University of Ghana http://ugspace.ug.edu.gh

SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

USE OF SMART PHONE APPLICATIONS FOR CLINICAL DECISION MAKING AMONG JUNIOR MEDICAL PRACTITIONERS IN SELECTED HEALTH FACILITIES IN THE GREATER ACCRA REGION, GHANA

BY

KAFUI YAYRA SENYA

(10095887)

THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PUBLIC HEALTH DEGREE

NOVEMBER 2015

University of Ghana http://ugspace.ug.edu.gh

DEDICATION

This work is dedicated to my beautiful wife and best friend whose immense support has made this work possible.

University of Ghana http://ugspace.ug.edu.gh

ACKNOWLEDGEMENT

My deepest appreciation goes to my supervisor, Dr. Ibrahim Abdallah whose expert advice and guidance has played a very significant role in completing this work.

My friends and study group mates, who kept me going and in line when the going got tough I say a big thank you.

To the Greater Accra Regional Director of Health, heads of institutions where the study took place and all participants, I will eternally remain grateful.

To the Administrator and entire staff of the Ghana Health Service Ethical Review Committee, I appreciate your dedication to service.

To the Dean and all the lecturers of the School of Public Health, I appreciate you for impacting me with the knowledge that formed the basis for this work.

I thank my head pastor and mentor, Rev. Dr. Peter Sackey and the wife for their support.

The ultimate appreciation goes to God my creator without whom everything lacks meaning.

University of Ghana http://ugspace.ug.edu.gh

ABSTRACT

The health system in Ghana is fraught with many well documented challenges. Health service delivery is inefficient and unreliable in many respects, access to adequate and reliable health care personnel and services is limited and quality of service delivered at various health facilities continues to be problematic. Among factors hindering quality of service given to clients at health facilities are gaps in clinical decision making and information given to clients. There is evidence that smart phone technology for health is affordable and very applicable in low and middle income countries to help resolve the bottlenecks that hinder improved service delivery in the health sector.

This work explores the prevalence of the use of smart phone applications (apps) for clinical decision making among junior medical practitioners in selected health facilities in the Greater Accra Region of Ghana.

A total of sixty five junior medical practitioners were randomly selected and surveyed using a structured questionnaire which asked about ownership of smart phones and smart phone apps, frequency of use of apps, commonly used apps and factors influencing usage of apps.

The results show a universal ownership of smart phones among junior medical practitioners. Android phones were the most popular type of phone (70.7%) followed by apple i-Phone (16.9%), windows phone (4.6%), other smart phones (6.2%) and Blackberry phones (1.6%). All participants reported they used various smart phone apps for clinical decision making, with web access and drug reference apps being the most popular apps used for clinical decision making. Eighty eight percent (88%) of

University of Ghana http://ugspace.ug.edu.gh

respondents had third party medical related apps installed on their smart phones. The majority consider their knowledge of information technology as either moderate (52.3%) or high (44.6%), only 3.1% considered themselves to have low knowledge. When available, 64.2% of respondents would prefer to use their smart phone apps for clinical decision making rather than use a hardcopy protocol.

The study concludes that there is a very high prevalence of smart phones and smart phone apps ownership. The prevalence of usage of smart phone apps for clinical decision making among junior medical practitioners in the Greater Accra region of Ghana is also very high.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

TABLE OF CONTENTS

DECLARATION ii

DEDICATION iii

ACKNOWLEDGEMENT iv

ABSTRACT v

TABLE OF CONTENTS vii

LIST OF TABLES x

LIST OF FIGURES x

LIST OF ACRONYMS xi

CHAPTER ONE 1

1.0 Introduction 1

1.1 Background 1

1.2 Statement of the Problem 2

1.3 Justification 3

1.4 Objectives 5

1.5 Research Question 5

CHAPTER TWO - LITERATURE REVIEW 6

2.0 Introduction 6

2.1 Smart Phones and Smart Phone Applications 6

2.2 Ownership and Use of Smart Phones and Smart Phone Apps for Clinical Decision Making 7

2.3 Types of Smart Phone Apps 13

2.4 Conceptual Framework 15

2.5 Chapter Summary 18

University of Ghana http://ugspace.ug.edu.gh

CHAPTER THREE - METHODS 19

3.0 Introduction 19

3.1 Study Location..... 19

3.2 Sample Population 21

3.3 Sample Size Calculation 22

3.4 Variables 23

3.5 Data Collection Technique and Tool 25

3.6 Pretesting of Data Collection Tool and Quality Control 25

3.7 Statistical Analysis..... 26

3.8 Ethical Consideration / Issues 26

3.9 Chapter Summary 27

CHAPTER FOUR - RESULTS 28

4.0 Introduction 28

4.1 Demographic Characteristics of Participants 28

4.2 Ownership of Smart Phones and Medical Related Smart Phone Apps 31

4.3 Frequency of Utilization of Smart Phone Apps for Clinical Decision Making 32

4.4 Types of Apps used 33

4.5 Time (Duration) Spent Using Apps..... 37

4.6 Factors Affecting Utilization of Smart Phone Apps by Junior Doctors 38

4.7 Reliability of Internet Services..... 41

4.8 Usefulness of Smart Phone Apps 42

4.9 Respondents' General Comments 43

4.10 Chapter Summary 44

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE - DISCUSION OF FINDINGS 45

5.0 Introduction 45

5.1 Ownership of Smart Phones and Smart Phone Apps..... 45

5.2 Frequency of Utilization of Smart Phone Apps for Clinical Decision Making 46

5.3 Factors Influencing Utilization of Smart Phone Apps by Junior Doctors 49

5.4 Chapter Summary 50

CHAPTER SIX - CONCLUSION AND RECOMMENDATION 52

6.0 Introduction 52

6.1 Conclusions 52

6.2 Recommendations..... 53

6.3 Limitations of the Study..... 53

REFRENCES 55

APPENDICES..... 60

Consent Form 60

Participants Questionnaire 63

Ethical Approval from GHS-ERC..... 74

Ethical Approval for Amendment to protocol from GHS-ERC 76

Letter of Introduction from School of Public Health 78

Permission Letter to Regional Director of Health Services, Greater Accra 79

Letter of Approval for Study from the Regional Director of Health Services, Greater Accra..... 80

University of Ghana http://ugspace.ug.edu.gh

LIST OF TABLES

Table 3.1: Explanation of some key variables used in the study 24

Table 4.1: Demographic characteristics of participants 30

Table 4.2: Ownership of smart phones and medical related smart phone apps 32

Table 4.3: Junior doctor's perception of factors related use of smart phone apps for clinical decision making 40

LIST OF FIGURES

Figure 2.1 Conceptual framework of prevalence of smart phone use among junior medical practitioners..... 15

Figure 4.1 Frequency of Utilization of Smart Phone Apps for Clinical Decision Making 33

Figure 4.2: Percentage frequency of use of types of smart phone apps by junior doctors 36

Figure 4.3: Time junior doctors spend in a day using their smart phone apps for clinical activities 37

Figure 4.4: Junior doctor perception of their own level of ICT knowledge 39

Figure 4.5: Reliability of internet services for smart phone use by junior doctors 42

Figure 4.6: Percentage frequency of usefulness of smart phone apps for clinical decision making among junior doctors..... 43

University of Ghana http://ugspace.ug.edu.gh

LIST OF ACRONYMS

ACGME: Accreditation Council for Graduate Medical Education

E-Health: Electronic Health

GHS-ERC: Ghana Health Service-Ethical Review Committee

HEWs: Health Extension Workers

ICT: Information communication and technology

IT: Information Technology

LEKMA: Ledzokuku Krowor Municipal Assembly

LMIC: Low and Middles Income Countries

M-Health: Mobile Health

mLearning: Mobile Learning

MOTECH: Mobile Technology for Community Health

NGOs: Nongovernmental Organizations

PPH: Postpartum Hemorrhage

PubMed4Hh: PubMed for Handhelds

SMS: Short Message Service

UK: United Kingdom

University of Ghana http://ugspace.ug.edu.gh

USA: United States of America

WHO: World Health Organization

University of Ghana http://ugspace.ug.edu.gh

CHAPTER ONE

1.0 Introduction

The introductory chapter gives a detailed background for the research study. The problem statement the study addressed is presented and the justification for the study is given. The objectives and research question is also presented in this chapter.

1.1 Background

The World's first smart phone, which is believed to be IBM's Simon, went on sale to the public on 16 August 1994 (BBC News, 2014). It was the first device to combine mobile phone technology with a wide range of computing features. However what is now termed the smart phone revolution can be traced back to the launch of Apple's I-Phone in June 2007. This was followed by Google's launch of the Android-powered smart phone, the "G1" also known as 'Dream' in 2008 (Kent, 2011). These devices were originally manufactured for the business clientele and enterprises to enable them to have access to their desk on the go (BBC News, 2014). At that time few would have imagined smart phones ever playing a significant role in medicine and healthcare delivery. Yet smart phones are fast becoming essential tools in virtually every field of medicine today.

Smart phone use in medicine, commonly termed M-Health (Mobile-Health) has in recent time become very popular (Sidlow et al., 2014). It's use in medicine range from communication among health service providers to capturing of clients' health data. It is also being used to process and utilize vital health information on the go, as well as viewing of radiological information for emergency decision making among many

University of Ghana http://ugspace.ug.edu.gh

others (Andreatta, Debpuur, Danquah, & Perosky, 2011; Takao, Murayama, Ishibashi, & Karagiozov, 2012; Wu et al., 2011).

Perhaps one of the best applications of smart phones in medicine is its ability to enable healthcare providers to have valuable evidence based information at the point of care where it is most needed for clinical decision making (Mosa, Yoo, & Sheets, 2012). Though hitherto inaccessible, healthcare providers can now access entire text books, drug formulary, medical calculators, etc. from their smart phones (Payne, Wharrad, & Watts, 2012). This has the potential to improve accuracy of clinical decisions and reduce medical errors (Brodie-Mends, 2012).

Unlike other technology, the smart phone technology is such that it can be effectively used to solve health problems in resource constrained environments such as Ghana and similar other low-middle income countries (Goldbach et al., 2014; Vital Wave Consulting, 2009)

1.2 Statement of the Problem

In Ghana, the population-to-nurse ratio as at 2011 was 1,240: 1 and the population-to-doctor ratio 10,032:1 (Ghana Health Service, 2011). Most Ghanaians do not still have access to adequate and reliable health care personnel and services. Also quality of service delivered at various health facilities continues to be problematic (Ghana Health Service, 2011; Turkson, 2009). Among factors hindering quality of service given to clients at health facilities are gaps in clinical decision making and information given to clients (Oduro-Mensah et al., 2013).

University of Ghana http://ugspace.ug.edu.gh

There is research evidence to support the inclination of medical practitioners in Ghana to make use of guidelines and protocols where they are available in portable and easily accessible formats, such as the smart phone app, to enhance clinical decision making (Oduro-Mensah et al., 2013).

However, there is dearth of research in Ghana that explores the potential use of technological devices such as smart phones to influence clinical decision making among medical doctors.

The purpose of this study therefore is to assess if junior medical doctors in selected health facilities in the Greater Accra Region of Ghana make use of smart phones in clinical decision making and to explore the factors that influences the use or otherwise of smart phones apps for clinical decision making.

The findings from this study will inform policy formulation for the application of information communication and technology (ICT) to solve health problems and thereby improve health service delivery. It shall also form the foundation for future research work in this novel and interesting arena of health.

1.3 Justification

The potential that smart phone technology has for solving challenges in health service delivery is enormous (O'Connor et al., 2014). Medical Doctors can have entire medical text books, management protocols, drug references, medical calculators and much more in their palm for quick and easy referencing whenever they need it. Communication between clinicians is moved to an entirely new level where even videos and images can be shared instantly among closed groups of clinicians and within minute's diverse

University of Ghana http://ugspace.ug.edu.gh

levels of experience, expertise and knowledge is harnessed to ensure the patient gets the best available clinical care. Medical errors and litigation can significantly be reduced by use of this technology (Mosa et al., 2012). This technology is very affordable and has been proven to be very applicable in resource constrained settings such us Ghana (Goldbach et al., 2014). In fact, the potential benefits of using smart phone technology for clinical decision making can be a lot more than discussed earlier.

There are however, some potential disadvantages as far as using smart-phone apps for clinical decision making. Among these include the risk for abuse of patients' rights and wrong application of the technology which can lead to harm rather that restoration of health (Westbrook, Woods, Rob, Dunsmuir, & Day, 2010). There is hence the need for extensive research into the complete potential for use of smart-phone apps for clinical decision making.

Research into the use of smart-phone apps for clinical decision making in low-middle income countries (LMIC) is very limited. In Ghana, there is no known study that has explored the potential of smart phone apps for clinical decision making. The few known studies available are pilot projects that are experimental in nature and has been on very small scale (Ofosu, 2010). This study is potentially a pioneering research that explored this hitherto unexplored area of medicine in Ghana's health system. It laid the foundation for future research into this field, yet at the same time providing very relevant information to guide policy decisions for the ministry of health and all other stakeholders in health. Smart phone app developers, telecommunication industry, manufactures of smart phones will also find the results helpful in guiding the

University of Ghana http://ugspace.ug.edu.gh

development of apps for the health sector. Perhaps the smart phone use in medicine is indeed the future stethoscope in clinical decision making (Ofosu, 2010)

1.4 Objectives

1.4.1 General Objective

To explore the prevalence of the use of smart phone apps for clinical decision making among junior medical practitioners in selected health facilities in the Greater Accra Region of Ghana.

1.4.2 Specific Objectives

1. To determine the proportion of junior medical practitioners who own smart phones in selected health facilities in the Greater Accra Region of Ghana.
2. To determine the frequency of smart phone apps usage by junior medical practitioners for clinical decision making in selected health facilities in the Greater Accra Region of Ghana.
3. To identify smart phone apps that are commonly used by Junior Medical practitioners for clinical decision making in selected health facilities in the Greater Accra Region of Ghana.
4. To identify the factors that influences the use of smart phone apps for clinical decision making among junior medical practitioners in selected health facilities in the Greater Accra Region of Ghana.

1.5 Research Question

Are Smart phone apps being used frequently for clinical decision making among junior medical practitioners?

University of Ghana http://ugspace.ug.edu.gh

CHAPTER TWO - LITERATURE REVIEW

2.0 Introduction

This chapter begins with a definition of key concepts of the smart phone technology and then presents current literature on use of smart phone in health before concluding with a classification of smart phone apps.

2.1 Smart Phones and Smart Phone Applications

A smart phone is a hand-held mobile device that performs many of the functions of a computer, typically having a touch screen interface, internet access, and an operating system capable of running downloaded apps (Oxford Dictionary, 2014)

The four major smart phone operating systems are Apple's i-Phone (iOS), Google's Android, Microsoft's Windows Phone and BlackBerry produced by Blackberry Ltd. (Gartner Group, 2014).

A smart phone application (commonly called app) is the software that gives life to the smart phone hardware and there are hundreds of thousands of these smart phone apps (PCMagazine, 2104). All smart phones are sold with some set of factory installed apps which vary based on the manufacturer. A smart phone user can also download additional apps from third party app developers or vendors at the apps store, a virtual market on the internet where both free and paid for smart phone apps can be downloaded.

A medical related smart phone app as used in this study refers to smart phone apps developed specifically for use by medical professionals in the course of their duties. It is however important to note that the use of smart phone apps for clinical activities by

University of Ghana http://ugspace.ug.edu.gh

health care professionals is not limited to only the medical related smart phone apps (Bruno, 2015; Meera, 2015). Many smart phone apps which are not primarily developed for the specific use of medical professionals can be used for clinical related activities (Bruno, 2015; Meera, 2015). This study was thus not restricted to ownership and use of only medical related smart phone apps. All smart phone apps that can be used for clinical decision making were included in the study. However, the ownership of medical related smart phone apps among the participants was measured and discussed as part of the study.

2.2 Ownership and Use of Smart Phones and Smart Phone Apps for Clinical Decision Making

In a 2010 study at the Korle Bu Teaching Hospital, in Accra Ghana, the trend of usage of Personal Digital Assistants (PDAs) and smart phones amongst medical students and house officers was investigated in which the terms PDA and smartphones were used interchangeably (Brodie-Mends, 2012). Brodie-Mends (2012) used a cross-sectional study with a total sample of 103 participants, including 67 medical students and 36 house officers. The study found that 65.7% of medical students and 72.2% of house officers in KBTH owned PDAs or smartphones. More than 40% of medicals students and 42.3% of house officers used their PDAs for clinical related activities. Brodie-Mends (2012) found that 69.2% of house officers and 15.9% of medical students indicated that their use of PDAs influenced their clinical decision making and PDAs helped them avoid drug interactions when prescribing for patients.

The interchangeable use of the terms PDAs and smart phone in this study makes it difficult to apply the results to only smart phone usage as it exist today. Since the two

University of Ghana http://ugspace.ug.edu.gh

devices are significantly different it would have been useful to separate the data on each of the two devices in that study. Additionally, since the study population was limited to only one major hospital in Ghana, the data from the study may not be generalizable to the entire medical population who use PDA/smart phones in Ghana.

In a cross-sectional study, Payne et al (2012) explored the extent to which junior doctors and medical students own smart phones and use them to enhance their clinical activities in the United Kingdom (UK). It was found that 72.4% of junior doctors use medical apps during clinical activities. Smart phone apps that increased efficiency by saving time and allowed rapid 'mobile' decision making were preferred by the study sample (Payne et al., 2012).

In the United States of America, a similar study was done to evaluate the use of smart phones and smart phone apps among Accreditation Council for Graduate Medical Education (ACGME) practitioners (Franko & Tirrell, 2012). Franko and Tirrell (2012) found that more than 85% of the respondents used a smart phone, of which the i-Phone was the most popular (56%). Another 56% of the respondents reported using apps in their clinical practice. The most commonly used type of apps in the study were drug guides (79%), medical calculators (18%), coding and billing apps (4%) and pregnancy wheels (4%). Franko and Tirrell (2012) concluded that the clinical use of smart phones and apps was likely continue to increase. They also demonstrated an absence of high-quality and popular apps despite a strong desire among physicians and trainees.

Although very limited studies seem to have been done in Africa regarding the use of smart phone apps for clinical decision making, there was a study done in Botswana that

University of Ghana http://ugspace.ug.edu.gh

evaluated a smart phone-based mLearning (Mobile Learning) tool (Chang et al., 2012). It was found that smart phones loaded with point-of-care tools were effectively utilized by resident physicians in resource-limited settings both for accessing point-of-care medical information at the bedside and for self-directed learning at home (Chang et al., 2012). They also found that users required only a short period of time to learn how to use the smart phone and search for information.

Since Chang et al.'s (2012) work evaluated only medical residents who had been trained and provided with smart phones for the sole purpose of testing the pre-loaded mLearning tool, the results may not be generalized to medical practitioners who use personal mobile phones and apps for clinical decision making.

In a two-arm comparative study with crossover design conducted among resident physicians at the University of Botswana, the performance of resident physicians in answering eight multi-part clinical scenarios using PubMed abstracts accessed via the PubMed for Handhelds (PubMed4Hh) website versus medical/drug reference applications (Medical Apps) accessed via software on the mobile phone were compared (Goldbach et al., 2014). The study found that mobile apps with condensed content might be more appropriate for point-of-care information needs of physicians as compared to accessing point of care information from a website. While this study does show that physicians preferred the use of condensed material provided by smart phone apps, it did not explore the use of residents' personal smart phone.

University of Ghana http://ugspace.ug.edu.gh

In another study conducted in northern Ethiopia, twenty eight health extension workers (HEWs) and twelve midwives were provided with smart phones installed with locally developed apps (Little, Medhanyie, & Blanco, 2014).

Using an observational research design the participants were followed up for eighteen months. The study found that HEW and midwifes made good use of smart phones for maternal care. It also found that the mobile internet connection, although not fast, was found to be reliable, even in rural and quite remote areas (Little *et al.*, 2014).

In Ghana, the Government of Ghana through the Ministry of Health and Ghana Health Service have since 2003 been promoting ICT use for solving health problems (Afagbedzi, Obuobi, Aryeetey, & Bosomprah, 2013). There are policy statements stating clearly the government's intention to explore the use of ICT in the health sector (Ministry of Health, 2005; Republic of Ghana, 2003). However, besides few pilot projects, there is very limited information on the application of smart phone technology in medical practice in Ghana. In May 2013, Ghana Health Service launched the e-health project, a web based application aimed at providing the public with an avenue through which they could seek health information and gain access to medical practitioner and specialist consultation by just logging in to the website. The e-health project however, in a recent evaluation has been found to be fraught with many challenges that hinder its success (Bedeley & Palvia, 2014). This study was conducted by using both qualitative and quantitative methods to collect data from multiple perspectives of both health service providers and consumers. The top five challenges identified included issues related to: lack of ICT infrastructure; lack of basic ICT knowledge/skills; internet (accessibility & reliability); financial and sustainability issues, and privacy and/or

University of Ghana http://ugspace.ug.edu.gh

security of electronic record (Bedeley & Palvia, 2014). While some difference may exist, the results show great similarity between the views of providers and consumers of the new e-health system. As mentioned earlier, the use of smart phone technology by medical practitioners has the potential to overcome some of these challenges identified by Bedeley and Palvia (2014).

One situational analysis of mobile phone technology use in Ghana, suggests that the mobile phone could become as important as the stethoscope in the future (Ofosu, 2010). The study analyzed the various pilot projects being undertaken by various nongovernmental organizations (NGOs), under the auspices of the Ghana Health Service as at 2010.

The Mobile Technology for Community Health (MOTECH) pilot is one such project analyzed by Ofosu (2010). MOTECH is a Ghana Health Service supported programme consisting of two interrelated mobile health services:

The first is a "Mobile Midwife" application, which is a service that enables pregnant women and their families to receive Short Message Service (SMS) or voice messages that give essential information about their pregnancy weekly in their own language. The second application termed "Nurses Application" helps Community Health Workers to record and track the care delivered to women and newborns in their area (Wood et al., 2012). MOTECH is studying whether the use of mobile phone technology can help solve health service problems by significantly easing the utilization of information for health care providers, thus improving their efficiency and effectiveness. It seeks to test the promise of mobile phone use for transforming routine health information

University of Ghana http://ugspace.ug.edu.gh

operations. The Initiative has piloted in the Kassena-Nankana and Kassena-Nankana West Districts of the Upper East Region of Ghana (Wood et al., 2012).

The Builsa and the Bongo districts of the same region serve as control zones. Each rural health facility in the programme area is supplied with mobile phones on which the MOTECH Java application for health workers is installed. Nurses are required to input information about their clients' clinic visits into applications on the mobile phone and send this to servers at MOTECH head office. The MOTECH system analyses the data and sends a reminder message to patients who may have missed a scheduled appointment. The healthcare worker is also notified of patients who are overdue so they can follow up to reduce defaulter rates. The data is also used to generate some of the essential monthly reports that the facilities are required to submit to their district and regional health management teams. Wood et al., (2012) observed that this has significantly reduced the health workers workload. The MOTECH Nurses' Application also enables staff check the database , and retrieve lists of patients overdue for care, those due to deliver soon and such similar details (Wood et al., 2012).

In another work by Andreatta *et al*. (2011) ten birth attendants selected from the remote Sene District, in the Brong Ahafo region of Ghana participated in a study to evaluate the use of cell phones by birth attendants for reporting postpartum hemorrhage (PPH) data. The birth attendants were trained to send SMS text messages over a 90-day period from cell phones using a simple numeric protocol to report data on PPH, such as maternal age; use of bimanual uterine compression; maternal and neonatal mortality; and prenatal care. The results showed that both professional and traditional birth attendants can be trained to use cell phones to report health-related information which

University of Ghana http://ugspace.ug.edu.gh

may be a more accurate picture of what actually occurs since the reporting is in real time (Andreatta *et al*., 2011).

According to Oduro-Mensah *et al.*(2013) "the advent of smart phones makes a future link between mobile phone ownership and internet access and use in supporting decision making a definite possibility". They also suggest that the universal ownership of mobile phones by healthcare workers in their study area makes the use of mobile phone technology to support point of care decision making very possible. But as discussed earlier, there is very little research work exploring this possibility of smart phone use among doctors in Ghana and sub-Saharan Africa.

2.3 Types of Smart Phone Apps

There are numerous smart phone apps available for use in medical practice (DeCelles-Zwerneman, 2014; Mosa et al., 2012). The classification of smart phone apps used in medical practice differ from one expert to the other, and there is currently no universally accepted standard classification of smart phone apps used in medical practice.

For the purpose of this study, smart phone apps used for clinical decision making were grouped into six categories. The categories were created based on the classification of DeCelles-Zwerneman (2014) model and the author's own knowledge. Some further modification of the classification was done after pre-testing of the study questionnaire to arrive at the six categories described below.

1. Web Access Applications

This refers to smart phone apps that enable the doctor to access the internet for information to help them make clinical decisions. These include apps such as "Google

University of Ghana http://ugspace.ug.edu.gh

chrome", "opera mini", "internet" and "safari". These apps are not necessarily developed as medical apps (medical related apps) but can be used to access websites for essential medical information to aid clinical decision making.

2. Social Media Apps

These are smart phone apps that enhance communication among doctors. It includes apps such as "Whatsapp Messenger", "Twitter", "Facebook" and "Instagram". Some of these categories of apps such as "Doximity", "DocbookMD" and "OnPage" have been developed specifically for medical practitioners and have in built features to ensure secure transfer of information and protect patient privacy (DeCelles-Zwerneman, 2014). For example, a junior medical officer who comes across an unfamiliar skin condition of a patient can take a photograph of the skin condition and send it to a senior colleague for assistance in making a diagnoses using Whatsapp Messenger or Instagram (Meera, 2015).

3. Disease Diagnoses and Management Apps

These are smart phone applications that are developed and used as reference material for disease diagnoses and management. They include apps such as "Medscape", "Epocrates", "UpToDate" and "Isabel".

4. Drug Reference or Medication Formulary Apps

These are those smart phone apps used by doctors to cross check drug dosage, side effects, drug interactions and other relevant information on drugs and medications. These groups of apps are often incorporated as part of apps such as "Medscape" and "Epocrates".

University of Ghana http://ugspace.ug.edu.gh

5. Calculator and Clinical Score Apps

These groups of smart phone applications are used to calculate clinical scores such as coma scales, gestational age of pregnancy, basic metabolic rate and even staging of malignancies. They include e.g. "BMI calculator, "pregnancy wheel" and "GCS calculator". It also includes use of the factory installed calculator of a smart phone for clinical purposes.

6. Procedure Documentation Apps

This refers to smart phone apps that aid documentation of clinical procedures such as typing of clinical notes, making videos or pictures of a procedure and medical data collection and processing functions. Amongst such apps are "Medical Records", "onPatient", "myMedical" and "mMR". The use of the factory installed video and camera apps to document clinical procedures were also included in this category.

2.4 Conceptual Framework

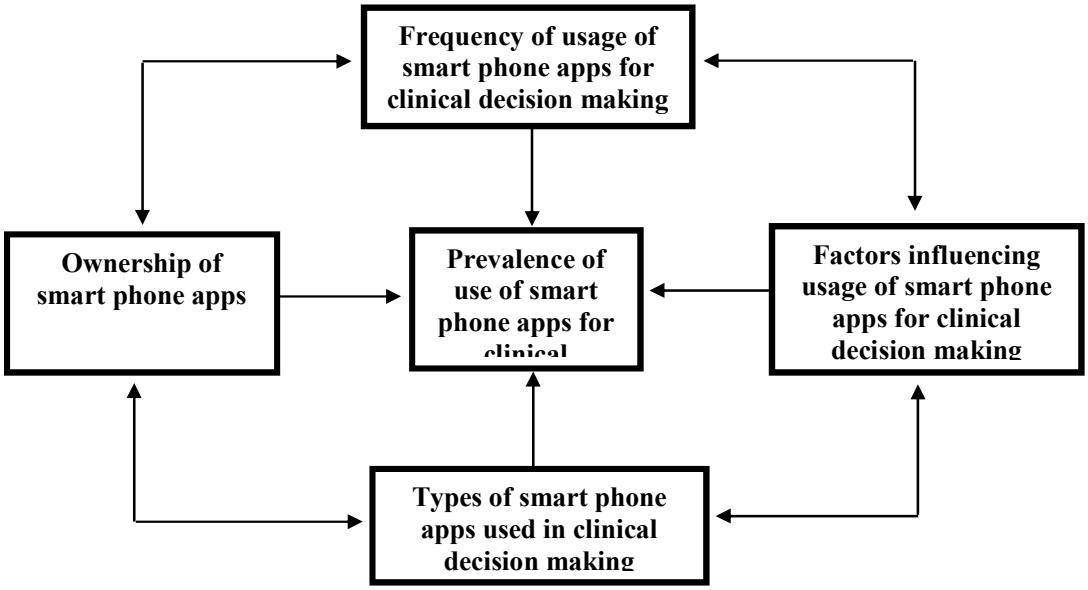

Figure 2.1 Conceptual framework of prevalence of smart phone use among junior medical practitioners

University of Ghana http://ugspace.ug.edu.gh

A junior medical practitioner must first own a smart phone and have apps that can be used for clinical decision making installed on the phone before he or she can use it for clinical decision making.

Various factors may influence the use of smart phone apps by junior medical practitioners for clinical decision making. The possible effects of these factors are described below:

1. Technological (ICT) Knowledge of Practitioner

The level of knowledge that a practitioner has in the use of smart phones and smart phone apps is likely to influence whether or not he or she makes use of a smart phone app when uncertain about a clinical condition. One who is conversant with the use of a smart phone and the apps installed on the phone is more likely to make use of it compared to one who is not.

2. Hard Copy Guidelines and Protocols

The availability of materials and literature to aid clinical decision making such as hard copy guidelines and protocols could also influence the decision of a clinician to turn to his or her smart phone to facilitate the clinical decision process. Factors of reliability and accuracy of information as well as suitability of the information for the settings in which one is working will come to play in which source of information one chooses to use where different options are available.

3. Availability of appropriate Apps

Clinical medicine is a broad field that is influenced by diverse factors and yet the principles are generally the same. However, the applications of medical principles in

University of Ghana http://ugspace.ug.edu.gh

the developed world are mostly different from the developing world. Constraints of resources often require adaption of protocols and standards across different settings. Thus smart phone applications designed for the developed world may in some situations not be appropriate for direct use in the developing world. Thus the availability of suitable smart phone apps for a particular clinical setting is expected to influence the use of smart phones and smart phone apps for clinical decision making.

4. Availability of Internet Services

Smart phones and smart phone apps are heavily dependent on internet availability. Even those that can be used offline need to be regularly updated via the internet to ensure that they have up to date information and functionality. The availability of a reliable internet service thus influences the ownership and use of smart phones and by implication their use for clinical decision making.

5. Cost Implications

Smart phones are rather expensive devices, and the cost of applications where they are not free can also be high, there is also the cost of internet service bundles. There are hence cost implications that influence the ownership and hence use of smart phone apps by a clinician for clinical decision making.

6. Clients Perception

A study in the United Kingdom found that clinicians were in some situations hesitant to take out their smart phone for clinical use due to their fear that the client may misinterpret that action as the physician playing on their phone, checking mails or using

University of Ghana http://ugspace.ug.edu.gh

social media rather than giving the patient full attention (Ak-kee & Khan, 2014; Payne et al., 2012).

7. Place of Work

The particular hospital and department in which a junior medical practitioner is working may also have some influence on whether or not a smart phone app is used to aid clinical decision making. Facilities where senior colleagues, supervisors and institutional policy encourage the use of such devices in clinical work is more likely to have higher prevalence of use compared to facilities that discourage use of technological devices in clinical work.

2.5 Chapter Summary

There is extensive literature that suggest the use of smart phone and smart phone applications for clinical decision making can help improve the health delivery system in a resource constrained setting such as in Ghana. There is however a gap in the literature on the use of this technology among medical practitioners for clinical decision making.

The next chapter reviews the methodology used in the study to help bridge this gap in the literature.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER THREE - METHODS

3.0 Introduction

This chapter explains the methods used in conducting the study, the study population and locations are first described. Then the sampling procedure is explained, giving details of sample size determination. The pretesting and data collection methods are next described followed by a detailed description data processing techniques and statistical analysis that were used. The key variables measured are described and the chapter ends with description of ethical issues considered during the study.

3.1 Study Location

The study was conducted at Ridge Regional Hospital, La General Hospital, Ledzokuku Krowor Municipal Assembly (LEKMA) Hospital and the University of Ghana Hospital, all in the Greater Accra Region of Ghana.

The Greater Accra Region encompass the capital city of Ghana, Accra and its environs. Almost fifty percent of the nation's health personnel are believed to be working in the Greater Accra Region (Bruce, 2014).

The University of Ghana hospital and the Ridge hospitals are located in the Accra Metropolitan Area, an urban metropolitan area with a population of 1,695,136 million people in the 2000 national population census (Ministry of Local Government and Rural Development, 2006). The La General hospital is located in the La Dede-Kotopon Municipality, one of the new districts created in 2012. It is one of the most southern districts in Ghana and consist of a mix of urban and semi urban communities. Ledzokuku Krowor Municipal Assembly (LEKMA) Hospital is the district hospital

University of Ghana http://ugspace.ug.edu.gh

serving the populace of the Ledzokuku Krowor Municipality, with a population of about 216, 517.(Ministry of Local Government and Rural Development, 2006)

The selected health facilities are secondary level public owned facilities accredited by the Ghana Medical and Dental Council to employ junior medical practitioners. By the laws of Ghana only health institutions accredited by the medical and dental council can employ junior medical practitioners (Ghana Medical and Dental Council, 2012). The selected facilities provide a broad range of health services, including pediatrics, internal medicine, surgery, obstetrics and gynecology and dental services. In addition they provide public health services such as reproductive health and immunization.

The University of Ghana Hospital is managed by the University of Ghana Health Services Directorate whiles, the other three are under the management of the Ghana Health Service.

3.1.1 Study Population

For the purpose of this study, Junior Medical practitioners, who form the population of this study, consist of first and second year house officers practicing in the Greater Accra Region of Ghana. In all 146 junior medical officers formed the study population. They are fully qualified medical and dental doctors who are undergoing a mandatory two year rotation in four selected specialties under close supervision of senior medical consultants and specialists, with each rotation lasting for a period of six months. It is assumed that this group of practitioners being younger are more likely to be information technology (IT) savvy and hence, are more likely to use smart phones than their senior counterparts (Payne et al., 2012).

University of Ghana http://ugspace.ug.edu.gh

Since the study requires a participant to have some level of experience in making clinical decisions as a medical practitioner, the study only selected junior medical practitioners who had completed at least, one of the mandatory six month rotations.

3.1.2 Health Facilities

The list of all health facilities accredited by the Medical and Dental Council of Ghana to employ junior medical doctors (house officers) in the Greater Accra Region of Ghana was obtained from the secretariat of the council. After initial enquiries at the various facilities, the Korle Bu Teaching Hospital was excluded from the study because as at the time of data collection junior medical practitioners who were at post had not completed at least their first rotation of six months and hence did not meet the entry requirements for the study. The names of the seven remaining health facilities, LA General Hospital, LEKMA Hospital, Princess Louise Memorial Children's Hospital, Ridge Hospital, Tema General Hospital, 37 Military Hospital and University of Ghana Hospital, were then written in alphabetical order and assigned numbers. Computer software (Microsoft Excel) was used to randomly select five facilities namely, Ridge Regional Hospital, La General Hospital, LEKMA Hospital, Thirty-Seven Military Hospital and the University of Ghana Hospital. From the five selected, the 37 Military Hospital was then randomly selected for pre-testing of the questionnaires leaving four facilities for the actual study. The study was limited to the four facilities due to time and logistical constraints.

3.2 Sample Population

The entire list of house officers who had completed at least one rotation of six months in each of the four randomly selected hospitals was obtained from the human resource

University of Ghana http://ugspace.ug.edu.gh

department of the hospitals. Each list was then arranged in alphabetical order where not already so, and assigned a unique number. Computer software (Microsoft Excel) was then used to randomly generate the sample population from the list of each hospital using a sampling fraction of 0.45 (65/146). The list of selected participants was then compiled and they were contacted at their hospitals mostly during clinical meetings to complete the questionnaire. Very few of the selected participants were unavailable, or for some reason unable to participate in the study, hence there was no need to replace such persons.

3.3 Sample Size Calculation

The minimum sample size required for this study was 50. The sample size was calculated using the Piface computer software (Lenth, 2006). The sample size was determined using the following assumptions:

$P_0 = 0.72$

$P = 0.54$

$\alpha = 0.05$

Power=0.8

Where P_0 is the hypothesized proportion/probability obtained from literature (Payne *et al.*, 2012)

P is the expected actual proportion/probability

α is the level of significance

University of Ghana http://ugspace.ug.edu.gh

A non-response rate of 23% was factored into the sample size to obtain a total sample size of sixty five participants (65). The nonresponse rate of 23% was based on the results of a study conducted in a hospital setting among junior doctors in Ghana (Darkwa, 2000).

3.4 Variables

Table 3.1 below describes some of the key variables that were explored in the study. It shows the categories of the variables, their definition and how they were measured.

University of Ghana http://ugspace.ug.edu.gh

Table 3.1: Explanation of some key variables used in the study

Variable	Working Definition	Scale of Measurement
Dependent		
Use of apps for clinical decision making	How frequently a respondent uses apps on his or her smart phone to aid clinical decision making	Categorical Very Frequently Frequently Occasionally Rarely Never
Independent		
Ownership of smart Phones	Does a respondent own a smart phone	Binary Yes No
Usefulness of apps	Doctor's perception of how useful smart phone apps are at work for clinical decision making	Categorical Always Very Often Sometimes Rarely Never
Client Perception	Effect of a patients perception of the doctor's use of smart phone during consultation on the doctor's decision to use the smart phone to aid clinical decision making	Binary Yes No
Cost	Affordability of internet service for smart phone to the junior doctor	Binary Yes No
ICT Knowledge	Respondents rating of their level of knowledge of ICT	Categorical High Moderate Low None
Internet Access	Reliability of internet service when smart phone is being used for clinical activities	Categorical Always Very Often Sometimes Rarely Never
Hard copy protocol	Preferred source of information to aid clinical decision making when both hard copy protocols and smart phone apps are available	Binary Yes No
Hospital	The hospital in which the doctor is currently working	Categorical Ridge Hospital LEKMA University Hospital LA General

University of Ghana http://ugspace.ug.edu.gh

Department	The department in which the doctor is currently working	Categorical Medicine Surgery Obstetrics/Gynecology Child Health Dental Rotation
Suitability of Apps	The doctor's perception of how suitable apps available to him are for clinical decision making	Binary Yes No

3.5 Data Collection Technique and Tool

The study is a cross sectional survey using a structured questionnaire (see appendix) with thirty three closed and one open-ended questions. The questionnaire was designed using information from literature and personal knowledge of the researcher. All questions were coded appropriately for data analysis. The questionnaire was administered to sixty nine randomly selected participants at their work place by the researcher over a period of three weeks in June 2015. Participants after reviewing and signing the voluntary consent forms were allowed to complete questionnaire themselves and mostly returned them immediately. A few however, took the questionnaires home to complete and returned them the next day.

3.6 Pretesting of Data Collection Tool and Quality Control

The questionnaire was pre-tested for content validity and reliability at the 37 Military Hospital in May 2015. The questionnaire was administered to ten junior medical officers selected by convenience sampling at the hostel facility of the junior medical doctors. Some modifications were made following the pre-testing, before final printing of questionnaires.

University of Ghana http://ugspace.ug.edu.gh

All items in the questionnaire were verified for completeness and clarity of response after collection from respondents. Data collected from the questionnaire were then entered into Microsoft Excel using the pre-defined code and verified for accuracy and consistency before importing into Stata version 12 for analysis (StataCorp.,2011). Some further data verification was done in Stata before actual analysis began.

3.7 Statistical Analysis

Stata version 12 (StataCorp., 2011) was used to analyze the data, relevant summary statistics such as proportions were obtained and the data displayed using tables and graphs as may be appropriate. Chi Square goodness of fit test was used to test for the significance of proportions observed in the study (UCLA: Statistical Consulting Group, 2014). Relationships between the observed variables were analyzed for significance using the chi squared test or fisher's exact test as may be appropriate (UCLA: Statistical Consulting Group, 2014).

3.8 Ethical Consideration / Issues

Ethical clearance was obtained from the Ethics Review Committee of the Ghana Health Service, through the School of Graduate Studies, University of Ghana (see appendix). Institutional approval was also obtained from the administration of the selected hospitals through the Greater Accra Regional Health Directorate as appropriate (see appendix). Since the study subjects were highly educated junior medical practitioners who were able to read and understand the contents of the consent form, they were allowed to read, and asked for any clarification that might be required before appending their signature. Except for minimal interruption of their work and private schedule, there was no risk of the study to the participants. There was no compensation /

University of Ghana http://ugspace.ug.edu.gh

payments to participants. However, they were informed that the knowledge obtained from the study might enhance the overall good of society. Privacy and confidentiality of all participants was ensured by secure storage of questionnaire and data throughout and beyond the study. The researcher had no conflict of interest issues and not funded by any agency.

3.9 Chapter Summary

The study was a quantitative study using a cross sectional study design. This study design was appropriate for achieving the objectives of the study as explained in this chapter. Ethical considerations have been appropriately addressed.

In the next chapter the results obtained using the methods described are presented.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FOUR - RESULTS

4.0 Introduction

In this chapter the summary statistics of the study are presented with the aid of tables, bar graphs and pie charts. The results are presented under sub themes such as demographic characteristics of participants, ownership of smart phones and medical related smart phone apps, frequency of utilization of smart phone apps for clinical decision making and factors affecting utilization of smart phone apps by junior doctors.

4.1 Demographic Characteristics of Participants

Table 4.1 below shows the demographic characteristics of participants. The participants consisted of 58.5% males (n=38) and 41.5% females (n=27).

Of the 65 participants three failed to state their age, the mean age was thus calculated with a sample size of 62 to give a mean age of 27.6 ± 2.2 years.

Majority of participants were single, 83.1% (n=54); while 15.4% (n=10) were married and one person was cohabiting (1.5%)

Seven respondents were foreign nationals. Of that five were Nigerians, one Liberian and another, a national of France. The remaining respondents were Ghanaians

The respondents were proportionately distributed among the four selected health facilities based on their junior doctor populations. Respondents working at La General Hospital were 15.4% (n=10), LEKMA Hospital 29.2% (n=19), Legon Hospital 26.2% (n=17) and Ridge hospital 29.2% (n=19).

University of Ghana http://ugspace.ug.edu.gh

There were respondents from all five major disciplines of housemanship training in Ghana. The Department of Obstetrics and Gynecology had the most representation, with 29.2% (n=19) of the sample working in that department. The department of Dentistry was the least represented forming only 3.1% (n=2) of the sample.

The majority of respondents were second year house officers 84.6% (n=55)

University of Ghana http://ugspace.ug.edu.gh

Table 4.1: Demographic characteristics of participants

Characteristics(N=65)	Number (%)
Gender	
Male	38 (58.5)
Females	27 (41.5)
Mean Age + SD	27.6 ± 2.2
Marital Status	
Single	54(83.2)
Married	10(15.4)
Cohabitation	1(1.5)
Nationality	
Ghanaian	58(89.2)
Foreign National	7(10.8)
Facility	
La General Hospital	10(15.4)
LEKMA Hospital	19(29.2)
University Hospital	17(26.2)
Ridge Hospital	19(29.2)
Position	
1st Year	10(15.4)
2nd Year	55(84.6)
Department	
Internal Medicine	18(27.7)
Surgery	12(18.5)
Obstetrics and Gynecology	19(29.2)
Child Health	14(21.5)
Dental Rotation	2(3.1)

University of Ghana http://ugspace.ug.edu.gh

4.2 Ownership of Smart Phones and Medical Related Smart Phone Apps

All 65 respondents (100%) reported that they owned a smart phone. Of that 70.8% (n=46) had a Google Android phone, 16.9% (n=11) owned an apple i-Phone, 4.6% (n=3) owned a Microsoft windows phone and only 1.54% (n=1) owned a Blackberry smart phone. Among all the respondents, 6.2% (n=4) reported owing more than one type of application smart phone. Of that three owned both an android and i-Phone and one person an android, windows and i-Phone.

Sixty percent (n=39) of the respondents said they had between one and three medical related smart phone app installed and one person representing 1.5% had installed as many as between five and seven apps. Only12.3% (n=8) of the respondents had no medical related smart phone application installed.

There was no significant relationship between the type of smart phone owned by a respondent and the number of medical related apps installed (p=0.069).

Table 4.2 below shows the summary of the type of smart phones owned by junior doctors and the quantities of medical related apps they have installed on them.

University of Ghana http://ugspace.ug.edu.gh

Table 4.2: Ownership of smart phones and medical related smart phone apps

Type of Smart Phone	Quantity of medical apps installed				
	None	**1 - 3**	**4 - 6**	**5 - 7**	**Total (%)**
Apple i-Phone	0	8	3	0	11 (16.9)
Android	4	29	12	1	46 (70.8)
Windows	2	1	0	0	3 (4.6)
Blackberry	1	0	0	0	1 (1.5)
Other	1	1	2	0	4(6.2)
Total (%)	8(12.3)	39(60.0)	17(26.1)	1(1.5)	65 (100.0)

4.3 Frequency of Utilization of Smart Phone Apps for Clinical Decision Making

All 65 junior medical doctors who participated in the study reported that they used smart phone apps for clinical decision making though to varying degrees. Over 43.1% (n=28) estimated that they used apps on their smart phone for clinical decision making "frequently" and another reported 15.4% (n=10) "very frequent" usage. Those who reported "occasional" and "rare" usage were 30% (n=20) and 10.8% (n=7) respectively.

University of Ghana http://ugspace.ug.edu.gh

section. Figure 4.2 below, is a bar chart of the frequency with which the different categories of smart phone apps are used by junior medical doctors for clinical decision making purposes.

Web access apps were used by all respondents in the study, though with varying frequency. Most reported they used web access apps to aid them make clinical decisions "frequently" 46.2% (n=30), while 20.0% (n=13) used such apps "very frequently", and only 4.6% (n=3) said they "rarely" used web access apps to aid them make clinical decisions.

Social media apps were utilized for clinical decision making by 90% of the junior medical doctors in this study for clinical decision making. Of this 26.2% (n=17) said they did use social media apps "frequently" to aid clinical decision making and 18.5% (n=12) reported their usage of social media apps for clinical decision making was "very frequent".

The prevalence of use of disease diagnoses and management apps was very high, with only 3.1% (n=2) of junior medical doctors surveyed reporting they "never" made use of disease diagnoses and management apps for clinical decision making. However most of them made use of disease diagnoses and management smart phone apps either "occasionally" 44.6% (n=29) or "rarely" 20.0% (n=13).

"Very frequent" usage of drug reference and medical formulary apps for clinical decision making was reported by 27.7% (n=18) of the junior medical practitioners and another 35.4% (n=23) reported "frequent" usage of smart phone apps in this category.

University of Ghana http://ugspace.ug.edu.gh

Only 4.62% (n=3) of the sample population reported they "never" used drug reference and medical formulary apps for clinical decision making.

Applications used for calculations and clinical score systems were found to be used by 13.9% (n=9) of respondents "very frequently", "frequently" by 23.1% (n=15), "occasionally" by 29.2% (n=19), and "rarely" by 21.5% (n=14). 12.3% (n=8) of respondents said they "never" made use of such apps for clinical decision making.

Procedure documentation apps were used with varying levels of frequency by 74.6% of respondents. Most junior medical practitioners in the study used this category of smart phone apps either "occasionally" 46.2% (n=30) or "rarely" 23.1% (n=15) for clinical decision making. Only 10.8% (n=7) of respondents reported "very frequent" use of procedure documentation apps for clinical decision making.

University of Ghana http://ugspace.ug.edu.gh

durations within a day were significantly more likely to report they utilized smart phone apps more frequently for clinical decision making (p=0.018).

4.6 Factors Affecting Utilization of Smart Phone Apps by Junior Doctors

4.6.1 Use of hospital specific apps

A significant majority of respondents 87.7% (n=57, *p*=<0.00) said when available, they would make use of smart phone apps developed specifically for their hospitals to aid them make clinical decisions. The remaining 12.3% (n=8) responded they would not.

4.6.2 Use of other handheld devices besides smart phones

With regard to using other handheld devices at work for clinical decision making besides smart phones, 26.2% (n=17) of the junior doctors reported using other hand held devices while the remaining 73.6% (n=48) did not use any other hand held devices. The other handheld devices specified by those who reported they use other devices were ipads and tablets, one person used both an ipad and tablet 6.7% (n=1/15) while equal proportions 46.7% (n=7/15) used either an ipad or tablet. Two persons failed to specify which other handheld device they used.

Most respondents reported they rated their knowledge of information technology as either “high” 44.6% (n=29) or “moderate” 52.3% (n=34). Only 3.03% perceived themselves to have “low” knowledge of information technology. No one reported having no knowledge of information technology. Figure 4.4 below is a pie chart of the respondents’ perception of their level of knowledge of information technology.

University of Ghana http://ugspace.ug.edu.gh

4.6.4 Suitability of available apps

Junior doctors also reported that they mostly found the smart phone apps currently available to them suitable 87.7% (n=57, $p<0.000$) for their needs in making clinical decisions. There was no significant difference between the junior medical practitioner's perception of suitability of available smart phone apps across the different departments ($p=0.140$) or hospital ($p=1.000$) in which they worked.

The frequency with which the junior medical practitioners used their smart phone apps for clinical decision making did not also show any significant relationship with perception of suitability of available apps for clinical decision making (p=0.150). Again, no significant relationship was established between junior doctors finding available apps suitable and how useful they found smart phone apps at work for clinical decision making (p=0.14).

Table 4.3 below summarizes the junior doctors' perception of the various factors related to use of smart phone apps for clinical decision making as explained under section 4.6

Table 1.3: Junior doctor's perception of factors related use of smart phone apps for clinical decision making

Factor(n)	Yes(n)	No(n)	*P Value*
Use apps rather than hardcopy protocols(65)	64.6%(42)	35.4%(23)	0.025
Suitability of apps(65)	87.7%(57)	12.3% (8)	<0.001
Affordability of internet(65)	50.8%(33)	49.2% (32)	0.8
Willingness to pay for apps(65)	47.7%(31)	52.3%(34)	0.45
Influence of clients perception on use of apps (64)	48.4%(31)	51.6%(33)	0.62

University of Ghana http://ugspace.ug.edu.gh

4.6.5 Effect of the Factors on Use of Smart Phone Apps

There were no significant differences in the junior doctors' perception of the affordability of internet services for their smart phones (p=0.8), whether or not they will be willing to pay for medical related apps (p=.45) and whether or not the clients' perception of a doctor using smartphone apps during consultation influences their use of smart phone apps (*p*=0.620).

4.7 Reliability of Internet Services

On the issue of how often respondents considered internet services to be reliable, 43.1% (n=28) reported they found internet services reliable when they needed to use it on their smart phones for clinical decision making "sometimes". Another 33.9% (n=22) considered internet services for their smart phones reliable "very often".

The reliability of internet services when a junior medical practitioner needed to use it on their smart phones for clinical decision making was not found to be significantly associated with the frequency with which a junior medical practitioner utilized smart phone apps for clinical decision making. (*p*=0.100)

The pie chart below (figure 4.5) shows how often junior medical practitioners who were surveyed found internet service for their smart phones reliable when they needed to use it for clinical decision making.

University of Ghana http://ugspace.ug.edu.gh

4.10 Chapter Summary

The findings of the study show a high ownership and use of smart phones and smart phone apps for clinical decision making among the respondents.

The next chapter discusses the relevance of the findings in relation to current literature.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE - DISCUSION OF FINDINGS

5.0 Introduction

The findings of the study are in this chapter discussed and compared to the findings of relevant literature. The chapter is divided into sub themes based on the specific objectives of the study.

5.1 Ownership of Smart Phones and Smart Phone Apps

The ownership rate of 100% found in this study is a significant increase ($p<0.000$) compared to the 72.2% ownership rate found by Brodie-Mends (2012) in 2005 at the Korle Bu Teaching Hospital. It is also significantly higher ($p<0.000$) than the UK study which found only 74.8% ownership among junior doctors (Payne et al., 2012). This high prevalence of smart phone ownership is very encouraging for the Ghanaian health system and other LMICs that may choose to implement m-health systems. Since smart phone ownership among junior medical practitioners is universal, huge cost can be saved as there will be no need to purchase smart phones for implementation of m-health systems. Also the cost in training is likely to be less since most are already likely to be familiar with the use of the smart phone.

The higher popularity of the Google Android phone (70.7%) among junior medical practitioners compared to the apple i-Phone (16.9%) contrasts that of the United Kingdom study that reported a higher ownership of i-Phones (68.4%) compared to ownership of Android phones (17.3%) as reported by Payne *et al.* (2012).

For a low-middle income country like Ghana, it is advantageous that majority of junior doctors use the android powered smart phones. This is because the Google play store

University of Ghana http://ugspace.ug.edu.gh

has more free apps as compared to the apple store (Gary, 2015). Hence, financial accessibility to android apps is expected to be better than for apple apps. It is however, interesting to note that there was no significant relationship between the type of smart phone owned and the number of apps installed by the junior practitioners surveyed (p=0.007).

Only 12.3% of participants in this study did not have any medical related app installed on their phones. The majority 60% had from 1-3 medical related apps installed and one person even had as much as 5-7 medical related apps installed. This finding of the study is not significantly different (p=0.191) from a 20.2% result, reported by Payne et al. (2012).

Most of the medical related apps are not factory installed and hence one only gets them installed if they choose to install them from third party vendors at the app store (DeCelles-Zwerneman, 2014). Hence, the high number of junior doctors who have medical related apps installed on their smart phones suggests high interest in use of medical related apps. It is worthy to note though that even without installing a third party medical related app on a smart phone, one can still use other factory installed apps for clinical related activities.

5.2 Frequency of Utilization of Smart Phone Apps for Clinical Decision Making

This study showed a higher frequency of use of smart phone apps for clinical decision making among the study population compared to other studies (Garritty & El Emam, 2006; Payne et al., 2012). One hundred percent (100%) of junior doctors used their smart phones for clinical decision making although with different levels of frequency.

University of Ghana http://ugspace.ug.edu.gh

Payne et al (2012), reported 72.4% of junior doctors made use of medical apps to varying degrees in their United Kingdom study. A systemic review in the USA concluded a usage frequency of between 45 and 85% (Garritty & El Emam, 2006). This very high prevalence of smart phone app usage for clinical decision making requires a more systematic institutional policy to support and promote the use of this great technology to enhance health care delivery in Ghana. Making use of local resources and opportunities to improve health systems is a recommendation of the World Health Organization (World Health Organization, 2009).

Web access apps were the most popular type of apps used by the respondents. All reported using them though with varying degrees to aid their making of clinical decisions. Drug reference apps were also very popular among the respondents, followed by diagnoses and management apps before social media apps and clinical score calculator apps. Procedure documentations apps were the least frequently used apps. Refer to Chapter 4. These results compare very well with the work of Brodie-Mends, (2012) which was done in the Korle Bu Teaching Hospital but differ slightly from the results from a United Kingdom study (Payne et al., 2012) where clinical score calculators were the most popular among junior doctors. Likewise, in the United States of America, medical calculators were the second most popular smart phone apps used for clinical activities (Franko & Tirrell, 2012).

The similarities and differences in the modes of use of smart phone apps suggest there might be important difference in the needs of junior medical doctors in developed and developing countries with regard to smart phone medical apps for clinical decision

University of Ghana http://ugspace.ug.edu.gh

making. Further research will be required to explore the specific needs of clinicians within the local setting to enable better adaptation of smart phone technology.

Though there are hardly any institutional infrastructure and systems for paperless documentation in all the facilities in this study (Achampong, 2012) 85% of respondents reported they did make use of procedure documentation apps. This finding agrees with those of pilot studies in which mobile apps were used for data collection and processing in rural areas in Ghana (Andreatta et al., 2011; Little et al., 2014). This calls for the need to quickly consider integrating paperless documentation technology into the health care system in Ghana, considering also that majority of junior doctors in this study, 87.7% reported they would be willing to make use of hospital specific apps to aid their clinical work.

Junior doctors in this study spend a very significant ($p<0.000$) amount of time making use of their smart phone during clinical activities, compared to results from Payne et al. (2012). As many as 18.5% reported spending over an hour in a day using their smart phones for clinical related activities. Such high usage of smart phone apps during clinical activities raises concern such as possible interruption of patient care which could lead to increased likelihood of medical errors (Westbrook et al., 2010). As this study did not investigate non-medical use of smart phone apps during clinical activities, further study will be informative and might show whether the time spent using the phone is really for clinical related issues or for other social uses.

University of Ghana http://ugspace.ug.edu.gh

The high prevalence of use of social media apps by junior medical practitioners in this study calls for regulatory frameworks and guidelines to protect patient privacy and confidentiality (DeCelles-Zwerneman, 2014).

All 65 respondents (100%) found smart phone apps useful at work to aid them make clinical decisions irrespective of their gender, hospital or department in which they work. Those who reported higher levels of usefulness were more likely to use apps more frequently for clinical decision making. In a comparable study only 50% to 82% of junior doctors found their hand held devices useful for various categories of clinical work (Brodie-Mends, 2012).

5.3 Factors Influencing Utilization of Smart Phone Apps by Junior Doctors

In general junior doctors in this study reported they had either high or moderate knowledge of information technology, only 3.1% rated their knowledge as low and none considered themselves to have no knowledge. As this study only determined the respondents' own perception of their level of ICT knowledge, a more objective method may be required to accurately determine the level of knowledge of junior medical practitioners of ICT. A practitioner's perceived level of knowledge of information technology did not show any significant influence on their frequency of use of smart phone apps for clinical decision making.

The results also suggest that junior doctors are more inclined to use smart phone apps to aid clinical decision making even if hard copy protocols and guidelines are available, see chapter 4. This finding is similar to the findings of the Botswana study which

University of Ghana http://ugspace.ug.edu.gh

reported that physicians preferred the use of condensed material provided by smart phone apps (Goldbach et al., 2014).

Among the top five challenges of the Government of Ghana's attempt to introduce e-health using computer based platforms include lack of ICT infrastructure and poor internet accessibility and reliability (Bedeley & Palvia, 2014). The results of this study suggest that the use of smart phone apps may be a solution to these challenges hindering the success of e-health systems in Ghana using computer based platforms. As in other studies, respondents in this study considered internet services for their smartphones to be fairly reliable when they need it for use in clinical related activities (Little et al., 2014). Infrastructural limitations are also less important as smart phone ownership is universal among the study respondents. The Ministry of Health should hence consider using smart phone technology more extensively compared to computer based e-health solutions.

Medscape was the most popular medical related app used by the junior doctors in this study. This agrees with the claim of the developers of the app that they are the leading smart phone medical app in the world with over one million downloads (Web MD, 2015). Specific features that junior doctors mentioned as favorable to them include offline features of the app, clinical details and drug referencing features.

5.4 Chapter Summary

The high prevalence and use of smart phone apps for clinical decision making among junior medical practitioners in selected health facilities in the Greater Accra Region of Ghana is compares favorably with the current literature. Factors that influence the use

University of Ghana http://ugspace.ug.edu.gh

of smart phone apps for clinical decision making such as level of ICT knowledge, ICT infrastructure, internet reliability and affordability and cost were shown in this study not to be a hindrance to the use of smart phone apps for clinical decision making among the study participants.

Based on these conclusions and recommendations for policy formulation are made in the next chapter.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER SIX - CONCLUSION AND RECOMMENDATION

6.0 Introduction

Smart phone apps have been established as holding immense promise for improving health systems (WHO & International Telecommunication Union, 2012). The potential of these technologies to improve entire health systems lies in their ability to positively impact multiple sections of the functional units of the health system. Use of an e-health application to enhance communication flow between health care providers leads to improved decision making and hence, better service delivery to clients (Mutale et al., 2013). There is enhancement of the knowledge and skill levels of the workforce and improvement in data quality which has positive implications for the governance and leadership unit of the health system. Mobile health applications are not only restricted primarily to the information unit of the health system, rather, it is used in almost all other units (Labrique, Vasudevan, Kochi, Fabricant, & Garrett, 2013).

The purpose of the study was to explore the role smart phone and smart phone apps are playing in improving the health delivery system in Ghana, specifically to determine if they are used by junior medical practitioners in clinical decision making.

6.1 Conclusions

The results of this study demonstrate there is universal ownership of smart phones among junior medical practitioners in the selected health facilities in the Greater Accra Region of Ghana. A significant majority of junior medical practitioners have medical related smart phone apps installed and frequently use these smart phone apps to aid their clinical decision making. A wide variety of smart phone apps are frequently utilized by junior medical practitioners for clinical decision making. The commonest

University of Ghana http://ugspace.ug.edu.gh

apps used are apps for web access and those for drug referencing. Even the least used category of apps, procedure documentation apps which do not have essential institutional infrastructural support is used by over 80% of the respondents.

The high prevalence of use of smart phone apps for clinical decision making among junior medical practitioners as shown in this study is thus very encouraging.

6.2 Recommendations

The high prevalence of use of smart phone apps in clinical settings also calls for the Ministry of Health and other stakeholders to accelerate policy that will help incorporate and regulate the use of this technology among medical practitioners. There is high risk of abuse of this technology in the absence of institutional frameworks and guides (Westbrook et al., 2010). The Ministry of Health should also consider using smart phone technology as a means of resolving some of the challenges identified in attempts to introduce computer based platforms of e-health in Ghana.

The private sector and business community, especially those in the telecommunication industry need to be involved and encouraged to support the use of smart phone apps for clinical decision making. Their support can help promote further research and development of apps for the local context.

6.3 Limitations of the Study

The study was also limited to only junior medical practitioners hence the results may not be representative of all levels of medical practitioners in Ghana. It will be useful to expand this work to involve all medical practitioners from diverse levels of qualification and specialty. There is also need for the further research to investigate the

University of Ghana http://ugspace.ug.edu.gh

effects of the high prevalence of use of smart phone apps on the clinical decisions made by medical practitioners.

University of Ghana http://ugspace.ug.edu.gh

REFRENCES

Achampong, E. K. (2012). The state of information and communication technology and health informatics in Ghana. *Online Journal of Public Health Informatics*, *4*(2), 1–13. doi:10.5210/ojphi.v4i2.4191

Afagbedzi, S., Obuobi, H., Aryeetey, R., & Bosomprah, S. (2013). A review of Ghana ' s e-health strategy. *Journal of Health Informatics in Africa*, *52*(Helina), 175–179. doi:10.12856/JHIA-2013-v1-i1-52

Ak-kee, Y., & Khan, A. A. (2014). The use of smartphones by junior doctors. *Medical Education Online*, *1*, 1–8.

Andreatta, P., Debpuur, D., Danquah, A., & Perosky, J. (2011). Using cell phones to collect postpartum hemorrhage outcome data in PubMed commons. *International Journal of Gynaecologist and Obtetricians*, *113*(2), 148–151. doi:10.1016/j.ijgo.2010.11.020.

BBC News - World's first "smartphone" celebrates 20 years. (2014). Retrieved June 14, 2015, from http://www.bbc.com/news/technology-28802053

Bedeley, R. T., & Palvia, P. (2014). A study of the issues of E-health care in developing countries: The case of Ghana. *Healthcare Information Systems and Technology*, 1–12. Retrieved from http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1112&context=amcis2014

Brodie-Mends, D. (2012). Medicine in the information age : use of personal digital assistants in a Ghanaian hospital. *InternatIonal Journal of Students' Research*, *2*(1), 10–13. Retrieved from http://www.ijsronline.com

Bruce, S. E. (2014). Doctors serving in deprived areas to be granted study leave next year. Retrieved October 10, 2014, from http://www.myjoyonline.com/news/2014/September-3rd/70-of-doctors-serving-in-deprived-areas-to-be-granted-study-leave-next-year.php

Bruno, S. O. (2015). 15 more smartphone apps to improve your practice. Retrieved July 21, 2015, from http://www.medscape.com/features/slideshow/apps2

Chang, A., Ghose, S., Ryan, L.-Q., Rachel, B. A., Andrea, K., Loeto, M., … Kovarik, C. L. (2012). Use of mobile learning by resident physicians in Botswana. *Telemedicine and E-Health*, *18*(1), 11–13. doi:10.1089/tmj.2011.0050

Darkwa, O. (2000). An exploratory survey of the applications of telemedicine in Ghana. *Journal of Telemedicine and Telecare*, *6*(3), 177–183. Retrieved from http://jtt.sagepub.com/content/6/3/177.short

University of Ghana http://ugspace.ug.edu.gh

DeCelles-Zwerneman, H. (2014). Everything you need to know about Mobile Health. Retrieved July 29, 2015, from http://blog.capterra.com/everything-need-know-mobile-health-apps/

Franko, I. O., & Tirrell, F. T. (2012). Smartphone App use among medical providers in ACGME training programs. *Journal of Medical Systems*, *36*(5), 3135–3139. doi:10.1007/s10916-011-9798-7

Garritty, C., & El Emam, K. (2006). Who's using PDAs? estimates of PDA use by health care providers: a systematic reviw of surveys. *J Med Internet Res*, *8*(2).

Gartner Group. (2014). Smartphone operating system definition. Retrieved November 15, 2014, from http://www.pcmag.com/encyclopedia/term/63006/smartphone-operating-system

Gary, S. (2015). Google play store vs the Apple app store: by the numbers (2015). Retrieved July 8, 2015, from http://www.androidauthority.com/google-play-store-vs-the-apple-app-store-601836/

Ghana Health Service. (2011). *Ghana health service annual report 2011*. Retrieved from http://www.ghanahealthservice.org/ghs-item-details.php?cid=5&scid=52&iid=94

Ghana Medical and Dental Council. (2012). *Guidlines for housemanship in Ghana*. Retrieved from http://www.mdcghana.org/docs/guidelines-on-housemanship-training-2015.pdf

Goldbach, H., Ay, C., Kyer, A., Ketshogileng, D., Taylor, L., Chandra, A., … Rijken, T. (2014). Evaluation of generic medical information accessed via mobile phones at the point of care in resource-limited settings. *Journal of American Medical Informatics Association*, *21*(1), 37–42. doi:10.1136/amiajnl-2012-001276.

Kent, G. (2011). A brief history of Android. Retrieved April 14, 2015, from http://technoblimp.com/2013/09/14/a-brief-history-of-android/

Labrique, A., Vasudevan, L., Kochi, E., Fabricant, R., & Garrett, M. (2013). mHealth innovations as health system strengthening tools: 12 common applications and a visual framework. *Global Health: Science and Practice*, *1*(2), 1–12. Retrieved from http://dx.doi.org/10.9745/GHSP-D-13-00031.

Lenth, R. V. (2006). Java applets for power and sample size. Retrieved from http://homepage.stat.uiowa.edu/~rlenth/Power/

Little, A., Medhanyie, A., & Blanco, R. (2014). Meeting community health worker needs for maternal health care service delivery using appropriate mobile technologies in Ethiopia. *PLoS ONE*, *9*(1), 1–15.

University of Ghana http://ugspace.ug.edu.gh

Meera, S. (2015). "Instagram for doctors" lets medics share patient pics. Retrieved July 21, 2015, from http://edition.cnn.com/2015/02/10/tech/figure1-photos-medical-app/

Ministry of Health. (2005). *Health sector ICT policy and strategy*. Accra. Retrieved from http://www.moh-ghana.org/UploadFiles/Publications/Health Sector ICT Policy and Strategy120330062728.pdf

Ministry of Local Government and Rural Development. (2006). Ghana Districts. Retrieved September 30, 2015, from http://ghanadistricts.com/districts/?r=1&_=3&sa=5724

Mosa, A. S. M., Yoo, I., & Sheets, L. (2012). A systematic review of healthcare applications for smartphones. *BMC Medical Informatics and Decision Making*, *12*(1), 67. doi:10.1186/1472-6947-12-67

Mutale, W., Chintu, N., Amoroso, C., Awoonor-Williams, K., Phillips, J., Baynes, C., … Sherr, K. (2013). Improving health information systems for decision making across five sub-Saharan African countries: Implementation strategies from the African health initiative. *BMC Health Services Research*, *13 Suppl 2*(Suppl 2), S9. doi:10.1186/1472-6963-13-S2-S9

O'Connor, P., Byrne, D., Butt, M., Offiah, G., Lydon, S., Mc Inerney, K., … Kerin, M. J. (2014). Interns and their smartphones use for clinical practice. *Postgraduate Medical Journal*, *90*(1060), 75–9. doi:10.1136/postgradmedj-2013-131930

Oduro-Mensah, E., Kwamie, A., Antwi, E., Bamfo, S. A., Bainson, H. M., Marfo, B., … Agyepong, I. A. (2013). Care decision making of frontline providers of maternal and newborn health services in the Greater Accra region of Ghana. *PLoS ONE*, *8*(2), e55610. doi:10.1371/journal.pone.0055610

Ofosu, A. (2010). *Mobile devices- the essential medical equipment for the future*. Retrieved from http://www.docstoc.com/docs/95721686/mobile-devices--the-essential-medical-equipment-for

Oxford Dictionary. (2014). Definition of smartphone. Retrieved November 15, 2014, from http://www.oxforddictionaries.com/definition/english/smartphone

Payne, F. B. K., Wharrad, H., & Watts, K. (2012). Smartphone and medical related app use among medical students and junior doctors in the United Kingdom (UK): a regional survey. *BMC Medical Informatics and Decision Making*, *12*(121). Retrieved from http://www.biomedcentral.com/content/pdf/1472-6947-12-121.pdf

University of Ghana http://ugspace.ug.edu.gh

PCMagazine. (2104). Smartphone definition from PC magazine encyclopedia. Retrieved November 15, 2014, from http://www.pcmag.com/encyclopedia/term/51537/smartphone

Republic of Ghana. (2003). The Ghana ICT for accelerated development. Retrieved June 7, 2015, from http://www.nita.gov.gh/system/files/nita_resource/Ghana_ICT4AD_Policy.pdf

Sidlow, R., Tran, K., Morra, D., Lo, V., Quan, S. D., Abrams, H., & Wu, R. C. (2014). Medical students and personal smartphones in the clinical environment : The impact on confidentiality of personal health information and professionalism. *Journal of Medical Internet Research*, *16*(May), 1–9. doi:10.2196/jmir.3138

Stata Statistical Software: Release 12. College Station, T. S. L. (2011). Stata 12.

Takao, H., Murayama, Y., Ishibashi, T., & Karagiozov, K. L. (2012). A new support system using a mobile device (smartphone). *STROKE American Heart Association*, *43*, 236–239. doi:10.1161/STROKEAHA.111.627943

Turkson, P. K. (2009). Perceived quality of healthcare delivery in a rural district of Ghana. *Ghana Medical Journal*, *43*(2), 65–70.

UCLA: Statistical Consulting Group. (2014). What statistical analysis should I use ? Retrieved June 16, 2015, from http://www.ats.ucla.edu/stat/stata/whatstat/whatstat.htm

Vital Wave Consulting. (2009). *mHealth for development*. *mhealth for Development: The opportunity of mobile technology for healthcare in the developing World.* (Vol. Washington). doi:10.1145/602421.602423

Web MD. (2015). Medscape on the app store on iTunes. Retrieved July 8, 2015, from https://itunes.apple.com/us/app/medscape/id321367289?mt=8

Westbrook, J. I., Woods, A., Rob, M. I., Dunsmuir, W. T. M., & Day, R. O. (2010). Association of interruptions with an increased risk and severity of medication administration errors. *Archives of Internal Medicine*, *170*(8), 683–690. doi:10.1016/j.ypat.2010.11.049

Wood, T., Osborn, J., Hutchful, D., Jacqui-Moller, L., Adimazoya, E., Kwarah, W., & Nyonator, F. D. (2012). *Mobile technology for community health in Ghana*. Retrieved from http://www.grameenfoundation.org/resource/motech-lessons-learned

World Health Organization. (2009). *Systems thinking for strengthening, health systems*. Retrieved from http://www.who.int/alliance-hpsr/alliancehpsr_overview_fr_eng.pdf

University of Ghana http://ugspace.ug.edu.gh

World Health Organization, & International Telecommunication Union. (2012). *National eHealth Strategy Toolkit*. Retrieved from http://www.who.int/ehealth/brochure.pdf

Wu, R., Rossos, P., Quan, S., Reeves, S., Lo, V., Wong, B., … Morra, D. (2011). An evaluation of the use of smartphones to communicate between clinicians: a mixed-methods study. *Journal of Medical Internet Research*, *13*(3), e59. doi:10.2196/jmir.1655

University of Ghana http://ugspace.ug.edu.gh

APPENDICES

Appendix A

Consent Form

SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

INFORMED CONSENT FORM

Study Title: Use of Smartphone Apps for clinical decision making among Junior Medical Practitioners in selected health facilities in the Greater Accra Region of Ghana.

Principal Investigator: Kafui Senya **GHS-ERC 68/02/15**

What you should know about this study

- You are being asked to participate in a research study with the above title
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- You are a volunteer. You can choose not to take part and if you begin, you may quit at any time. There will be no penalty if you decide to quit the study.

Purpose of research project

The purpose of this study is to assess if medical doctors in selected health facilities in the Greater Accra Region of Ghana make use of smart phones in clinical decision making and explore the factors at play in their use or otherwise of smart phones for clinical decision making

University of Ghana http://ugspace.ug.edu.gh

Why you are being asked to participate

You are being asked to participate because you are a junior medical practitioner currently working in the Greater Accra Region of Ghana

.**What is required from you?**

Having agreed to participate, we will ask you to complete a questionnaire, it take approximately 10 minutes to complete the questionnaire. You may choose not to answer any of the questions. The questions will assess your use of smartphones for clinical decision making. You will have up to one week to return the completed questionnaire to us, though we will appreciate if you could complete and return it to us immediately.

Benefits and Risk

There is no direct benefits to you, your participation may help improve the health system in Ghana. There is a risk of a short disruption in your work schedule as you answer the questionnaire. You will not receive any monetary payment for participation.

Protecting data confidentiality

We will not write your name on the questionnaire. We will not let anyone outside our work see your answers. We will do our best to keep your information safe by locking up the information. Only password protected computers will be used in the data entering and analysis.

Who do I call if I have questions or problems?

 Call Kafui Senya (principal investigator) at +233 26 8733153 if you have any questions or complaints. You can also

 Call or contact the Ghana Health Service Ethics Review Committee administrator

University of Ghana http://ugspace.ug.edu.gh

Ms. Hannah Frimpong at the following address:

Ghana Health Service Ethical Review Committee
P.O. Box 190
Accra, Ghana
Telephone: 0243235225; 0507041223

By completing, signing and returning this consent form you consent to the following:

"I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any question I have asked has been answered to my satisfaction. I consent voluntarily to participate as a subject in this study and understand that I have the right to withdraw from the study at any time without in any way it affecting my further medical care"

_____ _____

Signature Date

University of Ghana http://ugspace.ug.edu.gh

Appendix B

Participants Questionnaire

SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

USE OF SMARTPHONE APPS FOR CLINICAL DECISION MAKING AMONG JUNIOR MEDICAL DOCTORS IN SELECTED HEALTH FACILITIES IN THE GREATER ACCRA REGION OF GHANA.

PARTICIPANTS QUESTIONNAIRE

Demographic Information

1. Please state your gender:
    a. Male
    b. Female
2. Please state your age as at your last birthday. ……..years
3. Please state your marital status
    a. Married
    b. Single
    c. Divorced/Separated
    d. Widow/Widower
    e. Cohabitation
4. Please state your religious affiliation
    a. Christian
    b. Moslem
    c. African Traditional Religion
    d. Other, please specify ……..

University of Ghana http://ugspace.ug.edu.gh

5. Please state your Nationality
    a. Ghanaian
    b. Other, please specify…….
6. Please state your ethnicity
    a. Akan
    b. Ga
    c. Ewe
    d. Northerner
    e. Other, please specify …….
7. What is your place of work?
    a. Ridge Hospital
    b. LEKMA
    c. University Hospital
    d. LA General
8. Please state your current position

    a. 1st Year House Officer

    b. 2nd Year House Officer

Please Turn Over

University of Ghana http://ugspace.ug.edu.gh

9. Please state your current department of rotation

   a. Medicine

   b. Surgery

   c. Obstetrics and Gynecology

   d. Child Health

   g. Dental Rotation

Ownership of Smartphones and smartphone apps

10. Do you own an application smart phone? (If No please skip to questions 26 & 27)

    a. Yes

    b. No

11. If you own an application, please select which application smart phones you own

    a. Apple i-Phone (iOS)

    b. Android

    c. Windows

    d. Blackberry

    e. Other, please specify……

12. Concerning your smart phone, do you have medical related applications installed?

    a. Yes

    b. No

University of Ghana http://ugspace.ug.edu.gh

13. If yes, how many medical related apps do you have installed on your smart phone
    a. 1 – 3
    b. 4 – 6
    c. 7 – 9
    d. 10+

Frequency of utilization of smart phone Apps

14. Please estimate the frequency with which you utilize applications on your smart phone for clinical decision making.
    a. Very Frequently
    b. Frequently
    c. Occasionally
    d. Rarely
    e. Never

Please Turn Over

University of Ghana http://ugspace.ug.edu.gh

Instructions for questions 15 – 21: ***In relation to the following types of applications, please indicate how often you use them to help you with your clinical decision making***

15. Web access/ internet search engine e.g. Google

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

16. Social Media e.g., Facebook, Whatsapp, Twitter etc.

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

Please Turn Over

University of Ghana http://ugspace.ug.edu.gh

17. Disease diagnosis / management

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

18. Drug reference / medication formulary

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

Please Turn Over

University of Ghana http://ugspace.ug.edu.gh

19. Calculator / Clinical score systems e.g. Coma score and gestational age calculator

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

20. Procedure documentation e.g. typing notes, making videos/pictures of procedure etc.

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

Please Turn Over

University of Ghana http://ugspace.ug.edu.gh

21. Other, please specify……

    a. Very Frequently

    b. Frequently

    c. Occasionally

    d. Rarely

    e. Never

22. Please estimate the time you spend per day (in minutes) using smart phone applications related to clinical activities:

    a. none

    b. 1–10 minutes

    c. 11–20 minutes

    d. 21–30 minutes

    e. 31–40 minutes

    f. 41–50 minutes

    g. 51–60 minutes

    h. 61+ minutes

23. Would you utilize a smart phone app designed specifically for your current hospital to aid you make clinical decisions?

    a. Yes

    b. No

University of Ghana http://ugspace.ug.edu.gh

24. Do you find your smart phone useful at work for making clinical decisions?
    a. Always
    b. Very Often
    c. Sometimes
    d. Rarely
    e. Never
25. Do you use any other handheld computer/tablet at work for clinical activity?
    a. Yes
    b. No
26. If yes please specify…….

Factors affecting utilization of smartphone apps

27. How would you rate your level of knowledge of information communication and technology, specifically smart phone use?
    a. High
    b. Moderate
    c. Low
    d. None
28. When available, will you rather use hard copy clinical guidelines & protocols instead of your smart phone app to aid clinical decision making?
    a. I will use hard copy
    b. I will use smart phone apps

Please Turn Over

University of Ghana http://ugspace.ug.edu.gh

29. In your opinion do you find the medical apps available to you suitable or appropriate for your field of practice?
    a. Yes
    b. No
30. Do you find internet services for your smart phone reliable when you need to use it for clinical decision making?
    a. Always
    b. Very Often
    c. Sometimes
    d. Rarely
    e. Never
31. Do you consider the cost of internet service for your smart phone to be affordable
    a. Yes
    b. No
32. Will you be willing to pay money for a medical related smart phone app
    a. Yes
    b. No
33. Does your patient's perception of you using a smart phone app whiles working influence your decision to use a smart phone app during working hours?
    a. Yes
    b. No

University of Ghana http://ugspace.ug.edu.gh

34. Please detail any further comments you have regarding your use of medical related smart phone applications for clinical decision making: Which specific apps would you recommend? What features do you find most useful in a medical related app?

……

……

……

……

University of Ghana http://ugspace.ug.edu.gh

Appendix C

Ethical Approval from GHS-ERC

University of Ghana http://ugspace.ug.edu.gh

University of Ghana http://ugspace.ug.edu.gh

Appendix D

Ethical Approval for Amendment to protocol from GHS-ERC

University of Ghana http://ugspace.ug.edu.gh

University of Ghana http://ugspace.ug.edu.gh

Appendix E

Letter of Introduction from School of Public Health

University of Ghana http://ugspace.ug.edu.gh

Appendix F

Permission Letter to Regional Director of Health Services, Greater Accra

University of Ghana http://ugspace.ug.edu.gh

Appendix G

Letter of Approval for Study from the Regional Director of Health Services, Greater Accra