction of the system must be maintained which is to improve patient safety and provide a high level of information security.

Aminipour, Sadoughi and Ahambi (2014) note that Open MRS which is an open source version of the EMR system has been used and adopted in Nigeria Healthcare system, while Ojo and Popola (2015) reveal that a significant positive relationship exists between technical factors and EMR adoption in Nigeria teaching hospitals. The technical factors in this context include hardware and software compatibility. However, Ayeni and Oladoyinbo (2014) point out that there is poor patronage of EMR in hospitals because only 10% of Nigerians can afford it while Abimbola (2015) reveals that medical doctors in Nigerian embraced the need for EMR in improving effective medical care. He argues further on the need for more training for them to appreciate the benefits of EMR.

The next discussion focuses on the benefits of clinical informatics.

3.5 The benefits of clinical informatics

The literature review for this study reveals that there are various benefits of using clinical informatics. However, the present study will be premised on Leapfrog's (2006) and Minesh et

al.'s (2012) claim that it reduces cost, promotes efficiency, saves time and reduces medical errors.

3.5.1 Reduction in medical errors

Andel, Davidow, Hollander and Moren (2012) describe medical errors as the failure to complete planned action as intended, or the use of the wrong plans to achieve an aim. However, the advent of clinical informatics has brought about many changes to healthcare delivery because it has introduced a new way to improve the quality of healthcare. Several studies have shown that, the clinical informatics system has the capacity to reduce medical errors and improve medication safety (Wess et al., 2007; First Consulting Group, 2003: 2013; and Agency for Healthcare Research and Quality, 2014).

According to a report from Rodriguez-Gonzalez et al. (2012), 39% of medication errors in Madrid (Spain) could be traced to wrong prescriptions, while 23% could be traced to transcribing problems, which were due to poor hand writing. Another 23% could be attributed to poor administration, by nurses. In another development, Minesh et al. (2012) reveal that, 90 % of errors in United State occurred at the transcribing stage of medication due to poor handwriting. It has been observed that with clinical informatics in place, there will be reduction in medication errors.

Schiff et al. (2015) reveal that between 2003 and 2010, almost 1.04 million medication errors were recorded by MEDMARX in the USA, out of which 63040 cases could have been prevented, with the use of clinical informatics. Studies have revealed how clinical informatics systems can reduce Adverse Drug Effect (ADE). Smith (2013) describes an adverse drug effect as "an appreciably harmful or unpleasant reaction, resulting from an intervention related to the use of a medicinal product, which predicts hazard from future administration and warrants prevention or specific treatment, or alteration of the dosage regimen, or withdrawal of the product."

Thomas, Studdert and Burstion (2000) conducted a study on adverse drug effect at Colorado-Utah and another one in New York. The finding of the study reveals that ADE occurred in 2.9% and 3.7% of hospitals in the cities of Colorado and Utah with almost 8.8 % cases resulting in death. Similarly, 13.6% of hospitals, in New York, recorded cases of ADE. They reported that half of the cases of Adverse Drug Effect, in USA, were caused by medical errors that could have been prevented through the use of clinical informatics. Based on the findings from the study from Colorado, Utah, Angheluta (2010) submit that if 33.6 million patients are

admitted in USA hospitals, almost 44,000 of the citizens die annually as a result of medical errors.

Meanwhile, the result from Institute of Medicine (IOM), cited in Harold and Sox (2000), reveal that 98,000 citizens die annually due to medical errors from New York. This has revealed that medical errors claimed more lives in 1999 when compared with motor accidents (43,458), breast cancer (42,297) and AIDS (16,516) (Sun and Rau, 2014). Stroetmann, Dobrer and Stroetman (2007) conducted a study on patients in 2005 to find out if they had experienced a medical error in their treatments. The results indicate that, 34% of USA respondents admitted that, they have experienced one error or the other. Likewise, 30% respondents from Canada agreed that they had experienced medical errors. In addition, 20% respondents from Australia, 25% of New Zealanders, 23% of Germans and 22% of those from UK made similar allegation. The foregoing has shown the importance of clinical informatics access and use, in hospitals, in the reduction of medical errors.

3.5.2 Time economy

Leapfrog (2015) notes that the use of clinical informatics in hospitals saves the time of patients, not only regarding repeating tests but also with respect to pharmacy and radiology attentions. This may be due to the availability of requested information that is already in the system, which saves the time of the patients and reduces duplication of the efforts of medical doctors. Cucciniello, Lapley, Nasi and Paglari (2015) confirm this by stating that, clinical informatics is very relevant to modern healthcare delivery because it reduces the amount of hours spent on medical tests and laboratory examinations.

Clinical informatics provides valuable resources, which can increase efficiency and effectiveness in healthcare services. Stone et al. (2009) reveal that, clinical informatics saves time because it reduces the number of minutes medical doctors spend, in placing orders to the nurse, for a patient's medication. They affirm that before the implementation of clinical informatics, a doctor would spend a maximum of 41.20 minutes placing an order for medications, laboratory and nursing orders, for patient treatment. However, the use of clinical informatics has reduced that to 27 seconds per order. It can be concluded that, clinical informatics saves both the medical doctors' time and patients' time, as well as reduces unnecessary variation in healthcare services.

3.5.3 Improvement in efficiency

Clinical informatics is a valuable tool that promotes efficiency and effectiveness in the medical system. For example, it permits medical doctors to use the computer, to make an order for drug and laboratory tests which is mistake-free. Coustasse et al. (2013) observe that, medical doctors use computers directly to make orders for medication, laboratory tests and radiology examinations, without using intermediaries. It can be deduced that, access to clinical informatics has brought transformation to medical practices, by changing traditional ways of communicating, improving collaboration between medical doctors and other professionals in the healthcare sectors, as well as reducing interpersonal contact.

Lee, Ramayah and Zakaria (2012) list various ways in which clinical informatics can improve effective healthcare delivery. These include computerisation order of the request for drugs and prescription of cheaper but effective drugs, displaying patient's information and their laboratory results digitally, and checking for drug allergies and drug-drug interactions. Minseh et al., (2012) also describe the usefulness of clinical informatics system, which is basically for patients' care as it contains information about patients' drug allergies, laboratory examination reports, pharmacy prescriptions and biodata information. They highlight how clinical informatics promotes patients' safety by creating alerts or sending text messages to notify patients and doctors about contaminated drugs. The essence of the alerts is to create awareness about the dangers, in using contaminated drugs.

Considering the foregoing, it is glaring that clinical informatics helps medical doctors and patients in promoting effective healthcare services. It can also be said that, the automation of manual tasks allows free flow of information within the hospitals; this reduces the time wasted on the line queuing for drug, laboratory tests and medication.

3.5.4 Reduction of cost

The use of clinical informatics in the healthcare facilities has saved hundreds of billions annually in USA (Kopel et al., 2005). In another development, Kaushal et al. (2006: 262) reveal that the adoption of clinical informatics in a teaching hospital, in USA, for ten years saved the hospital about \$2.2 million annually with the total current saving of \$16.7 million per annual. Kaushal et al. (2006) explain how Brigham and Women's Hospital at Boston saved \$28.5 million from 1993-2002, after the introduction of clinical informatics, whereas the hospital spent \$11.8 million to implement clinical informatics. With the use of clinical informatics, there has been reduction in cost.

3.5.5 Increasing performance

Clinical informatics can improve the performance of medical doctors and promote preventive healthcare (Cresswell, Majeed and Bates, 2012). Agency for Healthcare Research and Quality (2014) state the positive impact of computerised decision making in the treatment of cancer screening, mammography and vaccinations, while Moja et al. (2014) maintain that clinical informatics promote strict adherence to standard healthcare and improved efficiency and quality healthcare system. Li, Talaei-Seale, Ray and Machinerytre (2013) opine that, clinical informatics system assists, in finding solutions to problems, in clinical practice. It contributes to the provision of accurate access to information for treatment of patients and provides effective communication between medical doctors and other healthcare workers.

The next section is on the availability of clinical informatics.

3.6 Availability of clinical informatics

Among the innovations of change in healthcare sector is the advent of the clinical informatics. Its availability and applications have revolutionized and promoted effective healthcare services (eTransformed Africa, 2012). This indicates that the availability of clinical informatics to healthcare will surely support, improve and promote effective healthcare delivery. Availability of clinical informatics, in healthcare facilities, provides opportunity for evidence-based medicine.

Globally, medical doctors are to provide effective healthcare service delivery to healthcare users. The availability of clinical informatics, in healthcare environment, has reportedly led to various benefits and increased effective diagnosis and treatment. Olasina et al. (2014) note that the availability of clinical informatics is imperative for effective medical care, particularly, in this information age. This implies that availability of clinical informatics has changed the ways medicine is being practised by improving the training and capacity building of medical practices. Contributing to this, European Commission (2008) asserts that, clinical informatics applications have a growing role in the medical doctors' practices and there are significant differences, in the availability of clinical informatics. The report states that, clinical informatics is available in 70% of the hospitals in European countries and 66% of the medical doctors in the countries use clinical informatics for medical consultations.

Olasina and Poopola (2014) report that, poor clinical informatics infrastructures among medical doctors in sub-Saharan Africa had caused many countries to suffer from poor and ineffective healthcare delivery. Bastholom et al. (2014) affirm that, clinical informatics tools

are readily available in the market and its use varies in hospitals and among medical practitioners.

Over the years, studies reporting the need for the availability of clinical informatics, in healthcare (Gray, Vanda and Jack 2011 and Shiferaw and Zolfo, 2013), show that the availability of clinical informatics will promote adequate follow-up to monitor patients' conditions. Several studies indicate that, the availability of clinical informatics on healthcare systems, in developing countries, such as Nigeria and South Africa, will significantly transform the medical practices to what obtains in developed countries (Bukachi and Pakehanmo, 2007; Bates et al., 2003 and Seror, 2001). This suggests that the availability of clinical informatics, in healthcare delivery system, has the potential to strengthen human resources for healthcare and at the same time increase access to healthcare and promote quality health services. In the same vein, Nwagwu and Adio (2013) explain that the availability of clinical informatics in the healthcare facilities will serve as a tool for improving medical services.

Furthermore, Moahi (2009) is of the view that, ICT has allowed clinical information to be effectively managed in the hospitals, particularly among medical doctors. He notes that, the availability of ICT, in hospital environments, will determine medical doctors' accessibility and utilisation of healthcare facilities for their medical practices. This implies that, health facilities in the continent need to make clinical informatics available. Ajuwon (2014) explains that apart from making ICT available to different professionals such as medical doctors, there is the need for effective computer training in order to promote adequate utilisation of the facilities. This is in support of the assertion of Kinengyere (2007) that, the availability of ICT resources, for various professionals, does not indicate actual usage. The availability of clinical informatics can increase the quality of healthcare, not only in rural hospitals but also in urban hospitals.

Several empirical studies show the availability of ICT in various healthcare facilities in Norway (Archangel, 2007), India (Sahay, 2007) and Finland (Ranta, 2005). Ash, Goman, Sesha and Hersh (2004) conducted a study on the availability and use of computerised physician order entry in USA hospitals and the result reveals that the facility is available in only 10% of the hospitals in the country. In another dimension, Herdy (2005) conducted a similar study in England on the availability of Electronic Medical Record, which reveals that 3% of hospitals have access to it.

In Africa, Ahmed (2007) indicates that clinical informatics is available in very few hospitals in Uganda; and Archangel (2007) reports the same about Tanzania. However, Archangel attributes the poor adoption of clinical informatics to inadequate funding of healthcare in the country, poor capacity building and poor attitude to computer use. Rao (2009) reveals that the availability of clinical informatics in the India healthcare is very low.

Nwagu and Adio (2013) conducted a study in Nigeria on the utilisation of ICT by medical practitioners in private hospitals, grouping the ICT resources into two: general ICTs and specific hospital ICT resources. Concerning the general ICT available in the hospitals, only few respondents have computers (37.9%), mobile phones (33.6%) and internet (12.8%). The results from specific hospital ICT indicate the availability of digital thermometer at 15.6%, digital glucometer at 6.6%, and ultra sound machine at 22.7%, ECG at 2.8% and Sphygmomanometer at 8.5%.

The next discussion is on accessibility of clinical informatics.

3.7 Accessibility to clinical informatics

The importance of clinical informatics, to medical doctors, in decision making, cannot be ignored and the successful integration of clinical informatics in effective healthcare facilities has been found to depend on the extent to which the tools are accessible. It is in support of this that the National e-Health Strategy Sweden (2010) observes that access to secured information about patients' treatment is a key to the promotion of effective healthcare service delivery.

Nwargu and Adio (2013) note that, accessibility to clinical informatics tools assist medical doctors in making accurate judgement about patients, conduct medical examinations and diagnoses on them. Access to clinical informatics is a determinant to effective healthcare delivery services (Ahiaku, 2015). Aramide et al. (2015) highlight various factors that affect access to ICT which include location, social status and degree of accessibility.

Access describes the extent to which a particular user is able to locate particular resources for use as well as the degree of accessibility of such resources. Access is one of the factors that can influence the use of clinical informatics by medical doctors (Ahiaku, 2015). Kosteniuk, Morgan and D'Arcy (2013) agree that information is very important for medical doctors, particularly in clinical decision making and medical education. The various reasons why medical doctors are in need of information were identified by David (2009). They include seeking patients' information, particularly on treatment, medical history and diagnosis

methods. It has been observed that adequate and effective healthcare delivery needs intensive information and efficient information flow between different units and departments in the hospital. This is necessary for effective decision making among medical doctors (e-health Sweden, 2010:6).

In the same vein, Ruxwana, Herselman and Conradie (2010:17) acknowledge that access to clinical informatics could serve as a link to better clinical decision making and towards the improvement of the quality of healthcare and job satisfaction in doctors. Nwargu and Adio (2013) note that access to clinical informatics make the work of medical doctors easier, faster, quicker and more efficient. They discuss further that clinical informatics tools can be used for both medical records and drug prescriptions. Al –Dousari (2008) recognises that despite the availability of medical knowledge and information from patient records to assist medical doctors in their clinical judgments, they still need access to clinical informatics tools for accurate and timely information.

Oyegoke (2013) emphasises that access to clinical informatics, in Nigerian hospitals, will improve the quality of healthcare systems and contribute to the improvement of the efficiency of medical doctors as well as increasing access to quality and reliable healthcare services. Access to clinical informatics is very necessary for improving health outcomes for different socio-economic groups in African continent (Flynn-Dapah and Rashid, 2010). They argue further that clinical informatics is increasingly being used in different aspects of healthcare which include healthcare delivery, administration, and communication. For many years, many international organisations such as Melinda Gate Foundation, Rockefeller Foundation, Rotary International and World Bank have sought to introduce effective access to clinical informatics by donating the tools to many countries in Africa and encourage the use of clinical informatics in developing countries (Flynn-Dapah and Rahid, 2010). To achieve this, World Health Organisation adopted a resolution for clinical informatics and e-Health strategy, in member countries, which as a result, established the Global e-Health Observatory with the mandate to monitor access and the use of clinical informatics, in various healthcare facilities, in developing countries (WHO, 2013).

Many factors can be associated with access to clinical informatics. Nwargu and Adio (2013) suggest that, access to clinical informatics by medical doctors can be examined in three contexts, which are individual context, technological assessment and implementation evaluation. They further argue that, the individual context is related to issues about computer confidence, computer usage, computer anxiety, ICT competency, computer self-efficacy and

attitude toward use of computer. The technological consideration, on the other hand, is about the perception of medical doctors, about technology and its role in medical practices; and lastly the implementation stage refers to professional environment of medical doctors (Schaper and Pervan, 2007).

Many doctors have no access to clinical informatics application and many of them are still using manual processes with scant information regarding the use of information for decision support systems, in order to improve medical care (Haluza and Jungwirth, 2014). This indicates that, medical doctors need access to right information at the right time for effective clinical outcome. Gatero (2011) maintains that, inadequate access to clinical informatics affects medical doctors, in harnessing the potentials of clinical informatics and in improving quality healthcare services.

Oдини and Omuoke (2014) note that, prevailing diseases, particularly in Africa countries, require medical doctors to acquire enough training on how to access clinic informatics, for effective and better performance. This implies that there is a need for medical doctors to keep themselves abreast of up-to-date information, knowledge and skills on how to access clinical informatics, for effective healthcare service delivery, because it will give them the opportunity to have access to valuable medical information. Flynn-Dapaah and Rasidi (2010) observe that there is unequal access to clinical informatics, among medical doctors, in many African countries. For medical doctors to effectively use clinical informatics, they must have easy access to various forms of clinical informatics tools.

Ahiaku, (2015) states that, races, geographical location and nature of healthcare facilities are some of factors that determine the types of clinical informatics medical doctor may have access to. Joudey and Robson (2010) observe that, medical doctors, in white dominated areas in South Africa, have access to more clinical informatics tools to address the health needs of the white patients when compared with the doctors in black dominated areas. In Nigeria, Baba and Omotare (2012) observe that most healthcare facilities, including clinical informatics, are located in the southern part of the country compared with what is available in the northern part of the country. The implication of this is that clinical informatics resources are not evenly distributed in Nigeria. These may be due to inadequate funding to implement infrastructure that will support access to clinical informatics and failure of government to provide an enabling environment for the promotion of clinical informatics.

Oдини and Omuoke (2014) acknowledge that many hospitals, in Kenya, are facing a lot of challenges in providing quality, efficient and accessible healthcare to patients because of the

lack of clinical informatics among their medical doctors. This is a major obstacle affecting good healthcare in the continent. Similarly, the continent is not a healthy place because all healthcare indicators reveal that, Africa is lagging behind. For example, life expectancy at birth in year 2012 was 54 in Africa, 66 in Eastern Mediterranean and 75 in Europe (World Health organisation, 2013).

The number of physicians per 1000 people in 2010 in Africa was 2.3, Eastern Mediterranean was 11.0 and in Europe it was 33.3. Much of this gap, which has widened, is a consequence of the poor access to clinical informatics in healthcare facilities (KPMG, 2012:5). This points to the fact that, there is an urgent need for African governments to embrace the use of clinical informatics, in healthcare facilities, to enable medical doctors and more people have access to quality and effective healthcare delivery.

International Telecommunication Union (2012) also confirms that, access to clinical informatics among medical doctors is still inadequate. This is attributed to insufficient medical infrastructures, high cost of facilities, poor ICT skills and absence of legislation. Despite the fact that the use of clinical informatics such as computer, Internet and electronic health records is well documented in literature, there is the problem of access to clinical informatics use among medical doctors in Nigeria (Ajuwon and Rhine, 2008; Ajayi, 2013).

Despite the benefits linked with the access and use of clinical informatics in healthcare, its adoption in healthcare delivery has been poor. Institute for Healthcare Informatics (2014) observes that access to clinical informatics is being limited due to the risk-aversion nature of the sector. This can be attributed to the conservative ways in which medical doctors perform their clinical activities which makes access to clinical informatics slow.

Guruajan, Hafeez-Bang and Don (2008) opine that the successful access and use of clinical informatics in the hospital environment is not the function of good technology but the ability of medical doctors to access the technology. Burney, Mohmond, and Abass (2015) note that, clinical informatics has different access options for medical doctors in hospitals. Some are for use by all the doctors, while some will need professional assistance before they could be operated. However, it is evident that, good access to clinical informatics, by medical doctors, will bridge the gap between the current situation of medical practices and difficulty in decision making concerning patients' treatment and diagnoses.

African Development Bank (2014) observes that, access to good and quality healthcare is lacking in African countries, due to lack of clinical facilities and infrastructures in most

hospitals. As a result, the bank has proposed to spend \$30 billion in buying various clinical informatics tools, in order to improve effective healthcare delivery, in the African region. The Bank has decided to play a leading role in providing ICT-enabled environment in healthcare sectors in the continent with the following interventions:

- Various regional operations will be established to promote ICT development in hospitals. The Bank has agreed to provide modern ICT with the mission to establish a strong ICT infrastructure to support hospitals operations.
- The Bank has decided to promote the development of a hospital information system linked to medical health records.
- It will provide technical support and capacity building to manage clinical informatics tools in hospitals.
- The Bank will ensure necessary training for various health workers on how to operate various clinical informatics tools.

Various Studies have revealed the position of accessibility to clinical informatics tools, in developing and developed countries. Reddy, Pura and Kelly (2008) note that many doctors in rural hospitals, in Africa, lack access to clinical informatics. It has been observed by Bean, Davis and Valdez (2013) that, there are many factors that contribute to the gaps in access to clinical informatics by medical doctors. Some of these problems are nature of hospitals, computer skills and environment. The United State of America's Department of Health and Human services note that, access to clinical informatics is a means to improve the health and healthcare of underprivileged (Moidyddin and Moore, 2008). This suggestion is based on the department's discovery that, accessing medical health information through clinical informatics will increase health status. They argue further that, medical doctors that work in racial and minor ethnic groups and people with low income tend not to have access to clinical informatics to obtain health information and have worse health outcomes than medical doctors that work in major ethnic groups.

Kommalage and Gunawardena (2008) compare clinical informatics access between industrialised and developing countries and the result reveals that industrialised nations have invested more in clinical informatics integration into their healthcare system than the developing countries. This made it possible for their medical doctors to have access to the latest clinical informatics' resources.

On the other hand, medical doctors, in developing countries, are affected by a number of factors in accessing clinical informatics, which include inadequate funding and social and

economic challenges (Woreta, Kebede and Zegeye, 2013). In corroboration of the foregoing, Houshyari et al. (2012) note that medical doctors in developed countries benefit greatly from the access and use of clinical informatics, in their healthcare delivery, because their governments make clinical informatics tools accessible to them. However, doctors in developing countries do not benefit from clinical informatics' use in their healthcare facilities due to poor access to the tools. From this, it can be said that medical doctors, in advanced countries, have adopted ICT use as part of medical practices, while the reverse is the case in the developing countries.

Also, several empirical studies, on access to clinical informatics among medical doctors, will be of relevance to this study. Although, all these studies are related to the research, none of them has focused on access and use of clinical informatics in effective healthcare delivery system, particularly among two countries. Olasina and Popoola (2014) reported a survey of medical doctors' access and use of clinical informatics in American, European and Asian countries. It reveals that 80% of medical doctors had accessed to the computer, while 44 % of the medical doctors have access to internet resources. Houshyari et al. (2012) reported a study at Vienna Medical School. The finding reveals that, 94% of the medical students had access to computers, while only 5% of the students depended on the university computers. Majority of the students claimed to have access to internet facilities. A study carried out in New Zealand and Denmark reveals that, 99% of medical doctors access clinical informatics in diagnoses and treatment of patients and they also used the resources to record clinical consultation records (Protti, Bowden and Johansen 2008).

Devitt and Murphy (2004) conducted a study in United Kingdom among medical doctors' access to ICT for clinical purposes at an acute hospital. The finding of the research reveals that, medical doctors access computers in their offices, particularly to conduct literature searches, write clinical report and prepare presentations. In another development, Gatero (2011) conducted a study on the access to ICT by medical doctors at Kenyatta National Hospital, Kenya. The finding reveals that, very few medical doctors have access to the Internet in their offices.

In another development, De Boer, Versteengen and Wijhe (2007) reported that, 83% of the medical doctors at Netherland have access to internet resources, while 47% use the Internet to obtain medical information. Fox and Jones (2009:2) reported that, 61% of the USA medical doctors have access to clinical informatics for medical information. Simba (2004) had early reported that, over 50% of medical doctors, in USA, have access to clinical informatics in the

year 2004. Particularly, the Internet and the tool keep them abreast with the latest information in the medical field. Based on this, over 80% of medical doctors are to have access to clinical informatics by the year 2015. Access to clinical informatics has brought increase in data accuracy and promoted availability of health information, in electronic form and has reduced paper work (Simba, 2004).

Access to clinical informatics among medical doctors, in the European countries, has been assessed as relatively adequate. European Commission (2008) surveyed the clinical informatics access among medical doctors across Europe and the finding reveals that about 70% of the medical doctors have access to clinical informatics and 66% of medical doctors access it in their hospitals for medical consultations. Denmark medical doctors have the highest access to clinical informatics (91%) and Romania has the lowest (5%). They attribute the disparity to the fact that Denmark has the highest broadband connections with high-speed internet connectivity, coupled with adequate funding of health institutions by the government.

In another development, Salman and Ahamed (2013) conducted a study among medical doctors access to clinical informatics in Pakistan. Majority of the doctors admitted that they did not have access to clinical informatics. The study reveals that access to clinical informatics is “location divide”, that is, some hospitals in the remote rural areas of the country as well as the medical doctors working in the rural areas have no access to clinical informatics.

Similarly, Organisation for Economic Development and Co-operation (2011) conducted a study in over 80% of OECD countries on access to clinical informatics by medical doctors. Majority of the medical doctors admitted that, they had access to clinical informatics in their hospitals and that the clinical informatics is useful to them. Realising the importance of clinical informatics in effective healthcare delivery, OECD (2015) notes that, access to clinical informatics in medical practices will support and facilitate patients’ and medical doctors’ empowerment, in the area of communication, health promotion, and disease prevention. It also provides opportunity for monitoring of healthcare parameters for integration of effective diagnosis and treatment. Jha et al. (2008) examined the clinical informatics accessibility among medical doctors in seven countries which are USA, Canada, Australia, New Zealand, and Germany. The survey also included Netherlands and the UK. They discovered that many medical doctors have access to EMR but lacked other forms of clinical informatics resources. This may be attributed to failure of hospitals to adopt other forms of clinical informatics

Contributing to this, Safdari et al. (2014) maintain that, medical doctors need access to information for clinical guidelines, drug reference, clinical calculations, patients' demographic information and scientific evidence at the point of care, every time. Therefore, to get such information, needed in the field of medicine, access to clinical informatics appears to be very important because it is a technology which has an operating system and the capacity to provide evidence based medicine and support medical doctors in decision making.

In a study put forward by Safdari, Jebracity, Rahimi and Doulani (2014), 85% of medical doctors have access to smartphones which they used for medical purposes at least once a day and 77% admitted that they used at least one medical application on their smart phones. Compared with a study by Payne, Wharrad, and Watts (2012), 79% of medical doctors have access to smartphones and majority of them claimed that they used it to seek medical information.

Coleman, Horseman and Coleman (2013) conducted a study on the use of ICT to support doctors in rural areas of South Africa and they state that, accessing ICT has led to an increase in the promotion of healthcare for rural and marginalised people. Arvantis and Loukis (2016) conducted a study in 743 hospitals from 18 European countries to find out the level of access to clinical informatics. The study identifies the availability of four types of clinical informatics but reveals that Computerised Physicians Order Entry, Diagnosis Image Archiving and Electronic Medical Records are accessible to medical doctors. It shows further that, access to them has had positive impact on their job performances. The reason for this may be due to the types of clinical informatics and support they received from the use of clinical informatics. Bension (2011), in a study of access to clinical informatics of Iowa hospitals reveal that, 80% of medical doctors in urban hospitals have access to clinical informatics and 30-40% medical doctors in hospitals, in rural areas, have access to clinical informatics. They attributed the disparity in clinical informatics' accessibility to the robust financial capabilities of urban hospitals.

Clinical informatics has made medical knowledge accessible for patients. Patients use clinical informatics to understand better their medical situations and medical issues. Karsenti and Charlin (2008) observe that, the internet has brought changes into medical practices, as medical knowledge is now becoming accessible for everybody around the globe. Medical knowledge is no longer the monopoly of medical doctors. Bello et al. (2004), in his study at Obafemi Awolowo University, Ile-Ife, Nigeria, revealed that only 26% of the medical doctors

have access to computers. The analysis showed a low level of use of clinical informatics by medical doctors in Nigeria.

Li, Talaaei, Seale, Ray and MacInye (2012) note that, ICT in healthcare system has the potential to improve the quality and efficiency of care delivery, through the automation of manual processes. Clinical informatics provides the opportunity to revolutionise the healthcare system, by enabling innovations in work practice and changes to professional roles and responsibilities resulting in new models of care delivery (Christensen, Bohmer and Kenagy, 2000). Likewise, Chhanbhai and Holt (2010) point out that, access to clinical informatics provides equal opportunities for effective healthcare delivery system, particularly for the people living, in rural areas, in Africa.

However, despite the relevance of clinical informatics to effective healthcare delivery, Ani and Afeseye (2007) observe that, there are still disparities, especially among countries in Africa, concerning access to clinical informatics by medical doctors. Ani (2014) notes that African countries are known to be poor when it comes to the accessibility of ICT infrastructure and that ICT infrastructure is least developed in African teaching hospitals. This reflects that teaching hospitals, in African countries, have inadequate access when compared with other developed countries in the use and accessibility of clinical informatics.

The next discussion is on digital divide and clinical informatics.

3.7.1 The digital divide and clinical informatics

There is no single universal acceptable definition for the word digital divide. Ali (2011) describes digital divide as uneven distribution of information and communication infrastructure between countries or between the rural and urban areas. Similarly, Mutula (2008) defines digital divide as the vacuum that exists between countries or among various professionals that have access to ICT or the facilities.

Jiyane (2012) traces the origin of the term to Larry Irking of the Department of Commerce, in the United States of America. The essence of the concept is to examine the existing gap, in the access to information services, between those that can afford ICT and those that cannot. The disparity in the access to ICT can bring discrimination, which can prevent affected citizens to take part in the development of the country.

According to Jiyane (2012) digital divide is more focused on countries with ICT infrastructure use or lack of use. It has been observed by Osunkunle (2010) that, developed countries, such as USA and Switzerland, have access to ICT while under-developed countries in Africa, like

Togo and Mali, may not really enjoy access. They went further to reveal that 66 out of 100 people in USA have access to personal computers while 71 out of 100 people have access to computers in Switzerland.

However, in some Africa countries, such as Nigeria, Ethiopia and Congo, it was revealed that 1 out of 100 people have access to personnel computers. A gap exists in the literature regarding the total number of clinical informatics tools that are available in the Nigerian healthcare facilities. Nonetheless, the data estimate is less than 5% available clinical informatics in the country healthcare (Benson, 2011).

Meanwhile, Mutula (2011) agrees that, there is a digital gap between developing and developed countries. Various reasons attributed for this include poor ICT policy implementations and funding problems. Other possible problems include inadequate computer skills, lack of awareness about the importance of ICT in the healthcare sector and the problem of attitude, since many doctors are not ready to embrace the use clinical informatics because they believe using the tools may take them away from their jobs.

However, disparity in digital gap may be due to the commitment of governments, in developed countries, to the creation of awareness and an enabling environment that promotes access to ICT use in their countries. Conversely, it could be that most African countries are negligent of the development of ICT access, in their counties, due to inadequate funding towards the goal of adopting and diffusing clinical informatics in their health system. Contributing to this, Krauss (2009) states that the failure of African countries to embrace access to ICT will make them to be at disadvantaged positions in different ways and they will not be part of the information society.

The digital divide has been identified as a special problem due to disparity to effective healthcare delivery service among medical doctors. Many medical doctors may take the clinical informatics for granted due to lack of e-readiness (Shiferaw and Zolfo, 2012). A study by Acilar (2011), on the causes of digital divide in developing countries, found that poor supply and high cost of IT resources is a major obstacle to access to internet resources. There is the need for governments, in the continent, to put the right mechanisms in place to bridge the digital divide and encourage the use of ICTs, particularly in the health sector. Adequate access to clinical informatics, among medical doctors in the continent, will contribute immensely to global knowledge and economic development. Also, medical doctors will benefit from a knowledgeable society (United National Educational Scientific and Cultural Organisation, 2005).

The next discussion is on the challenges to access and use of clinical informatics

3.8 Challenges to access and use of clinical informatics

There are several obstacles facing the access and use of clinical informatics in many African countries. Idowu et al. (2008) categorise the problems into three: the people, government, and ICT infrastructure. Simbia (2004) states that, poor access to ICT, poor government attitude, lacks of political will and poor data quality are some of the problems facing the use of clinical informatics in African countries. The challenges facing the development of clinical informatics, in Nigeria and South Africa, are discussed in the next section.

3.8.1 Poor access to telecommunication

Telecommunication services are very important for effective clinical informatics operations. Its role, in effective healthcare system, cannot be overemphasised. It is in support of this, that Coiera (2006) lists various telecommunication modes necessary for effective utilisation of clinical informatics which include: Integrated telecommunication technology, interactive notification, interactive mode security protocol and a host of others.

However, in many Africa countries, there is limitation to broadband access. In countries where it is available, it is very expensive for the people. The poor ICT infrastructure status, in many African countries, has made it impossible to effectively allow the healthcare sector to benefit from the opportunity of ICT use in healthcare delivery. Lintho (2010) reveals that due to poor ICT facilities in the continent, very few hospitals are connected to the Internet and many of them have limited access. Internet World Stats (2016) affirms that, most countries in Africa are not well connected to the internet. For example, only 29.6% of the households in Ghana are connected; South Africa claimed 52.6%; Angola, 37.3%; Kenya, 68.4%; and Nigeria, 5%. The statistics has revealed that many African countries have problems with inadequate telecommunication facilities, Nigeria and South Africa inclusive.

Poor access to ICT by medical doctors can be traced to inadequate telecommunication services, in Nigeria and South Africa. Though, these countries were rated high in the telecommunication sector as the fastest growing economies, it is glaring that this applies solely to the use of mobile phones. Majority of the health institutions in the two countries have poor access to broadband facilities (Idowu, 2008). Kim, Kelly and Raja (2010) note that, every 10% point increase in broadband services, particularly in health sector, will lead to an increase in productivity of medical doctors and other health workers with 1.3%. This indicates the importance of increase in broadband, in clinical informatics. The resource is necessary in

operating various clinical informatics tools. From the foregoing, it can be deduced that there is need for adequate broadband facilities for effective diagnosis and reduction in medical errors in African countries.

3.8.2 Resistance to new technology

Technology is meant to improve efficiency, accuracy and productivity. However, technology resistance is a way by which people resist change brought about by technology, particularly, when people are faced with new innovation or change (Fagerberg and Srhole, 2009). Idowu et al. (2008) note that introduction of innovation or technology may be welcomed with mixed feelings by users.

Medical doctors may resist the introduction of a technology that they believe will have negative impact on their jobs. Idowu et al. (2008) and Abdullai and Haruna (2008) list various reasons why medical doctors' may resist the adoption of clinical informatics, in medical practices. Their resistance may be a reaction to new knowledge, skills and training on how to use the new technology, as well as the tendency of increase in job functions. In addition, people may resist the introduction of new technology/technologies because they may be afraid of job loss, due to reduction of staff. As a result of this, there is need for the government to build confidence in workers, in the hospitals, before introducing the technologies and map out ways to train the hospital staff on how to use them, rather than lay staff off (Zheng, 2004).

3.8.3 Poor ICT skills

In this era of ICT, it is very necessary for medical doctors to use the computer and other ICT components for their job performances. Anderson, Asher and Whitter (2007) note that, medical doctors need to possess the following skills, apart from their academic and professional qualifications: computer operating system, use of application software packages, knowledge of databases and medical tools automation, and technical skills. However, the potentials of ICT has not been fully utilised in many developing countries because of poor ICT skills among medical doctors (Gatero, 2011).

As a result of poor ICT skills, medical doctors would deny the opportunity to have access to adequate and reliable information. Ololube, Ubogu, and Ossai (2007) affirm that medical doctors' lack of ICT skills is a major obstacle militating against the use. There are three approaches to ICT skills competency standard for medical doctors. These are technological literacy, knowledge deepening and knowledge creation (UNESCO, 2011). These approaches are development continuums to promote the use of ICT among medical doctors and each has

its usefulness for the healthcare delivery system, particularly in diagnosis, treatment, professional development of medical doctors, medical practices and hospital administration.

The information and communication technology skills of medical doctors, in Africa, are very low (Idowu et al., 2008). They further assert that, many medical doctors, in Africa, lack the basic skills to operate computers. As a result, many of them would find it difficult to operate clinical informatics tools.

3.9 Summary

In this chapter, different types of clinical informatics were identified which include EMR, CDSS, CPOE, and DIA. Despite the fact that their tools are designed to support evidence-based medicine, many doctors still either do not have access to these tools or are not familiar with the use of these tools. Clinical informatics is becoming an increasingly important aspect of medical practice, and it has contributed significantly to healthcare development at all levels. The adoption of clinical informatics promises a number of significant benefits, which include time management and better healthcare. Serious unintended consequences from the non-implementation of these facilities have emerged, particularly in developing countries.

Poor access to clinical informatics resources can result in medical errors, lessen the quality of care, and endanger healthcare development on the continent. Incorrect medical diagnoses, on the part of medical doctors, may have serious legal and financial implications on healthcare facilities. Lack of clinical informatics also has serious implications on the fight against preventable diseases and premature deaths, in developing countries. The poor adoption of clinical informatics, in developing countries, can be traced to poor ICT readiness. ICT readiness can be grouped into basic readiness, ICT readiness, government readiness and clinical informatics.

The health systems, of many African countries, are haunted by challenges of accessibility and availability of clinical informatics, despite the impressive opportunities that can be gained from the adoption of clinical informatics in healthcare. Extant literature indicates that clinical informatics development is basically limited to advanced countries in the world, with many healthcare facilities in Africa still lagging behind, in clinical informatics' access and use.

Extant literature, in this chapter, indicates a divide in the use of healthcare facilities, particularly between urban and rural healthcare facilities and developed and under-developed countries. Gaps also exist within healthcare facilities (between departments) and healthcare facilities within the same geo-political zone, particularly in Africa. The adoption of clinical

informatics can help to bridge this gap. Through the adoption of clinical informatics, challenges such as distance would no longer be a barrier to delivering quality healthcare. The availability of clinical informatics can contribute significantly to the socio-economic development of rural dwellers.

Even among developed countries, some countries place greater emphasis on clinical informatics than others. For example, Denmark has a very high level of clinical informatics in her health facilities compared to other Scandinavian countries. The prevalence of the digital divide, in many African countries, is a serious threat to the effective use of clinical informatics in healthcare delivery. Reasons for this may be the unavailability of clinical informatics policies and poor budgetary allocation to health. Any implementation of clinical informatics must also be sensitive to the needs of healthcare users. Effective healthcare depends on the accessibility and availability of clinical informatics because clinical informatics is the backbone of the services that prevent, diagnose and treat diseases and ailments.

There are various studies on different types of clinical informatics but none has combined different types of clinical informatics and examined access and use, particularly in the context of teaching hospitals in Nigeria and South Africa. This is one of the contributions of this chapter.

The next chapter discusses the theory on which this study is based.

CHAPTER FOUR: THEORETICAL FRAMEWORK

4.1 Introduction

In research, theory is important because it provides a framework for analysis, facilitates the efficient development of the field. Theory is needed to solve the real world problems. Therefore, this chapter presents background information on the theories that constitute the framework for this study. The need to separate the theoretical framework chapter from literature review is based on the argument of Creswell (1994) that in academic research, theoretical framework needs to be separated from literature review chapter. Kerlinger (1979) had earlier explained that a theoretical framework bridges the independent and dependent variables in academic research.

However, the theoretical framework was employed in this study to examine the problem areas, as discussed in Chapter One of the study. The organisation of this chapter is based on

Creswell (1994) guidelines on the manner in which the theoretical framework should be presented in a research work. Creswell (1994) claims that the theoretical framework chapter needs to show the relationship between the theoretical framework and literature review. In consequence, this chapter is divided into the following sections. The meaning of theoretical framework, overview of related theoretical frameworks on access and use of technology, UTAUT model, implications and applications, justification for using the theory, limitation of the theory and summary.

4.2 Theoretical framework

Brink, van derWalt and Rensburg (2013:12) note that there are various definitions of the term ‘theory’ in research literature. While some are narrow and specific, others are broad and general. Contributing to this, Pettigrew and McKechnie in Ocholla and Le Roux (2011) affirm that before a working definition can be given to a theoretical framework, there is need to define what a theory is. As a result, they define a theory as ‘a conceptual explanation of a phenomenon and how it interacts with others (occurrences), in space and time, in order to broaden the understanding and application of a concept.’

In another development, Neuman (2015) describes theory as an explanation of a specific social phenomenon that identifies a set of causally relevant factors or condition. He argues that, theory provides insights into the real meaning of a social phenomenon, by offering an illuminating interpretation and by telling what research is all about. Chinn and Krammer, cited by Brink et al., (2014) define theory as a ‘systematic abstraction of reality that serves some purpose’. They further describe each of the concepts in the definition as follows: ‘systematic’ implies a specific organisational pattern; ‘abstraction’ means a representation of reality; and ‘purposes’ include description and explanation of phenomena, as well as the control of reality.

A theory also summarises and organises current understanding of a particular phenomenon, and may be systematically tested by a research. It presents a systematic explanation and relationship among phenomena (Polit and Beck, 2008). From the foregoing definitions, a theory can be described as interrelated concepts and propositions that explain the relationship among variables. At the same time, it can be described as an assumption, a conjecture, a hypothesis or a speculation with the intention to explain some phenomena. Olorunisola (2008) identifies various characteristics of theories as:

- Logical, relatively simple

- Composed of concepts and propositions
- Able to interrelate concepts to create a specific way of looking at a particular phenomenon
- Capable of forming the basis for testable hypotheses
- Consistent with other validated theories, laws and principles with unanswered questions for investigation
- Contributing to and assisting in increasing the general body of knowledge through research implemented to validate them.

From the explanation above, a strong relationship can be established between theory and research. It can be said that a theory is a pillar on which a research is built and that theory provides the context which makes a research to be meaningful. We can then claim that theory and research are dependent on each other.

Having examined the theory, it is also necessary to discuss the meaning of theoretical framework. Extant literature has revealed that there is no single universal definition for the concept of theoretical framework. Ocholla and Le Roux (2011) note that there is no single universal acceptable definition for the concept. They highlight four major components of theoretical framework which include the research hypothesis/research questions, the theoretical model, the research methodology, and literature review. They emphasise that for any acceptable definition of theoretical framework, the four components must be put into consideration.

Neuman (2015) observes that theoretical framework provide assumptions, concepts and forms of explanation in a scholarly research. The importance of theoretical framework in scholarly research was restated by Ocholla and LeRaoux (2011) who claim that, theoretical framework enhances research clarity, promotes appropriateness of research and ensures effectiveness in research work. Grix (2010), too, argue that theoretical framework provides a guideline to research design, result interpretation and data analysis. It is important to note that the application of theoretical framework in research activities has played a great role in research development (Brink et al., 2013).

4.3 Technology acceptance theories

In the medical field, many studies have revealed that information and communication technology is underutilised in many healthcare facilities, causing huge economic loss to healthcare development. The National Centre for Chronic Disease Prevention and Health Promotion (2009), likewise, observes that, the United State of America spent huge amounts of

funds on ICT in healthcare delivery, in the past years without any considerable results. This implies that failure of users to accept the use of ICTs in an organisation would constitute a big hindrance to its successful adoption (Olasina and Poopola, 2014).

Mahoney et al. (2013) attribute this failure to poor acceptability of use of ICTs by the people involved. It can be inferred from the above that, ICTs cannot improve the performance of any organisation if the users are not ready to embrace and accept it. To buttress this, Kaplan and Kimberley (2009) note that over 40% of ICT adopted in various hospital environments in the USA had witnessed failure and abandonment. They identified various reasons that could be responsible for this. These reasons include lack of adequate knowledge of ICT skills and poor acceptability. Contributing to this, Lewis et al. (2011) maintain that effective ICT implementation in any hospital environment is a function of an individual's acceptance and user's utilisation. Kinengyere (2007) emphasises that, the availability of ICT, among various professionals, such as medical doctors, does not automatically lead to its usage and acceptance. Wills, El-Gayar and Bernet (2008) argue that, failure of medical doctors to use clinical informatics placed a very heavy burden on the hospital managements, patients and other healthcare workers.

This indicates that, the failure of users to accept the use of technology, in any organisation, will constitute a big hindrance to the successful adoption of information technology system, in such organisation. David, Bagozzi and Warshaw (1993) note that, user acceptance is an important determinant of the success or failure of any new information and communication technology project introduced to a system. From the foregoing, user acceptance can be described as the ability and willingness of user groups to employ technology for the tasks it is designed to perform or support

However, there are many theories relevant to a study of user acceptance of ICT. Many of these theories focus on people's intention to engage in a particular behaviour (i.e. adoption and use of ICT) as a relevant conceptual framework. Moreover, the growing rate of the use of information and communication technology, in various healthcare facilities around the globe, has led to the recognition of technology acceptance as an important issue, in the implementation of technology, in healthcare facilities (Hu et al., 1999; Sun et al., 2013).

Olasina (2014) notes that research on access and use of information and communication technologies has been informed by a number of theories. Likewise, Evans (2013) lists some of the theories that are relevant to access and use of ICT among various professionals. The following are among the accepted models he identifies:

- The UTAUT by Venkatesh et al. (2003)
- Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975)
- The Theory of Planned Behaviour (TPB) (Ajzen, 1991)
- The Technology Acceptance Model (TAM) (Davis, 1989)
- The Combined-TAM-TPB (Taylor and Todd, 1995)
- The Model of PC Utilization (MPCU) (Thompson, Higgins, and Howell., 1991)
- The Motivational Model (MM) (Davis et al., 1992)
- The Social Cognitive Theory (SCT) (Bandura, 1986)
- Innovation Diffusion Theory (IDT) (Rogers, 1995)
- IS Successful Model (DeLone and Mc Lean, 2003)
- Task-Technology Fit Model (Goodhue and Thompson, 1995)

This study will be informed by the use of the Unified Theory of Acceptance and Use of Technology (UTAUT). These two are found suitable for providing a conceptual model for this study. The Unified Theory of Acceptance and Use of Technology (UTAUT) is a user acceptance model that was introduced by Venkatesh et al. in 2003. The model is an acceptance and adoption model, stemming from the field of business and management at four universities - University of Maryland, University of Virginia, University of Minnesota and University of Arkansas. The model was built upon the conceptual and empirical similarities across eight acceptance technology models. (See Table 4.1).

Table 4.1: Compositions of the UTAUT theory

Theory	Constructs	Moderators
Theory of Reasoned Action	1, Attitude toward behaviour 2. Subjective norm	1. Experience 2. Voluntariness
Technology Acceptance Model	1. Perceived usefulness 2. Perceived ease of use 3. Subjective norm	1. Experience 2. Voluntariness
Motivation Model	1. Extrinsic motivation 2. Intrinsic motivation	Nil

Theory of Planned Behaviour	1. Attitude toward behaviour 2. Subjective norm 3. Perceived behavioural Control	1. Experience 2. Voluntariness
Combined Technology Acceptance Model and Theory of Planned Behaviour (CTAMTPB)	1. Attitude toward behaviour 2. Subjective norm 3. Perceived behavioural control 4. Perceived usefulness	Experience
Model of PC Utilisation (MPCU)	1. Job fit 2. Complexity 3. Long-term consequences 4. Affect toward use 5. Social factors 6. Facilitating condition	Experience
Innovation Diffusion Theory (IDT)	1. Relative advantage 2. Ease of use 3. Result demonstrability	Experience
Social Cognitive Theory	1. Outcome expectation performance Outcome expectation personal	Nil

Source: (Venkatesh et al., 2003; Kripanont, 2007)

From the above indication in Table 4.1 there are similarities and differences among technology acceptance theories, particularly in terms of their constructs and moderators. Their constructs range from two (TRA and MM) to six in IDT. Some of the theories such as MM and SCT did not include moderators. The UTAUT has the highest number of moderators. Experience is the very common moderator to all the theories that have moderators. UTAUT theory adopts constructs and moderators from other eight theories of user's acceptance,

The study introduces a model that examines people's intention to use technology and adoption behaviours. The model can, for instance, be very useful in examining medical doctors' adoption behaviour of clinical informatics. It is also suitable to apply to hospital environments in order to determine the degree of medical doctors' motivation to adopt a new technology

(Yoo, Han, and Huang, 2012). Examining the level of usage of the UTAUT, William, Rand, and Dwivedi (2015) claim that, the theory has been cited in over 5000 research papers.

Venkatesh, Sykes and Zhang (2011) conducted a study on how the UTAUT has been used by different scholars by employing Web of Science and Google scholar. Their findings reveal that UTAUT was cited nearly 1000 times in Web of Science and 3000 times in Google Scholar. MIS Quarterly also lists the paper as the 2nd most cited since the inception of the journal. This confirms that the theory has been widely applied in a variety of studies on technology acceptance.

According to Venkatesh et al. (2003), one of the reasons for creating a unified theory was to make it easier and simpler for researchers to select a theory without necessarily using references or contributing to other theories. The UTAUT condensed the thirty two variables found in the existing eight models into four main effects and four moderating factors (Venkatesh et al., 2003:467). The combination of the existing constructs has increased the UTAUT predictive efficiency to 70%, which is a major improvement over the previous TAM theory (Oye, Lahal and Rahim, 2012).

Prior to their use of the Unified Theory of Acceptance and Use of Technology, scholars employed Technology Acceptance Model (TAM) to examine users' behaviour. Venkatesh, Thong and Xu (2012) and Venkatesh et al. (2012) note that, the UTAUT has since been used in various organisational and non-organisational settings such as banking, health, education and e-government, and involved various participants such as medical doctors, nurses, bankers, computer programmers and corporate managers etc.

Furthermore, the theory has been used, in various countries, such as Taiwan, USA, China, Iran and Saudi Arabia. Among the works that focus on healthcare are studies by Holden and Karsh (2010), Ifinedo (2012), Cilliers, Stephen, and Flowerday (2013), Kijasanatoyin et al. (2009), Nworgu and Adio (2014) and Williams et al. (2015). All these works applied the UTAUT theory in medical research. Many other research works have been done in various health organisations globally.

The justification for using the UTAUT in technological acceptance studies, particularly in the context of clinical informatics access and use can be summarised thus:

- It has been widely used when conducting studies on organisational adoption of technology (Marchewka, Liu and Kostiwa, 2007).

- It has been observed that a level of synthesis can be achieved when the strength of some of the most widely used models in acceptance studies are combined, particularly in explaining individual behaviour (Kim, Lee, Hwang and Yoo, 2016).
- Kim et al. (2016) notes that the UTAUT could be employed with the strength of the healthcare framework to explain medical doctors' clinical informatics acceptance and use behaviour.

Given the significant role that clinical informatics has played in effective healthcare delivery, it is very necessary to examine and evaluate the use of technologies by various health workers, particularly medical doctors, to ensure that they fulfill their purposes of implementation. Applying the theory to a study on clinical informatics access and use, in developing countries' healthcare systems, for example, in teaching hospitals such as in Nigeria and South Africa, will surely expand the understanding of the model's robustness in research.

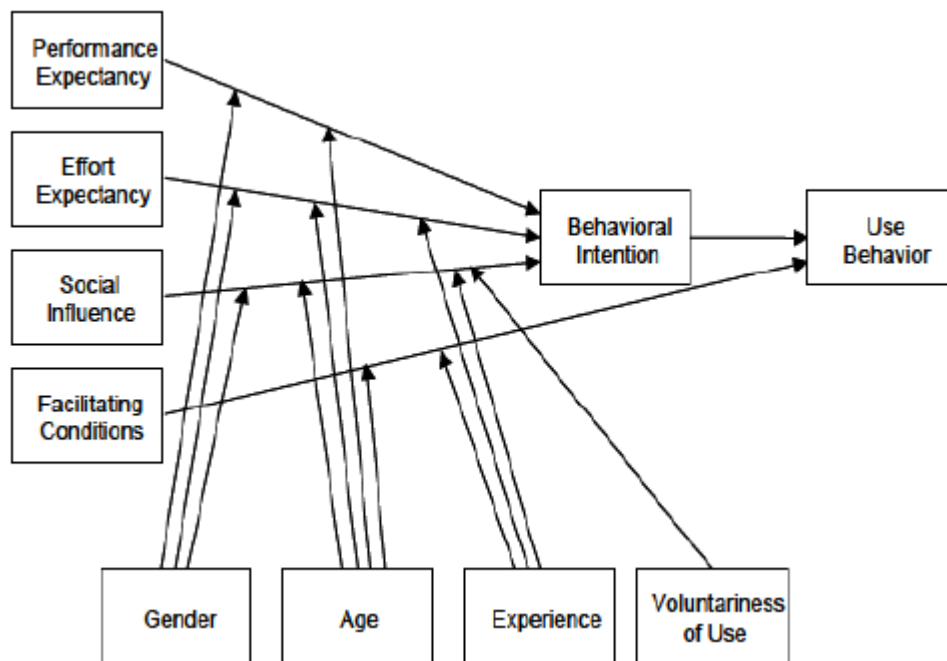


Figure 4.1: UTAUT diagram Venkatesh et al., (2003)

4.4 Factors that influence the use of clinical informatics by medical doctors

The UTAUT theory identifies four key constructs that directly determine user acceptance and usage of technology. These are Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC), and four control variables, namely gender, age, experience, and voluntariness of use (Liu, 2013).

4.4.1 Performance expectancy

Performance expectancy is about the perceived benefits a user believes will be gained from using the technology in his or her job, either to improve productivity or the quality of services (Cohen, Bancillion and Jones, 2013:45). Venkatesh et al. (2003) describe performance expectancy as the degree to which an individual believes that using ICT would assist him or her with achieving better results.

Performance expectancy is basically about the benefits that the user will enjoy, with the new technology compared to the old system, in relation to job performance. The authors reveal that performance expectancy is the strongest determinant of behavioural intention. It is well recognised in user acceptance studies that users' intentions to use a new technology are determined primarily by the perception that such a technology would be advantageous and increase job performance (Davis, 1989). Tamblyn et al. (2006) posit that, clinical informatics has the potential to improve medical doctors' productivity, job performance, and also to improve the quality of the diagnosis and treatment of patients.

The effect of performance expectancy can be seen as the most salient factor, in medical doctors' acceptance of clinical informatics. Mourad (2012) opines that 'job fitness' or 'job relevance' has an effect on medical doctors' use of clinical informatics. Putzer and Park (2010) discovered that job relevance is a factor that is significantly associated with the use of clinical informatics among medical doctors in community hospitals in the USA. Medical doctors will appreciate how clinical informatics can meet their job requirements and improve efficiency and effectiveness at work. Putzer and Park (2010) employ the term 'job fit' from Rogers's DOI theory. Whittaker et al. (2011) note that, clinical informatics is a decision making support tool for medical doctors. The ability of a tool to provide evidence based clinical investigation to medical doctors is perceived as an essential factor that may encourage use (Alsos et al., 2012).

The introduction of clinical informatics to healthcare services and its continued usage will depend on the level of service that the tools will provide (Nuq and Aubert, 2013). Medical doctors will use clinical informatics, if the tools can provide accurate diagnoses and are simple to use, improve the treatment of patients, and enable doctors to save lives (Olasina and Poopola, 2014). Koppel (2009) note various ways in which medical doctors can benefit from using clinical informatics. These include the provision of adequate information, such as Electronic Health Record, Computerised Physician Order Entry, Computerised Decision Support System and Diagnosis Imagery.

Clinical informatics is assumed to be an essential mechanism in resolving major healthcare issues because it has the ability to improve the efficiency and effectiveness of healthcare. MacDonald (2008) observes that, the use of clinical informatics is expected to reduce healthcare costs and at the same time, promote productivity amongst medical doctors. A study by Pynoo et al. (2012) revealed that medical doctors, in Belgium, are likely to accept clinical informatics if they discovered that clinical informatics would enhance their job performance. Anja, Heiko and Ulrich (2014) identify the free flow of information in hospitals as major reason medical doctors, in Germany, accepted clinical informatics. This shows how Performance Expectancy encourages the use of ICT in the health sector.

4.4.2 Effort expectancy

Effort expectancy is “the degree of ease associated with the use of a system” (Venkatesh et al., 2003). Effort expectancy can be described as the degree of ease of access and use of technology (Venkatesh et al., 2003). There are three constructs that capture the concept of effort expectancy. These are perceived ease of use (TAM/TAM2), complexity (MPCU) and ease of use (IDT) (Venkatesh et al., 2003:450). Effort expectancy shares a lot of similarities with the TAM’s perceived ease of use.

Zhang et al. (2010) found out that the Perceived Ease of Use (PEOU) of the TAM theory, which is related to effort expectancy, had a significant effect on the adoption of clinical informatics by doctors. Almulhey (2015), likewise, noted that medical doctors’ impression of clinical informatics is one of the factors that determine its use. They further argue that, attitude and ease of use of clinical informatics would also determine its use. Schaper and Pervan (2008) maintain that effort expectancy is a key factor in behavioural adoption among medical doctors in Australia. However, it was found to have no effect on behavioural intention among medical doctors in Hong Kong (Chau and Hu, 2002).

Nuq and Aubert (2013) theorise that, in underdeveloped countries, such as Nigeria and South Africa, effort expectancy among medical doctors could be a factor that could influence behavioural intention to use clinical informatics. They argue that effort expectancy is a very important factor in measuring clinical informatics acceptance, among medical doctors in developing countries. Kifle (2008) notes that experience and ease of use are very important, in measuring the use of clinical informatics by medical doctors in developing countries.

Effort expectancy has been proven to be a key behavioural adoption factor (Shaper and Pervan, 2007). Roese et al. (2005), for example, note that system speed is one of the determinants of clinical informatics use by medical doctors. Other factors that motivate medical doctors to adopt the use of clinical informatics are neatness, durability, and ease of use. In a survey of medical doctors carried out in five countries (Malaysia, Pakistan, Uganda, Bhutan and Mexico), Nuq and Aubert (2013) observe that, clinical informatics would be used effectively by medical doctors if there were more training and more information available, particularly documented success stories from different parts of the world that prove its usefulness. They further state that, there is a need for adequate support from health managers and governments to create awareness about the importance of clinical informatics in medical practice.

Venkatesh et al. (2003) state that effort expectancy is moderated by gender, age and experience and it has an influence on behavioural intention. It can be inferred from this assertion that, age has an effect on users' ability to operate new technology, and users with adequate experience of technology will operate it effectively. Venkatesh et al. (2003) also examined various studies (Bem and Allen, 1974; Bozionelos, 1996; Ventatesh and Morris, 2000), and their results revealed that effort expectancy is more prominent among females than males.

A study by Aggehdhis and Chatzoglou (2009) revealed that, effort expectancy was a significant determinant of users' intention to use technology among medical doctors in Greek hospitals. Cilliers and Luiz (2013) conducted a study on the use of telemedicine among health workers, where the majority of the respondents admitted that the system was user-friendly. Seventy-one percent (71%) claimed that they could use the technology with ease, and 69% admitted that the system was very easy to learn. These results may be due to previously gained computer knowledge and the training that the staff had undergone.

4.4.3 Social Influence

Social influence can be described as the extent to which an individual places importance on others' belief that he or she should use (or not use) a new technology (Venkatesh and Davis, 2000). Venkatesh et al. (2003) describe social influence as the extent to which an individual allows the opinions of others to influence his/her decision to use a system. This construct is related to TRA, TAM, TPB and C-TAM-TPM, and it can also be traced to MPCU and DOI as social factors.

Studies have shown that, an individual's intention to use a new technology can be influenced by the views, opinions and perceptions of the people around him or her, particularly in his/ her immediate environment (Venkatesh and Davis, 2000). According to Venkatesh et al. (2003), "individuals are more likely to comply with others expectations when those referent others have the ability to reward or punish non-behaviour". Chau and Hu (2013) conducted a study on medical doctors' decision-making processes regarding the use of clinical informatics in Hong Kong. The research was conducted in a hospital environment, and they discovered that social influence may differ from one country to another.

Olasina (2014), Venkatesh et al. (2003) and Evans (2013) observe that, age, gender, experience and voluntariness are some of the factors that moderate the influence of social influence and behavioural intention, which they maintain is stronger among women than men. Gronland (2010) likewise notes that, women are more prone to social influence than men, and that social influence is more noticeable among older people but always decreases with experience.

Vogd (2004) examines the hierarchical structure among medical doctors in German hospitals and the influence of supervisors on the use of clinical informatics. The study agrees that, social influence has a significant impact on behaviour. The disagreement between the doctors and their supervisors on whether a technology should be adopted may explain the young doctors' reluctance to use clinical informatics. Kim and Kankanhalli (2009) confirm that professional colleagues' opinions are a salient social influence, in the use of clinical informatics, in hospital environments.

Social influence among medical doctors is not tied to their professional colleagues' perceptions alone, but also to how their patients in hospitals perceive their usage of clinical informatics (Mourad, 2012). Anja and Heiko (2014) and Kim and Kankanhalli (2009) claim the negative attitude of senior medical doctors, toward the use of clinical informatics, may affect the attitude of young medical doctors, towards the use of the tools. This implies that if

senior medical doctors do not use clinical informatics, they may negatively influence others' decisions to use them.

4.4.4 Facilitating conditions

A facilitating condition is an individual's belief regarding the existence of adequate technical infrastructure as well as management policies and other internal support mechanisms that will encourage the use of the technology (Venkatesh et al., 2003). Facilitating conditions refer to the degree to which users believe that organisational and technical infrastructure will support the use of Information and Communication Technology (Venkatesh et al., 2003). Facilitating conditions are related to the TAM's perceived ease of use, combined facilitating conditions (MPCU), and compatibility (DOI). Unlike constructs, such as social influence, facilitating conditions and effort expectancy are not found to influence users' intentions significantly (Nwargu and Adio, 2013). Nuq and Aubert (2013) found out that there is a significant relationship between organisational and facilitating conditions and the actual degree of usage.

Scholars such as Nuq and Aubert (2013), Olasina and Popoola (2013) and Pynoo (2012) agree that there are three mediating factors that are enablers of clinical informatics use among medical doctors, namely organisational support, adequate clinical informatics infrastructure, and technical support. Organisational support and readiness for change are very important determinants of medical doctors' use of clinical informatics, in a hospital environment (Pare et al., 2011).

Abubakar and Ahamed (2013) observe that facilitating conditions are related to compatibility, which is the degree to which a technology is perceived as being in consonance with the existing norms, practices, needs, interests and experiences of the user. In addition, Wu et al., (2005) claim that medical doctors' compatibility assessments have an impact on their intention to use clinical informatics. Venkatesh et al. (2003) postulate that the influence of facilitating conditions on usage can be moderated by age and experience such that the effect will be stronger for older workers, particularly with increased experience. The point enunciated here by the authors is that, age and experience are moderating factors that influence facilitating conditions. In other words, users that acquire enough experience on the job will be able to use the ICT well enough and they would have gained enough skills to enable them to use the ICT very well.

Holden and Karsh (2010) note that facilitating conditions are very important in the acceptance of technology in healthcare. They observe that the availability of resources, which include technical knowledge and adequate knowledge of computers, are some of the facilitating

conditions that promote the use of clinical informatics. Kijasanatoyin et al., (2009) likewise note that, facilitating conditions are very important in medical doctors' acceptance of clinical informatics because they are a factor that significantly explains technology use.

Cillers, Stephen and Flowerday (2013) highlight the various resources that promote facilitating conditions in hospitals to include technical services, knowledge of the system, and compatibility with other systems already in place. Extant literature has affirmed that when medical doctors have the right attitude toward ICT, their intention to use the technology in their hospitals tends to be positive (Melas et al., 2011).

4.5 Implications and applications of the theory

The UTAUT has been accepted as a model for measuring users' acceptance of technology because the model has been tested, applied, and it explains user behaviour (Taiwo and Downe, 2013). Users' acceptance of technology is about how people accept and adopt technology. The major purpose of technology acceptance studies is to motivate technology users and to determine challenges facing the acceptance and use of technologies (Louho et al., 2006).

Table 4. 1: Studies on factors that influence behavioural intention to use clinical informatics

Authors	Studies	Result of the findings
Maillet, Mathieu and Sicotte. (2015)	Modelling factors explaining the acceptance, actual usage, and satisfaction of nurses using EMR in an acute care setting: An extension of the UTAUT	The result indicates the importance of effort expectancy and performance expectancy. Modelling factors explain the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT.
Sharifian and Aakarian. (2014)	Factors influencing nurses' acceptance of hospitals information system in Iran: Application of UTAUT	The results indicate that nurses' acceptance of hospital information was influenced by the four constructs. Performance expectancy had the strongest influence on users' intention.
Griebel, Sedlmayer, Prokosh, Criegee, Pieck and Sedminary (2013)	Key factors for the successful implementation of personalised e-health services	Performance expectancy, effort expectancy, social influence, facilitating conditions, anxiety, trust and attitude are identified as some of the factors that

	.	influence the use of e-health.
Helsmans, Aertgeerts, Donceel , Geens , Van der and Ramaekers (2012)	Family physicians' perceptions and use of Electronic Clinical Decision Support during the first year of implementation	Perceived usefulness and facilitating conditions are two factors that promote the use of the Electronic Decision Support System.
Nuq and Aubert (2013)	Toward a better understanding of the intention to use e-health services by medical professionals: the case of developing countries	Performance expectancy, social influence, moderators, policy, medical training and medical knowledge contribute to the intention to use clinical informatics services.
Schaper and Perrance (2007)	IT acceptance and utilisation by occupational therapists	Effort expectancy influences the intention to use.
Duyck, Pynoo, Devolder, Voet, Adang , Ovaere and Vercrusa (2008)	Monitoring the PACS Implementation Process in Large University Hospital- Discrepancies between radiologists and physicians	Facilitating conditions and performance expectancy influence medical doctors' intention to use.
Willis, El-Garying and Bennerth. (2008)	Examining healthcare professionals' acceptance of electronic medical records using UTAUT	Social influence is the main factor promoting the usage of the resources.
Kijsanayotin Pannarunothai and Speedie (2009)	Employed UTAUT to examine factors influencing ICT acceptance and use	The study discovered that performance expectancy and social influence are the major factors promoting intention to use ICT by medical doctors.
Bogdanos, Lagours and Ekonos (2008)	Health Information System in Greek Hospitals; System and Human Integration	Social influence and facilitating conditions were discovered to have an influence on behavioural intention to use the system
Steel, Secombe and	Acceptance and perception of WSN-based monitoring	Social influence is the major factor

Wong (2009)	system	influencing the intention to use WSN.
Holtz and Krein (2011)	Understanding Nurse Perceptions of a Newly Implemented Electronic Medical Record System	Performance expectancy was the main factor that influenced the intention to use EMR by nurses.
Jeng and Tzeng (2012)	Examined factors predicting medical professionals' behaviour and intention to use CDSS	Performance expectancy influenced the intention to use the CDSS.

The analysis of Table 4.2 indicates that UTAUT is a well-established theoretical framework in studies that resemble the current study

Table 4. 2: Researchers that have applied the UTAUT to inform their studies in South Africa and Nigeria between 2010 and 2015

Researchers that employed UTAUT in their studies in Nigeria and South Africa(2010-2015)	Titles
Olasina and Mutula (2015)	The influence of national culture on performance expectancy on e-parliament adoption
Erumi-Esin and Heek (2015)	E-business adoption and use among Africa women-owned SMEs: An analytical study in Nigeria
Olasina (2014)	E-parliament services as tools for anti-corruption and transparency
Echeng , Usoro and Majewski (2013)	Factors influencing the acceptance of web 2.0 technologies in learning environment of Nigeria: A conceptual framework
Olatubosun and Rao (2012)	Empirical study of the readiness public servants on e-government
Motsi and Kaema (2015)	Knowledge sharing framework for educators in Southern Africa. Case study of secondary schools in Tshwane South district
Maduku (2015)	Factors e-book use intentions perspective of students in a developing country
Folim and Van Belle (2015)	Using mobile phones for public participation with local government in Cape Town
Bere (2014)	Exploring determinant for mobile learning, user

	acceptance and use: an application of UTAUT
Cupido and Van Bell (2012)	Increased public participation in local government through the use of mobile phones. What do young South Africans think?

Sources: Scopus database, 2010-2015

The SCOPUS database was used to analyse the number of articles that employed UTAUT to inform their research between 2005 and 2015. The justification for using SCOPUS was based on the assertion of Chadegani, Salehi and Yumus (2013) that SCOPUS is the largest abstract and citation database of peer reviewed literature. The results are presented in Table 4.3.

Table 4. 3: Analysis of UTAUT based on publication types, countries and subject areas

Types of publications (2005-2015)	Number of Publications	Country	Number of publications per country 2005-2015	Subject areas that employed UTAUT (2005-2015)	Number of publications from the subjects
Articles	299	USA	128	Computer Science	378
Conference paper	276	Malaysia	70	Social Sciences	189
Conference Review	09	Taiwan	61	Business Management	119
Book Chapter	08	China	56	Engineering	94
Review	07	UK	52	Decision Sciences	70
		South African	03		
		Nigeria	06		

Sources: Scopus database, 2005-2015

The findings from the database reveal that, between 2005 and 2015, 607 publications employed the UTAUT in their studies in which 7 documents were from Nigeria and 6 documents were from South Africa. Evidence from SCOPUS reveal that, by September 2015,

57 documents had employed the UTAUT in their various studies, while in 2014, 101 used the UTAUT in their studies; in 2013, 103 documents used the UTAUT; and in 2012 and 2011, 87 and 81 studies respectively used the UTAUT. Nevertheless, the analysis also indicates that UTAUT has not been applied in the context of clinical informatics among doctors in Nigeria and South Africa.

4.6 Criticisms of the theory

Despite the relevance of this model to user acceptance studies, a number of limitations exist. The model combines other models and each of the models utilises several terminologies within their phraseology of acceptance. Many of these models are often similar in nature and this is affecting the viability of UTAUT (Waehama, McGrath, Korthars and Fong, 2014). The model also has limitation concerning its relationship between the intention and use behaviour. Another limitation of the theory is that behavioural intention is a reflection of an individual's internal schema of beliefs (Venkatesh et al., 2003) and it does not represent the external factors that can affect the performance of behavior. Thus, the role of external variables that can facilitate the performance of behaviour is not adequately captured by behavioural intention.

In addition, the behavioural intention has a very weak explanatory ability concerning unforeseen events between the time the intention is formed and the behaviour is performed (Moghavvemi, Salleh and Abesi, 2013). The limitations of the theory include its inflexibility and difficulty to adapt to different contexts and situations. For example, in a study on ICT acceptance in Saudi Arabia, Gahtani, Hubona and Way (2007) discovered that the cultural differences of the country presented a significant obstacle to the use of the UTAUT theory to examine workers' adoption of ICT. Saudi Arabian workers have different work related values compared to workers in western countries.

Bagozzi (2007) observes that the UTAUT is another expansion of the Technology Acceptance Model (TAM), and that despite the fact that all the variables that influence intention and usage are in the UTAUT, the theory may not be considered acceptable because these variables are in piecemeal parts in technology acceptance. In the same vein, Gronland (2010) argues that, the UTAUT is an attempt to patch the Technology Acceptance model, with no integration and co-ordination with the model.

4.7 Summary

The chapter reveals that, while many studies focus on ICT design and implementation in healthcare facilities, very few studies focus on how medical doctors react to already implemented clinical informatics facilities, particularly from the viewpoint of end users (medical doctors), to show the fit between clinical informatics and the healthcare system. The study addresses this by examining factors that would promote the use of clinical informatics among medical doctors in the two countries.

The chapter contributes to the discussion and debate on the UTAUT. Moreover, this study contributes to efforts to identify factors that influence clinical informatics usage among medical doctors. Findings of , this study will benefit the University College Hospital, Ibadan, Nigeria, and King Edward VIII Hospital, Durban, South Africa, if well applied.

The next chapter explains the research methodology of this study.

CHAPTER 5: RESEARCH METHODOLOGY

5.1 Introduction

This chapter explains the methodology of the research. To achieve this, the chapter is organised into the following sections: Introduction, Research Designs, Population of the Study, Sample and Sampling Techniques, Instruments, Procedure for Data Collection and Data Analysis Method.

Research is important to every profession. It is frequently referred to as the cornerstone of the development of a profession (Brink, van der Wailt, and van Renburg, 2013). Every professional needs knowledge on which to base his practice. Scientific knowledge provides a particularly solid foundation (Brink et al, 2013). It is an integral part of healthcare practice, education, business and management.

Research has been defined by various scholars. Yunus and Tambi (2014) define it as a systematic process of collecting and analysing information to increase the understanding of a phenomenon under study. Weman, Kauger and Michell (2012) define research as a process that involves obtaining scientific knowledge by means of various objective methods and procedures. Burns and Grove (2009) opine that, research is a diligent systematic enquiry to validate and refine existing knowledge and generate new knowledge. Contributing to this, Creswell (2009) claims that research method involves the techniques of data collection, analysis and interpretation that a researcher proposes for his/her study.

Based on the foregoing definitions, research can be described as systematic inquiries or investigation in order to establish facts and bring out a new finding. With regard to these definitions, the following can be inferred as some of the characteristics of research:

1. The results of a research are to bring about increase in knowledge (Burns and Grove, 2009).
2. Research begins with a question or a problem (Leedy and Ormond, 2010).
3. Searching, discovery or enquiries are some of the methods by which knowledge is obtained (Leedy and Ormond, 2010).
4. In research, the search is always systematic and diligent, which implies the need for planning, organisation and persistence (Burns and Grove, 2009; Leddy and Ormond 2010).

5. Research is a process (Brink et al, 2013).
6. Research is a scientific process (Brink et al, 2013).

It can be summarised that the main objective of a research is to find out new knowledge.

5.2 Philosophical paradigm

Philosophical ideas remain largely hidden in research and the term has been given various meaning by different scholars (Creswell, 2014). Guba (1990) describes philosophical worldviews as a set of beliefs that guide action. Lincoln et al (2011) and Mertens (2010) refer to worldview as paradigms. Creswell (2014) describes philosophical worldviews as a general orientation about the world which examines the nature of research that a researcher is investigating. Creswell goes further to say that a researcher can use any of the term to inform his/her study because research paradigm directs the method in which research will follow.

Creswell (2014) explains that in picking any of these concepts, the researcher needs to consider the following; nature of the research, discipline orientations, students and supervisors inclinations and past research experience. Moody (1990) suggests that the term paradigm is commonly used in health related research because it assists a researcher to organise his/her thinking. Based on Moddys' assertion, the research would adopt the concept philosophical paradigm.

The concept paradigm originated from the Greek word 'paradeigma' which simply denote pattern. Paradigm was first used by Thomas Kuhn in 1962. Kuhn (1977) defines paradigm as "an integrated cluster of substantive concepts, variables and problems attached with corresponding methodological approaches and tools..." He explains further that, paradigm is a research culture that lay emphasis on beliefs, values and assumptions, which a community of researchers has in common, regarding the nature and conduct of research. Polit and Beck (2008) defines paradigm as a way of examining a natural phenomenon that encompasses a set of philosophical assumptions that guide one's approach to an enquiry.

On the other hand, a research paradigm is a set of philosophical assumptions about fundamental aspects that give rise to a particular worldview (Maree, 2011; 2009). Moody (1990) states that, research paradigm assists researcher to think logically, presents ways of observing and assists in the manner of interpreting. Likewise, Creswell (2003) views research paradigm as knowledge claims that a researcher will employ to commence a study. Neuman (2014) notes that a research paradigm is a model shared assumptions, or an entire system of thinking about some aspect of the world.

Grix (2010) highlights the following as the benefits of research paradigms, in academic research:

1. It assists the researcher to see how close many of the perspectives in different academic disciplines are.
2. It provide adequate familiarity with language, terms, potential and various core texts, associated with the main perspectives, that a researcher may likely face.

From the foregoing, it can be said that research paradigm is a pointer and directory that guides a study and also assists the researcher to focus, particularly on the research methodology, topic and assumptions to employ. According to Weaver and Olson (2006) and Michel (2008), the research paradigm that is frequently employed in health related research is positivist; post positivist, interpretive and critical social theory. From this, it can be said that, paradigm is a belief that guide how empirical knowledge is created

There are various schools of thought on the categories of research paradigms, in academic research. Scotland (2012) notes that, every paradigm has its own ontological and assumptions, as well as methodological approaches. Creswell (2009) and Neuman (2014) opine that philosophical paradigm is part of methodology in academic research.

Grix (2004) observes that, philosophical paradigm is an approach to academic research. Researchers' contradictory ontological, philosophical and epistemological positions often lead to different research approaches, toward phenomenon. Inuah and Eston (2013) note that, philosophical paradigm is an approach that examines research problem and employs various approaches available to investigate and understand the problem rather than focusing on the method.

Laudan (1995) and Creswell (2014) categorise research paradigm into three. These are Ontology, which is a patterned set of assumptions about reality; Epistemology, which is the knowledge of that reality; and Methodology which is the particular ways of knowing about that reality. It can be deduced from the foregoing that research has three processes which are ontology, epistemology and methodology. He goes further to say that a research paradigm is a combination of interrelated practices and thinking that define the nature of these three research processes. Maree (2011) lists the three categories of research paradigms to include positivism, critical theory and interpretive paradigm. On the other hand, Creswell (2014) categories research paradigms into four which are constructivism, post positivism, transformative and pragmatism.

The interpretive approach to social science research emphasises the importance of the insider's viewpoint to understand social reality (Brink, 2014). Gephart (1999) argues that, the interpretive approach has the tenet that knowledge and meaning are based on interpretations which does not involve any objective knowledge and is independent of thinking and human reasoning. This implies that, the interpretive approach provides meaning to event, through the meaning that people give to them.

Interpretive paradigm examines and put research analysis in context. Not only that, it lays more emphasis on understanding the world, from subjective experiences of individuals and they employ meaning, interviewing or participant observation in getting information. As a result, interpretive research does not consider dependent and independent variables but focuses on the detail complexity (Reeves and Hedberg, 2003).

Cohen (2008) lists various characteristics of interpretive approach, to include accommodating naturalistic methods, which include interviewing, observation and analysis of existing text. Brink et al. (2013) describe positivism paradigm as the observable facts which are fashioned toward quantitative research. In the same view, Maree (2014) opines that positivism is related and associated with quantitative research, which focuses on empirical studies and establishes facts on evidence that is valid and reliable in terms of existence of phenomena rather than generalisation. Grix (2010) lists the premises on which positivism research is based. These are:

1. Realism which believes that the world exists independently of our knowledge of it;
2. Employment of scientific methods to analyse the social world;
3. Giving explanation in social research as opposed to understanding through the conduct of scientific investigation;
4. Allowing observation, verification and empirical practice; and
5. Promoting objectivity in research.

All these imply that, positivism approaches, in conducting research, encourage precision and empirical method, in the gathering of data in social science research, since positivism is a way of conducting research with more emphasis on observable facts. Neuman (2014) notes that, positivism is the research method that combines deductive logic with precise empirical observations of individuals, particularly for discovering and confirming probabilistic causal laws, which is very useful to predict general patterns of human activity. It can be said that,

positivism approaches to research places emphasis on empirical theory in the creation of knowledge.

The advantage of positivism, in the field of social science research, is that it values precision, exactitude and power of prediction, which is relevant to social sciences research which can be done through observation and the measurement of objective reality (Creswell, 2009). Maree (2014) states that, it produces precise, verifiable, systematic and theoretical answers to research questions. He goes further to say that, employing scientific method provides accurate and unbiased answers in research conduct, which does not depend on the perception of the researcher.

According to Weaver and Olson (2006), the paradigms most commonly utilised, in health related research, are positivist, post positivist, interpretive, and critical social theory. Guba (1981) suggests that, researchers should select the paradigm that is suitable to phenomenon under investigation. This entails that, the philosophical paradigm will give the research greater opportunity to address issues and ask questions such as why and how clinical informatics is being used among medical doctors.

However, the study employs the post positivists' paradigm which Maree (2014) describes as a research tradition, which occupies the space between positivism and constructivism. Seale (1999) notes that, post positivism is a research paradigm useful for scholars that have interest in some aspects of positivism, such as quantification and at the same time incorporate interpretive concerns around subjectivity. Brink et al. (2013) identify the characteristics of post positivist research. They claim that, academic research is wide rather than specialised and that, theory and practice cannot be separated in research because a lot of things make up research. This implies that, post positivism is a pragmatic combination of qualitative and quantitative methods. Schratz and Walker (1995) also opine that, the researcher's motivation for and commitments to studies are very important to the project and that there is a need to employ various methods and techniques for collecting information for a research. Based on the submission of Brink et al. (2013), this study would employed post positivism.

In addition, the researcher considered the complex nature of the research study, and there was no single research paradigm, that could successfully deal with all of the required methodological aspects. As a result, the researcher found out that, it is necessary to combine positivist with interpretive paradigm. The blending of the two research approaches provided the study with the capacity to statistically analyse the empirical data and provide adequate explanations on access, benefits and factors influence use of clinical informatics. The

discussion that comes after this gives an impetus on how the paradigm and methodological approaches were used in this study.

Table 5. 1: Research paradigm

Characteristics	Positivist approach	Interpretive approach
Purposes	Questionnaire would be administered	It allows for interviews and observations as sources of data collections.
Beliefs	<ul style="list-style-type: none"> • One truth exists • Must be objective 	<ul style="list-style-type: none"> • Many truths and realities • Different people have different perceptions , needs and experiences
Research Methods	Quantitative	Qualitative
What study data is based upon	Measurable outcomes from questionnaire data	Descriptive and explanatory and content analysis
Study sample	Clear and precise inclusion and exclusion data	Representatives who are able to provide expertise from different points

(Source: Michel, 2008)

5.3 Research method/Research approach

The research approach is a way, in which research strategy of enquiry moves from the underlying assumptions to research design and data collection (Myers, 2009). Maree (2011) explains that, research approach is one of the elements in the research framework that involves data collection, data analysis and interpretation, which researchers propose for their studies.

Appropriate research approaches are required to conceptualise research problems and describe the phenomena that are being investigated. Supporting this, Johnson and Christensen (2014) claim that, selecting appropriate research approach for a study is a very important issue because it is the pillar on which the dissertation stands. He goes further to say that, the nature of the study will determine the approach to be used in order to underpin the study. The purpose of research approach is basically to reveal how the investigation would be done and how research problems would be solved.

Welma et al., (2012), Brink et al., (2013) and Neurman (2014) highlight various types of research approaches to include quantitative, qualitative and the mixed methods. The choice of a research approach, in academic research, depends on the research problem, data-collection procedure, the research problems, data analysis plans, the paradigm chosen and the research design to be employed (Creswell, 2009). The quantitative approach uses techniques that apply more numerical data. Quantitative approach includes ways in which the research identifies general patterns and relationships among variables, testing hypotheses and theories in order to make predictions based on the results (Ragin, 1994). Creswell (2014) notes that, quantitative approach is basically for testing objective theories by examining the relationship among variables. He goes further to say that, the variables can be analysed through the use of various statistical tools.

Grix (2010) states the various common methods associated with quantitative research. These are social surveys, official statistics and structured observation. Copper and Schinder (2008) argue that, quantitative research approach attempts precise measurement of something and it concerns more on questions such as how much, how often, how many, who and when. Grix (2010) observes that, quantitative approach are interested in comparison and causality between independent variables which cause variance or change in the dependent variable and they generally use a large number of cases. Creswell (2014) notes that quantitative approach is very useful for testing objectives theories by examining the relationship among variables.

Qualitative approach is seen by many as the opposite of quantitative research. It is usually a depth investigation of knowledge in various ways such as observation and interview (Ragin, 1994). Qualitative approach is an approach for exploring ways an individual or groups ascribe human problems (Creswell, 2014). In addition, qualitative approach aims at examining the many nuances and complexities of a particular phenomenon (Brink et al, 2014).

There are various methods associated with qualitative approach which include interview and observation. This approach is tailored towards the certain research designs, such as case study, ethnography, grounded theory and action research (Copper and Schinder, 2008). There are many ways of collecting data in qualitative approach. Some of these include focus group, observation, interview and documentary study. The commonly used data analysis techniques are content analysis and observations (Copper and Schinder, 2008). In this approach data is commonly collected from various sources such as people, government documents, organisation, texts, objects, and events (Copper and Schindler, 2008).

Creswell (2014) describes mixed method approach as an approach that combined both quantitative and qualitative data and integrated the two forms of data. Punch (2009) argues that, mixed method is an empirical research approach that combine both qualitative data and quantitative data. Johnson and Onwuegbuzie (2004) note that, the logic of mixed method is in inductive and deductive. Cameron (2011) lists various fields that always use mixed method to include social sciences, education and political science.

Qualitative and quantitative basically refer to two natures of knowledge which relate to accurate understanding of the world and the importance of the research (Grix, 2012). This indicates that, qualitative and quantitative methods refer to ways in which data are collected and analysed for research purposes, and the type of generalisations that occur from the data. Burns and Grove (2011), Polit and Beck (2008) and Brink et al. (2014:10) distinguish between quantitative and qualitative approaches. They claim that the quantitative approach has its roots in logical positivism and focuses on measurable aspects of human behaviour while the qualitative approach has its roots in symbolic phenomenology and concentrates on qualitative aspects such as meaning, experience and understanding.

Another difference between the quantitative and qualitative approaches is in the nature of the data for research. Qualitative research employs soft data which are in the form of impressions, words and symbols while quantitative research employs the use of hard data which are in the form of numbers (Nueman, 2015). The research findings in a qualitative research cannot be generalised to wider population within the same degree of certainty that quantitative analyses can (Polit and Beck, 2008).

Streubert and Carpenter (2005) list various features of qualitative research which include belief in multiple realities and the involvement of participants in the study and in the research processes. Analyses of data are being done in a literary style which involves participant commentaries. Nieuwenhuis (2014) describes qualitative research as a research methodology that understands social and cultural environment, which underlie various behavioural patterns and is basically concerned with the reason for action. This implies that qualitative research is more people-oriented, because, it interacts with people and observes them in their natural environment. Qualitative research is more concerned with the use of raw data, because it employs the inductive approach which emphasises the development of insights and generalisation (Neuman, 2014).

On the other hand, Neuman (2014) claims that quantitative research design is primarily used to collect data in numerical forms. Weingand (1993) and Kiplanga'at (2004) observe that,

quantitative research is very useful for large volumes of data, in which sampling can be generalised in order to represent the total target population. These opinions were supported by Neuman (2014), who affirms that quantitative research is more focused on measurement and sampling procedure because it is deductive in nature and lays more emphasis on adequate planning, prior to the commencement of data collection. Neuman (2014) explains the relationship between qualitative and quantitative approaches. He explicates that, the two approaches are used to gather data, but the difference can be noticed in terms of data gathering methods, employment of logic, different research paradigm, methods of analysing data and ways of presenting the research findings.

Table 5. 2: Characteristics of quantitative and qualitative research

QUANTITATIVE	QUALITATIVE
Focuses on a relatively small number of concepts.	This Attempts to grasp and understand the phenomenon in its entirety rather than focusing on specific concepts
Begins with preconceived ideas about the concepts are interrelated	Has few preconceived ideas and stresses the importance of people interpretation
Employs structured procedures and formal instruments to collect information	Collects information without formal structured instruments
Data are usually collected under controlled conditions.	Context of the research not controlled but rather captured in its entirety
Emphasises objectivity in collection and analysis of information	Assumes that subjectivity is essential for the understanding of human experience
Uses numeric information through statistical procedures	Employing narrative information in an organised manner
Incorporates logistic deductive reasoning	Inductive and dialectic reasoning are predominant

(Sources: Brink et al., 2014; Burns and Grove 2011; Polit and Beck 2008)

The justification for the use of qualitative and quantitative methodologies in this study is based on their various benefits (Pickard, 2007; Edmonds and Kenndy, 2010; and Brinks et al, 2013). The authors assert that both quantitative and qualitative methods are very useful because they complement each other. They further note that qualitative method provides insightful and in-depth clarification while quantitative method provides numerical data needed to test required objectives in research.

However, this study employed qualitative and quantitative methods to investigate and provide a comprehensive analysis in order to achieve the research objectives. Both quantitative and qualitative methods in this research would allow for adequate exploratory description and at the same time full explanation of each of the research questions which would provide accurate research finding (Maree, 2014). In addition, the study would employ the combination of both

qualitative and quantitative methods in order to gather numerical data and interpretive information which would be analysed together to bring out credible results from the study.

In the same vein, Poligar and Thomas (2000) claim that adopting both qualitative and quantitative methodologies in health related research assist in preventing biases because each method can be used to check the other. This implies that the subjectivity that is associated with qualitative research is reduced by the objectivity of quantitative research. Similarly, the researcher believes that these two methodologies are relevant to the study because access and use of clinical informatics require an in depth understanding through the exploration of data as well as the need for the quantification of information. Consequently, the mixed method will aid the understanding of the factors that influence the use and access to clinical informatics among medical doctors, in the teaching hospitals, in Nigeria and South Africa.

Furthermore, various scholars (Domegan and Fleming, 2007; Henning, Van Renburg and Smith, 2004; and Brink et al, 2014) argue that, the major way of researching into human learning is by employing qualitative and quantitative methods. This study is about human learning and effective use of emerging technology (clinical Informatics), particularly in examining the factors that promote their access and use. Qualitative research method is generally concerned with processes while quantitative research is about outcomes.

Another justification for using the both quantitative and qualitative methods in study is to support the submission of Brink et al. (2013) that using the two methods in health research allows for confirmation and supporting the data collections from the two approaches. Likewise, Kiplang'at (2004) affirms that the two methods are interconnected, particular at the level of data collection, study design and data analysis.

Based on the foregoing, both the qualitative and quantitative approaches would be used in this study for data collection because they will complement each other. This would enable the researcher to gather useful and relevant information from the respondents and give the opportunity to solicit for data from two different directions, allowing the research to be investigating from different viewpoints. King, Keohane and Verba in Kiplant (2004) note that, good research often combines both the qualitative and quantitative approaches in order to be more informative.

This implies that the study would combine both methods to gather numerical data and interpretive information which would be very useful to examine and analyse the results of the research in order to obtain authentic results.

5.4 Research design

The research design can be described as the overall scheme of plan for the study which includes all ideas, research concepts, variables and their relationships and the appropriate ways of collecting and analysing data (Mugenda, 2008: Bryman, 2004; and Wakari, 2012). Kumar (2011) describes research design as a procedural plan and arrangement employed by the researcher to provide answers to research questions and research objectives. Research design is the detail outline and planning procedure indicating the order of how an investigation will take place. This includes the types of instrument to be employed, how the data is to be collected and ways of analysing the research data (Brink et al., 2014).

This indicates that the research design is a framework on which the research is built. Brink et al., (2014) note that for effective research to be conducted, there is need for research design .They go further to say that research design is a mechanism that will provide answers to the research questions and indicate the order of successions of activities in the research outlines. Social science research design can be categorised into two which are experimental and non-experimental (Brink et al., 2014).

However, in selecting appropriate research design the following parameters must be put into consideration ; objective of the study (b) information requirement of the researcher (c) nature of the respondents (d) nature of independent variables (d) level of researcher's control over the study under investigation (e) time and financial implication (f) focus on contemporary issues related to the study. The essence of research design is to ensure that the study under investigation are being investigated with appropriate tools for effective research outcome.

The purpose of a research design as identified by Mouton (2009) is to include the ability to plan and structure the research in such a manner that will maximise the validity of research findings, either to minimise or to remove identifiable errors. Brink et al (2014) note that research design provides structured plans of action, methods and outlines for conducting research in order to realise research objectives. Likewise, Bryman (2010) and Wakari (2012) opine that research design is the blueprint of a research which includes all the necessary action plans and strategy to be adopted in gathering and analysing research data.

There are different types of research designs in both qualitative and quantitative designs. These include: experimental, non-experimental and non –traditional (Brink et al., 2014).

Experimental research is the type of research in which the researchers actively introduce an intervention or treatment. At the same time, experimental research are basically concerned with the testing hypotheses and establishing causality (Brink et al, 2014). However, the study would adopt non-experimental designs. There are many types of non-experimental designs in research literature which include ; descriptive design, survey design , simple survey, longitudinal survey, developmental survey comparative survey, correlation designs, ex-post factor designs, retrospective, prospective, path analysis and predictive.

Moreover, Creswell (2014) and Brink et al. (2014) categorise them into two. These are descriptive and correlation design. In addition, non-experimental design does not give room for manipulation of the independent variable and does not allow for intervention (Brink et al., 2014). This implies that, in non-experimental research, studies are conducted in a natural setting and phenomena are observed as they occurred. The major benefit of non –experimental research is that it describes phenomena, explores and at the same time explains the relationship between variables. Brink et al. (2014) note that researcher in non-experimental research is regarded as bystander because researcher needs to obtain valid research result; as a result, there is a need for him to consider the extraneous variables that would validate his study.

The justification for using non – experimental design is based on the assertion of Brink et al. (2014) who revealed that non - experimental design does not allow for intervention or controlling of research setting. This study would be carried out in teaching hospitals in Nigeria and South Africa and the research would examine the phenomena as they occur. This corroborated the submission of Brink et al. (2012) that, major purpose of non-experimental research is to describe phenomena and at the same time explain the relationship between variables. This shows that non-experimental is very useful in creating knowledge in environmental that is unfavourable for experimental research. However, the following factors were considered before selecting research design for the study; the nature of the population, absence of control variable, and the required information which is based on respondents' regarding current phenomena. Based on this justifications, a non-descriptive research design was selected for the study.

The research design for this study was a survey which is a form of non-experimental design which involves the use of qualitative and quantitative methods. Leddy and Ormrod (2013) had early reported that descriptive research is synonymous with survey research. This position indicated that the two terms can be used interchangeably.

5.4.1 Survey research

Survey research is a fact - finding research method that is used to collect data from a sample, to determine the status of the particular population, with respect to one or more variable (Wakari, 2013 and Neuman 2014). Robson (1997) states that survey research assists a researcher to gather relevant information about the target population without undertaking complete enumeration. Burton (2007) also describes survey research as the choice of instrument and sampling in academic research. Burton (2007) lists various characteristics of survey research to include data collection procedure, sampling method, quantitative, self-monitoring, systematic, impartial representative and theory based. According to Maree and Pietersen (2014), in survey research, researchers select samples of respondents before administering questionnaires or conducting interviews, in order to get information about their attitudes, values, habits, ideas, demographics, feelings, opinions, perceptions, plans and beliefs.

Maree and Pietersen (2014) state various ways by which survey can be conducted. These include questionnaires, interviews, telephone call and observation. Mathers, Fox and Hurn (2007) and Brink et al. (2014) are of the view that, survey is the most acceptable technique for collection of data which is always very useful in seeking data on respondents' beliefs, opinion, attitudes, motivation and behaviour. Being descriptive in nature, it is very useful in obtaining information in order to investigate existing phenomena.

Survey can also be used to explain the existing issues of two or more variables at a particular point in time (Mugenda and Mugenda, 1999; Wakari, 2012; and Brink, 2014). It is commonly used in applied social science research. Dooley (2007) and Trochim (2006) note that, survey research is primarily used by social scientists to collect data because of its flexibility and ability to save time and resources. Fowler (2014) also highlights some of the advantages of survey research to academic study. It is identified as being easy to administer even remotely via the internet, cell phones, by post and email, inexpensive, very useful for large population, easy for software analysis of results and that it could be used for a broad range of data such as attitudes, opinions, belief, values and behaviour.

In keeping with the objectives of this research access and use of clinical informatics among medical doctors, survey research became relevant because it would not have been possible to collect data from medical doctors due to their busy nature. Coupled with limited time and resources, survey research design was used in this research because of reduction in cost, time

economy and accessibility. In addition, the uses of survey research allows for generalisation from the simple onto the rest of the population. The research employed the use of survey research to corroborate the submission of Neuman (2000) that, survey research is relevant where there are many objectives and variables to be examined.

In addition, the survey research design was used in order to identify problems with current practices concerning access and use of clinical informatics among medical doctors. Contributing to this, Brink et al. (2014) observe that survey research encompasses a wide variety of designs that utilise both quantitative and qualitative methods that will enable researcher to gather information from representative of population which will be of a great benefit to the study. The choice of survey research design in this study was largely informed by the research approach the study used, the form of data that were collected, the sample design and the manners in which the data were analysed. It enabled the adequate investigation of access and use of clinical informatics among medical doctors in teaching hospitals in Nigeria and South Africa (see sections 5.3 - 5.6.5, 5.7-5.11). Survey design also provides opportunity for standardised information through the use of questionnaire and interview to solicit for data in order to get accurate result.

Another factor that promoted the use of the survey in this study is based on the submission of Cohen, Manion and Morrison (2007) that, survey design has ability to provide descriptive and inferential data which can be processed statistically, through the use of various statistical tools. The design also encouraged gathering of reliable data through the use of questionnaire and interview question (Brink et al., 2014). Triangulation of data allows the study to use multiple sources to draw conclusions of what constitutes the truth about a single phenomenon and at the same time bring clarity and better understanding of the phenomenon (Polit and Beck, 2008). Another justification for using survey method is based on the fact that the method allows for adequate validation of research instruments, through pre-testing, leading to acceptable reliability of the instrument.

5.5 Target population

The entire set of elements about which the researcher would like to make generalisations is called the target population (LoBiondo-Wood and Haber 2010). Target population can be described as the entire group of individuals or objects from which researchers are interested in generalising the conclusion. The target population usually has different characteristics, it is also known as the theoretical population (Brink and Wood, 1998; Burns and Grove, 2011; Polit and Beck, 2008). De Vos (2005) and Brink et al. (2013) describe the term as setting

boundaries with regard to the elements or participants. The target population for this study was all the medical doctors in the selected medical department used for the study. For the study the two populations were made up of two hundred medical doctors from KEH and eight hundred and five medical doctors from UCH.

5.5.1 Accessible population

The accessible population is the fraction of the entire research population which the researcher can access due to reasons of convenience or availability and the population to which the conclusions for generalisation are applied. This population is a subset of the target population. However, it is from the identified accessible population that the researcher draws the samples for the study. Based on the foregoing, the accessible population for this study were medical doctors in the ten selected medical departments in the two selected teaching hospitals in Nigeria and South Africa respectively. This comprised of three hundred and forty three medical doctors from UCH and One hundred and sixty-seven medical doctors from KEH. The total number of accessible population was five hundred and ten medical doctors from the two teaching hospitals.

5.6 Sampling procedures and methods

The sampling process is the step involved in taking a relatively small number of a subject from a population (Yunus and Tambi, 2013). The selected group of subjects serves as a source of data. In a survey research with a very high population, “it is impractical and uneconomical to involve all the members of the population in a research” (Welman, Kruger and Mitchell, 2005: 55). In addition, in using a large population for academic research, the study will be time consuming and involve huge amount of money. The population parameters are estimated on the basis of sample statistics and the accuracy of estimate depends on the match among the sampling design, data characteristics, sample size and sample selection (Yunus and Tambi, 2013).

However, sampling for the study needs to be representative of the whole population from which it is drawn. Ani (2014) notes that, there is need for representative sample to have the same characteristics as the population used for the study. Based on this, the study would discuss sampling techniques, sample frame and sample size. .

5.6.1 Sampling techniques

A sample is a process of selecting participants for a piece of research. It is the means by which researcher obtain a sample or a portion of the survey population (Fin, Elliot and Walton,

2001). This implies that, a sample is a sub-set of the population selected for inclusion in the research. This means that sample is smaller than the population from which it is drawn. The main objective of the sampling is to obtain a representative selection of the sampling units with the population (Finn et al., 2001).

Furthermore, a research sample needs to be a representative of relevant characteristics of population. It must be in the same proportions as they are reflected in that population, in order to be free from bias (Gay, 2014). There are many advantages of using sampling in social science research. One of the advantages is that, it brings about reduction in cost because it saves researcher's time and money. It also allows for accuracy and effective interaction with the subject.

There are several alternative way of sampling in Social Sciences research. The alternative sampling techniques may be grouped into probability and non- probability (Neuman, 2014; Struwig and Stead, 2001; de Vos, Fouche and Delpont, 2011; Finn, Elliot-White and Walton, 2000; and Gray, 2014). In probability sampling, every element in the population has an equal chance of being included in the sample (Gray, 2014 and Bertram and Christianse, 2014). In other words, a probability sample is a technique which adopted a random sample, which by implication is likely to be free of potential bias and allows for the precision of the results (Finn et al, 2001). There are various types of probability sampling which include simple random sampling, systematic sampling, stratified sampling, cluster sampling, and multi-stage sampling (Struwig and Stead, 2001).

On the other hand, non-probability sampling examples include: Conveniences sampling, quotas sampling, purposive sampling, snowball sampling, homogeneous sample, heterogeneous, quota sample and structured sample (Finn et al, 2000). However, non-probability is the procedure in which the sample was selected based on the subjective judgement of the researcher; it does not involve random selection. Both probability and non-probability sampling were used in the study.

5.6.2. Purposive sampling

Purposive sampling, which is also known as judgemental or selective sampling, is a form of non-probability sampling technique (Brink and Wood, 1998; and Burns and Grove, 2011). Purposive sampling allows researcher to select sampling based on his personal judgements. There are different types of purposive sampling which include; maximum variation, homogeneous, typical case, extreme, critical case, total population and expert sampling (Patton, 1990; Patton, 2002 and Kuzel, 1996).

There are many advantages of purposive sampling in academic research and each have a different goal, and they can provide research with the reason to make generalisation from the research that has been conducted. Based on this, the study would use purposive sampling to select the teaching hospitals that will be used for the study. In addition, purposive sampling allows the researcher to select the sample based on knowledge of the phenomena being studied. Haven look at purposive sampling, the research would use the sampling to select the teaching hospitals for the study.

The justification for using purposive sampling to select the teaching hospitals was anchored on the submission of Neuman (2014) that using purposive sampling in a research allows the researcher to have easy access to the target audiences and have quick access to information. Wakari (2012) supports the use of purposive sampling to select province or places that provide accessible information to a researcher. King Edward VIII Durban, South Africa and University College Hospital, Ibadan, Nigeria were purposively selected for the study.

The two teaching hospitals were selected for several reasons. It was also assumed that the two teaching hospitals would reflect some similarities and differences in terms of clinical informatics resources, policy framework, human resources and access and use of clinical informatics.

The status of clinical informatics was discussed in the two countries in order to show the similarity and dissimilarities in the two countries (see chapter 2). In addition, purposive sampling was used in the selection of medical departments from the two teaching hospitals (University College Hospital, Ibadan, Nigeria and King Edward Hospital, Durban, South Africa). In order to have adequate information that were relevant to the study from the medical doctors, ten departments were purposively selected form the two hospitals .

The selected departments were Anaesthesia, haematology, medicine, orthopaedic and trauma, paediatric, eye, noise and teeth (ENT) psychiatry, radiology, surgery, obstetrics and gynaecology. This is in line with various studies by Ani (2013) that explore accessibility and utilisation of e-electronic resources. He used purposive sample, based on the faculties, to select five faculties from University of Ibadan, Nigeria and University of Calabar, Nigeria respectively. On the other hand, Gatero (2011) explores utilisation of ICT for accessing health information by medical professionals in Kenya. He purposively selects ten departments (anaesthesia, dentistry, dermatology, radiology, general practice, internal medicine, obstetrics/gynaecology, paediatrics, pharmacy, and surgery) for his research, from Kenyatta National Hospital, Kenya. Coleman, Herselman and Coleman (2012) adopt similar method in

the study on improving computers mediated synchronous communication of medical doctors in the rural areas of South Africa. The medical doctors, used in the study, covered the ten community hospitals in the North West Province of South Africa. The hospitals were selected purposively because of their geographical location.

Adetimirin (2012) used purposive sample to select four faculties in seven universities in Nigeria for her studies. The reason for doing this was based on the availability of the similar faculties in the seven universities. Popoola (2008) employed the use of purposive sample in the three similar disciplines, in nine universities, to study the effective of information among researcher in Nigeria. Other studies that used purposive sample in social informatics researches are Badu and Marwei (2005), Adomi and Kpangban (2010), and Cetin, Ergun, Tekindal, Tekindal, and Tekindal (2015).

However, for the purpose of this study, similar medical departments, in the two teaching hospitals, were purposively selected in other not to allow for bias.

Table 5. 3: List of medical departments in the two hospitals

SN	UCH	KEH
1	Anaesthetics	Anaesthetics
2	Surgery	Surgery
3	Radiology	Radiology
4	Psychiatry	Psychiatry
5	Paediatrics	Paediatrics
6	Obstetrics and Gynaecology	Obstetrics and Gynaecology
7	Haematology	Haematology
8	Medicine	Medicine
9	ENT(Otorhinolaryngology)	ENT
10	Orthopaedics and Trauma	Orthopaedics and Trauma
	Family Medicine	Accident and Emergency
	Restorative Dentistry	Maxillo Facial
	Oral Pathology	Dermatology
	Medical Microbiology	ICU
	General Dental Practice	Infectious Diseases
	Child Oral Health	
	General Dental Practice	
	Oral and Max Surgery	
	Pathology	
	Plastic Reconstructive and Aesthetic Surgery	
	Community Medicine	
	Clinical Pharmacology	
	Radiology Oncology	
	Chemical Pathology	
	Neurology	
	Nuclear Medicine	

	Child and Adolescent Psychiatry	
--	---------------------------------	--

Note: selected departments highlighted in bold format

5.6.3 Convenience sampling

Convenience sampling is refer to the collection of information from mebers of the population who are conviently available (Yunus and Tambi, 2013). Leedy and Ormord (2010) describe convenience sampling as ‘accidental sampling’ because it takes people or other units that are readily available. Etikan, Musa and Alkassim (2016) note is a form of non-probability where sampling of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time or the willingness of the respondents to participate. Etikan et al. (2016) identify the main objectives of convenience sampling are basically to collect information from participants who are easily accessible to the research. In addition, they clearly stated that the members of the target population must be homogeneous. Lund Research (2012) lists various advantages of convenience sampling to include;

- The sampling is affordable, easy and the subjects are readily available.
- It saves time and cost. This enables researcher to achieve the sample size he or she wants in a relatively fast and inexpensive manners.
- The convenience sample assist researcher to gather useful data and information that would not have possible through the use of probability sample techniques, which require more access to lists of populations.

The study employed the sampling because it very easy to use, and at the same time, it saves time and cost. Concerning the busy nature of the respondents, the sampling would assist the researcher reaches the respondents without much difficulty. Despite the various advantages of convenience sampling technique Saunder, Lewis, and Thronhill (2012) state the following as the limitations to the sampling which include inability to generalise research findings, relevance of bias and high sample error.

5.6.4 Sampling frame

A sample frame is a comprehensive list of the sampling elements in the target population (Brink et al, 2013). Sample frame provides a guide for researcher on how to draw the sample from the population. The sampling frames for the study were the departmental lists of medical doctors from all the medical departments used in the survey from University College Hospital, Ibadan, Nigeria and King Edward V111 hospital, Durban, Nigeria. The researcher sought and obtained permission form Chief Medical Officer at King Edward Hospital, Durban and Chairman Medical Advisory Committee at University College Hospital, Ibadan, Nigeria to

use their medical doctors staff lists as sample frames to guide the study. In sum, the population and sample size used for this research were based on the obtained medical doctors' lists at the surveyed teaching hospitals.

5.6.5 Sample Size

Bless and Higson-Smith (2010) explain that sample size is a subset of the whole target population that is actually investigated from which characteristics are generalised to the entire population. Scholars have agreed that a sample needs to be representative in a research and at the same time it must be a good proportion of the population (De Vaus ,1993; Welman, Kruger and Mitchell, 2005; Fin ,Elliott-White and Walton,2000; Struwig and Stead ,2001 and Ani ,2013). A sample size is the actual number of member of the population that are in the sample. Sample size, in academic research, contributes meaningfully to determine the accuracy of the research findings and results. It is can be stated that the larger the sample, the better it is. A large sample is often an advantage in quantitative research (Brink et al, 2013).

Bryman (2008:179) states that as the population increases in size, the sample size required for precision in estimation remain constant. This indicates that when the sample size increases the sampling errors decreases. This implies that sample size assists in determine the accuracy of the research results. Neuman (2014), Maree and Pietersen (2014) and Kasinulevicious *et al* (2006) identify various ways in which sample size can be determined in clinical informatics research. These include the application of sample size of similar studies, using published sample size tables and application of sample formulas to calculate a sample size.

Kasinulevicious, Sapoka and Filipauciule (2006) observe that adequate sample size in clinical informatics research is very vital because it will ensure reliable information. The danger of conducting clinical informatics research without adequate sample size will make the research effort futile and at the same time unethical. Brigg and Gray (1999), Scheinin *et al* (2010), and Cai and Zeng (2004)) earlier employed the use of sample size in similar studies.

Welman, Kruger and Mictchell (2005) and, Zikmund (1994) state that not only the size of the population should be considered when determining the sample size, but that variances of the population also need to be put it considerations. Such variances include; heterogeneity/homogeneity of the population. For a homogeneous population, a large population is not require but a small sample is aright compared with heterogeneous population that require a larger sample (Daniel, 2014).Welman, Kruger and Mitchel (2005) recommended the needs to draw large sample, considering the fact that many of the respondents may decide or unavailable to honour the questionnaire or to grant the conduct of interview due to various

reason. They clearly stated, “It is usually advisable to draw a larger sample than the one for which complete data is desired in the end”. Bertram and Christiansen (2014) argue that “there is no clear-cut for answer to the sample size, since it depends on the purpose of the study”

In addition, Biau, Kerneis and Porcher (2008) state the importance of adequate sample size in medical research. They clearly stated that adequate sample size ‘is very important for planning and interpreting medical research’ (Biau et al, 2008).

This is in line with the submission of Frankfort-Nachmias and Nachmias (1996) that, a researcher should “determine the strata; from each stratum, select a random sample with Probability Proportionate (PPS) to the Size of the stratum in the population”. In addition, Babbie (2009) argues that whenever clusters sample, in academic research, are of differing sizes, it is advisable to use Probability Proportionate to Size (PPS) in order to give each cluster a change of selection proportionate to its size. This implies that proportional allocation method was used. The sample size was calculated propositional to the population size. Based on this, medical departments were used as a stratum for determine the size of the study.

However, Probability Proportionate to Size (PPS) had been used in various studies. Ani (2014) used Probability Proportionate to Size (PSS) in his study on accessibility and utilization of information resources for researcher and effects in productivity in Nigerian universities. Evans (2013) employed the use of Probability Proportionate to Size (PSS) in his study on predicting user acceptance of electronic learning. Gichohi (2016) also used PSS in his study on the role of public libraries in the development of small-scale enterprises in Meru County, Kenya. The justification for using this sample size was based on the account of limited resources which include time and money at the researcher disposal.

5.7 Data collection methods

Data collection instruments devices are tools which are used for data collection while conducting research. Examples of these instruments are: questionnaires, tests, checklists, rating scales and observation. At time, a researcher may use or modify an existing research instruments or develop a new instrument.

5.7.1 Questionnaire

There are many ways in which data can be collected in social science research. These include the use of questionnaires, interview schedules, focus group discussions, observation and standardised tests (Maree, 2014; Brink et al, 2014). In this study, data would be collected through the use questionnaire. A questionnaire is a research instrument designed primarily to

gather information while conducting research. It usually consists of a series of questions and other prompts that will give researcher necessary information (Brink, 2014). The questionnaire is a standard tool commonly employed in social science research and it is appropriate in clinical informatics research (Viitanen et al, 2011).

Middlenton (2008), McKenna, Hasson and Keeney (2006), and Brink et al (2014) justify the need for using questionnaires in clinical informatics research. They affirm that questionnaire is very cheap, fast and efficient in gathering large amounts of information from a large sample of people. Maree and Pietersen (2014) also observe that questionnaire can be mailed to respondent either through the internet or postal system. They go further to say that questionnaire can be completed at respondents' convenient time and that it is relatively cheap.

Questionnaires could be structured or unstructured and should be sequenced. Kothari (2004:120) and Maree and Pietersen (2014) suggest that questions in questionnaire must be simple, contain a neat sequence of questions and clean, in order to convey intended meaning.

5.7.1.1 Questionnaire construction

The manner and way in which questions are formulated and framed is very important for constructing a very useful questionnaire that will achieve the objectives of the study. It will be very difficult to achieve a reasonable research objective if the questionnaire was not properly constructed. Based on this, Sekaran (2003) states that three areas need to be examined in constructing a research oriented questionnaire. He recommends that the wording of the questionnaire should of the same level of respondents that is the respondents should be able to understand the language of the questionnaire; the language should not be ambiguous.

Secondly, there should be adequate planning particularly concerning the manner in which the variables will be measure and how they will be scaled and coded after the respondents must have filled the questionnaire. The third stage is about the outlook of the questionnaire. He goes further to say that questionnaire should be very neat and attractive with needed instructions on way it needs to be filled. He furthers states that, personal information such as monthly income, and open-ended questionnaire should be asked toward the end of the questionnaire, in order to avoid bias.

Gay et al. (1996) has given the insight on ways to develop an effective questionnaire which include; the need for questionnaire to be brief, precise and very easy to fill; the need for the questionnaire to be neat and attractive, and that the questions should be straight forward. There should be a section for demographic variable for respondent identifications. Best and

Kahn (1999), pointed out that a good questionnaire must deal with a relevant topic, it can be used to solicit information that cannot be got elsewhere, questionnaire should be attractive, neat and well arranged. It should be very brief instructions. It needs to define operational terms and should be written in simple and correct English.

However, in developing the questionnaire for the study all the aforementioned tips and suggestions by various authors were put into considerations. Clear and brief instructions were given for the respondents on way to fill the questionnaires and the questionnaire was written in simple and straight forward English as recommended by Best and Kahn (1999). Five-point Likert scale was used for the items and respondents were asked to place themselves on the continuum from ‘Strongly agreed =5, Agreed=4, Undecided=3, Strongly Disagreed =2 and Disagreed’

The justification for using five-point scale for the study was based on the submission of Losby and Wetmore (2012) that Likert scale is commonly used in clinical informatics research because it is often used to measure the respondents attitudes by asking the extent to which they agree or disagree with a particular questions, as related to access and use of clinical informatics. In another development, the study uses Likert scale because it has been used in various similarly studies. Olok, Yagos and Ovuga (2015) used it in their study on the knowledge and attitude of doctors toward e-health use in Uganda. Also, Litho (2010), Anuobi and Edeka (2010) had used it in their different studies. Another reason for using Likert scale in the study is that allow for adequate comparison of the results and it has been proven scale for the studies in Social Science. (See appendix 1).

5.7.2 Interview

The interview is a method of data collection in which an interviewer obtains responses from a participant in a face-to-face encounter, through telephone call or by electronic means (Brink et al, 2013:159). Nieuwenhuis (2014:87) argues that interview in academic research is a two-way conversation in which the interviewer will ask the participants questions in order to collect data and to learn about ideas, beliefs, views, opinions and behaviours of the participants. The aim of interview in academic research is to obtain rich descriptive information that will assist the researcher to understand the participant’s construction of knowledge and social reality. Nieuwenhuis (2014) and Brink et al. (2014) list various forms of interview to include face-to-face, webcam, telephone, email, and instant message and chat interviews. Mgenda and Mgenda (1999) assert that interview schedule can be in various forms which are structured, semi-structured and unstructured questions.

The study used structured interview which was purposively done with head of ICT of the two teaching hospitals. The reason for this was based on the fact that the heads of the ICT is responsible for ICT services in the two hospitals and they were responsible for ICT infrastructure and management in the two hospitals. In addition, the heads of ICT unit are in charge of operating maintaining, and provision of ICT based services. They organised training, provide support services and promote the use of clinical informatics development in the two teaching hospitals. ICT services in the two teaching hospitals are centralised and put under directorate. In Nigeria there is a director of ICT and in South Africa, there is a manager of ICT. The need for the interview was to obtain qualitative data on accessibility and use of clinical informatics by medical doctors.

In structured interview, the questions are formally structured, in that, wording is not altered from one participant to the other (Struwig and Stead, 2001). Consistent with the advantages described by Brink et al. (2014), this interview method is the most appropriate when a researcher needs a straightforward, factual information about a phenomena such as access and use of clinical informatics.

The research searched through existing literature and published articles on clinical informatics to develop the interview questions (See appendix b). The instrument used to collect the data was interview schedule. The interview schedule were presented to each respondents in exactly the same way. The interview schedule was restricted to the provided questions in the order in which they appear on the schedule.

The researcher met the respondents face-to-face for the interview session. This was based on Mgenda and Mgenda's (1999) that face-to-face interview is flexible, ensures a very high rate of control of interview situation, enables the recording of conversation and the elicitation of unintended responses as well as the provision of in-depth data that will be useful to achieve the specific objectives of the research. It can be said that interviews is very useful in getting very valuable information as well as supplementary, insightful observation regarding the opinions of the respondents about the subject of the research. Opdenaker (2006) claims that, face-to-face interview encourages very rich data, due to a high level of personal interest and response to the research from the interviewees. This implied that, interview technique enables the researcher to collect first-hand information about the interviewee's knowledge, value, beliefs and preference.

5.7.3 Triangulation

The study also employed the use of triangulation in the validation of data through cross verification from various sources. Triangulation is the use of multiple sources or referents to draw conclusions of what constitutes the truth about a single phenomenon and to bring clarity to and understanding of that (Polit and Beck, 2008). This implies that triangulation is the use of multiple methods to collect and interpret data about some phenomenon in order to have accurate representation of reality in academic research. In addition, using triangulation in academic research will remove the weakness of biases and challenges that may come from single-method.

Write Content Solutions (2016) states various reasons for using triangulation in academic research. These include: the need for additional sources of information to complement in order to give more information about a research, multiple sources of data gathering which allows for verification of similar data. It allows for more comprehensive data and prevents inconsistencies in data sets which are more easily detected. Yeasmin and Rahman (2012) note that, triangulation provides opportunity for researcher to validity their research results. They go further to say that, research triangulation allows the researchers to be more confident about their research results. Global Health Science (2015) reinstated the importance of triangulation in healthcare research. Using triangulation in healthcare research will allow for combination of qualitative and qualitative studies which can be incorporated for effective health care and for treatment program information.

Similar studies that have used triangulation include, Ziyani, King, and Ehlers (2005) who used the triangulation of research methods to examine family planning practices among the people of Swaziland. Farmer, Robinson, Elliot and Eyles (2006) also used triangulation methods to explain the result of an empirical research in qualitative health study. Based on this, the study used triangulation methods. Brink et al. (2014) describe four types of triangulation which include: research triangulation, data triangulation, theory triangulations, methodology triangulation, and analysis triangulation. For the purpose of this research, the researcher used data triangulation.

The research used both questionnaire and interview in order to ensure accurate validation of the result. Methodological triangulation is the use of multiple methods to study a single topic. The study, used both qualitative and quantitative methods in the research for cross fertilization of accurate information. Lastly, analysis triangulation which is the used of two or more analytical techniques to analyse one set of data will make the findings of the research robust

and details (De Vos, 2005; Poliet and Beck, 2008). Based on this submission, the study employed the use of triangulation.

5.8 Pilot study

Poliet et al (2001) describe pilot study in health research as a feasibility study which may be a trial version in preparation for the real study. This implies that pilot study is pre-testing a research instrument. Brinks et al. (2013) list various reasons for using pilot study in health related research to include developing and testing the adequacy of the research instruments, and using it to evaluate the likely outcome of the proposed research methods.

Therefore, in this study, the pilot study was carried out so as to test, verify and refine the research instruments in order to identify any problems that the respondents might face in understanding the questions and to reduce inaccuracies and inconsistencies in the questionnaire and interview schedules. This is to justify the assertion of Gikenye (2012) which states that, a pilot study assists to improve the reliability of the instrument. As a result, the pilot study would be done to ascertain any weakness that the questionnaire might have. Based on these observations, the information obtained would be used to modify and improve the questionnaires before they are administered to the doctors in the selected teaching hospitals in Nigeria and South Africa. According to Rea and Packer (2005) and Mugwisi (2012), pre-test of a questionnaire would bring about questionnaire clarity, comprehensiveness and acceptability, before the main study.

Thus, based on convenience sampling, Ngewelezane Hospital, South Africa, was used for the pilot study. The hospital is a tertiary hospital that performs functions that are similar to that of the two teaching hospitals used for this research. Fifty medical doctors were given copies of the questionnaire to fill in and they were allowed to comment on the clarity and suitability of the instrument. The directors of ICT would be interviewed.

5.8.1 Validity of instruments

Brink et al. (2013) describe validity as the degree to which a research measures what it intends to measure. Kazi and Khalid (2012) identify the three types of validity to include content validity, criterion-related validity and construct validity. They go further to say that it is necessary for a research questionnaire to undergo validation procedure in order to measure what it is designed to measure. Brink et al. (2013) list various ways in which a research questionnaire can be validated to include face validity and through the conduct of pilot study.

Based on these assertions, the questionnaire for the study will be examined by supervisors, colleagues and research experts to ascertain its construct and content validity. Frankford-Nachmias and Nachmias (1996) and Ani (2013) had early observed that professional's view point on the research instrument is very important in measuring validity in social science research.

However, the justification for validating the questionnaire is based on the submission of Anthoine, Moret, Reganult, Sebile and Hardoium (2014) that, validating research questionnaire in health related research is to prevent biased and unrealistic research results. This implies that validity assists a researcher to draw a very sound conclusion from his research data. In addition, the questions in the questionnaire were adapted from early pre-tested tools with this it enhanced the validity of the instruments. The questions in the questionnaire were also adapted from pre-tested tools in similar studies, which enhanced the validity of the instrument.

5.8.2 Reliability of survey instruments

Reliability is a way of ensuring that research instrument is of good quality (Kimberlin and Winterstein, 2008). It is essential to conduct a test to determine the extent to which the research instrument is reliable. Brink et al. (2014) claim that reliability refers to the extent to which the research instrument measures consistently whatever it was designed to measure. They go further to say that reliability is based on the association between two sets of scores, representing the measurement obtained from the instrument when it was used with a group of individuals. The following procedures can be used to estimate reliability coefficient and all of them have a computational formula that can be used to calculate the reliability coefficients of an instrument. They are Split-half, Kuder-Richardson Procedures, Parallel Forms of Alternate form, Test, re-test, and Cronbach.

Field, Robinson, Elliot and Eyles (2006) note that reliability is a way in which a scale consistently replicates the construct it supposes to measure. For the purpose of this research SPSS software packaged was used to access the reliability of the questionnaire as instrument for data collection in the study. However, the justification for using reliability in the research is to support the submission of Johnson (1997) and Golafshani (2003) that using reliability in health related research give credible and defensible results.

To ensure adequate reliability of the questionnaire Cronbach's coefficient alpha, was used to measure the internal consistency of the questionnaire items. De Vaus (2005) observes that cronbach's coefficient alpha is the most famous and generally acceptable methods of

measuring reliability of a Likert scale. He recommended that alpha-values should not be less than 0.7. However, the alpha values here is between 0.712- 0.925 which indicated acceptable range for the continuation of the study. This implies that all the items in the sections are reliable for use in the study as revealed in the table.

Table 5. 4: Reliability of the instruments

Items in the questionnaire	Number of items	Reliability coefficient
Perceived factors that influence behavioural intention to use clinical informatics		
Performance expectancy	04	0.925
Social influence	04	0.772
Effort expectancy	03	0.712
Facilitating condition	03	0.882
Behavioural intention	03	0.879
Purpose of using clinical informatics	10	0.841
Benefits of using clinical informatics	06	0.879
Challenges of using clinical informatics	08	0.721

On the other hand, Bellamy (2012) and Silverman (2001) note that reliability is very difficult to measure with interview schedule as a source for data collection. Ani (2013) and Silverman (2001) recommend that for effective reliability of interview schedule in academic research, the researcher needs to allow the respondent to understand the interview questions very well so that the answers can be coded without the possibility of uncertainty. For the purpose of this research, the following measures were put into consideration in order to increase reliability of the interview schedule in the research. The questions were straight forward. The researcher employed the used of simple concepts. Ambiguous questions were removed. In addition, pilot study was conducted in order to pre-test the interview schedule and this allowed for modifications of interview questions.

5.9 Data analysis

To determine the statistical analysis of the study, the respondents' data were fed into the Statistical Package for Social Sciences (SPSS) version 20.0 which is a computer statistical software program specifically designed for the social science research. The importance of

using SPSS in the study is to select the correct statistical tests that will be used to analyse the data. Statistical analysis of data enables the researcher to reduce, summarise, organise, manipulate, evaluate, interpret and communicate qualitative data (Brink, 2013).

The most powerful tool available to the research, in analysing quantitative data, is statistics. Without the aid of statistics, the quantitative data would be simply a chaotic mass of numbers. The importance of statistics in academic research cannot be over-emphasised; statistics is a scientific way in which numerical data that are gathered from the field are analysed, in order to enable us to have meaningful interpretation of the data. This implies that statistics assists researcher to turn data into meaningful information.

Statistics can be divided into two categories which are descriptive and inferential statistics (de Vos et al, 2011 and Brink et al., 2013). For the purpose of this research both descriptive and inferential statistics were used in the study.

5.9.1 Descriptive statistics

Descriptive statistics are used in the research to describe and summarise the data and informed what the data set looks like. These statistics convert and condense a collection of data into an organised, visual representation or picture, in a variety of ways in order for the data to be meaningful. The descriptive statistics, in this study, included frequency distributions with minimum and maximum value, means percentages, standard deviation. Bertran and Christiansen (2015) note that descriptive statistics transform a set of data into either a visual overview such as a table, graph, or into a few numbers that summarises the data. The study used descriptive statistics because it is the most fundamental way to summarise data and it is very useful in interpreting the results of quantitative or large scale-scale research (Bertran and Christiansen, 2015).

5.9.2 Inferential Statistics

The study used inferential statistics to sample data in order to make an inference about the population of the study, point estimate, confidence intervals and hypothesis testing. Leedy and Ormrod (2010) note that inferential statistics enable a researcher to estimate the population's parameters and to test hypothesis. Brinks et al. (2013) state that there are two types of inferential statistics which are parametric and non-parametric. The study used a non-parametric which are also referred to as distribution-free statistical tests, since they are commonly applied to data, where no assumptions are made regarding the normal distribution

of the target population (Brink et al, 2014). They go further to say that the statistics methods are normally applied when the variables have been measured on a nominal or ordinal scale.

5.10 Ethical considerations

The research was conducted in an ethical manner. The ethical manner starts from the conceptualization, planning phases, to the final stages. The researcher has the right to always search for truth in the most rigorous way, but never at the expense of the rights of the individual and communities (Babbie and Mouton, 2001).

In order to conduct research ethically, the research must put the following into considerations: conduct the research competently, with sound and well articulate methodology; adequate management of the resources; acknowledge those that contributed to the success of the research; effective and ethical communication of the result; and consider the consequences of the research for the field of study in particular and the society in general (Brink et al., 2014).

Based on this, the research was conducted in line with various ethical issues; firstly ethical clearance was collected from University of Zululand ethical committee (See appendix C). In addition, ethical approval letters were collected from Department of Health Kwa Zulu-Natal (KZN) (see appendix D). At UCH Ibadan, Nigeria, ethical letter was collected from University College Hospital and University of Ibadan health ethical committee (See appendix E). This indicated that the data for the study was conducted in line with the approved data collection protocol.

Furthermore, the participants in this research were informed about the nature and purpose of the study and their confidentiality was granted and protected concerning the information they gave to us. They were also told that their participation in the study was voluntary. Permission was sought from the Chief executive officer and heads of the departments from various medical departments before the research instruments were given. All works used in the study were duly acknowledged as expected in every academic research.

5.11 Summary

Triangulation, which is the use of multiple sources that are both quantitative and qualitative, was used to collect and analyze data. The quantitative approach was used to analyze the research subject, in terms of trends and frequencies, while the qualitative approach was used to determine the meaning of the phenomenon, through adequate description. The qualitative approach therefore captured non-quantifiable aspects of the study, such as issues of policy. The review of methodology indicated that the use of both quantitative and qualitative

approaches has a significant impact on clinical informatics research development, particularly in obtaining better results. Various statistical methods were used to analyze the data, ranging from descriptive to inferential statistics.

The chapter provides the opportunity for a critical discussion and debate on clinical informatics research methodology. Research is undertaken in social informatics with a view to improve the use of ICT for the benefit of mankind. This can only be done through adequate methodology.

The next chapter presents the analysis and interpretation of the data.

CHAPTER 6: DATA PRESENTATION AND ANALYSIS OF THE SURVEY QUESTIONNAIRE

6.1. Introduction

This chapter presents the data collected through questionnaires that were administered to medical doctors at King Edward Hospital VIII in Durban, South Africa and the University College Hospital in Ibadan, Nigeria. The information obtained from the respondents was collated, coded and analysed using descriptive statistics (frequency counts, percentages and cross tabulation) and inferential statistics test (t-test, chi-square, and Regression analysis). The significance level used for the inferential statistics was 0.05.

The chapter is divided into themes based on the research objectives as follows: i) Demographic characteristics of the respondents; ii) Purposes of using clinical informatics, iii) Availability of clinical informatics infrastructure in the two teaching hospitals; iv) Accessibility of the clinical informatics facilities in the two hospitals; v) Perceived factors that influence behavioural intention to use clinical informatics; vi) Benefits of using clinical informatics by medical doctors; and vii) Challenges faced with use of clinical informatics.

6.2. Demographic characteristics of the respondents

The demographic characteristics of the respondents that were considered in this study are: age, sex, medical experience, professional position, medical department and academic qualifications. Based on the UTAUT model and the literature review, it was important to determine whether any of these socio-demographic variables influenced the use of clinical informatics.

6.2.1 Distribution of respondents according to teaching hospitals

The respondents were selected from two teaching hospitals, namely the University College Hospital in Ibadan, Nigeria, and King Edward VIII Hospital in Durban, South Africa. The two teaching hospitals were compared to investigate access and use of clinical informatics among medical doctors in the two teaching hospitals. The distribution of respondents revealed that 176 (68.20%) of the medical doctors were from the University College Hospital (UCH) and 82 (31.80%) were from King Edward Hospital.

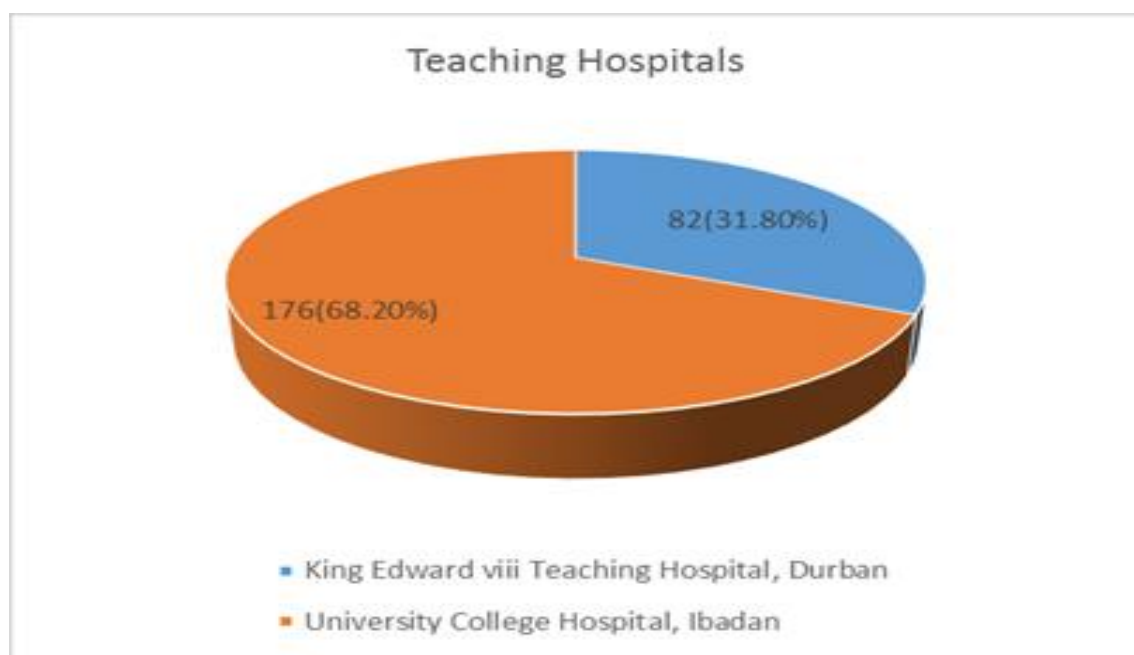


Figure 6.1: Distribution of medical doctors according to teaching hospitals

6.2.2 Gender of the respondents

Table 6.1 revealed that 159 (61.60%) of the respondents were male and 99 (38%) were female. A significantly higher number of male medical doctors participated in the study. This could be attributed to the high number of males in nominal staff roles (see discussion in 8.1).

Table 6. 1: Gender representation of medical doctors

	Male	Female
Hospital	N (%)	N (%)
KEH	45(54.9)	37(45.1)
UCH	114(64.8)	62(35.2)
Total	159(100)	99(100)s

6.2.3 Age of the respondents

The age range of the respondents from King Edward VIII hospital indicated that majority of the medical doctors, 42 (51.2%), were between the ages of 20-29 years. However, from the UCH, Ibadan, Nigeria, 59(33.5%) doctors, were between the age ranges of 20-29years. Furthermore KEH had 24(29.3%) doctors within the age range of 30-39 years, and UCH, Ibadan, Nigeria has 94(53.4%) doctors within the same age range. Taking together, the two

teaching hospitals had majority of medical doctors, 118(82.7%), within the age range of 30-39 years .Within the age range of 40 years and above, KEH had 16(19.5%) doctors and UCH had 23 (13.1%). Collectively, the two hospitals had 39 (32.6%) doctors.

Table 6. 2: Age range of the doctors

Age range	UCH	KEH
20-29	59(33.5%)	42(51.2%)
30-39	94(53.4%)	24(29.3%)
40-above	23(13.1%)	16(19.5%)

6.2.4 Medical practice experience of the respondents

The information about the length of service of the respondents was sought. It was revealed that 71(40.3%) of the respondents from UCH had between 6-10 years medical practice experience. From the same hospital 69 (39.2%) of the respondents had between 1-5 years medical practice experiences. Majority of the respondents from KEH responded that they had between 1 to 5 years medical practice experience. Majority of the respondents from the two hospitals, 108 (86.8%) had between 1 to 5 years of medical practice experience. The majority of the respondents had only spent between 1 to 5 years in the profession and therefore had limited practical experience (see discussion in 8.1).

Table 6. 3: Medical practice experience of the respondents

Medical practice experience	UCH	KEH
1-5 years	69(39.2%)	39(47.6%)
6-10 years	71(40.3%)	20(24.4%)
11-15 years	27(15.3%)	14(17.0%)
15-above	9(5.1%)	09(11.0%)

6.2.5 Distribution of the respondents by job status

This refers to the career structure and placement of medical doctors. A medical consultant is the title of a senior hospital-based physician or surgeon who has completed his/ her specialised training and passed the necessary examinations. A consultant leads a team of

medical doctors consisting of speciality registrars and house officers, also known as medical interns. Resident doctors receive postgraduate training in different fields of medicine with the intention to become consultants. The training is always done in accredited institutions, such as teaching hospitals, and a Fellowship is awarded after passing the prescribed examinations.

In the context of this study, medical officers are senior medical doctors who are not under resident training and are permanent staff of the hospitals. A medical intern is a doctor who has graduated from a medical school, has a medical degree, and is working under supervision and being mentored by experienced medical doctors. In Nigeria, medical interns are referred to as ‘house officers’.

Distribution of medical doctors by status revealed that majority of them at UCH were medical registrars 95(54%). The result from KEH revealed that majority of the respondents 33 (40.2%) were medical interns. This indicated that majority of the respondents in the study were medical registrars, 110 (72.3%).

Table 6. 4: Distribution of the respondents by job status

Current position	UCH	KEH
Medical consultant	07(4%)	4(4.9%)
Medical intern	45(25.5%)	33(40.2%)
Medical officer	29 (16.5%)	30(36.6%)
Medical registrars	95(54%)	15(18.3%)

6.2.6 Distribution of respondents by medical department

Teaching hospitals consist of various clinical departments, traditionally called wards (particularly when they have beds for inpatients), and a clinic where medical doctors consult with their patients. Every clinical department in a teaching hospital has a head of department who is responsible for the smooth running of the department. He or she also ensure supervision of the interns and residents doctors during their medical training.

The combined analysis of the data obtained from the two hospitals, 48 respondents (19%) were from the Department of Medicine, followed by 35 (14%) from the Department of Obstetrics and Gynaecology, and 34 (13%) from Surgery. Others were: 29 (11%) from

Paediatrics, 20 (08%) from Radiology, 27 (10%) from Anaesthesia, 22 (09%) from Orthopaedics & Trauma and 19 (07%) from Psychiatry in that order. The least number of respondents were from Haematology (11; 4%) and Ear, Nose and Throat (ENT) (13; 05%).

Table 6. 5: Distribution of respondents by medical department

Medical Department	UCH		KEH		TOTAL	
	Frequency (176)	%	Frequency (82)	%	*(258) Frequency	%
Anaesthesia	16	9.1	11	13	27	10
ENT	11	6.3	02	04	13	05.
Medicine	30	17	18	22	48	19
Surgery	22	12.5	12	14	34	13
Orthopaedics and Trauma	15	8.5	07	08	22	09
Paediatrics	19	10.8	10	12	29	11
Psychiatry	15	8.5	04	05	19	07
Radiology	15	8.5	05	06	20	08
O and G	25	14	10	12	35	14
Haematology	08	4.5	03	04	11	04
Total	176	100	82	100	258	100

*Note: N=258 is the total number of respondents that completed the questionnaires from the two surveyed teaching hospitals out of the 413 copies of questionnaires that were administered

6.2.7 Educational qualifications of the respondents

Analysis of data on highest academic and professional qualifications of the respondents revealed that 152 (86.4%) of the respondents from UCH had MBBS certificate.

Likewise, 72(87.8%) of the respondents from KEH also had MBBS, 72 (87.8%). From the two hospitals, 12 (4.7%) of the respondents had Masters' degrees, and a total of 22 (8.50%) were Fellows of Colleges. The majority of respondents 224(86.80%) had MBBS degrees.

The Fellowship of the College of Physicians of South Africa (FCP) (SA), is under the auspices of the College of Medicine of South Africa. The body is for prospective resident doctors who intend to become medical consultants after passing prescribed examinations. The college has twenty three colleges. In Nigeria, there are two bodies that conduct professional

examinations for resident doctors. They are National Postgraduate College of Medicine which is the apex of medical education in Nigeria. It has fifteen approved faculty boards and organises the training, evaluation and certification of medical doctors and dentists. The body awards the fellowship degrees called National Post Graduate College of Medicine. The second body is called the West Africa Postgraduates Medical College (WAPM). The college awards the Fellowship of College of Physicians of West Africa.

Table 6. 6: Distribution of respondents by educational qualification

Highest qualifications	UCH	KEH
Fellow of college	15 (8.5%)	7(8.5%)
Master degree	9(5.1%)	3(3.7%)
MBBS	152(86.4%)	72(87.8%)

6.2.8 The association between socio-demographic variables and the use of clinical informatics tools

The relationship between socio-demographic variables such as age, gender, and years of experience, department, job status, academic qualifications, and the use of clinical informatics resources was sought. Studies have indicated that there is a digital divide in the access to and use of clinical informatics resources based on socio-demographic variables, particularly between male and female, young and old medical doctors, and between medical departments and various medical occupations. This section therefore, sought to find out whether socio-demographic differences are really affecting medical doctors' access to and use of clinical informatics resources.

Table 6. 7: Descriptive statistics of use and non-use of clinical informatics

	Hospital	Always	Often	Sometimes	Rarely	Never
Electronic Medical Record (EMR)	KEH	NA (%)	NA (%)	NA (%)	NA (%)	NA (%)
	UCH	11(29.7)	11(29.7)	10(27.1)	5(13.5)	139(46.6)
Clinical Decision Support Systems(CDSS)	KEH	13(15.9)	18(22.0)	11(13.4)	11(13.4)	29(35.4)
	UCH	32(18.2)	58(33.0)	20(11.4)	20(11.4)	46(26.1)
Computerised Provider Order Entry(CPOE)	KEH	NA	NA	NA	NA	NA
	UCH	NA	NA	NA	NA	NA
Diagnosis Image Archiving (DIA)	KEH	42(51.2)	9(11.0)	6(7.3)	7(8.5)	18(22.0)
	UCH	28(15.9)	30(17.0)	34(19.3)	40(22.7)	44(25.0)

The result from table 6.7 indicated use and non-use of different types of clinical informatics by the respondents. Always, often, sometimes and rarely indicated that the respondents had used the resources before. While never was used to indicate that the respondents had not used the resources before. See Table 6.8.

Table 6. 8: Use and non –use of clinical informatics

	Hospital	Use	Non use
Electronic Medical Record (EMR)	KEH	NA %	NA %
	UCH	37(21.0)	139
Clinical Decision Support Systems(CDSS)	KEH	53(64.6)	29(35.4)
	UCH	130(73.9)	46(26.1)
Computerised Provider (Physician) Order Entry(CPOE)	KEH	NA	NA
	UCH	NA	NA
Diagnosis Image Archiving (DIA)	KEH	64(78.0)	18(22.0)
	UCH	132(75.0)	44(25.0)

The result from Table 6.8 revealed that 37 (21%) of the respondents from UCH had used the EHR while 139(79%) of the respondents claimed that they had never used the resources. On the other hand, the tools were not available at the KEH. Clinical decision support system was used by majority of the respondents from the two teaching hospitals 130(73.9%) of respondents from UCH claimed to have used the CDSS. On the other hand, 53(64.6%) of respondents from KEH agreed that they had used the CDSS. Examination of DIA revealed that 64 (78%) from KEH had used the DIA, while 132 (75%) from UCH claimed to have used the DIA.

6.2.8.1. The socio-demographic characteristics and the use of Electronic Medical Records

A closer look at the association between the socio-demographic characteristics of the respondents and the use of Electronic Medical Records (EMRs) revealed that medical doctors in the Psychiatry department at University College Hospital, Nigeria were the most likely to use Electronic Medical Records, closely followed by medical doctors in the Radiology department at the same hospital. The results revealed that there was a significant association between medical departments and the use of EMRs ($\chi^2 = 17.709$, $p < 0.05$). However, age, experience, gender, position and qualification were not significantly associated with the use of EMRs ($p > 0.05$).

Table 6. 9: Association between social-demographic characteristics and the use of Electronic Medical Records

	USE	NON USE	Df	Total	Chi-Square	
	N (%)	N (%)		N (%)	χ^2	p-value
Gender			1			
Male	26(22.8)	88(77.2)		114	0.621	0.431
Female	11(17.7)	51(82.3)		62		
Age(years)			2			
20-29	12(20.3)	47(79.7)		59	0.409	0.815
30-39	19(20.2)	75(79.8)		94		
40-Above	6(40.0)	17(60.0)		23		
Medical Practice (years)			5			
1-5	16(23.2)	53(76.8)		69	3.054	0.383
6-10	14(19.7)	57(80.3)		71		
11-15	7(25.9)	20(74.1)		27		
Above 15 years	0(0.0)	9(100.0)		3		
Position			3			
Medical Officer	7(24.1)	22(75.9)		29	0.695	0.874
Medical Intern	8(17.8)	37(82.2)		45		
Medical Consultant	2(28.6)	5(71.4)		7		

Medial Register	20(21.1)	75(78.9)		95		
Department			9			
Anaesthesia	3(20.0)	12(80.0)		15	17.709	0.039
Haematology	2(22.2)	7(77.8)		9		
Medicine	3(8.6)	32(91.4)		35		
O & G	4(16.7)	20(83.3)		24		
Orthopaedics & Trauma	0(0.0)	12(100.0)		12		
Paediatrics	5(29.4)	12(70.6)		17		
ENT	1(14.3)	6(85.7)		7		
Psychiatry	6(50.0)	6(50.0)		12		
Radiology	9(37.5)	15(62.5)		24		
Surgery	4(19.0)	17(81.0)		21		
Qualification			3			
MBBS	34(22.4)	118(77.6)		152	2.571	0.277
Fellow of Colleges	3(20.0)	12(80.0)		15		
Master Degree	0(0.0)	9(100.0)		9		
Total	37(21.0)	139(79.0)		176(100.0)		

6.2.8.2. Association between socio-demographic characteristics and the use of the clinical decision support system

Analysis of data on the relationship between the socio-demographic characteristics of the respondents and the use of the Clinical Decision Support System (CDSS) revealed that seventy five percent 81 (75%) of the respondents within 1-5 years of medical practice experience had used the Clinical Decision Support System, while 70(76.9%) of the medical practitioners within 6-10 years of practical experience had used the technology. This indicates

that there was a significant association between years of practice and the use of the CDSS ($\chi^2=16.489$, $P < 0.05$). However, age, gender, department, qualification, and teaching hospital were not significantly related to the use of CDSS ($p > 0.05$). See Table 6.9

Table 6. 10: Social- demographic characteristics and the use of the clinical decision support system

	USE	NON USE		Total	Chi-Square	
	N (%)	N (%)	df	(N)	χ^2	p-value
Name of the hospital			2			
KEH	53(64.6)	29(35.4)		82	2.311	0.128
UCH	130(73.9)	46(26.1)		176		
Gender			1			
Male	112(70.4)	47(29.6)		159	0.488	0.826
Female	71(71.7)	28(28.3)		99		
Age(years)			2			
20-29	77(76.2)	24(23.8)		101	5.371	0.068
30-39	84(71.2)	34(28.8)		118		
40-Above	22(59.3)	17(40.7)		39		
Years of Practice			5			
1-5	81(75.0)	27(25.0)		108	11.020	0.012*
6-10	70(76.9)	21(23.1)		91		
11-15	21(51.2)	20(48.8)		41		
Above 15 years	11(61.11)	7(38.89)		18		
Position			3			
Medical Officer	39(66.1)	20(33.9)		59	1.082	0.782
Medical Intern	55(70.5)	23(29.5)		78		
Medical Consultant	8(72.7)	3(27.3)		11		
Medial Register	81(73.6)	29(26.4)		110		
Department			9			

Anaesthesia	17(68.0)	8(32.0)		25	10.343	0.323*
Haematology	9(75.0)	3(25.0)		12		
Medicine	37(75.5)	12(24.5)		49		
O & G	17(51.5)	16(48.5)		33		
Orthopaedics & Trauma	15(65.2)	8(34.8)		23		
Paediatrics	21(70.0)	9(30.0)		30		
ENT	9(69.2)	4(30.8)		13		
Psychiatry	14(87.5)	2(12.5)		16		
Radiology	20(76.9)	6(23.1)		26		
Surgery	24(77.4)	7(22.6)		31		
Qualification			3			
MBBS	163(72.8)	61(27.2)		224	3.484	0.175
Fellow of Colleges	14(63.6)	8(36.4)		22		
Master Degree	6(50.0)	6(50.0)		12		
Total	196(70.9))	75(29.1)		258(100.0)		

6.2.8.3: Association between socio-demographic characteristics and the use of diagnostics image archiving

The association between socio-demographic characteristics of the respondents and the use of Diagnostics Image Archiving (DIA) revealed that more than 81(76.9%) of the medical doctors within 1-5 years of experience in the profession claimed to have used the technology. Medical doctors that were over 30 years of age indicated that they always used DIA for medical diagnosis. The analysis further revealed that medical consultants were the category of doctors that used Diagnostics Image Archiving the most. The implication of this is that there was association between socio-demographic variables of respondents and the use of diagnostic image archiving. Result indicated that age ($\chi^2 = 10.819$, $p < 0.05$), years of practice ($\chi^2 = 11.288$, $p < 0.05$), and current position ($\chi^2 = 11.792$) were also significantly related to the use of DIA. See Table 6.10

Table 6. 11: Asociation between social-demographic characteristics and the use of diagnostic image archivng

	USE	NON USE		Total	Chi-Square
--	-----	---------	--	-------	------------

	N (%)	N (%)	df	N (%)	χ^2	p-value
Origin			1			
KEH	64(78.0)	18(22.0)		82	0.285	0.594
UCH	132(75.0)	44(25.0)		176		
Gender			1			
Male	124(78.0)	35(22.0)		159	0.925	0.366
Female	72(72.7)	27(27.3)		99		
Age(years)			2			
20-29	82(81.2)	19(18.8)		101	10.819	0.004*
30-39	79(66.9)	39(33.1)		118		
40-Above	35(92.6)	4(7.4)		39		
Years of Practice			3			
1-5	83(76.9)	25(23.1)		108	11.288	0.010
6-10	60(65.9)	31(34.1)		91		
11-15	37(90.2)	4(9.8)		41		
Above 15 years	16(88.89)	2(11.11)		18		
Position			3			
Medical Officer	54(91.5)	5(8.5)		59	11.792	0.008*
Medical Intern	58(74.4)	20(25.6)		78		
Medical Consultant	9(81.8)	2(18.2)		11		
Medial Register	75(68.2)	35(31.8)		110		
Department			9			
Anaesthesia	22(88.0)	3(12.0)		25	13.327	0.148*
Haematology	12(100.0)	0(0.0)		12		
Medicine	34(69.4)	15(30.6)		49		
O & G	28(84.8)	5(15.2)		33		
Orthopaedics &	16(69.9)	7(30.4)		23		

Trauma						
Paediatrics	19(63.3)	11(36.7)		30		
ENT	9(69.2)	4(30.8)		13		
Psychiatry	12(75.0)	4(25.0)		16		
Radiology	22(84.6)	4(15.4)		26		
Surgery	22(71.0)	9(29.0)		31		
Qualification			3			
MBBS	172(76.8)	52(23.2)		224	2.147	0.342
Fellow of Colleges	17(77.3)	5(22.7)		22		
Master Degree	7(58.7)	5(41.7)		12		
Total	196(76.0)	62(24.0)		258(100.0)		

6.3: Objective 2: The purposes of using clinical informatics

The literature reviewed has revealed that clinical informatics is the backbone of modern healthcare services in both developed and developing countries. The technologies assist medical doctors in various ways, particularly in improving healthcare for individuals and communities. To a large extent, medical doctors have largely benefited from the evolution of clinical informatics.

This section sought to identify what the medical doctors use clinical informatics for in the selected teaching hospitals. Ten use of clinical informatics were listed in Table 6.11. The most common reason for using the technology identified by the respondents in the two hospitals was the use of clinical informatics for medical diagnosis. 77 (93.9%) respondents from KEH and 153(86.3%) from UCH indicated this. This was followed closely by the use of clinical informatics for decision making, by 67(81.7%) respondents from KEH and 147(83.6%) from UCH. The use of clinical informatics for decision making came third with 65(79.2%) respondents from KEH and 138(78.4%) respondents from UCH. The least cited purpose was the use of clinical informatics for administrative information with 51(62.2%) respondents from KEH and 101(57.3%) from UCH.

Table 6. 12: Purposes of using clinical informatics

		SA	A	N	D	SD	Median
	Hospital	N (%)	N (%)	N (%)	N (%)	N (%)	
I use clinical informatics for medical diagnostic purposes	KEH	27(32.9)	50(61.0)	5(6.1)	0	0	2
	UCH	54(30.7)	99(56.3)	21(11.9)	2(1.1)	0	2
I use clinical informatics for decision making	KEH	27(32.9)	40(48.8)	8(9.8)	3(3.7)	4(4.9)	2
	UCH	48(27.3)	99(56.3)	17(9.7)	8(4.5)	4(2.3)	2
I use clinical informatics for research purposes	KEH	26(31.7)	32(39.0)	11(13.4)	6(7.3)	7(8.5)	2
	UCH	40(22.7)	93(52.8)	21(11.9)	17(9.7)	5(2.8)	2
Clinical informatics is used for disease management	KEH	22(26.8)	43(52.4)	6(7.3)	7(8.5)	4(4.9)	2
	UCH	29(16.5)	109(61.9)	18(10.2)	18(10.2)	2(1.1)	2
I use clinical informatics to share knowledge with my professional colleagues and medical students	KEH	29(35.4)	36(43.9)	9(11.0)	3(3.7)	5(6.1)	2
	UCH	35(19.9)	91(51.7)	24(13.6)	26(14.8)		2
I use clinical informatics for communication purposes to alert patients about their treatments	KEH	14(17.1)	38(46.3)	11(13.4)	13(15.9)	6(7.3)	2
	UCH	30(17.0)	71(40.3)	34(19.3)	36(20.5)	5(2.8)	2
I use clinical informatics for the treatment of my patients	KEH	20(24.4)	40(48.8)	11(13.4)	3(3.7)	8(9.8)	2
	UCH	30(17.0)	79(44.9)	30(17.0)	33(18.8)	4(2.3)	2
I use clinical informatics in order to promote effective healthcare delivery	KEH	28(34.1)	34(41.5)	9(11.0)	3(3.7)	8(9.8)	2
	UCH	33(18.8)	98(55.7)	30(17.0)	13(7.4)	2(1.1)	2
I use clinical informatics for administrative information	KEH	22(26.8)	29(35.4)	20(24.4)	6(7.3)	5(6.1)	2
	UCH	30(17.0)	71(40.3)	36(20.5)	34(19.3)	5(2.8)	2
I use clinical informatics for treatment and practice in the hospital	KEH	19(23.2)	37(45.1)	8(9.8)	9(11.0)	9(11.0)	2
	UCH	33(18.8)	96(54.5)	23(13.1)	22(12.5)	2(1.1)	2

SA= Strongly Agree, A=Agree, N= Neutral, D= Disagree, SD= Strongly Disagree

6.3.1 Association between the selected teaching hospitals and the use of clinical informatics for medical diagnosis

This question examined the association between each of the two teaching hospitals and the use of clinical informatics for medical diagnosis. The results revealed that there was no association between the teaching hospital and the use of clinical informatics for medical diagnosis ($p > 0.05$).

Table 6. 13: Association between the teaching hospitals and the use of clinical informatics for medical diagnosis

	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total	χ^2	p-value
KEH	27(32.9)	50(61.0)	5(6.1)	0(0.0)	0(0.0)	82(100.0)	3.127	0.372
UCH	54(30.7)	99(56.3)	21(11.9)	2(1.1)	0(0.0)	176(100.0)		
Total	81(31.4)	149(57.8)	26(10.1)	2(0.8)	0(0.0)	258(100.0)		

6.3.2 Association between the teaching hospital and the use of clinical informatics for disease management

There was no association between teaching hospital and the use of clinical informatics for disease management ($p > 0.05$).

Table 6. 14: Association between the teaching hospital and clinical informatics' use for disease management

	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total	χ^2	p-value
KEH	27(32.9)	40(48.8)	8(9.8)	3(3.7)	4(4.9)	82(100.0)	2.523	0.641
UCH	48(27.3)	99(56.3)	17(9.7)	8(4.5)	4(2.3)	176(100.0)		
Total	75(29.1)	139(53.9)	25(9.7)	11(4.3)	8(3.1)	258(100.0)		

6.3.3 Association between the teaching hospital and the use of clinical informatics for research purposes

There was no association between teaching hospital and the use of clinical informatics for research purposes ($p > 0.05$).

Table 6. 15: Association between the teaching hospital and the use of clinical informatics for research

	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total	χ^2	p-value

KEH	26(31.7)	32(39.0)	11(13.4)	6(7.3)	7(8.5)	82(100.0)	8.312	0.081
UCH	40(22.7)	93(52.8)	21(11.9)	17(9.7)	5(2.8)	176(100.0)		
Total	66(25.6)	125(48.4)	32(12.4)	23(8.9)	12(4.7)	258(100.0)		

6.3.4 Association between the teaching hospital and the use of clinical informatics for decision making

There was no association between the teaching hospital and the use of clinical informatics for decision making ($P > 0.05$).

Table 6. 16: Association between the teaching hospital and the use of clinical informatics for decision making

	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total	χ^2	p-value
KEH	22(26.8)	43(52.4)	6(7.3)	7 (8.5)	4(4.9)	82(100.0)	7.930 ^a	0.094
UCH	29(16.5)	109(61.9)	18(10.2)	18(10.2)	2(1.1)	176(100.0)		
Total	51(19.8)	152(58.9)	24(9.3)	25(9.7)	6(2.3)	258(100.0)		

6.3.5 Association between the teaching hospital and the use of clinical informatics to share knowledge with professional colleagues and medical students

There was an association between teaching hospital and the use of clinical informatics to share knowledge with professional colleagues and medical students ($p < 0.05$).

Table 6. 17: Association between the teaching hospital and the use of clinical informatics to share knowledge with professional colleagues and medical students

	SA N (%)	A N (%)	N N (%)	D N (%)	SD N (%)	Total	χ^2	p-value
KEH	29(35.4)	36(43.9)	9(11.0)	3(3.7)	5(6.1)	82(100.0)	19.794	0.001
UCH	35(19.9)	91(51.7)	23(13.1)	26(14.8)	1(0.6)	176(100.0)		
Total	64(24.8)	127(49.2)	32(12.4)	29(11.2)	6(2.3)	258(100.0)		

6.3.6 Association between the teaching hospital and the use of clinical informatics for communication purposes with patients on their treatments

There was no association between the hospitals and the use of clinical informatics for communication purposes to alert patients about their treatments ($p > 0.05$).

Table 6. 18: Association between the teaching hospital and the use of clinical informatics for communication purposes with patients

	SA	A	N	D	SD	Total	χ^2	p-value
	N (%)	N (%)	N (%)	N (%)	N (%)			
KEH	14(17.1)	38(46.3)	11(13.4)	13(15.9)	6(7.3)	82(100.0)	4.847 ^a	0.303
UCH	30(17.0)	71(40.3)	34(19.3)	36(20.5)	5(2.8)	176(100.0)		
Total	44(17.1)	109(42.2)	45(17.4)	49(19.0)	11(4.3)	258(100.0)		

6.3.7 Association between the teaching hospital and the use of clinical informatics for the treatment of patients

There was an association between the two teaching hospitals and the use of clinical informatics for the treatment of patients ($p < 0.05$).

Table 6. 19: Association between the teaching hospital and the use of clinical informatics for the treatment of patients

	SA	A	N	D	SD	Total	χ^2	p-value
	N (%)	N (%)	N (%)	N (%)	N (%)			
KEH	20(24.4)	40(48.8)	11(13.4)	3(3.7)	8(9.8)	82(100.0)	18.070	0.001
UCH	30(17.0)	79(44.9)	30(17.0)	33(18.8)	4(2.3)	176(100.0)		
Total	50(19.4)	119(46.1)	41(15.9)	36(14.0)	12(4.7)	258(100.0)		

6.3.8 Association between the teaching hospital and the use of clinical informatics to promote effective healthcare delivery.

Chi square analysis indicated that there was an association between the two teaching hospitals and the use of clinical informatics for effective healthcare delivery ($p < 0.05$).

Table 6. 20: Association between the teaching hospital and the use of clinical informatics to promote effective healthcare delivery

	SA	A	N	D	SD	Total	χ^2	p-value
	N (%)	N (%)	N (%)	N (%)	N (%)			
KEH	28(34.1)	34(41.5)	9(11.0)	3(3.7)	8(9.8)	82(100.0)	21.158	0.000
UCH	33(18.8)	98(55.7)	30(17.0)	13(7.4)	2(1.1)	176(100.0)		
Total	61(23.6)	132(51.2)	39(15.1)	16(6.2)	10(3.9)	258(100.0)		

6.4. Comparison of responses from KEH and UCH on the purposes of using clinical informatics

Examination of the difference in responses concerning the purposes of using clinical informatics among medical doctors in the two teaching hospitals was done using Mann-Whitney Test. It was revealed that respondents at UCH used clinical informatics to share knowledge with their professional colleagues compared with the respondents from KEH. The result was statistically significantly higher than the responses from KEH with ($U = 6006.5, p = .02$) as the mean rank at UCH was 136.37 and for KEH 114.75. On the other hand, using clinical informatics for disease management in UCH was not statistically significantly higher than KEH ($U = 6721.5, p = .314$). Also, use of clinical informatics for medical diagnostic purpose was not statistically significantly higher than KEH ($U = 6721.5, p = .657$). In addition, using clinical informatics for research purposes among medical doctors was not significantly higher than the KEH ($U = 7056, p = .758$).

Table 6. 21: Mean ranks of purposes of sing clinical informatics

	Hospital	N	Mean Rank	Sum of Ranks
Clinical informatics is used for disease management	KEH	82	123.47	10124.50
	UCH	176	132.31	23286.50
	Total	258		
I use clinical informatics for medical diagnosis purposes	KEH	82	126.77	10395.00
	UCH	176	130.77	23016.00
	Total	258		
I use clinical informatics for research purposes	KEH	82	127.55	10459.00
	UCH	176	130.41	22952.00
	Total	258		
I use clinical informatics for decision making	KEH	82	122.55	10049.50
	UCH	176	132.74	23361.50
	Total	258		
I use clinical informatics to share knowledge with my professional colleagues and medical students	KEH	82	114.75	9409.50
	UCH	176	136.37	24001.50

	Total	258		
I use clinical informatics for communication purposes, to alert patient on their treatments	KEH	82	127.20	10430.00
	UCH	176	130.57	22981.00
	Total	258		
I use clinical informatics for the treatment of my patients	KEH	82	118.36	9705.50
	UCH	176	134.69	23705.50
	Total	258		
I use clinical informatics in order to promote effective healthcare delivery	KEH	82	120.36	9869.50
	UCH	176	133.76	23541.50
	Total	258		
I use clinical informatics for administrative information	KEH	82	119.56	9804.00
	UCH	176	134.13	23607.00
	Total	258		
I use clinical informatics for treatment and practice in the hospital	KEH	82	132.68	10879.50
	UCH	176	128.02	22531.50
	Total	258		

Table 6. 22: Mann-Whitney test

Test Statistics	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
Clinical informatics is used for disease management	6721.5	-1.006	0.314
I use clinical informatics for medical diagnostic purposes	6992	-0.444	0.657
I use clinical informatics for research purposes	7056	-0.308	0.758
I use clinical informatics for decision making	6646.5	-1.151	0.25
I use clinical informatics to share knowledge with my professional colleagues and medical students	6006.5	-2.334	0.02
I use clinical informatics for communication purposes to alert patients about their treatments	7027	-0.355	0.722
I use clinical informatics for the treatment of my patients	6302.5	-1.737	0.082
I use clinical informatics in order to promote effective healthcare delivery	6466.5	-1.457	0.145
I use clinical informatics for administrative information	6401	-1.523	0.128
I use clinical informatics for treatment and practice in the hospital	6955.5	-0.506	0.613

6.5 Objective 3: Benefits of using clinical informatics

This section examined the benefits of using clinical informatics from the views of the medical doctors in the selected hospitals. Benefits refer to the contributions of clinical informatics systems to the success of medical doctors in the course of their duties. Majority of medical doctors in UCH claimed that they used clinical informatics basically to reduce medical errors 158 (87.7%). While doctors from KEH indicated that the major benefit of using clinical informatics was basically to improve diagnostic efficiency. This was the response of 70 (85.1%) doctors from the hospital. Other important benefits of using clinical informatics as shown by the results were: it saves the time of medical doctors. 69(84.1%) respondents from KEH agreed; using clinical informatics to reduce medical error was also indicated by 69(84.1%) respondents. Clinical Informatics increases performance , KEH 64(78.1%) and

UCH 156 (88.1 %); It reduces adverse drug effects, KEH 56(68.2%), UCH 96(50.6) and lastly, It brings about reduction in cost, KEH 52(62%) and UCH 69(50%).

Table 6. 23: Benefits of using clinical informatics

	Hospital	SA	A	N	D	SD	Median
Clinical informatics improves diagnostic efficiency	KEH	37(45.1)	33(40.2)	7(8.5)	5(6.1)	0(0)	2
	UCH	57(32.4)	97(55.1)	16(9.1)	6(3.4)	0(0)	2
It saves the time of medical doctors	KEH	32(39)	37(45.1)	6(7.3)	6(7.3)	1(1.2)	2
	UCH	69(39.2)	88(50)	13(7.4)	6(3.4)	0(0)	2
Clinical informatics can reduce medical errors	KEH	32(39)	37(45.1)	9(11)	4(4.9)	0(0)	2
	UCH	68(38.6)	90(51.1)	13(7.4)	5(2.8)	0(0)	2
Reduces adverse drug effects	KEH	28(34.1)	28(34.1)	17(20.7)	8(9.8)	1(1.2)	2
	UCH	31(17.6)	65(36.9)	54(30.7)	23(13.1)	3(1.7)	2
Reduces costs	KEH	28(34.1)	24(29.3)	15(18.3)	15(18.3)	0(0)	2
	UCH	26(14.8)	63(35.8)	32(18.2)	48(27.3)	7(4.0)	2
Increases performance of medical doctors	KEH	29(35.4)	35(42.7)	14(17.1)	2(2.4)	2(2.4)	2
	UCH	49(27.8)	107(60.8)	18(10.2)	2(1.1)	0(0)	2

6.6. Objective 4: To ascertain the availability of clinical informatics infrastructure in the selected teaching hospitals

An assessment of the availability of clinical informatics tools in the selected teaching hospitals revealed that Electronic Medical Records were available at UCH but not at KEH. Clinical Decision Support Systems and Diagnosis Image Archiving were both available at UCH and KEH, while Computerised Provider (Physician) Order Entry was not available at any of the teaching hospitals.

Table 6. 24: Availability of clinical informatics tools n the teaching hospitals

Types of Clinical Informatics	Available Clinical Informatics	
	KEH	UCH
Electronic Medical Records	No	Yes
Clinical Decision Support Systems	Yes	Yes
Computerised Provider (Physician) Order Entry (CPOE)	No	No
Diagnosis Image Archiving	Yes	Yes

6.7: Objective 5: To identify the clinical informatics facilities that are accessible to the medical doctors

6.7.1 Accessibility of clinical informatics

In terms of accessibility, the results in Table 6.19 revealed that Electronic Medical Records were not accessible to the majority of medical doctors at UCH 101(57.4%). A total of 135 (76.7%) respondents at UCH and 64 (78%) at KEH indicated that Clinical Decision Support Systems were accessible to them. In addition, 152 respondents (86%) from UCH and 67 (81.7%) from KEH indicated that Diagnosis Image Archiving was accessible to them. The results indicated that DIA was the most accessible tool at both hospitals, and that both Clinical Decision Support Systems and Diagnosis Image Archiving were more accessible than Electronic Medical Records at the selected teaching hospitals. However, Electronic Medical Records were not available at all at KEH, and Clinical Decision Support Systems were significantly more accessible at UCH.

Table 6. 25: Accessible clinical informatics tools

	KEH	UCH
	N (%)	N (%)
Electronic Medical Records		
Accessible	NA	75(42.6)
Not Accessible	NA	101(57.4)
Clinical Decision Support Systems		
Accessible	64(78)	135(76.7)
Not Accessible	18(22)	41(23.3)
Diagnosis Image Archiving		
Accessible	67(81.7)	152(86)
Not Accessible	15(18.3)	24(14)

NA: EMR not available

6.8 Objective 5: The factors that influence the behavioural intention to use clinical informatics tools

This section sought to provide a further understanding of the issues surrounding the acceptance of clinical informatics resources by medical doctors at the selected hospitals. As explained previously (Chapter 4), the UTAUT by Venkatesh et al. (2003) was used in this study to determine the perceived factors that influence the behavioural intention to use clinical informatics tools by medical doctors. Various studies on technology acceptance have used the UTAUT to examine perceived factors that influence behavioural intention to use ICT, with varying results. Some of the results, from the theory are consistent with original postulations while others contradict them. Despite this, the UTAUT theory was used because it is considered to be more comprehensive than other theories.

The respondents were asked questions on perceived factors that influence their behavioural intention to use clinical informatics resources. The most rated statement under performance expectancy was: “I find clinical informatics useful in my job”. This was supported by 71(86.6%) from KEH and 164 (93.2%) from UCH. Coming first under the social influence construct was the statement that, “people who are important to me think that I should use clinical informatics”. This was supported with 52(63%) from KEH and 84(47.7%) from UCH.

Under effort expectancy, the statement that, “it will be easy for me to become skilful at using clinical informatics tools” claimed 58 (70.7%) from KEH and 148 (84.1%) from UCH respectively. The highest ranked statement from the respondents from KEH under facilitating conditions was, “My organisation has the support system necessary to use clinical informatics”. While the highest ranked statement from the respondents from UCH was that “My organisation motivates me to use clinical informatics tools”. This was represented with 55 (31.2%). Examining the statement under behavioural intention, it was revealed that majority of the respondents from the two hospitals agreed with the statement that “They used clinical informatics any time they were in the hospitals”

Performance Expectancy (PE)							
	Hospital	SA	A	N	D	SD	Median
I find clinical informatics useful in my job.	KEH	53(64.6)	18(22.0)	5(6.1)	1(1.2)	5(6.1)	1
	UCH	103(58.5)	61(34.7)	11(6.3)	0	1(0.6)	2
Using clinical informatics tools enables me to accomplish tasks more quickly.	KEH	47(57.3)	21(25.6)	8(9.8)	3(3.7)	3(3.7)	2
	UCH	80(45.5)	73(41.5)	19(10.8)	3(1.7)	1(0.6)	3
Using clinical informatics tools improves my job performance.	KEH	42(51.2)	27(32.9)	8(9.8)	0	5(6.1)	3
	UCH	75(42.6)	80(45.5)	18(10.2)	2(1.1)	1(0.6)	3
Using clinical informatics tools saves me time.	KEH	48(58.5)	21(25.6)	8(9.8)	2(2.4)	3(3.7)	3
	UCH	71(40.3)	74(42.0)	22(12.5)	8(4.5)	1(0.6)	2
Social Influence (SI)							
People who influence my behaviour think that I should use clinical informatics.	KEH	27(32.9)	20(24.4)	20(24.4)	7(8.5)	8(9.8)	2
	UCH	24(13.6)	52(29.5)	52(29.5)	33(18.8)	15(8.5)	2
People who are important to me think that I should use clinical informatics.	KEH	24(29.3)	28(34.1)	17(20.7)	7(8.5)	6(7.3)	3
	UCH	24(13.6)	60(34.1)	47(26.7)	36(20.5)	9(5.1)	3

My seniors in the profession have been helpful in the use of clinical informatics.	KEH	16(19.5)	22(26.8)	15(18.3)	18(22.0)	11(13.4)	3
	UCH	17(9.7)	64(36.4)	32(18.2)	44(25.0)	19(10.8)	2
In general, the hospital has been supporting me in the use of clinical informatics.	KEH	16(19.5)	19(23.2)	9(11.0)	20(24.4)	18(22.0)	2
	UCH	14(8.0)	51(29.0)	37(21.0)	50(28.4)	24(13.6)	2
Effort expectancy							
It will be easy for me to become skilful at using clinical informatics tools.	KEH	25(30.5)	33(40.2)	8(9.8)	9(11.0)	7(8.5)	2
	UCH	41(23.3)	107(60.8)	17(9.7)	8(4.5)	3(1.7)	2
I find clinical informatics tools easy to use.	KEH	26(31.7)	31(37.8)	19(23.2)	3(3.7)	3(3.7)	2
	UCH	24(13.6)	102(58.0)	39(22.2)	9(5.1)	2(1.1)	2
Learning to operate clinic informatics tools is easy for me.	KEH	23(28.0)	29(35.4)	25(30.5)	2(2.4)	3(3.7)	2
	UCH	23(13.1)	95(54.0)	42(23.9)	13(7.4)	3(1.7)	2
Facilitating conditions (FC)							
My organisation has the support system necessary to use clinical informatics.	KEH	16(19.5)	19(23.2)	16(19.5)	20(24.4)	11(13.4)	3
	UCH	6(3.4)	47(26.7)	58(33.0)	43(24.4)	22(12.5)	2
My organisation motivates me to use clinical informatics tools.	KEH	11(13.4)	23(28.0)	13(15.9)	21(25.6)	14(17.1)	3
	UCH	8(4.5)	47(26.7)	43(24.4)	54(30.7)	24(13.6)	3
ICT departments help to organise training on the use of clinical informatics tools.	KEH	5(6.1)	26(31.7)	13(15.9)	24(29.3)	14(17.1)	3
	UCH	7(4.0)	46(26.1)	44(25.0)	53(30.1)	26(14.8)	2
Behavioural Intentions							
I intend to use clinical informatics in the work regularly	KEH	15(18.3)	33(40.2)	14(17.1)	12(14.6)	8(9.8)	2
	UCH	31(17.6)	101(57.4)	29(16.5)	9(5.1)	6(3.4)	2
I would use clinical informatics any time I am in the hospital	KEH	24(29.3)	32(39.0)	14(17.1)	6(7.3)	6(7.3)	2
	UCH	25(14.2)	97(55.1)	35(19.9)	11(6.3)	8(4.5)	2
I plan to use clinical informatics	KEH	28(34.1)	31(37.8)	13(15.9)	4(4.9)	6(7.3)	2

any time my patients come to my hospital	UCH	34(19.3)	104(59.1)	24(13.6)	10(5.7)	4(2.3)	2
--	-----	----------	-----------	----------	---------	--------	---

Table 6. 26: Descriptive statistics of the factors that influence the behavioural intention to use CI

6.8.1 Correlation analysis between independent and dependent variables at KEH

The study examined the correlative significance between the independent variables performance expectancy (PE), social influence (SI), effort expectancy (EE) and facilitating conditions (FC)) and the dependent variable (behavioural intention (BI)).

The result from Table 6.26, revealed that performance expectancy and effort expectancy were highly positively correlated with behavioral intentions. Assessments of the inter-correlation matrix between the dependent and the independent variables revealed that performance expectancy had the highest correlation with behavioural intention ($r = 0.566$), followed by effort expectancy ($r = 0.539$). The results indicated that each of the independent variables were all significantly correlated with the medical doctors' behavioural intention to use clinical informatics resources at KEH.

The predictive relationship between the three independent (predictor) variables- performance expectancy (PE), social influence (SI), facilitating condition and effort expectancy (EE) and behavioural intention (BI) were assessed through ordinal linear regression of (BI) on the predictor variables. The coefficient of determination (Pseudo R^2) was 97.7 which indicated that 97.7% of the variance in behavioural intention was explained (predicted) jointly by PE, EE, FC and EE.

The goodness of fit of the regression model was measured by $\chi^2=196.778$ and its significance of 0.000, which indicates a good model. Finally, the result indicated that both performance expectancy ($p=0.00<.05$) and effort expectancy ($p=.00<.05$) Contributed positively to the behavioural intention to the use of clinical informatics.

Table 6. 27: Correlation analysis between the independent and the dependent variables: KEH

		BI
SI	Correlation Coefficient	.366
	Sig. (2-tailed)	.001
	N	82

FC	Correlation Coefficient	.231
	Sig. (2-tailed)	.037
	N	82
PE	Correlation Coefficient	.566
	Sig. (2-tailed)	.000
	N	82
EE	Correlation Coefficient	.539
	Sig. (2-tailed)	.000
	N	82

Table 6. 28: Model fitting information: KEH

Origin	Model	-2Log Likelihood	Chi-Square	Df	Sig.
KEH	Intercept Only	196.778			
	Final	.000	196.778	15	.000

Table 6. 29: Pseudo R-Square

KEH	Cox and Snell	.909
	Nagelkerke	.977
	McFadden	.897

Table 6. 30: Parameters estimates

Origin			Estimate	Std. Error	Df	Sig.
KEH	Threshold	[BI = 1]	49.237	5486.317	1	.993
		[BI = 2]	44.951	5486.317	1	.993
		[BI = 3]	41.873	5486.317	1	.994
		[BI = 4]	29.213	5481.961	1	.996
	Location	[PE=1]	15.316	3876.338	1	.000
		[PE=2]	14.671	3876.338	1	.000
		[PE=3]	-12.687	3876.338	1	.000
		[PE=4]	-37.758	8882.027	1	.000
		[PE=5]	0 ^a	.	0	.
		[SI=1]	7.476	1.741	1	.997
		[SI=2]	5.575	1.390	1	.997
		[SI=3]	4.866	1.379	1	.997
		[SI=4]	0 ^a	.	0	.
		[EE=1]	19.918	3876.339	1	.000
		[EE=2]	18.439	3876.339	1	.000
		[EE=3]	-17.553	3876.338	1	.000
		[EE=4]	-16.121	3876.339	1	.997
		[EE=5]	0 ^a	.	0	.
		[FC=1]	40.615	4942.051	1	.993
		[FC=2]	20.141	218.568	1	.927
		[FC=3]	-18.166	218.566	1	.934
		[FC=4]	-18.481	218.567	1	.933
		[FC=5]	0 ^a	.	0	.

6.8.2 Relationship between use behaviour and behavioural intention to use at KEH

An assessment of the relationship between use behaviour and behavioural intention to use clinical informatics resources. The coefficient of determination (Pseudo R^2) was 0.060 which indicated that 6.0% of the variance in behavioural intention was explained (predicted) jointly

by use of clinical informatics. The goodness of fit of the regression model was measured by $\chi^2=14.675$ and its significance of 0.000, which indicated a good model. Finally, the result indicated that use of clinical informatics ($p=0.019<.05$) contributed to behavioural intention

Table 6. 31: Model fitting information

Model	-2Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	51.233			
Final	36.558	14.675	1	.000

Table 6. 32: Pseudo R-Square

Cox and Snell	.055
Nagelkerke	.060
McFadden	.022

Table 6. 33: Parameter estimates

Origin			Estimate	Std. Error	Df	Sig.
KEH	Threshold	[BI = 1]	-1.696	.362	1	.000
		[BI = 2]	.460	.304	1	.131
		[BI = 3]	1.740	.382	1	.000
		[BI = 4]	2.310	.459	1	.000
	Location	[USE]	.508	.413	1	.019
		[NON USE]	0 ^a	.	0	.

6.8.3 Relationship between use behaviour and facilitating condition to use: KEH

An assessment of the relationship between use behaviour and facilitating conditions. The result revealed that the coefficient of determination (Pseudo R^2) was 0.067 which indicated that 6.7% of the variance in facilitating condition was explained (predicted) jointly by use of clinical informatics.

The goodness of fit of the regression model was measured by $\chi^2=45.65$ and it had the significance of 0.000, which indicated a good model. Finally, the result indicated that use of clinical informatics ($p=0.031<0.05$) contributed to facilitating conditions.

Table 6. 34: Model fitting information

Model	-2Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	71.233			
Final	86.58	45.65	1	.000

Table 6. 35: Pseudo R-Square

Cox and Snell	.058
Nagelkerke	.067
McFadden	.029

Table 6. 36: Parameter estimates

Origin			Estimate	Std. Error	Df	Sig.
KEH	Threshold	[FC = 1]	-3.258	.532	1	.000
		[FC = 2]	-1.246	.338	1	.000
		[FC = 3]	.797	.316	1	.012
		[FC = 4]	2.001	.426	1	.000
	Location	[USE=1.00]	-.905	.420	1	.031
		[USE=2.00]	0 ^a	.	0	.

6.8.4. Correlation analysis between independent and dependent variables at UCH

The study examined the correlative significance between the independent variables performance expectancy (PE), social influence (SI), effort expectancy (EE) and facilitating conditions (FC)) and the dependent variable (behavioural intention (BI)). The results in Table 6.36 showed that there was a significant relationship between the independent variables and

dependent variables. The result from Table 6.36 indicated that performance expectancy and effort expectancy were highly positively correlated with behavioural intentions. Assessments of the inter-correlation matrix between the dependent and independent variables showed that performance expectancy had the highest correlation with behavioural intention ($r = 0.668$), followed by effort expectancy ($r = 0.570$). The results revealed that PE, EE, FC were significantly correlated with the medical doctors' behavioural intention to use clinical informatics resources at UCH while SI was significantly correlated. Which was an indication of a moderately strong correlation between PE, EE and BI while FC and SI had weak correlation

The predictive relationship between the three independent (predictor) variables, performance expectancy (PE), social influence (SI), facilitating condition (FC) and effort expectancy (EE) and behavioural Intention (BI) were assessed through ordinal linear regression of (BI) on the predictor variables. The results indicated in Tables 6:36, 6:37 and 6:38 shown that the coefficient of determination (Pseudo R^2) was 0.822 which indicated that 82.2% of the variance in behavioural intention was explained (predicted) jointly by PE, EE, FC and EE.

The goodness of fit of the regression model was measured by $\chi^2=83.941$ and its significance of 0.000, which indicated a good model. Finally, the result indicated that both performance expectancy ($p=0.00<.05$) and effort expectancy ($p=.00<.05$). Contributed positively to behavioural intention to use clinical informatics in the hospital.

Table 6. 37: Correlation between behavioural intention and SI, FC, EE, FC, EE, PE at UCH

Origin		BI
PE	Correlation Coefficient	.668
	Sig. (2-tailed)	.000
	N	176
SI	Correlation Coefficient	.114**
	Sig. (2-tailed)	.132
	N	176
EE	Correlation Coefficient	.570**
	Sig. (2-tailed)	.000

	N	176
FC	Correlation Coefficient	.282*
	Sig. (2-tailed)	.000
	N	176

Table 6. 38: Model fitting information

Origin	Model	-2Log Likelihood	Chi-Square	Df	Sig.
UCH	Intercept Only	300.518			
	Final	216.577	83.941	14	.000

Table 6. 39: Pseudo R-Square

UCH	Cox and Snell	.779
	Nagelkerke	.822
	McFadden	.809

Table 6. 40: Parameters estimates

UCH	Threshold	[BI = 1]	38.859	3511.354	1	.991
		[BI = 2]	35.421	3511.354	1	.992
		[BI = 3]	33.206	3511.354	1	.992
		[BI = 4]	15.843	3078.511	1	.996
	Location	[PE=1]	.084	.573	1	.883
		[PE=2]	.915	.452	1	.043
		[PE=3]	2.234	.000	1	.
		[PE=5]	0 ^a	.	0	.
		[SI=1]	1.804	1.370	1	.188
		[SI=2]	1.542	1.259	1	.220
		[SI=3]	.915	1.246	1	.463
		[SI=4]	0 ^a	.	0	.
		[EE=1]	.262	3511.354	1	.000
		[EE=2]	1.473	3511.354	1	.000

		[EE=3]	-1.319	3511.354	1	1.000
		[EE=4]	.109	3511.354	1	1.000
		[EE=5]	0 ^a	.	0	.
		[FC=1]	-42.318	1.358	1	.000
		[FC=2]	-38.290	.538	1	.000
		[FC=3]	-37.302	.431	1	.000
		[FC=4]	-37.469	.000	1	.
		[FC=5]	0 ^a	.	0	.

6.8.5 Relationship between use behaviour and behavioural intention to use at UCH

An assessment of the relationship between use behaviour and behavioural intention to use clinical informatics resources revealed thus: The coefficient of determination (Pseudo R²) was 0.078 which indicated that 7.80% of the variance in behavioural intention was explained (predicted) jointly by use of clinical informatics.

The goodness of fit of the regression model was measured by $\chi^2=17.75$ and its significance of 0.000, which indicated a good model. Finally, the result shown indicated that use of clinical informatics ($p=0.009<.05$) contributed to behavioural intention (Table 6:40, 6:41 and 6:42).

Table 6. 41: Model fitting information

Model	-2Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	71.33			
Final	46.658	17.75	1	.000

Table 6. 42: Pseudo R-Square

Cox and Snell	.067
Nagelkerke	.078
McFadden	.032

Table 6. 43: Parameter estimates

Origin			Estimate	Std. Error	Df	Sig.
UCH	Threshold	[BI = 1]	-2.432	.329	1	.000
		[BI = 2]	.412	.260	1	.113
		[BI = 3]	2.120	.349	1	.000
		[BI = 4]	3.561	.607	1	.000
	Location	[USE]	-.837	.319	1	.009
		[NON USE]	0 ^a	.	0	.

6.8.6 Relationship between use behaviour and facilitating condition at UCH

The predictive relationship between the three independent (predictor) variables- Use behavior and behavioural intention (BI) were assessed through ordinal linear regression of (BI) on the predictor variables. The results indicated in Tables 6.43, 6.44 and 6.45 shown that the coefficient of determination (Pseudo R^2) was 0.18 which indicated that 18% of the variance in facilitating condition was explained (predicted) by use behaviour.

The goodness of fit of the regression model was measured by $\chi^2=98.33$ and its significance of 0.000, which indicated a good model. Finally, the result indicated that both use behaviour ($p=0.00<.05$) contributed positively facilitating condition in the hospital.

The following tables assessed the use behaviour and facilitating condition at UCH

Table 6. 44: Model fitting information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	98.33			
Final	106.658	98.0	1	.000

Table 6. 45: Pseudo R-Square

Cox and Snell	.087
Nagelkerke	.180
McFadden	.077

Table 6. 46: Parameter estimate

Origin			Estimate	Std. Error	df	Sig.
UCH	Threshold	[FC = 1]	-3.955	.462	1	.000
		[FC = 2]	-1.555	.289	1	.000
		[FC = 3]	.722	.263	1	.006
		[FC = 4]	3.484	.604	1	.000
	Location	[USE=1.00]	1.001	.315	1	.001
		[USE=2.00]	0 ^a	.	0	.

6.9 Objective 8: Challenges facing the use of clinical informatics

This section examined some of the challenges facing access to and the use of clinical informatics in the two teaching hospitals. The most prominent challenge demonstrated by the medical doctors in UCH was non-availability of desired clinical informatics resources which claimed 168(95.4%). In KEH, absence of sufficient training programme on clinical informatics was rated very paramount which claimed 76 (92.7%). Lack of technical support was rated second among medical doctors in UCH 166(94.3%) and 66 (80.5%) in KEH respectively. The least significant challenges identified were: technophobia UCH 60 (34.1%) and KEH 25 (28.5%). Followed by the negative attitude towards clinical informatics usage, KEH 11(12.2%) and UCH 28(15.9%).

Table 6. 47: Challenges facing the use of clinical informatics among medical doctors

	Hospital	SA	A	N	D	SD	Median
Non-availability of desired clinical informatics tools	KEH	46(56.1)	29(35.4)	3(3.7)	2(2.4)	2(2.4)	2
	UCH	97(55.1)	71(40.3)	7(4.0)	1(0.6)	0.	2
Absence of sufficient training programme on clinical informatics' use	KEH	46(56.1)	30(36.6)	4(4.9)	0	2(2.4)	2
	UCH	90(51.1)	75(42.6)	6(3.4)	4(2.3)	1(0.6)	2
Poor ICT skills on the part of medical doctors	KEH	21(25.6)	32(39.0)	13(15.9)	6(7.3)	10(12.2)	2
	UCH	39(22.2)	88(50.0)	23(13.1)	10(5.7)	16(9.1)	2
Lack of technical support	KEH	35(42.7)	31(37.8)	10(12.2)	3(3.7)	3(3.7)	2
	UCH	68(38.6)	98(55.7)	7(4.0)	2(1.1)	1(0.6)	2
Limited and unreliable supply of electricity	KEH	20(24.4)	31(37.8)	17(20.7)	7(8.5)	7(8.5)	2
	UCH	67(38.1)	75(42.6)	20(11.4)	9(5.1)	5(2.8)	2
Limited access to clinical informatics resources	KEH	19(23.2)	45(54.9)	11(13.4)	3(3.7)	4(4.9)	2
	UCH	63(35.8)	70(39.8)	21(11.9)	9(5.1)	13(7.4)	2
Technophobia	KEH	4(4.9)	21(25.6)	21(25.6)	14(17.1)	22(26.8)	2
	UCH	16(9.1)	44(25.0)	39(22.2)	28(15.9)	49(27.8)	2
I have a negative attitude towards clinical informatics	KEH	4(3.7)	7(8.5)	11(13.4)	22(26.8)	38(46.3)	2
	UCH	12(6.8)	16(9.1)	16(9.1)	56(31.8)	76(43.2)	2

SA= strongly agree, A=Agree, N= Neutral, D= Disagree, SD= strongly disagree

6.10 Summary

This chapter presented and interpreted the data collected using the questionnaire. The questionnaire looked at demographic variables in the respective teaching hospitals in conjunction with benefits, reasons, access to and the use of clinic informatics by medical doctors in the two teaching hospitals. The majority of the respondents were male, and most of the medical doctors were over the age of 30. There were differences in terms of work experience, and it was noted that most of the medical doctors from the two teaching hospitals

had spent less than five years on the job. The medical doctors were largely well qualified and some had acquired Fellowship certificates, which are the equivalent of postgraduate degrees.

Further analysis revealed that age; years of experience, and occupation were significantly related to the use of Diagnostics Image Archiving (DIA). This suggests that these socio-demographic characteristics influence medical doctors' use of DIA. The reason for this may be that DIA allows medical doctors to share medical imagery with members for professional advice. It was also revealed that medical doctors in the Psychiatry department used EMR more than other doctors in the surveyed departments. This indicates that there is a significant association between medical department and the use of clinical informatics.

Regarding the availability of clinical informatics, it was established that Computerised Decision Support Systems and Diagnosis Image Archiving were available in the two teaching hospitals, while EMR was only available at the University College Hospital in Nigeria. The two teaching hospitals had no access to Computerised Decision Order Entries.

In terms of access to clinic informatics, it was revealed that DIA and CDSS were accessible to the medical doctors, and DIA was the most commonly used tool by medical doctors in the two hospitals. There was unequal access to clinical informatics among medical doctors; some departments appeared to have more access to clinical informatics tools than others. This is indicative of a digital divide in the use of clinical informatics among medical doctors in the selected hospitals. Clinical informatics infrastructure was rather inadequate in the selected hospitals, especially considering the fact that the two teaching hospitals are training grounds for medical doctors.

The study employed the use of the theory to determine the factors that influence medical doctors' behavioural intention to use clinical informatics resources and to provide an explanation on clinical informatics' access and use. The study complements related research on technology acceptance and use by exploring the applicability of the UTAUT theory to clinical informatics research. The research revealed that performance expectancy and effort expectancy were the factors that influence medical doctors' behavioural intention to use clinical informatics.

The use of clinical informatics to improve medical diagnosis was rated as the main purpose of adopting clinical informatics. The medical doctors in the two hospitals revealed that clinical informatics assisted them with sharing knowledge with their professional colleagues and their medical students. Knowledge sharing among medical doctors forms a significant part of

effective medical care. It is crucial for medical doctors to share with each other and freely express their ideas and medical experiences. Adequate knowledge sharing among medical doctors both within and outside the hospital may provide tremendous synergies for effective healthcare delivery. It was also noted that there was an association between medical doctors in the two teaching hospitals and the use of clinical informatics for the treatment of patients. The doctors in the two teaching hospitals also admitted that they used clinical informatics for effective healthcare delivery.

The medical doctors stated that the main benefit of using clinical informatics was its ability to reduce medical errors. It was also revealed that the non-availability of clinical informatics' tools was a major challenge facing access to and the use of clinical informatics.

The next chapter presents the interview findings.

CHAPTER 7: DATA PRESENTATION AND ANALYSIS INTERVIEWS

7.1 Introduction

As stated in Chapter five of this study, interviews were used to collect qualitative data in order to triangulate and complement the quantitative findings in Chapter six. The key informants for the interviews consisted of two individuals who were in charge of the ICT departments in the selected teaching hospitals. The head of the ICT unit, at the University College Hospital, is referred to as the Director, while the officer in charge of ICT at the King Edward Hospital is called the Informatics Manager

The research questions that were addressed in both the questionnaire and interviews include: purposes and benefits of using clinical informatics resources; available and accessible clinical informatics resources; factors that influence behavioural intention to use clinical informatics resources; and challenges facing their use. The question on institutional policies was only asked in the interviews; it was not included in the questionnaire. It was believed that in the interviews, the ICT experts would be able to go into far greater detail about the various policies guiding the use of clinical informatics, particularly since they were in charge of ICT development in their respective hospitals (see Appendix B).

Table 7 1: Allignment of research questions and interview questions

	Research Questions	Interview Questions
1	What are the purposes of using clinical informatics tools among medical doctors in the two teaching hospitals?	<ul style="list-style-type: none"> • As experienced Heads of ICT, can you describe various purposes of using clinical informatics tools? • Do you consider clinical informatics useful among medical doctors?
2	What are the benefits of using clinical informatics in the selected Nigerian and South African teaching hospitals?	<ul style="list-style-type: none"> • Can you explain various benefits of using clinical informatics in your hospital? Do the medical doctors appreciate the use of clinical informatics tools? • What are your comments on the benefits of clinical informatics for effective healthcare delivery?
3	What types of clinical informatics tools are available in your hospitals?	<ul style="list-style-type: none"> • Do you have clinical informatics resources in your hospital? • What types of clinical informatics tools are available in your hospital?
		<ul style="list-style-type: none"> • How do you acquire the clinical informatics tools?
		<ul style="list-style-type: none"> • Do you have a committee that recommends the clinical informatics resources that need to be bought?
		<ul style="list-style-type: none"> • Do you have a maintenance department for repairing the clinical informatics resources?
	Which of the clinical informatics tools are accessible to medical doctors in the two hospitals?	<ul style="list-style-type: none"> • Which of the clinical informatics resources are accessible to the medical doctors in your hospital? • Where are the access points for the use of clinical informatics resources? • sAre you satisfied with the clinical informatics resources that are available in the hospital? • Do you think medical doctors in your hospital have the relevant ICT skills to operate the clinical informatics resources?
	What are the factors influencing medical	<ul style="list-style-type: none"> • Identify the various factors that can promote access to and

	doctors' behavioural Intention to use clinical informatics?	<p>the use of clinical informatics resources in your hospital.</p> <ul style="list-style-type: none"> • How often do you organise the training of medical doctors on the use of clinical informatics resources? • Do you have any incentives for the medical doctors concerning the use of clinical informatics? • Do the medical doctors consult your office before using the clinical informatics resources?
	What are the institutional policies that are in place towards effective access to and utilization of clinical informatics resources by medical doctors in the selected Nigerian and South African teaching hospitals?	<ul style="list-style-type: none"> • Do you have ICT policies in your hospital? • Are the medical doctors aware of ICT policy documents? • Do you include the teaching of ICT in the medical school curriculum for the medical students? • Do you consider the ICT skills of medical doctors before employing them in the hospital? • What strategies has the hospital put in place to encourage medical doctors to use clinical informatics resources? • What are your opinions on medical doctors' use of ICT?
	What are the challenges facing access to and the use of clinical informatics in the two teaching hospitals?	<ul style="list-style-type: none"> • What are the challenges facing access to and the use of clinical informatics?

7.2. What are the demographic characteristics of the respondents?

The respondents were asked about their educational qualifications, status, and the names of their respective hospitals. Under the demographic characteristics of the respondents, the following characteristics of the respondents were considered. Some of these are: the name of the hospital, qualifications of the respondents and status of ICT managers.

Table 7 2: Characteristics of the participants from the teaching hospitals

Name of the hospital	Status	Qualification	Remarks
UCH, Ibadan, Nigeria	Director of ICT	BSC, M.SC	The ICT department is a department on its own with a functional building and staff.
King Edward Hospital, Durban	Informetric manager	Diploma Certificate	The ICT department has only one office with no supporting staff. The department is under the office of the CEO.

7.3 What are the purposes of using clinical informatics tools?

The question sought to know the purposes for which clinical informatics is being used.

Table 7. 3: The purposes of using clinical informatics tools

University College Hospital, Ibadan	<ul style="list-style-type: none"> I think there are many purposes of using ICT, by medical doctors, in this hospital. First, the medical doctors use ICT to diagnose their patients and to share and search for information. We also use it to teach our medical students - if you visit our telemedicine centre, we use ICT to teach our medical students. They can also watch operations being done in a hospital in India; we have an agreement with that hospital. Another purpose of using clinical informatics is to monitor the health condition of the patients. In our ICU unit, we have a lot of vital machines that can send signals about the health condition of patients, such as BP; even in our eyes clinic. There is no area of medicine in which we don't need ICT. Even in checking patients' records, we need it. Basically, diagnosis, treatment of patients, and providing medical
-------------------------------------	---

	doctors with an insight into patients' conditions are some of the reasons why medical doctors need ICT.
King Edward VIII, Durban	<ul style="list-style-type: none"> • There are a lot of reasons why medical doctors need ICT, such as for the effective diagnosis and treatment of the patients. It can also help them to understand the medical history of the patients. In fact, it can even guide them in prescribed treatment. Look at how X-ray is being done now; the results will appear on the doctors' computers without patients' carrying films. • The same with laboratory tests. Albert Luthuli, here in Durban, is a paperless hospital. The hospital is fully computerised.

7.4 What are the benefits of clinical informatics to medical doctors in your hospital?

- This question sought to investigate if clinical informatics is useful in medical practice.

Table 7. 4: Usefulness of clinical informatics in medical practice

UCH, Ibadan	Clinical informatics is very useful to medical doctors, particularly in diagnosis. It assists medical doctors with making clinical decisions.
KEH	Clinical informatics assists medical doctors with examining patients, diagnoses, and reducing medical errors.

7.5 Are clinical informatics resources available in your hospital?

- This question established whether clinical informatics resources were available in the two hospitals.

Table 7. 5: Availability of clinical informatics

Hospital	Yes we have clinical informatics
KEH	Yes

UCH	Yes
-----	-----

7.5.1 How do you acquire clinical informatics tools?

- This question aimed to identify how the respondents acquired clinical informatics tools for their hospitals

Table 7. 6: Acquisition of clinical informatics

	Ways of acquiring clinical informatics tools
KEH	<ul style="list-style-type: none"> • From the KZN Department of Health
UCH	<ul style="list-style-type: none"> • There are many ways in which we get ICT equipment for the hospital, beginning with the Federal Government of Nigeria, through the Federal Ministry of Health which is the owner of the hospital. • Secondly, through Public Private Partnerships (PPPs). • Through donations; recently the National Communication Commission donated some computers to the hospital. • At the same time, the hospital buys various ICT tools in order to promote effective healthcare delivery.

7.5.2 Do you have a committee that recommends clinical informatics tools to you?

- It was necessary to determine whether there was a committee in place to recommend clinical informatics resources.

Table 7. 7: Committee that recommends clinical informatics tools

Hospital	Comments
KEH	<ul style="list-style-type: none"> • There is no committee in place. All the ICT tools we use in the hospital were sent from the province, while NHLS provides access to computers in the laboratory.
UCH	<ul style="list-style-type: none"> • Yes. We have a committee in place that recommends the necessary ICTs that the hospital needs to the Chief Medical Director of the hospital. • At times, individual medical doctors can recommend some specific tools to us. • As the first teaching hospital in Nigeria, we have an alliance with some hospitals outside the country and they recommend the latest ICT tools to

	us.
--	-----

7.5.3 Do you have maintenance department for repairing clinical informatics resources?

- This question aimed to identify how the hospitals repaired faulty clinical informatics tools.

Table 7. 8: Availability of maintenance department

KEH	<ul style="list-style-type: none"> • We have a general maintenance department. However, if it is a major repair, it will be sent to the Department of Health in the province.
UCH	<ul style="list-style-type: none"> • There is a department for repairing medical equipment and clinical informatics tools. The department is called the Bio-medical Equipment unit, and their main duty is to repair medical equipment.

7.6 What clinical informatics resources are available in your hospital?

- This question aimed to identify the various clinical informatics resources that are available in the hospitals.

Table 7. 9: Available clinical informatics tools in the hospitals

Types of clinical informatics tools	King Edward Hospital	University College Hospital
Electronic medical records (EMR)	Not available	Available (Patients Registration System)
Computerised decision support system (CDSS)	Available	Available
Computerised physician order entries (CPOE)	Not available	Not available

Diagnosis Imagery archiving(DIA)	Available	Available
----------------------------------	-----------	-----------

7.6.1 What are the sources of finance for acquiring clinical informatics resources?

- This question was asked to identify the sources of finance for purchasing clinical informatics resources, for the two hospitals.

Table 7. 10: Sources of fianance for acquiring clinical informatics resources

KEH	<ul style="list-style-type: none"> • We get all the ICT equipment from the KZN Department of Health. We don't buy any ICT equipment on our own. It is the responsibility of the Department of Health.
UCH	<ul style="list-style-type: none"> • Mostly, we get our finances for ICT from the Federal Ministry of Health. Individuals can also donate to the hospital, and also from hospital management.

7.7 Which of the clinical informatics resources are accessible to the medical doctors in your hospital?

The aim of this question was to identify the clinical informatics tools that are accessible to the medical doctors in the teaching hospitals.

Table 7. 11: Accessible clinical informatics tools

Clinical informatics	UCH	KEH
CPOE	<ul style="list-style-type: none"> • We don't have this in the hospital but we are working on a pharmacy module, in which doctors will prescribe a drug and the pharmacist will get the prescription on his or her computer. 	<ul style="list-style-type: none"> • No. We don't have it in the hospital. The National Health Laboratories are in charge of clinical informatics tools in the Province. • NHLS are the ones that provide computers to all the laboratories. The Department of Health (DOH) provides computers to the clinics. NHLS provided the doctors with the password in order to access the computers and link to the website of the organisation.

CDSS	<ul style="list-style-type: none"> • Yes we have. Some use it for vital sign tests. We also have it in the ICU, theatres, emergency, and in some departments like haematology and the dental centre. 	<ul style="list-style-type: none"> • We have, mostly in the laboratories, clinics and theatres.
DIA	<ul style="list-style-type: none"> • Yes, we do have 	<ul style="list-style-type: none"> • We have the radiology machine that can send X-rays to medical doctors' computers in the clinics
EMR	<ul style="list-style-type: none"> • We have an abridged version of EMR at the hospital. We have this in the geriatrics unit of the hospital and it is called the Patient Registration System. The information on the card of the patients is transferred to computers and medical doctors have access to the patients' information at the Health Information Unit of the hospital through the file number. However, it has not been done in the other clinics, in the hospital, apart from the geriatrics unit, which was donated to the hospital. 	<ul style="list-style-type: none"> • As I said earlier, we don't have it. NHLS and DOH have not provided it to the hospital. As a result, EMR is not accessible to medical doctors in the hospital. We are still using traditional file and paper for patients' information.

7.7.1 Where are the access points for the use of clinical informatics?

- This question sought to identify various access points via which medical doctors can access clinical informatics

Table 7. 12: Access points for the use of clinical informatics

KEH	<ul style="list-style-type: none"> • We have different access points. We have (access) in the laboratories, particularly for checking laboratory results through computers, and this can be done by using the patient's surname, out-
-----	--

	<p>patient number, dates on specimens, and blood codes. Radiologists can also send X-ray reports to medical doctors' computers in the clinics.</p> <ul style="list-style-type: none"> • There are different classifications of patients in hospitals. The same method is applicable in all the healthcare facilities in the province. We have full paying healthcare users, subsidised healthcare users and free patients. • Subsidised patients are classified based on their ability to pay for healthcare services which are H0, H1, H2 and H3. • Patients are grouped from H1 to H3 which is largely dependent on their income. • While H0 are those that cannot afford to pay the stipulated fees. Particularly those who are called social pensioners. • Fee paying patients are those that are enjoying health insurance scheme, hence, need to pay.
UCH	<ul style="list-style-type: none"> • Apart from the geriatrics unit that has EMR, no other unit has it in the hospital. We are making arrangements to connect the doctors in their different clinics and wards, but they can access the EMR in the Health Information Unit. • In terms of the computerised decision support system, we have the system in different clinics for examining patients and for vital sign monitoring. We also have other ICT equipment in various units in the hospital. • The X-ray units are domicile in the radiological department of the hospital, and doctors can use their system to view the results of an X-ray. MRI and CT scans are also available and medical doctors have access to them. There are some PPP initiatives for the use of clinical informatics. From the PPP diagnosis center in the hospital they can send the results to medical doctors' email addresses or the doctors can also visit the centres to confirm the results. Work is still ongoing on the following modules: clinical management module, pharmacy module, and laboratory module.

	<ul style="list-style-type: none"> • In this hospital, patients pay for the use of clinical informatics; medical diagnosis, either with PPP or by using the hospital tools. Our patients pay for the services. They are not free services. In those with NHIS (National Healthcare Insurance), they pay through their healthcare providers.
--	--

7.7.2 Are you satisfied with the clinical informatics resources that are available in the hospital?

- The question sought to determine if the medical doctors were satisfied with the clinical informatics resources.

Table 7. 13: Satisfaction of medical doctors with clinical informatics resources

KEH	<ul style="list-style-type: none"> • Concerning this question, I don't think our doctors are satisfied with the ICT tools they use. Bear in mind that, many of our doctors are working at Albert Luthuli and they see the types of ICT resources that they have. I think they would like to have more ICT resources in the hospital.
UCH	<ul style="list-style-type: none"> • Surely they are not; they would like to have better ICT resources. They would like to view information about patient health on their system. Well, we will get there.

7.8 What are the various factors that can promote clinical informatics' access and use in the two hospitals?

- The essence of this question was to identify various factors that can promote access to and the use of clinical informatics among medical doctors.

Table 7. 14: Factor that can promote the use of clinical informatics in the hospitals

KEH	<ul style="list-style-type: none"> There are many factors that can promote the use of ICT among medical doctors. These factors include the availability of the resources. If they are available and accessible, the medical doctors will use them.
UCH	<ul style="list-style-type: none"> Yes, the availability of the resources can promote access and use. Adequate training and good computer skills are other factors that can promote the effective use of the tools. There should be adequate awareness about the importance of the resources. Medical doctors would like to have state of the art ICT facilities, good networks, and robust applications.

7.8.1 How often do you organise the training of medical doctors on the use of clinical informatics?

This question sought to determine the frequency of training in the use of clinical informatics by medical doctors.

Table 7. 15: Frequency of training in the use of clinical informatics

KEH	<ul style="list-style-type: none"> The issues of training can only be handled by the Department of Health at provincial level. However, if any medical doctor is employed, the senior doctors can teach him/her how to operate the tools. At the hospital level, we don't have anything to do with issues of training.
UCH	<ul style="list-style-type: none"> We have training for various modules like the pharmacy module. We always organise training for them on various modules, aside from various ICT training that we offer for all members of staff at the hospital. Training and retraining of members of staff is one of our basic functions in the department. We organise the training on a departmental and individual basis.

7.8.2 Do they consult your office before using clinical informatics tools?

- This question sought to determine if the medical doctors consult the ICT units for any assistance concerning the use of clinical informatics tools.

Table 7. 16: Consulting the ICT units for assistance concerning the use of ICT

UCH	<ul style="list-style-type: none"> • Yes. They do consult us anytime they encounter challenges in the use of the modules, particularly when a new module is introduced.
KEH	<ul style="list-style-type: none"> • Yes, but we always refer their complaints to the KZN Department of Health.

7.9 Do you have an ICT policy in your hospital?

- The question sought to know if the hospitals have ICT policy that guide the use of clinical informatics.

Table 7. 17: ICT policy in the two teaching hospitals

UCH	<ul style="list-style-type: none"> • The hospital has no ICT policy, but we follow the Federal Government of Nigeria and Computer Society of Nigeria Policy, to guide our operations in the department.
KEH	<ul style="list-style-type: none"> • We don't have an ICT policy in the hospital. As I said earlier, we only take directives from the KZN Department of Health. Likewise, we use the ICT policy from the province. As for the hospital, we don't have an ICT policy in the hospital.

7.10 What are the challenges facing the use of clinical informatics resources?

- This question was asked to identify the challenges facing the use of clinical informatics resources in the two hospitals?

Table 7. 18: Challenges facing the use of clinical informatics

UCH	<ul style="list-style-type: none"> • We have many challenges facing the use of clinical informatics in the hospital. The major problem is funding. It will be of interest to you, to know that some of these equipment are very expensive, and the high inflation rate and foreign exchanges make it very difficult for the hospital to buy some of these latest equipment. • Secondly, there is problem of power supply. Due to the shortage of power supply to the hospital, equipment is mostly operated with alternative power sources which are too expensive for the hospital.
KEH	<ul style="list-style-type: none"> • Our major challenge is that, we cannot do anything in the hospital without

	informing the Provincial health Department. Concerning the acquisition of clinical informatics, we cannot buy any of the tools on our own. We need to inform the Department of Health.
--	--

Table 7. 19: Strategies to promote the use of clinical informatics resources among medical doctors

UCH	<ul style="list-style-type: none"> • We organise the training of medical doctors on the use of ICT. This can be done on an individual and departmental basis. We educate them on how to use new modules and we create awareness about the importance of clinical informatics in effective healthcare. • We also advise the hospital management on the need to acquire various ICT tools that will support better healthcare delivery in the hospital. • We also organise meetings with various bodies. The hospital is on its way to develop access to and the use of ICT in the hospital. • We submit annual strategy plans for ICT development to the hospital management.
KEH	<ul style="list-style-type: none"> • The issues of strategy on ICT development, in the hospital, are being handled by the Department of Health. We only serve as a link between the hospital and the Department of Health. Everything concerning training, policy, and strategic plans is in the hands of the KZN Department of Health.

7.11 Summary

This chapter presented the interview responses by ICT experts at the two teaching hospitals. The interviews were conducted in order to confirm the quantitative data gathered from the questionnaire. The heads of the ICT departments were asked to provide their insights concerning the policy issues guiding the use of ICT. This question was not included in the questionnaire. It was revealed that the two hospitals had no policy guiding the use of ICT. Rather they were depending on professional bodies and their respective Departments/ Ministries of Health's ICT policies. The lack of an ICT policy at the two hospitals may be slowing down clinical development in the two hospitals and impeding the awareness of the importance of clinical informatics in effective healthcare delivery.

The next chapter discusses the findings from the questionnaire and interviews

CHAPTER 8: DISCUSSION OF THE FINDINGS

8.1. Introduction

This chapter discusses the findings of this study on the access to and use of clinical informatics at King Edward VIII Hospital, Durban, South Africa, and University College Hospital, Ibadan, Nigeria. Kothari (2004) affirms the importance of the interpretation of research findings, as an interaction between theoretical orientation and empirical observation that introduces originality and creativity into academic research. Kalusopa (2011) observes that, unguided and unsupported discussions may lead to incorrect interpretation and inaccurate conclusions, even if the data was properly collected and analysed.

The discussion is based on the objectives of the study as stated in Chapter one. These objectives include:

1. to determine the association between socio-demographic variables and the use of clinical informatics;
2. to explain the purposes of using clinical informatics among medical doctors in the selected teaching hospitals;
3. to determine the benefits of using clinical informatics in the selected hospitals;
4. to ascertain the availability of clinical informatics infrastructure in the selected hospitals;
5. to identify the clinical informatics facilities that are accessible to medical doctors in the selected South African and Nigerian teaching hospitals;
6. to determine the factors that influence behavioural intention to use clinical informatics by medical doctors in the selected teaching hospitals;
7. to determine the policies that guide the use of clinical informatics in the selected teaching hospitals;
8. to investigate the challenges facing both the access to and use of clinical informatics among medical doctors in the selected teaching hospitals.

8.2. Characteristics of the respondents in the selected teaching hospitals.

The respondents consisted of medical doctors from ten departments in King Edward VIII Hospital, Durban, South Africa, and the University College Hospital, Ibadan, Nigeria. 82

respondents (31.8%) from King Edward Hospital participated in the study and 176 respondents (67.2%) participated from the University College Hospital. The high number of medical doctors at UCH, Ibadan, Nigeria may be attributed to the fact that the hospital has high medical personnel compared with King Edward VIII hospital, Durban, South Africa. At the same time, the hospital is the premier hospital in the country and it is the hospital of the last referral, which is located in the biggest city in West Africa.

Questionnaires were administered to medical doctors in the two hospitals. In addition, two managers in charge of the Information and Communication Technology departments of the two teaching hospitals were also interviewed.

The frequency distribution reveals that, males constituted the majority of respondents from the two teaching hospitals (159; 61.60%) compared to females (99; 38%). The dominance of male medical doctors, in hospitals, is frequently reported in literature (Olok et al, 2015; Ajuwon, 2015 and Gunds et al., 2012). Evidence from the study suggests that, there were more male medical doctors than female medical doctors. Khan (2012) observes that males' preference for the medical profession was stronger than females in the UK hospitals. According to the report on the State of Medical Education in UK 2013, there were 252, 553 registered medical doctors in UK in 2012 in which 57% of them were male and 43% were female (General Medical Council, 2013). In Japan, 18.9% out of 55,897 medical doctors were females while 81% were male medical doctors (Nomura, Yamazaki, Grupper, Horrie, 2015).

In Nigeria, Okonta, Akpayank, Amusan, Effiong, Adamu and Ocheli (2015), in their study on house officers' choice of medical areas of specialisations in Nigeria, found out that 79 (61.2%) of medical doctors in the country were males while 50 (38.8%) were females. They attributed the poor attitude of females to the issue of long working hours, which they claimed many female medical doctors were against. In the same vein, Matthew (2015) affirms that, the poor enrolment of females to the medical profession is the outcome of the societal belief that it is a patriarchal profession. With respect to age, it was established that, the majority of the respondents from the two teaching hospitals were between the ages of 30 - 39 years (45%), closely followed by those who were 20- 29 years of age (39.10%). A large number of the respondents were young medical doctors between the ages of 30 and 39 years. These doctors are considered to be in their prime, in terms of medical practice. This age grade is advantageous to the two teaching hospitals with respect to building the careers of doctors. There were also experienced medical doctors to mentor the younger, incoming generation of medical doctors. The finding of the study supports the submission of Okonta et al. (2015)

that, most of the medical doctors in Nigerian teaching hospitals were between the age of 21 and 40, with the mean of 22.4.

Gesensway (2013) notes that, medical doctors at Michigan are usually younger people whose average age is less than 40 years. This is contradicting the finding of The Physicians Foundation (2012) that over 72% of medical doctors in United States of America is over 40 years of age. Also, the finding contradicts the submission of Young et al. (2015), in their research, on medical doctors in the United States of America, where it was revealed that the majority of medical doctors in the country were between the ages of 47 - 55 years. This could be due to the government policy in the United State of America that does not permit high school certificate holders to seek admission to medical schools; only graduates with a first degree are allowed to do so. However, in Nigeria and South Africa, fresh secondary students are allowed to enrol in the university for Medicine without any first degree certificate.

A critical examination of the years of experience of the respondents revealed that, the majority of the surveyed medical doctors, in the two teaching hospitals, had spent between 1-5 (41.90%) years in the profession. Teaching hospitals are designed to train young medical doctors on how to conduct medical research and deliver effective medical care. The indication that there were more young medical doctors in the two teaching hospitals may be due to one of the distinctive aims of a teaching hospital, which is to provide medical education, training, and innovation in medical care, and simultaneously engage in the treatment of needy healthcare users. The American Hospital Association (2009) notes that teaching hospitals are training grounds for young medical doctors in their resident programmes, and for fresh graduates who are ready to serve as housemen.

On the other hand, Rouf, Whittle, Lu and Schwartz (2007) note that, the years of experience of medical doctors contribute to their conscientiousness on the job. This implies that the years of experience of medical doctors may enhance their job performance and increase their practical knowledge.

The study establishes that there was a digital divide with respect to certain socio-demographic variables and the use of clinical informatics, particularly with the age variable, where it was found that young medical doctors used clinical informatics tools more than the older doctors. It was also found that years of medical experience were associated with the use of clinical informatics tools. This supports the submission of Brook and Menachemi (2006) that the use of clinical informatics by medical doctors indicates the significant relationships with various

variables such as age, medical specialisation, and medical experiences among medical doctors in the state of Florida.

The results of the study revealed that, most of the respondents in the two teaching hospitals were medical registrars (110; 42.6%), closely followed by medical officers (78; 30.2%). The high number of medical registrars can be attributed to their need to receive postgraduate training in accredited teaching hospitals in order to become specialists or medical consultants in any field of medicine. It was also found out that the Department of Medicine had the highest number of respondents compared to the other departments surveyed in the study. The Department of Medicine had (49; 19%), followed by the Department of Obstetrics and Gynaecology (35:14%). The high number of medical doctors in the Department of Medicine may be due to the availability of various areas of specialisation.

It was also revealed that, there were few respondents from the Department of Haematology (2; 4.7%). This serves to corroborate the result of a study by Salary and Voice (2016) that, there were very few medical doctors in the Department of Haematology in USA teaching hospitals. Salary and Voice (2016) attributed this to the fact that haematologists spend a lot of time on research in order to use their expertise, abilities and skills for the effective treatment of their patients. They further state that, becoming a haematologist requires a lot of training. This may be the reason so few of them participated in the present study.

Survey results, describing the level of medical doctors' educational qualifications, indicate that the majority of the medical doctors in both teaching hospitals (224; 86.80 %) had the MBBCH degree. 12 (4.7%) of the respondents had Master's degrees, and 22 (8.05%) of the respondents were fellowship members. Ayanian and Weissman (2002) affirm that, fresh graduates from medical schools gain their clinical knowledge and necessary experience, by engaging in training, in teaching hospitals. It is the standard qualification for becoming a medical practitioner.

The presence of many MBBCH graduates confirms the teaching aspect of the hospitals. The graduates need to get adequate medical education and training for the effective treatment of patients, and to specialise in their various fields. Carrs, Celensa, Puddey and Lake (2014) observe that, the educational qualifications of medical doctors encourage better task performance, because they provide them with the necessary knowledge and skills to use in the tasks ahead. It is widely accepted that effective healthcare and the safety of patients can only be ensured when medical doctors are well prepared for the job ahead.

8.3. Association of socio-demographic variables and the use of clinical informatics tools

This section discusses the association between socio-demographic variables and the use of Electronic Medical Records, the Clinical Decision Support System, and Diagnosis Imagery Archiving. The socio-demographic variables that were considered include gender, age, and years of experience, professional position, department, teaching hospitals, and qualifications.

8.3.1 Association between socio-demographic variables and the clinical decision support system

In examining the association between socio-demographic factors and the use of the Clinical Decision Support System (CDSS), it was observed that the teaching hospital, position, years of experience, age, department and qualification had a significant association with the use of CDSS ($P > 0.05$), while gender did not. A study by Ngwenya (2013) indicates that age, years of experience and qualification had a significant influence on the application of CDSS among staff in selected universities in Zimbabwe.

Earlier studies have also revealed that there is variation in the use of ICT by various disciplines (Al-Shanbari and Meadow, 1995; Jankowska, 2004; and Tahir et al., 2010). Santucci, Day, and Baysari (2016) state that, the intensive care unit in a teaching hospital, in Sydney, used CDSS than other general wards in the hospitals, in the two countries. They attribute this to the fact that the ICU unit experiences higher rates of observation of critical health conditions of patients, work load of medical doctors, and intensity of care of patients in the medical unit. They concluded that CDSS in ICU units can have positive impacts on drug prescription, reduce medical errors and adverse drug events.

Ash, McCormack, Sittig, Wright, McMullen and Bates (2011) reveal that the hospital type determines the association between the CDSS and teaching hospitals. They state that out of 5795 hospitals in US, only teaching hospitals (11.9%) have access to CDSS. Patel, Green, Shahzard, and Larkin's (2015) reveal that, in a UK teaching hospital, junior doctors use Clinical Decision Support System more.

8.3.2 Association between socio-demographic variables and the use of Electronic Medical Records

The majority of medical doctors in the Psychiatry Department claimed to have used Electronic Medical Records (EMRs). Closely followed they are the medical doctors in the Radiology Department. The results reveal that there was a significant association between medical

departments and the use of EMRs at the University College Hospital, Ibadan, Nigeria ($X^2 = 17.709$, $P < 0.05$). The result is confirmed by Stewart et al. (2010), who discovered that, medical doctors in Psychiatry units used EMR more than other doctors in the hospital. This is because EMR limits the unnecessary flow of communication with their patients. Medical doctors can access the information of their patient on the system and at the same time maintaining the confidentiality of the health records of patients. Using EMR assists Psychiatry doctors with gaining access to information about the patient and promotes the confidentiality and privacy of the information that is exchanged between patients and medical doctors.

In addition, the result revealed that Radiology department came second in the use of EMR. This supports the submission of McEnery (2013) that, the electronic medical record is the core information system for healthcare users across the healthcare system. It was stated that EMR is the core information system for medical doctors in radiology department, particularly in booking for healthcare users' appointment, patients' examination performance and tracking of results, distribution of results and for procedure billing. Mc Energy (2013) states that in 2009, 85% of medical doctors in radiology department in Spanish hospitals used EMR for various medical examinations on patients.

8.3.3 Association between socio-demographic variables and the use of diagnostic image archiving

The majority of the medical doctors claimed to have used Diagnostic Image Archiving (DIA), in one way or another, during their careers. The results indicated a strong association between the socio-demographic characteristics of respondents and the use of Diagnostic Image Archiving. Age ($X^2 = 12.513$; $P < 0.05$), years of experience ($X^2 = 12.262$, $P < 0.05$), and position ($X^2 = 11.792$) were significantly related to the use of Diagnostic Image Archiving.

Furthermore, age of medical doctors is significantly related to use of DIA. This contradicts the finding of Pare, Lepanto, Aubry and Sicotte (2005) that there is no significant difference between the ages of radiologist doctors and the use of DIA in a teaching hospital in Canada. Likewise, Aladosari (2012) confirms this finding among radiology staff at KAMC, Riyadh, Saudi Arabia. In the same vein, Ward, Steven, Brentnall and Briddie (2008) conducted a literature review on various demographic variables concerning the attitude of health care staff to IT and found out that, age and gender did not have any significant effect on the respondents' attitude towards health-related IT. In another study, Duyck, Pynoo, Devolder, Voet, Adang and Ovaer (2010) examined the DIA implementation in a teaching hospital. The study also supports that gender and age do not have influence on the use of DIA. In addition,

Duyck et al. (2010) and Goodarzi et al. (2016) state that there is no significant difference in the acceptance of DIA among various medical specialities concerning the use of DIA.

However in this study, it was discovered that years of experience were significantly related to the use of DIA by medical doctors. Duyck et al. (2008) note that, the years of experience of medical doctors in the use of DIA led to an overall improvement in the use of the technology in a teaching hospital in Belgium. However, Ward et al. (2008) observe that, medical occupation, professional ranking, age and years of experience which are related to the use of DIA by medical doctors produce mixed results, and none of the demographic variables appear to be consistent indicators that can influence the use of the technology.

8.4. Purposes of using clinical informatics among medical doctors in the selected teaching hospitals

The surveyed medical doctors stated that, their main reason for using clinical informatics was for medical diagnosis. This finding was corroborated in the interviews with the ICT specialists. Medical diagnosis is the process of examining conditions in order to determine an individual's symptoms and ailments. This supports Chiffi and Zanotti's (2014) assertion that, medical diagnosis is a very important aspect of effective healthcare delivery among medical doctors. The use of relevant ICT tools by medical doctors, in the examination of patients, is an indicator of quality healthcare. The use of clinical informatics resources in medical examinations can prevent wrong treatment and misdiagnosis and assist medical doctors with analysing medical data and testing patients accordingly. Early diagnosis is also very important in the medical examination of patients because it helps medical doctors quickly identify the next line of action.

In the past, medical examinations could only be performed by physically looking for symptoms and interacting with patients to determine what is wrong. With the advent of clinical informatics, there have been various innovations and developments that have made diagnoses more accurate, evidence-based and faster. These innovations include DIA equipment such as CAT and MRI. Hasting Centre Report (1991), Olorode and Oladuni (2002) and Maharana et al. (2009) concur that appropriate medical diagnosis is one of the main reasons medical doctors use clinical informatics facilities.

The associations between the two teaching hospitals and the use of clinical informatics for knowledge sharing with their professional colleagues, treatment of patients and use of clinical informatics to promote effective healthcare delivery were revealed. Panahi (2014) affirms

that, knowledge sharing is necessary to improve the quality of care among medical doctors in teaching hospital. He highlights knowledge that medical doctors in teaching hospitals can share to include, 'sharing of clinical experiences, skills, know-how or know-who, is known to have a significant impact on the quality of medical diagnosis and decision' Lai (2005) confirms that, clinical informatics tools are very convenient for sharing and disseminating knowledge among medical doctors. The survey report of McGowan et al. (2012) confirm that, 60% of medical doctors in USA teaching hospitals use clinical informatics to share knowledge with their professional colleagues.

Olatokun and Adeboyejo (2009) corroborate the finding in their study on the use of ICT among medical doctors in a Nigerian teaching hospital. It was revealed that one of the reasons why health workers in the country used ICT is for knowledge sharing. Ajuwon (2006) affirms that the use of clinical informatics promotes effective knowledge sharing among medical doctors in a teaching hospitals in Nigeria. Asemahagn (2014) conducted a study on knowledge sharing among health workers in Ethiopia. In that study, 218 medical doctors (70%) acknowledge the importance of knowledge sharing in their medical practices.

Another finding of the study was the association between the use of clinical informatics in teaching hospitals and treatment of patients. This indicates that, medical doctors find clinical informatics useful for them to treat their patients, particularly in the teaching hospitals. The finding affirms the submission of Kilbridge and Classen (2008) that, medical doctors generally use clinical informatics to treat patients in order to improve patients' safety, particularly in the teaching hospitals. Supporting this, Bates, Leape, Culler, Laird and Teich (1998) assert that, clinical informatics use by medical doctors in teaching hospitals contribute toward effective treatment of patients, through improving access to clinical information and reducing reliance on medical doctors' use of their memories. Nwargu, Adegunwa and Soyannwo (2013), in their study on managing patients with cancer, at a teaching hospital in Nigeria, claim that, there is an association between the use of clinical informatics among medical doctors in teaching hospitals and treatment of patients. The study reveals how medical doctors, in the hospital, used ICT in the treatment of patients with advance cancers.

In another development, Tsiachristas, Water, Adams, Bai and Ruttlen-van Molken (2014) confirm that there is an association between the use of ICT and treatment of patients with chronic diseases in Netherlands teaching hospitals. Contradicting the findings of the studies above, is the position of Olok, Yagos and Ovuga (2015). Their study explains that, there is an association between the use of clinical informatics in private hospitals in Uganda and better

healthcare delivery. The research also discovered that, medical doctors in the private hospitals in Uganda use clinical informatics in the treatment of their patients.

In addition, the study also found out that, there is an association between the teaching hospital and promotion of effective healthcare service. This supports the submission of Ayani and Weissmar (2002) that clinical informatics use by medical doctors in teaching hospitals promotes effective healthcare delivery to patients. They go further to say that, the quality of medical care in teaching hospitals is higher than non-teaching hospitals. Rivard et al. (2011) examined the association of teaching hospital with the promotion of effective healthcare delivery, which indicates that there is a positive association with promotion of healthcare delivery and teaching hospitals, particularly in the use of clinical informatics. Thomas, Oravie and Brennan (2000) examined 15,000 hospital discharges, in US, in order to determine the association between hospitals and use of clinical informatics for promotion of effective healthcare delivery. They discovered that, teaching hospitals had high rate of clinical informatics for effective healthcare delivery compared with non-teaching hospitals. In another development, Jencks and Huff (2003) and McGlynn et al. (2003) argue that, the quality of care is generally better in teaching hospitals, due to availability of clinical informatics, than other forms of hospitals. On the other hand, Al-haider and Wan (1991), Elixhauser, Steiner, Franser (2003), observe that better healthcare management is consistency associated with variables such as size of the hospital, nurse staff and location of the hospital. Their finding shows that inconsistency is associated with variables like teaching hospitals, status, etc.

8.5 Benefits of using clinical informatics in selected teaching hospitals

Various research give credence to the numerous benefits that can be derived from the use of clinical informatics in the health sector (Info Dev, 2007; Gargon, 2012; and Rouleau, Gagon, and Cote 2015). The respondents in this study believed that reducing medical errors, often borne out of making medical decisions, based on the wrong information, is the main benefit of using clinical informatics in the two teaching hospitals. This perception from the survey also corroborated the submissions from the interviews.

Bryan and Boren (2008) agree that, the main benefit of clinical informatics to medical doctors is that it reduces medical errors. This is also supported by Alfaee (2014) in their research on the role of ICT-based healthcare in Jordan, where the majority of medical doctors felt that the major benefit of using ICT, in healthcare, was to reduce medical errors. Ortiz and Clancy (2003) and Agrawal (2009) likewise found that the major benefit of using clinical informatics in the United States of America was to reduce medical errors. In line with this, Ortiz and

Clancy (2003) recommend that the government should direct the Agency for Healthcare Research and Quality (AHRQ) to provide various clinical informatics resources that would reduce medical errors and promote patients' safety, with an approximate sum of \$50 million for hospitals to acquire various clinical informatics tools.

The essence of their recommendation is echoed in a report by the Institute of Medicine (2000), which reveals that 44,000 patients die annually due to medical errors in the US. Various studies have affirmed the finding of this study. Bates, Leape, Cullen, Laird, Petersen and Seger (1998) claim that, clinical informatics was associated with 5% reduction in medical errors in USA. In a similar study by the same researchers, they affirmed that effective use of clinical informatics among medical doctors in USA can reduce medication errors to 86%. Also, in another study by Devine, Hansen, Wilson-Norton, Lawless, Fisk, Blough, Martin and Sullivan (2010), it was observed that, clinical informatics used by medical doctors brought about reduction in error rate among medical doctors in Colorado from 8.2% to 18.2%. Koppel, Metlay, Cohen, Abaluck, Localio and Kimmel (2006) report that, clinical informatics use among medical doctors is associated with the reduction in 22 types of medication errors risks in a teaching hospital at Pennsylvania.

In 1991, a Harvard medical practice study was done to examine cases of hospitalisation, and it was discovered that 98,000 deaths were related to medical errors in USA (Kels and Grant-Kels, 2009). The report attributes 19% of the medical errors to drugs, 14% to wound infections, and 13% to complicated issues. (National Patients Safety Agency, 2003). Su (2013) also states that in the United States, hospitals are prone to have at least one medication error per day.

Contributing to the issue of medical errors and ICT use, Liewllyn et al. (2009) observe that 1 in every 274 medical doctors in South Africa records six incidents of medical errors per month. They concur that reducing medical errors is a major benefit of using clinical informatics. Arulogun, Oluwole, and Titilayo (2011) discover various cases of prescription errors among medical doctors in Nigeria. A total number of 1424 cases were reviewed out of which 55.2% of prescription errors were due to illegitimate and wrong dose (4.9%).

Valiani et al. (2014) argue that medical errors are responsible for the deaths of over 800 pregnant women all over the world, every day. Medical errors therefore constitute a serious challenge to effective healthcare delivery and are a major threat to healthcare users' safety. It is therefore pertinent to raise awareness about the fact that, reducing risks and improving

patients' health outcomes are some of the major benefits of using clinical informatics (Epstein et al., 2010; Gruman et al., 2010; and Graffigna et al., 2013).

Clinical informatics has a well-established role to play in the improvement of medical care and in reducing medical errors to the barest minimum. The use of clinical informatics resources is very important to medical doctors, in all specialities, because the technologies improve clinical diagnoses, clinical judgment, and accurate decision making. Knowledge is necessary for informed decision making in healthcare, and clinical informatics provides up-to-date, reliable and evidence-based information that can reduce medical errors.

Effective use of clinical informatics enhances service delivery by improving access to various Information and Communication Technology that assist medical doctors. This will provide evidence-based medicine and increase patients' safety. Arulogun, Oluwole and Titilayo (2011) state that some clinical informatics tools can be used to examine drug allergies, prescribe drugs, and eliminate problems that stem from illegible handwriting. Various clinical informatics tools such as COPE, EMR and CDSS have been proven to provide substantial benefits to healthcare by reducing medical errors (Bates et al., 2001; Bates et al., 2003).

The surveyed medical doctors also stated that another benefit of clinical informatics is that it saves them time. This is corroborated by Lokemendeldsverket (2010), who found that clinical informatics saved the time of medical doctors in Sweden. Eighty percent (80%) of the doctors in their study claimed that they used Electronic Prescribing System to prescribe drugs, which really saved time. They also used computers to send messages to other units in the hospitals. Also supporting the research finding, the Health ICT Industry Group (2009) states that, clinical informatics saves the time of medical doctors because they can use appropriate clinical informatics resources to move patients' data from one place to another or to place orders, such as medical tests. The finding is also corroborated by Srivastava et al. (2014), in a study conducted on the use of ICT among medical doctors in Malaysia. The majority of the medical doctors' respondents stated that, using clinical informatics in healthcare delivery saved them time because they could use the resources to communicate effectively. Barlett and Toms (2005) and Bratianu and Orzea (2010) note that, ICTs save doctors' time by providing access to accurate and timely clinical information and medical knowledge when they attend to patients.

Results from the interview revealed that clinical informatics is very useful to medical doctors, particularly in the diagnosis, examination of patients. It reduces medical errors. All these corroborated the findings from the questionnaire.

8.6 Availability of clinical informatics in the selected teaching hospitals

The assessment of the available clinical informatics infrastructure, in the two hospitals, revealed that, Electronic Medical Records (EMRs), Clinical Decision Support Systems (CDSS) and Diagnosis Image Archiving (DIA) were available at the University College Hospital (UCH), Ibadan, Nigeria. The interview with the ICT Director revealed that an abridged version of Electronic Medical Records, called the Patient Registration System, was available at UCH. The EMR was available in the Geriatrics section of the hospital, but other medical departments did not have the facility. The Clinical Decision Support System was available in various medical departments, either for vital sign tests or for various medical examinations, while Diagnosis Image Archiving was available in the hospital under the joint venture of Private Public Partnerships (PPPs).

There were various places where patients could get examined using ‘MRI, CT SCAN, ECG, X-RAY’ and a host of other facilities in the hospital, upon the payment of a stipulated amount, particularly at UCH, Ibadan, Nigeria. At King Edward Hospital in Durban, South Africa, the Clinical Decision Support System in the hospital was available and cut across various units of the hospital. EMRs were not available in the hospital. The hospital had a specific place where Diagnosis Image Archiving was done, and the reports were then sent to medical doctors’ computers in their clinics. It was noted that, the two hospitals were still using the old system of filing patients’ information through a card system. Although UCH was in the process of doing a retrospective conversion of patients’ files into computers, the available clinical informatics resources in the UCH was not linked to the doctors’ computers. It was, however, linked to the doctors’ computers at KEH VIII.

Neither of the hospitals had Computerised Physician Order Entry (CPOE). Some of the medical doctors’ offices and consulting rooms and wards did not have computers, particularly in Nigeria. However, the National Health Laboratory Service (NHLS) in South Africa, which provides diagnostic pathology services, makes a provision for medical doctors to examine the results of tests through the use of computers in the hospital. Findings from the interview indicate that, there was no EMR in King Edward VIII Hospital, Durban, South Africa and at the same time there was no CPOE in the two hospitals. However, the two hospitals have access to DIA and CDSS.

The finding of the study corroborates the submission of Rwashana and Williams (2008) that availability of ICT in the Ugandan healthcare facilities was low. This implies that ICT resources are not available in major teaching hospitals in the country.

Ruxwana, Herselman, and Conrade (2010) note that, despite the availability of various clinical informatics for effective medical diagnosis, they are not available in most hospitals in South Africa. Herselman and Jacobs (2003) argue that, poor state of healthcare delivery in the continent can be attached to non-availability of clinical informatics. They attributed this to limited availability of the resources.

8.7 Clinical informatics facilities that is accessible to medical doctors in selected hospitals

Access to clinical informatics resources by medical doctors enhances optimal clinical information and promotes good health intervention outcomes. Effective healthcare delivery therefore, requires access to clinical informatics resources that can produce real time information to medical doctors, for clinical decision making. Access to clinical informatics also saves patients' and medical doctors' time, and promotes evidence-based healthcare. Asah (2011:85) and Hassler, Hennessy and Lubasi (2011:17) note that, the access to clinical informatics resources by medical doctors may influence the use of the technology.

An increase in the access to and use of ICT among medical doctors in hospitals has been reported in various studies all over the world (Gatero, 2011; Norum, et al. 2003; Udousoro, 2014; and Coleman, 2013). As noted in Chapter 3, various studies have been done on the variations in the extent of accessibility and utilisation of clinical informatics within and between various countries and hospitals. These studies include Achampong (2013) who examined the access and use of clinical informatics in Nigeria and Ghana; Ajuwon and Rhine (2008), who conducted a study on the level of internet access among health professionals in developing countries; and Gatero (2011) who conducted a study on access to clinical informatics resources among medical doctors at Kenyatta National Hospital.

The present study found out that there was poor access to clinical informatics resources among medical doctors in the two teaching hospitals in Nigeria and South Africa. The information from the survey was in line with the submissions from the interviews. This finding is also corroborated by Adamson et al. (2014), Bello et al. (2004) and Gatero (2011). Bello et al. (2004) conducted a study on medical doctors' access to ICT. The study reveals that, only 27% of the medical doctors in Nigeria have access to ICT. The findings of this research also support the submission of Gatero (2011) that, most of the medical doctors in Kenyatta National Hospital do not have access to clinical informatics. Adamson et al. (2004) also found that only 5.3% of medical doctors in Malawi had access to the Internet, and the

majority of the doctors admitted that they used clinical handovers and seminar notes as their major sources of clinical information.

The poor access to clinical informatics, as seen in this study, is also corroborated by Chen et al. (2004) who surveyed 46 countries in sub-Saharan Africa and discovered that there was poor access to ICT by medical doctors. In addition, Ogunyande and Oyibo (2003), Ajuwon (2003), and Bello et al. (2004) confirm that, access to clinical informatics tools among medical doctors in sub-Saharan Africa is very poor.

Nevertheless, Diagnosis Image Archiving (DIA) was discovered to be the most accessible clinical informatics tool among medical doctors in King Edward VIII Hospital (67; 81.7%) Durban, South Africa, and in the University College Hospital (152; 86%), Ibadan, Nigeria. The next most accessible tool was the Clinical Decision Support System, with 64 respondents (78%) claiming it was accessible at King Edward VIII, and 135 (76.3%) indicating that the technology was accessible at the University College Hospital. However, there was limited access to Electronic Medical Records at UCH, with 101 (57.4%) stating that it was not accessible. The interview with the ICT manager revealed that a version of EMR was only available in the Geriatrics unit of the hospital, although it could also be accessed by other departments through the Health Information Unit.

Muller et al. (2004) conducted a similar study at the University Hospital in Geneva, and found that DIA was the most accessed clinical informatics tool. He explained that, over 12,000 images were produced in a day in the year 2002. Weatherburn et al. (1999) also found that DIA was the most accessed clinical informatics tool among medical doctors at Hammersmith Hospital in West London. They attributed this to the fact that DIA is frequently used by medical doctors in order to assist them with the initial diagnoses of patients. This implies that it improves diagnostic performance.

Castro (2009) gives an interesting report that is contrary to the perceived differences in access to clinical informatics facilities between developing and developed countries. The report indicates that, less than 5% of the medical doctors in Australia, France, Switzerland, and the USA have access to Computerised Physician's Order Entry (CPOE); 15% have access in the UK; and 20% have access in the Netherlands. However, 81% have access to CPOE in South Korea, and an impressive 100% have access in Finland. However, this study reveals that the facilities are not available to medical doctors in the two teaching hospitals in Nigeria and South Africa.

Canada Health Infoway (2010), and Herrick, Gorman and Goodman (2010) also discover that some governments provide financial incentives for ICT in healthcare. This is essential considering the fact that access to effective healthcare information is very important, particularly in the promotion of health education, health policy and patient care. Creswell, Bates and Sheikh (2013), Lweis et al. (2013), Cline and Luiz (2013), Burney, and Mahmoud, Abbass (2010) explain various ways in which access to clinical informatics can be improved among medical doctors; these include adequate training opportunities, provision of available clinical informatics and inclusion of computer training in medical school curriculum.

Cohen, Bancilliohon and Jones (2013) employed UTAUT to study the importance of access to clinical informatics tools to medical doctors in South Africa. Olasina and Popoola (2014) also employed UTAUT to study the use of e-medicine by medical doctors in Nigeria. The authors found that access to clinical informatics tools increases the performance of medical doctors. They recommend that improving facilitating conditions such as training, availability of resources, policy and access, etc., would encourage medical doctors to use the tools. The results of this study revealed that there is poor access to clinical informatics resources among medical doctors in the two teaching hospitals in Nigeria and South Africa. This corroborates studies by Nwargu and Adio (2013); Asangasi et al. (2008); Adeleke et al. (2015); Bello et al. (2004); Alwan, Awoke and Tilahun (2015); Udusoro (2014) and Olasina and Popoola (2014). Extant literature indicates reasons behind limited access to clinical informatics to include the unavailability of the facilities (Achampony, 2012; Shiferw and Zolfo, 2012), inadequate ICT training, lack of support from hospital management (Scollin, 2001), poor attitude towards the facilities (Hughs and Pakieser, 1999), low level of computer skills and ICT literacy (Pelletier, 2001), and techonophobia are associated with clinical informatics (Scollin, 2001). Anwar and Shamin (2012); Ajuwon (2015) and Ajami and Bagheri (2013) list various factors that cause limited access to clinical informatics by medical doctors in the United Kingdom to include the unavailability of resources, poor organisational support, cultural barriers, and inadequate training.

However, results from the interview indicate that access to clinical informatics in Nigeria is through PPP mostly. The patients visit various diagnosis centres in the hospital and pay fees and the report is sent to the medical doctors in paper form. Some of these doctors do not have direct access to some of the clinical informatics. Patients usually come to them with the results. At King Edward, some of the patients paid, particularly those that have medical aids,

while the old and the physically challenged do not pay. After the medical tests from diagnosis centre, the medical doctors then have access to the results through his /her computer.

8.8 Factors that influence medical doctors' behavioural intention to use clinical informatics tools in the selected hospitals

Both descriptive and inferential statistics were used to analyse the perceived factors that influence the use of clinical informatics resources. The study establishes that effort expectancy and performance expectancy were two of the UTAUT constructs that positively and significantly influenced medical doctors' behavioural intention to use clinical informatics in the two hospitals. This result is consistent with findings by Oye et al. (2012), Deng et al. (2010), Wong et al. (2013), Carlson et al. (2006), and Knutsen (2005). The findings are also consistent with previous research in the field of technology acceptance. Performance expectancy and effort expectancy have a significant positive influence on the behavioural intention to use ICT (Venkatesh et al., 2003; Jirakul et al., 2009).

Performance expectancy's influence on behavioural intention to use clinical informatics is confirmed in a number of studies (Wang, Patel, Schueth, Bradley, Wu, Crossopn , Glassina and Bell ,2009; Chismar and Wiley-Patton, 2003; Coshen, Bancilon and Jones,2013, Millet 2015, Lee et al,2016 ; Kim et al2016; and Kijasnatoyin, 2009). The implication is that, medical doctors, who believe that using clinical informatics tools will be beneficial to them, will accept the technologies a lot more than medical doctors with lower performance expectancies.

The results of the study indicated that, effort expectancy had the strongest influence on medical doctors' behavioural intention to use clinical informatics tools. This is corroborated in findings by Kijasnatoyin (2009), Wright and Marvel (2013) and Nanji et al(2011). The result indicated that, medical doctors, who assume that a clinical informatics tool will be easy to use and not require a lot of effort, tend to embrace the use of the system. Clinical informatics designers need to take note and make their technologies easy to operate and use (Wang et al., 2009).

There are many studies that used the acceptance model to analyse medical doctors' behavioural intention to use clinical informatics in the healthcare sector. However, there are discrepancies in the results. For example, Esmailzadeh et al. (2015) used a modified UTAUT to examine the behavioural intention of medical doctors to use the Computerised Decision Support System in Malaysia, surveying 335 doctors and 12 hospitals. The results revealed that

performance expectancy, self-efficiency, and social networks were the factors that influenced the use of the facility. The findings of Maillet et al. (2015) also differ from the findings of this research. The authors discovered that, performance expectancy and facilitating conditions are the major factors that influence medical doctors' behavioural intention to use clinical informatics tools.

Dunnebeil (2012) used the UTAUT and the TAM to confirm the degree of acceptance of clinical informatics facilities among medical doctors in Germany. The findings revealed that, perceived usefulness and perceived ease of use (PEOU) greatly influenced medical doctors' behavioural intention to use clinical informatics tools. Likewise, Kijisanayotin et al. (2009) used UTAUT to investigate the use of ICTs among community health workers in Taiwan. The study revealed that performance expectancy, effort expectancy, social influence, and attitude were the factors that influenced the behavioural intention of healthcare workers to use the technologies.

8.9 The ICT policies that are in place towards effective accessibility and utilisation of clinical informatics tools in the selected teaching hospitals

The study sought to identify the institutional ICT policies that are in place to promote the accessibility and utilisation of clinical informatics tools, in the two teaching hospitals. The introduction and formulation of ICT policies and other strategies are very necessary to promote the effective access to and use of clinical informatics among medical doctors in the teaching hospitals. The ICT managers were asked during the interviews if their hospitals had ICT policies. They admitted that, their respective teaching hospitals did not have an ICT policy. At UCH, it was stated that, they used the National Policy on ICT, and the Computer Society Policy. At King Edward Hospital, they were guided by the KZN ICT policy. In a lot of the responses, the ICT managers merely stated that, the responsibilities lay with the government or provincial department. The two teaching hospitals therefore had no ICT policy to support and encourage clinical informatics' access and use among medical doctors. Khoja et al. (2012) note that the absence of appropriate policies may lead to a variety of problems, including failure to achieve intended goals or realise anticipated benefits.

Medical doctors, health workers and healthcare users consider clinical informatics' access and use to be critical factors in transforming healthcare delivery in most African teaching hospitals (Kilbridge, David and Classen, 2008). Info Dev (2006) Achampong (2012) , Linto (2010),

Ani (2011) and Oyegoke (2013) note that the adoption of ICT policies in teaching hospitals is a necessary step towards the provision of adequate access to and utilisation of clinical informatics resources in the healthcare environment. The authors advocate the need for an ICT policy in every hospital to promote strategic development with regard to clinical informatics. Department of Health and Children (2006) attributes the increase in healthcare costs and high rate of chronic diseases to the failure of many hospitals to implement an adequate ICT policy. Many advanced countries have established national ICT policies in their healthcare sectors in order to facilitate improvement in the delivery of services.

The absence of relevant ICT policies in the two teaching hospitals has brought about a variety of problems, including the inability to achieve the intended objectives and anticipated benefits of using clinical informatics resources. The formulation of an ICT policy for healthcare delivery in the hospitals would assist with realising the national health objectives and serve as a driving force on how investments can be made to support and promote the application of ICT for better healthcare delivery.

8.10. Challenges facing the use of clinical informatics by medical doctors in the selected teaching hospitals.

Studies by Info Dev (2006), Idowu et al (2008), and Asemahagn (2015) agree that medical doctors face a lot of challenges in the use of clinical informatics. In the present study, the medical doctors identified the unavailability of clinical informatics tools as the main challenge in the two teaching hospitals. Wattas and Ibegbulam (2006), Ogunyade et al. (2003), Burnley et al(2010), and Maharaham and Biswal (2009) agree that, the unavailability of ICT infrastructure in the healthcare environment is a major challenge to the use of clinical informatics by medical doctors. Idowu et al. (2006) indicate that, only 5% of the teaching hospitals in the African continent have the necessary clinical informatics tools.

The availability of adequate clinical informatics tools in teaching hospitals would definitely contribute to ingenuity aimed at promoting and facilitating effective and better healthcare delivery (Achampong, 2012; Shiferaw et al., 2012 and Kilbridge et al., 2008). The availability of relevant clinical informatics tools is fundamental to the effective adoption of clinical informatics in the healthcare sector. Another key challenge, as identified by the respondents, was the absence of sufficient training programmes on clinical informatics, a finding that is corroborated by Gatero (2011), Houshayari (2012), Asangansi et al. (2008), Mugo and Nzuka (2014), Olok (2015), and Adeleke et al. (2015). The need for adequate training is confirmed

by various authors (Srivastara et al., 2014; Houshyari et al, 2012; Kareenti et al., 2008). Training can be linked to the facilitating conditions in UTAUT.

The availability of clinical informatics tools and adequate training on how to use them will affect the attitudes of medical doctors towards their use.

8.11 Summary

The characteristic profiles of the surveyed medical doctors reveal that, there were more male doctors than female doctors. Majority of the medical doctors were between the ages of 30-39, years. This may be due to the fact that many of them are willing to become medical consultants. These young doctors need to train in teaching hospitals.

The hospital, occupation, medical experience, age, department and qualification had a significant association with the use of the Computer Decision Support System ($P > 0.05$). The years of experience and professional position were also significantly related to the use of Diagnosis Image Archiving. There was also a significant association between medical departments and the use of Electronic Medical Records ($X^2 = 17.709$, $P < 0.05$). The Psychiatry and Radiology departments used EMR, which was only available and accessible via the Health Information Unit based on the response from the interview. The most used clinical informatics tool was Diagnosis Image Archiving. The reason for this may be due to the ability of DIA to deliver timely and efficient access to images and interpretations that assist medical doctors, with effective diagnosis and the provision of evidence-based services. Another reason could be that, it is the most available tool.

Furthermore, it was revealed that there was an association of teaching hospital with the use of clinical informatics for knowledge sharing, the treatment of patients, and the promotion of effective healthcare delivery.

There are few studies that have explored UTAUT in order to examine the factors that influence the access to and use of clinical informatics in the context of Nigerian and South African teaching hospitals. In this study, effort expectancy and performance expectancy were discovered to be factors that influence medical doctors' intention to use clinical informatics tools.

Clinical informatics facilities are being used globally with the objective to improve healthcare delivery. The study also revealed a low level of access to clinical informatics facilities and their application among the medical doctors in the two hospitals.

Overall, clinical informatics tools have a significant role to play in promoting effective healthcare delivery by supporting medical doctors, assisting with information sharing, and promoting evidence-based medicine. The benefits of clinical informatics are especially important on the African continent, which suffers from poor budgetary allocations to health, coupled with a low number of medical doctors (see Chapter 2).

It is apparent that clinical informatics integration in health delivery is a developmental process that requires various stakeholders to take active roles. The process requires stakeholders, in particular the government, hospital's management and various healthcare workers to bridge the gaps in the access and use of clinical informatics and provide lucid directions for its effective utilisation in the two hospitals.

The next chapter presents a summary of the findings, and the conclusion and recommendations of the study.

CHAPTER 9: SUMMARY, CONCLUSION AND RECOMMENDATIONS

9.1. Introduction

The chapter provides the summary of findings, given in the Chapters six and seven. The chapter also provides recommendations for policy and further research.

The purpose of the study was to determine the access and use of clinical informatics among medical doctors in the teaching hospitals in Nigeria and one in South Africa. The study investigates the association between socio-demographic variables and the use of clinical informatics; the purposes for using clinical informatics among medical doctors; the benefits of using clinical informatics; the availability of clinical informatics infrastructure in the two hospitals; the clinical informatics facilities that are accessible to medical doctors in the two teaching hospitals; the factors that influence behavioural intention to use of clinical informatics; and the policies that guide the use of clinical informatics in the two teaching hospitals.

The study was guided by the theoretical frame known as Unified theory of acceptance and use of technology (UTAUT). The post –positivist was used to address the research problem. This is to allow for triangulations of research results.

The study adopted survey design. The sample for the study was drawn from medical doctors in the selected teaching hospitals, in Nigeria and South Africa. The teaching hospitals were King Edward VIII Hospital, Durban, South Africa and University College Hospital, Ibadan, Nigeria. Data was collected from 258 medical doctors using survey questionnaires and an interview schedules was used to collect data from heads of ICT departments in the two teaching hospitals. The overall response rates were 63% from the total distributed copies of the questionnaires. The quantitative data aspect of the study was analysed using descriptive statistics and SPSS, while interview responses were analysed through the use of contents analysis.

The chapter provides a summary of the study's findings, the conclusions of the study, and recommendations that may inform the creation of policies, practice and future studies.

9.2 Summary of findings

This section presents the summary of the findings under each of the research objectives. The summary is subsequently used to draw conclusions and propose recommendations.

9.2.1. Objective 1: To determine the association between social demographic variables and the use of clinical informatics

The research question that corresponded with this objective was as follows:

- What are the associations between social demographics variables and the use of clinical informatics?

The study investigates how demographics variables were associated with the use of clinical informatics among medical doctors.

The finding of the study reveals that, there was an association between the demographic variables and the use of clinical informatics. It was established that, there was a significant association between the medical department and the use of electronic medical records ($X^2 = 17.709$, $P < 0.05$). However, age, experience, gender, position and qualification were not significantly associated with the use of Electronic Medical Records.

An assessment of the socio-demographic characteristics and the use of the Clinical Decision Support System revealed that there was a significant association between the years of medical practice and the use of Clinical Decision Support System ($X^2 = 16.489$, $P < 0.05$). However, age, gender, position, department, qualification and hospital were not significantly related to the use of CDSS ($P > 0.05$).

Furthermore, the socio-demographic characteristics of the respondents and the use of Diagnostics Image Archiving revealed that there is an association between the social demographic variables such as age ($X^2 = 12.513$; $P < 0.05$), years of practice ($X^2 = 12.262$, $P < 0.05$), and current position ($X^2 = 11.792$). They were all significantly related with the use of diagnostic image archiving.

The study established that there was a digital gap in relation to the socio-demographic variables and the use of clinical informatics, particularly with the age variable, as it was found that young medical doctors use clinical informatics more than the older ones. Also, it was found that years of medical experience are associated to the use of clinical informatics. In sum, the significant levels of the chi-square for the variables were 0.05.

9.2.2. Objective 2: To explain the purposes for using clinical informatics among medical doctors in the two teaching hospitals

In achieving this objective, this research question was asked:

- What are the purposes for using clinical informatics by medical doctors in the two teaching hospitals?

The study established the purposes for which medical doctors use clinical informatics. It was established that there are many reasons why medical doctors use clinical informatics. The prominent among them is medical diagnosis. This is a way of investigating the natures and types of ailment brought to the medical doctors. The clinical informatics serves as pointers and it provides relevant clinical information to the medical doctors. It was also discovered that there is association between the teaching hospitals and the use of clinical informatics for knowledge sharing. In addition, clinical informatics was found to influence the spirit of team work amongst the medical doctors, through knowledge sharing with their professional colleagues and their medical students. It was also discovered that, there was association between the teaching hospitals treatment of patients and effective healthcare delivery.

9.2.3. Objective 3: To find out the benefits of using clinical informatics in the two teaching hospitals

In working towards the achievement of this objective, the study was guided by this research question:

- What are the benefits of using clinical informatics in the two teaching hospitals?

The medical doctors indicated various benefits of using clinical informatics in the two hospitals. According to the surveyed respondents, reduction in medical errors, which is commonly caused by lack of information, is the main benefit of using clinical informatics. Other notable benefits are: it saves the time of medical doctors, improves diagnoses, increases performance, and reduces cost. Thus, the use of clinical informatics is becoming increasingly important to medical doctors and other health workers, because it assists medical doctors in decision making and allows effective dissemination of information amongst all the clinical departments in the hospitals. Effective healthcare delivery can be built on accessibility and availability of necessary ICT for proper diagnosis and evidence-based medicine. World Health Organisation (2006) notes that ICT provides a great benefit for effective healthcare delivery, since it is the backbone of the services: to ‘prevent, diagnose, and treat illness and disease’.

Benson (2011) notes that the unavailability of clinical informatics, in most African teaching hospitals, would lead to medical tourism among the rich subset in the continent. In addition, the unavailability of the clinical informatics will lead to increase in morbidity, poor healthcare delivery and very poor medical outcome

9.2.4. Objective 4: To ascertain the availability of clinical informatics infrastructures in the selected teaching two hospitals

In working toward this objective, the following research question was asked.

- What are the available clinical informatics infrastructures in the selected teaching hospitals?

The assessment of available clinical infrastructure in the two hospitals reveals that Electronic Medical Record, Clinical Decision Support System and Diagnosis Image Archiving are available at University College Hospital, Ibadan, Nigeria. The abridged version of Electronic Medical Record that is available at UCH, Ibadan is called Patient Registration System. This EMR is available at Geriatrics section of the hospital, but other medical departments do not have the facility. Clinical Decision Support System is available in various medical departments, either for vital signs or for various medical examinations. Diagnosis Image Archiving is available in the hospital under the joint venture of private public partnership (PPP). There are various places where patients can do medical examinations, such as MRI, CT SCAN, ECG, X-RAY and a host of others, in the hospitals, with the payment of the stipulated amount. Similarly, at King Edward Hospital VIII, Durban, South Africa, there is availability of Clinical Decision Support System in the hospital. It cuts across various units of the hospital. The Electronic Medical Record is not available in the hospital. The hospital has a specific place where Diagnosis Image Archiving is being done, and from where the report is being sent to medical doctors. It was noted that, the two hospitals are using the old system of filing patients' information through cards system. Although UCH is doing a retrospective conversion of patients' files into computers, the available clinical informatics in the two hospitals were not linked to the doctors' computers.

Some of the medical doctors' offices and consulting rooms and wards do not have computers, particularly in Nigeria. However, the National Health Laboratory Service (NHLS) in South Africa, which provides diagnostics pathology services, makes provision for medical doctors to examine the results of tests through the use of computers in the hospital. This is not available in Nigeria.

The clinical informatics infrastructure environments in the study were verified in terms of the clinical informatics that was available to the medical doctors in the two selected teaching hospitals. The availability of clinical informatics in the two teaching hospitals is found to be below expectation, in relation to global literature (Infor Dev, 2006; Infor Dev, 2007; ICT for Health, 2010; Report of the Health ICT Industry Group, 2009; European Parliamentary 2015).

Its availability in healthcare is unceasingly evolving, as the quality of patient care in modern days seems to depend on timely acquisition of necessary clinical informatics infrastructure that will provide effective healthcare delivery system.

The unavailability of clinical informatics facilities restricts access to the resources. This makes it difficult to fully integrate clinical informatics into the health care delivery system of many African countries (Sanchez, Salinas and Harris, 2011). In an ideal situation, medical doctors should use clinical informatics for effective healthcare delivery. This was not possible in these two teaching hospitals, as clinical informatics facilities had not been extended to all the clinical departments. Also, medical doctors' consulting rooms, wards and theatre rooms were not connected with various clinical informatics facilities. However, in the two teaching hospitals, patients had to go to designated centres to do the necessary diagnosis test and come with the result in paper form.

9.2.5. Objective 5: To identify the clinical informatics facilities that are accessible to medical doctors in South Africa and Nigeria teaching hospitals.

In working towards the achievement of this objective, the study was guided by this research question:

- Which of the clinical informatics tools are accessible to medical doctors in the two hospitals?

Access can be described in terms of physical access to clinical informatics facilities. Warschauer (2004) notes that the best way to describe access is in terms of ownership of facilities, though ownership is not the only means by which medical doctors have access to ICT. Olatokun (2009) states that people can have access to ICT through the member of a household, neighbour, work place or public place.

Aramide et al. (2015) note that ICT can be accessed through individual access point, the household and community ownership. Moshap and Hanrahan (2004) identify private service access, ownership of the facilities and communal service access as means of accessing the clinical informatics by medical doctors. Thus access to ICT, by medical doctors, can be examined from two dimensions. These are direct and indirect access. Direct access is when the medical doctors have access to the clinical informatics directly and use it to diagnose patients. Indirect access occurs when medical doctors wait for the report of a specialist that has direct access to clinical informatics and then gets the report to the medical doctors based on the doctors' expertise. Understandably, it is not possible for all the medical doctors to have

access to MRI, CT scan and ECG machine in various medical departments; their ICT skills can also be limited.

For the purpose of this study, both direct and indirect accesses were used to examine the accessibility to clinical informatics by the medical doctors, in the selected teaching hospitals. In developing countries, the high rate of preventable diseases and premature deaths is alarming; and inequality of access to clinical informatics is the major factor responsible for this (World Health Organisation, 2009). The study reveals poor access to clinical informatics among medical doctors. This implies low usage of the facilities, for clinical service and persistent poor quality of health care services that is also common in most countries in Africa. For effective healthcare to be accorded its position, there is need for timely acquisition of relevant clinical informatics.

The study reveals that Diagnosis Image Archiving is the most accessible clinical informatics among medical doctors in the two countries. Closely followed are the Clinical Decision Support System and Electronic Medical Record which are available at UCH Ibadan. However, they are only available in the Geriatrics unit. It was noted that Computerised Decision Order Entry is not available in the two hospitals. These facilities make it possible for medical doctors in Africa to have access to accurate medical information and help in the situation where there is shortage of qualified medical doctors.

The claim by the medical doctors, in the two selected teaching hospitals, that there was poor access to the clinical informatics was also statistically proven as reported in the study. (See Section 6.6.1. and Table 6.19).

9.2.6. Objective 6: To determine the factors that influence behavioural intention to the use of clinical informatics by medical doctors in the two teaching hospitals

In working toward this objective, this research question was asked:

- What are the factors that influence behavioural intention to the use of clinical informatics by medical doctors in the two teaching hospitals?

The medical doctors require the use of clinical informatics for support in information processing, clinical decision making and effective diagnosis. The success of access of clinical informatics and its use among medical doctors in healthcare delivery system depend on the availability and accessibility of the facilities. Apart from the availability and accessibility, there is the need to identify the various factors that promote the use of the clinical informatics. This has been done in some studies in which the importance of accessing various factors that

enhance the use of ICT, by medical doctors in developing countries, has been underscored (Nwargu and Adio, 2013 and Olasina et al., 2014).

This study therefore examines the factors that influence medical doctors' intention to use clinical informatics, using both the questionnaire and interview methods. Since the objectives of UTAUT are to explain the users' intentions to use computer and examine usage behaviour, UTAUT constructs were used to find out the factors that influence the behaviour intention of the medical doctors in the two hospitals, towards the use of clinical informatics. The four constructs of the theory are performance expectancy, effort expectancy, social influence and facilitating condition. Studies relating to the theory of technology acceptance and its use indicate that, UTAUT is very useful in explaining professionals' intentions to use ICT compared with any other theories (see Section 3.8, 4.4 and 4.7.2).

The study established that, Effort Expectancy and Performance Expectancy are the two UTAUT constructs that positively and significantly influence the medical doctors' behavioural intentions to use clinical informatics in the two teaching hospitals. The two constructs (Effort Expectancy and Performance Expectancy) were highly significant with ($P > 0.05$). They have positive influences on the behavioural intentions of using clinical informatics in the two hospitals. The interview conducted also indicates that medical doctors will like to use clinical informatics if they understand that it will assist them in their work, particularly in diagnosing the patients before making clinical decisions.

9.2.7. To find out about policies that guides the use of clinical informatics in the two teaching hospitals.

In working towards this objective, the following research question was asked:

- What policies guide the use of clinical informatics, in the two teaching hospitals?

Information and communication technology policy can be described as a document that states the objectives, goals, principles and strategies to guide and regulate the development, application, access and use of ICT (Ani, 2013). For effective ICT policies to be in place, there is the need to take cognizance of other policies which include health, education, trade and development, and economic development policies.

The need for ICT policy in effective healthcare delivery was reinstated by African administrators, in 1976, through the establishment of PANAFTEL (The Pan –Africa Telecommunication network), which was saddled with the responsibility of promoting the use of ICT in all spheres of life. Studies indicate that the formulation of ICT policy is necessary

for effective access and use of ICT, particularly for medical doctors (Halford, Obstelder and Lotherington, 2009). Ani (2014) notes that, the rapid uses of ICT, by various professionals in Africa, require an urgent need for ICT policies that will encourage and promote the effective use of the resources. ICT policy in healthcare delivery is a prerequisite for promoting effective healthcare in developing countries (Anie 2011; Rwashana and Williams, 2008). It has been noted that, ICT policy, in healthcare, provides a set of goals and a vision on how healthcare delivery will work when ICT is being introduced into the healthcare delivery in the two hospitals. Achampong (2008) recommends that various hospitals, particularly the academic hospitals, should provide necessary resources that will support ICT policy development, in their various healthcare facilities.

This implies that, ICT policy in healthcare would provide the opportunity for effective monitoring of healthcare conditions and guide medical doctors and other workers, in hospitals, on what ways to take very good care of patients.

Through the use of interview, the ICT policies put in place, by the two selected teaching hospitals, to promote the use of clinical informatics, were investigated. The study reveals that, the two hospitals have no ICT policy. At the UCH, Ibadan, it was stated that they used the ICT policy of Computer Association of Nigeria and ICT policy of Federal Government of Nigeria. The hospital admitted that they did not have their own ICT policy. Similarly, King Edward Hospital, Durban, South Africa had no ICT policy of its own. It was revealed that the hospital uses ICT policy from KZN, Department of Health. Thus, the two hospitals do not have ICT policy of their own. Rather, they depend on the ICT policies that are not tailor made for their purposes from government. Studies have indicated that many African countries do not have ICT policies in respect to effective healthcare delivery (Anie, 2011).

9.2.8. Objective 8: To investigate the challenges facing both access and use of clinical informatics among medical doctors in the selected teaching hospitals.

In working with this objective, this research question was used:

- What are the challenges that faced the medical doctors in access and use of clinical informatics tools in selected teaching hospitals?

Clinical informatics has become an important part in medical practices, particularly for medical doctors. However, medical doctors experience challenges in its access and use. Various challenges militating against the use of clinical informatics by medical doctors in the

two selected teaching hospitals were reported. The unavailability of clinical informatics was rated very high. Other prominent factors are the absence of sufficient training programme on clinical informatics, poor ICT skills by the medical doctors, lack of technical support, limited access to internet, and poor power supply particularly in Nigeria.

9.3. Conclusion

Fundamentally, this study has found that the clinical informatics environments in the two teaching hospitals are inadequate. Also the use of clinical informatics is very low among medical doctors in the two hospital surveyed. It was also discovered that, there is poor access to clinical informatics resources among medical doctors in the two selected teaching hospitals. The poor accessibility is largely attributed inadequate resources. Diagnosis Image Archiving was found to be the most accessible clinical informatics among medical doctors in the two hospitals. The study also revealed that although medical doctors were enthusiastic concerning the use of clinical informatics for medical practices but non-availability is a big barrier to the utilization of the resources.

It was further established that effort expectancy and performance expectancy are two of UTAUT constructs that influence behavioural intention towards the use of clinical informatics by medical doctors in the two hospitals. Performance expectancy can be attributed to the perceived belief that using clinical informatics will make a medical doctor's work easier, and improve their performance at work, while effort expectancy is about how easy the system is to use. Also, the two teaching hospitals have no supportive institutional policy guidelines that can promote the use of clinical informatics.

There are various limitations to the study. These include geographical to population limitations, access limitation and concept limitation. The study has geographical and population limitations. As stated, the study was carried out in two selected hospitals in Nigeria and South Africa. Based on this, the finding of the study cannot be generalised in the two countries.

There were also the limitations in concepts. The concept of clinical informatics encompasses various terminologies such as medical informatics, health informatics, health information technology and e-health. The study was limited to four types of clinical informatics which are Electronic Medical Record, Diagnosis Imager Archiving, Computerised Decision Support System and Computerised Physician Order Entry. The decision to use four types of the clinical informatics was based on the fact that the socio-economic conditions of most

countries in Africa, do not favourably support the access to and use of most clinical informatics facilities, particularly newer, more complicated and expensive system.

Despite the permission from health related authorities and ethical permission from the Department of Health, of Kwa Zulu-Natal the research still faced some challenges. At King Edward Hospital for example, the researcher was mandated to meet all the heads of the department of the hospital and brief them on the nature of the research. The meeting was fixed for 3rd of November, 2015 at 8.30 in the morning and the venue was the conference hall of the hospital, under the chairmanship of the acting Chief Executive.

At University College Hospital, Ibadan, Nigeria, the researcher was subjected to ethical examination and peer review of his research proposal. The ethical examination was later cancelled upon the presentation of the ethical clearance from the University of Zululand, but review assessment came and a certificate was given before the researcher was allowed to conduct the research. After this, another permission letter was sent to the Chairman Medical Advisory Council at the University College Hospital, Ibadan, Nigeria, before the researcher was allowed to distribute the questionnaires in the hospital. With the co-operation of the heads of the departments and various chief resident doctors, the researcher was able to commence the study. Doctors were met during their clinical meetings for the distribution of the questionnaires.

9.4 Originality and contribution of the study

The contributions of this work can be considered from the point of view of literature, practice, policy and theory. A major contribution of this study lie in the fact that, it is the first of its kind to examine the position of clinical informatics in selected teaching hospitals in Nigeria and South Africa, particularly at University College Hospital, Ibadan, Nigeria and King Edward Hospital VIII, Durban, South Africa.

The study also adds to literature by contributing to the conceptualization of clinical informatics, as aspect of social informatics, particularly with the paucity of literature in the field of social informatics in Africa countries (see Chapter 1, Chapter 2 and Chapter 3). The study has also provided an insight into the importance and relevance of clinical informatics to modern day healthcare delivery. In addition, the study contributes to debates and discussions on clinical informatics and social informatics.

The study contributes to knowledge, in the area of medical practice, by providing fresh data and information for the policy makers, medical doctors and hospital administrators, on the

importance of clinical informatics in the improvement of medical healthcare. With the advent of clinical informatics in the healthcare delivery system, medical doctors will acknowledge the importance of clinical informatics for the improvement of the accuracy of their medical diagnoses and in the treatments of patients.

The study was also the first of its kind to use UTAUT theory to examine the factors that influence the behavioural intention towards the use of clinical informatics in Africa. The research shows the effect of Effort Expectancy and Performance Expectancy in the use of clinical informatics by medical doctors. These results are unique and contribute to knowledge in this field.

The study joins in the debate and discussion about UTAUT theory. In addition, UTAUT model is used to find out the factors that influence medical doctors' intention to use clinical informatics in the two different countries. The evidence from the study on the factors that influence behavioural intention toward the use of clinical informatics provide a strong opportunity for better understanding of factors that can motivate medical doctors to use clinical informatics effectively (see Chapter 3, Section 6.6, 6.6.1, 6.6.2., 6.6.3, 6.6.5. and 6.6.9). The result from listed sections demonstrates the need to extend UTAUT theory in studying technology incorporation of clinical informatics for medical diagnosis in hospitals.

The essence of clinical informatics is to improve the quality and efficiency of the healthcare system. This can only be achieved when medical doctors accept to use these facilities. Clinical informatics application is merging ICT with the healthcare sector to bring about changes in access to healthcare and provide opportunities for effective healthcare delivery. However, the adoption and diffusion of clinical informatics in many African countries are very slow. The effective implementation of clinical informatics requires the attitudes and motivational factors of various stakeholders, such as medical doctors, to be considered. It was noted that the behavioural intention of medical doctors is one of the critical factors that can determine successful clinical informatics acceptance, in any healthcare environment. The UTAUT was adopted in this study because it is a theory that could be used to examine the factors that influence behavioural intention to use clinical informatics among medical doctors in Nigeria and South Africa. The study is unique in the sense that it examines all the UTAUT constructs without adding other variables in order to identify factors that influence the use of clinical informatics among medical doctors.

A better understanding of the factors that influence clinical informatics integration would promote the effective utilization of its tools. These factors include facilitating condition, effort

expectancy, social influence and performance expectancy. However, the study found that effort expectancy and performance expectancy are two main constructs that influence access to and use of clinical informatics among medical doctors in the two hospitals surveyed for the study.

Lastly, the study contributes to research output and knowledge sharing through the publication of the thesis on the Institutional Repository at the University of Zululand as well as the dissemination of thesis in journals, book chapters, social media such as Research Gate, CSW presentations and in lectures (see Section 1.11).

9.5. Recommendations

This section outlines the recommendations that could be implemented to bridge the gap that were identified.

9.5.1. Objective 1: Association between social demographic variables and the use of clinical informatics

The study establishes that there was a positive relation with social demographic variables and the use of clinical informatics. Based on this, the hospital managements should consider creating awareness on different types of clinical informatics that can be used in various medical departments in the two teaching hospitals. For example, more departments should be made aware of abridge version of EMR that can be accessed at the Health Information Unit at the UCH. Awareness would encourage evidence based medicine and address the issue of non-use and give the medical doctors the opportunity to identify and select the clinical informatics tools that are relevant, for their various specializations areas of medicines.

In addition, accessibility of clinical informatics, among medical doctors in different medical wards, consultant offices, theatres and offices, should be provided. Lastly, there should be various incentives for the use of clinical informatics in the hospitals.

9.5.2. Objective 2: The purposes for using clinical informatics by medical doctors in the two teaching hospitals

The research reveals various purposes of using clinical informatics. These include medical diagnoses, disease management, research, decision making, knowledge sharing and communication, promotion of effective healthcare delivery and for administrative purposes. Based on this finding, the study recommends the need for developing countries in Africa, especially the Nigerian and South African health administrators, to organise themselves

nationally and regionally in order to benefit more from developed world in terms of knowledge transfer, capacity building in healthcare and infrastructure development.

Secondly, there is the need for the two teaching hospitals to include the teaching of health informatics in their medical school curricula. This would allow the medical doctors to understand and become a part of the information society.

9.5.3. Objective 3: The benefits of using clinical informatics in the two teaching hospitals

The result of the study indicates that clinical informatics improve efficiency. It saves the time of medical doctors, reduce medical errors, reduce adverse drug effects and increase performances. Based on this, the study recommended that medical doctors need to improve their ICT skills, in order for them to be able to harness the potential benefits of using clinical informatics. However, the hospital managements have a role to play. In doing this, they can organize computer training for medical doctors locally or send them outside the country for trainings on ICT. This is necessary for effective clinical informatics usage. Adequate usage will bring benefits to medical doctors and patients.

Secondly, the hospital managements should create awareness on the importance and benefits of clinical informatics to various healthcare workers, particularly the medical doctors. This can be done by bringing experts in the field of health informatics to educate the medical doctors on the benefits of clinical informatics.

9.5.4. Objective 4: The availability of clinical informatics infrastructures in the two selected teaching hospitals

The study established that there was poor availability of clinical informatics in the two teaching hospitals. The recommendations were basically on the followings: firstly, there is need for hospital management to increase their level of investments in clinical informatics.

Secondly, the hospital managements need to partner with relevant stakeholders such as government, corporate bodies and ministries or departments of health, multinational organisations, international health organisations such as WHO, and non-governmental organisations (NGO). This is towards the provision of adequate and suitable environment to support the availability of clinical informatics. Thirdly, adequate budgetary allocation should be earmarked for acquiring relevant clinical informatics. In acquiring relevant clinical informatics, Public Private Partnership should be encouraged, particularly in Nigeria, since the government alone cannot face the burden of effective healthcare delivery.

9.5.5. Objective 5: Clinical informatics facilities that is accessible to medical doctors in South African and Nigerian teaching hospitals

The finding of the study reveals poor access to clinical informatics among medical doctors. With the exception of DIA, most of the clinical informatics were not accessible to the medical doctors. As stated earlier, the availability of clinical informatics facilities does not necessarily translate into its accessibility. This implies that the resources may be available but their access may be limited. EMR were only available in the Geriatrics department and accessible to other departments via Health Information Unit. This was revealed during the interview.

There is therefore a need for the hospital managements to provide adequate training and re-training opportunities for medical doctors in order to enable them to effectively use the clinical informatics. The training can be done locally, or if there is a need, it can be done overseas. Training is a necessary requirement that influences medical doctors' attitudes towards the use of clinical informatics (Galanouli, Murphy and Gardner, 2004). With the adequate training on the use of clinical informatics, there will be cost reduction, improved performance, increased consistency and job satisfaction.

Also, lack of access was mostly due to unavailability. The hospital management needs to make clinical informatics available to medical doctors for effective utilization and at the same time there will be need for adequate awareness.

9.5.6. Objective 6: The factors that influence behavioural intention towards the use of clinical informatics by medical doctors in the two teaching hospitals

The study established that Effort Expectancy and Performance Expectancy were two of UTAUT constructs that positively and significantly influence medical doctors' intention towards the use of clinical informatics in the two hospitals. Therefore, there is a need for the hospitals' managements to put in place various measures that will enhance the access and use of clinical informatics among medical doctors. The measures include: the need for the facilities to be user-friendly, easy to use, and adequate education on the usefulness of clinical informatics on their job performance. There is also the need for conducive environment, which include adequate power supply, particularly in Nigeria.

The clinical informatics facilities that will be used in the two countries' healthcare systems should be relevant to the need and aspirations of the medical doctors. It implies that, medical doctors must have adequate knowledge on how to operate the facilities; it must be easy to use and easy to maintain. It must be suitable to the healthcare system of the two countries. Beekhuyzen, et al. (2005), Merchant (2007), and Colby and Albert (2003) recommend fitting

technology adoption for medical practice. This recommendation is based on the need that some medical doctors may be resistant to change, but if they see the value and the result in the use of technology, they may embrace it.

9.5.7. Objective 7: Institutional ICT policies that are put in place toward effective accessibility and utilisation of clinical informatics among medical doctors in the two hospitals

The finding established lack of ICT policy concerning the use of clinical informatics in the two teaching hospitals. There is therefore a need for institutional policy on the integration of clinical informatics access and use in medical activities. The findings of the study support the formulation of ICT policies that will facilitate and promote effective access and use of clinical informatics in the two hospitals. Hence, it is important that the two hospitals formulate ICT policies that will promote equitable and sustainable access to and use of clinical informatics facilities.

In order to draft an effective ICT policy, the hospitals' should involve various stakeholders (such as policy makers, ICT experts, technology providers, researchers and various healthcare workers) to offer their contributions, since clinical informatics is a multidisciplinary process.

9.5.8. Objective 8: Challenges facing both the access and use of clinical informatics among medical doctors in the selected teaching hospitals

In the study, various challenges militating against the development of clinical informatics were identified. These include unavailability of clinical informatics, absence of sufficient training, poor ICT skills on the part of medical doctors, lack of technical support and negative attitude.

There is the urgent need for governments and various healthcare administrations to make appropriate recommendations to the relevant organs of governments on the need for them to have the necessary clinical informatics in their hospitals. The hospital managements also need to gear towards making various clinical informatics available for medical doctors' use. This can be done through their internal generated revenue.

In addition, the two hospitals need to have very sound ICT departments that will be involved in designing these ICT facilities for the medical doctors' use in the hospitals; and they should be able to provide adequate maintenance for the facilities.

Furthermore, the hospitals' managements need to provide suitable environment for medical doctors' use of clinical informatics. There should be adequate education on ethical issues related to the use of clinical informatics such as privacy, accuracy, access and property.

9.6. Recommendations for further research

The study investigated the access to and use of clinical informatics in selected teaching hospitals in Nigeria and South Africa. Further research can focus on the various types of health informatics such as nursing informatics, pharmacy informatics, bio-informatics, veterinary informatics and imagery informatics. The essence of these is to examine the access and the use of these types of informatics by different medical professionals in order to promote the use of ICT in effective healthcare delivery. Further research is necessary in order to explore the potential of health informatics. In addition, studies need to be conducted on e-health and telemedicine adoption in various hospitals in order to know the position of their development in teaching hospitals in the continent.

The study was limited in scope to the two hospitals in Nigeria and South Africa. Studies should be conducted to access the effects of demographic variables on the access to and the use of clinical informatics in both countries and the effects of ICT policy on the access to and use of clinical informatics in teaching hospitals in Nigeria and South Africa. It is also suggested that the study should be extended to other regions of Africa.

REFERENCES

- Aarts, J. and Koppel, R. (2009). Implementation of CPOE in seven countries. *Health Affairs*; 28 (1), 404-414. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/19275996>. Accessed on 13th January, 2015.
- Abdullahi, Z. M., and Haruna, I. (2008). Utilization of information and communication for information services delivery in university Libraries in Adamawa State. *Information Technologist*. 5 (2). 24-30. Retrieved from www.ajol/index.php/ICT/article/view/32023. Accessed on 7th January, 2015
- Abidi, S. R. Cheah, Y. N. and Curran. J. (2005). A knowledge creation infrastructure to acquire and crystallize the tacit knowledge of health-care experts, *IEEE Transactions on Information Technology in Biomedicine*, 9. (2). 193-204. Retrieved from <https://dspace.library.library.dal.ca/handle/10222/34644>. Accessed on 7th January, 2015.
- Abimbola, I. G. (2015). Assessing value added in the use of EMR in Nigeria PhD thesis submitted to the Department of Management and Technology, University of Walden, University.
- Abouzahr, C. and Boerma, T. (2005). Health information systems; the foundation of public health. *The International Journal of Public Health* 83(8), 578-583. Retrieved from <http://www.who.int/bulletin/volumes/83/8/578.pdf> Accessed on 10th January, 2015.
- Abubakar, F. M. and Ahamad, H. (2013). The moderating effect of technology awareness of the relationship between UTAUT constructs and behavioural intension to use technology. *Australian Journal of Business and Management Research* 3(2) 14-22. Retrieved from <file:///C:/Users/0/AppData/Local/Temp/aus-29-75i02n3a2.pdf>, Accessed on 7th March, 2015.
- Achampong, E. K. (2012). State of ICT and health informatics in Ghana. *Journal of Public of Public Health Informatics*.4 (2), 22-30, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3615810/>, Accessed on 6th March, 2015,

- Acilar, A. (2011). Exploring the digital divide in a developing countries. *Issues in Informing Science and Information Technology* 8 (1), 1-14. Retrieved from <http://iisit.org/Vol8/IISITv8p231-244Acilar248.pdf> Accessed on 9th March, 2015.
- Adamson, S. M. Misiri, H. Chimailezi, Y. and Nyaka, A. (2014). Access to continued professional education among health workers in Blantyre. *Malawi. African Health Science* 5 (9), 182-184, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2688328/>. Accessed on 22 May, 2105.
- Adelaide University (2014). Scopus guide Retrieved from http://libguides.adelaide.edu.au/research_support/publishing. Accessed on 22 May, 2105.
- Adeleke, I. T. Salami, A. A. Achinbee. M. Anamah, T.C., Zakari, I. B. and Wasgi, M. C. (2015). ICT knowledge utilization utilisation and perception among healthcare providers at National Hospitals, Abuja, Nigeria. *America Journal of Health Research* 3(1) 47-53 Retrieved from <http://article.sciencepublishinggroup.com/pdf/10.11648.j.ajhr.s.2015030101.17.pdf> Accessed on 13 May, 2105
- Adeloye, A. (2000). The information market in Nigeria. *Journal of Information Science* 26(4), 282-285, Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.860.9891&rep=rep1&type=pdf> Accessed on 12 May, 2105.
- Adetimirin, A. E. (2012). ICT literacy among Undergraduates in Nigerian Universities. *Education and Information Technologies*, 17 (4), 381-397. Retrieved from https://ai2-s2-pdfs.s3.amazonaws.com/f00b/64cfab6b8a646d9b1fb7eddbf5c417e1_415e.pdf Accessed on 22 May, 2105
- Adindu, A. and Asquo, A. (2013). Training human resources for the 21st century Nigeria Health Sector. *Global Journal of Human Resources Management* 1(3), 1-11. Retrieved from <http://www.eajournals.org/wp-content/uploads/TRAINING->

[HUMAN-RESOURCE -FOR-21ST -CENTURY-NIGERIAN-HEALTH-SECTOR.pdf](#). Accessed on 13 May, 2105.

Adomi, E. and Kpangban, E. (2010). Application of ICTs in Nigerian Secondary Schools. *Library Philosophy and Practice*. Paper 345, 1-9. Retrieved from <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1353&context=libphilprac>. Accessed on 22 May, 2105.

Adoni, E. E. (2006). Mobile phone usage patterns of library and information science at Delata State University, Abraka, and Nigerian. *Electronic Journal of Academic and Special Librarianship* 7(1), 12-21. Retrieved from <http://southernlibrarianship.icaap.org/index.html>. Accessed on 10 May, 2105

Afolayan, O. T. and Oyekunle, R. A. (2014). Availability, accessibility and frequency of use ICT by health professional in Ilorin, Metropolis. *Covenant Journal of Informatics and Communication Technology*.2 (1), 1-13. Retrieved from <http://cujourneys.covenantuniversity.edu.ng/index.php/cjict/issue/view/13> Accessed on 29 May, 2105

Africa Development Bank, (2014). Investing in ICT –enabled hospital. Africa Development Bank publication. Retrieved from <https://www.afdb.org/en/news-and-events/article/investing-in-ict-enabled-hospitals-13284/> Accessed on 22 June, 2105

Agbele, K. Nyongeza, H. and Adesina, A. (2010). ICT and information security perspective in e-health system. *Journal of Mobile Technology* 4(1), 17-22. Retrieved from <https://repository.uwc.ac.za/handle/10566/1060>. Accessed on 4 July.2015

Agency for Health Care Research and Quality (2001). Clinical informatics to promote patient safety. Retrieved from <http://grants.nih.gov/grants/guide/rfa-files/RFA-HS-01-006>. Accessed on 5 May, 2015.

Agency for health care research and quality (2015). CPOE 1-5. Retrieved from <https://psnet.ahrq.gov/primer/primer/6/computerized-provider-order-entry> Accessed on 5 May, 2015

- Agency for Health Care research and Quality Effective Healthcare Programme (2014). Decision support tools for screening and treatment decision in early cancer. Comparative Effectiveness Review. 45(1), 116-121 Retrieved from <https://www.effectivehealthcare.ahrq.gov/ehc/products/529/2029/cancer-decision-support-tools-report-141223.pdf> Accessed on 5 May, 2015
- Aggelidis, V. P. and Chatzoglou, P. D. (2009). Using a modified technology acceptance model in hospitals. *International Journal of Medical Informatics*, 78(2), 115-126. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18675583> Accessed on 5 May, 2015
- Agrawal, A. (2009). Medication error; prevention using IT systems (2009). *British Journal of Clinical Pharmacology*. 67 (6), 681- 694. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19594538> Accessed on 5 May, 2015
- Ahamed, N. (2013). Medical surgeries and safari in South Africa. *Medical Students Journal of Austria* 2(3) 1-12 .Retrieved from <http://msja.anu.edu.au/surgeries-and-safaris-in-south-africa.php> Accessed on 13 June, 2015
- Ahamed, S. (2008). Computer in library management. New Delhi: APH Publisher.
- Ahiaku, P. K. (2015). Utilisation of healthcare facilitates in Mthonjaeni Local Municipality, First degrees project, University of Zululand, KwaDlangezwa
- Ahmed, M. (2007). Evaluating the effectiveness of information communication technology use in urban hospitals in Uganda, doctoral thesis, Department of Computing and Information Technology, University of Makerere, Uganda.
- Aina, L. O. and Ajiferuke, I. S. Y. (2002). Research methodologies in information sciences. In Aina, L. O. (2002) (ed). *Research in information science: An African Perspectives* ed. by L. O. Aina. Stirling – Horden Publishers: Ibadan
- Ajami, S. and Bagheri, T. (2013). Barriers for adopting EHR by physicians. *Journal of Academic of Medical Science Bosnia and Herzegovia* 21(20) 129-134. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3766548/> Accessed on 13 May, 2015

- Ajayi, W. A. (2013). Impact of health informatics on nurse's computer skills and the role of the library. *The Electronic Library* 31(2), 157-166.
- Ajuwon, E. A. and Popoola, S. O. (2014). Influence of internet accessibility and demographic factors on utilization of web-based health information resources by resident doctors in Nigeria. *Africa. Journal of Medical Science* 43(1), 61-71. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4679180/> Accessed on 4 June, 2015
- Ajuwon, G. (2003). Computer and internet use by first year clinical and nursing students in a Nigerian teaching hospital. *BMC Medical Informatics and Decision Making* 3: (10)115-126, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1764751/>, Accessed on 4 June, 2015
- Ajuwon, G. A. (2006). Use of the Internet for health information by physicians for patient care in a teaching hospital in Ibadan, Nigeria. *Biomedical Digital Libraries* 3(12), 1-9. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1764751/pdf/1742-5581-3-12.pdf> Accessed on 4 June, 2015
- Ajuwon, G. A. (2015). Internet accessibility and use of online health information resources by doctors in training healthcare institutions in Nigeria. *Library Philosophy and Practice* (e-journal). Paper 1258. Retrieved from <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=3377&context=libphilprac> Accessed on 5 December, 2015
- Ajuwon, G. and Rhine, L. (2008). The level of internet access and ICT training for health information professionals in Sub-Saharan Africa. *Health Information and Libraries Journal* 3(12), 175-185. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1764751/pdf/1742-5581-3-12.pdf> Accessed on 4 June, 2015
- Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, 50(2), 179-211. Retrieved from

<https://pdfs.semanticscholar.org/6256/ca4853f44ab9acb98f91f0d7848c54185ca7.pdf> Accessed on 4 June, 2015

- Alabi, R. A. Adams. O. O. Chime, C. C. and Aiguumodu. F. (2011). Marginal benefit analysis of public spending in Nigeria .PEP-PMMA Working Paper, 457 Retrieved from <http://dx.doi.org/10.2139/ssrn.1809018> Accessed on 4 July, 2015.
- Al-Ansari, H. (2006). Internet use by the faculty members of Kuwait University. *The Electronic Library*. 25(14), 791-804. Retrieved from <http://www.qou.edu/arabic/researchProgram/eLearningResearchs/internetUse.pdf>. Accessed on 4 June, 2015
- Alao, I. A. and Folorunsho, A. L. (2008). The use of cybercafés in Ilorin, Nigeria. *The Electronic Library*, 26(1), 238-248. <http://www.emeraldinsight.com/doi/abs/10.1108/00330331211296286?mobileUi=0&journalCode=prog>, Accessed on 13 July, 2015.
- Alawadhi, A. and Morris, A. (2008). Factors influencing the adoption of e-government services. *Journal of Software*. 4(6), 584-590. Retrieved from <http://www.jsoftware.us/vol4/jsw0406-13.pdf> . Accessed on 7 July, 2016
- Alawiye, A. (2011). The power sectors industrial development in Nigeria Case; Power Holding Company of Nigeria. Thesis submitted for Bachelor degrees programme in International Business Autumn, Lanti University of Applied Sciences
- Alder-Milstein, J. Ronchi, E. Cohen, G. B. Winn, L. A. and Jha, A. (2014) Benchmarking health IT among OECD countries better data for better policy . *Journal of America Medical Information Association*, 21(2), 111 -116. Retrieved from <http://pubmedcentralcanada.ca/pmcc/articles/PMC3912720/> Accessed 7 July, 2015
- Aldosar, B. (2012). User acceptance of a picture archiving and communication system (PACS) in a Saudi Arabian radiology department. *BMC Medical Decision Making*, 12(44), 33- 44.

- Al-Dousari, H. (2008). Patient satisfaction according to type of primary healthcare practitioner in capital health region, Kuwait. *Kuwait Medical Journal*, 5 (1), 31-38.
- Alfaee, M. A. H. (2014). The role of ICT-based healthcare in enhancing the effectiveness of health care systems case study. Hashemite Kingdom of Jordan. *International Journal of Managerial Studies and Research* 2 (7), 65-76. Retrieved from <https://www.arcjournals.org/pdfs/ijmsr/v2-i7/8.pdf> Accessed on 4 August, 2016.
- Al-Haider, A. S. and Wan, I. T. (1991). Modelling organizational determinants of hospital mortality *Health Service Research* 26(3), 1-22. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1069827/pdf/hsresearch00072-0034.pdf> 3 January, 2015
- Ali, A. (2011). Exploring the aspects of digital divide in a developing country; issues. *Informing Science and Information Technology*, 8 (1), 231-244, Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1850742 Accessed on 5 July, 2016
- Almulhen, J. A. (2015). Importance of medical informatics in medical students' curricula in Saudi Arabia. A thesis submitted to the Department of Health care Informatics, University of Wisconsin – Milwaukee.
- Alrawashdeh, T. A. Muhairat, M. I. and Alqatawnah, S. M. (2012). Factors affecting acceptance of web-based training system: Using extended UTAUT and structural equation modeling. arXiv preprint arXiv:1205. Retrieved from <https://arxiv.org/abs/1205.1904> Accessed on 5 July, 2016
- Al-Shafi, S. and Weerakkody, V. (2009). The use of wireless internet parks to facilitate adoption and diffusion of e-government services: an empirical study in Qatar. Paper presented at the 14th Americas Conference on Information Systems (AMCIS 2008) Toronto, Ontario.
- Al-Shanbari, H. and Meadows, A. J. (1995). Problems of communication and information-handling among scientists and engineers in Saudi Universities. *Journal of Information Science*, 21 (6), 473-478, Retrieved from

<http://journals.sagepub.com/doi/abs/10.1177/016555159502100606> Accessed on 5 May, 2016.

Alsos, O.A. Dabelow, B. and Faxuag, A. (2012) Doctors' concern of PDAs in ward round situation lesson from a formative simulation study. *Methods of information in Medicine* 50 (2) 190-200.

Alwan, K, Awoke, H. Ayele T. and Tilahun, B. (2015). Knowledge and utilization of computers among health professionals in a developing country. A Cross-Sectional. *Study Journal of Medical Internet Research* 2(1).1-9. Retrieved from <https://humanfactors.jmir.org/2015/1/e4/>. Accessed on 12 July, 2016

America Association of Medical Informatics (2015). Informatics areas of clinical informatics. *America Journal of Information* 2 (1), 1- 4. Retrieved from <https://www.amia.org/applications-informatics/clinical-informatics> Accessed on 10 July, 2016.

American Hospital Association (2009) .Teaching hospitals their impact compartments and the future care work force. Trend watch. Retrieved from <http://www.aha.org/research/reports/tw/twsept2009teaching.pdf>.

Ami-Narah, J. and Williams, P. (2012). A revised UTAUT model to investigate e-health acceptance of health professionals in Africa. *Journal of Emerging Trends in Computing and Information Science* 3 (10), 1383-1320 Retrieved from <http://www.cisjournal.org/journalofcomputing/archive/vol3no10/vol3n> Accessed on 5 July, 2016.

Aminpour, T. Sadoughi, F. and Ahambi, M. (2014). Utilisation of open source of EHR around the word. A systematics review. *Journal Res Medical Science* 19 (1), 67-74. Retrieved from http://www.sid.ir/en/VEWSSID/J_pdf/91720140109.pdf Accessed on 7 July, 2016.

Andel, C. and Davidow, S. L. Hollander, M. and Moren, D. A. (2012). The economics of healthcare quality and medical errors. Retrieved from *Journal of Healthcare Finance*. 39 (1), 39-50. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed?cmd=Link&dbFrom=PubMed&fromuid=19738266>

- Anderson, D. Asher, M. L. and Whitler, T. (2007). Physician's computer skills a prerequisite to the future in healthcare services .*Journal of KY Medical Association*.105 (2), 66-77. Retrieved from <http://www.mc.uky.edu/ohrd/Phys%20Comp%20Skills%20%20Feb%202007.pdf> Accessed on 5 July, 2016
- Angelu, A. (2010). Adverse events dangerous but preventable. *Management in Health* 14(4), 1-13
- Angheluta, C. (2010). Adverse events-dangerous but preventable. *Management in Health*, 14 (4). 1- 10, Retrieved from <http://journal.managementinhealth.com/index.php/rms/article/view/164/458>
- Ani, O. E. (2013). Accessibility and utilization of electronic information resources for research and its effect on productivity of academic staff in selected Nigerian universities between 2005-2012. Phd thesis submitted to the department of Information Science, University of South Africa.
- Ani, O. E. and Ateseye, E.U. (2007). Building the digital divided in Nigeria a study of internet use in Calabar metropolis. *Nigeria Library Management* 28 (6), 355-265.
- Anie, S. O. (2011). The economic and social benefits of ICT policies in Nigeria. *Library Philosophy and Practice* Paper 457. Retrieved from <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1475&context=libphilprac> Accessed on 5 May, 2016
- Anja, N. and Heiko, G. (2014). Why do they resist? Examining the salient factors of physicians' it adoption behavior. PACIS Proceedings. Paper 223 Retrieved from http://www.academia.edu/30992917/Why_Do_They_Resist_Examining_Salient_Factors_Influencing_Physicians_Adoption_Behaviour Accessed on 8 June, 2016
- Anthoine, E. Moret, L. Regnault, A. Seville, A. and Hardoiuin, A.(2014). Sample size used to validate a scale: a review of publications on newly-developed patient reported outcomes measures. *Health Quality Life Outcome*, 12(2),1-10 Retrieved from

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4275948/pdf/12955_2014_Article_176.pdf Accessed on 5 October, 2016

- Anunobi, C. V. and Edeka, B. E. (2010). Use of ICT facilities for serials functions in southern Nigeria federal university libraries: *Library Philosophy and Practice* (e-journal). Paper 355. Retrieved from <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1363&context=libphilprac> Accessed on 5 October, 2016.
- Anwar, F. Shamim, A. and Khan, S. (2012). Barriers in adoption of health information technology in developing societies. *International Journal of Advanced Computer Science* 2(1), 18-23. Retrieved from <http://thesai.org/Downloads/Volume2No8/Paper%208-> 10 October, 2016.
- Aramide, K. A. Ladipo, S. O. and Adebayo, I. (2015). Demographic variables and ICT access as predictors of information communication technologies' usage among science teachers in federal unity schools In Nigeria. *Library Philosophy and Practice* (e-journal). Paper 1217. 1-28. Retrieved from <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=3208&context=libphilprac> Accessed on 5 October, 2016.
- Archangel, B. (2007). Integration or patchwork for communication and messages in a hospital, master thesis, Department of Telematics, Norwegian University of Science and Technology.
- Aroja, D. and Metha, Y. (2014) Use of PACS for system for imaging radiological films in cardiac surgical intensive Care Units. *Journal of Surgical Intensive Care* 30 (3) 447-446 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4152706/> Accessed 5 October, 2016.
- Arulogun, O. Oluwole, S. K. and Titiloye, M. (2011). Prescription errors prevalent in four units of a university teaching hospital in Nigeria. *Journal of Public Health and Epidemiology* 3(11), 513-519.
- Arvanities, K. and Loukis, E. (2016). Investigating the effects of ICT on innovation and performance of European hospitals: an exploratory study. *European Journal of Health Economic* 17(4), 403-418. Retrieved from

<http://link.springer.com/article/10.1007/s10198-015-0686-9>. Accessed on 6 November, 2016.

Asah, F. (2011). Computer usage among nurses in rural health-care facilities in South Africa: Obstacles and challenges. *Journal of Nursing Management*, 21(3), 499-510. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23409780> Accessed on 6 November, 2016.

Asangasi, I.E. Adejoro, O. Farri. O. and Makinde, A. (2008). Computer use among doctors in Africa survey of trainees in a Nigerian teaching hospital. *Health Informatics in Developing Countries* 2(1), 10-14. Retrieved from <http://www.jhidc.org/index.php/jhidc/article/view/10> Accessed 12 July, 2015

Asemahagn, M. A. (2015). Challenges of ICT utilization among health professionals: the case of public hospitals in Addis Ababa, Ethiopia. *SM Journal Health Epidemiology* 1 (3), 1-6. Retrieved from [smjournals.com/public-health-epidemiology/download.php?file = fulltext/smjphe-v1-1012.pdf](http://smjournals.com/public-health-epidemiology/download.php?file=fulltext/smjphe-v1-1012.pdf) Accessed on 6 November, 2016.

Asemangahgn, M. (2016). Health professionals' Challenges in using ICT s to manage their patients the case of hospitals in Addis Ababa, Ethiopia. *Online Journal of Nursing Informatics*, 20(2), 1-7. Retrieved from <http://www.himss.org/ojni> Accessed on 6 November, 2016.

Ash, J. A. (2012). Recommended practices for computerised clinical decision support and knowledge management in community settings a qualitative study . *Medical Informatics and Decision Making*. 12 (6). 1-19. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3334687/pdf/1472-6947-12-6.pdf> Accessed on 6 November, 2016

Ash, J. S. McCormack, J. L. Sitting, D. F. Wright, C. and Bates, D.W.(2012). Standard practices for computerized clinical decision support in community hospitals: a national survey. *Journal of America Informatics Association* 19 (6). 980-987 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3486730/> Accessed on 6 November, 2016.

- Attama, R. O. and Ezema, J. I. (2005). Library and information services: a practical approach. Enugu: Mikon Press.
- Awopetu, R. G., Anhanye, S. and Ocheibi, V. A. (2014). Perceived influence of ICT in clinical service delivery among care givers and patients in Makurdi metropolis. *Research on Humanities and Social Sciences* 4 (17), 69-73. Retrieved from <http://www.slideshare.net/AlexanderDecker/technology-on-clinical-service-delivery-among-caregivers-and-patients-in-makurdi-metropolis> Accessed on 6 November, 2016,
- Ayanian, J. Z. and Joel, S. Weissman, J. Z (2002). Teaching hospitals and quality of care: a review of the literature. *The Milbank Quarterly* 80, 569–93. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2690120/> Accessed on 6 July, 2016.
- Ayeni, E. and O. Oladoyinbo. O. (2014). Overcoming barriers of electronic health records and effective health care delivery system in Nigeria using socialized medicine, (2014). International conference on Electronic Computer and computation (1CECCO), Abuja, 29th Sept.
- Ayers, D. J. Menachemi, N. Zo, R. Matthews, M., and Brooks, R. G. (2009). Adoption of electronic medical records: The role of Network Effects. *The Journal of Product and Brand Management*, 18 (2), 980-987. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3486730/> Accessed on 6 July, 2016.
- Baba, M. and Omotara, B. (2012). Nigeria's public health: gains and challenges. *Equilibrium, Milano* 2(1), 1- 2.
- Babbie, E. (2009). The practice of social science research, Canada: Wadsworth Cengage Learning.
- Babbie, E. and Mouton, J. (2010). The practice of social research, Cape Town: Oxford University.
- Badu, E. E. and Markwei, E. D. (2005). Internet awareness and use in the University of Ghana. *Information Development* 21(4), 260-268. Retrieved from

<http://journals.sagepub.com/doi/abs/10.1177/0266666905060069> Accessed 6 on July, 2016.

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems*. 8 (4), 1-12, Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.361.5863&rep=rep1&type=pdf> Accessed on 13 July, 2015.

Baker, W. M. Lusk, E. J. and Neuhauser, K. L. (2012). On the use of cell phones and other electronic devices in the classroom: Evidence from a survey of faculty and students. *Journal of Education for Business*, 87(5), 275-289. Retrieved from <https://www.learntechlib.org/p/74647>. Accessed 12 July, 2016.

Bandiwala, S. I. Fonn, S. Osegbeagbe, O. and Tollaman, S. (2010). Workforce resources for health in developing countries. *Public Health Review* 32(1), 296-318. Retrieved from http://www.cpha.ca/uploads/progs/_/sopha/public_health_review_workforce.pdf Accessed on 6 August, 2016

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory: Englewood Cliffs Prentice –Hall: NJ

Bardhan, I. M. and Thouin, C. (2013). Health information technology and its impact on the quality and cost. *Healthcare Delivery Decision Support Systems* 55(2), 438-44 Retrieved from: <http://www.sciencedirect.com/science/article/pii/S0167923612002588>.

Bartholomew, L. K. Parcel, G. S. Kok, G. Gottlieb, N. H. and Fernández, M. E. (2011). *Planning health promotion programs: An intervention mapping approach* (3rd ed.). Jossey-Bass: San Francisco.

Bartlett, J. and Toms, E. (2005). Developing a protocol for bioinformatics analysis: an integrated information behaviour and task analysis approach. *Journal of the American Society for Information Science and Technology*, 56(5), 11-15 Retrieved from 469-482. <http://onlinelibrary.wiley.com/doi/10.1002/asi.20136/abstrac> Accessed on 16 August, 2016

- Bateman, C. (2012). Will our public healthcare sector fail the NHI? *South Africa Medical Journal*. 102(11), 817–818, Retrieved from <http://www.samj.org.za/index.php/samj/article/view/6358/4747> Accessed on 6 August, 2016
- Bates, D .W. Kuperman G. J. Wang, S. Gandhi, I. Kittler, A. Volk, L., Spurr, C, Khorasani, R., Tanasen, N., and Milleater, B. (2003) Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *Journal of American Medical Information Association* 10(6), 523–530. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC264429/> Accessed 13, 2016
- Bates, D. (2000). Using information Technology to reduce rate of medical errors in hospitals. *BMJ* 320. 1 -12. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1117776/> Accessed on 6 August, 2016
- Bates, D. (2001). Reducing the frequency of errors in medicine using information technology, *Journal of the American Medical Informatics Association*. 8 (1), 299-308, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1117776/> Accessed on 13 August, 2016.
- Bates, D. (2003). Patient safety: improving safety with information technology, *The New England Journal of Medicine*. 348 (1), 2526-2534., Retrieved from <http://www.nejm.org/doi/pdf/10.1056/NEJMsa020847> Accessed on 18 August, 2016
- Bates, D.W. Leape, L. Cullen, D. J. Laird, N. Petersen, L. A. Teich, J. M. Burdick, E. Hickey, M. Kleeffeld, S. Shea, B. Vander, V. M. and Seger, D. L. (1998). Effect of computerised physician order entry and team intervention on prevention of serious medication errors .*Journal of American Medical Association*. 280 (15), 11311-1316, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/9794308> Accessed on 12 July, 2016
- Bates, M. J. (2006). Fundamental forms of information. *Journal of the American Society for Information Science and Technology*. 57 (8), 1033-1045. Retrieved from <http://dl.acm.org/citation.cfm?id=1133203> 4 July, 2015.

- Bean, K. Davis, A. and Valdez, H. (2013). Bridging the digital divide; a bilingual interactive by health kiosk for disparity. *The Journal of Community Informatics*. 9(2) 1-7 Retrieved from <http://ci-journal.net/index.php/ciej/article/view/934/1006> Accessed on 17 May, 2016 .
- Bellamy, C. (2012). Principle of methodology research design in social science. *Journal of Multidisciplinary Evaluation* 8(18), 788-791. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1117776/> Accessed on 18 August, 2016
- Bello I.S. Arogundade F.A. Sanusi, A. A. Ezeoma, I.T. Abioye-Kuteyi, E. A. and Akinsola, A. (2004). Knowledge and utilization of information technology among health care professionals and students in Ile-Ife, Nigeria: A case study of a university teaching hospital. *Journal of Medical Internet Research* 6(4), 1-12. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/15631969> 8 May, 2016.
- Bem, D. J. and Allen, A. (1974). On predicting some of the People some of the Time: The Search for Cross-Situational Consistencies in Behaviour. *Psychological Review* 8 (6), 506–520. Retrieved from http://pages.ucsd.edu/~nchristenfeld/DoG_Readings_files/Class%204%20-%20Bem%201974.pdf Accessed on 24 May, 2016.
- Benson, A.O. (2011). Hospital information systems in Nigeria. A review of literature. *The Journal of Global Health Care Systems*, 1 (3), 1- 26. Accessed 18 October, 2016.
- Bere, A. (2014). Exploring determinant for mobile learning user acceptance and use: an application of UTAUT. ITNG 14 proceedings of the International Conference on Information Technology: New Generations. IEEE Computer Society, Washington, DC.
- Bertram, C. and Christiansen, I. (2015). Understanding research: an introduction to reading research. Van Schaik Publisher: Cape Town
- Best, J.W. and Kahn, J. V. (1999). Research in education New Delhi: Prentice-Hall of Private Limited.

- Bhardj, V. (2016). Does Nigeria have the lowest healthcare budget in Africa? Africa Check. Retrieved from <https://africacheck.org/reports/does-nigeria-have-the-lowest-health-budget-in-africa/> Accessed 18 October, 2016.
- Biau, D. J. Kerneis, S. and Porcher, R. (2008). Statistics in brief: the importance of sample size in the planning and interpretation of medical research. *Clinical Orthopaedics and Related Research*, 2(3), 2282-2288. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18566874> Accessed on 18 July, 2016.
- Birch, A. and Irvine, V. (2009). Preserve teachers' acceptance of ICT integration in the classroom: applying the UTAUT model. *Educational Media International*. 46(4), 295 — 315, Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/09523980903387506?journalCode=remi20>. Accessed on 13 May, 2016.
- Bless, C. and Higson-Smith, C. (2010). Fundamentals of social research methods: an African perspective. Cape Town: Juta. .
- Bogdaro, C. Lagouros, M. and Ekonomous, L. (2008). Healthcare informatics systems in Greece system and human integration. *Journal of Communication and Information Technology* 1(3), 196-200. Retrieved from <http://www.wseas.us/e-library/conference/nces/2008/naun/cd/29.pdf> , Accessed on 13 April, 2016
- Bowles, K. Dykes, P. and Demiris, G. (2015). The use of health information technology for improve care and outcomes for older adults. *Research Geronted Nursing* 8(1), 5-10. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4431690/> Accessed 5 June, 2016.
- Bozionelos, N. (1996). Psychology of computer use: prevalence of computer anxiety in British managers and professionals. *Psychological Report*, 78(3), 995-1002. <https://www.ncbi.nlm.nih.gov/pubmed/8711058> Accessed on 5 March, 2016
- Bratianu, C. and Orzea, I. (2010). Tacit knowledge sharing in organizational knowledge dynamics”, Proceedings of the 2nd European Conference on Intellectual

Capital, ISCTE Lisbon University Institute, Lisbon, Portugal, 29-30, Academic Publishing.

- Brink, H. Walt, C. H. B. and van, Rensburg, G. (2013). Fundamental of research methodology for healthcare professionals (4th ed) Cape Town: Juta.
- Brink, H., Walt, C. H., B. and van Rensburg, G. (2014). Fundamental of research methodology for healthcare professionals (5th ed) Cape Town: Juta
- Brink, P. J. and Wood, M. J. (1998). Advanced design in nursing research (2nd ed). London: Sage publisher.
- Brink, H. Walt, C. H. B. and van Rensburg, G. (2012). Fundamental of research methodology for healthcare professionals (4th ed). Cape Town: Junta.
- Brodaty, H. Mothakunnel, A. de Vel-Palumbo, M., Ames, D. Ellis, K. A. Reppermund, S., Kochan. E., Savage, G., Trollor, J., N., Crawford, J., and Sachder, P., S. (2014). Influence of population versus characteristics in studies of cognitive aging. *Journal of American College of Epidemiology* 24(1), 63-71. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/24211070> Accessed on 7 May, 2015.
- Brooks, R. and Menachem, N. (2006). Physicians' use of email with patients factors influencing electronic communication and adherence to best practices. *JMR Publication*. 8(1), 10- 22.
- Bryan, C. and Boren, S. A. (2008) .The use and effectiveness of electronic clinical decision support tools in the ambulatory /primary care setting: a systematic review of the literature. *The Journal of Innovation in Health Informatics*. 16(2), 79-91. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18713524> Accessed 7 on May, 2016.
- Bryman, A. (2004). Social research methods (2nd ed,) London: Oxford University Press
- Buabeng –Andon, A. (2012). Factors influencing teacher's adoption ICT into teaching; a review of the literature. *International Journal of Education and Developing using ICT* 8(1), 135-155.
- Bukachi, F. and Pakenhamo-Walsh, N. (2007). Information technology for health in developing countries. *Chest* 132 (50), 1624-1630.

- Burger, D. (2010) South Africa year Books 2009/10.
- Burney, S. M. A. Mahmood, N. and Abbas, Z. (2010). Information and communication technology in healthcare management systems: Prospects for developing countries. *International Journal of Computer Applications*.4 (2), 27–32.
- Burns, N. and Grove, S. K. (1993). Understanding nursing research. Saunders: Philadelphia.
- Burns, N. and Grove, S. K. (2009). Understanding nursing research (4thed). Philadelphia: Saunders.
- Burns, N. and Grove, S. K. (2011). Understanding nursing research (5thed). Philadelphia, Saunders.
- Burt, C. W. and Sisk, J. E. (2005). Which physicians and practices are using electronic medical records? *Health Affairs*, 24(5), 1334–1343. Retrieved from <http://content.healthaffairs.org/content/24/5/1334.full> Accessed on 7 May, 2016
- Burton, L. (2007). Survey research: choice of instrument, sample. Johns Hopkins, Bloomberg School of Public health, Johns Hopkins, University.
- Busch, D. (2005). The role of diversity in US competitiveness; April; Las Vegas, NV. Keynote address given at the 3rd joint meeting of the WEPAN/NAMEPA
- Cai, J. and Zeng, D. (2007). Power calculation for case –cohort studies with non-rare events. *Biometric* 63(4), 1-7. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/j.1541-0420.2007.00838.x/abstract> Accessed on 4 May, 2016.
- Cameron, R. (2011). Mixed methods research: the five Ps framework. *Electronic Journal of Business Research* 9(2), 96-108. Retrieved from <https://espace.curtin.edu.au/handle/20.500.11937/3001> Accessed 7 May, 2016
- Canada Health Inforway (2009). Annual Report 2009-2010. Canada Health Inforway. Retrieved from <https://www.infowayinforoute.ca/en/component/edocman/resources/i-infoway-i-corporate/annual-reports/42-annual-report-2009-2010>. Accessed 10 June, 2015.

- Canada Health Inforway, (2010). Health Information Technology: innovation to improve healthcare quality access and availability .*Digital Canada* 150 1- 7. Retrieved from <https://www.inforway-inforoute.ca/en/component/edocman/resources/i-inforway-i-corporate/annual-reports/42-annual-report-2009-2010>. Accessed 5 June, 2016
- Carlsson, C. J. Carlsson, K. Hyvönen, J. Puhakainen, and Walden, P. (2006). Adoption of mobile devices/services: searching for answers with the UTAUT, Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06), Track 6: 1-10
- Carr, S. E. Celenza. T. and Lake, F. R. (2014). Descriptive analysis of junior doctor's assessment in the first postgraduate year. *Medical Teacher Journal*, 36(11), 983-990.
- Castaneda, C. Nalley, K. and Mannion, C. (2015). Clinical decision support for improving diagnostics accuracy and achieving precision medicine. *Journal of Clinical Bioinformatics* 5(4), 1- 2.
- Castro, D. (2009). Explaining international IT application leadership health IT. Retrieved from <http://ssrn.com/abstract=1477486>. Accessed 5 April, 2016
- Central Bank of Nigeria, (2011). Corporate activates of the Central Bank of Nigeria: Annual report
- Cetin, S. Erglin, M. Tekindal, M.A. Tekindal, M.A. and Tekindal, M. (2015). A qualitative evaluation of knowledge levels of nurses regarding informatics and health informatics; the case of Atatiirick training and research hospital. *International Journal of Caring Sciences* 8(3) 11-18 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4825491/> Accessed on 7 May, 2016.
- Chadegani, A. A. Salehi. H. Yunus, M. M. Farhadi, H. Fooladi, M. Farhadi, M. and Ebrahim, N. A.(2013). A comparison between two main academic literature collections Web of Science and Scopus databases. *Asian Social Science* 9 (5). 11- 21.

- Chandrasekhar, C. P. and Ghosh, J. (2001). Information and communication technology and health in low-income countries: The potential and constraints. *Bulletin of World Health Organisation*, 79, 850 – 855. Retrieved from <https://halshs.archives-ouvertes.fr/hal-00819821/document> Accessed on 7 April, 2016.
- Chang, I. Hwang, H. G. Hung, W. F. and Li, Y. C. (2007). Physicians' acceptance of pharmacokinetics-based clinical decision support systems. *Expert Systems with Applications*, 33(2), 296-303, retrieved from <http://www.sciencedirect.com/science/article/pii/S0957417406001436>. Accessed on 10 July, 2016.
- Chau, P. and Hu, P. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Information Manager* 39, 297-311. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0378720601000982> Accessed 14 on May, 2016,
- Chen, L. and Evans, T. (2004). Human resources for health: overcoming the crisis. *Lancet*. 27, 1984-1990. Retrieved from http://www.who.int/hrh/documents/JLi_hrh_report.pdf Accessed on 13 May, 2016.
- Cheng, D. Liu, G. and Qian, C. (2008). On determinants of user acceptance of internet banking: a theoretical framework and empirical study. Proceedings of the 2008 IEEE Advanced Management of Information for Globalized Enterprises, AMIGE. 28-29 September. Beijing, China.
- Chhanabbai, P. N. and Holt, A. (2010). The disparity information and communication technology for developing countries has in the delivery of healthcare information. *Open Medical Informatics*, 4(1), 195-201 Retrieved from , <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096885/pdf/TOMINFOJ-4-195.pdf> Accessed on 12 May, 2016
- Chiffi, D. and Zanotti, R. (2014). Medical and nursing diagnoses: a critical comparison. *Journal of Evaluation in Clinical Practice*. 21(1), 1-6. Retrieved from

<https://www.ncbi.nlm.nih.gov/pubmed/24819249> Accessed on 18 March, 2016

- Chikotie, T. T. (2013). ICTs and public health care service delivery in a developing country content. *Journal of Health Informatics in Africa* 3 (1), 133-440 Retrieved from <http://jhia-online.org/index.php/jhia/article/view/62>. Accessed on 16 June, 2016
- Chismar, W. G. and Wiley-Patton, S. (2003). Does the extended technology acceptance model apply to physicians? Proceedings of the 36th Hawaii International Conference on System Sciences, Department of Information Technology Management, University of Hawai'i.
- Chiu, T. (2008). Usage and non-usage behaviour of health services among Chinese Canadians caring for a family member with dementia, in Graduate Department of Health Policy, Management, and Evaluation. University of Toronto.
- Chong, J. Chong, A. Y. Ooi, K. and Lin, B. (2011). An empirical analysis of the adoption of m-learning in Malaysia. *International Journal of Mobile Communication*, 9(1), 1-18. Retrieved from <http://dl.acm.org/citation.cfm?id=1924546>. Accessed on 19 May, 2016
- Chowles, T. (2015). Western Cape rolls out mobile clinics to schools. Retrieved from <http://ehealthnews.co.za/news/western-cape-mobile-clinics-schools-2/> Accessed on 16 August, 2016
- Christen, C. M. Grossman, J. N. and Hwan, J. (2014). The innovations prescription a disruptive solution to the healthcare. New York: McGraw.
- Christensen, C. M. Bohmer, R. and Kenagy, J. (2000). Will disruptive innovations cure healthcare? *Harvard Business Review* 78 (5), 102-112. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/11143147> Accessed on 16 June, 2016
- Cillers, S. and Flowerday, V. (2013). Health information systems of improve healthcare: a telemedicine case study. *South Africa Journal of Information Management* 15(1), 1-5. Retrieved from <http://www.sajim.co.za/index.php/SAJIM/article/view/541> Accessed on 10 June, 2016.

- CiocoIU, N. Hîncu, D. Dobrea, C. Valentina, V. and Burcea, Ș. (2013). Driving force of WEEE management: a PEST analysis of Romania, *Environmental Engineering and Management Journal*, 12 (3), 535-548, Retrieved from http://omicron.ch.tuiasi.ro/EEMJ/pdfs/accepted/66_370_CiocoIU_10.pdf Accessed on 10 May, 2016
- Cline, G. B. and Luiz, J. M. (2013) Information technology systems in public sector health facilities in developing countries: the case South Africa. *BMC Informatics and Decision Making* 13(13). 1-5. Retrieved from <http://www.sajim.co.za/index.php/SAJIM/article/view/541> Accessed on 16 June, 2016
- Cohen, D. and Crabtree, B. (2008). Evaluative criteria for qualitative research in healthcare: controversies and recommendations. *Annals of Family Medicine* 6 (1) 331-339. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18626033> Accessed on 18 April, 2015.
- Cohen, J. F. Bancihon, J. and Jones. M. (2013). South African physicians of e-prescribing technology: an empirical test of a modified UTAUT model. *South Africa Computer Journal* 50 (1), 43-50. Retrieved from <http://sacj.cs.uct.ac.za/index.php/sacj/article/view/175> Accessed 13 May, 2016
- Cohen, L. Manion, L. and Morrison, K. (2007). Research methods in education 6th ed., London: Rutledge.
- Coiera, E. (2006). Communication systems in healthcare. *Clinical Biochem Rev* 27 (2), 88-98. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1579411/> Accessed on 16 July, 2016.
- Coleman, A. (2013). Using a virtual ICT training framework to support doctors in rural hospitals in South Africa. *Ethno Med* 7(3), 137-141. Retrieved <https://www.researchgate.net/publication/286966143> Accessed 10 May, 2015
- Coleman, A. Herselman, H. E. and Corade, D. P. (2010). ICT applications as e-health solutions in rural healthcare in the Eastern Cape –Province of South Africa. *Health Information Management Journal* 39(1), 17-26. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20335646> Accessed on 16 June, 2016

- Colle, R. and Roman, R. (2002). Handbook for telecaster staff. Cornell University: New York
- Colleman, A. Herselman, M. E. and Coleman, M. (2012) Improving computer-mediated synchronous communication of doctors in rural communities through cloud computing: A case study of rural hospitals in South Africa. *Journal of Computer Science and Information Technology* 4(5), 13-22. Retrieved <http://airccse.org/journal/jcsit/4512ijcsit02.pdf> . Accessed on 12 April, 2015
- Cooper, C. R. and Schindler, P. S. (2008). Business research methods McGraw-Hill: Boston
- Cooper, C. P. Gelb, C. A. Rim, S.H. Hawkins, N.A. Rodriguez, J. L. and Polonec, L. (2012). Physicians who use social media and other internet-based communication technologies. *Journal of the American Medical Informatics Association*, 19 (6)1-7. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22634078>. Accessed on 2 March, 2016
- Council for Medical Schemes (2014). Annual Report 2014/15 , 15 years of the pulse .South Africa Retrieved from https://www.medicalschemes.com/files/Annual%20Reports/AR2014_2015.pdf Accessed on 12 July, 2016
- Coustansse, A. Shaffer, J. Conley, K. and Sikula, D. (2013). CPOE- benefits and concerns: a status report. *Journal of Information* 6 (3) 1-16 Retrieved from <http://www.igi-global.com/article/computer-physician-order-entry-cpoe/97626> Accessed on 2 March, 2016.
- Cresswell, J. W. (2014). Research design: qualitative, quantitative and mixed methods approaches. London: Sage publication
- Cresswell, K. Bates, D. and Sheikh, A. (2013). Ten key consideration and adoption of large scale health information technology. *Journal America Medical Information Association* 20 (1), 1-10. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3715363/> Accessed 2 on March, 2016.
- Creswell, J. W. (2003). Research design: qualitative and quantitative approaches. London: Sage publication.

- Creswell, J. W. (1994). Research design: qualitative & quantitative approaches. London: Sage publication.
- Creswell, J. W. (2009). Research design: Qualitative and quantitative approaches. London: Sage publication
- Creswell, K. Majeed, A. Bate, B. W. and Sheikh, A. (2013). computerised decision support systems for healthcare professionals: an interpretative review. Retrieved *Inform Primary Care* 20 (2), 115-128. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23710776> Accessed 2 on March, 2016
- Crotty, M. (1998). The foundations of social research. London: Sage publication
- Cucciniello, M. Lapley, I. Nasi, G. and Paglari, C. (2015). Understanding key factors affecting electronic medical records implementation: a socio technical approach. *BMC Health Service Research* 15 (268)1-14. Retrieved from <http://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-015-0928-7> Accessed on 15 March, 2016.
- Cullians, K. (2006). Health services in South Africa: a basic introduction. Health –e News Service. *Health Management* 1(1), 1-2. Retrieved from <https://www.health-e.org.za/2006/01/29/health-services-in-south-africa-a-basic-introduction/> Accessed 2 on November, 2016.
- Cupido, K. and Belle, J. P. (2012). Van. European Conference on e-Government. 2 (2)159-160, Academic Conferences International Limited. Retrieved from <http://www.gurteen.com/gurteen/gurteen.nsf/id/eceg> Accessed 29 March, 2016.
- Dandu, R. V. (2008). Storage media for computers in radiology. *Indian Journal of Radiology*. 18(4), 287 -289. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2747448/> Accessed 16 March, 2016.
- Daniel, G. O. and Oyetunji, M. O. (2013). Nursing informatics: a key to improving nursing practice in Nigeria. *International Journal of Nursing and Midwifery* 5(5), 90-98.

- Daniel, L. (2014). Performing high-powered studies efficiently with sequential analyse. *European. Journal of Social Science* 44 (1) 43-54. Retrieved from [file:///C:/Users/0/Downloads/LakensPerforming2014\(1\).pdf](file:///C:/Users/0/Downloads/LakensPerforming2014(1).pdf) Accessed March, 2016
- David, A. (2009). Information Behaviours of physicians: implications for digital reference *Health Information and Libraries Journal* 24(1) 78-94. Retrieved from https://sites.ualberta.ca/~sulz/600_capping/physicianinfobehaviour.pdf Accessed on 10 March, 2016.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 35(8), 982-1003. Retrieved from https://www.jstor.org/stable/249008?seq=1#page_scan_tab_contents Accessed on 12 June, 2015
- Davis, F. D. Bagozzi, R., P, and Warshaw, P., R. (1993). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*. 35, (8); 982-1003, Retrieved from <http://home.business.utah.edu/actme/7410/DavisBagozzi.pdf> Accessed 13 on May, 2016.
- Davis, F. D. Bagozzi, R., P., Warshaw, P., R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology* 22, 1111–1132, Retrieved from https://www.researchgate.net/publication/229514608_Extrinsic_and_Intrinsic_Motivation_to_Use_Computers_in_the_Workplace1 Accessed on 13 May, 2016
- Dawaon, J. A. (2007). Comparative study on system requirements and success factors of telemedicine solution in resource poor setting. Master thesis Norway: Faculty of Mathematics and Natural Science, Department of Informatics University of Tromso.
- Dawdling, D. (2013). Using computerised decision –support systems. *Nursing Time*, 109 (36).
- De Rosis, A. and Seghieri, C. (2015). Basic ICT adoption and use by general practitioners: an analysis of primary care system in 31 European countries. *BMC Medical*

Informatics and Decision Making. 15 (70).1- 14 Retrieved from
<https://www.semanticscholar.org/paper/Basic-ICT-adoption-and-use-by-general-Rosis-Seghieri/8c81a79e5accf287c29b86e773994fbbbd76bfb0>
Accessed on 13 May, 2016 .

De Vaus, D. A. (1993). *Surveys in Social Research*. Third Edition. University College: London

De Vos, A. S. (2005). *Research at grass root*. Pretoria: VanSchaik

De Vos, A. S. and Strydom, H. (2011). Intervention research. In De Vos, A.S., Strydom, H., Fouché, C.B. and Delport, C.S.L., Eds., *Research at Grass Roots: For the Social Science and Human Service Professions*. Pretoria :Van Schaik

Dearnley, C. and Haigh, J. and Fairhall, J. (2008). Using mobile technologies for assessment and learning in practice settings; a case study *Nurses Education in Practice* 8(3), 197-204. Retrieved from
<https://www.ncbi.nlm.nih.gov/pubmed/17765015> Accessed 3 on September 2016.

DeBoer, M. J. Versteegen, G. J. and van Wijhe, M. (2007). Patients' use of the internet for pain-related medical information. *Patient Education and Counselling*. 68 (1) 86-97. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/17590563>
Accessed on 10 September, 2016.

Deloitte (2014). 2015 Healthcare outlook South Africa. Retrieved from
<https://www2.deloitte.com/content/dam/Deloitte/uy/Documents/life-sciences-health-care/2015-health-care-outlook-global.pdf> Accessed on 5 July, 2015

DeLone, W. H. and Mclean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Information Systems Management*. 19(4), 9-30. Retrieved from
<https://pdfs.semanticscholar.org/e086/a205220b7746e08ce9b7e031f32e1714d25d.pdf> Accessed on 7 July, 2016.

Demirbilek, M. (2014). The digital native's debate; an investigation of the digital propensities of university student, *Eurasia Journal of Mathematics, Science and Technology Education* 10(2), 115- 123.

- Deney, A. and Tewksbury, R. (2013). How to write literature. *Journal of Criminal Justice Education*. 24(2), 219-234. Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/10511253.2012.730617?journalCode=rcje20> Accessed on 7 July, 2016.
- Deng, H. (2010). Emerging patterns and trends in utilizing electronic resources in a higher education environment: An Empirical Analysis. *New Library World* 111 (3/4), 87-103. Retrieved from <https://researchbank.rmit.edu.au/view/rmit:10285> Accessed on 12 July, 2016.
- Deng, S. Liu, Y. and Qi, Y. (2011). An empirical study on determinants of web based question-answer services adoption. *Online Information Review*. 35 (5). 789-798 Retrieved from <https://pdfs.semanticscholar.org/e086/a205220b7746e08ce9b7e031f32e1714d25d.pdf> Accessed 18 June, 2016.
- Department of Communication (2014). South Africa national broadband. National Broadband Policy. South Africa. Retrieved from <http://www.ellipsis.co.za/wp-content/uploads/2014/01/DOC-Presentation-NBP-2013-PPC-19-February-2014-.pdf> Accessed 7 July, 2016.
- Department of Communication, National Integrated ICT Policy Green Paper (2014). South Africa. Retrieved from http://www.gov.za/sites/www.gov.za/files/37261_gon44.pdf Accessed on 18 September, 2016.
- Department of Health (2011). Toward quality care for patient .National Core Standard for Health Establishment in South Africa. Retrieved from http://www.gov.za/sites/www.gov.za/files/37261_gon44.pdf Accessed on 10 July, 2016.
- Department of Health (2012). Management and governance of public sector hospital under the national health insurance. South African Department of Health, Pretoria
- Department of Health (2013). Annual report 20013-2014, Department of Health, Republic of South Africa.

- Department of Health (2013). Annual report South Africa. Retrieved from <http://www.gov.za/documents/department-health-annual-report-20132014>
Accessed on 7 March, 2016
- Department of Health (2013). Government Gazette, Republic of South Africa .Anther. Retrieved from http://www.gov.za/sites/www.gov.za/files/37112_gon951.pdf
Accessed on 7 January , 2016
- Department of Health (2013). South Africa Strategies Plan 2014/15 2018/19. Department of Health. South Africa Retrieved from https://www.brandsouthafrica.com/wp-content/uploads/brandsa/2015/01/Department_of_Health_Strategic_Plan_2014_to_2019.pdf Accessed 7 on July, 2016.
- Department of Health (2014). Province of Kwa Zulu-Natal; King Edward V111 Retrieved www.kznhealth.gov.za/kingedward hospital.htm. Accessed on 12 June, 2015
- Department of Health (2012).National Department of Health annual report 2012/2013
- Department of National Treasury (2014). Republic of South Africa. Retrieved from <http://www.gov.za/about-government/contact-directory/organisation/1136/28>
Accessed on 13 July, 2015
- Detmer, D. E. and Shorliffe, E. N. (2014). Clinical informatics prospect for a new medical subspecialty. *Journal of America Medical Association* 311(20), 2067-2068, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/24823876> 13
Accessible on 13 October, 2016.
- Devine, E. B. Hansen, R. N. Wilson-Noron, J. Lawless, N. W. Blough, D. K. Martin, D. P. and Sullivan, S. D. (2010). The impact of CPOR on medication errors in a multispeciality group practice, *Journal of America Information Association*. 17(1), 78-84. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2995630/> Accessed on 13 July, 2016,
- Devitt, N. and Murphy, J. (2004). A survey of the information management and technology training needs of doctors in an acute NHS trust in the United Kingdom. *Health Information and Libraries Journal* 21 (3), 164-172. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/15318914> Accessed 7 February, 2016,

- Devolder, P. and Pynoo, B. F. (2009). Optimising physicians' instruction of PACS through e-learning; Cognitive load theory applied. *Journal of Digital Imaging* .22(1) 25 - 32. Retrieved from <http://link.springer.com/article/10.1007/s10278-007-9089-5> Accessed on 7 July, 2016,
- Dighe, A. and Reddi, U. (2006). Women's Literacy and Information and Communication Technologies: Lessons That Experience Has Taught Us, Commonwealth of Learning (COL), Vancouver and the Commonwealth Educational Media Centre for Asia, (CEMCA) New: Delhi.
- Domegan, C. and Fleming, D. (2007). Marketing Research in Ireland, Theory & Practise, Dublin : Gill and MacMillan.
- Dooley, K. (2007). Viewing agricultural education research through lens. *Journal of Agricultural Education*, 48(4), 32-43. Retrieved from http://www.jae-online.org/attachments/article/146/Dooley_48_4_32-42.pdf. Accessed on 9 July, 2015
- Drury, T. (2005). The e-health agenda for developing countries .*World Hospitals and Health Science* 41(4). 1-5. Retrieved from singtimes.net/clinical-archive/healthcare-it/using-computerised-decision-support-systems/5063003.article Accessible on 7 May, 2016
- Dunnebeil, S. Sunyaev A, Blohm I, Leimeister J. M, and Krcmar, H. (2012). Determinants of physicians' technology acceptance for e-health in ambulatory care. *International Journal Medical Informatics*, 81(11), 746–760. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22397989> Accessed on 22 May, 2015
- Duyck, P. Pynoo, B. Devolder, P. Voet, T. Adang, L. and Ovaere, D. (2010). Monitoring the PACS implementation process in large university hospital-discrepancies between radiologist and physicians, *Journal of Digital Imaging*. 23(1), 73-80, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18956231> Accessed on 13 July, 2016.
- Duyck, P. Pynoo, B. Devolder, P. Voet, T. Adang, L. and Vercruysse, J. (2008). User Acceptance of a Picture Archiving and Communication System--Applying the Unified Theory of Acceptance and Use of Technology in a Radiological

- Setting. *Methods of Information in Medicine*, 47(2), 149-156. , Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18338086> Accessed on 18 July, 2016
- Echeng, R., Usoro, A. and Majewski, G. (2013). Acceptance of web 2.0 in learning education. Case study Nigeria. *International Journal of Advanced Computer Science and Application* 4 (10), 146 -151.
- Echeng, R., Usoro, A. and Majewski, G. (2013). Acceptance of Web 2.0 in learning in higher education: a case study of Nigeria. *International Journal of Advanced Computer Science and Application* 4 (10), 146-151. Retrieved from https://thesai.org/Downloads/Volume4No10/Paper_22Acceptance_of_Web_2.0_in_learning_in_higher_education.pdf Accessed on 12 June, 2016
- Econex (2013). The South Africa private healthcare sector: role and contribution of the economy. South Africa private forum. South African private practitioners forum Retrieved from <http://www.mm3admin.co.za/documents/docmanager/f447b607-3c8f-4eb7-8da4-11bca747079f/00060290.pdf> Accessed on 7 July, 2016
- Edmonds, W. A. and Kennedy, T. D. (2010). A reference guide to basic research design for education and the social and behavioural sciences. New York: Pearson Educational Resources, Inc.
- Education Labour Relations Council (2003). South African policy handbook for educators, Universe prints group.
- Ehealth stakeholder Group (2013). Ehealth stakeholder group report perspective and recommendation on Interperability. Department of Health, South Africa
- E-health strategy plan South Africa (2012). Department of Health, South Africa. Retrieved from <https://www.health-e.org.za/2014/09/11/report-ehealth-strategy-south-africa-2012/> Accessed on 9 June, 2016.
- e-health Sweden (2010). National ehealth Strategy .Telemedicine and ehealth.
- Ehikhamenor, F. A. (2003). Internet facilities: use and non-use by Nigerian university scientist. *Journal of information sciences*, 1(29), 35-48. Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/016555150302900104> Accessed on 17 July, 2016.

- Elixhauser, A. Steiner, C. and Fraser, I. (2003). Volume thresholds and hospital characteristics in the United States. *Health Affairs* 22(2), 167-177. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/12674419> Accessed on 30 July, 2016.
- Eneji, M. A. Dickson, V. J. and Onabe, B. J. (2013). Healthcare expenditure health status and national productivity in national productivity in Nigeria 1999-2013. *Journal of Economics and International Finance*.5 (7), 1-15 Retrieved from http://www.academicjournals.org/article/article1383042323_Eneji%20et%20a1.pdf Accessed on 5 May, 2016
- Engel, P. (2008). Tacit knowledge and visual expertise in medical diagnostic reasoning. *Medical Teach* 30 (7), 184-189. Retrieved from 5 <https://www.ncbi.nlm.nih.gov/pubmed/18777417> Accessed 7 April, 2016
- Epstein, J. N. Langberg, M.J. Lichtenstein, K. Brinkman, W. B. House, K. Lori, B. A. and Stark, J. (2010). Attention-deficit and hyperactivity disorder outcomes for children treatment in community paediatric settings. *Archive Paediatric Adolescent Medicine* 146 (2), 160-165 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20124145> Accessed on 7 July, 2016
- Erasmus, J. C. (2008). Vacancy analysis report, report on HSRC survey commissioned by the Department of Labour, South Africa.
- Erumi-Esin, R. and Heeks, R. (2015). E-business adoption and use among Africa women-owned SMEs; an analytical study in Nigeria. 7th International Conference on ICT and Development, NewYork.
- Esmaeilzadeh, P. Sambasivan, M. Kumar, N. and Nezakati, H. (2015). Adoption of clinical decision support systems in a developing country: Antecedents and outcomes of physician's threat to perceived professional autonomy. *International Journal of Medical Informatics*, 84(8), 548-560. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/25920928> Accessed on 7 August, 2016
- Eta, S. B. (2009). Clinical decision support system theory and practice .Springer : Birmingham.

- Etikan, I. Musa, S. and Akassin, R. S. (2016). Comparisn of convenience sampling and purpose sampling. *American Journal of Theoretical and Applied Research*. 5(1). 1-4,
- eTransformed Africa (2012). The transformational use of information and communication technologies in Africa. World Bank.
- European Commision (2008). Survey takes pulse of e-health in Europe and prescribes wider ICT use among doctors, press realise data base [Retrieved from release IP-08-641en.htm?locale=en](#) Accessed on 6 July, 2016
- European Parliamentary (2015). e- Health technology for health –technology. SJFGOH 1(1),1-8, Retrieved from http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/551324/EPRS_BR I%282015%29551324_EN.pdf Accessed on 19 June , 2016.
- Evans, N. D. (2013). Predicting user acceptance of electronic learning at the University of Zululand. PhD thesis Department of Information Studies.
- Eyesenbach, G. Sa, E. R. and Diepgen, T. L. (2002). Shopping around the internet today and tomorrow: Towards the millennium cyermedicine, *BMJ*.319, (7222), 1-8 [Retrieved from ww.bmj.com/content/319/7220/1294/related](#) Accessed on 7 July, 2016.
- Ezeamalu, B. (2010). Groups lament harassment in Akwa Ibom. 234next. Retrieved from <http://234next.com/csp/cms/sites/Next/Home/5643063146/story.csp4> Accessed on August, 2016 .
- Fagerberg, J. and Srholec, M. (2009). National innovation systems, capabilities, and economic development. *Research Policy* 37 (9), 1417-1435 Retrieved from [https://books.google.com.ng/books?hl=en&lr=&id=AaRyLGPjkEOC&oi=fnd &pg=PA83&dq=Fagerberg,+J.+and+Srholec.+M.,\(+2009\).+National+inn.](https://books.google.com.ng/books?hl=en&lr=&id=AaRyLGPjkEOC&oi=fnd &pg=PA83&dq=Fagerberg,+J.+and+Srholec.+M.,(+2009).+National+inn.) Accessed on 13 July, 2015
- Fang, Y. and Yang, M. C. (2006). Financial assessment of a picture archiving and communication system in implementing. *Journal of Digital Imaging* 19 (1), 44-51 Retrieved from .

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3045175/> Accessed on 10 July, 2015.

Farmer, T. Robinson, K. Elliot, S. J. and Eyles, J. (2006). Developing and implementing a triangulation protocol for qualitative health research. *Quality Health Research* 16 (377). Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/1049732305285708p://journals.sagepub.com/doi/abs/10.1177/1049732305285708> Accessed on 13 July, 2015

Farri, S. (2015). Information and Knowledge sharing among academics in selected universities in Nigeria and South Africa Phd thesis submitted to the Department of Library and Information Science, University of Zululand, KwaDelzenwas.

Federal Government of Nigeria, (2013). Road map for power reform, Presidential Task force in Power Federal Ministry of Power, Abuja.

Federal Ministry of Finance, (2013). 2013 Budget, Federal Ministry of Finance, Abuja.

Federal Ministry of Finance, (2015). 2015 Budget. Federal Ministry of Finance, Abuja.

Federal Ministry of Health, (2010). National Strategic Health Development Plan 2010 -2015, Federal Ministry of Health, Abuja

Federal Ministry of Health integrated disease surveillance and response policy (2005). Abuja.

Federal Ministry of Health. (2004). Health sector reform programme: strategic thrust with logical framework and plan of action 2004 – 2007. Federal Ministry of Health, Abuja.

Felt-Lisk (2006). Issues brief: new hospital information technology. Is it helping to improve quality? Washington DC. *Mathematics Policy Research*. 3(1), 1-5 Retrieved from <https://pdfs.semanticscholar.org/a9cf/8964284b2de0c4a840c720d5965bd0b2fc0.pdf> Accessed on 13 July, 2016

Field, A., P. (2005). Discovering statistics using SPSS 2nd Sage: London

- Figiredo de, and Oliveira, A. (2014). Health professionals as organization lack of awareness regarding the IT resources usage in front of their major beneficiary patients. *Health System Management Journal* 3 (1), 1-7. Retrieved from <https://dialnet.unirioja.es/servlet/articulo?codigo=5037427> Accessed on 16 July, 2016
- Finn, M. Elliot-White, M. and Walton, M. (2000). Tourism and leisure research methods: data collection analysis and interpretation, Harlow: Longman
- First Consulting Group (2003). Computerised physician order entry: Costs, benefits and challenges: a case study. *Approach Health America* 1-50 Retrieved from https://healthit.ahrq.gov/sites/default/files/docs/page/Leapfrog-CPOECostsBenefits_Challenges.pdf Accessed on 13 July, 2016
- Fishbein, M. and Ajzen, I. (1975). Belief attitude, intension and behaviour reading Massachuset: Addison-Wesley.
- Fisher R. A. (1954). Statistical methods for research workers. London: Oliver and Boyd.
- Flynn-Dapaah, K. and Rashid, A. T. (2010). Gender digital equity in ICT intervention in health: evidence from IDRC supported projects in developing countries. *The Journal of community Informatics* 6(1), 1-9 . Retrieved from <http://ci-journal.net/index.php/ciej/article/view/526/512> Accessed on 13 August, 2016
- Foli, M. and Belle, J. P. (2015). Using mobile phones for public participation with local government in Cape Town. IIMC International Information Management Corporation. 1(1), 1- 4, Retrieved from <http://ieeexplore.ieee.org/document/7190526/> Accessed on 6 June, 2016 .
- Foon, Y. S. and Fah, B. C. Y. (2011). Internet banking adoption in Kuala Lumpur: an application of UTAUT model. *International Journal of Business and Management*, 6(4), 161-17 retrieved from <http://www.ccsenet.org/journal/index.php/ijbm/article/view/10083> Accessed on 13 November, 2016.
- Fowler, F. (2014). Survey research methods. Los Angeles: Thousand Oak.
- Frankfort-Nachmias, C. and Nachmias, D. (1996). Research methods in the Social sciences. London: Arnold

- Fullmore, C. Bray, B. E. and Kawamotok, K. (2013). Systematic review of clinical decision support intervention with potential for in patient cost reduction .*BMC Medical Informatics and Decision Making* 13 (135), 1- 10 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/24344752> Accessed on 13 July, 2016
- Gagnon, M. P. Desmartis, M. Labrecque, M. Car, J. Pagliari C. and Pluye, P. (2012). Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals, *Journal of Medicine System*, 36 (1), 241–247. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20703721> Accessed on 13 July, 2016
- Gahtani, S. S. Hubona, G. S. and Wang, J. (2007). Information technology (IT) in Saudi Arabia: Culture and the acceptance and use of IT. *Information and Management*, 44 (3), 681-691, Retrieved from <http://www.sciencedirect.com/science/article/pii/S0378720607000973> 11 September, 2016
- Galanouli, D. Murphy, C. and Gardner. J. (2004). Teachers’ perceptions of the effectiveness of ICT-competence training. *Computers and Education*, 43(1), 63-79. Retrieved from <http://www.sciencedirect.com/science/article/pii/S036013150300143X> 5 August, 2015.
- Gatero, G. (2010). Utilisation of ICTs for accessing health information by medical professional in Kenya; a case study of Kenyatta National Hospital. *Journal of Health Informatics in Developing Countries* 5 (1), 1- 7, Retrieved from <http://www.jhidc.org/index.php/jhidc/article/view/55> Accessed on 13 July, 2016.
- Gay, L. R. (2014). Educational research: competencies for analysis and application New York: Macmillan.
- Gbadamosi, L, (2006). Challenges of e-teaching profession and way forward: An educational planner view paper presented at ICT workshop. Organised by Teacher Registration Council (TRCN) Adeniran Ogunsanya College of Education, Ijanikin, and Lagos 2nd -8th July.

- General Medical Council (2013). The state of medical education and practice in the UK. General Medical Council: London.
- Gephart, R. (1999). Paradigms and research methods. [Online] Research Methods Forum, 4 (summer), Retrieved June, 3 2016. From the Academy of Management website, http://division.aomonline.org/rm/1999_RMD_Forum_Paradigms_and_Research_Methods.htm . Accessed on 13 July, 2016.
- Ghalandari, K. (2012). The effect of performance expectancy, social influence and facilitating conditions on acceptance of e-learning in Iran: the modelling role of age and gender .*Middle –East Journal of Scientific Research* 12 (6), 801-807. Retrieved from <https://pdfs.semanticscholar.org/33e5/17029aab95714fd3209963b3868d4fda14c5.pdf> Accessed on 13 August, 2016
- Ghobahloo, M. Zulkiflu, N. B. and Aziz, F. A. (2010). The Interactive user information technology acceptance and satisfaction in small and medium-sized enterprises, *European Journal of Economics, Finance and Administrative Sciences* 19 (1), 7-27, Retrieved from <http://www.eurojournals.com> Accessed on 14 June, 2016.
- Gichohi, P, M. (2016). The role of public libraries in the development of small –scale business enterprises in Meru, country Kenya. Phd thesis submitted to the Department of Information Science, University of South Africa.
- Gikenye, W. (2012). The diffusion of information and communication technologies in the informal sector in Kenya. PhD thesis, Submitted to the department of Information Science, University of Zululand.
- Glden, Z. (2011). Searching for integrated strategy in chronic disease management: a potential role for ICT. *Management in Health* 15(4), 1-9. Retrieved from <http://journal.managementinhealth.com/index.php/rms/article/view/210> Accessed on 10 July, 2016
- Golafshani, N. (2003). Understanding reliability and validity in qualitative research. The Qualitative Report, 8(4), 597-606. Retrieved from

- <http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf>. Accessed on 5th July, 2015.
- Goodarzi, M. N. (2016). User acceptance of PACS system in the emergency department. *Iran Journal of Radiology* 13(2), 10- 14 Retrieved from http://iranjradiol.com/?page=article&article_id=20102 Accessed on 23 July, 2016.
- Goodhue, D. L. and Thomson, D. (1995). Understanding user evaluations of information systems, *Management Science*. 41 (12), 1827-1844. Retrieved from <http://dl.acm.org/citation.cfm?id=227160> Accessed on 12 July, 2016
- Government of South Africa (2015). Estimates of national expenditure 2015. Pretoria: National Treasury publication.
- Graffigna, G. Barello, S. and Riva, G. (2013). Technologies for patient's engagement. *Health Affairs* .32(2), 1- 8, Retrieved from <http://content.healthaffairs.org/content/32/6/1172.4.full> Accessed on 14 July, 2016
- Gray, A. and Verda, Y. (2014). Health Policy and legislation. In padarathe, A.English. *South Africa Health Review* 2013/14. 3 (1), 1 – 7.
- Gray, D. E. (2014).Doing research in the real world. Sage publications: London
- Gray, L. P. and Airasian, P. (1996). Educational research: competencies for analysis and Application. New Jessesy: Prentice Hall.
- Greenhalgh, T. Robert, G. Bate, P. Kyriakidou, O. Macfarlane, F. and Peacock, R. (2006). How to spread good ideas - A systematic review of the literature on diffusion, dissemination and sustainability of innovations in health service delivery and organisation. Report for the National Co-ordinating centre for NHS Service Delivery and Organisation R & D (NCCSDO),
- Grix, J. (2004). The foundations of research. London: Palgrave Macmillan
- Grix, J. (2010). The foundations of research. London: Palgrave Macmillan:
- Grix, J. (2012). The foundations of research. Basingstoke : Palgrave, Hound mills.

- Grondland, M. (2010). User acceptance of information technology: an empirical study of the learning. Master thesis submitted to the Department of Computer Science, Norwegian, University of Science and Technology.
- Gruman, J. Holmes-Rovner, M. French, M. and Prager, D. (2010). From patient education to patient engagement implications for the field of patients education. *Patient Education and Counselling* 78(3).1-8. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20202780>
- Gruman, J. Rovner, M. H. French, M. E. Jeffress, D. Sofaer, S. Shaller, D. and Prager, D. J. (2010). From patient education to patient engagement: implications for the field of patient education. *Patient Education and Counselling*, 78(1), 350-360, retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20202780> Accessed on 13 July, 2016,
- Guba, E. (1990). The paradigm dialogue. London: Sage publication:
- Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries, *Educational Communication and Technology Journal*, 29 (2), 75-91 Retrieved from <http://link.springer.com/article/10.1007/BF02766777> Accessed on 14 July, 2016.
- Gund, A. Lindercrants, K. Schaufelberger, M. Patel, H. and Sjoquist, H. (2012). Attitudes among health towards ICT and home follow –up-chronic heart failure care, *BMC Medical Informatics and Decision Making* 12.(1), 18-23 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23190602> Accessed on 15 July, 2016,
- Gururajan, R. Hafeez-Bang, R. and Don. K. (2008). Pakistani health care professional's views and opinions in health environment. *Electronic Journals of Health Informatics* 3 (2), 1- 1. Retrieved from <https://eprints.usq.edu.au/4716/> Accessed on 23 July, 2016.
- Hains, I. Georgious, A. and Westbrook, J. (2012). The impact of PACS on clinical work practices in the intensive care units a systematic of the literature .*Journal of America Medical Information Association* , 19 (1), 506-513. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3384105/> Accessed on 13 March, 2016

- Haluza, D. and Junqwirth, D. (2014). ICT and the future of healthcare aspects of human promotion. *International Journal of Medical Informatics*, 84(1), 48-57. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/25293532> Accessed on 13 July, 2016.
- Hamidfar, M. Limayem, M. and Zegordi, S. H. (2008). Using the UTAUT model to explore Iranian physicians and nurses' intention to adopt electronic patient records. Proceedings of International Conference on E-learning, *E-Business, Enterprise Information Systems, and E-Government.3* (3), 420-426. Retrieved from <https://www.researchgate.net/publication/221186485> Accessed on 10 July, 2016.
- Harold, C. and Sox, M. D. (2000). How many deaths are due to medical error? Getting the number right. *American College of Physicians' Society of Internal medicine*, 6 (27) 1- 12. Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/183335831404300303> 14 May, 2016 .
- Hashim, H. R. and Mustapha, W. N. (2004). Attitudes towards learning about and working with computers of students at UITM. *The Turkish Online Journal of Educational Technology*, 3 (2), 1303-6521. Retrieved from <http://tojet.net/articles/v3i2/321.pdf> Accessed on 17 July, 2016.
- Hassler, B. Hennessy S. and Lubasi B. (2011). Changing classroom digital practice using a school-based professional development approach to introducing resources in Zambia [Electronic version]. *Itupale Online Journal Affair Study*, 3 (1) 17-23 Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.458.6035> Accessed on 13 November, 2016.
- Haßler, U. Hennessy, S. and Lubasi, S. (2011), *Changing Classroom Practice using a School-Based Professional Development Approach to Introducing Digital Resources in Zambia*, *Itupale Online Journal of African Studies*, 11 (1).
- Hassn, O. Siyanbola, W. and Oyebisi, T. O. (2011). Effect of information technology policy on Nigerian health sector. *Journal of Emerging Trends in computer and Information Science* 2(6), 296-299. Retrieved from

<https://pdfs.semanticscholar.org/6a48/41ddb8bb417d3b38d829079c4025edfbed6.pdf> Accessed on 24 July, 2016.

Hasting Center Report (2011). Bio and medical ethic, the hastening report centre. 44 (1), 1-12
Retrieved from

<http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291552-146X/issues?ActiveYear=2014>. Accessed on 11 July, 2016.

Haux, E. (2006). Health information systems: Past, present, future. *International Journal of Medicare* 75 (1), 268-281. Retrieved from

<https://www.healthcatalyst.com/healthcare-information-systems-past-present-future> Accessed on 10 June, 2016.

Hayrinen, K. Saranto, K. and Nykanen, P.(2008). Definition, structures, content and use. Impacts of electronic health records; a review of the research literature. *International Journal of Medical Informatics*, 77 (5), 291-304. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/17951106>

Health ICT Industry Group (2009). ICT role in healthcare transformation: report of the health ICT Industry Group.

Health Sector Strategic Framework (1999). 1999-2004. South African Government Department of Health. Retrieved from <http://www.gov.za/documents/health-sector-strategic-framework-1999-2004> Accessed on 10 July, 2016.

Health Workforce Country Profile for Nigeria (2008). Federal Ministry of Health, Abuja
Retrieved from http://www.unaids.org/sites/default/files/media_asset/JC2524_Abuja_report_en_0.pdf. Accessed on 13th April, 2015.

Helck, A. Matzko, M. Trumm, C.G. Grosse, C. Piltz, S. and Reiser, M. (2009). Assessing hospitals physicians' acceptance of clinical informatics systems: A review of the relevant literature, 15(1), 15- 34. Retrieved from <https://lirias.kuleuven.be/bitstream/123456789/434817/1/s2.pdf>. Accessed on 10 July, 2016

Helsman, A. Aertgeerts, A. Doncel, P. Van de Velde, S. and Ramaekers, D. (2012). Family physicians perception and use of clinical support during first year's implementation. *Journal of Medical System* 36(6), 3677-3684. Retrieved from

<https://lirias.kuleuven.be/bitstream/123456789/434817/1/s2.pdf> Accessed on 13 December, 2016

Henning, E. Van Ransburg, W. and Smith, B. (2004). Finding your ways to academic writing Pretoria: Van Schaik Publisher

Henricks, W. (2011), Meaning use of electronic health records and its relevance to libraries and pathologists 2(7). *Journal of Pathology Informatics* Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3049251/> Accessed on 13 July, 2015.

Herrink, D. Gordma, L. and Goodman, J. C. (2010). Health information technology: Benefits and Problems. National Center for Policy Analysis Dallas. Retrieved from <http://www.ncpa.org/pdfs/st327.pdf> Accessed on 13 July, 2016

Herselman, M. and Jacob, S. J. (2003). Analysis of the success of ICT at the Ikageng MPCC in support of the Itasoseng community: a case study. Retrieved from <http://wits.ac.za/content/view/127688/77/>. Accessed on 13 July, 2016.

Heterick, B. (2002). Faculty attitudes toward electronic resources. *Educes Review* 1(2) 1-3 Retrieved from <https://net.educause.edu/ir/library/pdf/erm0248.pdf> Accessed on 30 July, 2016.

Hillestrad, R. Bigelow, A. Baren, A. Giroi, F. Meili, R., S. and Taylors, R. (2005). Can electronic medical record systems transform health care? Potential Health benefits, savings and costs. *Health Affairs* 24(5), 1-5. Retrieved from <http://content.healthaffairs.org/content/24/5/1103.abstract> Accessed 11 Noverber, 2016.

Hochwaster, S. Cuongm, D. Chuc, N. T. and Larrison, M. (2014).Towards an electronic health record system in Vietman; A core readiness assignment. *Journal of Health informatics in developing countries developing countries*.8 (2), 93-103. Retrieved from <https://pdfs.semanticscholar.org/6a48/41ddb8bb417d3b38d829079c4025edfbed6.pdf> Accessed on 13 July, 2016.

Holden, R. J. and Karsh, B. T. (2010). The Technology Acceptance Model: Its past and its future in health care. *Journal of Biomedical Informatics*. 43(1), 159-172.

Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19615467> Accessed on 13 July, 2016.

Hollander, M. D. and Moreno, D. (2012). The economics of health care quality and medical errors. *Journal of Healthcare Finance* .39(1). 1-13. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23155743> Accessed on 17 July, 2016

Holtz, B. and Krein, S. (2011). Understanding nurse perceptions of a newly implemented electronic medical record system. *Journal of Technology in Human Services*, 29(4), 247-262. Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/15228835.2011.639931> Accessed on 14 July, 2016

Houshyar A. B. Bahadorani, M. Tootoonchi, M. Gardiner, W. and Adib, P. (2012). Information and communication technology in medical education: An Experience from a Developing Country. *Journal of Pakistan Medical Association* 3(2) 71-75. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22768465> Accessed on 13 June, 2016.

Hsiao, G., and Hing, E. (2014). Use and characteristics of EHR systems among office – based physician practices: United States 2001-2013 NCHS Data Brief No 143 Department of Health Services

Hsiao, J. L. and Chen, E. F. (2016). Critical factors influencing physician's intention to use computerized clinical practice guidelines: an integration model of activity theory and the technology acceptance model. *BMC Medical Informatics and Decision Making* 16 (3).16 -23. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4715302/> Accessed on 11 July, 2016

Hu, P. J. Chau, P. Y. K. Liu- Sheng, O. R. and Tam, K. Y. (1999). Examining the technology acceptance model using physician acceptance of telemedicine technology. *Journal of Management Information Systems* 16 (1), 291-112. Retrieved from <https://www.jstor.org/stable/40398433?> Accessed on 7 July, 2016.

Huang, N. and Qin, G. (2011). A study of online virtual fitting room adoption based on UTAUT. Paper presented at the E-Business and E-Government (ICEE), International Conference.

- Hubner, U. Liebe, J. Egberit, A. and Frey, A. (2013). IT report Gesindeithswesen
schwepunkt IT in Kranken Schwepunkt IT in Kranken hairs.
- Hug, B. Witkowski, D. and Sox, C. (2010). Adverse drug event rates in six community
hospitals and the potential impact of computerized physicians order entry for
prevention. *Journal of General Interim Medicine* 25(1), 31-35. Retrieved from
<https://www.ncbi.nlm.nih.gov/pubmed/19894081> Accessed on 13 August,
2016.
- Hughes, J. A. and Pakieser, R. A. (1999). Factors that impact nurses' use of electronic mail
(e-mail). *Computers in Nursing*, 17(6), 251-258. Retrieved from
<https://www.ncbi.nlm.nih.gov/pubmed/10609399>. Accessed on 9th July, 2016.
- Human Resource for Health Country Profile (2013). United Republic of Tanzania. Ministry
of Health and Social Welfare. Retrieved from
[http://www.tzdpg.or.tz/fileadmin/documents/dpg_internal/dpg_working_group
s_clusters/clust](http://www.tzdpg.or.tz/fileadmin/documents/dpg_internal/dpg_working_group_s_clusters/clust) Accessed on 9th July, 2016.
- Human Science Research Council (2009). Annual Report 2009-2010, South Africa
Government.
- Idowu, B. Adagunodo, R. and Adedoyin, R. (2006). Information technology infusion model
for health sector in developing country: Nigeria as a case. *Technology and
Health Care*, 14(2), 69-77. Retrieved from
<https://www.ncbi.nlm.nih.gov/pubmed/16720950> Accessed on 9th July, 2016
- Idowu, B. Ogunbodede, E. and Idowu, B. (2004). Information and communication
technology in Nigeria health sector experience. *Journal of Information
Technology Impact*. 3(2), 69-76. Retrieved from
[https://www.researchgate.net/publication/235248559_Information_Communic
ation_Technology_In_Nigeria_The_Health_Sector_Experience](https://www.researchgate.net/publication/235248559_Information_Communication_Technology_In_Nigeria_The_Health_Sector_Experience) Accessed on
27 July, 2016.
- Idowu, D. C. Cornford, D. and Batin, L. (2008). Health Informatics development in Nigeria.
Journal of Health Informatics in Developing Countries 2(1), 15-33. Retrieved
from <http://www.jhidc.org/index.php/jhidc/article/view/11> Accessed on 9th
July, 2016.

- Ifinedo, P. (2012), Technology acceptance by health professionals in Canada; an analysis with a modified UTAUT model 45th Hawaii International Conferences in system science Retrieved from <https://pdfs.semanticscholar.org/4227/745bb67742917dc7a83c7fbf2686f61375d5.pdf> 17 April, 2016.
- Ihuah, P. and Eaton, D. (2013). The pragmatics research approach; a framework for sustainable management of public housing estates in Nigeria. *Journal of US – China Public Administration* .10 (10), 933-944. Retrieved from https://www.researchgate.net/profile/Paulinus_Ihuah/publication/265793964 8 August, 2016
- Ikolo, V. E. (2010). Gender digital divide and national ICT policies in Africa. In Adomi E.E., (Ed.) Handbook of research in library and information science. London: IGI Publications.
- Ikolo, V. E. and Okiy, R. B. (2012). Gender difference in computer literacy among clinical medical students .in selected Southern Nigerian Universities. *Library Philosophy and Practice* Retrieved from <http://www.webpages.uidaho.edu/~mbolin/ikolo-okiy.htm> Accessed on 9th July, 2016.
- Imam, I. and Olorunfemi, G. (2006) Clinical diagnosis of stroke: need for Audit. *Annals of Africa Medicine* 3(4). 167-169. Retrieved from <http://www.ajol.info/index.php/aam/article/view/8331> Accessed on 20 July, 2015.
- Imhoff, M. Webb, A. and Goldschmidt, A. (2001). Health Informatics. *Intensive Care Medicine* 27(1), 176-186. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/11280631> Accessed on 18 July, 2016
- Imoughele, L. and Ismaila, I. (2013). Determinants of public healthcare expenditure in Nigeria: an error correction mechanism approach .*International Journal of Business and Social Science* 4(13).1- 13, Retrieved from http://ijbssnet.com/journals/Vol_4_No_13_October_2013/24.pdf Accessed on 10 August, 2016

- Info Dev (2006). Improving health, connecting people: the role of ICTs in the health sectors of developing countries; a frame work paper. World Bank 1(1). Retrieved from Retrieved from <http://documents.worldbank.org/curated/en/234041468163474585/> Accessed on 15 August, 2016.
- Info Dev (2007). Improving health connecting people the role of ICTs in the health sector of Developing countries; A frame working document paper No1 2007.Health Retrieved from WorldWide.Ahttp://www.infodev.org/infodevfiles/resource/InfodevDocuments_84.pdfvailableat .Accessed on 18 January, 2015 .
- Ingwersen, P. and Järvelin, K. (2005). The turn: Integration of information seeking and retrieval in context. New Jessy: Springer.
- Institute of Health Informatics (2014). Riding the information technology waves in life science .priorities, pitfalls and promise. Parippay : IMS publication.
- Institute of Medicine (1999). To err is human: building a safer health system; national academy Press. Washington [https://www.nationalacademies.org/hmd/~/media/Files/Report Files/1999](https://www.nationalacademies.org/hmd/~/media/Files/Report%20Files/1999) Accessed on 9th July, 2016.
- International Telecommincation Union (2012). Key ICT indicators 2012-2014.World TelecommunicationPress[http://www.itu.int/en/ITU-D/Statistics/Pages/publication s/w tid.aspx](http://www.itu.int/en/ITU-D/Statistics/Pages/publication%20s/w%20tid.aspx) Accessed on 9th July, 2016.
- International Telecommunication Union (2003). Measuring the information society: Executive summary ITU. International Telecommunication Union, Geneva. Retrieved from <http://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf> Accessed on 27 July, 2016.
- International Telecommunication Union (2010).Monitoring the WSIS target: a mid term review. Geneva: ITU publication

- Internet World Stats (2012). Internet usage statistics for Africa. Internet usage statistics for Africa. Miniwatts Marketing Group Retrieved from <http://www.internetworldstats.com/stats1.htm> Accessed on 9th August, 2016.
- Internet World Stats (2016). Internet usage statistics for Africa. Internet usage statistics for Africa. Miniwatts Marketing Group Retrieved from <http://www.internetworldstats.com/stats1.htm> Accessed on 9th August, 2016
- Jankowska, M. A. (2004). Identifying university professors' information needs in the challenging environment of ICT. *The Journal of Academic Librarianship* 30 (1), 51-66. Retrieved from <http://www.sciencedirect.com/science/article/pii/S009913330300140X> Accessed on 10 July, 2016
- Jayasuriya, R. (1998). Determinants of microcomputer technology use: implications for education and training of health staff. *International Journal of Medical Informatics*.50 (1-3), 187-194. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1386505698000677> Accessed on 23 January, 2016.
- Jencks, S. F. Hull, E., D., and Cuerdon, T. (2003). Change in the quality of care delivered to medicare beneficiaries 1998 - 2001. *Journal of American Medical Association* 289(3), 7- 14 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/12525231> Accessed on 9 July, 2016
- Jeng, D. J. F. and Tzeng, G. H. (2012). Social influence on the use of Clinical Decision Support Systems: revisiting the unified theory of acceptance and use of technology by the Fuzzy DEMATEL Technique. *Computer and Industrial Engineering* 62(2012), 819- 826 .
- Jha, A. K. Dolan, D. Grandt, D. Scott, T. and Bates D. W. (2008). The use of health Information Technology in Seven Nations. *International Journal of Medical Informatics*, 77 (2) 848-854. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18657471> Accessed on 23 July, 2016
- Jha, A. Desroches, C. M. Capbell, E. G. Donelan. K. Rao, S. Timothy, F. Sheilds, A. Rodenbary, S. and Bluementhel. M.D. (2009) Use of electronic health records in US hospitals New England. *Journal of Medicine*. 360. 1628-1638. Retrieved

from

<http://www.nejm.org/doi/full/10.1056/NEJMsa0900592#t=article> Accessed on 23 July, 2016.

Jha, H. (2011). The promise of EHR around the corner or down the road? *Journal of the American Medical Association* 308 (8), 801- 802 Retrieved from <http://jamanetwork.com/journals/jama/article-abstract/1104253> Accessed on 9th November, 2016

Jiang, J. Hsu, M. K. Klein, G. and Lin, B. (2000). E-Commerce user behavior model: An empirical study. *Human Systems Management*, 19(4), 265–276 Retrieved from <http://jamanetwork.com/journals/jama/article-abstract/1104253> Accessed on 13 July, 2016.

Jirack, K. Praneetpolgrang, P. and Mekhabunchakij, K. (2009). An acceptance of mobile learning for higher education students in Thailand. The 6th International conference on e-learning for knowledge –based society. Thailand Retrieved from http://www.elearning2014.com/eLAP2009/Proceedings/36_Full_Kallaya%20Jairak_Online.pdf Accessed on 19 June, 2016

Jiyane, G. V. (2012) .The role of information and knowledge society in poverty alleviation and economic empowerment among informal sector women entrepreneurs in South Africa. Phd submitted to Department of Information Studies, University of Zululand

Johnson, B. R. (1997). Examining the validity structure of qualitative research. *Education*, 118(3), 282-292.

Johnson, R. B. and Christensen, L., B. (2014). Educational research methods: quantitative, qualitative, and mixed approaches. Sage: Los Angeles

Johnson, R. B. and Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come, *Educational Researchers*. 33 (7), 14-26. Retrieved from <http://journals.sagepub.com/doi/abs/10.3102/0013189X033007014> Accessed on 9th October, 2016.

- Joudey, R. and Robson, K. (2010). Practising medicine in two countries South Africa physicians in Canada. *Sociology of Health and Illness* 32(4). 528-544. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20163562> 19 June, 2016
- Jung, E. (2006). Report central: quality reporting tool in an electronic health record .AMIA.2 (2), 1-7.
- Jung, S. (2006). The perceived benefits of health care information technology adoption: construct and survey development: Master thesis Submitted to Department of Information System and Decision Sciences, Louisiana State University.
- Kalusopa, T. (2011). Developing an e-records readiness framework for labour organization in Bostwana PhD thesis submitted to the Department of Information Science, University of South Africa,
- Kaplan, B. N. T. and Shaw, W. (2004). Future directions in evaluation research: people, organizational, and social issues. *Methods of Information in Medicine*, 43(3), 215– 231. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/152275515> May, 2015
- Kaplan, B. and Kimberley, D. (2009). Health IT success and failure; recommendations from literature and AMIA workshop .*Journal of Medical Informatics Association* .16(3), .291-299 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2732244/> Accessed on 29 July, 2016
- Karsenti, T. and Charlin B. (2008). Information and communication technologies (ICT) in medical education and practice: The major challenges. *International Journal of Technologies in Higher Education*. 5. 68-81. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3577362/> Accessed on 12 July, 2016
- Kasiulevicius, V. Sapoka, V. and Filipaviciute, E. (2006). Sample size calculation in epidemiological studies .*Gerontological* 7 (4), 225-231. Retrieved from http://www.gerontologija.lt/files/edit_files/File/pdf/2006/nr_4/2006_225_231.pdf Accessed on 11 Febuary, 2016

- Kaur, B. and Verma, R. (2009). Use and impact of electronic journals in the Indian Institute of Technology, Delhi, India. *The Electronic Library* 27 (4), 611-622. Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/02640470910979570> Accessed on 10 March, 2016
- Kaushal, R. Shojania, K. W. and Bates, D. W. (2003). Effects of computerised physicians order entry on medication safety; Asystematics review *JAMA Internal Medicine* 163(12) 1- 12 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/12824090> Accessed on 13 May,, 2016
- Kaushaul, K. (2008). Return of investment for a computerised physicians order entry system. *Journal of America Medical Informatics Association* 13 (3), 261-267,
- Kawamoto, K. Houlihan, C. A, Balas E. A. and Lobach, D. F. (2005). Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *BMJ*. 330(7494), 1-12, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1513660/> Accessed on 19 July, 2016.
- Kay, R. (2006). Addressing gender differences in computer, ability, attitude and use. The laptop effect. *Journal of Education Computing Research* 187-222, 34(2) Retrieved from http://faculty.uoit.ca/kay/files/pubs/gender/Kay_2006_JECR_GenderDiffs_Laptop.pdf Accessed on 9 July, 2016
- Kazi, A. M. and Khalid, W. (2012). Questionnaire designing and validation. *Journal of the Pakistani Medical Association*, 62, 514–516. Retrieved from http://ecommons.aku.edu/cgi/viewcontent.cgi?article=1013&context=pakistan_fhs_mc_women_childhealth_paediatr Accessed on 16 July, 2016.
- Kels, B. and Grant-Kels, J. (2012). The spectrum of medical errors: when patients sue. *International Journal of General Medicine*., 5 (1), 613-619. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3422898/> Accessed on 7 May, 2015.
- Kerline, F. N. (1979). Behavioural research: A conceptual approach. Philadelphia: Holt publication.

- Khan, S. and Dominic, J. (2012). Use of internet by the faculty members of engineering Colleges of Moradabad: A Comparative Study. ICAL: Library Services. :h Retrieved from [ttp://crl.du.ac.in/ical09/papers/index_files/ical95_124_278_1_RV.pdf](http://crl.du.ac.in/ical09/papers/index_files/ical95_124_278_1_RV.pdf). Accessed on 10 May, 2016.
- Khana, R. and Yen, T. (2014). Computerised physician order entry promise pevils and experience. *Neurohospitlist* 4 (1), 26 -33. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/24381708> Accessed on 14May, 2016.
- Khechine, H. Lakhal, S. and Ndjambou, P. (2016). A meta-analysis of the UTAUT model: eleven years later. *Canadian Journal of Administrative Sciences* 33(2), 1-12. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/cjas.1381/abstract> Accessed on 10 June, 2016.
- Khoja, S. Durrani, H. Scott, R. E. Sajwani, A. and Piryani, U. (2012). Conceptual framework for development of comprehensive e-health evaluation tool. *Telemedicine and e-health*. 19(1).48–54I Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22957502>. Accessed on 10 May, 2016.
- Khould, A., O. Dennis, C. Hegazy, A. and Abdah, M. (2015) . How visibile is the UTAUT model in a non-western context .*International Business Research* 8(2). 204-219 Retrieved from <http://www.ccsenet.org/journal/index.php/ibr/article/view/44125> Accessed on 10 June, 2016.
- Kifle, M. (2008). A telemedicine transfer model for sub –Saharan Africa. Proceedings of the 41st Hawaii International Conference in System Science
- Kijsanayotin, B. Pannarunothai, S. and Speedie, S. M. (2009). Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International Journal of Medical Informatics*, 78(6), 404-416. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19196548>
- Kilbridge , P. and Classen, D. (2008) .The informatics opportunities at the intersection of patient safety and clinical informatics. *Journal of Medical Informatics*

- Association*. 15(4) 394-403 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2442268/> Accessed on 10 May, 2016
- Kim, H. W. and Kankahalli, R. (2009). Investigating user resistance to information systems implementation; a status quo bias perspective. *Management Information System Quarterly* 32(3), 1- 12, Retrieved from <http://misq.org/investigating-user-resistance-to-information-systems-implementation-a-status-quo-bias-perspective.html> Accessed on 10 May, 2016
- Kim, S. J. Hyuck, H. and Yoo, A. (2016). Analysis of the factors influencing healthcare professionals adoption of mobile electronic medical using the UTAUT in a tertiary hospital. *BMC Medical Informatics and Decision Making* 16 (12).11-21 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4736616/> Accessed on 10 May, 2016.
- Kim, Y. Kelly, T. and Raja, S. (2010). Building broadband : strategies and policies for the developing world. World Bank publication. <https://openknowledge.worldbank.org/handle/10986/2469> 13 November, 2015
- Kimberlin, C. L. and Winterstein, A. G. (2008). Validity and reliability of measure measurement used in research. *American Journal Health System Pharm.* 1(23).1-12 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19020196> Accessed on 13 December, 2016
- Kinengyere, A. A. (2007). The effect of information literacy on the utilization of electronic information resources in selected academic and research institutions in Uganda. *The Electronic Library*, 25(3), 328-341. Retrieved from <http://emeraldinsight.com/doi/abs/10.1108/02640470710754832> Accessed on 14 June , 2016.
- Kiplang'at, J. (2004). Diffusion of information and communication technologies in communication of Agricultural information among agricultural researchers and extension workers in Kenya. KwaDlangezwa: University of Zululand, Department of Information Studies

- Kirk, M. and Zander, C. (2004). Bridging the digital divide by co- creating a collobration computae scienc classroom. *Journal of Computing Sciences in College* 18(2) .
- Kleynhans, K. (2011). Is South Africa ready for a national electronic health record (HER)? Thesis submitted to the Department of Business Studies for the award of master degree from Univserity of South Africa.
- Kling, R. (1999). What is Social Informatics and Why Does it Matter? *D-Lib Magazine*. 5 (1). 1-10 Retrieved from <http://www.dlib.org/dlib/january99/kling/01kling.html> Accessed on 7 May, 2016.
- Knutsen, L. Constantious, L. and Damsgaard, J. (2005). Acceptance and perceptions of advanced mobile services: alterations during a field study. In Proceedings of International Conference on Mobile Business. Sydney, Australia, 326-332.
- Kommalage, M. and Gunawardena, S (2008). Feasibility of introducing information technology based activities into medical curricula in developing countries, *Medical Education*, 42 (1), 113-120 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/18181850>. Accessed on 10 June, 2016
- Koppel, R. (2009). Implementation of CPOE in seven countries .*Health Affairs* 28(2), 404-414, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19275996> Accessed on 10 December, 2016.
- Koppel, R, Nethley, J. O. A. and Cohen, A. (2006). Role of COPE in facilitating medication errors .*Journal of American medical Association*. 293(10).1197-1203. Retrieved from <http://jamanetwork.com/journals/jama/fullarticle/200498> Accessed on 10 May, 2016 .
- Korpelainen, E. (2011). Theories of ICT System Implementation and Adoption - A Critical Review, Working Paper, Department of Industrial Engineering and Management, School of Science, Aalto University, Helsinki.
- Kosteniuck, J. C. Morgan, D. G. and D' Arcy, C. K. (2013) Use and perceptions of information among famly physician's sources considered accessible, relevant and reliable. *Journal of Medical Library Assocaition* 101(1), 32-37, Retrieved

from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3543145/> Accessed on 10 May, 2016.

- Kothari, C. R. (2004). Research methodology: methods and techniques. New Delhi: Age International (P) Ltd Publisher.
- Kotler, P. (1998). Marketing management-analysis, planning, implementation and control, Cliffs Englewood: Prentice-Hall.
- KPMG (2012). Funding NHI: a spoonful of sugar? An economic analysis of the NHI. KPMG South Africa.
- Krauss, K. (2009). Proceedings of the 3rd International IDIA Development Informatics Conference, 28-30 October 2009. 29th -30th National Pack, South Africa
- Krippendorff, K. (1980). Content Analysis: An introduction to Its Methodology. CA Newbury Park: Sage publication.
- Krueger, A. (2010). 6 ways technology is improving healthcare. *Business Insider Strategy*.1 (1) 1 -12.
- Kuhn, T. S. (1977). The structure of scientific revolutions. Chicago : Chicago press.
- Kuo, Y. F. and Yen, S. N. (2009). Towards an understanding of the behavioral intention to Use 3G mobile value-added services. *Computers in Human Behavior*, 25(1), 103-110. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/20202780> Accessed on 10 May, 2016
- Kuzel, H. J. (1996). Rietveld qualitative XRD analysis of Portland cements 16th International Conference of Cem. Microse
- Läkemedelsverket, K. (2010). Swedish Medical Products Agency, Läkemedelsboken, 2011-2012.
- Labuschagne, M. Robbertze, W. Robbertze, W. Rozmiarek, J. Strydom, W. and Diedericks, B. J. S. (2011). Errors in drug administration by anesthetists' in public hospitals in Free State Province, South Africa *Medical Journal* 101(5). 1-12
- Lai, I. L. A. (2005). Knowledge management for Chinese Medicine; a conceptual model. *Information Management and Computer Security* 13 (2). 1-12

http://eprints.qut.edu.au/50068/1/Social_Media_and_Tacit_Knowledge_Sharing-Sirous_Panahi.pdf Accessed on 13 May, 2016

Lakbala, P. and Dindarlo, K. (2014), Physician perception and attribute toward electronic medical record. *Springer plus* 3 (63), 1-12, Retrieved from <https://springerplus.springeropen.com/articles/10.1186/2193-1801-3-63> Accessed on 09 May, 2016.

Lapoinde, L. and Rivards, Z. (2005). A multi-level model of resistance to information technology implementation. *Management Information System Quarterly* 29(93)1, Retrieved from - https://www.jstor.org/stable/25148692?seq=1#page_scan_tab_contents. Accessed 8 July, 2016

Lau, B. and Sim, C. (2008). Exploring the Extent of ICT Adoption among Secondary School Teachers in Malaysia.. *International Journal of Computing and ICT Research*, 2 (2), 19-36. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.372.5339&rep=rep1&type=pdf> Accessed on 10 May, 2016

Laudan, L. (1995). Beyond positivism and relativism: theory, method and evidence, Boulder: Westview Press

Leapfrog group (2015), CPOE: Leapfrog Hospital Survey Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.372.5339&rep=rep1&type=pdf> Accessed on 14 May, 2016

Leapfrog group (2006). Policy Leadership. How safe is your hospital? Available at: http://www.leapfroggroup.org/policy_leadership leapfrog news/4894464.

Lee, H. W. Ramayah, T. and Zakaria, N. (2012). External factors in hospital information system (HIS) adoption model: a case on Malaysia. *Journal of Medical systems*, 36(4), 2129-2140. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21384267> Accessed on 11 May, 2016

Leedy, P. D. and Ormrod, J. E. (2013). Practical research: Planning and design Boston: Pearson Education.

- Leedy, P. D. and Ormrod, J. E. (2010). Practical research: planning and design. Boston: Pearson Education.
- Leon, N, and Scheider, H. (2012). Mhealth 4CDS in South Africa. A review of the role of mobile phones technology for moniteoring and evaluation of a community based health service. Cape Town.
- Lewis, D. Hodge, H. Gamage, D. and Whittaker, A. (2011) Understanding the role of technology in health information sytem.*Health Information System* 17 (1) 1-18 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23240349> 15 June, 2015
- Lewis, T. Synowiec, C. Lagomarsino, G. and Chweitzer, J. (2013). E-health in low- and middle-income countries: findings from the Center for Health Market Innovations. *Bulletin of World Health Organization*, 90 (3), 332–340. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22589566> Accessed on 10 May, 2016.
- Li, J. Talaaei-Khoei, Seale, H. Ray, P. and MacInyre, C. R. (2013).Health care provider adoption of e-health systematics literature review. *Internet Journal Medical Research* 2(1).1-12 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23608679>. Accessed on 14 May, 2016
- Li, J. Westbrook, J. C. Callen, J. and Georgious, A. (2012). The role of ICT in supporting disruptive innovation: a multi site qualitative study of nurse practitioners in medical informatics. *Journal of Medical Informatics and Decision Making* 12 (27).1-7, Retrieved from <http://bmcmeginformdecismak.biomedcentral.com/articles/10.1186/1472-6947-12-27> Accessed on 10 May, 2016
- Liewelly, R. L. Gordon, R. C. Wheatcroff, D. L. Reed, A. Butt, A .D.Lundegren, A . C. and James, M. F. (2009). Drug administration errors: a prospective survey from South African teaching hospitals. *Anaesthetic Intensive Care* 37(1), 93-98. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19157353> Accessed on 10 July, 2016.
- Lincoln, Y. S. Lynham, S. A. and Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences revisited. In N. K. Denzin & Y. S.

Lincoln, the SAGE handbook of qualitative research. London: Thousand Oaks, Sage publication.

Link, T. M. and Marz, R. (2006). Computer literacy and the attitude towards e-learning among first year medical students. *BMC Medical Education* 6(3), 6- 34

Lipshitz, R. and Popper, M. (2000). Organisational learning in a hospital. *Journal of Applied Behavioural Science*. 36(3), 345-361. Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/0021886300363005> Accessed on 10 July, 2016.

Litho, P. K. (2010). ICTs and health in Uganda: benefits, challenges and contradictions. Retrieved from <http://www.genderit.org/en/index.shtml?apc=a11e11&x=95473>. Accessed on 10 August, 2016

Littlejohns, P. Wyatt J. C. and Garvican L. (2003). Evaluating computerised health information systems: hard lessons still to be learnt. *BMJ* .326 (12), 860-863. Retrieved from <http://www.bmj.com/content/326/7394/860> Accessed on 22 May, 2016.

Liu, C. T. and Cheng, T. J. (2015). Exploring critical factors influencing physicians acceptance of mobile electronic medical based on dual-factor model a validation in Taiwan .*BMC Medical Informatics and Decision Making*.15(4). 15-24 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4333263/> Accessed on 10 May, 2016.

Liu, J. (2013). E-learning in English classroom; Investigating factors impacting on ESL (English as second language) the Modular Object-oriented dynamic learning environment (Moodle Learning Environment (Moodle) Phd thesis Iowa State University.

LoBiondo-Wood, G. and Haber, J. (2010). Nursing research methods and critical appraisal and utilization St Louis: Mosby.

Losby, J. and Wetmore, A. (2012). CDC coffee break: Using Likert Scales in evaluation survey work. Centers for Disease Control and Prevention. Retrieved from

- https://www.cdc.gov/dhds/pubs/docs/CB_February_14_2012.pdf Accessed on 14 May, 2016.
- Louho, R. Kallioja, A. and Oittinen, P. (2006). Factors affecting the use of Hybrid media. *Graphic Arts in Finland*, 35(3), 11-21 Retrieved from http://media.tkk.fi/GTTS/GAiF/GAiF_PDF/GAiF2006_3-2.pdf Accessed on 10 July, 2016.
- Loveday, M. Smith, J. and Monticeli, F. (2006). Health information audit report South Africa. *Health System Trust*. Retrieved from <http://www.hst.org.za/publications/health-information-audit-report-south-africa> Accessed on 10 June, 2016
- Lpshitz, R. and Popper, M. (2000). Organizationl learning in a hospital. *Journal of Applied Behavioral Science* .36(3), 345-361. Retrieved from <http://www.ormanager.com/wp-content/uploads/2007/05/ORmanagersFinal.pdf> Accessed on 18 May, 2016
- Luncd Research, (2012). Convenience sampling. Laerd dissertation. Lund research Ltd
- MacDonald, R. J.(2008). Professional development for information communicationtechnology integration. Identifying and supporting a community of practice through design-based research. *Journal of Research on Technology in Education* 40 (3), 429-445. Retrieved from <http://files.eric.ed.gov/fulltext/EJ826085.pdf> Accessed on 11 May, 2016.
- Maduku, D. (2015). Factors of e-book use intentions: perspective of studentsin a developing country. *Perspective on Global Development and Technology*, 14(6), 597-618 Retrieved from booksandjournals.brillonline.com/content/journals/10.1163/15691497-12341364
- Maharana, B. Biswal, S. and Sahu N. K. (2009). Use of information and communication technology by medical students: A survey of VSS Medical College, Burla, India. *LibraryPhilosophy Practices*: Retrieved from <http://digitalcommons.unl.edu/libphilprac/281>. Accessed on 10 May, 2016

- Mahony, D. O. Wright, G. Yogeswaran, O. and Goverance, N. (2013). Knowledge and attitudes of nurses in community and attitudes of nurses in community health centers about EMR. *Journal of the Democratic Nursing Organisation of South Africa*. 37(1).1-12 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/24832678>. Accessed on 12 May, 2016
- Maillet, É. Mathieu, L. and Sicotte, C. (2015). Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT. *International Journal of Medical Information*. 84(1), 36–47. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/25288192>
- Marchewka, J. T. Liu, C. and Kostiwa, K. (2007). An application of the UTAUT model for understanding student perceptions using course management software. *Communications of the IIMA*, 7(2), 93-104. Retrieved from <http://docplayer.net/9143911-An-application-of-the-utaut-model-for-understanding-student-per> Accessed on 10 June, 2105.
- Marchionini, G. (1995). Information seeking in electronic environments. Cambridge: University press
- Maree J. G. and Pietersen, J. (2014). The quantitative research process. In JG Maree (ed). *First steps in research*. Pretoria: Van Schaik publisher
- Maree, K. (2011). *First Steps in Research*. Pretoria: Van Schaik Publishers.
- Maree, K. (2014). *First Steps in Research*. Pretoria: Van Schaik Publisher.
- Mars, M. S. and Seebregts, S. (2008). Country case study for ehealth. South Africa Rockfeller Foundation.
- Marshall, M. Carter, B. Rose, K. and Brotherton, A. (2009). Living with type 1 diabetes: perceptions of children and their parents. *Journal of Clinical Nursing*, 18(12), 1703-1710. Retrieved from <http://www.wiley.com/bw/journal.asp?ref=0962-1067> Accessed on 17 May, 2016.
- Mathers, N. Fox, N. and Hum, H. (2007). Survey and questionnaires. National Institute Health Research. East Midland.

- Matthew, D. (2015). Sociology in nursing: how gender influences health inequalities. *Nursing Times* 111 (43), 21-23.
- Mc Donals, D. M. (2008). Evaluating the implementation of picture archiving and communication systems in New found land and Labrader Memorial University of Newfound Land, Phd Theis.
- McAlearny, A. S. Schweikhart, S. and Medow, M. (2004). Doctors experience with handheld computers in clinical practice: *Qualiative study. BMJ.* 11(62), Retrieved from <http://www.bmj.com/content/328/7449/1162> Accessed on 10 June, 2016.
- McGlynn, E. A. Asch, S. M. Adams, J. Kessey, J. DeCristofaro, A. and Kerr, E. A. (2003). The quality of healthcare delivered to adults in the United State. *Northern England Journal Medicine.* 348(26).1- 12, Retrieved from <http://www.nejm.org/doi/full/10.1056/NEJMsa022615#t=article> Accessed on 11 May, 2016.
- McGrowan, B. Wako, M. Vartabedian, S. Miller, R., and Freiheri, D. (2012). Understanding the factors that influence the adoption and meaning use of social media by physcians to share medical information. *Journal of Medical Informatics Research*, 14 (5).117 -211. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23006336> Accessed on 8 August, 2016
- McKenna, H. Hasson, F. and Keeney, S. (2006). Surveys. In Gerrish K, Lacey A. The Research Process in Nursing. Blackwell publishing: Oxford
- McKenzie, K. Whitley, R. and Weich, S. (2002). Social capital and mental health. *British Journal of Psychiatry*, 181(3) 280– 283. Retrieved from <http://bjp.rcpsych.org/content/181/4/280> Accessed on 10 May, 2016
- Media Club South Africa (2012). Health care in South Africa. South Africa.Info. Retrieved from www.brandsouthafrica.com/investments-immigration/economynews/sa-economy-key-sectors 12 December, 2016
- Medical Club of South Africa (2013). South Africa Department of Health
- Medical Schemes Act No 131 of 1998, South Africa medical schemes Acts No 131 of 1998. Medical Schemes Act No 131 of 1998, Retrieved from

http://www1.chr.up.ac.za/undp/domestic/docs/legislation_52.pdf 9 November, 2015 .

- Melas, C. Zampetakis, L. Dimopoulou, A. and Moustackis, V. (2011). Modelling the acceptance of clinical informatics systems among hospitals medical staff; an extended of TAM model. *Journal of Biomedical Informatics*.44 (4), 553-564. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21292029> Accessed on 10 December, 2016
- Menachemi, N. and Brooks, R. G. (2006). Reviewing the benefits and costs of electronic health records and associated patient safety technologies. *Journal of Medical System* 30 (3), 159-168. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/16848129> Accessed on 8 May, 2016
- Mertens, D. (2010). Philosophy in mixed methods teaching: the transformative paradigm as illustration. *International Journal of Multiple Research Approaches*. 4(1), 8-18. Retrieved from <http://teachingphilosophyworkgroup.bgsu.wikispaces.net/file/view/philosophy+in+mixed+methods+teaching.pdf> Accessed on 10 May, 2016
- Michel, C. M. (2008). Implementing a Forensic Educational Package for Registered Nurses in Two Emergency Departments in Western Australia PhD thesis. University of Notre Dame, Australia.
- Middlenton, H. E. (2008). Researching technology education: Methods and techniques, Sense Publishers: Rotterdam
- Miller, R. and Sim, I. (2004). Physicians use of EMR barriers and solutions. *Health Affairs*. 23(2). 116-126. Rotterdam Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/1504613613> June, 2015.
- Minesh, P. Isha. P. Jongwaha, C. and Rarus, C. (2012). Computerised physician order entry systems: An introduction. *Journal of Pharmacy Research*. 5(10), 4962 - 4967
- Minton, H. L. and Schneider, F. W. (1980). Differential Psychology. Prospect Heights: IL
- Mistra, A. Lenzmeier, S. Steffensmeier, T. Avon, R. Qu, N. and Hazen, M. (2001). Gender and computer use in academics institution. Report from a longitudinal study.

Journal Education computing Research 23(1), 67-84. Retrieved from
<http://journals.sagepub.com/doi/pdf/10.2190/BG2M-A5ER-KV7Y-N0J5>
 Accessed on 11 May, 2015

- Moahi, K. H. (2007). Globalization, Knowledge Economy and the implication for Indigenous Knowledge. *International Review of Information Ethics*, 7 (1), Retrieved from http://i-r-i-e.net/inhalt/007/irie_007_full.pdf#page=55
- Moahi, K. H. (2009). ICT and health information in Bostswana: Towards the millemium development Goals. *Information Development*.25 (3), 198-206. Retrieved from
<http://journals.sagepub.com/doi/abs/10.1177/02666666909340790?legid=spidv%3B25%2F3%2F198&patientinform-links=yes> Accessed on 9 June, 2015
- Modiba, F. S. and Kotz, D. (2011). The challenges of accessing ICT technologies as indicating woman enterprenuer in Pretoria South Africa. *International Journal pf indersisiplinary Social Science* 6(4), 1- 12 Retrieved from
<http://iji.cgpublisher.com/product/pub.88/prod.1446> Accessed on 13 May, 2015,
- Moghavveni, S. Salleh, N. A. and Abessi, M. (2013). Deaterminants of IT related innovation acceptance and use behavior: theoretical intergration of UTAUT and entrepreneurial potential model. *Social Technologies* 3(2), 243-260. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2762055
 Accessed on 30 May, 2016
- Moja, L. Liberrati, E. R. Galupo, L. Gorli, L. Maraidi, O. Rigion, G. Ruggeri, P. and Kwangi, K. H. (2014). Barriers and facilities to the update of computerised decision support systems in a speciality hospitals: protocol for a qualitative cross –sectional study. *Implemented Science*. 9 (105), 6-17 Retrieved from
<https://implementationscience.biomedcentral.com/articles/10.1186/s13012-014-0105-0> Accessed on 16 May, 2016
- Moody, L. E. (1990). Advancing nursing science through research. Newbury : Sage publication.
- Moon, J. Hossain, M. D. Kang, H. G. and Shin, J. (2012). Analysis of agricultural informatization in Korea: the government’s role in bridging the digital divide.

- Information Development* 28 (2), 102-116. Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/0266666911432959> Accessed on 10 June, 2016.
- Moosa, S. Luiz, J. M. and Carmiclad, T. (2012). Introdcing a national health insurance system in South Africa A general costing. *South Africa Medical Journal*. 102(10). 1- 12 Retrieved from https://www.researchgate.net/publication/232008003_Introducing_a_national_health_insurance_system_in_South_Africa_A
- Morton, M. and Weidenbeck, S. (2010). Electronic Health Records acceptance factors in ambulatory care: a survey of physician perceptions.Perspective *Health Information Management*. 7(1), 12 -22. Retrieved from <http://perspectives.ahima.org/ehr-acceptance-factors-in-ambulatory-care-a-survey-of-physician-perceptions/> Accessed on 11 May, 2015
- Moshapo, S. and Hanara, H. (2004). ICT services for poor rural community development – what is missing in current implementation? Southern African Telecommunications and Applications Conference (SATNAC), Proceedings, 7-10, September.
- Motsi, L. and Kalema, B. (2015). Knowledge sharing framework for educators in South Africa; a case study of secondary schools in Tshwane South District. *IIMC International Information Management Corporation*. (1), 1-7.
- Moududdin, A. and Moore, J. (2008) .The underserved and health information technology issues and opportunities United National Department of Health and Human Services.
- Mourad, N. (2012). Perceived factors influencing acceptance and adoption of mobile technology by clinicians in practice; a master thesis submitted to the Faculty of Health Policy and Management at the University of Minnesota
- Mouton, J. (2009). Understanding social research Pretoria: van Schaik.
- Mowday, R. Porter, L. and Steers, R. (1982). Employee–organization linkages: The psychology of commitment, absenteeism, and turnover. New York: Academic press.

- Mugenda, A. (2008). Social science research. Nairobi: applied research and training services. Nairobi.
- Mugenda, O. L. and Mugenda, A. G. (1999). Research methods: quantitative and qualitative approaches. Nairobi: African Centre for Technology Studies publication .
- Mugo, D. M. and Nzug, D. (2014). Determinants of electronic health in developing countries. *International Journal of Arts and Commerce* 3(3). 49-50, Retrieved from http://business.ku.ac.ke/images/stories/research/determinants_of_electronic_health.pdf 15 June, 2015
- Mugwisi, T. (2012). The information needs and challenges of Agricultural researchers and extensions workers in Zimbabwe. PhD thesis KwaDlangezwa: Department of Information Studies, University of Zululand
- Müller, H. Michoux, N. Bandon, D. and Geissbuhler, A. (2004). A review of content-based image retrieval systems in medical applications clinical benefits and future directions. *International Journal of Medical Informatics*. 73(3),1-23. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1386505603002119> Accessed on 10 April, 2016,
- Mutual, S. M. (2008). Digital Divide in Africa: Its Cause and Amelioration, Strategies In Information and Knowledge Management in the Digital Age: Concepts Technologies and African Perspectives” edited by Aina, L.O. Mutual, S.M. and Tiamiyu, M.A, Ibadan : Third World Information Service Limited
- Mutula, S. M. and Mostret, J. (2010). Challenges and opportunities of e-government in South Africa. *The Electronic Library* 28(1), 38-53., Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/02640471011023360> Accessed on 10 March, 2016.
- Mutula, S. N. (2008). Digital divide and economic development: Case study of Sub-Saharan Africa. *Electronic Library*, 468-489. 26 (4) Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/02640470810893738>
- Mwangi, J. C. Namusonga, G. S. and Sakwa, M. (2016). Factors influencing medical practitioner’s use of ICT in provision of health services in Kenya. *Journal of*

the Strategic Business and Change Management. 3(1), 5- 15, Retrieved from <http://strategicjournals.com/index.php/journal/article/view/208> Accessed on 14 May, 2016.

Myers, M. D. (2009). Qualitative research in business and management. London: Sage publisher.

Nanji, K. Rothschildren, J. M. Zignant, K. Devita, J. Bates, D. W. and Poon, E. A. (2011). Errors associated with outpatient computerized prescribing systems. *Journal of the American Medical Informatics Association*. 18(6), 767-773, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21715428>. Accessed on 10 June, 2016

National Agency for Control of Aids (2014). Global aids response country progress report Nigeria .Federal Ministry of Health, Abuja.

National Center for Education Statistics: Statistical analysis report (2000) : Teachers tools for the 21st Century US Department of Education Office of Educational Research and Improvement.

National Centre for Chronic Disease prevention and health promotion (2009).The power of prevention: chronic the public health challenges of the 21st century. CDC-Info Atlanta,

National Department of Health (2011). Towards quality care for patient. National Core standard in South Africa, Department of Health. Republic of South Africa.

National ehealth (2010).The strategy for accessible and secure information in health and social care.Ministry of Health and Social care Netherlands. Department of Health, South Africa.

National e-health strategy in South Africa (2012).Department of Public Health South Africa 1(2), 1-36, Retrieved from <http://www.google.co.za/url/?sa=j&esrc>

National ehealth Strategy South Africa 2012/13-2016/17(2012). Ehealth strategy South Africa Department of Health, Republic of South Africa.

National Health Act (2003). Act 61 of 2003. Department of Health, South Africa.

National Health Amendment Act 12 of 2013. South Africa Government, Department of Health.

National Health Bill (2014), Federal Ministry of Health, Abuja.

National Health Equipment Policy for Nigeria Draft (2005). Federal Ministry of Health, Abuja.

National Health Insurance (2012). Department of Health, South Africa.

National Health Management Information System (NHMIS) Unit Revised Policy Programme and Strategic Plan of Action (2007). Federal Ministry of Health, Abuja.

National Health Policy (2014). Federal Ministry of Health, Abuja.

National Health Promotion Policy (2005). Federal Ministry of Health, Abuja

National Healthcare Facilities Baseline (2012). Summary report. Department of Health, Republic of South Africa.

National Human Resources for Strategies Health Plan 2008-2012., (2007). Federal Ministry of Health, Abuja.

National Human Resource for Health (2006). Federal Ministry of Health Abuja.

National ICT Policy (2012). Federal Ministry of Communication Technology, Abuja.

National Information and Communication Technology ICT (2012). Final Draft Policy, Federal Ministry of Communication, Abuja.

National Integrated ICT policy Green Paper (2013). Department of Communication, South Africa.

National Integrated ICT Policy (2014), Department of Communication, South Africa..

National Patients Safety Agency (2003) .The incident decision tree; Information and advice on use NIS Confederation. Available at <http://www.chpso.org/sites/main/files/file-attachments/idtadvice2003>. Accessed on 7 July, 2015.

National Planning Commission (2012). Department of Presidency Republic of South Africa.

- National Planning Commission (2014).Department of Presidency Republic of South Africa.
- National Policy on Health (2005) .Federal Ministry of Health, Abuja.
- National Policy on Integrated Disease Surveillance and Response, (2005). Federal Ministry of Health, Abuja.
- National Policy on Public Private Partnership for Health in Nigeria (2005). Federal Ministry of Health, Abuja.
- National Prevention Council (2011), National Prevention Strategy: America's Plan for better health and wellness .Washington, DC:
- National Service Delivery Agreement (2012). Department of Health, South Africa
- National Strategic Health Development Plan Framework (NSHDP) 2009-2015, (2010). Federal Ministry of Health, Abuja.
- National Strategies health development plan (NSHDP) 2010-2015(2009). Federal Ministry of Education, Abuja.
- Neal, D. (2011) .Choosing an electronic health records system. *Innovations in Clinical Neuroscience* 8(6), 43-45, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3140898/> Accessed on 9th July, 2016
- Netha, M .A and Mostert, B. J. (2011). Availability and utilization of ICT for service delivery; a South Africa case study. *South Africa Journal of Library and Information Science* 77(2). 10 --17 Retrieved from <http://sajlis.journals.ac.za/pub/article/view/55>. Accessed on 13 May, 2016
- Neuman, W. L. (2011). *Social research methods: qualitative and qualitative approaches*. (6th ed) Boston: Pearson Education Limited.
- Neuman, W. L. (2000). *Social Research Methods: Qualitative and Quantitative Approaches*. Allyn and Bacon: Boston
- Neuman, W. L. (2009). *Social research methods: Qualitative and quantitative approaches* (7th ed.). Allyn & Bacon: Boston
- Neuman, W. L. (2014) *Social research methods: qualitative and qualitative approaches*. (8th) Pearson Education Limited: Harlow.

- Neuman, W. L. (2015). Social research methods: qualitative and quantitative approach .Pearson Education Limited: Harlow.
- Ngwenya, B. (2013). Application of Decision Support Systems and Its Impact on human resources output: a study of selected universities in Zimbabwe. *Journal of Computer Sciences and Applications* 1(3): 46-54.Retrieved from <http://pubs.sciepub.com/jcsa/1/3/4/> Accessed on 10 May, 2016.
- Nieuwenhuis, J. (2014). Qualitative research designs and data gathering techniques. In: K Maree (Ed.): First Steps in Research. Pretoria: Van Schaik
- Nigeria National Broadband Plans in Nigeria 2013 -2018, (2012). Federal Ministry of Communication, Abuja.
- Nigeria Project Agenda, (2010). Nigeria project and shared aspiration Retrieved from <http://www.ab.xlibx.com/1economy/6361-1-table-contents-abstract-introduction-the-nigeria-project-and-s.php>.
- Nigerian National Human Resources for Health Policy (2007). Federal Ministry of Health, Abuja.
- Nomura, K. Yamazaki, Y. Gruppen, L. Horie, S. Takeuchi, M. and Illing, J. (2015). The difficulty of professional continuation among female doctors in Japan: a qualitative study of alumnae of 13 medical schools in Japan. 5 (3), 1-7, *BMJ Open* Retrieved from <http://bmjopen.bmj.com/content/5/3/e005845> Accessed on 10 May, 2016.
- Norum, J. Grev, A. Moen, M. Balteskard, K. and Holtha, K. (2003). Information and communication technology (ICT) in oncology. Patients' and relatives' experiences and suggestions. *Support Care Cancer* 11 (1). 286– 293.
- Nuq, A. and Aubert, B. (2013). Towards a better understanding of the intention to use ehealth services by medical professionals. The case of developing countries. *International Journal of Health Care Managemnet* 6(4). 1- 12 Retrieved from <https://theses.ncl.ac.uk/dspace/handle/10443/1591> Accessed on 13 June, 2015
- Nuq, P. A. (2012).Towards a better understanding of the intention to use ehealth services by medical professionals; the case of developing countries Phd thesis submitted to the School of Management, University of Newcastle.

- Nwagwu, W. and Adio, A. (2013). Contexts of utilisation of ICT by medical practitioners in private hospitals in Osun State, Nigeria. *World Journal of Science Technology and Sustainable Development*. 10(3), 229-246, Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/WJSTSD-01-2013-0004>. Accessed on 13 June, 2015
- Nwakeze, N. M. and Kandala, N. S. (2011). The spatial distribution of health establishments in Nigeria. *Africa Population Studies*. 25(2), 680-696. Retrieved from <http://www.bioline.org.br/pdf?ep11047>. Accessed on 13 June, 2015
- Nwargwu, E. W. Adekannbi, J. and Bello, O. (2009). Factors Influencing Use of the Internet: A Questionnaire Survey of the Students of University of Ibadan, Nigeria. *The Electronic Library* 27(4). 1- 9, Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/02640470910979651> Accessed on 12 October, 2015
- Nwargwu, W. Adegunwa, G. and Soyannwo, O. A. (2013). ICT and collaboration management of terminal cancer patients at the University College Hospital, Ibadan, Nigeria. *Health and Technology* 3(4) 309-325 Retrieved from <http://link.springer.com/article/10.1007/s12553-013-0063-6> Accessed on 13 June, 2015
- Nwoko, I. (2011). Transforming healthcare delivery in Nigeria. *The Vanguard*, December, 2nd.
- O'Connell, M. T. Rivo, M. L. Mechaber, A. J. and Weiss, B. A. (2004). A curriculum in system-based care: experiential learning changes in student knowledge and attitudes. *Family Medicine* 99(104), 10 – 17. Accessed on 8 December, 2015.
- Obasan, S. A.J. and Orimisan, A. (2013). Healthcare financing prospects and challenges. *Mediterranean Journal of Social Science* 4(10). 197-221, Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.661.8861&rep=rep1&type=pdf>. Accessed on 13 June, 2015.
- Ocholla, D. N. and LeRoux, J. (2011). Conceptions and misconceptions of theoretical frameworks in Library and Information Science research. Presented at the 6th Biennial Prolissa Conference. Pretoria 9-11, March.

- Odini, S. and Omuoke, A. (2014). Use of ICT by medical professionals in accessing information for healthcare delivery at Moi Teaching and Referral Hospital (MTRN) in Eldoret Kenya. *Journal of International Academic Research for Multidisciplinary* 2(5), 153-180, Retrieved from <http://www.jiarm.com/June2014/paper12952.pdf> Accessed on 19 June, 2015
- Oghiagbephan, A. D. and Asamigo, E. E. (2010). Gender equality and ICT policies: the challenges for Nigeria. Being a paper presented at the International Conference on Gender Equality and Sustainable Development in the Attainment of the Millennium Development Goals. Held from 18th- 22nd, Benin Edo State.
- Ogunyade, T. and Oyibo W. A. (2003). Use of CD-ROM MEDLINE by medical students of the College of Medicine, University of Lagos, Nigeria. 5(1) 1- 9, *Journal of Medicine Internet Research* 31(1) Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1550553/> Accessed on 13 June, 2015.
- Ojeniyi, A., and Adetimirin, A. (2013). Gender influence on ICT use by undergraduates in two university libraries in Nigeria. *Computer Communication and Collaboration*. 1(2), 62-71, Retrieved from http://www.academia.edu/30418229/Gender_Influence_on_ICT_Use_by_Undergraduates_in_Two_University_Libraries_in_NIGERIA. Accessed on 12 April, 2015.
- Ojo, A. and Popoola, S. O. (2014). Some correlates of EHR management system success in Nigerian teaching hospitals. *Biomedical Informatics Insights*. 7 (1), 1–9, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4426943/> Accessed on 11 June, 2015
- Okiy, R. B. (2010). Globalization and ICT in academic libraries in Nigeria: the way forward. *Library Philosophy and Practice* (e-journal). Paper 501. Retrieved from <http://www.webpages.uidaho.edu/~mbolin/okiy.pdf> 14 April, 2016.
- Okonta, K. E. Akpayak, I. C. Amusan, E. O. and Ekpe, E. E. (2015). Multi-center survey of house officer's choice of medical specialities in Nigeria; preferences and

- determining factors. *Pan Africa Medical Journal* 20(1), 330- 338. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/26175828> Accessed on 13 June, 2015.
- Okoro, C. C. and Okoro, I. (2009). The use of medical information in Nigeria: the influence of gender and status. *Journal of Continuing Education in the Health Professions* 29(4), 13- 20. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19998448> Accessed on 23 June, 2015
- Olasina, G. (2014). E-parliament services as tools for anti-corruption transparency. *Electronic Governance* 7(1), 12- 18.
- Olasina, G. (2014). Predictors of legislators ICT acceptance and use in the performance of legislative functions at the Nigerian National Assembly PhD thesis submitted to the Department of the Information Studies in the University of Kwazulu-Natal Pietermaritzburg,
- Olasina, G. and Mutula, S. (2014). The influence of national culture on performance expectancy of e-parliament adoption. *Behavioural and Information Technology* 34(5), 22- 32. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/1999844> Accessed on 13 April, 2015.
- Olasina, G. and Popoola, T. (2014). Predictors of the use of e-medicine by medical doctors. *Journal of Health Medical Informatics* 5 (166), 16- 24
- Olatokun, M. and Adeboyejo, C. (2009). Information and communication technology use by reproductive health workers in Nigeria: state of the art, issues, and challenges, *An Interdisciplinary Journal on Humans in ICT Environments* 5(2), 181-207. Retrieved from <http://www.humantechnology.jyu.fi/archives/abstracts/olatokun-adeboyejo09.html>. Accessed on 8th September, 2014.
- Olatokun, W. M. (2009). Analysing social –demographic differences in access and use of ICTs in Nigeria using the capability approach .*Issues in Informing Science and Technology* 6 (1), 22-29, Retrieved from <http://ejournal.narotama.ac.id/files/Analysing%20Socio-Demographic%20Differences%20in.pdf> Accessed on 13 April, 2015.

- Olatokun, W. M. (2007). Availability, accessibility and use of ICTs by Nigerian women academics. *Malaysian Journal of Library and Information Science* 12 (2), 13-33. Retrieved from <http://ejum.fsktm.um.edu.my/article/564.pdf> Accessed on 10 June, 2015.
- Olatubsoun, O. and Rao, M. K. S. (2012). Emperical l study of the readiness of public servants on the adoption of e-governmnt. *International Journal of Informational Systems and Change Management* 6(1), 1- 10. Rerived from <http://dl.acm.org/citation.cfm?id=2400640> Accessed on 10 June, 2015
- Olok, G. T. Yagos, W. O. and Ovuga, E. (2015). Knowledge and attitudes of doctors toward e –health use in healthcare delivery in government and private hospitals in norther Uganda; a cross sectional study. *BMC Medical Information Decisions Making* 15(87).11- 21 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4634590/> Accessed on 13 June, 2015.
- Ololube, N. P. Ubogu, A. E. and Ossai, A.G. (2007). ICT and distance education progrmme in a sub –Sahara African country; a theoretical perspective. *Journal of Information Technology Impact* 7(3), 181-194, Retrieved from <http://www.jiti.net/v07/jiti.v7n3.181-194.pdf> Accessed on 10 May, 2015
- Olorode, O. A.and Oladunni, E. O. (2012). E-health in biomedical its role and challenges in Bayelsa State, Nigeria, Africa. Paper presented at 1st International Technology, Education and Environment Conference of the African Society for Scientific Research (ASSR), Omoku, Nigeria March 13 – 17.
- Olorunisola.A. O. (2008). Design and development of conceptual frameworks in post graduate research In *Methodology of basic and applied research*. Ibadan: University of Ibadan press.
- Ong, C. S. and Lai, Y. K. (2006). Gender differences in perceptions and relationship among dominats of e-learning acceptance. *Computars in Human Behaviour*.22 (5), 816-829 Retrieved from <http://www.qou.edu/arabic/researchProgram/eLearningResearchs/genderDifferences.pdf> : Accessed on 12 June, 2015 .

- Onu, I. and Agbo, S. (2013). Factors that affect the use of ICT in Nigeria nursing profession in Ebonyi State. *Journal of Information Engineering and Application* 2(1), 61-67. Retrieved from <http://www.iiste.org/Journals/index.php/JIEA/article/view/8489>. Accessed on 25 May, 2016.
- Opara, U. N. (2003). The nature if information: some concerns for information management. *Journal of the Nigerian Library Association*.2 (1), 8-15. Accessed on 4 July, 2016.
- Opdenakker, R. (2006). Advantages and Disadvantages of four Interview techniques in Qualitative Research. *Forum Qualitative Social Research*. 7(4), 11- 20, Retrievedfrom <http://www.qualitative-research.net/index.php/fqs/article/viewArticle/175/391> &s Accessed on 6 July, 2015.
- Open Clinic (2013). COPE; Knowledge Management for medical care Open Clinic (2013) Retrieved from www.openclinical.org/ Accessed on 6 July, 2015.
- Organisation for Economic Cooperation and Development (2011). Health at a glance OECD indicator. Retrieved from Directorate for Employment, Labour and Social Affair. Retrieved from <https://www.oecd.org/health/health-systems/Draft-oecd-guide-to-measuring-icts-in-the-health-sector.pdf> Accessed on 6 July, 2015.
- Organisation for Economic Cooperation and Development (2015).Draft OECD guide to measure ICT in health sector. Directorate for Employment, Labour and Social Affair. Retrieved from <https://www.oecd.org/health/health-systems/Draft-oecd-guide-to-measuring-icts-in-the-health-sector.pdf> Accessed on 6 July, 2015.
- Ortiz, E. and Clang, C. (2003). Use of information technology to improve the quality of health care in United State. *Health Services Research* 38(2), 5- 12. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1360897/> Accessed on 9 July, 2016.
- Oshlyansky, L. Cairns, P. and Thimbleby, H. (2007). Validating the unified theory of acceptance and use of technology (UTAUT) tool cross-culturally. A Web

7(11) 1- 12, Retrieved from

http://www.bcs.org/upload/pdf/ewic_hc07_sppaper21.pdf Accessed on 6 July, 2015.

Oshroff, J. Teich, J. M. Middleton, B. and Elane, B. (2007). A roadmap for national action on Clinical Decision Support. *Journal of the Medical Informatics Association*. 14 (2), 141-145, Retrieved from

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2213467/>

Osunkunle, O. O. (2010). Bridging the Digital Divide and the Impact of New Media Technologies on Development in South Africa, New Achievements in Technology Education and Development, Safeeullah Soomro (Ed.), Retrieved from: http://cdn.intechopen.com/pdfs/10526/InTechBridging_the_digital_divide_and_the_impact_of_new_media_technologies_on_development_in_south_africa.pdf Accessed on 18 July, 2015.

Ouma, S. and Herselman, M. E. (2008). Digital divide affecting e-health implementations in rural hospitals; Case study of Kenya, 2nd IFIP International Symposium on Wireless Communications and Information Technology in Developing Countries, Pretoria, South Africa, 6-7 October .

Oye, N. D. A. Iahad, N. and Rahim, N. (2013). The history of UTAUT model and its impact on ICT acceptance and usage by academicians. *Education and Information Technologies*. 19 (1), 251-270.

<http://link.springer.com/article/10.1007/s10639-012-9189-9> Accessed on 16 July, 2015

Oye, N. D. Iahad, N. and Ab Rahim, N. (2012). A comparative study of acceptance and use of ICT among University academic staff of ADSU and LASU. *Journal of Science and Technology* 12 (3), 103-120., Retrieved from http://iet-journals.org/archive/2012/jan_vol_2_no_1/649431325511381.pdf Accessed on 12 June, 2015.

Oyegoke, L. (2013). .Adoption and utilisation of ICT in Nigeria hospitals Bachelor thesis in Business IT Haag – Helia. University of Applied Sciences.

- Oyibocho, E. O. Irinoye, O. Sagua, E. O. Ogungide-Essein O. T. Edeku, J. E. and Okome, O. (2014) Sustainable healthcare systems in Nigeria Vision, strategies and challenges. *Journal of Economics and Finance*. 5(2), 88-89. Retrieved from
- Ozumba, B. (2002). The world congress on the Internet in medicine. MEDNET. Retrieved from <http://www.medscape.com/viewarticle/523074> Accessed on 6 July, 2015
- Panahi, S. (2014). Social media and tacit knowledge sharing: Physicians perspectives and experiences. Phd thesis submitted to the Department of Information System School, Queensland University of Technology.
- Pare G., Lepanto, L. Aubry, D. Sicotte, C. (2005). Toward a multidimensional assessment of picture archiving and communication system success. *International Journal of Technology Assessment in Health Care*. 21(4), 471–47. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/16262970> Accessed on 8 July, 2015
- Paré, G. and Trudel, M. C. (2007). Knowledge barriers to PACS adoption and implementation in hospitals. *International Journal of Medical Informatics*. 76(1), 22-33. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/16478675> Accessed on 13 August, 2015
- Pare, G. Sicotte, G. Poba –Nzaou, P. and Balouzaki, G. (2011). Clinician's perceptions of organizational readiness for change in the context of clinical informatics system projects insight. *Implementation Science* 6(15), 9 -17 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21356080>. Accessed on 12 May, 2015
- Patel, R. Green, W. Martines, M. M. and Shahzad, M. W. and Larkin, C. (2015). A study of foundation year doctors prescribing in patients with kidney disease at a UK renal unit: a comparison with other prescriber's regarding the frequency and type of errors. *European Journal of Hospital Pharmacy*. 23 (2). 12-20 Retrieved from <http://ejhp.bmj.com/content/early/2015/03/31/ejhpharm-2014-000620> Accessed on 13 July, 2015.
- Patton, M. Q. (1990). Qualitative evaluation and research methods (2nd ed.). Newbury Park, CA: Sage publication; London

- Patton, M. Q. (2002). *Qualitative research and evaluation methods*. Sage publication: London.
- Paul, A. S. Reddy, M., Abraham, J., and Deflitch, A.(2008). The usefulness of information and communication response. *AMIA* 2 (1), 1- 12.
- Paulin, D. and Sunneson, K. (2012). Knowledge transfer, knowledge sharing and knowledge barriers – three blurry terms in KM. *The Electronic Journal of Knowledge Management*. 10 (1), 81-91. Retrieved from <http://publications.lib.chalmers.se/publication/156127-knowledge-transfer-knowledge-sharing-an> Accessed on 6 July, 2015
- Payne, K. F. Wharrad, H. and Watts, K. (2012). Smart phones and medical related application use among medical students and junior doctors in United Kingdom UK; a regional survey. *Medical Informatics Decision Making* 12 (121). 19 – 28, Retrieved from https://www.researchgate.net/publication/232740533_Smartphone_and_medical_related_App_use_am Accessed on 13 July, 2015.
- Payne, T. H. (2000). Computer Decision Support Systems. *Chest*. 47(52), 1- 6. Retrieved from <http://publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21951/47s.pdf> Accessed 10 August, 2016.
- Pearson Education (2014). South Africa from fact Monster
- Phichitchaisopa, N. and Naenna, T. (2013). Factors affecting the adoption of healthcare information technology. *EXCLI Journal*.12 (2), 413-436
- Physicians Foundation (2012). A survey of America's physicians; practice patterns and perspectives. The Physicians Foundation
- Pickard, A. J. (2007). *Research methods in Information*, Facet publishing: London.
- Poelmans, S. Truyen, F. and Deslé, R. (2009). Perceived computer literacy among different types of undergraduate students: Findings of a survey. 2nd International Conference of Education, Research, and Innovation, 16-18 November, 2009, Madrid, Spain.

- Polar, S. and Thomas, S. A. (2000). Introduction to research in the health sciences. London: Churchill Living stone.
- Polasek, O. and Kern, I. (2012). Medical informatics scientific output in 35 *Europeans Countries, Informatics for Health and Social Care* 37(1), 12-22. Retrieved from: <http://www.ncbi.nlm.nih.gov/pubmed/21999433>
- Polgar, S. and Thomas, S.A. (2000). .Introduction to research in health science (4th ed) Edinburgh: Churchill Livingstone.
- Poliet, D. F. Beck, C. T. and Hungler, B., P., (2001). Essentials of nursing research: methods, appraisal and utilisation Philadelphia: Lipponcott
- Polit, D. F. and Beck, C. T. (2008). Nursing research: generating and assessing evidence for nursing practice. Philadelphia: Lippincot
- Pope, C. Halford, S. Turnbull, J. Pirchard, J. and May, C. (2013). Using computer decision support systems in NHS emergency and urgent care; ethnographic study using normalisation process theory. *BMC Services Research*. 13 (1111). 12- 19
Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23522021>
- Popoola, S. O. (2006.). Information accessibility and utilization as factors influencing decision-Making of Managers in Commercial Banks in Nigeria. *Ghana Library Journal* 18 (1), 1-24 Retrieved from <http://www.ajol.info/index.php/glj/article/view/33957> Accessed on 6 July, 2015
- Popoola, S. O. (2008.). The use of Information Sources and Services and Its Effect on the Research Output of Social Scientists in Nigerian Universities. *Library Philosophy and Practice*. Retrieved from <http://www.webpages.uidaho.edu/~mbolin/popoola.htm>. Accessed 5 May, 2016
- Powell-Cope, G. Nelson, A. L. and Patterson E. S. (2008). Patient care technology and safety in Huges, patient safety and quality. An evidence –based hard hand book for nurse, US Department for Health and Human Services: Rockvilla.
- Prgoment, M. Georgious, A. and Westbrook, J. (2009). The impact of mobile head held technology on hospital physicians work practices and patients care. A

systematics Review. *Journal of America Informatics Association* 16(6), 792-801. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19717793> Accessed on 6 July, 2015.

Protti, D. J. Bowden, T. and Johansen, I. (2008). Adoption of information technology in primary care physician offices in New Zealand and Denmark, part 1: Health care system comparisons. *Informatics in Primary Care*, 16(3), 183-187. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19192331>. Accessed on 8 September, 2016.

Public Finance Management Act No 1 of 1999. South Africa Public Finance Management Act (No1 of 1999 as amended by Act 29 of 1999).

Public Service Regulation (2001). South Africa Public Service Regulation rule Federal Republic of South Africa.

Punch, K. F. (2009). Introduction to social research: Quantitative and qualitative approaches (2nd ed.). Thousand Oaks, CA Sage: London

Putzer, G. J. and Park, Y. (2010). The affects of innovations factors on smartphone adoption among nurses in community hospitals. Perspectives in Health information Management. *American Health Information Management Association* 7 (1). 1-13 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2805554/> Accessed on 13 July, 2015.

Pynoo, B. (2013). IT –acceptance by autonomous professionals: factors that contribute to successful or failure .Phd thesis. Faculty of Psychology, University of Gents, Westernscappaer.

Pynoo, B. Devolder, P. Duyck, W. Braak, J. V. Sijnave, B. and Duyck, P. (2012). Do hospital physicians' attitudes change during PACS implementation? A cross-sectional acceptance study. *International Journal of Medical Informatics*, 81 (1), 88-97, Retrieved from <http://www.ijmijournal.com/article/S1386-5056%2811%2900217-6/abstract> Accessed on 6 July, 2015.

Quma, S. and Herselman, M. E. (2008). E-health in rural areas .Case of developing countries. *World Academy of Science, Engineering and Technology* 2 (4) ,

560-566, Retrieved from <http://waset.org/publications/14873/e-health-in-rural-areas-case-of-developing-countries> Accessed on 26 July, 2015.

Ragaban N. Day, K. and Orr, M. (2012). Align share responsibility and collaborate: potential considerations to aid in e-health policy development. *Study Health Technology Inform* 178, 186-191. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22797040> Accessed on 24 July, 2015

Raghupati.W. and Raghupathi, W. (2014). Big data analytics in healthcare promise and potentials. *Health informatics Science and Systems* 2 (3), 1- 8. Retrieved from <https://hissjournal.biomedcentral.com/articles/10.1186/2047-2501-Accessed> on 4 February, 2015.

Ragin, C. C. (1994). Constructing Social Research: The unity and diversity of method. London: Pine Forge Press

Ranking of Web Universities. (2014). Retrieved from http://www.webometrics.info/en/Ranking_africa. Philadelphia,

Ranta, P. (2005). Information and communications technology in health care master's thesis, Department of Economics, Aalto University School of Economics.

Rao, S. S. (2009). Role of ICTs in India rural communities. *Journal of Community Informatics*. 5(1), 1- 6, Retrieved from

Rea, L. M. and Parker, R. A. (2005). Designing and conducting survey research: A comprehensive guide. Jossey-Bass: San Francisco,

Reeves, T. C. and Hedberg, J. C. (2003), Interactive Learning Systems Evaluation, Educational Technology Publications, and Englewood Cliffs: New Jersey.

Report on the HealthCare Industry Group (2009). ICT role in healthcare transformation. Retrieved from https://www.hisi.ie/.../Report_of_the_Health_ICT_Industry_Group_November_2009. Accessed on 6 July, 2015

Resddy, M. Purao, S. and Kelly, M. (2008). Developing IT infrastructure for rural hospitals: case study of the benefits partnerships. *Journal of Medical Informatics Association* 15(4), 1- 12 Retrieved from <http://www.jamia.org/cgi/reprint/15/4/554/> Accessed on 23 July, 2015

- Research ICT Africa (2012). Understanding what is happening in ICT in Nigeria: A study and demand –side analysis of the ICT sector Research ICT Africa net.
- Ridely, D. (2012). The literature review a step-by-step guide for students. Sage: London
- Rivard, S. Lapointe, L. and Kappos, A. (2011). An organizational culture-based theory clinical informatics system implementation in hospital. *Journal of the Association for Information System*. 12 (1), 11- 17, Retrieved from <http://aisel.aisnet.org/jais/vol12/iss2/3/> Accessed on 6 July, 2015
- Robson, C. (1997). Real world research. Blackwells: Oxford
- Rodrigues-Gonzalez, A. Herranze-Alonso, A. Duran-Garcia, M. I. and Sanjurjo, M. (2012). Prevalence of medication administration errors in two medical unit with automated prescription and dispensing. *Journal of the American Medical Informatics Association* 19 (1), 72-78 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21890872> Accessed on 6 July, 2015
- Rogers, E. M. (1995). Diffusion of innovations (4th ed). New York: The Free press
- Rolinson, J. Meadows, A. J. and Smith, H. (1995). Use of information technology by biological researchers. *Journal of Information Science* 21 (2): 133-139, Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/016555159502100207> Accessed on 12 January, 2015.
- Rose, A. F. Schnipper, J. L. Park, E. R. Poon, E.G. Li, Q. and Middleton, B., (2005). Using qualitative studies to improve the usability of an EMR. *Journal of Biomedical Informatics*, 38 (1), 51-60, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/15694885> Accessed on 23 July, 2015
- Rouf, E. Whittle, J. Lu, N. Schwartz, M. D. (2007). Computers in the exam room: differences in physician–patient interaction may be due to physician experience. *Journal of General Internal Medicine* 229(1), 43–48.
- Rouleau, G. Gargon, G. and Cote, D. (2015). Impacts of ICT on nursing care: an overview of systematic reviews (protocol). *System Rev.*, 4(75) 1-12. Retrieved from <https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-015-0062-Accessed> on Accessed on 6 July, 2015

- Ruawana, N. Herselman, M. and Conradie, D. P. (2010). ICT applications as e-health solutions in rural healthcare in the Eastern Cape Province of South Africa. *Health Information Management Journal* 39(1), 17-26. Retrieved from www.himaa.org.au/.../Ruawana%20et%20al%20ICT%20rural%20healthcare%20St%20h%20ealth%20solutions%20in%20rural%20healthcare%20in%20the%20Eastern%20Cape%20Province%20of%20South%20Africa
- Rwashana, A. S. and Williams, D. W. (2008). Enhancing healthcare delivery through ICTs; A case study of the Ugandan immunization system. *International Journal of Education and Development using ICT*. 4(2), 144-158, Retrieved from http://cit.mak.ac.ug/iccir/downloads/SREC_07/Agnes%20Semwanga%20Rwashana%20and%20Ddembe%20Willeese%20Williams_07.pdf. Accessed on 6 July, 2015
- Ryu, S. Ho, S. H., and Han, I. (2003). Knowledge sharing behavior of physicians in hospitals. *Expert Systems with Applications* 1(9), 113-122. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0957417403000113> 23 May, 2015
- SA Medical Scheme Acts 131 of 1998. .Department of Health, South Africa, Pretoria
- SA medical stats (2012). Health24.South Africa medical care. Health 24.
- SA National Health Amendment Act 12 of 2013. Department of Health, South Africa, Pretoria
- SA Strategic and Nation Health Act 61 of 2003. Department of Health. Department of Health, South Africa, Pretoria
- SA Year Book (2015). South Africa year book .Retrieved from www.gov.za/about-sa/health, Accessed on 13 May, 2015.
- SA year book 2014/15 (2014). Mid-year population estimates 2014. Government of South Africa
- Safdari, R. Jebraeily, M. Rahimi, B. and Douhani, A. (2014). Smartphones medical training of medical students of UMSU and its influencing factors. *Religia Research Library*. 2 (1), 633-637, Retrieved from <http://www.imedpub.com/articles/smartphone-medical-applications-use-in->

[the-clinical-training-of-medicalstudents-of-umsu-and-its-](#) Accessed on 6 July, 2015

- Sahay, S. (2007). Focusing equally on 'E' and health: case studies from India and Ethiopia. *E-Health*, 2 (1), 15-23.
- Salamn, S. B. and Ahamed, S. (2013). Information seeking in primary care: A survey of doctors working in remote government health facilities in Pakistan. *Library Philosophy and Practices*, Paper 9. Retrieved from [digitalcommons.unl.edu › 100](#) Accessed on 12 July, 2015.
- Salary and Voice (2016). Hematologist salary, Retrieved from [www.salaryvoice.com/haematologist-salary](#).
- Sandefer, R. Khairat, S. Piceckics, D. and Speedie, S. (2015). Medinfor e-health –enabled health: Proceeding of the 15th World Congress on Health and Biomedical Informatics. Sao Paulo, Brazil. 19th -23th, August.
- Sander, M. Lweis, P. and Thronhill, A. (2012). Research method for business students, Hallow: Pearson.
- Saunders, M. N. K. Lewis, P., and Thornhill, A. (2012). Research methods for business students. England: Pearson Education.
- Schaper, L. K. and Pervan, G. P. (2007). Ict and ots: a model of information and communication technology acceptance and utilisation by occupational therapist. *International Journal of Medical Informatics*. 76 (1), 212–221.
- Schiff, G. Amato, M. G. Equale, T. Boehne, J. J. Wright, A. Rasidee, A. N. Elson, R. B., Whitetney, D. L. and Bates, D. W. (2015). Computerised physicians order etyry –related medication errors analysis of reporting errors and vulnerability testing of current systems. *BMJ Qualilative Saferty*. 124 (4). 264-271.
- Schiller, J., (2003). Working with ICT Perceptions of Australian principals. *Journal of Educational Administration*, 41(2), 171-185, Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/09578230310464675>. Accessed on 6 July, 2015.
- Schoen, C. R. Osborn, P. T. Huynh, M. Doty, K. Zapert, J. and Peugh, J. (2005). Taking the pulse of health care systems: experiences of patients with health Problems

- in Six Countries. *Health Affairs*. 2 (3), 509–525. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/16269444> Accessed on 16 July, 2015.
- Schratz, M. and Walker, R. (1995). Research social change: new opportunities for qualitative research. London: Routledge.
- Scollin, P. (2001). A study of factors related to the use of online resources by nurse educators. *Computers in Nursing*. 19(6), 249-256. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/1176471> Accessed on 6 August, 2015
- Scotland. J. (2012). Exploring the philosophical underpinnings of research: Relating to ontology and epistemology to the methodology and methods of the scientific, interpretive and critical research paradigms. *English Language Teaching*. 5(9). 9-16.
- Scott, G. L. S. (2011). An assessment of health and safety management in selected rural hospitals. Mini-Dissertation submitted to the Department of Business Administration, North-West University South Africa.
- Seale, C. (1999). Quality in qualitative research. *Qualitative Inquiry*. 5(4), 465-478, Retrieved from www.bmj.com/content/320/7226/50. Accessed on 6 July, 2015.
- Searle, C. (1998). Research as a modifier of the constraints in developing nursing practice in South Africa: an overview. In nursing research for nursing practice: An International Perspective. London: Chapman and Hall .
- Sekaran, U. (2003). Research methods for business. NJ; John Wiley & Sons: Hoboken
- Seligman, L. S. (2001). Perceived value impact as an antecedent of perceived usefulness, perceived ease of use, and attitude: A perspective on the influences of values on technology acceptance. *Dissertation Abstracts International*. 62(12), 679-701. Retrieved from dl.acm.org/citation.cfm?id=934500 679- Accessed on 6 November, 2015.
- Sepeame, M. and Ajala. E. B. (2013). Investigating factors affecting adoption and implementation of m-government in the South African department of home affairs: an ongoing research. *International Journal of Computer Science and Business Informatics* 5 (2), 1- 7, Retrieved from

www.ijcsbi.org/index.php/ijcsbi/article/download/114/46 Accessed on 6 July, 2015

- Seror, A. (2001). The internet global healthcare management system and sustainable development future scenaro electron .*Journal of InformationSystem Development*. 5(1). 1-10, Retrieved from <http://www.ejisd.org/ojs2/index.php/ejisd/article/view/26> Accessed on 23 July, 2015
- Shabi, O. Kuteyi, E. A. Odewale, M. A. and Shabi, I. N. (2008). Information needs of family physcians in Nigeria. *South Africa Family Practice*. 50 (5), 1- 6, Retrieved from <http://www.safpj.co.za/index.php/safpj/article/view/915>. Accessed on 6 July, 2015.
- Sharifian, R. Asakarian, F. Nematolahi, M. and Farhadi, P. (2014). Factors influencing nurses' acceptance of hospital information in Iran. Application of the unified theory of acceptance and use of technology. *Health Information Management Journal* 43 (2), 23-28 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/2468271>
- Sharpey-Sciafer, K. and Suleman, H. (2008). Evaluation health information systems for developing countries using simulation. IST-Africa Conference 2008, Windehoek, Namibia.
- Shifeew. F. and Zolfo. M. (2012). The role of ICT towards universal health coverage. The first steps of a telemedicine. *Global Health Action* 5 (1), 1- 17
- Short, D. Frischer, M. and Bashford, J. (2004). Barriers to the adoption of computerized decision support systems in general practice consultations: a qualitative study of GPs' perspectives. *IJIM.*, 73,(1), 357–362, Retrieved from <http://www.sciencedirect.com/science/article/pii/S1386505604000152> Accessed on 13 July, 2015
- Sidani, S. and Barden, C., J., (1998). Evaluating nursing interventions; a theory –driven approach, Sage publication: London.

- Sieh, H. F. and Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research* 15 (9), 1277-1288 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/16204405> Accessed 12 May, 2015.
- Silow-Carrol, S. Edward, J. W. and Rodin, D. (2013). Using electronic health records to improve quality and efficiency. The experiences of learning hospitals. *Issues Brief Commonwealth Fund Publisher*. 17 (1), 1-40
- Silverman, D. (2001). Interpreting qualitative data, methods for analyzing talk, text and interaction (2nd ed.) London: Sage publication.
- Simba, D. (2004). Application of ICT in strengthen health information systems in developing countries in the wake of globalisation. *African Health Science* 4(3), 194-199. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/15687075> Accessed on 14 July, 2015
- Smart, P. Pearce, C. and Tonukari, J. (2004). E-publishing in developing economies. *Canada Journal of Communication*, 29(3), 1-6, Retrieved from <http://www.cjc-online.ca/index.php/journal/article/view/1424/1530> Accessed on 6 July, 2015
- Smith, W. (2013). A diverse drug reactions: allergy? Side –effect? Intolerance? *Focus Medication* 42(1), 12-16
- South Africa Constitution (1996), Republic of South Africa.
- South –Africa Government (2013). Launch of Albertina Sisulu Executive leadership programme in health (ASEPLH).
- South Africa Info (2012). Healthcare in South Africa. Department of Health, South Africa, Pretoria
- South Africa Info (2013). Budget 2014 spending at a glance. SA news.
- South Africa Info (2014). South Africa more fast fact. Retrieved from www.south.infor/ Department of Health, South Africa, Pretoria
- South Africa Infor (2012). Healthcare in South Africa. Republic of South Africa .
- South Africa Infor (2014). Budget 2014 spending at a glance SA news. Republic of South Africa

South Africa year book (2013). South Africa consulate general ; New York.

South African Government (2013). Launch of Albertina Sisulu Executive Leadership Programme in health. Retrieved from <http://www.gov.za/launch-albertina-sisulu-executive-leadership-programme-health-aselph> Accessed on 13 July, 2015

Soyinbo, A. Olaniyan, O. and Lawan, O. (2009). National Health Accounts: structure trends and sustainability of health expenditure in Nigeria. *African. Journal of Economics Policy* 14(1), 83-109. Retrieved from www.ajol.info/index.php/ajep/article/view/44195 Accessed on 6 November, 2015.

Srivastava, T. Wahmare, L. J. Agzaper, A. Quazi, N. and Mishra, P. (2014). Role of ICT technology in higher education: learner's perspective in rural medical schools. *Journal of Clinical and Diagnosis Research* 8(6), 9-11, Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4129270/> . Accessed on 16 July, 2015

Staageler, N. and Thompson, B. (2002). The evolution of definition for nursing informatics: A critical analysis and revised definition. *Journal of America Medical Informatics Association* 9(3), 255-261. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC344585/>.

State Information Technology Agency (1998). Government Gazette, Republic of South Africa.

Statistics Act 6 of 1999. South Africa Government

Statistics Netherlands (2005). Research personal ICT-use. Department of Communication.

Statistics South Africa (2013). Statistical release: Mid-year population estimates.

Steele, R. Lo, A. Secombe, C. and Wong Y. K. (2009). Elderly person's perception and acceptance of using wireless sensor networks to assist healthcare. *International Journal of Medical Informatics* 78 (12), 788-801,

Steininger, K. Rückel, D. Dannerer, E. and Roithmayr, F. (2010). Healthcare knowledge transfer through a Web 2.0 Portal: An Austrian Approach. *International Journal of Healthcare Technology and Management*. 11(2), 13-30. Retrieved

from www.inderscienceonline.com/doi/abs/10.1504/IJHTM.2010.03327

Accessed on 6 July, 2015.

- Stemler, S. (2001). An overview of content analysis. Practical assessment. *Research and Evaluation*, 7(17), 1- 6. <http://pareonline.net/getvn.asp?v=7&n=17> Accessed on 6 July, 2015.
- Steve Biko Academic Hospital (2014). Department of Health, South Africa, Archive Retrieved from <http://www.stevebikoacademic>. 12 March, 2015
- Stewart R. F. Kroth P. J. Schuyler, M. and Bailey, R. (2010). Do electronic health records affect the patient-psychiatrist relationship? A before & after study of psychiatric outpatients. *BMC Psychiatry*, 10(3).1-19. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2818653/>
- Stigler, J.W. Gonzales, P. Kawanaka, T. Knoll, S. and Serrano, A. (1999). The TIMSS videotape classroom study: methods and findings from an exploratory research project on eighth-grade mathematics instruction in Germany, Japan, and the United State. US Department of Education.
- Stocwell, M. and Filks, A. (2013). Utilising health information technology to improve vaccine communication and coverage. *Human Vaccines and Immunotherapeutics* 9(8), 1802-1811. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23807361> Accessed on 17 July, 2015.
- Stoetmann, V., Dobreu, A., and Stronetmann, K., A. (2007). Impact of ICT on pateint safety and risk. *E-health for Saferty*, 4(2), 12- 19.
- Stone, M. W. Smith, B. E. Shaff, J. and Nelson, B. S. (2008). .Impact of a computerised physicians order entry system. *American College of Surgeon*, 208 (5), 960-967 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23807361> Accessed on 16 July, 2015.
- Storetmann, V. Thierry, J. P. Stroetmann, K. and Dobrew, A. (2007). Ehealth for safety impact of ICT on patient safety. Offical Publication of European Communities. <file:///C:/Users/0/Downloads/eHealthforSafety-FinalReport2007.pdf>

- Strategic Priorities for the National Health System (2004). 2004-2009. Department of Health, South Africa.
- Streubert, H. J. and Carpenter, D. R. (2005). Qualitative research in nursing: Advancing the humanistic imperative. Lippincott Williams and Wilkins. Strauss, Corbin: Philadelphia:
- Struwig, F. and Stead, G. (2001). Planning, designing and reporting research. Pearson Educational: Cape Town
- Su, I. (2013). Medication errors: will punitive measures help to decrease the occurrence? A case study. *Nursing and Health* 1 (2), 15-20. Retrieved from <http://www.hrpub.org/download/201308/nh.2013.010201.pdf> Accessed on 6 July, 2015
- Sukums, F. Mensah, N., Mpembeni, R. Kaltschmidt, Haefeli and Blank (2014). Health workers' knowledge of and attitudes towards computer application. *Globe Health Action* .7(10) 1 – 12, Retrieved from www.globalhealthaction.net › Accessed on 25 July, 2015
- Sun, N. and Rau, P. P. (2013). How to promote patient safety in social media; a comparison between messages in social media: a comparison between messages cross-cultural design International Conference held as part of HCI International Heraklion, Crete Greece, and June.
- Sun, Y. Wang, G. Guo, X. and Reng, Z. (2013). Understanding the acceptance of mobile health services. A comparison and intergration of alternative models. *Journal of Electronic Commerce Research* 14(2), 183 -203. Retrieved from <http://web.csulb.edu/journals/jecr/issues/20132/paper4.pdf> Accessed on 6 July, 2015
- Tahir, M. Mahmood, K. and Shafique, F. (2010). Use of electronic information resources and facilities by humanities scholars. *The Electronic Library* 28 (1). 122-136. Retrieved from www.emeraldinsight.com/doi/pdf/10.1108/02640471011023423
- Taiwo, A. and Downe, A. (2013). The theory of user acceptance and use of technology (UTAUT): A meta-analytic review of empirical findings. *Journal of*

- Theoretical and Applied Information Technology*, 49(1), 48–58. Retrieved from <http://www.emeraldinsight.com/doi/abs/10.1108/02640471011023423>
- Tamblyn, R. Huang, A. Kawasumi, Y. Bartlett, G. Grad, R. Jacques A. Dawes, M. Abrahamowicz, M. Winslade, N. Poissant, L. and Pinsonneault, A. (2006). The Development and Evaluation of an Integrated Electronic Prescribing and Drug Management System for Primary Care. *Journal of the American Medical Informatics Association*. 13(2), 148-159. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/1635735>
- Taylor, S. and Todd, P. (1995). Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International Journal of Research in Marketing*, 12 (1), 137-156. Retrieved from www.sciencedirect.com/science/article/pii/01678116940001 Accessed on 6 July, 2015.
- Telkom (2015), Intergated report for the year 2015.Telkom, South Africa.
- Tella, A. and Mutula, S. M. (2008). Gender difference in computer literacy among undergraduate students at the University of Botswana: implication for library use. *Malaysian Journal of Library and Information Science* 13 (1), 59-76. Retrieved from <https://www.researchgate.net/publication/228863362>
- Tellis, W. M. (1997). Application of a case study methodology. *The Qualitative Report*.3 (3), 1-19.
- Tezci, E. (2009). Teacher effect, on the use of ICT in education. *The Turkey simple procedia-social behavoioural Science*, 1(1), 1- 7, Retrieved from https://www.researchgate.net/publication/228863362_Gender_differences_in_computer_litera
- The Information 2015 ISO/TC Information and Documentation, Standard catalogue. Retrieved from 12 January 2016, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=48750. Accessed 12 March, 2015
- The National Healthcare facilities Baseline Audit: National Summary Report (2012). Department of Health, South Africa

- Thomas, E. Orav, E. J. and Brennan, T. (2000). Hospital ownership and preventable adverse events. *Journal General Internal Medicine* 15(4), 12 – 17 Retrieved from <https://www.infona.pl/resource/bwmeta1.element.springer-349af39d-0828-38b8-993d-cca62ccfa9> Accessed 16 April, 2015.
- Thompson, R. L. Higgin, C. A. and Howell, J. M. (1991). Personal computing toward a conceptual model of utilization. *MIS Quarterly*, 15 (1), 144-176. Retrieved from <https://www.jstor.org/stable/24944>
- Tierrney, W. M. Achieng, M. Baker, E. Biodich, P. Kayiwa, D. Mamlin, B. Musinquzi, N. Kayiwa, D. and Yeung, A. (2010). Experience implementing EHR three African countries. *Study Health Technology Information* 160 (1) 371 -375.
- Treadwell, D. (2013). *Introducing communication: Paths of inquiry*. (2nd ed). London:Sage publication .
- Trevor, A. M. (2007). Budget speech 2007. Minister of Finance, .South Africa.
- Trochim, W. M. K. (2006). What is the research methods knowledge based? 1 (2) Research methods Retrieved from www.socialresearchmethods.net/kb/. Accessed 16 April, 2015.
- Tsiachristas, A. Water, B. H., Adams, S. A. Bal, R. and Molken, R. (2014). Identifying and explaining the variability in development and implementation costs of disease management programs in the Netherlands. *BMC Health Service Research* 14(518), 1- 6. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/2534396> Accessed 1 May, 2015.
- Turmamao, M. G. (2014). Literature reviews of clinical decision support systems. University of the Philippines-Dilimen
- U.S. Department of Education. National Center for Education Statistics. (2000). Teachers' tools for the 21st Century: A Report on teachers' use of technology. US Department of Education.
- Udousoro, N. M. (2014). Use and gratification of ICT by healthcare personnel in Nigeria South- South tertiary hospitals. *Asian Journal of Social Sciences and Humanities*. 3 (4), 12 -18 Retrieved from www.ajssh.leena-

[luna.co.jp/AJSSHPDFs/Vol.3\(4\)/AJSSH2014\(3.4-22\).pd](http://luna.co.jp/AJSSHPDFs/Vol.3(4)/AJSSH2014(3.4-22).pd) Accessed 16 April, 2015

Ukwoma, B. and Muracy, C. (2002). Government begins N1.36 upgrading programme for 15 hospitals .The Guardian Newspaper, Friday, Febuary, 29th.

UNAIDS (2013). Abuja +12; shaping the future of health in Africa, Federal Ministry of Health, Abuja. Retrieved from http://www.unaids.org/sites/default/files/media_asset/JC2524_Abuja_report_en_0.pdf. Accessed on 13th May, 2014.

UNESCO (2005). Towards knowledge societies, UNESCO publishing: Paris.

UNESCO (2011). UNESCO ICT competency framework for teachers, UNESCO publication: Paris

United Nation (1948).The universal declalrtaion of human rights. UNO publication: New York

United Nation (2016). Susitanable development agenda .UN web services section, Department of Public information, UN

United Nation Programme in HIV/AIDS global repor (2013). UNAIDS report on the global AIDS epidermic UNO publication: New York

United National Foundation (2014). Assessing enabling enviroment for ICT for health in Nigeria: a review of policies; United Nation Foundation Support of ICT .Federal Ministry of Health, Abuja

Universal Declaration of Human right (1948), United National Organisation

University College Hospital (2011).Rebirth of Excellence .UCH press: Ibadan

University of Southampton (2014). HLTH6 Health care informatics. (2014). Retrieved from [http://www/Southampton.ac.health sciences/](http://www/Southampton.ac.health%20sciences/) Accessed on June 22, 2014.

Ushie, B., A. Salami, K. K. and Jegede, A. S. (2013). Knowledge and perceived reactions to medical errors in a tertiary health facility in Nigeria. *African. Health Science* .13(3), 820 -826 Retrieved from [https://www.ncbi.nlm.nih.gov/NCBI/Literature/PubMedCentral\(PMC\)](https://www.ncbi.nlm.nih.gov/NCBI/Literature/PubMedCentral(PMC)) Accessed 17 April, 2015

- Uzoka, F. M. Osuji, J. and Obot, O. (2011). Clinical decision support system in the diagnosis of malaria: A case comparison of two soft computing methodologies. *Expert Systems with Application* 38 (1), 1532-1553 Retrieved from www.sciencedirect.com/science/article/pii/S0957417410006962 Accessed 16 April, 2015.
- Valiani, M. Majidi, J. and Beiga, M. (2014). Perspective of midwives working at hospital affiliated to the Isfahan Univeristy. *IranNursing and Midwifery research* 20 (5) 1- 5, Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/26457089> Accessed 13 May, 2015.
- van Dijk, J. Peters, O. and Ebbers, W. (2008). Explaining the acceptance and use of government Internet services: A multivariate analysis of 2006 survey data in the Netherlands. *Government Information Quarterly* 25(3), 379-399. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0740624X0700127X> Accessed 16 April, 2015.
- Venkatesh, V. and Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies, *Management Science*. 46 (2), 186-204. Retrieved from pubsonline.informs.org/doi/abs/10.1287/mnsc.46.2.186.1192 Accessed on January, 2015.
- Venkatesh, V. and Morris, M. G. (2000). Why Don't Men Ever to Stop to Ask for directions? Gender, Social Influence, and their role in technology acceptance and usage Behavior. *MIS Quarterly* 24 (2), 115-139. Retrieved from <https://www.jstor.org/stable/3250981> Accessed 16 April, 2015
- Venkatesh, V. Morris, G. Michael, G. Davis, G. and Davis, F. D. (2003) .User acceptance of information technology: toward a Unified View. *MIS Quarterly*. (27), 425-478 Retrieved from <https://www.jstor.org/stable/30036540> Accessed on 16 April, 2015.
- Venkatesh, V., Sykes, T.A., and Zhang, X. (2011). Just what the doctor ordered: A revised UTAUT for EMR system use by doctors. 44th Hawaii International Conference on System Sciences, January 4-7, Kauai, HA.
- Venkatesh, V. Thong, J. and Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology.

- MIS Quarterly*. 36(1), 157-178. Retrieved from <https://www.researchgate.net/file.PostFileLoader.html?id...assetKey> 13 March, 2016.
- Verbeke, F. Karara, G. and Nyssen, M. (2013). Evaluating the impact of ICT-tools on health care delivery in sub-saharan hospitals. *Studies in Health Technology and Informatics*. 192 (1).11- 21 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23920609> Accessed 13 March, 2016
- Viitanen, J. Hyponen, H. Laaveri, T. Vanska, J. and Jarmo, I. (2011). National questionnaire study on clinical ICT systems proofs: physicians suffer from usability. *International Journal of Medical Informatics* 80(10), 708-725. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/2178470> Accessed on 13 March, 2016
- Virtanen, J. I. and Nieminen P. (2002). Information and communication technology among undergraduate dental students in Finland. *European Journal of Dental Education*. 6 (4), 147-52. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/12410665> Accessed 13 March, 2016
- Vogd, W. (2004). Ärztliche Entscheidungsprozesse des Krankenhauses im Spannungsfeld von System- und Zweckrationalität: Eine qualitativ rekonstruierte Studie unter dem besonderen Blickwinkel von Rahmen ("frames") und Rahmungsprozessen. VWF, Berlin.
- Waehama, W. McGrath, M., Korthaus A. and Fong, M. (2014). ICT adoption and the UTAUT. A paper presented at the International conference in Educational Technology with information technology, Bangkok, Nov., 8-9.
- Wakari, G. (2012). The diffusion of information and communication technologies in the informal sectors in Kenya PhD thesis Kwadlanceziwas: Information Studies University of Zululand
- Wakili, I. (2013). Nigeria: Jonathan -25,000 Nigerian doctors practicing in US Daily Trust. 9th, Oct.,
- Walsh, M. (1997). How nurses perceived barriers to research implementation. *Nursing Standard* 11(1)34-39. Retrieved from

<http://journals.rcni.com/doi/abs/10.7748/ns1997.04.11.29.34.c2449> Accessed 13 March, 2016

- Wang, C. J. Patel, M. H. Schureth, A. J. Bradley, M. Wu, S. Crosson, J.C. and Bell, D. S. (2009). Perceptions of Standards-based Electronic Prescribing Systems as Implemented in Outpatient Primary Care: A Physician Survey. *Journal of American Medical Information Association*. 16(4), 493-502. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/1939010> Accessed 13 March, 2016.
- Wang, Q. Fau, A. Allgri, M. D., Brenner, S. and Kalmus, H. T. (2015) Out of pocket expenditure in chronic non communicable diseases in sub –sahara Africa; The case of rural Malawi .*PLOS 1* 10 (1), 1- 7, Retrieved from journals.plos.org/plosone/article?id=10.1371/journal.pone.011689 Accessed 13 March, 2016
- Ward, M. M. Jaana, M. Bahensky, J. A. Vartak, S. and Wakefield, D. S. (2006). Clinical information system availability and use in urban and rural hospitals. *Journal of Medical Systems*, 30(6), 429–438.
- Ward, R. Stevens, C. Brentall, and P. and Briddon, J. (2008). The attitudes of healthcare to information technology: a comprehensive review of the research literature. *Health Information Libararies*. 25(2), 81-97.
- Warschauer, M. (2004). Of digital divides and social multipliers: Combining language and technology for human development. Information and communication technologies in the teaching and learning of foreign languages: State of the art, needs and perspectives 46-52. Moscow: UNESCO Institute for Information Technologies in Education
- Watts, C. and Ibegbulam, I. (2006). Access to electronic healthcare information resources in developing countries: Experiences from the medical library, College of Medicine, University of Nigeria. *IFLA Journal*, 32(54). Retrieved from <http://ifl.sagepub.com/content/32/1/54.full.pdf+htm>
- Weatherburn, G. Bryan, S. Nichollaas, A. and Cocks, R. (1999) .The effect of a picture archiving and communications system (PACS) on diagnostic performance in the accident and emergency department. *Journal of Accidents Emergency Medicine*. 17(3), 180-184 Retrieved from

[http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.819.4653&rep=rep1
&type=pdf](http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.819.4653&rep=rep1&type=pdf) Accessed 11 March, 2016

- Weaver, K. and Olson, J. K. (2006). Understanding paradigms used for nursing research. *Journal of Advances Nursing* 53(4), 459-469
- Weber, R. P. (1990). Basic content analysis. *Quantitative application in the Social Science* 49 (1), 1 – 13.
- Week, R. (2013). The convergence of systematic threads shappingng a futureSouth Africa health dispensation: a technology management perspective. ACTA Commercial Independent. *Research Journal in the Management Science* 13(1). 1-12 .
- Weingand, D. E. (1993). Grounded theory and qualitative methodology. *IFLA Journal*, 19(1), 17-26.
- Welman, J. C. Kruger S., J., and Mitchell, B. (2012). Research methodology. Cape Town Oxford University Press.
- Welman, J. C. Kruger S.J, and Mitchell, B., (2005). Research methodology Oxford University Press: Cape Town
- Welter, P. Desemo. T. Fischer, B. Gunther, R. W. and Spreckeler, C. (2011). Towards care based medical learning in radiological decision making using content –based image retrieval. *BMC Medical Informatics and Decision Making*. 11 (1): 1- 12 Retrieved from
8<http://bmcmmedinformdecismak.biomedcentral.com/articles/10.1186/1472->
Accessed on 12 Janaury, 2016
- Welter. P. Topal. F. and Jonhsen, S. (2001) . Combined DICOM and HL7 viwewer in support of a bridgr from content-based image retrieved at computer-assisted diagnosiss. *Advance Intelligent Soft Computation* 69 (1), 145- 152
- Weng, Y. H. Kuo, K. H., Yang, C. H. Lo. N. L. Shih, Y. N. Chen, C., and Chiu, Y. W. (2013). Inceasing utilization of Internet –based medicine a national study in Taiwan. *BMC Medical Informatics and Decsion Making*. 13(4), 7- 19, Retrieved from

<https://bmcmmedinformdecismak.biomedcentral.com/articles/10.1186/1472-6947-13-4> Accessed on 13 March, 2016.

- Wess, M. C. Enbi, P. Besier, T. Lowey, C. Anderaon, P. F. and Hegneer, G. (2007). Effect of computerised provider order entry system on medication at a community hospital and university hospital. *Amia Annual Journal*, 3 (1), 796- 800.
- Wheelock, A. Bebell, D. J., and Haney, W. (2000). What can student drawings tell us about high-stakes testing in Massachusetts? *Teachers College Record* 1 (1) 1- 3 Retrieved from [www .tcrecord](http://www.tcrecord.com).
- White paper for the transformation of the transformation of the health system in South Africa (1997) .Notice 667of 1997.Retrieved from [./www.gov.za /files/17910-gen667-0](http://www.gov.za/files/17910-gen667-0) .Accessed on July, 2015.
- Whittaker, L. Van Zyl, J. and Soicher, A. S. (2011). What is the point of the point-of-care? A case study of user resistance to an e-health system. *Telemedicine. Journal and e-Health: The Official Journal of the American Telemedicine Association*, 17 (1) Retrieved from <http://online.liebertpub.com/doi/abs/10.1089/tmj.2010.0008> Accessed on 19 March, 2016
- WHO (2000). The World health report 2000. Health system improving performance. Retrieved from <https://who.int/whr/2000/en> WHO publication: Geneva
- WHO (2007). A safer future: global public health security in the 21st century. WHO publication Geneva; WHO press
- WHO (2008). Framework and standards for country systems ;WHO publication : Geneva
- WHO (2009). Global Health Risks: mortality and burden of disease attributable to selected major risks. Geneva : WHO press
- WHO (2013). E-health and innovation in women's and children health: a baseline review .Global Observatory for ehealth WHO press. Retrieved from www.who.int/goe/en. Accessed on 13 July, 2016.
- WHO (2015). HIV/AIDS fact sheet WHO media, Geneva: WHO publication.

- WHO. (2006).eHealth tools and services: needs of the member states report of the WHO, Geneva: WHO publication.
- Williams, M. D. Rana, P. N. and Dwivedi, Y. K. (2015). The unified theory of acceptance and use of technology (UTAUT): a literature review, *Journal of Enterprise Information Management*, 28 (3). 2- 8.
- Wills, M. J. El-Gayar, O. F. and Bennett, D. (2008). Examining healthcare professionals' acceptance of electronic medical records using UTAUT. *Issues in Information Systems*, 9(2), 396-401.
- Wong, I. A. and Dioko, L. D. A. (2013). Understanding the mediated moderating role of customer expectations in the customer satisfaction model: The case of casinos. *Tourism Management*, 36, (1), 188-199.
- Wootton, R. Patil, N. G. Scott, R. and Ho, K. (2009). Telehealth in the developing world. *Health Inform Research*. 16(2). 140-141.
- Woreta, S.A. Kebede, Y. and Zegeye, D. T. (2013) Knowledge and utilisation of ICT among health science students at the University of Gondar, North Western Ethiopia.*Medical Informatics Decision Making* 13(13). 1- 12.
- World Bank (2006).Connecting People, improving health: the role of ICTs in the health sector of developing countries. New York: World Bank press.
- World Bank (2015) World Bank working paper: the role of identify and post development agenda. New York: World Bank publication:
- World Health Organisation, (2005). Connecting for health global vision, local insight: report for world summit on the information society. Geneva: WHO press.
- World Health Organisation, (2008). Information technology in support of healthcare. WHO press: Geneva Retrieved from [http:// www.who.int/eht/en/information Tech pdf](http://www.who.int/eht/en/information%20Tech.pdf). Accessed on 13 March, 2016
- World Health Organization (2000). Health systems: improving performance. Geneva: WHO press,. Retrieved from [/www.who.int.proxy.lib.uwo.ca:2048/whr/2000/en/whr00_ch4_en.pdf](http://www.who.int.proxy.lib.uwo.ca:2048/whr/2000/en/whr00_ch4_en.pdf). Accessed on 4 March, 2016

- World Health Organization (2006). Taking stock: health worker shortages and the response to AIDS. Geneva: WHO press
- World Health Organisation (2013), Global Observatory for eHealth. Geneva: WHO press.
- World Health Report (2000). Bullentin of WHO. Geneva: WHO press.
- World Health Report (2007). A safer future: global public health security in the 21st century. Geneva: WHO publication
- Wright, E. and Marrel, J. (2013). Electronic health records: post adoption physiciansatisfaction and continued use. *Healthcare Management* 31(3) 259-267
- Write Content Solution (2016). Data Trigulation: How the trigulation of data strengthens your research. Crowd sources. Retrieved from <http://www.write.com/writing-guides/research-writing/citing-references/> . Accessed on 12 March, 2015
- Wu, J. and Wang, S. (2005). What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information and Management* 42(1). 719-729.
- Wu, M.Y. Yu, P. Y. and Weng, Y. C. (2012). A study on user behavior for pass by UTAUT: Using Taiwan\'s MRT as an Example. *Asia Pacific Management Review*.17(1), 92-111. Retrieved from <http://apmr.management.ncku.edu.tw/comm/updown/DW1204184516.pdf> Accessed on 12 March, 2015.
- Yahya M. Nadzar, F. Masrek, N. and Rahman, B. A. (2011). Determinants of UTAUT in Measuring User Acceptance of E-Syariah Portal in Syariah Courts in Malaysia. The 2nd International Research Symposium in Service Management, Yogyakarta, Indonesia, 26 – 30 July. 242-250. Accessed on 12 March, 2015
- Yarbrough, A. (2007). Technology acceptance among physicians a new take on TAM. *Healthcare Sciences and Services* 22(89), 650 -672 Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/17717378> Accessed on 18 March, 2015

- Yeasmin, S. and Rahman, K. F. (2012), Triangulation research method as the tool of social science research 1 (1), 154- 164, BUP Journal Retrieved from <http://www.bup.edu.bd/journal/154-163.pdf> Accessed on 12 March, 2015
- Yin, R. K. (2011). Qualitative research from Start to finish. Guilford press: New York
- Yoo, S. J. Han, S. H. Zanotti, R. and Chiff, D. (2014). Dignostic framework and nursing diagnosis a normative stance. *Nursing Philosophy* 16(1) 61-73, Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.819.4653&rep=rep1&type=pdf> Accessed on 12 March, 2015
- Yoo, S. J. Han, S. H. and Huang, W.B. (2012). The roles of intrinsic motivators and extrinsic motivators in promoting e-learning in the workplace: A case from South Korea. *Computers in Human Behavior*. 28, (1), 942-950, Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/nup.12074/abstract> 12 May, 2015
- Young, A. Chaundhry, H. J. Xiaomei, M. S. Halbeslebank, K. Polk, D. and Durgan, M. (2015). Insightful Practice: a method to address a gap in medical regulation. *Journal of Medical Regulation*. 101 2(8), 1 -12 Retrieved from <http://discovery.dundee.ac.uk/portal/en/research/insightful-practice%288aefe674-00a5-4571-8726-e78cb0143bf0%29.html> 16 June, 2016
- Yunus, O. O. and Tambi, A., M. (2013). Essential of research method. UiTM Kuala-Lumpur..
- Yusoff Y. M. Muhammad Z. Zahari, M. S. M. Pasah E. S. and Robert, E. (2009). Individual differences, perceived ease of use, and perceived usefulness in the e- Library usage. *Computer and Information Science*, Retrieved from 2(1), 76-83 <https://pdfs.semanticscholar.org/b6cb/d78b9b3d4dcad6b7583d478515ff066fd885.pdf> Accessible on 16 June, 2016.
- Yusuf, A. A. and Alhaji, A. A. (2015). Knowledge, attitude, and use of internet for medical information by patients attending specialist clinics in ABUTH Zaria-Nigeria. Sub-Saharan., *African Journal of Medicine*. 2 (4), 160-164 Retrieved from <http://www.ssajm.org/article.asp?issn=2384-5147;year=2015;volume=2;issue=4;spage=160;epage=164;aulast=Yusuf> Accessible on 16 June, 2016

- Zakaria, N. Mohd Affendi, S. Yusof, S. and Zakaria, N. (2010). Managing ICT in healthcare organization: culture, challenges, and issues of technology adoption and implementation', in Y. K. Dwivedi, K. Khoubati, B. and Lal, A. Srivastava (eds), Handbook of Research on Advances in Health Informatics and Electronic Healthcare Applications: Global Adoption and Impact of Information Communication Technologies, IGI Global, Hershey.
- Zandieh, S. Yoon-Flannery, K. Kuperman, G. Langsam, D. Hyman. D. and KaushL, R. (2008). Challenges to EHR implementation in electronic-versu paper-based office practices. *Journal General Internal Medicine* 23 (6), 755- 761 Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2517887/> Accessible on 16 June, 2016.
- Zhang, H. Cocosile, M. and Archer, N. (2010). Factors of adoption of mobile information technology by homecare nurses; A technology acceptance model 2 approach. *Computers Informatics* 28 (1), 49-50. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19940621> Accessible on 16 June, 2016
- Zheng, S. (2004). Overcoming resistance to new technology: employee buy- in is crucial for successful Information System Implementation. *Behavioral Health Management. 1* (2), 1- 5 Retrieved from <http://www.highbeam.com/doc/1G1-114366707.html> Accessed 19 July, 2015.
- Zikmud, W. G. (1994). Business research method. Harcourt: The Dryden Press
- Ziyani, I.S. Ehlers V. J. and King L. J. (2005). Socio-cultural deterrents to family planning practices among Swazi women. *Curationis*, 26(4), 39-50. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/1502727> Accessible on 16 June, 2016

APPENDIX 1: Questionnaire for Medical Doctors

VOLUNTARY QUESTIONNAIRE FOR MEDICAL DOCTORS

Access and use of clinical informatics among medical doctors in selected teaching hospitals
in Nigeria and South Africa



Faculty of Arts

Department of Information Studies

University of Zululand

Please complete this voluntary questionnaire on access and use of clinical informatics among
medical doctors in selected teaching hospitals in Nigeria and South Africa.

.

Department of Information Science,
University of Zululand,
Private Mail Bag X1001, Kwadlangezwa,
3886,
South Africa.

Dear Respondents,

I am a Ph.D student in the above named department, conducting research on clinical informatics' access and use among medical doctors in selected teaching hospitals in Nigeria and South Africa. The purpose of this research is to establish the level of access to and use of clinical informatics facilities among medical doctors in the selected teaching hospitals in Nigeria and South Africa. I kindly ask for your time to complete the questionnaire based on your professional knowledge and experience as a medical doctor and return it at your earliest convenience. Your frank feedback will be taken as a contribution to this research. I assure you that the information provided will be kept confidential and solely used for the purposes of this study.

Thanking you in advance for your time.

Yours sincerely,

Owolabi, K.Abayomi

Researcher/Ph.D student

yomiowolabi2000@yahoo.com

+27734401247

SECTION A: BIO-DATA

1. Gender: Male () Female ()

2. Age:

20- 29 ()

30-39 ()

40-49 ()

50-59 ()

60 and above () 3. Medical Practice experience:

1-5 years ()

5- 10 years ()

11-15 years ()

16-20 years ()

21-25 years ()

26 years and above ()

4. Teaching Hospitals:

University College Hospital, Ibadan, Nigeria ()

King Edward VIII Hospital, KZN, South Africa ()

5. Current Position: -----

6. Department: -----

7. Please indicate your highest qualification-----

SECTION B: Access and use of clinical informatics among medical doctors in selected teaching hospitals in Nigeria and South Africa

Clinical informatics can be described as the use of ICT to diagnose and deliver health care services.

Kindly tick as it applies to you.

8. Have you used clinical informatics before? Yes () No ()

9. What types of clinical informatics tools are accessible to you? Please tick

Electronic Medical Records	
Clinical Decision Support Systems	
Computerised Provider (Physician) Order Entry(CPOE)	
Diagnosis Image Archiving	

10. Where do you normally access the clinical informatics tools? Tick appropriately

Consultancy room	
Wards	
Offices	
Homes	
Laboratory	

Other specify-----

11 How often do you use these clinical informatics tools?

Types of clinical informatics	Clinical Informatics	Always	Often	Sometimes	Rarely	Never
Electronic Medical Record (EMR) is a repository of patients' data in digital form, stored and exchanged and accessible by multiple authorized users within a hospital system.	Electronic Medical Record (EMR)					
Clinical Decision Support Systems (CDSS) is a computer application designed to assist medical doctors in making diagnostic and therapeutic decisions in patient care.	Clinical Decision Support Systems (CDSS)					
Computerised Physician Order Entry (CPOE) is a process that allows medical doctors to enter medical orders directly through electronic form and communicate directly to responsible individuals or departments.	Computerised Provider Order Entry (CPOE)					
Diagnosis Image Archiving. This is a system that is able to store, exchange, display and manipulate images and associated diagnoses for	Diagnosis Image Archiving (DIA)					

medical use.						
--------------	--	--	--	--	--	--

12. Perceived factors that influence medical doctors' intention to use clinical informatics

(SA- Strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree)

Performance Expectancy (PE)	SA	A	N	D	SD
I find clinical informatics useful in my job					
Using clinical informatics enables me to accomplish tasks more quickly					
Using clinical informatics improves my job performance					
Using clinical informatics saves me time					
Using clinical informatics enables me to accomplish tasks more quickly					
Social Influence (SI)					
People who influence my behaviour think that I should use clinical informatics					
People who are important to me think that I should use clinical informatics					
My seniors in the profession have been helpful in training me in the use of clinical informatics					
In general, the hospital has been supporting me in the use of clinical Informatics					
Effort expectancy					
It will be easy for me to become skilful at using clinical informatics					
I find the clinical informatics tools easy to use					

Learning to operate the clinic informatics tools is easy for me					
Facilitating Conditions (FC)					
My organisation has the support system necessary to use clinical informatics					
My organisation motivates me to use clinical informatics					
ICT department helps to organise training on the use of clinical informatics tools					
Behavioural Intention to Use the System					
I intend to use clinical informatics in the work regularly					
I would use clinical informatics any time I am in the hospital					
I plan to use clinical informatics any time my patients come to my hospital					

13. Benefits of using clinical informatics

Benefit of clinical informatics	SA	A	N	D	SD
Clinical informatics can reduce medical errors					
It saves the time of medical doctors					
Clinical informatics improves diagnostic efficiency					
Reduces adverse drug effects					
Reduction of cost					
Increases the performance of medical doctors					

14. Purposes of using clinical informatics

(SA- Strongly Agree, A-Agree, N- Neutral D-Disagree, SD-Strongly Disagree)

	Purposes for using clinical informatics	SA	A	N	A	SD
1	Clinical informatics is used for disease management					
2	I use clinical informatics for medical diagnosis purposes					
3	I use clinical informatics for research purposes					
4	I use clinical informatics for decision making					
5	I use clinical informatics to share knowledge with my professional colleagues and medical students					
6	I use clinical informatics for communication purposes, to alert patient on their treatments					
7	I use clinical informatics for the treatment of my patients					
8	I use clinical informatics in order to promote effective healthcare delivery					
9	I use clinical informatics for administrative information					
10	I use clinical informatics for treatment and practice in the hospital					

15. What are the challenges facing the use of clinical informatics among the medical doctors?

(SA- strongly agree, A-agree, N- Neutral D-disagree, SD-strongly disagree)

The following are challenges besetting the use of clinical informatics by medical doctors:

S/N	Challenges facing the use of clinical informatics	SA	A	N	SD	D
1	Non-availability of desired clinical informatics tools					
2	Absence of sufficient training programmes on clinical informatics					
3	Poor ICT skills on the part of medical doctors					
4	Lack of technical support					
5	Limited and unreliable supply of electricity					
6	Limited access to the Internet					
7	Technophobia					
8	I have negative attitude towards clinical informatics					

14. What recommendations do you propose to improve the challenges faced by medical doctors in the use of clinical informatics?-----

APPENDIX 2: Interview schedule for the Heads of the ICT units



University of Zululand

Faculty of Arts

Department of Information Studies

Background information

Name of the teaching hospital-----

Department -----

Current -----

Years of experience-----

Academic qualifications -----

Section B

- What are the purposes of using clinical informatics tools among medical doctors in your hospital?
- As an experienced Head of ICT, can you describe various purposes of using clinical informatics?

- Do you consider clinical informatics useful among medical doctors?
- Can you explain various benefits of using clinical informatics in the hospitals?
- Do the medical doctors appreciate the use of clinical informatics?
- What are your comments on the benefits of clinical informatics for effective healthcare delivery?
- Do you have clinical informatics in your hospital?
- Which types of clinical informatics tools are available in your hospital?
- How do acquire the clinical informatics resources?
- Do you have committees that recommend the clinical informatics resources that need to be bought?
- Do you have a maintenance department for repairing the clinical informatics tools?
- Which of the clinical informatics tools are accessible to the medical doctors in your hospitals?
- Where are the access points for the use of the clinical informatics?

- Are you satisfied with the clinical informatics resources that are available in the hospital?
- Do you think medical doctors in your hospitals have relevant ICT skills to operate the clinical informatics resources?
- Identify the various factors that can promote access to and the use of clinical informatics in the hospitals?
- How often do you organise training for medical doctors on the use of clinical informatics?
- Do you have any incentives for the medical doctors concerning the use of clinical informatics?
- Do they consult your office before using the clinical informatics tools?
- Do you have ICT policies in your hospital?
- Are the medical doctors aware of ICT policy documents?
- Do you include the teaching of ICT in the medical school curriculum for the medical students?
- Do you consider the ICT skills of medical doctors before employing them in the hospital?
- What are the strategies that the hospital put in place to encourage medical doctors to use clinical informatics?
- What are your opinions on medical doctors' use of ICT?
- How often do you organize training for them on the use of ICT?
- What are the challenges facing access to and the use of clinical informatics in

APPENDIX 3: UNIVERSITY OF ZULULAND ETHICAL CLEARANCE

**UNIVERSITY OF ZULULAND
RESEARCH ETHICS COMMITTEE**
(Reg No: UZREC 171110-030)



RESEARCH & INNOVATION

Website: <http://www.unizulu.ac.za>
Private Bag X1001
KwaDlangezwa 3886
Tel: 035 902 6887
Fax: 035 902 6222
Email: ManqeleS@unizulu.ac.za

ETHICAL CLEARANCE CERTIFICATE

Certificate Number	UZREC 171110-030 PGD 2015/91						
Project Title	Access and use of clinical informatics among medical doctors in selected teaching hospitals in Nigeria and South Africa						
Principal Researcher/ Investigator	KA Owolabi						
Supervisor and Co- supervisor	Dr ND Evans				Prof DN Ocholla & Prof TP Mhlongo		
Department	Information Studies						
Nature of Project	Honours/4 th Year		Master's		Doctoral	x	Departmental

The University of Zululand's Research Ethics Committee (UZREC) hereby gives ethical approval in respect of the undertakings contained in the above-mentioned project proposal and the documents listed on page 2 of this Certificate.

- Special conditions:**
- (1) The Principal Researcher must report to the UZREC in the prescribed format, where applicable, annually and at the end of the project, in respect of ethical compliance.
 - (2) Documents marked "To be submitted" (see page 2) must be presented for ethical clearance before any data collection can commence.

The Researcher may therefore commence with the research as from the date of this Certificate, using the reference number indicated above, but may not conduct any data collection using research instruments that are yet to be approved.

Please note that the UZREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the documents that were presented to the UZREC
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

KA Owolabi PGD 2015/91

Page 1 of 1

Classification:

Data collection	Animals	Human Health	Children	Vulnerable pp.	Other
X					
Low Risk		Medium Risk		High Risk	
		X			

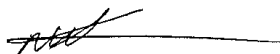
The table below indicates which documents the UZREC considered in granting this Certificate and which documents, if any, still require ethical clearance. (Please note that this is not a closed list and should new instruments be developed, these would require approval.)

Documents	Considered	To be submitted	Not required
Faculty Research Ethics Committee recommendation	X		
Animal Research Ethics Committee recommendation			X
Health Research Ethics Committee recommendation			X
Ethical clearance application form	X		
Project registration proposal	X		
Informed consent from participants	X		
Informed consent from parent/guardian			X
Permission for access to sites/information/participants	X		
Permission to use documents/copyright clearance			X
Data collection/survey instrument/questionnaire	X		
Data collection instrument in appropriate language		Only if necessary	
Other data collection instruments		Only if used	

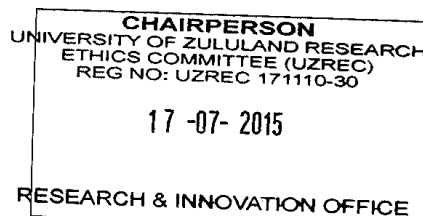
The UZREC retains the right to

- Withdraw or amend this Certificate if
 - Any unethical principles or practices are revealed or suspected
 - Relevant information has been withheld or misrepresented
 - Regulatory changes of whatsoever nature so require
 - The conditions contained in this Certificate have not been adhered to
- Request access to any information or data at any time during the course or after completion of the project

The UZREC wishes the researcher well in conducting the research.



Professor Nokuthula Kunene
Chairperson: University Research Ethics Committee
 17 July 2015



APPENDIX 4: APPROVAL LETTER 1



health

Department:
Health
PROVINCE OF KWAZULU-NATAL

330 Langalibalele street,
Private Bag X9051 PMB, 3200
Tel: 033 395 2805/3189/3123 Fax: 033 394 3782
Email: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

DIRECTORATE:

Health Research & Knowledge
Management (HKRM)

Reference: HRKM299/15
KZ_2015RP3_396

20 October 2015

Dear Mr K A Owolabi
(University of Zululand)

Subject: Approval of a Research Proposal

1. The research proposal titled '**Access and Use of Clinical Informatics among Medical Doctors in Selected Teaching Hospitals in Nigeria and South Africa**' was reviewed by the KwaZulu-Natal Department of Health.

The proposal is hereby **approved** for research to be undertaken at King Edward VIII & Ngwelezana Hospitals.

2. You are requested to take note of the following:
 - a. Make the necessary arrangement with the identified facility before commencing with your research project.
 - b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.
3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Ms G Khumalo on 033-395 3189.

Yours Sincerely

Dr E Lutge

Chairperson, Health Research Committee

Date: 22/10/15

APPENDIX 5: APPROVAL LETTER 2



INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT) **College of Medicine, University of Ibadan, Ibadan, Nigeria.**



Director: **Prof. Catherine O. Falade**, MBBS (Ib), M.Sc, FMCP, FWACP
Tel: 0803 326 4593, 0802 360 9151
e-mail: cfalade@comui.edu.ng lillyfunke@yahoo.com

UI/UCH EC Registration Number: NHREC/05/01/2008a

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Availability, Access and Use of Clinical Informatics among Medical Doctors in the University College Hospital, Ibadan, Nigeria and King Edward VIII Academic Hospital, South Africa

UI/UCH Ethics Committee assigned number: UI/EC/15/0448

Name of Principal Investigator: **Owolabi, Kehinde Abayomi**

Address of Principal Investigator: Department of Information Studies,
University of Zululand,
South Africa

Date of receipt of valid application: 01/12/2015

Date of meeting when final determination on ethical approval was made: N/A

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and *given full approval by the UI/UCH Ethics Committee.*

This approval dates from **06/01/2016 to 05/01/2017**. If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the UI/UCH EC assigned number and duration of UI/UCH EC approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC early in order to obtain renewal of your approval to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. No changes are permitted in the research without prior approval by the UI/UCH EC except in circumstances outlined in the Code. The UI/UCH EC reserves the right to conduct compliance visit to your research site without previous notification.



Professor Catherine O. Falade
Director, IAMRAT
Chairperson, UI/UCH Ethics Committee
E-mail: uiuchec@gmail.com

APPENDIX 6: Letter from the editor

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF ENGLISH

nikjob@yahoo.com



E-mail: aa.akinjobi@ui.edu.ng
+234-805-733-1905

January 13, 2017

Department of Information Studies,
University of Zululand,
South Africa.

Dear Mr Owolabi,

**EDITING OF PHD THESIS: ACCESS AND USE OF CLINICAL INFORMATICS AMONG
MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN NIGERIA AND SOUTH
AFRICA**

This is to certify that the thesis titled “ ACCESS AND USE OF CLINICAL INFORMATICS AMONG
MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN NIGERIA AND SOUTH
AFRICA” was edited by me. Errors relating to content, expression, organisation, and mechanical
accuracy were meticulously corrected. I strongly recommend that the thesis be processed for
examination.

Yours faithfully,


Adenike Akinjobi (Prof)

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF ENGLISH

nikjob@yahoo.com



E-mail: aa.akinjobi@ui.edu.ng

+234-805-733-1905

January 13, 2017

Department of Information Studies,
University of Zululand,
South Africa.

Dear Mr Owolabi,

**EDITING OF PHD THESIS: ACCESS AND USE OF CLINICAL INFORMATICS AMONG
MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN NIGERIA AND SOUTH
AFRICA**

This is to certify that the thesis titled " ACCESS AND USE OF CLINICAL INFORMATICS AMONG
MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN NIGERIA AND SOUTH
AFRICA" was edited by me. Errors relating to content, expression, organisation, and mechanical
accuracy were meticulously corrected. I strongly recommend that the thesis be processed for
examination.

Yours faithfully,

A handwritten signature in blue ink, appearing to read "Adenike Akinjobi".
Adenike Akinjobi (Prof)

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF ENGLISH

nikjob@yahoo.com



E-mail: aa.akinjobi@ui.edu.ng

+234-805-733-1905

October 18, 2016

Department Information Studies,
University of Zululand,
South Africa,

Dear Owolabi,

**EDITING OF PHD THESIS: ACCESS AND USE OF CLINICAL INFORMATICS
AMONG MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN
NIGERIA AND SOUTH AFRICA**

This is to certify that the thesis titled "ACCESS AND USE OF CLINICAL INFORMATICS
AMONG MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN NIGERIA
AND SOUTH AFRICA" was edited by me. Errors relating to content, expression,
organisation, and mechanical accuracy were meticulously corrected. I strongly recommend
that the thesis be processed for examination.

Yours faithfully,

A handwritten signature in blue ink, appearing to read 'Akinjobi', with a stylized flourish at the end.

Adenike Akinjobi (Prof)



UNIVERSITY COLLEGE HOSPITAL, IBADAN

The pioneer Teaching Hospital in Nigeria.

P.M.B. 5116, Ibadan Tel: 0700 824 4357, +234 02 903 1012, +234 02 903 1021 Email: cmd@uch-ibadan.org.ng Website: www.uch-ibadan.org.ng

January 12, 2015

Mr. Owolabi Kehinde Abayomi,
Department of Information Studies,
University of Zululand,
South Africa.

Dear Mr. Owolabi,

Re: Permission to Administer Questionnaire

Please refer to your letter dated January 8, 2016 on the above subject. I hereby inform you that approval has been given for you to administer questionnaire to randomly selected medical doctors in the hospital for your project titled **"Availability, Access and Use of Clinical Informatics among Medical Doctors in the University College Hospital, Ibadan, Nigeria and King Edward VIII Academic Hospital, South Africa"**.

You are requested to submit a copy of the final report of your research to the office of the Chairman, Medical Advisory Committee of this Hospital.

Yours faithfully,

A handwritten signature in blue ink, appearing to read "A. O. Afolabi", is written over a faint, larger signature.

Dr. A. O. Afolabi
Chairman, Medical Advisory Committee
Director of Clinical Services, Research & Training
For: Chief Medical Director

Prof. Temitope O. Alonge - MBBS (Ibadan), FRCS Edinburgh, FWACS, MD Leicester, FPA - *Chief Medical Director*
Dr. Adefemi O. Afolabi - MBBS (Ibadan), FWACS - *Chairman, Medical Advisory Committee; Director of Clinical Services, Research & Training*
Mr. P. O. Oloosun - Bsc (Hons) Pol. Sci, MBA, AHA, MNIM, ACIPM - *Director of Administration & Secretary to the Board*

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF ENGLISH

nikjob@yahoo.com



E-mail: aa.akinjobi@ui.edu.ng

+234-805-733-1905

October 18, 2016

Department Information Studies,
University of Zululand,
South Africa,

Dear Owolabi,

**EDITING OF PHD THESIS: ACCESS AND USE OF CLINICAL INFORMATICS
AMONG MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN
NIGERIA AND SOUTH AFRICA**

This is to certify that the thesis titled "ACCESS AND USE OF CLINICAL INFORMATICS
AMONG MEDICAL DOCTORS IN SELECTED TEACHING HOSPITALS IN NIGERIA
AND SOUTH AFRICA" was edited by me. Errors relating to content, expression,
organisation, and mechanical accuracy were meticulously corrected. I strongly recommend
that the thesis be processed for examination.

Yours faithfully,

A handwritten signature in blue ink, appearing to read 'AAkinjobi'.

Adenike Akinjobi (Prof)