A MOBILE PHONE BASED ANTENATAL APPOINTMENT MANAGEMENT SYSTEM

CASE STUDY: UGANDA MARTYRS HOSPITAL LUBAGA

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2013-M132-20036

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August: 2015

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DEDICATION

I dedicate this book to my loving family and friends whose support, devotion and encouragement worked miracles. Also to all that see value in education, love Information Communication Technologies and believe they can change the world into a better place.

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LIST OF ACRONYMS

ANC	Antenatal Care
CMR	Child Mortality Ratio
CHW	Community Health Worker
DFD	Data Flow Diagram
EHR	Electronic Health Records
EMR	Electronic Medical Records
EMRS	Electronic Medical Record System
ERDs	Entity Relationship Diagrams
FANC	Focused Antenatal Care
GIS	Geographical Information System
HIT	Health Information Technology
HIV	Human Immune Deficiency Virus
HMN	Health Metrics Network
MEAN	Mongo Express Angular Node
MPAAMS	Mobile Based Antenatal Appointment Management System
MOH	Ministry of Health
MDGs	Millennium Development Goals
MMS	Multimedia messages service
SMS	Short Message Service
VHT	Village Health Team

ABSTRACT

Low utilization of antenatal care services is one of the reasons that have kept maternal and child mortality high in most of the developing world WHO 2012. Millennium development goals (MDGs) 4 and 5 aim at reducing mortality of mothers and infants. Some of the reasons forwarded for this poor trend in antenatal care (ANC) utilization are; mothers' forgetfulness about their ANC visit schedules because of long distances to and from the health units and poor information management which lead to the fear that if they lost their ANC card then there is no need for them to visit the clinic. As a result, nearly 3.8 million lives of mothers and children are lost annually in sub-Saharan Africa, due to pregnancy complications which are preventable given proper and adequate ANC.

Therefore, this study is set out to find out how to manage information and simplify communication in order to improve ANC services. The current ANC service process was studied and this helped the researcher to develop a mobile phone based antenatal appointment management system to help in reminding mothers about their ANC schedules and allocate time.The system is meant to register mothers for ANC, follow up their ANC visit details and conditions during pregnancy until delivery. It is also meant to register staff at the antenatal clinic and make their work easier, especially data and Management Information. Uganda Martyrs Hospital Lubaga antenatal clinic was used as a case study. Data was collected using interviews and observation to ascertain the existing antenatal care processes and their challenges. Microsoft Excel was used in analyzing the data.

Then a design for the mobile phone antenatal appointment management system (MPBAAMS) was done and the system was developed and tested. If adopted, MPBAAMS will improve the level of antenatal care service utilization by mothers.

The MPBAAMS will also help to improve antenatal service delivery by managing antenatal care communication at the antenatal clinic. It is hoped that this will help in reducing maternal mortality.

CHAPTER ONE: INTRODUCTION AND BACKGROUND TO THE STUDY

1.0 Introduction

This chapter introduces the study and presents the mobile phone antenatal appointment management system **(MPBAAMS)**.The main topics discussed in this chapter are background, of the study, problem statement, objectives of the study, project scope, significance and justification of the study**.**

1.2 Introduction of the study

In recent times technological advancement and ICT are evident all over the world. Technological advancement through better management systems has proved efficient, reliable, time saving, not to mention all the other benefits of advanced technology. A case in point is the wide spread use of a mobile phones in the world and more rampantly of recent years in developing countries (Benkler, 2004).This has simplified communication, and saved resources. These new gadgets besides other forms of technological advancement have influenced all sectors of life the health sector inclusive. In 2007 the World Health Organisation (WHO) with its implementation and effective management of health services in the health units is dependent among other things on how the health, antenatal care and other programmes are planned, monitored and managed. This study sets out to solve the communication gap between mothers and the Antenatal Care (ANC) clinic, taking a case study of Uganda Martyrs Hospital Rubaga, with the main objective of developig a mobile phone antenatal appointment system.

1.2.1 Background to the study

Internationally, ICT and improved technology are timely inventions humanity has realised. Whereas in developed countries improved technology and ICT have been used in the management of organisations for over a period of time, technological advancement in

developing countries and Uganda in particular is something of recent but spreading widely day by day. Taking an example of the spread of mobile phone usage, statistics show that out of every 100 Ugandans, 80 have got a mobile phone, both in rural and urban areas (Evanjeline 2008). This escalation among other things has streamlined communication compared to the manual ways of doing things as it was before. In the same vein, besides the wide spread of ICT and mobile phone usage, the issue regarding reducing as much as possible the maternal and infant mortality and the number of mothers who die of pregnant related issues has remained a point of reckoning (UN 2012). Government and donor agencies have invested a lot of resources and time to eliminate this problem.One of the millennium development goals aimed at reducing maternal mortality (UN,2012). Whereas attempts have been made to improve access to antenatal services, there has been less monitoring to ensure that women put them to use and if not find out why not and what can be done. It should be appreciated that antenatal care can be defined differently depending on different contexts. According to the National Institute for Health and Care Excellence antenatal care visits means regular check-ups of a pregnant woman by a midwife or doctor before giving birth (NICE, 2008). Anoh, et al (2001) noted that good care during pregnancy is important for the health of the mother and the development of the unborn baby. For antenatal care visits to be a success; there is need for proper planning in making appointments and monitoring their progress. Planning is a process based on situation analysis that defines who does what (Green 2010). The medical staff at any level have a crucial role in planning for, monitoring and implementing public health approaches and appointment systems in the increasingly decentralized systems.When a woman is pregnant or planning for a baby, she has a number of choices about where to give birth and who will care of during this time. Checking is important to mothers. They have to know the size and positioning of the uterus and fetus. In many clinics, hospital and health facilities where ANC services are carried out, each client (pregnant women) carry antenatal card which has appointment days on it. This

card has to be carried every time she visits the clinic and it's made of paper. In most developing countries Antenatal care is slowly being taken seriously and important, but the methods of booking appointments still remains manual where by a woman travels to the clinic to make an appointment physically and this is quite cumbersome to discourages the mothers (clients). Planning, implementing, monitoring and proper management of appointments contribute significantly to effective management of health services, minimizes the wastage of resources and directs the activities in the units, giving priority to the most essential health needs of the service area. (WHO, 2009). Since the 1980's many Sub-Saharan countries have been undergoing structural reforms and technological improvements with a view of promoting efficient service delivery. Proper management of antenatal services is seen as one of the public sector reforms with strategies to increase service delivery (Kabeba, 2008). In Uganda ANC is in poor conditions in all health sectors around the country, according to the reproductive health and child care (2012), all women in urban areas received antenatal care and delivered in a health facility are much higher in urban areas (79 percent) than in rural areas (32 percent). Mothers with secondary or higher education are three times more likely to deliver at a health facility than women with no education (72 percent and 21 percent, respectively). This is because there is no monitoring system (Bankusa, 2012). To ensure proper access to antenatal care services in Uganda the health sector has made a number of reforms among them decentralisation of services to the level of health centre ones (HC1s). The HC1s have no physical structure but only a team of people (called the Village Health Team (VHT) that which work as a link between health facilities and the community (WHO, 2009). The current information management system of antenatal care is mainly file system and paper based including control forms that are attached together and stored in files that are pilled in the file cabinets (Fraser, 2008). Paper materials are used as appointment cards for antenatal services and this is difficult for women especially during rainy seasons because they get wet and

information on them can easily get erased. moreover most women lose them as they are travelling. This stops the women from attending antenatal care services because of not having previous information, worse still papers don't show specific time of appointment and this means a woman has to come early for the ANC appointment. This leads to a lot of congestion at the clinic as everyone arrives more or less at the same time. This system is time consuming and unreliable in monitoring. The mentioned challenge of the current file system in the services of antenatal care has reduced the number of women attempting to have access to the services, this as result, has contributed to the high rate of maternal mortality**.** It is from this background, that the need to create a mobile phone based antenatal appointment management system becomes eminent. This new system will suffice, since now mobile phones have become an immediate device that can offer a better solution to the problem. This is mainly because almost every person can afford a phone a since it can help to pay bills and transfer money for instance mobile money, money pessa etc. therefore, mobile phones can as well be used to send appointment to ANC users in a timely and more reliable manner. The use of the mobile phone system unlike the paper file system will help in speeding up the process and ensuring proper monitoring and record keeping among other things.

1.3 Problem statement

Most hospitals still operate manual and file based systems with a lot of delays, this results into poor antenatal management as well failure to meet people's health needs, thus inefficient service delivery affects the turnover of pregnant mothers/clients and other consequences. Inefficient management systems have left a lot to be desired in hospitals especially with regard to be antenatal care services. All procedures are paper based. At the antenatal clinic, all data about a mother and her Pregnancy, screening results, next date of ANC visit are recorded on an antenatal form and books. These forms are sometimes misplaced, forgotten or lost by

mothers. The forms and books make it difficult to keep track of mothers ANC attendance since information retrieval form them is hard. Disseminating important information to mothers is also difficult with this way of operation. A lot of time is spent while recording data on antenatal cards, then some of that same data on the antenatal register. More time is spent on the tally sheets and compilations of data summaries to produce weekly, monthly quarterly and annual reports. These processes are hectic and are liable to errors.

A mother‘s antenatal information is typically dependant on the antenatal card carried, should the card be lost, then all historical antenatal information is lost. Mothers tend to forget their next antenatal visit dates and end up missing the visits. Follow up on defaulting mothers becomes difficult due to hardship in retrieving next appointment dates from the antenatal registers. It is from this background that the study of a mobile phone based antenatal management system is proposed to manage and simplify communication in ANC services.

1.4 Main objective

To develop a mobile based antenatal appointment management system to help in monitoring pregnant women appointments.

1.4.1 Specific objectives

i. To review the current system so as to identify its challenges
ii. To determine the requirements for developing and implementing the mobile antenatal appointment system for antenatal clinic.
iii. To design a mobile antenatal appointment system for antenatal clinic.
iv. To test and validate the developed prototype

1.5 Scope of the study

The study scope mainly focused on how antenatal information is captured, stored and used to help all pregnant women in Rubaga division, Kampala district. The pregnant women are attended to by nurses and midwifes. These interact with the system by viewing and entering

data for the pregnant women and appointment dates. The study was carried out at Uganda Martyrs Hospital Lubaga maternity clinic Rubaga division Kampala district .the results of this study can be generalized to all women in Uganda and it could be integrated into the ministry of health's programmes. The study was conducted for a period of eight months.

1.6 Significance of the study

Given the functionality of the mobile based antenatal appointment management system, nurses/midwives shall avoid delays in submitting reports about antenatal visits. According to Pinto, (2006) centralized access to data promotes effectiveness and efficiency in data storage, utilization and dissemination.

The design and development of a mobile based antenatal appointment management system is to enable users to perform queries, view and search for data from the database with adequate security and assured data privacy. Therefore the MPBAAMS is an asset for effective and efficient communication and this will reduce the long queues at ANC clinics and give users room to programme themselves accordingly.

1.7 Conclusion

This chapter presented the back ground of the study, the problem statement, objectives, scope and the significance of the study.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter presents a review of the existing literature as per the subject under study. In reviewing this existing material, the study identified the gaps that already exist therein and how the new study filled the gaps in place. The review flows according the objectives of the study.

2.1 Antenatal care

Antenatal care refers to the regular medical and nursing care recommended for women during pregnancy. Furthermore, it is a type of preventive care with the goal of providing regular checkups that allow doctors or midwives to prevent, detect as well as treat potential health problems that may arise in a pregnant woman, (WHO, 2012). AbouZahr and Wardlaw 2008). ANC offers a woman advice and information about appropriate place of delivery, depending on the woman‘s condition and status. It also offers opportunity to inform women about the dangerous signs and symptoms which require prompt attention from a health care provider. Furthermore, ANC may assist in eliminating pregnancy related complications through monitoring and prompt treatment of conditions aggravated during pregnancy, such as pregnancy induced hypertension, malaria, and anaemia which put at risk both the life of the mother and unborn baby (Srilatha et al. 2012; Awusi 2009).

Pell et al. (2013) argue that antenatal care is a key strategy to improve maternal and infant health. However, survey data from sub-Saharan Africa indicate that women often only initiate ANC after the first trimester and do not achieve the recommended number of ANC visits. They further assert that ANC, along with family planning, skilled delivery care and emergency obstetric care, is a key element of the package of services aimed at improving maternal and newborn health.

Some ANC interventions have been shown to be effective for the detection, treatment or prevention of conditions associated with serious morbidity or mortality: monitoring of chronic conditions, anaemia, for example; screening for and treatment of infections, including sexually transmitted infections (Carroli, Rooney and Villar, 2001); prevention of mother-to-child transmission of HIV (PMTCT); insecticide treated bed nets (ITNs) ; and intermittent preventive treatment of malaria (IPTp) with sulfadoxine pyrimethamine (SP) (Pell et al.2013).Antenatal care is also viewed as an important point of contact between health workers and women and an opportunity for provision of health education including how to detect pregnancy complications and development of a birth plan to ensure delivery at a health facility.

ANC has long been considered a basic component of any reproductive health care programme. Different models of antenatal care have been put into practice all over the world. These models are the result of factors such as socio cultural, historical, traditional nature as well as economy of the particular country. Moreover, human and financial resources of the specific health system substantially play a part in building the model (Shah and Say 2007). Most developed countries use traditional model of prenatal care which is based on larger number of visits, approximately 7-10 visits. They include starting antenatal as early as possible, monthly visits up to 28 weeks, followed by weekly up to 36 weeks until delivery, (Say and Raine 2007). Pregnant women in these high income countries receive adequate prenatal care which includes frequent tests, and ultra sound evaluation. They also give birth under supervision of medically trained personnel and have prompt access to emergence treatment if complications arise. On the contrary, most low income countries incorporated in their health systems a new model called Focused antenatal care the details of which will be elaborated in the subsequent section. The traditional ANC had not done well in most developing

countries including Uganda. Many of the mothers who attend antenatal care clinics come only once or twice and sometimes late in pregnancy (Shah and Say 2007).From such an understanding of Antenatal care, the limited ANC utilisation among Ugandan women and the ANC potential benefits, the researcher believes that if fully utilised, ANC services can be very helpful in reducing maternal and child mortality rates in Uganda, sub-Saharan Africa and the rest of the world.

2.2 Benefits of Antenatal care

Antenatal care contributes to good pregnancy outcomes and oftentimes benefits of antenatal care are dependent on the timing and quality of the care provided, (WHO and UNICEF, 2003). It has been shown that regular antenatal care is necessary to establish confidence between the woman and the health care provider, to individualize health promotion messages, and to identify and manage any maternal complications or risk factors (Srilatha et al. 2012). During antenatal care visits, essential services such as tetanus toxoid immunization, iron and folic acid tablets, and nutrition education are also provided (Awusi 2009). Lack of antenatal care has been identified as one of the risk factors for maternal mortality and other adverse pregnancy outcomes in developing countries (Adekanle 2008). Moreover, many studies have demonstrated the association between lack of antenatal care and perinatal mortality, low birth weight, premature delivery, preeclampsia, and anemia (Srilatha et al. 2012).

In a study conducted in Mexico by Coria-Soto et al. (2006), inadequate number of visits was associated with 63 per cent higher risk of intra uterine growth retardation. Similar results were reported in a Bangladeshi study where birth weight was positively correlated with the frequency of visits at antenatal clinics (Ahmed and Das, 2012). All these results point to the important role of antenatal care in identifying and mitigating the potential complications during pregnancy. Moreover, a study conducted in Canada by Heaman et al. (2008) on

inadequate prenatal care and association with adverse pregnancy outcome indicated that preterm birth, low birth weight, small for age gestational and increased mortality rate were associated with inadequate prenatal care. Raatikainen et al. (2007) showed similar findings in a study conducted in Finland, where an increase in low birth weight infants, more fetal deaths, and more neonatal deaths were common among those under attending ANC.Basing on these benefits of antenatal care, the researcher believes that an effort towards improving antenatal care quality, its uptake and frequency among Ugandan expectant mothers is worthwhile in reducing mortality of both mothers and newborns. A reason for developing an antenatal care Management Information and support system.

2.3 Health information system / Health management information system

A Health information system is one that integrates data collection, processing, reporting and use of information necessary for improving health service effectiveness and efficiency through better management at all levels of health service (Blumenthal, 2010).

Krishnan et al. (2010) argue that a health management information system (HMIS) is a process whereby health data (input) are recorded, stored, retrieved and processed for decision-making (output). Decision making broadly includes managerial aspects such as planning, organizing and control of health care facilities at the national, state and institution levels. The Information system is specially designed to assist in the management and planning of the health programs.

In public health programmes HMIS would be primarily concerned with health care delivery issues like -antenatal care, immunization, and disease control programs and administrative issues like reporting, inventory management, financial management, and vehicle and personnel

management issues. Therefore maintaining a good HMIS is an essential part of running a health system. This can be done manually as it is being done in most of India, or it can be maintained in a computerized system.

In evaluation of a Health Management information system in Uganda, based on intervi ews with doctors and nurses, Fenenga and Jager (2010) concluded that introduction of HMIS resulted in health workers valuing the data generated by them better; it supported program planning and decision making as well as improved the quality of and access to health care.

In order to function efficiently, health managers need to do regular monitoring of the health status of the population, medicines, vaccines, requirement and utilization patterns, equipment availability and status etc. Timely and accurate information is necessary to formulate and implement effective programmes. Such information is currently lacking in the health system in the country. Health workers generate lot of data in the village, send it to the PHC, where it is compiled in the form of monthly reports and transferred to the secondary level. Primarily the flow of data is unidirectional. In addition, a lot of data that the health workers collect is redundant or never utilized adequately. Efficient management of data is difficult in a manual system, and often involves duplication of efforts and wastage of time

2.4 The Role of Information Technology in Improving Health care Delivery

The implementation of health information technology has become a major priority in the health care industry due to: Rising health care costs, escalating concerns for patient safety and reducing medical errors, focus on improving the provision of evidence-based care; and the increasing number of regulatory requirements placed on health care providers (Doebbeling, Chow & Tierney, 2006).

To study the impact of IT on health care quality, it is important to identify not only the components and functionality of health information systems but also how they are used. There is a common agreement that widespread adoption of health information technology (HIT) has the potential to improve health care quality, reduce costs and increase the efficiency of the health care delivery system (Blumenthal 2010; Hillestad et al. 2005).It is envisioned that widespread use of health information technology will result in fewer medical errors, fewer unnecessary treatments or wasteful care, fewer variations in care, and will ultimately improve care (ONCHIT, 2004)

2.5 Cell phones and community health workers.

Community health workers (CHWs) have a key role to play if we are to achieve our ambitious goals to reduce child and maternal mortality globally (Global Health, Science and Practice 2014). A wide diversity of CHW cadres have been established in many countries, both in the public sector and with non-governmental organizations, yet several major challenges have emerged: Limited population coverage, motivation and retention (especially when CHWs are volunteers), Supervision, Quality of service, Best constellation of services for the most impact, without overburdening the CHWs.

While mobile Health is no panacea, it can help address each of these challenges substantially, notably via one simple technology; the increasingly ubiquitous cell phone. Campbell et al.demonstrate that use of mobile phones, accompanied by provision of good technical content, can markedly strengthen the role that CHWs play in delivering services in Malawi. Using the Net-Map methodology, which assesses the roles and influences in the health system‘s social network, the authors find that providing CHWs with a cell phone plus content relevant to their

jobs transformed the role of the CHW, from almost a social nonentity to a major hub in the health system's social network. Crawford and colleagues, also in Malawi, find that SMS messaging for pregnant women and caregivers of children under 1 year of age, often sent through CHWs as intermediaries, was effective in improving both the knowledge and intended positive behaviour of clients.

Lastly, Brunie and colleagues examine what motivates volunteer CHWs in Uganda. They find that provision of cell phones is itself a motivator. But more importantly, mobile phones can enhance many of the other key motivators: gains in knowledge and skills, social status, and client appreciation as well as ability to ameliorate challenges such as commodity stock outs, emergencies, and even disease outbreaks. So yes, it seems the cell phone can be a transformative technology for the CHW.

It is therefore on such a basis that the researcher believes that the developed MPBAAMS will have a great impact on improvement and frequency of antenatal care service consumption by mothers.

2.6 Definition and Understanding of the main concepts Management systems

Management systems are a key concept in every form of management and organisations. By definition, a management system is the framework of processes and procedures used to ensure that an organization can fulfil all tasks required to achieve its objectives.(Kenneth at ell 1995). This study will adopt this definition of a management system in an attempt to develop a mobile phone management system for antenatal care.

Antenatal care

The National Health Science Foundation report of 2012, defines antenatal care, as *the care a mother receives from healthcare professionals during her pregnancy*. It further gives the

importance and purpose of antenatal care as to monitor a mother's health as a whole, her baby's health and the support to make plans which are right for her according to NHS Foundation Trust (2012).

Monitoring and implementation

The two terms monitoring and implementation are common terms in the management and operation of organisations. This monitoring and implementation is always aimed at ensuring better service delivery to the users. To begin with as for Kurt,(2000), monitoring means supervising activities in progress to ensure they are on-course and on-schedule in meeting the objectives and performance target. Then implementation is the act of a specified set of activities designed to put into practice an activity to effect or fulfilment of a program. This study will adopt this definition by Kurt to implement the new mobile phone management system and ensure the objectives of the study are realised.

2.7 The challenges of the File Management system

It is important to note that in health facilities, there is already a system in place with which healthcare services are managed and offered. This system is famously known as the File management system. According to Heston the current system of antenatal care is mainly file system and paper based includes control forms that are attached together and stored in files that are pilled in the file cabinets (Heston, 2008) In this system less ICT is involved as patients records are managed manually and this has had its own shortcomings which has prompted the study to set out with the objective of finding out the challenges of the current system of managing antenatal care services in health facilities. Scholars have established the following among the shortcomings of the file management system.

Lost and Missing Documents

The loss and cries of the missing files of the clients is a common phenomenon of the file management system. As already mentioned, the current system of antenatal care is mainly

paper file system. In this case,the management system, which is paper based employs the use of control forms that are attached together and stored in files that are pilled in the file cabinets year in year out. ,This as mentioned above is mainly characterised by missing documents and records. Consequently,studies have shown that in using this system "7.5% of all documents get lost and 3% of the remainder are misfiled (cooper and Lybrand,2015)." This suggests that out of every one hundred documents, ten documents are sitting on the wrong desk, being removed from the office, etc. Some documents cannot be reproduced if lost and this dramatically increases the risks and costs associated with paper filing systems. In addition to what Copper and Lybrand mention of the shortcomings of the file system, the new study will bring out the danger this situation presents to the life of the patients since there would be no proper follow up on the health record of the client. This aspect does not seem to come out in what is advanced by Copper and Lybrand. Paper-based filing systems allow paper documents to reside in only one place at a time and to share documents; office workers generally make their own copies. Cooper and Lybrand, elaborate that the average document gets copied 19 times, and of course, many of these copies also get filed. It is also hard to keep track of who has used or copied which paper documents. Paper documents are often maintained with very low security control, companies' risk leaking critical information to unauthorized personnel.

The other challenge associated with the file management system, as system in place for the management of antenatal care in health facilities, is the situation of delay and time wasting in finding and retrieving information. Finding and retrieving a document using a paper-based system is slow. In situations where information contained in a document is required immediately to respond to a client's request, the delay may cause client dissatisfaction. In addition, re-filing paper documents wastes time and may result in misplacement of the files. When the time of clients is wasted there is always a possibility among others of clients abandoning the services or the facility where the system wastes their time.

Wastage of resources

The accessed literature revealed that the system requires a lot of human resource. Because there is less of ICT used in the management of things, there is great need of more people to manage the files and records which is not the case when improved technology is used in the management system. Because of the many staff members required in the use of the file management system, antenatal care services have been greatly affected.

The challenge of poor communication and its effect on antenatal care all connected to the file management system, is evidenced in a testimony presented by the human rights watch report (2011). "*My cousin was rejected twice at the community health centre. When we went for antenatal, the nurses did not even check her but just said she should come back when she had labour because she could not find her antenatal record. Because she was in a lot of pain, we borrowed transport money to go to Cecilia Makiwane Hospital where she had a Caesarean section delivery. The doctor complained that she had delayed and her old C/S operation scar was swollen, and he was worried she may Develop further complications. But, it is the nurses that delayed us because of their bad attitude and poor record keeping''.*

The new mobile phone system, will improve the communication and reduce the effect of attitude from the nurses because on some occasions it will not require the help of a nurse in record keeping and retrieving. However, this does not completely eradicate the problem of bias from the staff, because the new system is not completely free of operation from human beings though it lessens it.

2.8 The stages of designing and implementing a management system

Designing, implementing and managing any management system, goes through a procedure or stages. After knowing the factors to be considered, knowing the requirements in designing and implementing the system, it is important to pay attention to the stages/procedures of realising all this. This as a matter of fact takes time and effort. Anderson (2011), says that effective

Management System for the first time, it takes longer than expected, involves more people than planned, and grows in complexity. For purposes of designing and implementing a management system with success (Anderson 2011), advocates for dividing the process into five (5) distinct phases, each with clear objectives, that is; discovery, planning, development, implementation and rediscovery. These stages once followed according to Anderson will lead to designing and implementing an effective management system. The stages are adopted for this study of designing a mobile phone based management system for antenatal care in health facilities and bellow they are given in detail and what happens under each stage.

Discovery: Think of this initiation phase as all the things the coaching staff does up to and including the first pre-season team meeting. It is where the overall missions and goals are set, with clear effectiveness criteria established

Planning: This is excruciating detail to orchestrate materials and manpower. Inadequate project planning can result in waste, delays and a shoddy end-product. Building an effective management system is equally dependent on executing a strong planning phase

Development: The development stage, involves a process of building a strong policy and procedure system, is a non-linear process with a tremendous amount of "behind the scenes" support.

2.9 Implementation:

Implementing an effective management system is much like the first day of school. When young children walk into that big new classroom for the first time, the effect can be intimidating, even overwhelming. New students are like blank slates: intelligent, capable, but completely untested and unschooled in the challenges that lie ahead. By the time the final bell rings on their academic careers (many lectures, raised hands, and exams later) those same students have grown into talented experts in their chosen fields. The difference between "before" and "after" is training, testing, and time. Anderson (2011) gives rich in put on the

stages required in designing and implementing an effective management system. However, he fell short of what could be particular stages for this individual study, that is, a system that is mobile based and for antenatal care in particular. Whereas the new study contends with these systems it finds it important to suggest other things like; prior knowledge of the already existing system by the system developer so that one can capitalise on its short comings. Doing a pilot study is also very important in developing and designing a new system. The implementation stage should also pay attention to prior testing of the system kind of pretesting before it is fully used and implemented for use in an organisation. These among others are the short comings of Anderson's in put on the stages to be considered and this new study will put them into consideration.

2.10 Design a management system

Having reviewed the existing literature on the stages/procedures of designing a management system, bellow the study makes review of the available literature on how to implement a management system and paying particular attention to the mobile based management system purposely for antenatal care services. The system for this study is mobile phone application software, and as emphasised by Land, (2011), this can be developed by using different software development approaches. They include the following: incremental models, waterfall model, sequential model, the "V" model, the Parallel Development model, evolutionary models and incremental models.

2.11 Incremental models: according to Land, (2011) this type divides the project into a series of small subprojects [increments]". The total scope of work is decomposed to smaller chunks of work, increments, based on the risks, architecture and/or the requirements. In sequential models, the overall requirements of the final system or product are known at the start of the development phase however, a limited set of requirements is allocated to each increment and

with each successive (internal) release more requirements are addressed until the final (external) release satisfies all requirements.

2.12 Testing and implementing a management system

When a new management system is designed, it as well goes through the stage of implementation by the system developers. This pretesting of the system helps to identify the short comings which are corrected before the system goes into use in the service delivery to the clients. Using incremental development developments are divided into smaller, more easily managed modules. Each module passes through the requirements, design, implementation and testing phases. The phases presented bellow in testing and implementing management systems are according to (Sundararajan 2013).

The first phase is the system requirements: This establishes the components for building the system, including the hardware requirements, software tools, and other necessary components. Examples include decisions on hardware, such as plug-in boards (number of channels, acquisition speed, and so on), and decisions on external pieces of software, such as databases or libraries.

The second phase is the software requirements: this establishes the expectations for software functionality and identifies which system requirements the software affects. Requirements analysis includes determining interaction needed with other applications and databases, performance requirements, user interface requirements, and so on.

The third phase is the Architectural design: This determines the software framework of a system to meet the specific requirements. This design defines the major components and the interaction of those components, but it does not define the structure of each component. The external interfaces and tools used in the project can be determined by the designer. The fourth phase is the detailed design: Examines the software components defined in the architectural design stage and produces a specification for how each component is implemented. Coding:

This is the fifth phase and it implements the detailed design specification. Testing: Testing is the sixth phase of the process and it determines whether the software meets the specified requirements and finds any errors present in the code. Maintenance is the last phase and it in particular addresses problems and enhancement requests after the software releases. These stages once fully followed in testing and implementing a newly designed and developed management system, provide higher chances of establishing a reliable and effective management system. In the new study of the mobile phone management system of antenatal care services, the above stages will be fully followed so as to put in place an effective and reliable system.

2.13 The advantages of a mobile management system

Besides the already reviewed literature the researcher bellow makes mention of the advantages of a mobile management system in comparison to the other management systems like the file based kind.The advantages of mobile management system are. It makes the work easy, reliable and appropriate any moment in time. Among other advantages of the mobile phone based system, mobile computing can improve the service you offer your customers. For example, when meeting with customers you could access your customer relationship management system - over the internet - allowing you to update customer details whilst away from the office. Alternatively, you can enable customers to pay for services or goods without having to go to the till. For example, by using a wireless payment terminal diners can pay for their meal without leaving their table. According to Nibusines (2015), a mobile management system leads to great flexibility in working - for example, enabling home working, or working while travelling. Increasingly, networking 'hot spots' are being provided in public areas that allow connection back to the office network or the internet. The growth of cloud computing has also impacted positively on the use of mobile devices, supporting more flexible working practices by

providing services over the internet. The other advantage is Compliance**.** That with the use of mobile phone system, there are all sorts of laws to protect the records of patients and this facilitates easy and better access of services. In the present time, mobile devices are becoming a huge compliance challenge. The other aspect is on the Mobile Device Security**.** It is more difficult for thieves to access the sensitive information, regardless of where the employee happens to be at the time. For example, if a handheld is stolen, the mobile device management software can be used immediately to wipe the handheld clean. So even if an employee resigns or gets terminated, the device can be "Selectively Wiped". Only the corporate data gets removed. One of the advantages is that there is no Infrastructure Changes. In this situation, the MDM doesn't require you to change your existing Wi-Fi infrastructure….however, I should note, that if your wireless networking doesn't have the ability to handle a lot of capacity as well as manage and prioritize the types of users; you're going to have issues with BYOD Wegner, (2014) and the number of medical applications. But, assuming you've got a robust wireless network, MDM is simply an overlay to that network. There are no big changes to make to implement it. The next advantage is the automated Device Registration. The MDM allows you to send the users an email or allow them to download the application on their devices. No more handing out the pre-shared key that gets passed around to everyone and no more configuring devices for the IT staff. Device enrolment is as easy as loading an app.

The above and other advantages present the mobile management system as the available option in improving the better service delivery of antenatal care, compared to the old file management system that has crippled the sector on antenatal care in health service facilities.

2.14 Conclusion

This chapter has included a review of already existing literature, with the researcher making the relevant critique on prior researchers and authors, while identifying the existing gaps and

how the new study will attempt to fill them. The review has been made in line with the research objectives and any other information deemed relevant to the study.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter describes the research approach and techniques that were used while undertaking the development of a mobile phone based antenatal appointment management system. The researcher categorizes the research process into two sections, the research methodology and development methodology. The research methodology describes the techniques that were used in obtaining the requirements of the system. These include the study population, the data collection tools and techniques, the data analysis tools and the data presentation techniques, while the development methodology describes in detail the approach that informed the development of the system. These include the techniques for analysis, and design of the system.

3.1 Research Methodology

The research was mainly qualitative in nature. This enabled the researcher to explore in depth the problem area, the antenatal care business processes, the available Management Information infrastructure and how data is handled and used in the antenatal clinic, hence providing an understanding of the activities carried out during antenatal care. Two methods of data collection were used to study and gather all the requirements needed for the MPBAAMS.

Interviews

The requirements for the new MPBAAMS were gathered using interviews conducted with medical personnel and some pregnant women who were clients of the clinic MPBAAMS users. The researcher was guided by set of question guide.

Observation

Observation was used as a mechanism to establish the process flows at the Antenatal clinic. These provided comprehensive requirements and variables that were required for the MPBAAMS development.

3.1.1 Study Area

The researcher used the case study approach when collecting data with the aim of solving the broad spectrum problem of low antenatal clinic attendance during pregnancy in Uganda that has led to high maternal and child mortality. UMLH antenatal clinic was used as the study area with particular interest to study its system and base on it to develop a mobile phone based antenatal appointment management system.to be used by pregnant women during antenatal time to interact with the antenatal clinic.

3.1.2 Study Population

The relevant information was obtained from Doctors/gynaecologists, nurses/midwives and pregnant mothers/clients. This sample was selected using purposive sampling. This is because the research targeted only antenatal care service providers and antenatal care service recipients. The actual respondents were then selected conveniently basing on availability and willingness to participate in the study. The antenatal clinic has 15 staffs that are directly involved with antenatal care service delivery. Thirteen (13) of them were sampled and interviewed as shown in the table below.

Table 1: Respondents Distribution

TYPE	NUMBER INTERVIEWED
Doctor	**1**
Nurses	**5**
Midwives	**7**

Twenty (20) pregnant mothers were interviewed to get their opinions, attitudes and thoughts about the antenatal care service that they receive. They were categorised into two types namely those who visit the first time and those who have been visiting

Table 2: Respondents Distribution

TYPE	NUMBER INTERVIEWED
Pregnant women (First visit)	10
Pregnant women (more visits)	10

The total number of respondents were thirty three (33) in total. For each of the listed respondent categories, the people encountered and who were willing to participate in the study were interviewed.

3.2 Data Collection Methods and Tools

The researcher used two data collection techniques and tools for the study. These included: oral interviews, and observation.

3.2.1 Oral Interviews

These involved a one on one discussion with the respondents. The researcher came up with interview guides. Oral guided questions were administered between the researcher and the respondents. The respondents included Doctors, Nurses and pregnant mothers. Their responses were captured or noted down, analyzed and processed for use during the design and implementation of the project. They were also considered to be quicker and easier to administer compared to questionnaires.

3.2.2 Observation

With the help of a checklist, observation of antenatal care procedures was also carried out to determine how mothers are received, registered, examined, advised and scheduled for the next antenatal visits. Observation visits were made before the final conclusion to provide first hand information about the procedures and events that occur in the antenatal clinic, and to minimise any pretence and biases in the antenatal clinic work that may be caused due to presence.

Observation was used to help in verifying statements that were made during the interviews, to determine if procedures were operationalised as specified in the procedure guide and to obtain unbiased data that greatly supplemented the oral interviews. Observation provided first hand information about the procedures and events that occurred in the antenatal clinic, and was particularly helpful in determining the various work flow processes and procedures.

3.3 Data Analysis

The data collected, which was mainly qualitative, was analysed using Microsoft Excel 2007.The data was categorized, coded, summarized and displayed in tables, pie charts and bar graphs as simple analysis to determine the requirements for the system. Due to the predominantly qualitative nature of data collected, qualitative data analysis techniques were used. This was opted for mainly due to its applicability because of limited time available. Tasks accomplished included capturing data, generating statistical information, creation of tables and generating graphs needed to interpret collected data.

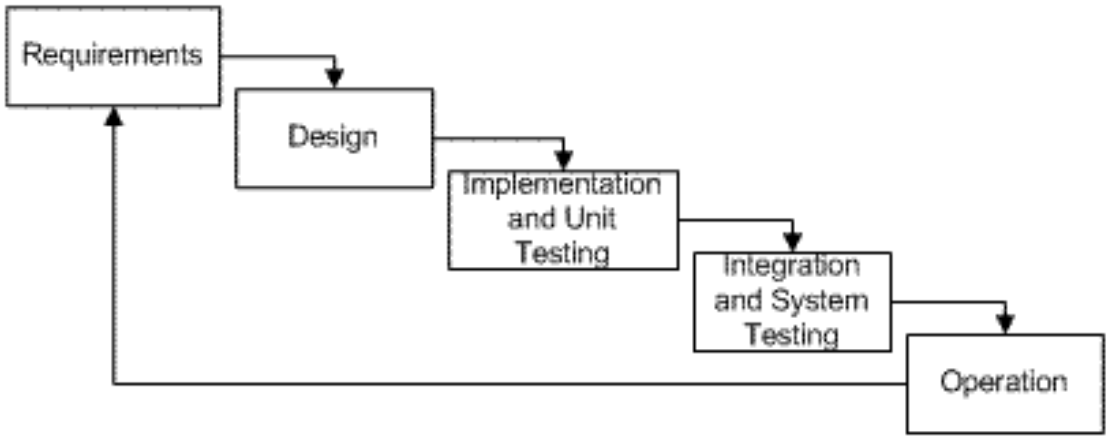
3.3.1 Data Presentation

Data collected has been presented in narrative descriptions and diagrammatic explanations in form of figures, drawn using MS Excel 2007, Visio paradigm, Edraw max7.8 and Microsoft Word.

3.4 Development methodology

Having carefully compared the strengths and weaknesses of the different alternative development methodologies, the researcher used the Incremental Model together with developmental prototyping mainly because Incremental method is a time saving and flexible methodology.

Figure 1: Adiagram showing incremental processes



Source: Software Licensing (1995),

It emphasizes the necessity of adjusting requirements in reaction to knowledge gained as the project progresses. Developmental prototyping is necessary when some requirements can't be fully specified, or when some functionality is unknown or not fully understood. Prototype tools are powerful enough to create a fully functional system. This enabled the researcher to occasionally adjust the application to meet the requirements as specified in the project domain thus ensuring better analysis and design in the Incremental development process. The methodology involves various stages that include requirements specification, analysis, design, implementation and testing as illustrated below;

3.5.1 Requirements Specification Phase

This phase established a clear view of the intended MPBAAMS, feasibility and risks were evaluated to identify the scope of the project. The outputs here determined the inputs for the next phase and these included a detailed work plan with time schedules with respective tasks.

3.5.2 Analysis Phase

This phase was used for organizational analysis to help gather requirements analyse them and use the analysis to build models that would be input for the design phase and these included, functional and non-functional requirements, system requirements and organizational requirements.

3.5.3 Design phase

During the design phase, the researcher used Ms Visio 2010, Visio paradigm, Edraw max7.8 and Microsoft word to define the MPBAAMS design techniques. A Context diagram, Level 0 Data flow diagrams (DFD) and Entity Relationship Diagrams (ERDs) were used to show the clear breakdown of entities, the relationship between them and their attributes. These helped the researcher to capture the functional requirements of the system. The diagrams supported the researcher to get a good start to the system development and provided a good analysis of the requirements.

3.5.4 Implementation phase

MEAN JS stands for (Mongo, Express, Angular, and Node java script)

MongoDB is a cross-platform document-oriented database. Classified as a NoSQL database, it eschews the traditional table-based relational database structure.

Angular is a development platform for building mobile and desktop web applications. AngularJS lets you extend HTML vocabulary for your application. The resulting environment is extraordinarily expressive, readable, and quick to develop

Expressjs is a Node.js web application server framework, designed for building single-page, multi-page, and hybrid web applications.

Node.js is an open source, cross-platform runtime environment for server-side and networking applications. Node.js applications are written in JavaScript.

The research used Mongo, Express, Angular, and Node java script (MEAN) because it contains most web development technologies in a single package with small and light Apache distribution. The researcher chose MEAN because it contains AngularJS used for designing user interfaces, NODEJS as scripting language to use at the server end, MONGO DB for

constructing database and is freely available. In addition, it contains Apache HTTP Server, PHP. Now SMS/MMS gateway was used to handle the messaging services.

The entire package made system development easy. The researcher found it easy to design the MPBAAMS interfaces, output reports, screen layouts for dedicated source-document input; inquiry screens for database interrogation, graphic and colour displays and requirements for special input/output device. Message delivery was also made possible through the now SMS/MMS gateway. It was also possible to implement security mechanisms in the developed system.

3.5.5 Evaluation and testing

Testing was carried out during and after system implementation. It was a way of ensuring that the system performed as expected. Testing was both functional and non-functional testing. Functional testing tested activities that verify a specification or function of the code. Non-functional testing tested aspects of the software that may not be related to a specific function or user action, such as scalability, behaviour under certain constraints, or system security. Compatibility testing was also done by running the MPBAAMS on different machine environments.

Testing

3.6 Conclusions

This chapter highlighted the selected research approach, tools and techniques that the researcher used for data collection, analysis, design and construction of the MPBAAMS. It also shows the proposed time frame for the scheduled activities.

CHAPTER FOUR: PRESENTATION OF SYSTEM ANALYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

This chapter presents the findings from the research. It analyzes the different antenatal care processes, the challenges found within the business processes and shows the different antenatal care requirements. Further, inferences from the findings of the research are made and suggested solutions of what should be done presented. In addition, the flow of data and information is shown and the current system presented.

A new situation is proposed and emphasis put on data and information system modelling for the new MPBAAMS for the antenatal Clinic at Lubaga Hospital. Steps that were used to develop the MPBAAMS that will be used to simplify the communication problems identified and provide detailed specifications of the system elements. The chapter presents the functional design, logical database design, entity relationship diagrams, physical database design and user interface design.

4.1 Organizational structure

Lubaga hospital is a catholic founded hospital. The hospital is managed by a hospital administrator. The administrator is answerable to the hospital management Board. The board is answerable to the Episcopal conference of Ugandan. The Hospital Medical superintendent supervises six service units. Each unit has various departments. The antenatal clinic is run by the nursing department in close collaboration with other departments that support their activities.

Organisational structure of Uganda Martyrs Hospital Rubaga Antenatal clinic hierarchies

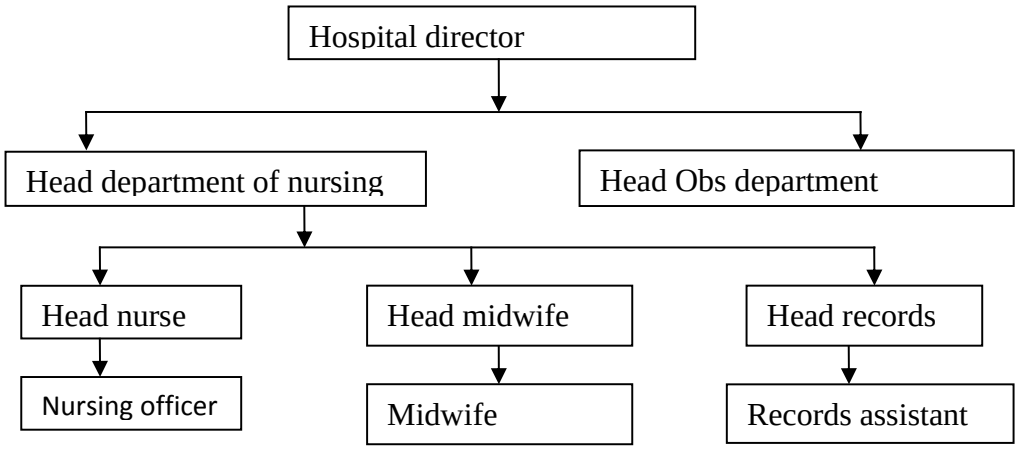


Figure 2: The Antenatal clinic hierarchy in Rubaga Hospital

***Source: Hospital HR manual*.**

Activities of the antenatal clinic include the following, receiving mothers that report for antenatal care on a daily basis. First time mothers are tested for pregnancy confirmatory tests, if found positive, they are registered for Antenatal care services and given antenatal cards. The nurses and midwives then record the mothers bio data, social and health histories, take physical examinations of the mothers and give antenatal education to the mothers. Mothers seen to have complications are sent to doctors and gynaecologists for further scrutiny and expert advice and care. The mothers are advised on return dates according to their conditions. These dates are recorded on the antenatal cards and the antenatal register. The records clerks then use the data on the antenatal register to fill the antenatal tally sheets, compile weekly and monthly antenatal reports that are used for planning and decision making at higher levels of management. The antenatal clinic is headed by the principal nursing officer who reports to the hospital administrator. The principle nursing officer heads the nursing department which owns the antenatal clinic. The principle nursing officer supervises all the staff of the antenatal clinic. These are the head nurse and all nursing officers, the head midwife and all midwives and the records clerks. The antenatal clinic works closely with the obstetrics and gynaecology

department that provides the doctors and gynaecologists and a theatre for operations during antenatal care or at child birth or for postnatal treatment.

4.2 The current Antenatal care flow

Currently, the antenatal clinic uses a manual paper based data management system. All records concerning pregnant mothers and their progress are captured on antenatal cards. An antenatal register is kept at the clinic.

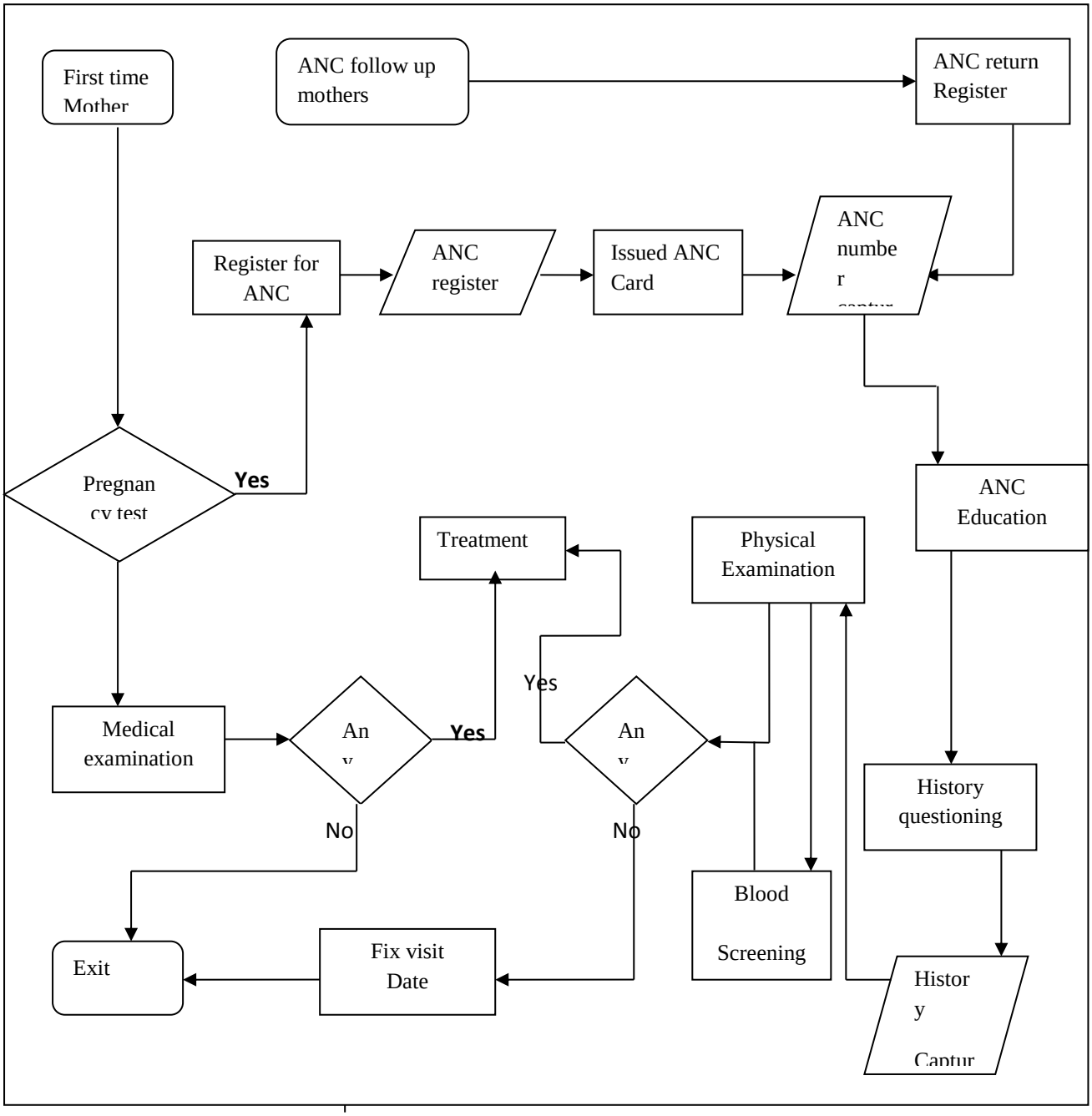


Figure 3: Current system flow

4.3 Requirements Gathering

This helped in determination of end-user requirements; it involved a thorough analysis of data findings from the research and a careful study of the current ANC system processes. A combination of the two, informed requirements of the proposed MPBAAMS

4.3. Data Analysis

Interviews, document reviews and observation were helpful in understanding the ANC situation. Nurses, midwives, doctors, data clerks and mothers were interviewed with the purpose of finding out their opinion about the current way of antenatal care service delivery and what they would like to see change about the current process. Data was collected from twenty five respondents respectively as indicated in the table below.

Table 3: Respondents Distribution by Category

Respondents Distribution	
Respondent category	**Number**
Doctors	1
Nurse	5
Midwife	7
Mother	20

Source Field data 2015

An investigation to find out factors that determine attendance of antenatal care was done across the different respondent categories. The results from the investigation are presented in the table 5;

Table 4: ANC attendance determinants

Antenatal care Attendance determinant factors	
Reason	**No**
Forget the visit	5
Lost antenatal card	5
Busy no time to line up for ANC	10

Source Field data 2015

Analysis of data about ANC attendance determinants indicated that there is a need for a tool to help the antenatal care and service processes especially to make appointments that can solve time management and make reminders. All the respondents generally pointed out similar reasons for low uptake and utilisation of antenatal services. The reasons are; mothers have no

time since they have work to do and forget the next visit this make them reluctant to go for antenatal care, some mothers lost their cards and fear to go back for antenatal, some are busy.

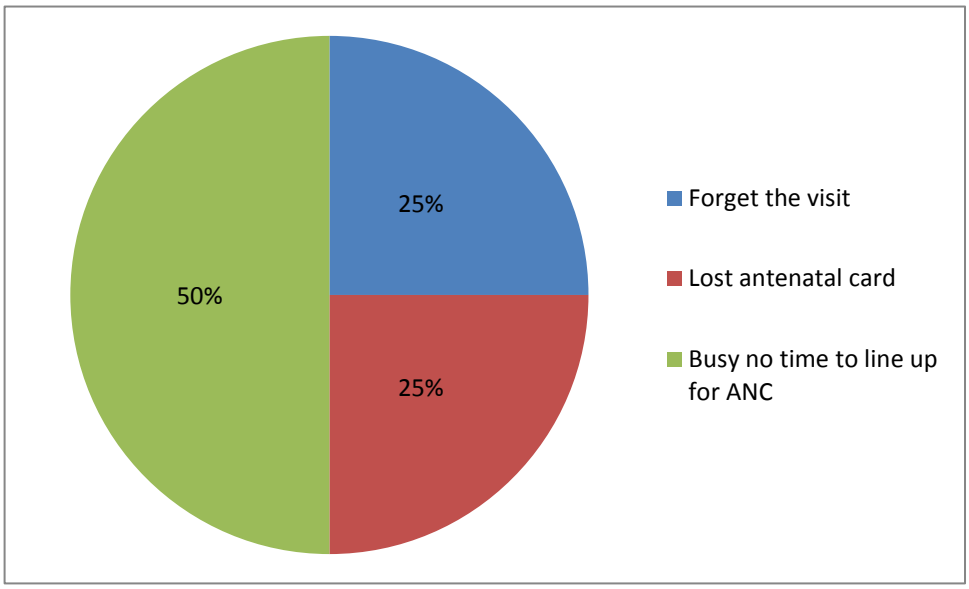


Figure 4: Antenatal Care determinant factors

Source Field data 2015

As noted in the above chart, it shows how buy women are they need streamlined programme in order to allocate time to same activities inclusive antenatal checkups. However these expectant women assume that since they feel fine or healthy it is okay to dismiss these checkups.

The developed antenatal MPBAAMS will remedy this by sending reminders to mothers about their next scheduled antenatal visits. A look at the quality of ANC services was done and the findings were as shown in the table below;

Table 5: Factors determining ANC quality

Reasons for low quality antenatal service	
Reason	**No**
Long queues at the clinic	10
Mother's absenteeism	8
Others	1

Changing rotas	1

Source Field data 2015

Health workers are overwhelmed by the many patients they handle on a daily basis and find it difficult to keep track of mothers and follow up those who miss their antenatal visits. High absenteeism rates of mothers caused by long queues at the clinic, and changing duty rotas of medical workers were fronted as reasons for low antenatal care service delivery and consumption. Due to the long queues, health workers find it hard to fully interact with mothers and so some basic details may not be given to mothers.

Table 6: ANC Improvement Factors

Factors that would improve Antenatal care utilization	
Factor	**Number**
Appointment time	15
Reminders	4
Others	1

Source Field data 2015

Generally, respondents agreed that appointments and reminders to mothers about their antenatal care schedules and other general information would improve antenatal care attendance and uptake. That this would in turn reduce pregnancy complications hence reducing mortality rates of mothers.

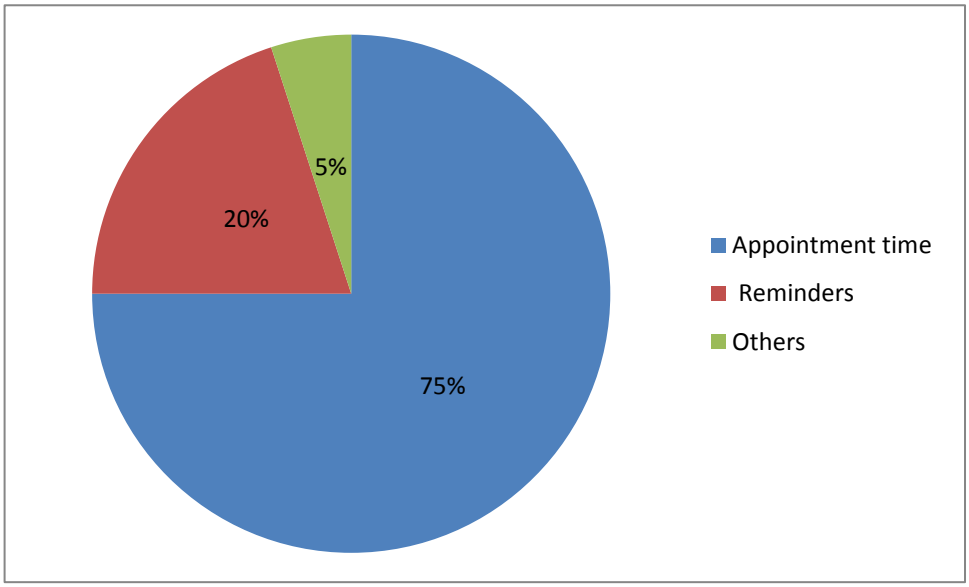


Figure 5: A Piet chart showing factors that can improve antenatal care utilisation

Source Field data 2015

A number of services are given to pregnant women in the various stages of their pregnancies according to trimesters. Each trimester has its own specifications and relevance in the antenatal care process.

4.3.1 Antenatal care current system processes

The researcher sought to understand how antenatal care service processes are executed at the antenatal clinic of Uganda Martyrs Lubaga Hospital.Through interviews, document review and observation, the researcher found out that the process is as follows;

All antenatal care related data is captured on a specialised card called antenatal card designed by the Ministry of Health for all health units in Uganda. The same card serves as a progress form for the pregnant woman for the entire pregnancy duration.

A patient is registered once. After this first registration, they are issued antenatal cards on which their medical records are entered. For the subsequent visits, patients are expected to present their antenatal cards for viewing so as to check on their progress and record more data on them. On every visit, the mothers are screened for various tests as may be deemed necessary. All data

regarding these tests are recorded on the antenatal card.These data capturing processes include the following;

- Serial Number.

A new serial number is given to mothers on the first clinic day of every month e.g.001

- Client Number

On the first day of the first visit a mother is given a client number which is indicated on her ANC Card. If a client is referred from another clinic then the ANC number on her card given to her by the other facility is recorded and the letter R is added at the beginning to show referral and to differentiate her from another client in the facility who may have the same number e.g.R002

- Name and age of the client

A mothers'full name is recorded. The age is captured in full years

- Address / Village and Parish / phone numbers

The postal addresses including village and parish of residence for client are captured. If the Village is not known, NK is recorded.But practitioners are advised to remain silent on this as this option may encourage complacence. If the mother has a phone, the phone number is captured, or that of their spouse or next of kin

- ANC visit

Numbers of visits are indicated. For example 1, 2, 3, or 4+

- Gravida / Para

Gravida:This is the number of this pregnancy in sequence.Para:This is the number of pregnancies carried beyond 7 months that the client has had before (exclude the current pregnancy).

- Previous Illness:

This includes a list of possible mothers 'illnesses that may have adverse effects on her health and that of the unborn baby. They are categorised under Medical and surgical illnesses.

- OBSTETRICS/GYNAECOLOGICAL

Information about a mother's previous obstetrics and gynaecological history is captured. These are considered important in determining the type of care the mother needs to receive.

i. Social History: Information like Smoking, Alcohol and husbands health is captured.
ii. Family History: this captures family characteristic disorders, like diabetes, sickle cell disease, epilepsy, hypertension and twins
iii. Menstrual and Contraceptive history: length and amount of menses and family planning methods ever used are captured.
iv. Present Pregnancy: the day of Last Menstrual period is capture. This helps in estimating the expected date of delivery. Period of gestation, complications and ailments are also recorded.
v. Physical examination: this involves capturing height in centimetres, weight in kilograms, Blood Pressure, Pulse, Temperature, Nutritional status and any other deemed relevant
vi. Pelvic examination: this involves involved screening of the vulva, vagina, cervix and moniliasis.
vii. Previous obstetric history details
viii. Antenatal progress examination details
ix. Ultra sound reports and dates

4.3.2 Antenatal care roles

Table 7 below shows the various roles/tasks done by the different categories of stake holders in antenatal care service delivery.

Actor	Summery	Description
Doctor	Individual responsible for diagnosing and treating extreme medical cases	Responds to and manages extreme maternal health Cases Views a pregnant woman‘s medical records and reports
Nurse	Individual responsible for handling ailments, immunizations, aids patients in medication	Register mothers views existing mother and pregnancy medical records Modify and updates a mothers medical records. Refer extreme medical cases to the Doctor.
Midwife	Individual responsible for monitoring and maintaining the health of pregnant women	Register pregnant women Screens women Views patient‘s antenatal medical records Modify and update a pregnant woman‘s details Refer extreme medical cases to the Doctor.
Pregnant Mother	Individual who carries a pregnancy and needs antenatal care services	Attends antenatal care

Table 8: Current Antenatal Care roles

Source Field data 2015

4.3.3 Challenges of the current system

All procedures are paper based. At the antenatal clinic, all data about a mother and her Pregnancy, screening results, next date of ANC visit are recorded on an antenatal form and books. These forms are sometimes misplaced, forgotten or lost by mothers. The forms and books make it difficult to keep track of mothers ANC attendance since information retrieval form them is hard. Disseminating important information to mothers is also difficult with this way of operation.

A lot of time is spent while recording data on antenatal cards, then some of that same data on

the antenatal register. More time is spent on the tally sheets and compilations of data summaries to produce weekly, monthly quarterly and annual reports. These processes are hectic and are liable to errors.

A mother‘s antenatal information is typically dependant on the antenatal card carried, should the card be lost, then all historical antenatal information is lost. Mothers tend to forget their next antenatal visit dates and end up missing the visits.Follow up on defaulting mothers becomes difficult due to hardship in retrieving next appointment dates from the antenatal registers.

There is therefore need for an application that can support antenatal care by reminding mothers about their antenatal visits and making appointments with the clinic, to improve antenatal care service providers especially about defaulting mothers. There is low utilization of antenatal care services by many pregnant women in Uganda. This has contributed to the high maternal and infant mortality rates in the country.Despite antenatal care services being offered for free at public health facilities, many women still find it difficult to attend antenatal care for even the four minimum recommended times of Focused antenatal Care.Many reasons have been fronted for this trend, among which are much time spend on the clinic and forgetfulness of mothers about their next visit appointments.

The Antenatal care clinic at UMR H is in need of systematic computerised information system that will enable them to monitor the clients registered with them. The Clinic will need to track clients from the point of registration through the various services that are offered to the point when a client either gives birth, transfer out, drops out, dies or is lost to follow-up.There are delays in serving the patient at the clinic this causes inefficiency in work processes

4.4 Requirements of the proposed MPBAAMS

The data collected from respondents through interviews, observation and literature review enabled the researcher to provide a description of the current system and extract its weaknesses. This then informed requirement for the proposed MPBAAS with SMS as specified below.

4.4.1 Functional Requirements of MPBAAMS

The application should capture processes and store patient (pregnant mother) information.

The application should permit the querying of patient records by authorized users.

The system should generates patient reports

It should allow users to view patient information as needed.

The system should send SMS text messages to respective patients when necessary.

The application should compute estimated date of delivery.

It should schedule the clients visit to the clinic

The system should capture all data pertaining to antenatal care of a patient (pregnant mother).This ranges from the registration details, the screening details, the patient‘s progress and the treatment processes.

The system should be able to keep track of each client and the services provided to them

Its should check and eliminate duplicates so as to ensure data integrity

The system should be able register its users (staff of the antenatal clinic).

4.4.2 Non Functional Requirements of MPBAAMS

The system should allow access to only authorized users who are expected to have a username and password

The system should be secure.

The system should be scalable in case of the need for some more additional features in future thus allowing for extensibility.

The system should be easy to maintain.

The system should be fast to allow for efficiency when accessing or entering information.

The system should be easy to learn and use by its users.

The system should be portable so that it may easily run on most operating systems

The data output should be accurate since the input data is validated.

4.4.3 System Use and Access Requirements

The system should provide access levels for all its functionalities, Administrators should be able to manage all authorized access and should know who to do what in the system.Non authorized users should be denied access to the system; while authorized users should be able to access it. This will ensure that all levels of access to the system is limited to users as Specified by security regulations thus preventing unauthorized persons from accessing the system. Each user is assigned a username and password and once one of the two is wrong during the time of logging in, the system should prompt for the right credential or else cannot continue.

Administrators should have full access to the system i.e. create users, edit/update and delete records, while other users should not be able to create users, delete records from the system.

4.4.4 Software Requirements

The **MPBAAMS** system requires minimum software requirements as listed below;

- Operating system: *mean.js*
- Databases: Mongodb
- Servers: Nodejf NowSMS/MMS gateway
- Browsers: Internet explorer, Mozilla Firefox, Google chrome, Opera, Safari and others.

4.4.5 Hard ware Requirements

The MPBAAS system requires minimum hardware requirements as listed below;

- Processor: dual core 2.4 GHz (Core Duo Intel processor)or higher

- Memory: 4 GB of RAM or higher

4.5 Proposed system Design

The MPBAAMS is supported by the proposed Antenatal Care Management Information system with a message services. The system will be used by the system Administrators, doctors, midwives and clients/mothers in execution of their duties.

4.5.1 Use case Diagram

This highlights the users of the system and their roles on the system. In this case, MPBAAS will have four categories of users. These are; Systems administrator, Doctor, mothers Midwives/nurses.

Figure 6: MPAAMS Use Case Diagram

4.5.2 Context Diagram

This is the highest level of representation of the MPBAAMS. The diagram shows the system

and how it interacts with the external entities. It further shows the data input into the system by the entities and data output from the system to the entities involved. The input and output actions are represented by arrows.

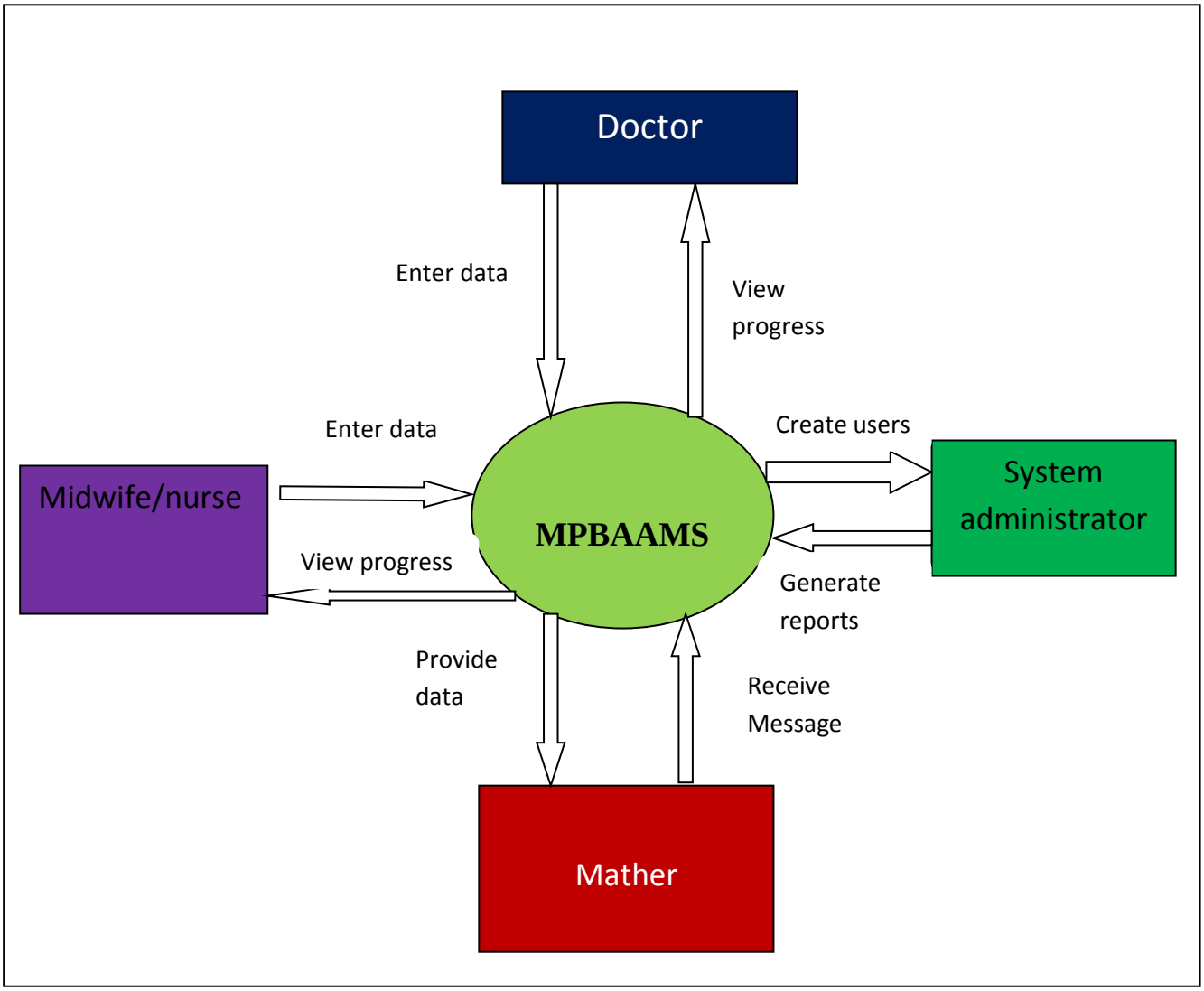


Figure 7: MPAAMS Context Diagram

4.5.2 Level 0 Data Flow Diagram

The level 0 diagram illustrates system user / actors, the processes performed and the respective data stores of the Antenatal care Management Information system with short service messages.

Level 0 Data Flow Diagram

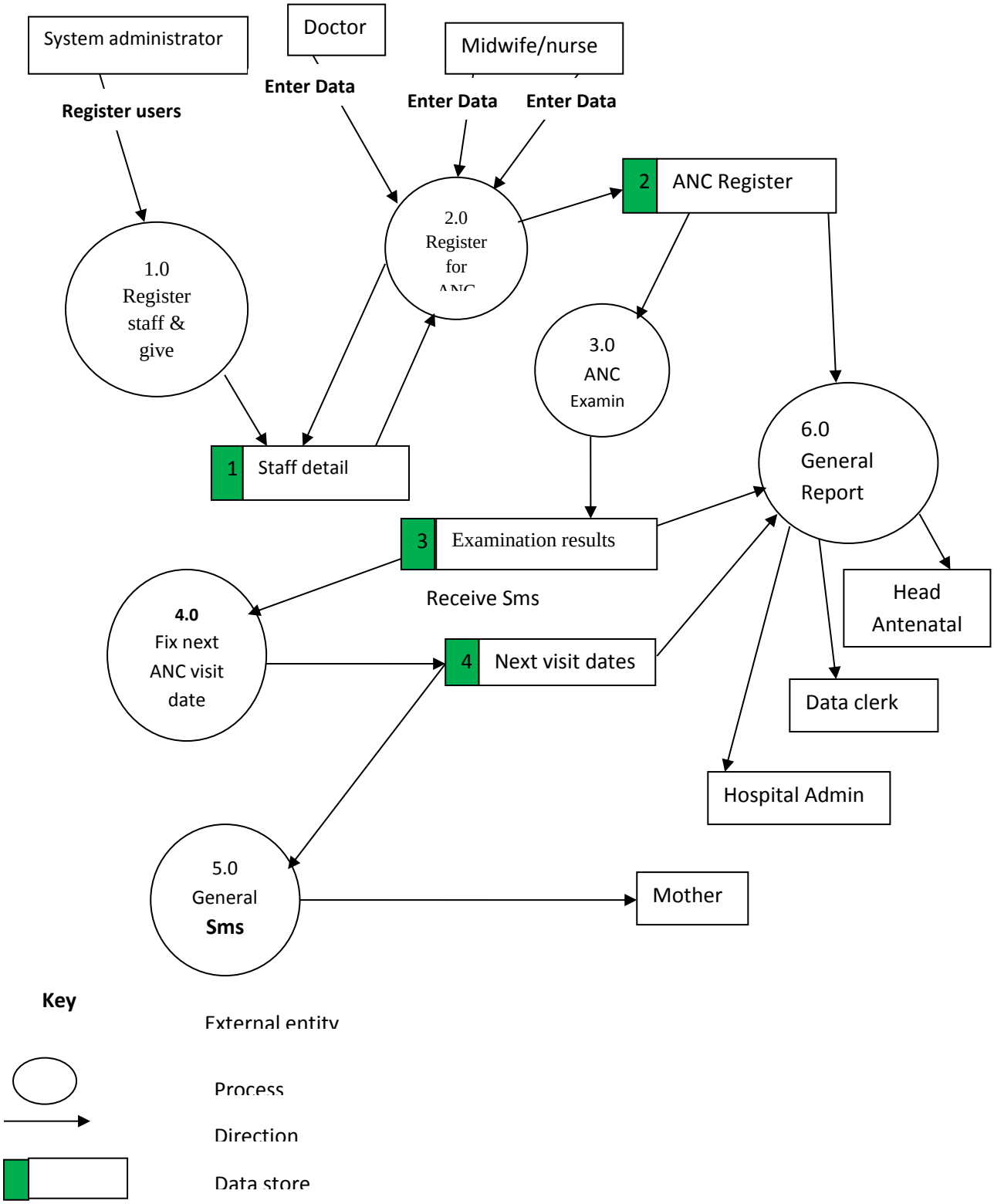


Figure 8: Figure: Data Flow Diagram

A data flow diagram (DFD) is used to reveal relationships among and between the various components in a system. A data flow diagram is an important technique for modelling a system's high-level detail by showing how input data is transformed to output results through

a sequence of functional transformations

4.6 Functional Design

- The MPBAAMS will allow authorised users to log in and block un authorised users from logging in.
- The system will capture processes and store patient (pregnant mother) information.
- The MPBAAMS will permit the querying of patient records by authorized users.
- The system will generates patient reports
- The system will allow users to view patient information as needed.
- The system will send SMS text messages to respective patients when necessary.
- The system will compute estimated date of delivery.
- The system will capture all data pertaining to antenatal care visits of a patient (pregnant mother). This ranges from the registration details to health treatment processes.
- The system will keep track of each client and the services provided to them
- The system will check and eliminate duplicates so as to ensure data integrity
- The system will register its users (staff of the antenatal clinic).

4.7.2 Entity relationship Diagram

The ERD presents all entities that make up the MPBAAMS. It high lights all entities, attributes and associated relationships. The ERD gives critical analysis of the database to avoid redundancy and build a data model that will result in a database t hat is flexible and can be extended.

4.7.3 Physical database design

The physical database design translates the logical data model into a set of Mongo db statements that define the database. The physical design of the database specifies the physical

configuration of the database on the storage media. Below are the Mongo db code that is used in the implementation of the physical database of the MPBAAMS,

4.8 User Interface design

The user interfaces will help the user access the system. It provides a user-friendly format with which the user can interact with the database in order to provide the services that they need to provide.

4.8.1 The Log in Form.

Access to the system will only be to members registered on the system. They will have All users login using the same login form; which require username and password of the user. Below is a sample design of the login form.

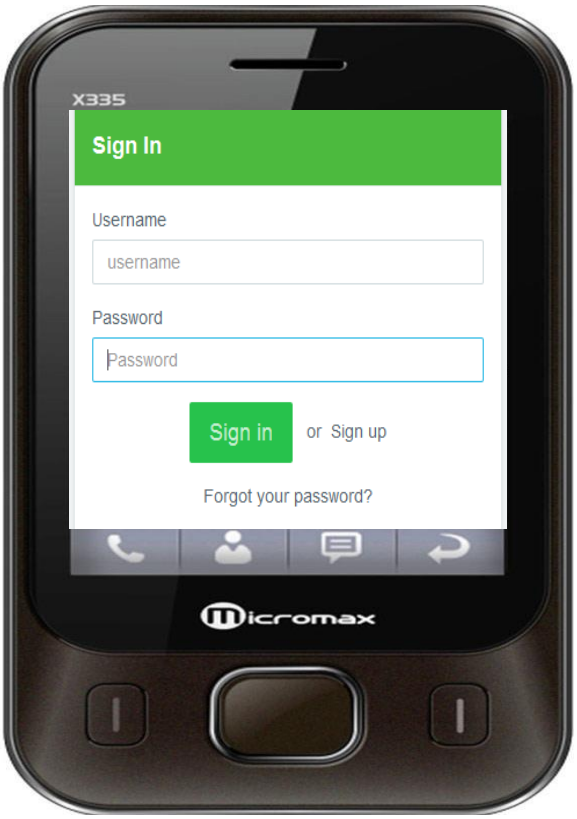


Figure 9: Login form

4.8.2 User Registration Form

All system users must be registered by the systems administrator before they can use the system. These will be Antenatal clinic staff at UMLH. Below is a design of the form that will be used to register them

4.8.3 Patient registration form

This is used to enter first time visit mother details into the system. It helps in putting data into the database

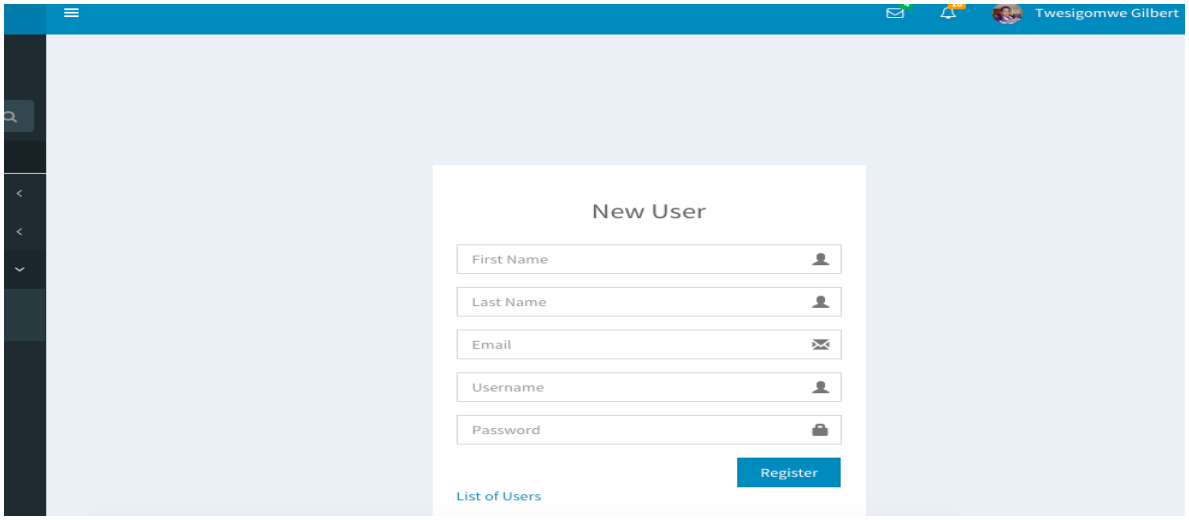


Figure 10: User Registration Form

4.8.4 new appointment form

This form is used to capture mother‘s new appointment to the clinic

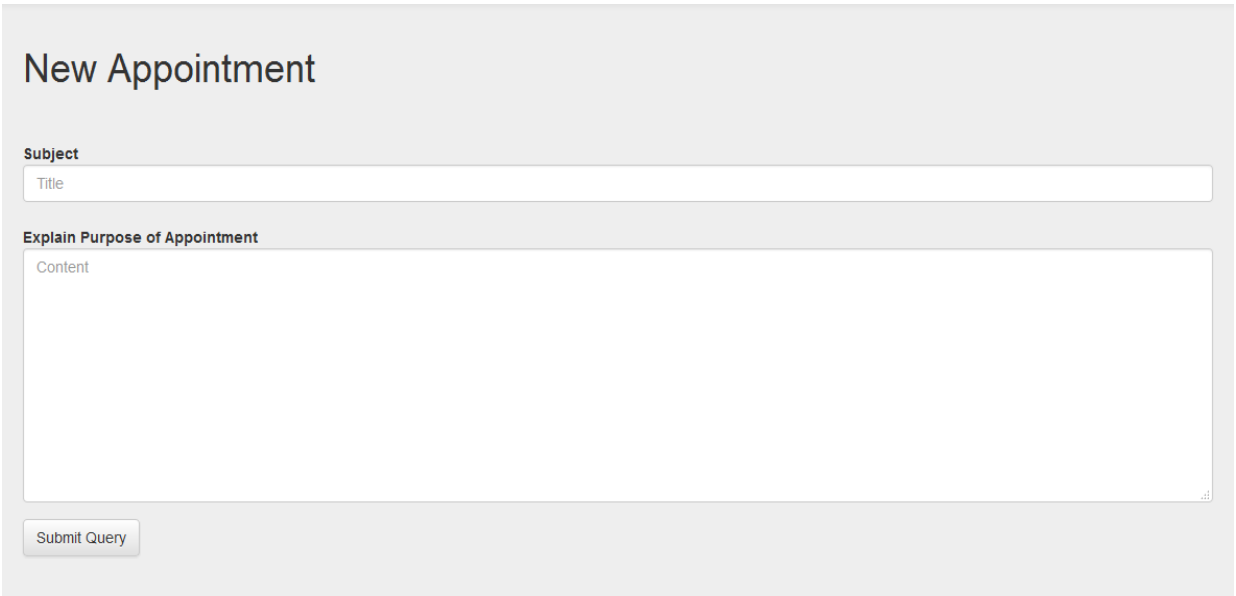


Figure 11: New appointment form

4.8.5 Appointment form

This form show already captured appointment information

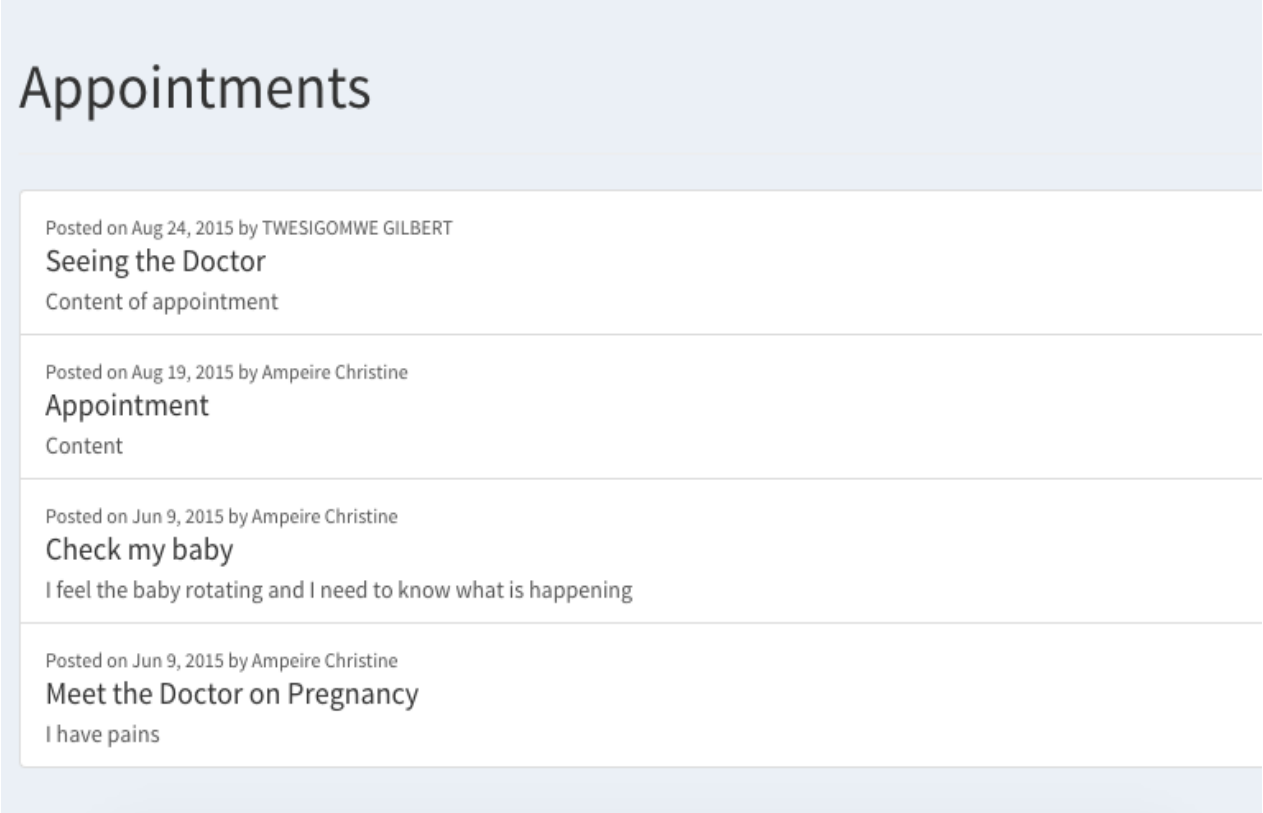
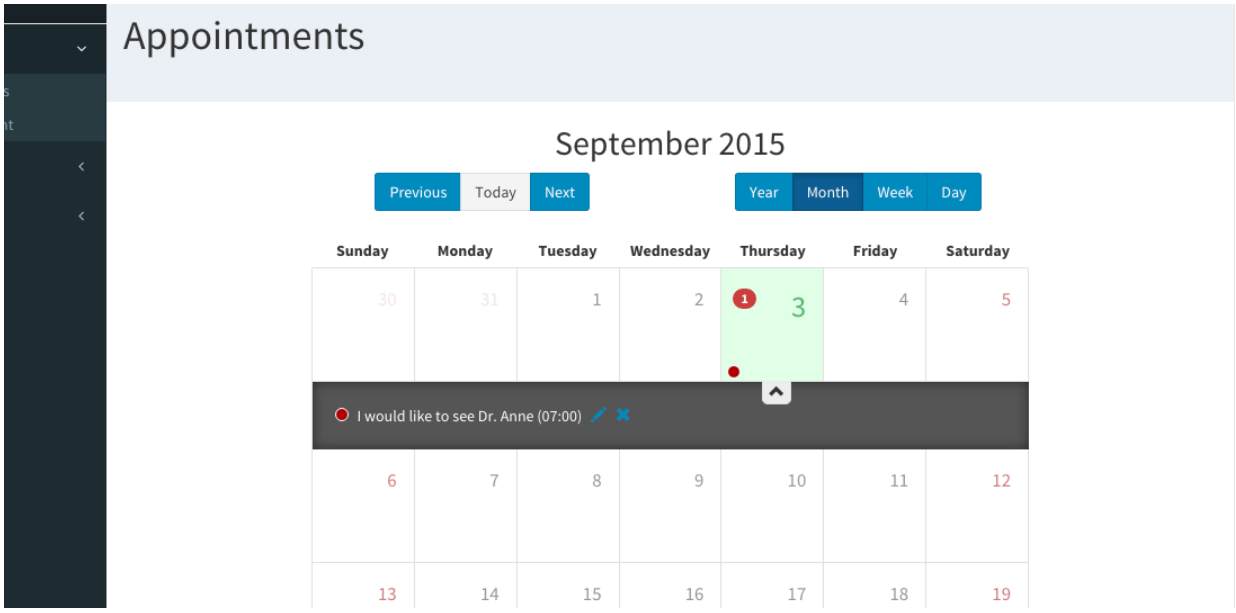


Figure 12: showing already captured appointment information

4.8.6 Appointment form used to select the day

This form is used to choose appointment day to visit the clinic

Figure 12: appointment form to choose the day



4.8.7 Edit Appointment

This form is used to edit appointments days of visiting the clinic

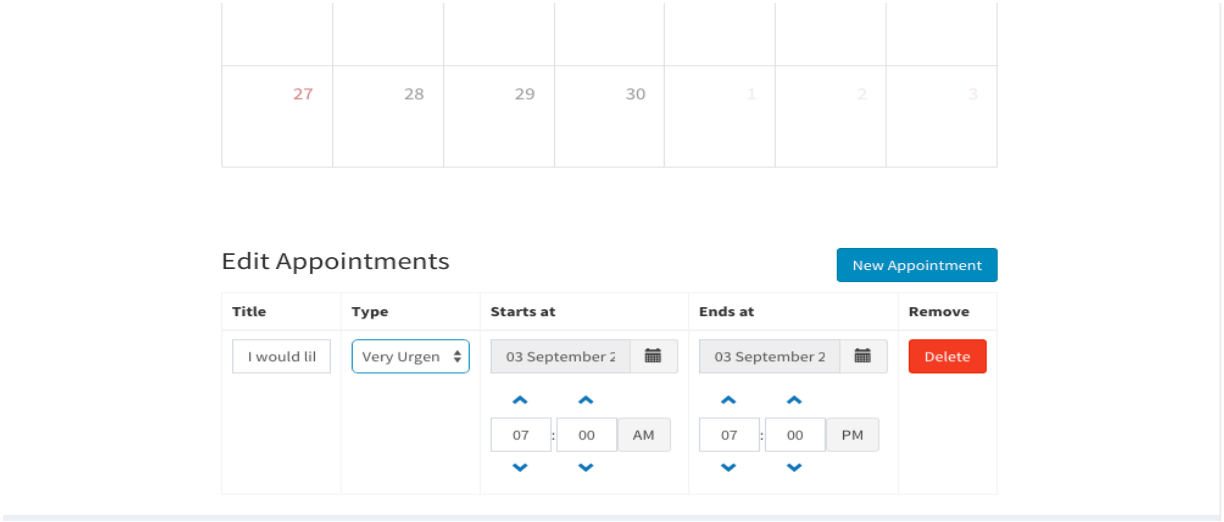


Figure 13: A form to edit appointments

4.10 Network and System Architecture

The Network and System architecture defines the technical environment of the system. It incorporates the network connection model, hardware and software specifications, design tools used and the security design. Figure 14 below is an illustration of the components and how they fit together. The network modal describes the communication infrastructure on which the new system is to operate. The components of the model include;

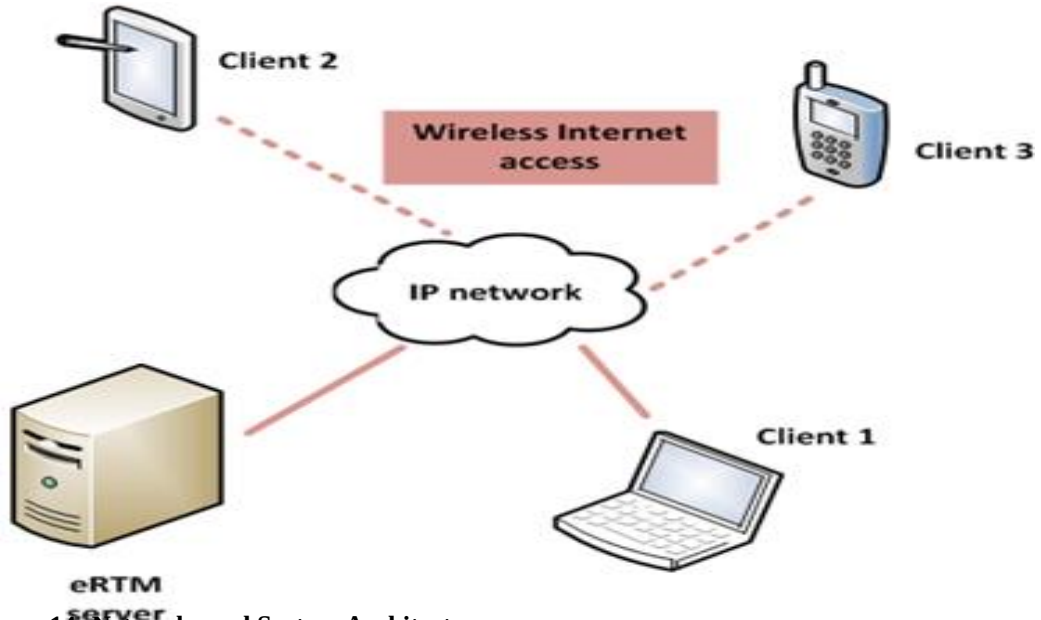


Figure 14: Networks and System Architecture

The MPAAMS registered users have access to the system and use it to capture details to the patient details to the data base; they can as well query the database for reports. Staff can send messages to patients‘ mobile phones the SMS gate way communicates with the telecom companies SMS server to deliver the SMSs through the telecom network. The MPBAAMS follows a multi-tier approach to application architecture as depicted in below, where a tier is a logical partition with a unique responsibility in the system. The architecture adheres to open standards, follows multi-tier architecture and service-oriented architecture, an architecture that supports communication between services and involves coordinating activities.

Figure: showing System Architecture

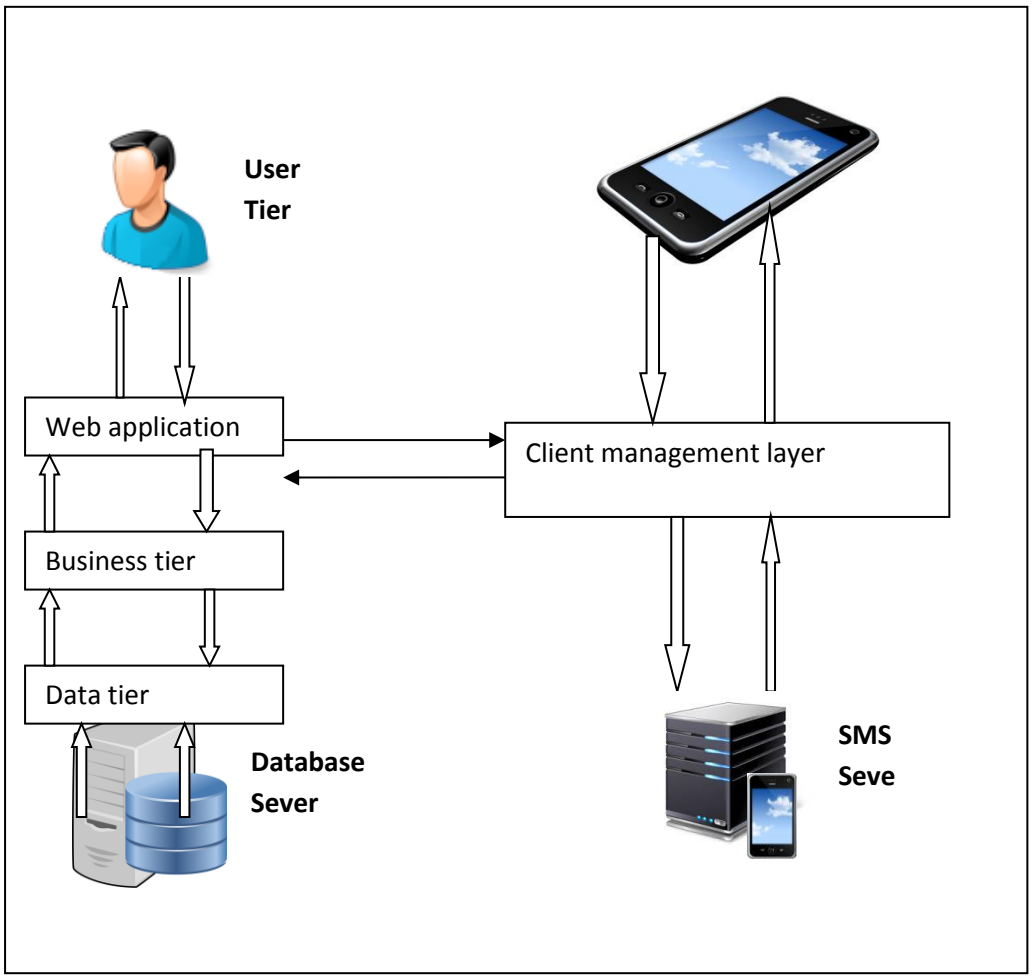


Figure 15: System Architecture

CHAPTER FIVE: SYSTEM IMPLEMENTATION

5.0 Introduction

This chapter describes and shows how the MPBAAMS designs were transformed into a working system. the designs from chapter five were translated into code and the physical realization of the database and the application designs to interface the user with the database were completed. Included here are; the overall implementation plan, code used, technical documents, details of the testing process and testing results of the system. It also gives support plan and maintenance future plan of the system.

5.1 Implementation Plan

This section shows the different activities, deliverables and tools that were carried out during the implementation of the system as listed in the table.

Table 9: Implementation Plan

Activity	**Deliverables**	**Tools Used**
Programming	-System code implementing application design components. -Main menu, data entry forms and report generation. -Link client interface to database	-Operating system: *mean.js* -Databases: Mongodb -Servers: nodejf SMS/MMS gateway
Testing	Implement test plan -Inspection of code for predictable errors -Review of the system / walk through -User testing of the system with simulated data -Security testing /Authentication	Operating system: *mean.js* -Databases: Mongodb -Servers: nodejf SMS/MMS gateway Ms word.

Installation **Plan**	Hard ware installation -Installing and upgrading hardware Software installation - Installing of mean.js - Install MPAAMS files - Validation of installed system functionality	Network servers

Source: field data 2015

5.2 Tools used in implementation

The system (mobile application) is hosted on a server running apache web server and Mongodb database management system. All users will access the system using a mobile phone web browser of your choice. Each user requires a mobile phone or a computer with internet connectivity with enough credit/airtime to meet the SMS charges.

5.3 Data Base Implementation

The database management system used was Mongodb, bootstrap user interfaces was used to create the database and all tables. All tables have primary keys and where necessary, there are foreign keys to ensure data integrity.

5.4 User Interface and business Logic

For the user interfaces/front end and logic, Bootstrap was used as the programming language embedded in JavaScript. Sample forms developed are:

The Log in form:

The login from allows a user to supply their user name and password so as to have access to the system.

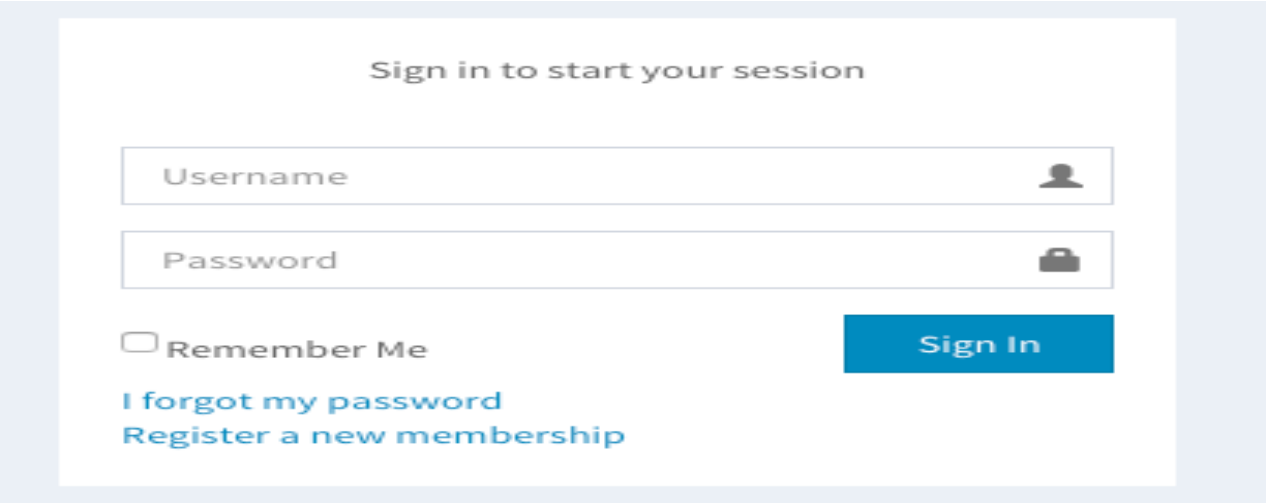


Figure 16: Log in form

If any of the entered username or password is wrong, access is denied. A user is given an error message and asked to try again as shown below,

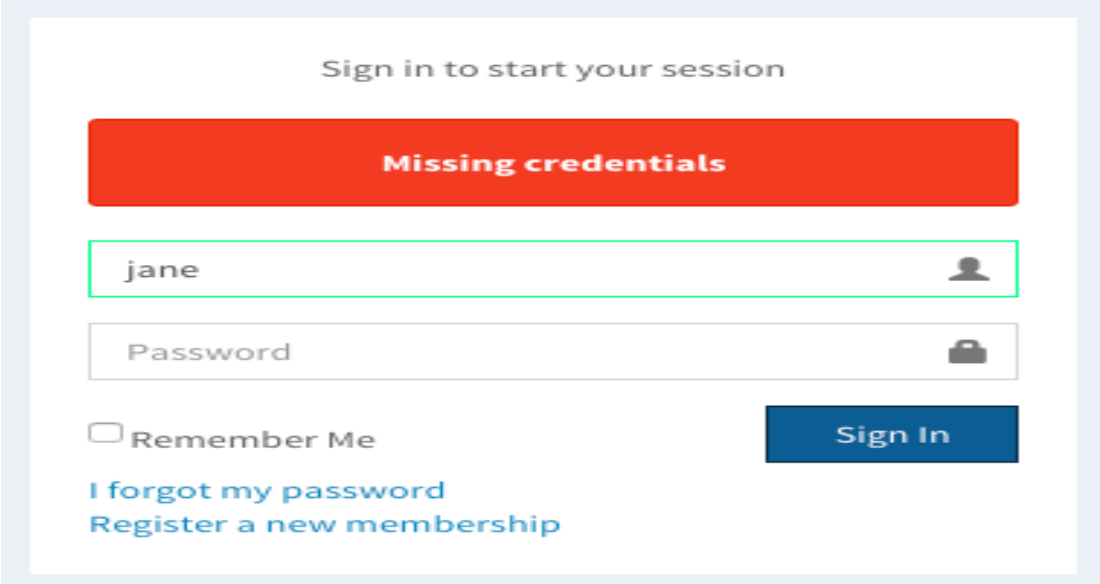


Figure 17: Log in error message

If the log in is successful, the users are allowed to do the various tasks that they are allowed to do on the system. These are according to the user type and privileges granted to the type of user account. Before users are allocated user names and passwords and allowed access to the system, they must be registered on the system. The form below is user for registering system users.

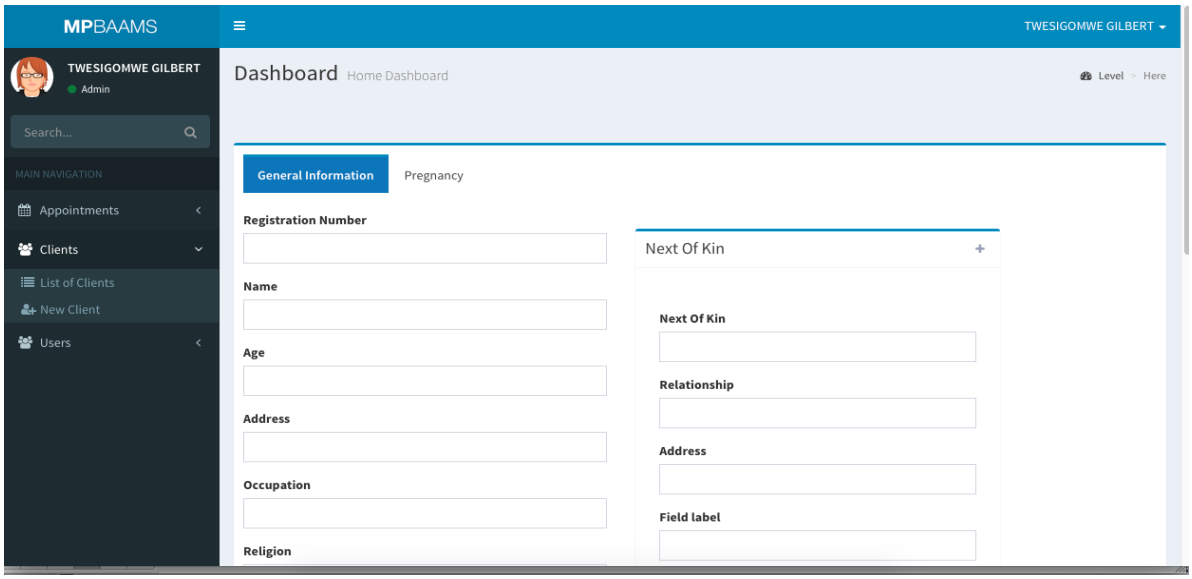


Figure 18: User registration form

After a mother has been registered, relevant examinations are done on her, and these are captured into the system using the antenatal progress form. The date of the current visit is captured, and the next visit date is determined at this point by the health worker and entered into the system. This is typically dependent on the health workers 'assessment of the patient and the condition observed.

As mothers progress with antenatal care, it may be necessary to make appointment send extra messages to them, like health tips, nutritional tips, announcements and any other messages as need may arise.

Messages are sent to mothers either in their categories, thus first, second and third trimester. Or the messages can be personalized to individual mothers. The interfaces below are used

The system also gives a report of all mothers enrolled to the system and some key information about them as interface below shows;

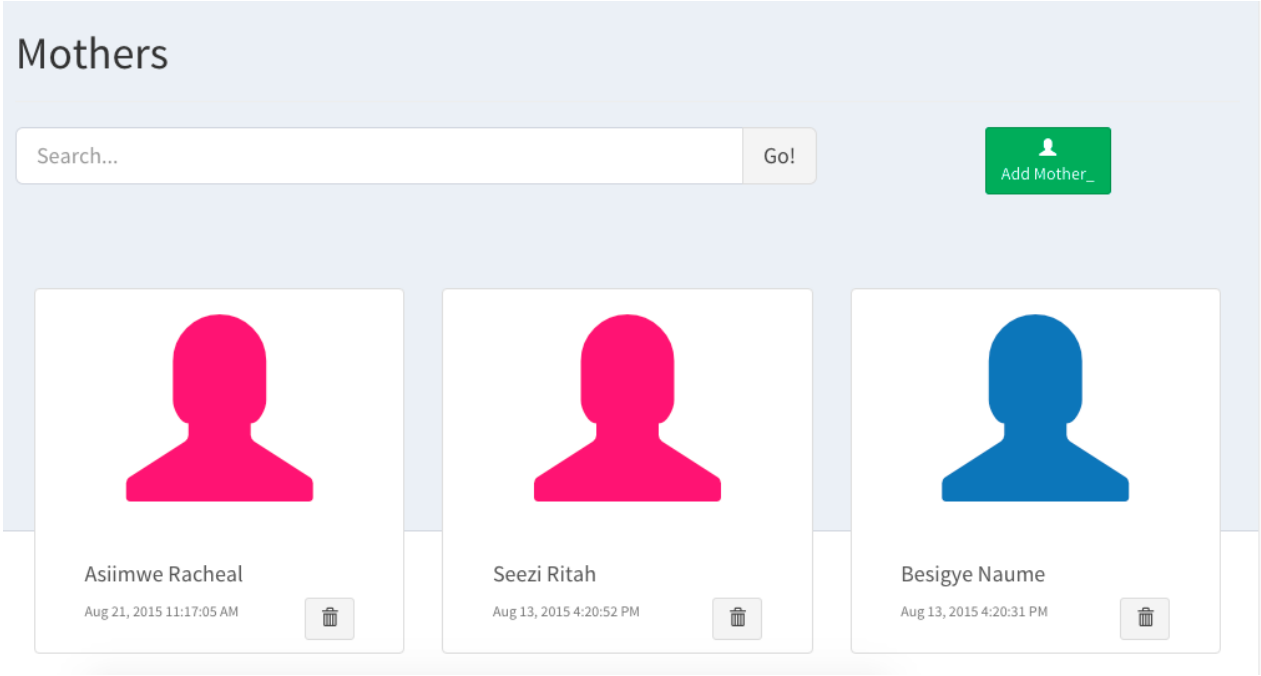


Figure 19: Registered mothers report

5.6 System Testing

This activity involved the execution of the application programs with the intent of finding errors and make sure the system satisfies the requirements before installation. Carefully planned test strategies and realistic data were used to show the following: System program faults, database structure faults, performance requirements faults, and ensure that the system was working according to the specifications.

Testing steps

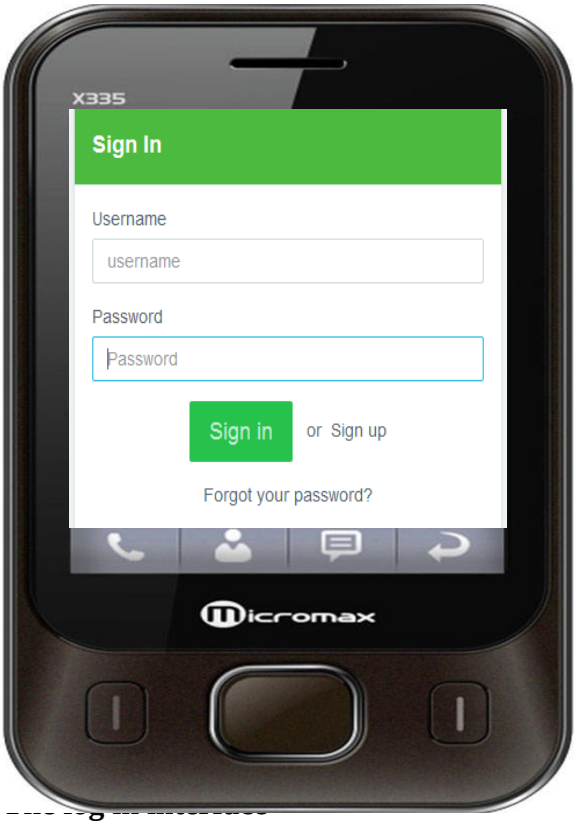
System Test Plan

- Installation/access
- Testing all interfaces
- Test reports

- Installation/access: **Mobile phone based antenatal appointment management system is accesses online bellow is the long in form on a mobile phone**

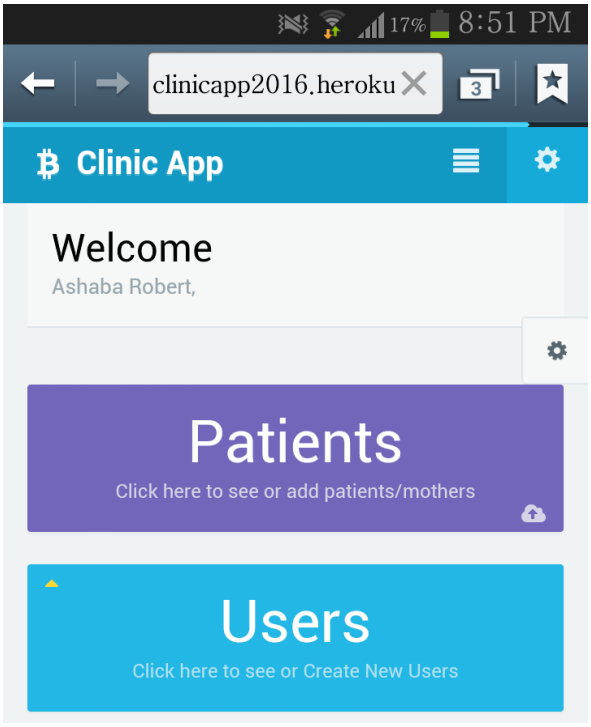
- Testing all interfaces: how all interfaces and forms work.

The sign in or sign up form



The interface above help users to sign in the system

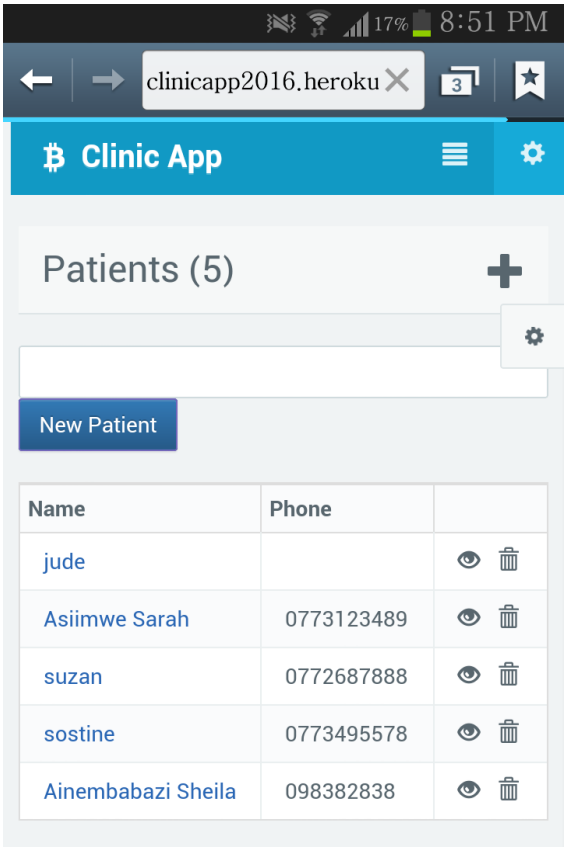
The welcome/home form



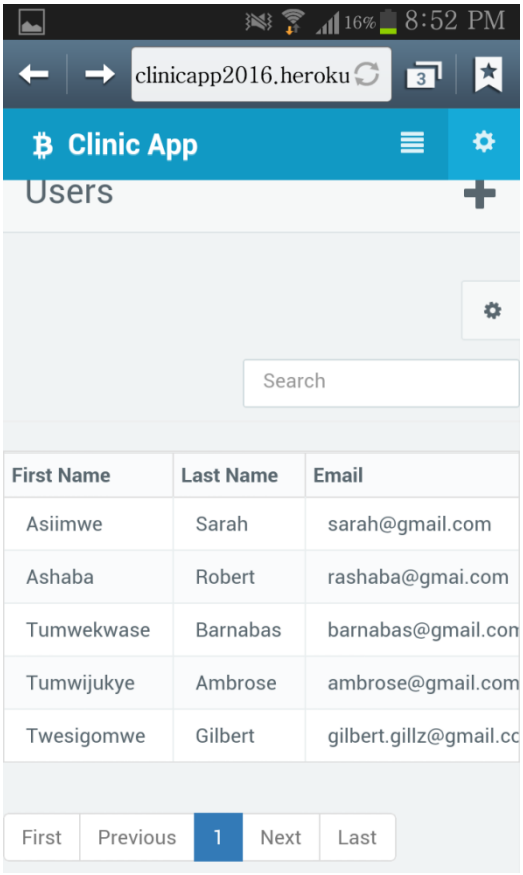
The welcome/home form

Interface provides user options

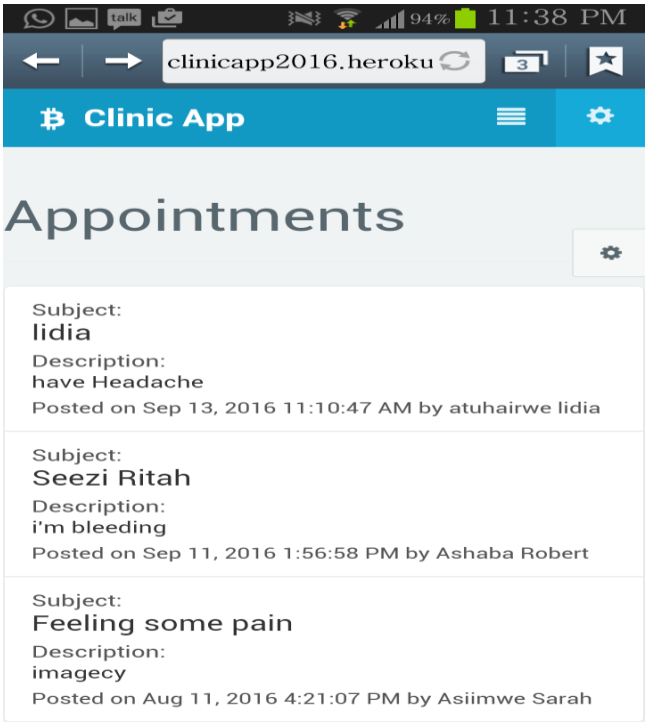
The Patients report this shows the information of the patients



The user report



The Appointments report



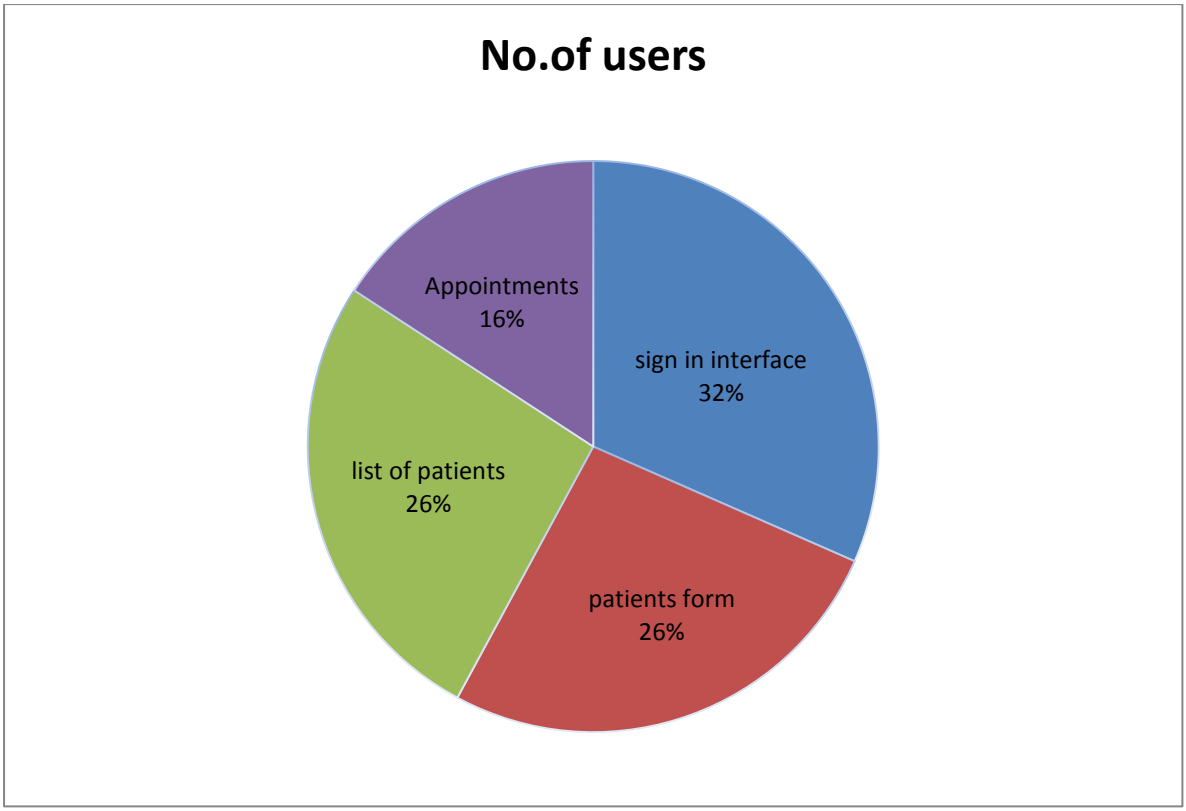
Item to Test	Test Description	Responsibility	No. of users
Sign in interface	Users who have signed in the system	Users	6
Patients form	How to use in logging inn the system	To use the system	5
List of patients	Produce the patients report	To use the system	5
Appointments	Produce the appointment report	Make appointment	3

Table showing test reports

- Test reports: Shows all different results from sub-systems

Item to Test	No. of users
Sign in interface	6
Patients form	5
List of patients	5
Appointments	3

Table showing test of items and Number of users



The chart showing items and number of users

Patients form: showing the number of who have successful registered compatibility testing was conducted on the MPBAAMS prototype to evaluate the application's compatibility with various computing environments.SMS testing was also done to ensure that the messages are sent and received by the right recipients instantly. End users and the designer were involved in the thorough testing process, which was critical in ensuring that the MPBAAMS meets user requirements and that those involved in testing would identify weaknesses beforehand. Procedures were also put in place to ensure correction of defects was done quickly and all corrections or modifications clearly documented as is necessary to maintain the integrity of the overall program documentation.

5.7 Installation Plan

Installation will involve both hardware and software installation. New Hardware will be procured for the antenatal clinic. These will include; Mobile phones, servers and printer,

webcams, router, switches, network cables, access point and cellular modems and connectivity lines.

The following software applications will be needed to have the MPBAAMS running effectively; Windows XP, Android platform, Linux or newer operating system, AMP server package, any web browser but preferably Google chrome and SMS/MMS gateway for the message service.

5.8 System User Training

Training will be implemented after the system has been installed. The training will target system administrators on how to install, configure and maintain the new system. Once the system is fully implemented and launched, system users at the antenatal clinic will be trained on how to use the MPBAAMS. Trainers will use PowerPoint presentations along with hands on practice to train users on how to use the system. Adequate training must be given before authorized users are allowed to use the system in the real antenatal care clinic environment.

5.9 User support

MPBAAMS users may encounter difficulties when interacting with the system and therefore the system must enable users to deal with and manage difficulties as they arise. In regard to this, the system developer will develop the training manual and documentation of the systems prior to handing over the researcher project. This means change management, implementation checklists, project management documentation, test scripts, and similar documentation and training are needed for the complete and final handover.

5.10 System Support

MPAAMS like any other system may not be perfect. There are many reasons that may necessitate change on the system. It could be corrective or improvement change. Any change could happen because of some unexpected input values into the system. In addition, the

changes in the system could directly affect the software operations. The software will be developed to accommodate changes that could happen during the post implementation period.

The maintenance activity involves making changes to the existing system modules and documenting to support its operational effectiveness.

Types of maintenance anticipated will include: Perfective maintenance thus improving efficiency by making changes to improve the system‘s performance, Corrective maintenance to fix errors, Adaptive maintenance; to add new capabilities and enhancements like enhancing security. It may also include Preventive maintenance to reduce the possibility of future system failure. During maintenance, it will be essential to determine the type of request. Whether the request is an: Error, adaptation or enhancement. To ensure modifications do not disrupt operations or degrade a system‘s performance or security

5.11 Backup and Disaster recovery plan

The MPAAMS will have the capability to perform routine backups of the data in the system. The data backups will be done to a storage media that can be stored off site and should also Provide for the ability to do backups to remote connected devices as well. The system will provide for data restore and recovery capabilities as well.

5.12 Conclusion

Given the nature of intended usage and audience of MPBAAMS the fitting application type for the system had to be a web based application with SMS gateway functionality. Being so it makes it quick to roll-out, easy to support and access. The future of the MPBAAMS is to have it used by all Antenatal care clinics that will take the same approach of managing antenatal care. The design took into consideration all web browsers but the preferred web browser is Google Chrome.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter provides a summary of what has been achieved by the implementation of this research project. In it, the researcher provides what was achieved, the challenges faced during the entire process of coming up with the MPBAAMS as well as recommendations for future works on the system.

6.1 Discussion of results

The main objective of the research project was to design and develop a Mobile phone antenatal appointment management system. This objective was archived through the fulfilment of the main objectives as explained below;

Specific Objective 1 was to analyse the current antenatal care processes, information management practices and challenges involved in those processes. This was done, and results of this are presented in Chapter 4, section 4.3 and different sections of chapter two as follows; an understanding of ANC is presented in sections 2.1, 2.1 and 2.3 respectively. Information management practices were studied between sections 2.4 and 2.8. The challenges involved in the current processes are discussed as well. All these were aimed at giving the researcher a clear understanding of ANC service processes; understand their challenges so as to be able to determine requirements for the Mobile phone antenatal appointment management system as presented in objective 2.

Objective 2 was to determine the requirements for the proposed mobile phone antenatal appointment management system. This was achieved and the system requirements are presented in chapter 4 section 4.4.the determined requirements led to the design and implementation phase as indicated in chapter 3.

Objective 3 was to design and implement the mobile phone antenatal appointment management system. Designs of the system were made as shown in chapter 4 section 4.5 with the help of a use case diagram, context diagram, dataflow diagram and an entity relationship diagram. User interface designs were also created. Implementation of the system was done basing on these designs as presented in chapter 5.tools like mean js,boot strap,angular js,node js,mongo db

Having done the system design and implementation, objective 4 was to test and validate the developed prototype. Testing and validation of the system was done together with users who are majorly health workers. This helped the researcher to meet the user requirements and enhance system functionality.

Generally, the objectives were achieved given that the MPBAAMS is in place and can do a number of tasks as had been specified in the functional requirements section.

6.2 Summary

This research project report comprises of six chapters. Below is a summary of the work. It is important to note that the MPBAAMS prototype that was developed was aimed at providing an indication that by following the data trail of antenatal care service processes, their challenges, reasons for low uptake and consequences of poor antenatal care, mobile phone antenatal appointment management system can directly contribute to improvement of antenatal care service delivery by health providers and improve antenatal care utilization by pregnant women.

Chapter one introduced the subject matter and provided a foundation for the MPBAAMS project. In it, the researcher was able to provide a background to MPBAAMS and the justification for it to help reduce the problem of mortality among women, their unborn and newborn children. This is by bettering antenatal care through better Mobile phone antenatal appointment management system through the reminder messaging service to client about their

next antenatal appointments and other antenatal information regarded necessary. The objectives of the study were then provided that contributed to the design and development of a Mobile phone antenatal appointment management system to help in managing antenatal care services and keeping clients updated about their antenatal visits.

Chapter two covered the Literature review and looked at the available literature on antenatal management Information systems, including the challenges that are faced during antenatal care service delivery and utilization. Some health management information systems were discussed, which culminated into the discussion on the development methodologies and tools that were used. A summary of the current antenatal information systems was provided in order to support the need for the development of this Mobile phone antenatal appointment management system in developing countries amidst other antenatal care systems that exist.

Chapter three covered the methodology used for determining the sample size and the tools and techniques that were to collect, analyze and implement the requirements for the system. A number of tools and techniques were used to carry out data collections; and these included, interviews, observation.

System analysis and design are in the fourth chapter of the study. In this chapter, the researcher was able to analyze the data that was collected. Context diagrams, level 0 data flow diagrams were used to understand the processes as described by the users. MsVisio, Edraw, visio paradigm and MS word were the tool used for presenting the outcomes of the analysis. Designs are proposed for the various entities. These include the logical and physical design of the system, the entity relationship diagram, the proposed network design and the user interfaces.

System implementation was the fifth chapter of the study. It involved the interpretation of all system designs and converting them into a working prototype. A number of activities were carried out which include hardware and software installation, actual system coding, testing and validation, developing user training and system support plans.

Chapter Six is the last chapter in this dissertation. It provides a summary of the steps undertaken by the researcher in designing and developing a mobile phone antenatal appointment management system. It also provides the challenges faced by the researcher, recommendations and finally the suggestion for future research.

6.3 Challenges.

While undertaking this research, a number of challenges where faced by the researcher. They were both personal and institution.

The Antenatal care clinic of Uganda Martyrs Hospital Lubaga where the research was undertaken is an antenatal care service provision institution with high numbers of Antenatal patients visiting the clinic. This implied that interacting with the antenatal clinic staff was not easy because of time. The limited time within which the researcher had to collect all the system requirements and data from both the staff and the clients, yet at most times the staff‘s kept on postponing the meeting days. This could not allow the development and implementation of the system to take off as initially planned. However this was overcome by the researcher to improvise same money to give them as their overtime in order to participant in the study.

During the literature review, the researcher found that a number of antenatal management information systems development projects have been undertaken without publishing. This meant that scanty published literature was existing about Antenatal management systems.

When testing out the prototype, the antenatal clinic did not have computers and mobile phones that where compatible to the application , yet the researcher could not afford to buy computers for testing purposes at the clinic. The researcher instead used his personal computer and phone to test the MPBAAMS. That implies that the antenatal clinic needed to buy computers and mobile phone. However this would not be possible given that the Hospital has a procurement policy in place. As such, the purchase of the hardware will occur in a phased

manner as stipulated in the policy. That is the clinic management decide to adopt the MPBAAMS.

There were programming issues where languages used were a bit complex to the researcher during the development and implementation of the system which made integration with some Computers, browsers difficult. The SMS implementation was challenging too. This was solved by the research to high a consultant who was expensive this increased the expenses that was not budgeted for.

6.4 Recommendations

Uganda Martyrs Hospital Lubaga needs to invest in Mobile phone appointment management system in her various departments to enable the Hospital maximize its potential in health service delivery.

The antenatal clinic particularly needs to embrace the MPBAAMS application given its demonstrated potential in improving antenatal care service delivery and utilization. There is need for Uganda Martyrs Hospital Rubaga to match the current technology trends. This implies that the hospital will need to undertake a number of reforms to changes in the organizational policies to ensure more effective and efficient way of service delivery especially with antenatal care.

6.5 Suggestions for future research

More research should be done in line with integrating geographical information system (GIS) function to help the application to calculate or identify the distance a client is in from the clinic so the application can arrange appointments according to the distance. the application should give the far rest client the first priority to have the service than the near client .

6.6 Conclusion

Health information systems have evolved in a non coordinated and fragmented way as a result of administrative, economic, and legal or donor pressures. Antenatal care information systems are fragmented based on demands that relate international initiatives. Health information system strengthening must start with a broad-based assessment of the system‘s own environment and organization, responsibilities, roles and relationships, and of the technical challenges of specific data requirements. System requirements describe the functionality of a system, its goals and constrains, which are applicable to the future system.

For example, patients seeking antenatal care are of different Ages and education backgrounds, as such it is important for such system to be compatible with the needs of all users, physicians and patients. Additionally, it should be user-friendly

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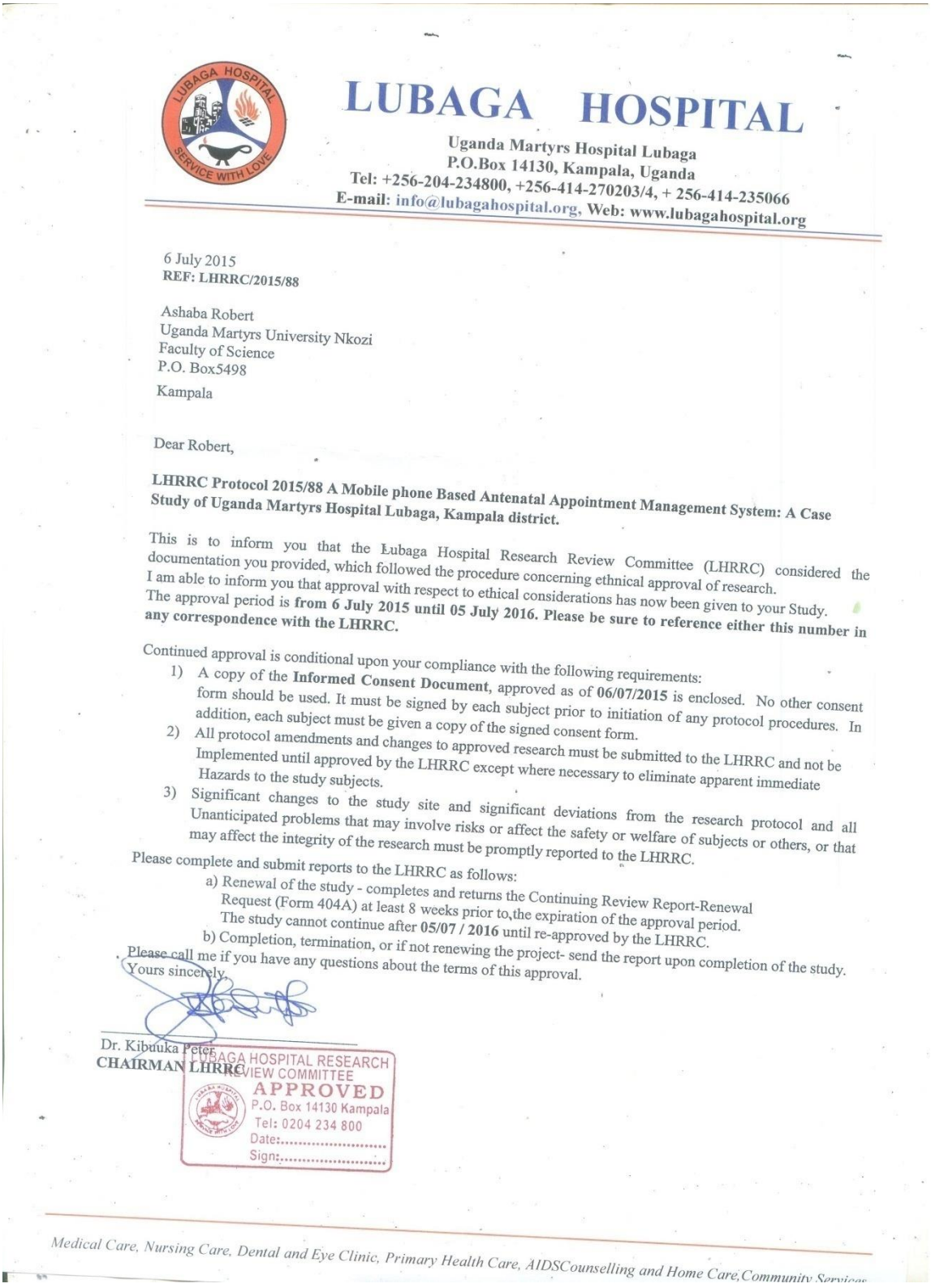
Appendices: Appendix A: Research permission letter



LUBAGA HOSPITAL

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6 July 2015
REF: LHRRC/2015/88

Ashaba Robert
Uganda Martyrs University Nkozi
Faculty of Science
P.O. Box5498
Kampala

Dear Robert,

LHRRC Protocol 2015/88 A Mobile phone Based Antenatal Appointment Management System: A Case Study of Uganda Martyrs Hospital Lubaga, Kampala district.

This is to inform you that the Lubaga Hospital Research Review Committee (LHRRC) considered the documentation you provided, which followed the procedure concerning ethnical approval of research. I am able to inform you that approval with respect to ethical considerations has now been given to your Study. The approval period is **from 6 July 2015 until 05 July 2016. Please be sure to reference either this number in any correspondence with the LHRRC.**

Continued approval is conditional upon your compliance with the following requirements:

1) A copy of the **Informed Consent Document**, approved as of **06/07/2015** is enclosed. No other consent form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject must be given a copy of the signed consent form.
2) All protocol amendments and changes to approved research must be submitted to the LHRRC and not be Implemented until approved by the LHRRC except where necessary to eliminate apparent immediate Hazards to the study subjects.
3) Significant changes to the study site and significant deviations from the research protocol and all Unanticipated problems that may involve risks or affect the safety or welfare of subjects or others, or that may affect the integrity of the research must be promptly reported to the LHRRC.

Please complete and submit reports to the LHRRC as follows:

a) Renewal of the study - completes and returns the Continuing Review Report-Renewal Request (Form 404A) at least 8 weeks prior to,the expiration of the approval period. The study cannot continue after **05/07 / 2016** until re-approved by the LHRRC.
b) Completion, termination, or if not renewing the project- send the report upon completion of the study.

Please call me if you have any questions about the terms of this approval.
Yours sincerely,

Dr. Kibuuka Peter
CHAIRMAN LHRRC

LUBAGA HOSPITAL RESEARCH REVIEW COMMITTEE
APPROVED
P.O. Box 14130 Kampala
Tel: 0204 234 800
Date:.....
Sign:.....

Medical Care, Nursing Care, Dental and Eye Clinic, Primary Health Care, AIDSCounselling and Home Care,Community Services

Appendix B:Doctors' Interview guide

DOCTORS' INTERVIEW GUIDE

Antenatal Care questions

INTRODUCTION

As student at UMU in the faculty of science pursuing a masters degree in information systems, I seek to carry out a survey on antenatal appointment management I intend to exploit certain venues of technology to developed a mobile phone based antenatal appointment management system this will enable different stakeholders to taking part in this survey, the will help me better understand the situation at hand

Research Questions

Age .....

Sex:.....

Department.....

Positions.....

1. Are you the head of the clinic?

2. How many staff do you have in the clinic?

3. How many times do a pregnant woman supposed to go to a health facility for prenatal Check-ups?

4. How many pregnant women come for antenatal a day?

5. What health care facilities are provided to pregnant women in their first trimester?

a) How relevant are they to both the pregnant women and unborn child.

6. What health care facilities are provided to pregnant women in their second trimester?

7. What health care facilities are provided to pregnant women in their third trimester?

Mortality questions

1. Please, estimate the percentage of mothers who die due to pregnancy

Complications in this hospital in a year? And what is the cause of death?

2. Please, estimate the percentage of babies who die due to avoidable pregnancy

Complications in this hospital in a year.

Management Information questions

1. How is communication curried out in this clinic?

2. How is antenatal information managed in this clinic?

3. Kindly explain the type of information you handle in this Antenatal clinic.

4. Given the scale ranging from bad, fair, good and excellent, rate how effective the existent Information System is.

5. Given the scale ranging from bad, fair, good and excellent, rate how effective it would be to remind pregnant women to come in for prenatal check-ups.

Appendix B Midwives'/ nurse's interview guide:

Antenatal Care questions

INTRODUCTION

As student at UMU in the faculty of science pursuing a masters degree in information systems, I seek to carry out a survey on antenatal appointment management I intend to exploit certain venues of technology to developed a mobile phone based antenatal appointment management system this will enable different stakeholders to taking part in this survey, the will help me better understand the situation at hand

Research Questions

Age .....

Sex:.....

Department.....

Positions.....

1. How many times is an average pregnant woman supposed to go to a health facility for prenatal check-ups?

2. On average, how many pregnant women come in for these check-ups in a week?

3. What health care facilities are provided to pregnant women in their second trimester?

5. What health care facilities are provided to pregnant women in their third trimester?

6. Estimate the average percentage of mothers who start and finish all the recommended antenatal visits

7. Are there cases where pregnant women may miss their prenatal visits?

a) If so what are the common reasons these women give for missing any given appointment?

8. On average, how many recorded births take place in this health care facility per week?

9. What strategies are in place to ensure that pregnant women are convinced /reminded? to come for their checkups?

10. How successful are the mentioned methods if any exist?

11. How many women usually come in for an initial check up and how many actually return for the scheduled checkups?

a) What reasons do they give for not returning?

12. Do you think with adequate reminders they would turn up for these checkups?

13. Given the scale ranging from low, medium, good and excellent, how would you rate the quality of antenatal care given to pregnant mothers?

Mortality questions

1. Please, estimate the number of mothers who die due to pregnancy Complications in this hospital in a month.

2. Please estimate the number of babies who die due to pregnancy complications in this hospital in a month.

Management Information questions

1. Kindly explains best as you can, how Information is managed in this Antenatal clinic; Works.

2. Kindly explain the type of information you handle in this clinic.

3. Given the scale ranging from bad, fair, good and excellent, rate how effective the existent Information System.

4. Given the scale ranging from bad, fair, good and excellent, rate how effective it would be to remind pregnant women to come in for prenatal check-ups.

a) Give a reason for your answer

6. Given the scale ranging from bad, fair, good and excellent, rate how effective it would be to remind mothers about best health and diet practices.

a) Give a reason for your answer

Appendix C: pregnant mothers interview guide

General Knowledge

INTRODUCTION

As student at UMU in the faculty of science pursuing a masters degree in information systems, I seek to carry out a survey on antenatal appointment management I intend to exploit certain venues of technology to developed a mobile phone based antenatal appointment management system this will enable different stakeholders to taking part in this survey, the will help me better understand the situation at hand

Research Questions

Age .....

Sex:.....

1. What is your level of education?

2. What is marital status?

3. How many pregnancies have you carried?

4. How many of your children are alive?

Antenatal Care questions

1. How many times on average is a pregnant woman supposed to go to a health facility? for prenatal check-ups?

    a) Give reasons for your answer

2. On average, how many times have you come in for these check-ups for this particular pregnancy?

3. What health care facilities are provided you in the first trimester?

a) How relevant are they you and your unborn child?

4. What health care facilities are provided you in the second trimester?

6. If this is not your first pregnancy, when did you start antenatal visits for previous pregnancy?

a) Did you finish all the recommended visits?

b) If not, what are your reasons?

7. Are there cases where you may miss your prenatal visits?

a) If so what are your reasons for missing any given appointment?

8. What strategies are in place to ensure that you are convinced /reminded to come for your checkups?

9. How successful are the mentioned methods if any exist?

10. How many times have you returned for scheduled checkups after your initial visit?

a) What reasons do you give for not returning?‖

11. Do you think with adequate reminders you would turn up for these checkups?

12. In your opinion, does antenatal care have any bearing on your child‘s health in the long run?

13. Given the scale ranging from low, medium, good and excellent, how would you rate the quality of antenatal care given to you?

Appendix D: System sample codes

Register a mother

```
var MotherSchema = new Schema({
  fullname: {
    type: String
    //,
    //default: '',
    //required: 'Please fill Mother name',
    //trim: true
  },
  dateOfBirth:{type: String},
  maritalStatus: {type: String},
  address:{
    district: {type: String},
    county: {type: String},
    village: {type: String}
  },
  contact: {
    phone: {type: String},
    email: {type: String}
  },
  pastMedicalHistory:[String],

  pastFamilyHistory:[{
    type: String
  }],

  pastObsetricHistory: {type: Array},

  pregnancies :[{
    lastMenstrualPeriod: {type: Number},
    expectedDateOfDelivery: {type: Date},
    tests: {type: Array},

    visits: {type: Array},

    birthPlan: {
      placeForDelivery: {type: String},
      deliveredBy: {type: String},
      howToGetThere: {type: String},
      tobeAccompaniedBy: {type: String},
      mamaKitReceived: {type: String},
      haveCleanClothForBaby: {type: String}
    },

    postNatalCare: {
      dateOfDelivery: {type: Date},
      modeOfDelivery: {type: String},
      placeOfDelivery: {type: String},
```

```
      sexofBaby: {type: String},
      weight: {type: Number},
      dateVitaminAReceived: {type: Date},
      conditionOfBaby: {type: String},
      conditionOfMother: {type: String}
    },

    familyPlanningChoice: {type: String}
  }],


  created: {
    type: Date,
    default: Date.now
  },
  user: {
    type: Schema.ObjectId,
    ref: 'User'
  }
});

mongoose.model('Mother', MotherSchema);
```

USER

```
var mongoose = require('mongoose'),
  Schema = mongoose.Schema,
  crypto = require('crypto');

/**
 * A Validation function for local strategy properties
 */
var validateLocalStrategyProperty = function(property) {
  return ((this.provider !== 'local' && !this.updated) || property.length);
};

/**
 * A Validation function for local strategy password
 */
var validateLocalStrategyPassword = function(password) {
  return (this.provider !== 'local' || (password && password.length > 6));
};

/**
 * User Schema
 */
var UserSchema = new Schema({
  firstName: {
    type: String,
```

```
    trim: true,
    default: '',
    validate: [validateLocalStrategyProperty, 'Please fill in your first name']
  },
  lastName: {
    type: String,
    trim: true,
    default: '',
    validate: [validateLocalStrategyProperty, 'Please fill in your last name']
  },
  displayName: {
    type: String,
    trim: true
  },
  email: {
    type: String,
    trim: true,
    default: '',
    validate: [validateLocalStrategyProperty, 'Please fill in your email'],
    match: [/.+\@.+\..+/, 'Please fill a valid email address']
  },
  username: {
    type: String,
    unique: 'Username already exists',
    required: 'Please fill in a username',
    trim: true
  },
  password: {
    type: String,
    default: '',
    validate: [validateLocalStrategyPassword, 'Password should be longer']
  },
  salt: {
    type: String
  },
  provider: {
    type: String,
    required: 'Provider is required'
  },
  providerData: {},
  additionalProvidersData: {},
  roles: {
    type: [{
      type: String,
      enum: ['user', 'admin']
    }],
    default: ['user']
  },
  updated: {
    type: Date
```

```
  },
  created: {
    type: Date,
    default: Date.now
  },
  /* For reset password */
  resetPasswordToken: {
    type: String
  },
  resetPasswordExpires: {
    type: Date
  }
});

/**
 * Hook a pre save method to hash the password
 */
UserSchema.pre('save', function(next) {
  if (this.password && this.password.length > 6) {
    this.salt = new Buffer(crypto.randomBytes(16).toString('base64'), 'base64');
    this.password = this.hashPassword(this.password);
  }

  next();
});

/**
 * Create instance method for hashing a password
 */
UserSchema.methods.hashPassword = function(password) {
  if (this.salt && password) {
    return crypto.pbkdf2Sync(password, this.salt, 10000, 64).toString('base64');
  } else {
    return password;
  }
};

/**
 * Create instance method for authenticating user
 */
UserSchema.methods.authenticate = function(password) {
  return this.password === this.hashPassword(password);
};

/**
 * Find possible not used username
 */
UserSchema.statics.findUniqueUsername = function(username, suffix, callback) {
  var _this = this;
  var possibleUsername = username + (suffix || '');
```

```
  _this.findOne({
    username: possibleUsername
  }, function(err, user) {
    if (!err) {
      if (!user) {
        callback(possibleUsername);
      } else {
        return _this.findUniqueUsername(username, (suffix || 0) + 1, callback);
      }
    } else {
      callback(null);
    }
  });
};

mongoose.model('User', UserSchema);
```