ADDIS ABABA UNIVERSITY SCHOOL OF INFORMATION SCIENCE
AND SCHOOL OF PUBLIC HEALTH
M.SC. IN HEALTH INFORMATICS PROGRAMME

REQIRMENT ANALYSIS AND SYSTEM DESIGN FOR VOICE MESSAGES FOR ANTENATAL AND POSTNATAL CARE SERVICES.

By: HIWOT ADANE

June 2014
Addis Ababa, Ethiopia

ADDIS ABABA UNIVERSITY SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC HEALTH M.SC IN HEALTH INFORMATICS PROGRAMME

REQIRMENT ANALYSIS AND SYSTEM DESIGN FOR VOICE MESSAGES FOR ANTENATAL AND POSTNATAL CAR SERVICES.

BY: HIWOT ADANE

Advisors

Dr. Rahel Bekele	**June 2014**	**Signature** _____
Prof. Mesganaw Fantahun	**June 2014**	**Signature** _____

Approved By Examining Board

_____	**June 2014**	**Signature** _____
_____	**June 2014**	**Signature** _____

ACKNOWLEDGEMENTS

First and for most, I would like to thank my advisers Dr.Rahel Bekele and Prof. Mesganaw Fantahun for all the guidance, input, and feedback throughout my project work.
A big thank goes to Instructor Besegawe Dereje for his cooperation and support to equip me with all the necessary information about the existing systems.

I would like to thank Ethiopia Telecom's communication expert for giving me recent and updated information about mobile coverage in Ethiopia

My appreciation goes to Ministry of Health maternal and child health and infrastructure officers for providing a relevant information and comment to my project work.

And I would like to thank Addis Ababa University for providing me with necessary fund for processing and finalizing my project work.

Finally, I would like to thank my family and friends for their support, encouragement and advice they have given me the whole time.

Contents

LIST OF FIGURES

LIST OF TABLE

ACRONYMS

AAU	Addis Ababa University
ANC	Antenatal Care
ARC	AIDS Resource Center
CDMA	Code Division Multiple Access
CHAI	Clinton Health Access Initiatives
CHWs	Community Health Workers
EDHS	Ethiopian Demographic Health Survey
ETC	Ethiopian Telecommunication Corporation
FANC	Focused Antenatal Care
FMOH	Federal Ministry of Health
GSM	Global System Mobile
HAPCO	HIV/AIDS Prevention and Control Office
HEWs	Health Extension Workers
HMIS	Health Management Information System
HSDP	Health Sector Development Program
ICT	Information Communication Technology
IMR	Infant Mortality Rate
IT	Information Technology
IVR	Interactive Voice Response
JSIRTII	John Snow. Inc. Research and Training Institute. Inc.
L10K	Last Ten Kilometer
LMIS	Logistic Management Information System
MDG	Millennium Development Goals
MMR	Maternal Mortality Rate
MNCH	Maternal Neonatal and Child Health
MNH	Maternal and Neonatal Health
MOTECH	Mobile Technology For Community Health
PHCU	Primary Health Care Unit
PNC	Postnatal Care
SNNPR	Southern Nation Nationality People of Representative
UK	United Kingdome
USAID	United States Agency for International Development
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

ABSTRACT

In Ethiopia maternal and neonatal morbidity and mortality are the major health problems.Some of the causes are delay in seeking and receiving skilled care, home delivery/ low utilization of service, lack of recognition of newborn danger signs and low levels of care seeking for new born at health facilities.

This project is therefore designed to contribute to the decrement of maternal and neonatal morbidity and mortality by sending voice messages instead of Simple Message System (SMS) directly to mothers. The system reminds mothers' appointment and makes them aware about the danger signs that can occur during pregnancy and postpartum period both in mother and in baby.

The general objective of this project is to prepare content and requirement analysis and system design for the development of voice messages for antenatal and postnatal care services.

Review of already existing mobile phone for MNCH which was developed by Clinton Health Access Initiatives (CHAI) and Addis Ababa University (AAU) and World Bank and Addis Ababa University (AAU) were made. Interview of a professional who was involved in the development of those systems was also conducted to develop user requirements. Different literatures, protocols, fact sheets, brochures and standard manuals were reviewed to develop messages both in Amharic and English in which are going to be sent to mothers/families mobile phone.

The health information messages organized for each trimester and postpartum weeks .After the pregnant mother is enrolled in the system she get health information messages every two week until delivery and during postpartum period every week until fourth week.

The appointment reminder messages delivery to the mother based on the World Health Organization (WHO) Focused Antenatal Care (FANC) and postnatal care schedule.

CHAPTER ONE

INTRODUCTION

1.1. Background

Ethiopia is the tenth largest country in Africa and has a total surface area of 1.1 million square kilometers. It is bordered on the north and northeast by Eritrea, on the east by Djibouti and Somalia, on the south by Kenya and on the west and south-west by Sudan. Administratively, the country is composed of nine Regional States and two City Administrations. These are sub-divided into 817 administrative Woredas (districts) which are further divided into around 16,253 Kebeles, the smallest administrative units in the governance structure. The size of the country and its location has accorded it with diverse topography, geography and climatic zones and resources (1).The projection of the 2007 population and housing census estimates the total population of Ethiopia for the year 2013 to be 86,613,986 of which 43,715,971 are males and 42,898,015 are females (2).

Ethiopia has a three-tier health care delivery system which is characterized by a first level of Woreda /district health system comprising a primary hospital (with population coverage of 60,000 –100,000 people), health centers (1/15,000-25,000 population), and their satellite health posts (1/3000-5,000 population). A second level in the tier made up of a general hospital with population coverage of 1-1.5 million people; and the third a specialized hospital that covers a population of 3.5-5 million. A primary hospital and each health center with five satellite health posts form a Primary Health Care Unit (PHCU) (1).

The major health problems of the country remain largely preventable, communicable diseases and nutritional disorders, although the country is increasingly facing the double burden of diseases due to chronic health problems such as cardiovascular diseases, diabetic mellitus and cancers (3).

Results from the Ethiopian Demography and Health Survey also show that there is sharp decrease in the under five-mortality rate to 88 per 1000 live births in 2010. The infant mortality rate has also decreased to 59 deaths per 1000 live births in 2010 while Neonatal mortality rate was reported to be 37/1000 live births'. The country's maternal mortality is 676 per 100,000 live births, which is among the highest in the world (4).

On the other hand, Ethiopia, over six years, developed an unusual but extensive mixed-capability ICT infrastructure that provides a blended coverage of 85% of the country's population, with the potential to serve 90% of its population (5).

As per the information obtained by interviewing Telecom's communication expert, in 2005E.C mobile phone users in Ethiopia was 23,637,007 but now until March 30, 2006 E.C it was 25,660,585.This data shows as the coverage is increasing from time to time.

1.2. Statement of the problem

Healthy women are the foundation of a strong community, and healthy newborns are the future. Globally each year, nearly 300,000 women die from complications of pregnancy and childbirth, and an estimated three million newborns die within the first month of life (6).

In Africa, it has been estimated that 25 percent of maternal deaths occur during pregnancy, with variability between countries depending on the prevalence of unsafe abortion, violence, and disease in the area. Between a third and a half of maternal deaths are due to causes such as hypertension(pre-eclampsia and eclampsia) and ante-partum haemorrhage, which are directly related to inadequate care during pregnancy. Certain pre-existing conditions like malaria, HIV/AIDS, anaemia and malnutrition become more severe during pregnancy. Moreover, they are associated with increased maternal and newborn complications as well as death (7).

As observed in Ethiopia MDGs progress report, in Ethiopia most of maternal and neonatal deaths occur during delivery and post-delivery period. This indicates that there are still significant obstacles in terms of access to and provision of antenatal and obstetric health care services, especially in rural areas (8).

Some of the causes of both maternal and neonatal deaths at community level are harmful traditional practices, delay in seeking and receiving skilled care, home delivery/ low utilization of service, lack of recognition of danger signs both in newborn and pregnant women (3).

In Ethiopia the proportion of mothers, attending ANC was low even for women with access to the services. As observed in 2011 EDHS, 19 percent of women with a live birth in the five years before the survey made four or more ANC visits during their pregnancy. Eleven percent of women made their first ANC visit before the fourth month of pregnancy. Generally, the ANC coverage and skilled delivery was 34% and 10% respectively, which are very low. In addition, the PNC coverage of the country was 6%, which is also very low (4).

As described by Save the Children, half of all postnatal maternal deaths occur during the first week after the baby is born, and the majority of these occur during the first 24 hours after childbirth. The leading cause of maternal mortality in Africa – accounting for 34 percent of deaths – is haemorrhage, the majority of which occurs postnatally. Sepsis and infection claim another 10 percent of maternal deaths, virtually all during the postnatal period. A newborn baby is about 500 times more likely to die in the first day of its life than at one month of age. Thus, the postnatal period is a time when skilled health provider close attention and care can make a huge improvement in the life chances of women and children in the community (7)

Different researches were conduct to show the problems, challenges and solutions in the area of MNCH. For example; Mihret H. and Mesganawe F. indicated that the poor awareness of women on the danger signs and a possible high chance of poor outcome of pregnancy. This could be attributing to presence or absence of relevant intervention to promote Birth Preparedness and Complications Readiness, utilization of health care services and information given during ANC visits (9). According to K. S. Sugathan receiving antenatal check-ups is the strongest predictor of institutional delivery. That means it is possible to promote institutional delivery by expanding antenatal-care coverage and associated counseling (10). And according to Gurmesa, providing information, education and communication, promoting female education, improving socio-economic status of women and husband involvement are recommended for better utilization of MNCH services.(11)

The Ministry of Health (MOH) has recognized the benefits of Information and Communication Technology (ICT) as a tool to support the health sector (12).
Some of the mHealth applications in the area of MNCH are:

- Mobile Phone for MNCH done by CHAI, AAU and RHBs
- SNNPR Mobile Phone Based Data Exchange done by World Bank and AAU
- EpiSurveyor done by JSIRTII, L10K, RHBs, UNICEF and USAID
- Tigray MNCH Mobile Health done by MU, Maastricht University, University Alcala and RHB (13).

All of these research projects done so far in Ethiopia are in the area of MNCH use SMS and Web based platform for information exchange and data collection. However, use of SMS has its own problems, which are identified during implementation for instance:

- The SMS is not in local language because of that it create misunderstanding or misinterpretation of the information,
- The communication made at the community level involves only HEWs that mean there is no way to ensure the mother get the appropriate information on the appropriate time.
- EpiSurveyor and Tigray MNCH Mobile Health projects use smart phones for data collection this indicate that the HEW must have smart phones to collect the data.
- Need of Java enabled mobiles to collect data in SNNPR by HEWs

Some of the challenges occurred during the implementations of the above mobile based health intervention projects were network coverage problems, internet connection, limited computer knowledge and skill of health center staff, electric power interruption, monthly mobile credit recharge for HEWs, ethical concerns and misuse of mobile apparatus by HEWs (13).

Although we make the SMS directly reach the mother, there is a problem of literacy to read the sent messages because according to EDHS 2011 50.8 % of women age 15-49 years was no education background (4).

IVR is well suited than SMS to a population with different demographic features. First, because it can be accessed by making a phone call, IVR audio content can be heard from any phone. Second, IVR does not require literacy and only entails very limited technical skills (the ability to dial a number and to press numbers on the phone in response to audio instructions). In many cases, poor, rural mobile phone users are already being expose to IVR through their mobile network operators, whether via automated customer care lines or when 'topping up' their mobile phones with pre-paid credit. IVR can thus serve as a simple, widespread solution to the needs of illiterate, poor populations in many developing countries by providing access to audio content via a simple phone call. To this end, the purpose of this project is to develop requirement analysis and system design and content for voice messages for ANC and PNC services (14).

1.3. Significance of the project

The proposed project will benefit mothers after it is programmed and implemented, by creating awareness about the danger signs that can occur in mothers and their baby in each pregnancy trimesters and postpartum weeks and by reminding their ANC and PNC follow up visit appointments that can help her not to miss the health care she and her baby can get during follow up visit. This will be contributing in addition to her health interventions in the reduction of maternal and neonatal morbidity and mortality.

Because we live in oral community (a society that has not developed literacy), using voice messages to transmit health information in different languages through any type of mobile phone that can create awareness directly to mothers/families will avoid the problem of literacy and language barriers and use of software enabled mobile phones.

1.4. Objective of the project

General objective

The general objective of this project is to prepare content and requirement analysis and system design for the development of voice messages for antenatal and postnatal care services.

Specific objectives

- To develop user requirements for voice messages for antenatal and postnatal care services.
- To develop messages that can create awareness of the steps that could lead to healthy pregnancies, deliveries and newborn babies.
- To prepare messages translated in Amharic.

1.5. Scope of the project

The scope of this project is developing health messages regarding the danger signs that can occur during pregnancy and postpartum period both in mothers and babies and ANC and PNC follow up reminder messages and translating the messages in to Amharic. In addition, system design document will be developed and documented. System programming, testing and implementation not done because of time and resource limitations.

1.6. Document organization

This project report is outlined as follows: Chapter 2 discusses general literature and related works on use of voice message for the delivery of health information regarding appointment reminder in the area of MNCH. Chapter 3 presents the methodology used is discussed.
Chapter 4 discusses the result of the project, which contains system analysis including the existing automated systems, recommendation for improvement analysis model and content.
Chapter 5 presents the conclusion, recommendation, and future work.

CHAPTER TWO

LITERATURE REVIEW

2.1. General literature

2.1.1. Maternal Health Service Utilization

Several factors can influence skilled maternal health care utilization within the dimensions of skilled maternal care definition. These factors are maternal education, parity, residence, awareness and perceptions related to the risks of pregnancy and skilled maternal services, previous experiences, women's decision-making power, household wealth and the availability, readiness, and quality of services as well as the type, competence and caring behavior of providers and the presence of low education coverage, geographical isolation, and high poverty rate in the community reduce access and utilization of skilled maternal services (15). Missed appointments are also a major cause of inefficiency in healthcare delivery, with substantial monetary costs for health systems; and delays in diagnosis and appropriate treatment for the non-attending patient (16).

In many developing countries, much of the population especially in rural areas do not have access to health care due to resources constraints, system inefficiency and a lack of awareness about services offered. In adequate presence of health facilities and providers in many communities has been compounded by a lack of access to care closer to people in need. And, the expansion of mobile communication is providing a way to accelerate this system by strengthening and bridging gaps between health care access and rural population that still exist. At the confluence of these trends lies mHealth (5).

2.1.2. mHealth Application

mHealth is a term used for the practice of medicine and public health , supported by mobile devices. The term is most commonly use in reference to using mobile communication devices, such as mobile phones, tablet computers and PDAs, for health services and information, but also to affect emotional states (17). mHealth applications include the use of mobile devices in collecting community and clinical health data, delivery of health care information to practitioners, researchers, and patients, real time monitoring of patients vital signs, and direct provision of care (18).

mHealth in low and middle-income countries has been recognized as a promising, creative, and potentially cost-effective intervention for health care workers addressing a number of diseases and creating a diverse array of interventions with varying degrees of efficacy and reproducibility (19).

The availability of timely, accessible, accurate and relevant information plays a key role in shaping knowledge, which in turn is a driver of health related change. Information also influences social norms and culture by increasing awareness about what other people are doing. In addition, information can create demand for health products and services (14).

Serving as a bridge between people and computer databases, as describe by International Engineering Consortium , interactive voice response systems (IVRs) connect telephone users with the information they need from anywhere at any time (20). Techno Brain states that IVR technology does not require human interaction over the telephone as the user's interaction with the database is predetermined by what the IVR system will allow the user to access (21).

2.2. Experience from mHealth Projects in Maternal and Child Health

In Ethiopia there are research projects being conducted on application of IT in health intervention programs. Those mHealth applications are:

- *Mobile Phone for MNCH* done by CHAI, AAU and RHBs with the objective of increasing access to and uptake of skilled delivery,
- *SNNPR Mobile Phone Based Data Exchange* done by World Bank, AAU with the objective of testing the impact of using mobile phone on the health outcome of mothers and children in rural areas,
- *EpiSurveyor* done by JSIRTII, L10K, RHBs, UNICEF and USAID with the objective of improving maternal, newborn and child health.
- *Tigray MNCH Mobile Health* done by MU, Maastricht University, University Alcala and RHB with the objective of researching ways in which mobile technologies can help to improve maternal and child health care in rural areas of Ethiopia.
- *Fitun Warmline* done by ARC, JHU/CCP and HAPCO with the objective of provides rapid, evidence-based responses to questions from health care professionals about HIV/AIDS and related health topics.

- *Wegen AIDS Talkline*- done by ARC, JHU/CCP and HAPCO with the objective of empowers Ethiopians to know their HIV status and help those HIV negatives maintain their status; and support PLWHIV and their families adopt a healthy life style.

- SMS printers for Lab Results- done by with the objective of reduce long turnaround time (TAT) of laboratory results for referred DBS samples to care for HIV-exposed and HIV- infected infants using SMS driven printer.

- *RapidSMS*- done by CHAI, HP and EHNR with the objective of enable the collection of data on stock balance, new admissions, location of distribution centers and the quantity of plumpy'nut received and consumed in pilot districts using Rapid SMS (13).

According to the Cheers Report, MOTECH has two interrelated mobile applications aimed towards women and their children. The "mobile midwife" program that was launched in July 2010 in Ghana enables pregnant women and other caregivers to receive text or voice messages that offer time-specific information about different stages of their pregnancy. These messages include alerts and reminders, advice and educational information in English and in the user's native tongue (22).

As described in Technology Overview of CommCare MOTECH Suite, a combination of MOTECH and Commcare technologies implemented in Bihar, India with the name of Project Ananya to improve access and delivery of health care service to underserved populations. This project includes a service targeted directly at client patients. This service, branded Kilkari, delivers voice messages to pregnant women and their families who are registered in the program. These messages are delivered weekly for the duration of the pregnancy and first two years of the child are life and contain suggestions for promoting greater health for the mother and child, including reminders of recommended antenatal appointments, information about warning signs, tips for pregnancy planning, and vaccine reminders. These messages can be accessed from any phone and are delivered in local language via IVR, so they are accessible regardless of the literacy level or mobile phone ownership status of the client (23).

On the second report of Jeannine Lemaire on scaling up mobile health describes different mHealth projects found in Africa. Some of them are:

Disease Surveillance & Mapping Project

The Disease Surveillance and Mapping Project covers the implementation of a mobile disease surveillance and mapping project to aid Botswana's fight against malaria with the use of mobile phone technology.

The program equips health workers with mobile devices that collect malaria data and can be viewed in a geographic map of disease transmission to generate more context-aware information about outbreaks in order for workers to respond accordingly.

This allows health workers to report real-time disease outbreak data, tag the data with GPS coordinates, and send out SMS disease outbreak alerts to all other healthcare workers in the district, and allows facilities to submit regular reports back to the MOH. The data is then aggregated in real-time on the backend and graphs and reports are generated in a matter of seconds.

This enables MOH officials to promptly collect and analyze context-aware data on malarial outbreaks, track developments in real-time and quickly dispatch medicines and mosquito nets, and monitor treatments using GPS coordinates.

After the enrollment of the project, response times to notify authorities of malaria outbreaks improved from four weeks to three minutes in the first year of the program, real-time notifications and updates on disease patterns to MOH officials and health workers reach 1,068 and 93% of facilities now reporting on time, compared to 20% previously (24).

Programme Mwana

Programme Mwana is a mobile health initiative implemented by the Zambian MOH with support from UNICEF and collaborating partners to strengthen health services for mothers and infants in rural health clinics, with particular focus on improving Early Infant Diagnosis (EID) of HIV and improving post-natal care for mothers and their children.

Programme Mwana launched a pilot in April 2010 to reduce these delays in results transmission from the HIV test laboratories to rural health facilities via SMS message. The pilot had two main SMS components: Results160 and RemindMi. Staff to securely deliver infant HIV results from the lab to the health clinics, while community health workers to remind the mothers to return to the clinics to receive their infant's results used RemindMi used Results160.

The following results were identified through a program evaluation: Over 5,000 infant HIV test results have been delivered (as of September 2012), the time between when the samples were collected and when the mother received the results was reduced by 56%, 30% more results were successfully delivered to mothers thanks to the digitization of the results (as the paper copies were often getting lost) (24).

Case studies were done to develop mHealth Field Guide for Newborn Health, some of them are described below:

Better Health for Afghan Mothers and Children (BHAMC)

Working with Dimagi's CommCare application, the project designed a mobile phone maternal and newborn healthcare application to be used by community health workers as they advise community members. The phone application served as 1) a job aid for CHWs and informing mothers, 2) emergency call and referral and 3) reporting home visits.

As a job aid, the application reminded CHWs of key messages. It was a resource for CHWs to share information with mothers. CHWs talked with pregnant women regarding the need for antenatal care visits and delivering in a facility, planning and preparing for birth, danger signs during pregnancy, labor, delivery, caring for a newborn, and the need for facility birth with the family and facilitated related decisions. When a woman went into labor, the CHWs made a referral call and linked the woman's family with a skilled provider at the nearest facility. CHWs were able to advise families on available transportation, including ambulances if available. It also helped communication with facility staff. The project manager was able to provide timely feedback to CHWs in the intervention area as the data was received in real time.

The evaluation of the project shows as the use of the mobile application produced changes on the development of birth plans (+12.6%), antenatal care visit (+20%), planning for transportation (+4.8%), coordination with health facilities (+12.6%), knowledge of danger signs during pregnancy (+12.9%), institutional deliveries amongst women (+11.6%), and early initiation of breastfeeding (8.7%) (25).

Reducing Maternal and Newborn Deaths (ReMiND)

The ReMiND Project contributes to improvements in maternal, newborn and infant health outcomes in target counties of Kaushambi District during 2012-2015 in India. It is designed to improve interpersonal communication and counseling by an ASHA during pregnancy and postpartum home visits, and to increase MNCH knowledge among pregnant women, mothers and their families. Through the ReMiND Project, ASHAs use basic cell phones running Dimagi's open source CommCare software. The software includes pregnancy, postpartum, infant and referral modules. Since many ASHAs are illiterate, these modules use audio and visual prompts to help ASHAs systematically counsel and assess women and babies for any danger signs during home visits before and after birth. Each module also contains in-depth counseling forms that systematically guide ASHA as they counsel pregnant and postpartum women and their families about key MNCH practices. Using CommCare, every supported pregnant woman is registered and tracked through pregnancy, delivery and the postpartum period with continued tracking of infants through their first year of life. Once a birth is reported, interactive voice response (IVR) reminders repeatedly prompt the ASHA to conduct a postpartum visit until that visit is recorded in CommCare

The project has recorded a 136% increase in clients who ask ASHAs questions during home visits. There has also been a 68% increase in ASHAs who encourage clients to use the next recommended health service since they started using the ReMiND application. Among pregnant women supported by ASHAs using the app, 78% give birth in health facilities compared to only 60% of women in the general population. In addition, qualitative information shared by ASHAs indicates that the mobile phone-based tool helps them better manage their workloads and improves the quality of their counseling (25).

Chipatala cha pa Foni (CCPF)

Chipatala cha pa Foni (CCPF)IV is a hotline and voice/text based tips and reminders service providing women and guardians of young children in rural and underserved areas with access to information, medical advice and referrals on reproductive, maternal, newborn, and child health (RMNCH) issues in Malawi. Chipatala cha pa Foni means Health Center by Phone. It aims to increase knowledge and improve health seeking behavior among pregnant women, guardians of young children and women of child-bearing age. Messages were developed in English, Chichewa and Chiyao. Messages were written in narrative form first, and then turned into shorter SMS messages and recorded as electronic voice files. Final messaging was submitted to and approved by district-level staff.

Preliminary data from the outcome evaluation indicate that use of CCPF increased home-based and facility-based practices among women, including use of a bed net during pregnancy, attending the recommended four antenatal care (ANC) appointments, starting ANC during first trimester, giving birth in a facility, and receiving a postnatal checkup within 2 days of birth. Home-based practices for children, including exclusive breastfeeding until six months of age, use of bed nets, and use of oral rehydration salts to treat diarrhea also increased (25).

Sistem Informasi Jejaring Rujukan Maternal & Neonatal (SIJARIEMAS)

Sistem Informasi Jejaring Rujukan Maternal & Neonatal (SIJARIEMAS*)* enables midwives to refer mothers and newborns in emergency situations to hospitals in Indonesia. The system then supports follow up visits and education after mothers return home, as part of the Expanding Maternal and Neonatal Survival (EMAS) program funded by USAID.

It uses SMS to reduce delays and enable facilities to prepare for incoming emergencies SIJARIEMAS uses SMS to reduce delays and enable facilities to prepare for incoming emergencies. A midwife identifies a complication and sends an SMS with patient data, vital-signs, diagnosis and pre-treatment information to the SIJARIEMAS system. The system automatically routes the message to the nearest hospital based on the referral pathway registered into the system,

where an alarm is triggered in the emergency room, maternity ward and newborn ward. If accepted, the incoming referral notification is automatically forwarded to the emergency team. If rejected, the system routes the message to the next closest hospital, or informs the health provider at the local health facility to treat the patient locally based on advice from the hospital doctor. Referral hospital staff assess whether they are able to handle the patient (based on bed availability, blood supply, specialists on duty, clinical equipments needed) and either accept or reject the referral (25).

From the reported mHealth projects in mhealth compendium technical report MAMA BANGLADESH project conducted in Malawi is one of the project reports there.

MAMA Bangladesh is implementing a "freemium" model that provides free basic services to the poorest 20% of mothers. The free services are subsidized by premium paid services targeted to higher income market segments.

Messages are delivered twice weekly in either short message service (SMS) or interactive voice response (IVR) format. The voice messages are entertaining and educational, formatted as 'mini-skits', with actors playing out real-life scenarios as characters, including a pregnant woman, doctor, husband and mother-in-law. MAMA Bangladesh has also created a unique service specifically for husbands, which reinforces messages provided to their wives and encourages their involvement in decision-making on pregnancy, birth and infant care.

Prior to the national launch in December 2012, MAMA Bangladesh conducted detailed formative research and the results indicated that almost 60% of women who subscribed to the service had their own phone, with the remaining women enrolling in services through gatekeeper or family member phones. Messages directed to household decision makers enabled improved household practices with respect to nutrition, antenatal care visits and preparation for delivery.
Pilot stage research also indicated that the willingness to pay for the service was low, yet poor subscribers were willing to pay more than high income (26).

CHAPTER THREE

METHODOLOGY

In this section, the methods used to address the objective of the project are discussed.

3.1. Study setting

The project was conducted from December 2013 to June 2014 in Ethiopia and focused on Health application. Ethiopia is a Democratic Republic with 11 regions of which the two regions are the sit's of the federal government while the remaining 9 regions has their own regional city administrative. These are subdivided into 817 administrative Woredas (districts) which are further divided into around 16,253 Kebeles.

3.2. Source population

Persons who are involved in the development and implementation of mHealth projects done by CHAI and World Bank in collaboration with AAU which are focused on MNCH and health professionals working in health facilities and health office were used as source population. The project was designed for pregnant mothers and mothers in postpartum period and newborn children found in Ethiopia.

3.3. Data collection and Analysis

The proposed project was designed using object oriented system analysis and design methodology with the iterative waterfall model. It includes content development both in Amharic and in English regarding the danger signs.

The object-oriented methodology uses a set of diagrams or models to represent various views and functionality of a system and is commonly known as Unified Modeling Language or UML. This modeling language is selected because it increase reusability and modification, it is easy and understandable and it is fast system developing approach and also existing system done by CHAI and AAU use this methodology .

The waterfall model lifecycle consists of:

- Analysis; where the problem is analyzed and requirements are gathered
- Design; where a solution to meet the requirements is planned
- Implementation; where the solution is realized in the form of code
- Testing; where the solution is tested against the requirements
- Deployment; where the solution is delivered to the client site

To identify user requirements for the development of voice messaging for ANC and PNC services the following activities were undertaken.

- Already existing web based systems of mobile phone for MNCH and SNNPR Mobile Phone Based Data Exchange, which were developed by CHAI and World Bank respectively in collaboration with Addis Ababa University and regional health offices were reviewed by installing the systems in laptop.

- Interview questions were developed and a professional who was involved in the development and piloting of Mobil Phone for MNCH and SNNPR Mobile Phone Based Data Exchange systems was interviewed.

To analyze the requirements use cases are identified, described and use case diagrams, to show the improved design class diagrams, and there description was done.

In addition, the required information to develop health information and follow up reminder messages was gathered by:

- Reviewing standard documents, guidelines, protocols, job aids, brochures, leaflets and literatures on the area of maternal and neonatal health.

- After reviewing checklist, that contains identified messages both in Amharic and in English was developed.

This checklist was used to prioritize and identify the massages that have to be delivered to the pregnant mothers, to collect comments and additional ideas.

The checklist was distributed to 5 participants. The participants are those working in MNCH department in health centers and hospitals, MNCH program officers who are working in regional health offices or FMOH. Based on the comments and additional ideas gain from the participants the final messages was developed.

3.4. Operational definition

Antenatal care - is care given for a mother with in her pregnancy period.

Postnatal care - is care given for a mother after delivery until 45 days.

Danger sign – is signs and symptoms of health problems that can occur during pregnancy or postpartum period both in mothers and in babies.

Actor – is a person, organization, or external system that plays a role in one or more interactions with the system.

3.5. Ethical Clearance

Ethical clearance was obtained from the school of public health ethical clearance committee. The willingness of the participants involved in interview and message review was asked.

3.6. Method of Dissemination of Results

The result of the project disseminated by using non-formal report and formal report and presentation to Federal Democratic Republic of Ethiopia Ministry of Health, Addis Ababa University School of Information Science and School of Public Health, Health Informatics Program, other respective health institution and other concerned and interested organization like CHAI and World Bank.

CHAPTER FOUR

DISCUSSION OF RESULT

4.1. System Analysis

4.1.1. Existing Automated Systems

From mHealth applications found in Ethiopia in the area of MNCH, which this project focused on and review to come up with the new system, are Mobile phone for MNCH and SNNPR Mobile Phone Based Data Exchange that are done by CHAI and World Bank respectively in collaboration with AAU. Based on the system and document review and interview of professionals who are involved during the development and implementation of those systems, the systems are described below in detail including problems and challenges.

Mobile Phone for MNCH

Mobile Phone for MNCH project is one of the interventions that are being pilot through CHAI Ethiopia's MNH programs with the aim to increase access to and uptake of skilled delivery in primary health care units in Ethiopia via improved tracking and referrals in Tigray and Oromia region and the funding was cover by both CHAI and RHBs.

Mobile Phone for MNCH the software is name as ENAT messenger, developed by AAU is an SMS management and Web-Based system using Java application.

The functionalities of the web-based application are Login Page to access the system, Administrator Page to manage the health center, health post and HEWs information under health centers, Data Clerk's page to manage the pregnant women information, Displaying Visit Information to provides a list in different colors showing the visit status of each mother due date is within one-month range.

The SMS management application, which runs silently in the background, is responsible for scheduling, sending receiving and forwarding messages as necessary. It also interacts with the web-based application in such a way that different color codes can be used to easily identify the status of a mother based on the confirmation message sent by the respective HEW who makes follow up of the mother.

The following are functionalities of the SMS management sub-system of the Enate Messenger system:

1. Sending Reminders

It is one of the SMS management sub-system functionality. After the sub-system, checks if there are pregnant women who left with one month or one week from their expected date of delivery. If such mothers exist, the system gets the phone numbers of the corresponding HEW (who is assigned to follow up the mother) and send the reminder to the mobile phone of the HEW. A message consists of a unique identifier number of the mother (which is auto generated by the system during registration), the name of the mother, her location (Gott), and her EDD. If a reminder is not send due to network or some other problem then it will be send again in the next checking time.

2. Receiving Confirmations

The SMS management sub-system is also responsible for receiving status messages (confirmation messages) from the HEW. The HEWs send messages composed of two numbers separated by a space. The first number represents the status of the mother and the second number represents a unique ID of the mother (Medical Record Number). Any message sent by HEWs begins with either 1 or 2. 1 means that the mother is in normal condition and has no problem (status: OK). On the other hand, 2 means that the mother is having labor or some other emergency and needs to go to the health center (status: EMERGENCY). After the first number, a space typed as separator and then the unique identifier of the mother (which sent as part of the reminder) will come. Confirmation messages treated separately based on their status and the web-based sub-system uses them to color code and indicate the status of the mothers to the health center nurses.

3. Forwarding Messages

The SMS management sub-system forwards incoming messages in two possible cases. The first is when the incoming message is an emergency message. In such cases, the system forwards the incoming message to the health center nurse so that necessary preparations would be done. It does not forward the incoming emergency message as it is. Rather, it fetches additional particulars about the mother (using her unique identification number) from the database and forwards detailed information to the health center nurse's phone. The second possibility is when a report is generated. In such a case, the report generated is forwarded to a mobile phone at CHAI so that the relevant CHAI staff can view summaries.

SNNPR Mobile Phone Based Data Exchange

The SNNPR Mobile Phone Based Data Exchange system is a research project, aimed at rigorously testing the impact of using mobile phone on the health outcomes of rural mothers and children in rural areas. By asking does, the use of a mobile phone based tool for patient registration, appointment reminders and inventory management in the hands of community health workers result in improved maternal and child health outcomes in health care in Ethiopia.

Health Extension Workers (HEWs) and Volunteer Community Health Workers (VCHWs) are involved and both are equipped with mobile phone.

The Java enabled mobile phone of the HEWs has different forms that used to register, request in addition, report in the area of MNCH services. Mother registration form is one of the forms used to register the pregnant mothers in the system. Based on the information registered the system automatically calculate the ANC visits and send reminder messages for the four ANC visits the mothers should conduct to the respective HEWs. According to the messages they received the HEWs communicate the mothers the day of their ANC visit day.

4.1.2. Challenges

Based on the interview of the developers and review of the system challenges and problems regarding the system were identified. These are:

- The message over load and network connection problems caused the system response very slow.
- Virus attack: Windows operating system was used as a platform for the system, which partly made the system susceptible to different kinds of virus attacks. In addition, these cause interruption of the work of the data clerk/Midwife's.
- Use for personal need: Tendencies to use the desktop machines placed at each health center for various personal needs by the health center staff were high to the extent of affecting the availability of the machines for the intended purposes.
- Limited computer knowledge and skill: The health center staff had little or no computer skill and knowledge, therefore making it difficult for them to use the system more effectively right away.
- Monthly mobile credit recharge and miss use: Problems were faced in finding a way to recharge the credits on the HEW's phones. And the HEWs use the credit which is recharged for them to send confirmation messages to the health center for their personal call and message. If they do not have the credit to send confirmation and emergency messages, it will cause problem to the pregnant mothers who are under the follow up the HEWs, also discontinue the communication between the HEWs and health centers, and cause wastage of resources. In addition to this some of the HEWs have lost or damaged their phones

- Literacy/language barrier: The reminder messages what the system send to the HEWs are in English. It leads to misunderstanding and misinterpretation of the message and cause problem on the mother and service delivery.
- As described above the actors involved in the operation of this system not include mothers. HEWs are the one who are responsible to deliver the reminder message to the mothers. In this case, there is no mechanism to make sure that the reminder messages deliver to the mother through HEWs on the right time.
- Even if we make the SMS delivery directly to the mother, it needs literacy of the mother to read and understand the messages.
- Need of distribution of Java enabled mobile phone for each HEWs in the pilot area, which is not cost effective.
- Forms uploaded in the HEWs phone accidentally or purposely canceled by some of HEWs.

4.1.3. Proposed sub-system

The proposed Voice Message management sub-system will do the following:

- Store message - messages that are prepared in different language will be recorded and stored. Each message will be labeled to the time of delivery. The system should give the facility to add new message, edit.
- Send message – the mothers are already registered and after the system checks the appointment date and the week of mother then automatically the respective messages will be send to the respective mother to her mobile phone without the need of operator.
- Display visit information - The authorized person should display mothers who was received reminder message and attained their follow up and not attained.
- Display message information – in addition the authorized person should display who was receive message and listen messages by following the menu provided.

4.2. Design Improvement

4.2.1. Scope of Improvement

From the above described problems and challenges of the existing system some of them were selected for improvement. These are:

- Personal use of mobile phone,
- Monthly mobile phone credit recharge and misuse,
- There is no mechanism to make sure that the HEWs deliver the message to the mothers on the right time/way,
- The mothers are not directly involved and,
- Literacy and language barriers,
- The need of software programmed or smart mobile phone for data collection and transfer,

To avoid or to minimize the above selected problems and challenges, the following recommendations was made to include to the content and system design.

I. Mothers/families should be directly involved to the interventions that are planned to address health problems. Because involving mothers/families used to empower mothers/families to decide about their own health and deliver any kind of intervention without any delay. This will avoid delay or not delivery of messages to the mothers through HEWs.

II. The messages should be in voice instead of text using interactive voice response application. Because by using interactive voice response application we can make the messages in multi-language, this can avoid language and literacy barriers. This help to retrieve the messages directly through mothers/families to any type of mobile phone they have by assuming in each family at least one mobile phone is available.

4.2.2. System design

The aim of analysis model is to produce a model of the system that is correct, complete, consistent, unambiguous, realistic and verifiable based on existing system review finding. In this section the system is described by showing its subsystems' functionalities by use cases, its static behavior by class diagram.

Identified actors

Table 1: List of Actors and their goal

Actors	Description	Goal
Clients/mothers	A pregnant mother or a mother in postpartum period who is registered to receive messages	To receive appointment reminder and health information messages
System	A machine used to store an send voice messages to any type of mobile phone	To send reminder and send health information
Operator	A person who is authorized to use the system	To display message information, and display visit information

Use Case Diagram

Use case diagram is the representation of the functionality of the system. This Section presents functionality of the system in terms of actors and use cases. A use case describes a function provided by the system that yields a visible result for an actor.

The identified use cases of the system are the following

No	Use Case	Description
1	Store message	This use case used to store messages recorded
2	Send message	This use case used to send appropriate message for the appropriate mother
3	Receive message	This use case used to retrieve appointment reminder and health information messages delivered to the respective mother
4	Display message information	This use case used to displays messages received and listened by each mothers
5	Display visit information	This use case used to displays who attained their appointment date after receiving reminder messages.

Table 2: List of use cases

Use case description

The description of each use case are listed below

ID	Uc- 1
Title	Store message
Description	The messages, which are going to delivered to mothers recoded and stored.
Primary Actors	System
Preconditions	The system should have database to store the messages.
Post conditions	Messages ready to deliver to the respective mothers
Main success Scenario	1. Messages recorded in different languages. 2. Messages assigned to the time of delivery. 3. Store in the database and ready to deliver. 4. Use case end.

Table 3: Description of use case Store Message

ID	Uc-2
Title	Send message
Description	Send appointment reminder and health information messages to the respective mothers
Primary Actors	System
Precondition	There should be pregnant women whose pregnancy period is at 16 weeks, 28 weeks, 32 weeks and 36 weeks. There should be also pregnant women in 6 day and 6 weeks after delivery.
Post condition	Appointment reminder and health information messages delivered to the right mother
Main success scenario	1. The system checks each day if there is pregnant women whose appointment date next day, at the end of each pregnancy months and at the beginning of each postpartum weeks. 2. The system gets the phone number of the mothers and the language they speak from the database. 3. The system peak the appropriate reminder and health messages for the mother whose appointment date is next day and who are in the last date of each pregnancy months. 4. Send messages. 5. Use case end

Table 4: Description of use case Send Message

ID	Uc - 3
Title	Receive message
Description	Appointment reminder and health information messages delivered to the respective mother
Primary Actors	Mothers
Precondition	The mother should have mobile phone. The system knows the phone number of the mother.
Post condition	Message delivered to the right mother
Main success scenario	1. The mother open the message box and listen the pre recorded message 2. The message offer the mothers to press a number assigned for the danger signs which they want to know. 3. Based on the number pressed the appropriate message will be selected from the database and played. 4. The mother finish listening the appointment reminder and health information messages then close the message box. 5. Use case end

Table 5: Description of use case Receive Message

ID	Uc - 4
Title	Display message information
Description	It displays messages received and listened by each mothers
Primary Actors	Operators
Precondition	Operator logs into the system
Post condition	Displayed each mothers who receive the message and listen
Main success scenario	1. The system list message information of mothers who receive the message and press a number to listen specific health information 2. Use case end

Table 6: Description of use case Display Message Information

ID	Uc- 5
Title	Display visit information
Description	It displays who attained their appointment date after receiving reminder messages
Primary Actors	Operator
Precondition	The operator log in to the system
Post condition	The visit information of each mother will be displayed
Main success scenario	1. The system list each mothers who receive appointment reminder messages and attained and not attained their follow up in the sated appointment dates. 2. Use case end

Table 7: Description of use case Display Visit information

Use case Diagram

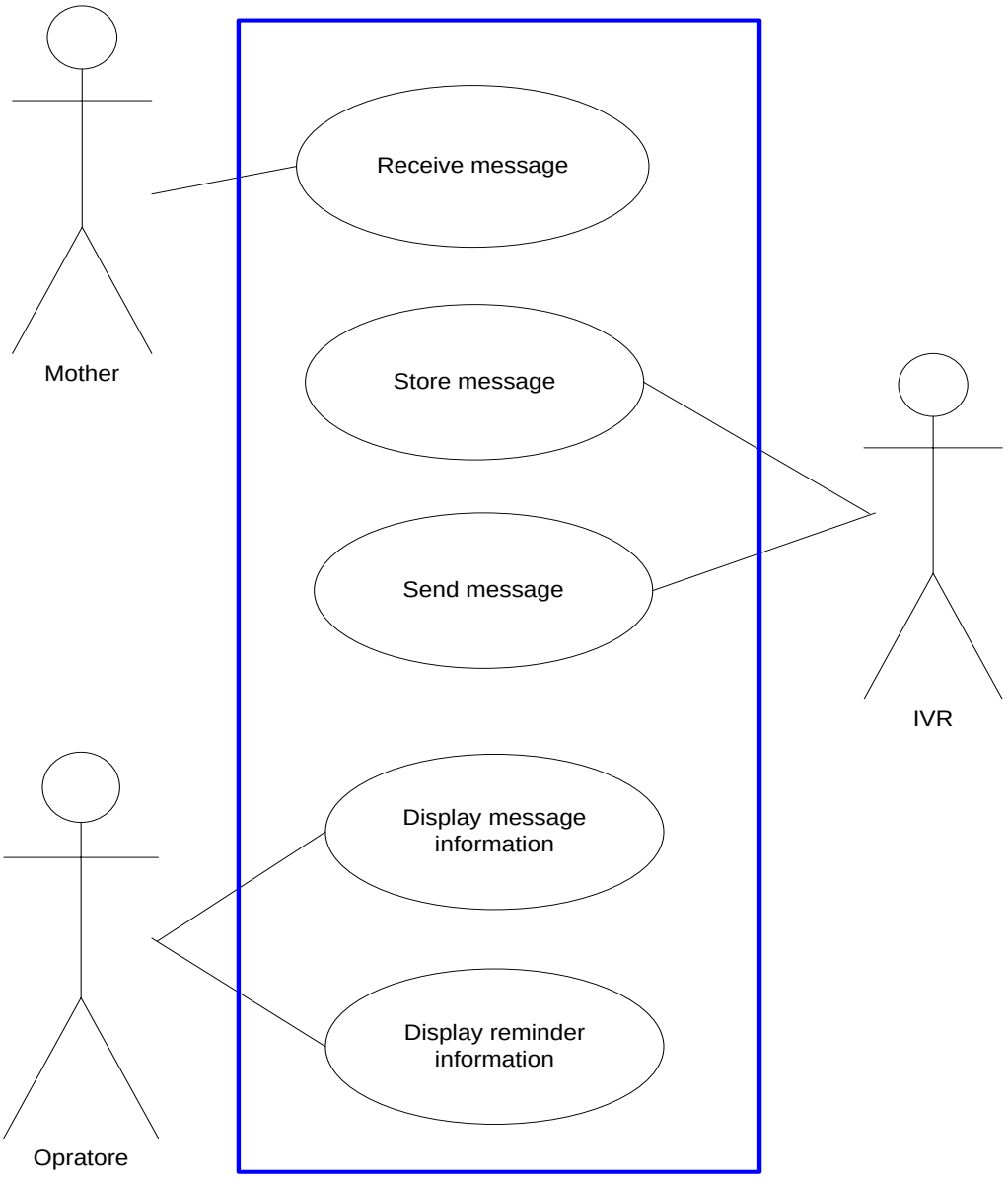

Figure1: Use case Diagram

Class Diagram

Class diagrams describes the structure of the system in terms of classes, attributes, operations and their associations, A class is an abstraction in object oriented programming languages.

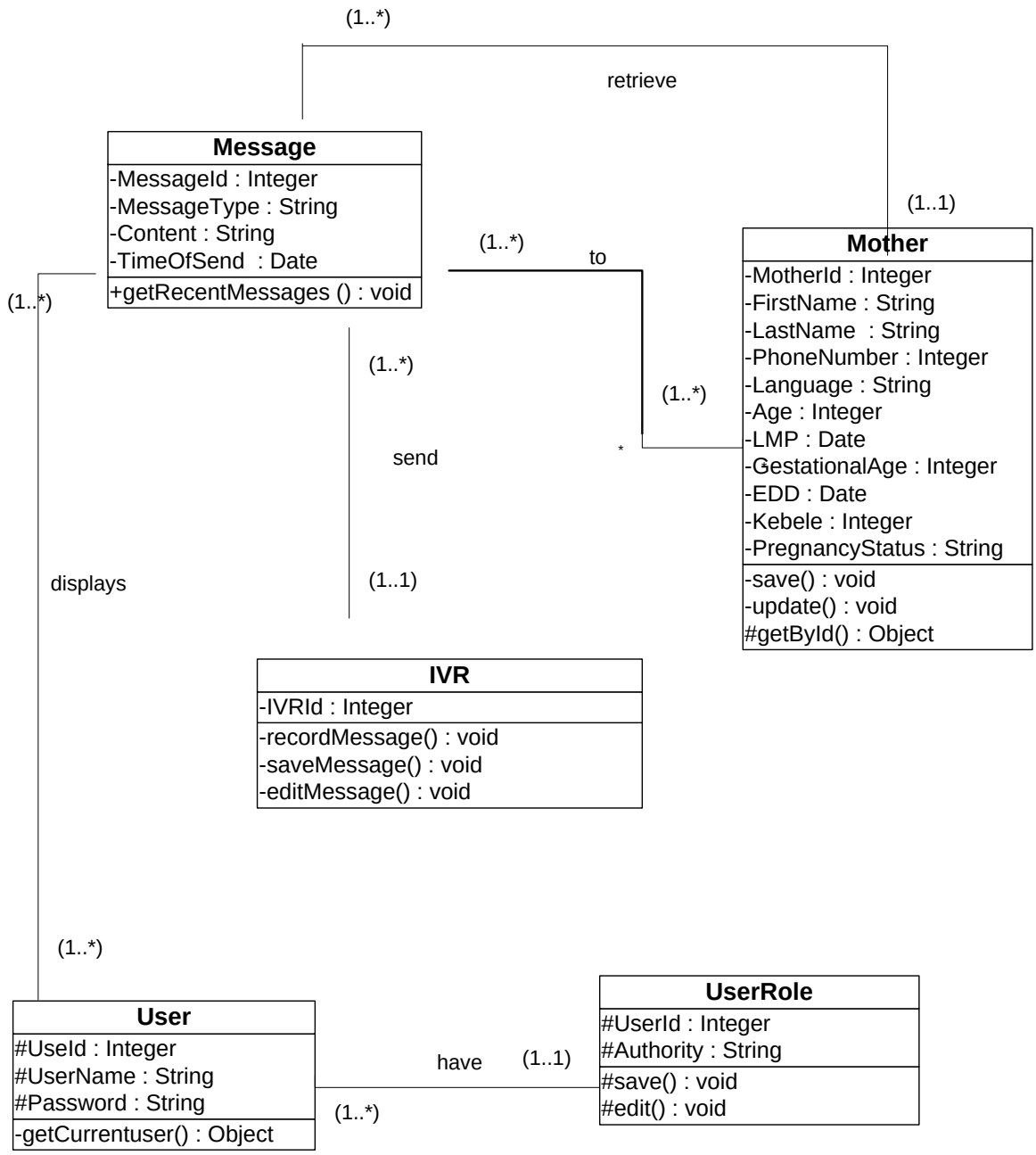

Figure 2: Class Diagram

Class diagram Description

1. Class Name: Mother – used to model data about a pregnant mother and its operation.

   Attributes:

MotherId	Type: Integer	Visibility: Private
FirstName	Type: String	Visibility: Private
LastName	Type:String	Visibility: Private
PhoneNumber	Type:String	Visibility: Private
Language	Type: String	Visibility: Private
Age	Type:Integer	Visibility: Private
LMP	Type:Date	Visibility: Private
GestationalAge	Type:Integer	Visibility: Private
EDD	Type: Date	Visibility: Private
Kebele	Type:String	Visibility: Private
PregnancyStatus	Type:String	Visibility:Private

   Methods:

   save () - this method saves pregnant mother information

   Visibility: Public

   Parameters: mother

   Return type: Void

   Preconditions: a pregnant mother information is available

   Post conditions: mother's information is added.

   update () – this method update new information on pregnant mothers

   Visibility: Public

   Parameters: mother

   Return type: Void

   Preconditions: an already registered information about a mother and a new one to update

   Postconditions: a mother's information is updated.

getById () :this method retrieves a specific mother's information by the id.

Visibility: Public

Parameters: MotherId

Return type: Object

Preconditions: an already registered information about a mother containing that id.

Post conditions: a particular mother's information retrieved with that id.

2. Class name: Message – used to model data about messages and its operations.

Attributes:

MessageId	Type: Integer	Visibility: private
MessageType	Type: String	Visibility: private
Content	Type: String	Visibility: private
TimeOfSend	Type: Integer	Visibility: private

Methods:

getRecentMessage: this method retrieve messages sent to the specific mother.

Visibility: Public

Parameters: Mother

Return type: Object

Preconditions: a pregnant mother information should be available.

Post conditions: messages retrieved.

3. Class name:IVR - used to model data about IVR and its operations.

Attributes:

IVRId	Type: Integer	Visibility: Protected

Methods:

recordMassage(): this method record voice messages which are going to be send to mother.

Visibility: protected

Parameter: Mother

Return type: void

Preconditions: messages which are going to be recorded should be available.

Post conditions: messages recorded and ready to send.

saveMessage(): this method used to save message and message information.

Visibility: protected

Parameters: IVR

Return type: void

Preconditions: recorded and ready to store and send messages should be available.

Post conditions: messages stored.

editMessage(): this method used to add, delete, edit messages,

Visibility: protected

Parameters: IVR

Return type: void

Preconditions: messages should be available.

Post conditions: additional deleted or edited messages

4. Class name: UserRoles – used to model the data about the different roles that users have and their operations.

Attributes:

UserId	Type: Integer	Visibility: Private
Authority	Type: String	Visibility: Private

Methods:

edit():this method used to edit the information of the users

Visibility: private

Parameters: none

Return type: void

Preconditions: new user and users information should be available.

Post conditions: users information.

save(): this method used to save users information

Visibility: private

Parameters: none

Return type: void

Preconditions: information of users should be available

Post conditions: saved information of users

5. Class name: User – used to model account data and their operations.

Attributes:

UserId: Type: Integer Visibility: private

Username: Type: String Visibility: private

Password: Type: Integer Visibility: private

Method:

getCurrentUsername(): this method used as to see the current users.

Visibility: private

Parameters: none

Return type: void

Preconditions: already registered user name.

Post conditions: users name retrieved.

4.2.3. Content

As described in chapter 1 of this report, one of the scopes of the project was developing messages that can create awareness of mothers on the danger signs that can occur during pregnancy and postpartum period and ANC and PNC follow up visit appointment reminder.

Messages developed for each trimester of pregnancy and postpartum period and appointment reminder messages will be pre-recorded in the IVR machine using different language in such a way that mothers/families can understand easily. The mothers/families can retrieve the messages directly through to any type of mobile phone they have by assuming in each family at least one mobile phone is available.

After reviewing and identifying maternal and neonatal danger signs and categorized them in each trimester (first- 1 to 12 weeks, second- 13 to 27, third- 28 to until delivery) of pregnancy and postpartum weeks (first, second, third and fourth). Based on the danger signs symptoms messages were develop first in English, then translated to Amharic, and annexed.

After all the necessary mothers information recorded in the system by health providers, based on those information every day the system checks if there is mothers whose appointment date and pregnancy or postpartum weeks arrived to get reminder or health messages. After the mother identified by the system automatically send appropriate message to the appropriate mother

After the messages sent by the system, the mother open the message, she will automatically connect to the IVR. After welcoming the mother, reminder messages will be played. In case of health message delivery after welcoming the mother the system, offer her menu to press what she want to listen. For example during her third trimester, she will be allowed to press for example press 1 for Bleeding, press 2 for fever….

In case the mother terminate the pregnancy or experience stillbirth or the baby died after born the health provider should update the mother pregnancy status as soon as possible to aware the system not to bother her by sending reminder and health information message.

The appointment reminder message is doing to be send to the mother two times. The first one, three days prior to the appointment day and the second one, one day prior to the appointment day. This is because to make her not to for gate her appointment and not to schedule other appointments in her follow up day.

If the mother have questions or problems which is not included in the messages she receive, the system should advice her to go to the health facility where she used to go and give her phone number to contact health provider and discuss her problem.

CHAPTER FIVE

CONCLUTION AND RECOMMENDATION

5.1. Conclusion

In our country mobile phone subscribers is increasing time to time. This will favor the use of mHealth applications as one of the interventions to contribute to the reduction of maternal and neonatal morbidity and mortality.

This paper presents narrated contents both in Amharic and in English, review of the existing systems and design improvement based on the findings of the review for the development of voice messages for ANC and PNC services. The content includes ANC and PNC appointment reminder messages and messages about danger signs that can occur during pregnancy and postpartum period both in mothers and in babies.

It is shown that it is possible to design a system, which can be transmit voice messages in different languages to any mobile phone mothers have to aware them about the danger signs and to remind their appointment date.

The retrieval of the message, which is going to be sent by the system to the respective mother, is simple enough for the mother/family because already mobile users are exposed to telecommunication service calls. That means when the message delivered to the mother and she open after greeting offer her a menu (press 1 for bleeding, press 2 for headache…) and she can press a number that she want to listen.

5.2. Recommendation and Future work

Use of mobile network for the transmission of pre-recorded messages to any mobile is under the authority of Ethiopian Telecome's. Because of that, Telecom's should be communicated and advised about the overall implementation of and the availability of the technology that can support this mHealth application.

Appointment reminder and message that can aware those about the danger signs are not the only information, which is required by the mothers/families, and the information that can increase the awareness of mothers/families on the area of MNCH services and contribute on the reduction of maternal, neonatal and child morbidity and mortality. Therefore, I recommend an extended work

towards the identification of the required information by the mothers by directly involving them and information that can create awareness, contribute to the increment of service coverage and the reduction of maternal, neonatal and child morbidity and mortality.

Mothers who are literate and can read English may prefer to get the messages in text form than voice. Use of both SMS and Voice for message delivery roots should be considered in this case to fulfill the need of the mothers.

The developed messages should be tested to know the understandability, appropriateness of the language and the usefulness.

References

1. Federal Democratic Republic of Ethiopia Ministry of Health. Health Sector development Program IV 2010/11 – 2014/15, Addis Ababa, Ethiopia; 2010.
2. Demographic of Ethiopia. Updated 23 April 2014retrieved from www.wikipedia.org in May 27, 2014.
3. Federal Democratic Republic of Ethiopia Ministry of Health. Road Map for Accelerating the Reduction of Maternal and Newborn Morbidity and Mortality 2012-2015, Addis Ababa, Ethiopia; 2012.
4. Federal Democratic Republic of Ethiopia, Central Statistical Agency. Ethiopia demographic and health survey, ICF International, Ethiopia; 2011.
5. Vital Wave Consulting .mHealth in Ethiopia Strategies for a New Framework. Ethiopian; 2011.
6. World Health Organization (WHO) and UNICEF. Countdown to 2015: Maternal, Newborn and Child Survival: Building a Future for Women and Children: The 2012 Report. Geneva; 2012.
7. Save the Children, USAID, UNFPA, UNICEF, WHO, Opportunities for Africa's Newborns: Practical Data, Policy and Programmatic Support for Newborn Care in Africa, 2006
8. Assessing progress towards the millennium development goals. Ethiopia MDGs report December 2012, Addis Ababa, Ethiopia; 2012
9. Mihret Hiluf, Mesganaw Fantahun. Birth Preparedness and Complication Readiness among women in Adigrat town, north Ethiopia. Ethiop.J.Health Dev. 2007;22(1):14-20.
10. K.S. Sugathan, Vinod Mishra, and Robert D. Retherford. Promoting Institutional Deliveries In Rural India: The Role of Antenatal-Care Services National Family Health Survey Subject Reports. 2001; Number 20.
11. Gurmesa Tura. Antenatal care service utilization and associated factors in Metekel Zone, Northwest Ethiopia, Ethiop J Health Sci. 2009; Vol.19, No. 2.
12. Menegesha. Electronic Solutions for Ethiopian Health Sector. Business Information Technology, Oulu University of Applied Sciences; 2011.
13. Serkalem J.Mobile Health Application In Ethiopia Existing Initiatives and Practices [Master thesis]. Addis Ababa University department of Health Informatics; 2013.
14. Yvonne MacPherson and Sara Chamberlain. Health on the Move, Can Mobile Phones Save Lives? Policy Briefing # 7, BBC media action; 2013.
15. Abebaw G.W, Alemayhu W.Y and Mesganaw. Factors affecting utilization of skilled maternal care in northwest Ethiopia: a multilevel analysis.BMC International health and human rights. Ethiopia; 2013.13:20.
16. Car J, Gurol-Urganci I, de Jongh T, Vodopivec-Jamsek V, Atun R. Mobile phone messaging reminders for attendance at healthcare appointments. Cochrane database of

systematicreviews;2012Issue7.Art.No.:CD007458.DOI:10.1002/14651858 .CD007458.pub2.
17. Cipresso P., Serino S., Villani D., Repetto C., Sellitti L., Albani G.,et al. Is your phone so smart to affect your states? An exploratory study based on psycho physiological measure. Neurocomputing; 2012. 84:23-30.
18. Germanakos P., Mourlas C., & Samaras G... A Mobile Agent Approach for Ubiquitous and Personalized eHealth Information Systems'', Proceedings of the Workshop on 'Personalization for eHealth of the 10th International Conference on User; (2005).
19. Chaiyachati KH, Loveday M, Lorenz S, Lesh N, Larkan L-M, et al. A Pilot study of a mHealth application for healthcare workers: Poor uptake despite high reported acceptability at a rural South African community-based MDR-TB treatment program. South Africa; 2013.
20. International Engineering Consortium. Speech-Enabled Interactive Voice Response System. Retrieved December 5, 2014, from http://www.iec.org .
21. Techno Brain. Maternal health. Retrieved December 10, 2013, from http://www.technobrainbpo.com
22. The Cheers Report. Mobile Midwife empowers Ghanaian Women. Retrieved Feb, 2014.From http://cheersreport.com/; September 23, 2013.
23. Technology Overview of CommCare MOTECH Suite. (n.d), Project Ananya. Retrieved May 10, 2014, from www.grameenfoundation.org.
24. Jeannine Lemaire .The second Report of Scaling Up Mobile Health.
25. Keisling, K. mHealth Field Guide for Newborn Health. Washington, DC: CORE Group; 2014.
26. Gayle, M, Lungi, O, Gwendolyn, M, and Sarah, K. mHealth Compendium, Volume 2. Arlington, VA: African Strategies for Health Project, Management Sciences for Health; 2013.

Annex.1 Messages both in Amharic and English

1. System directly send appointment reminder message for the four ANC visit and PNC to mothers

When the mothers open the message it says;

This is the voice message service specially prepared for mothers

ይህ በልዩ ሁኔታ ለእናቶች የተዘጋጅ የድምፅ መልእክት አገልግሎት ነው።

First appointment reminder message

- *How are you, Monday is your appointment day please go to the health facility where you used to follow your pregnancy.*
- **ጤና ይስጥልኝ የቀጠሮ ቀኖ ሰኞ ስለሆነ እባኮትን ክትትል ወደ ሚያደርጉበት የጤና ተቋም ይሂዱ።**

Second appointment reminder message

- *How are you, tomorrow is your appointment day please go to the health facility where you used to follow your pregnancy.*
- **ጤና ይስጥልኝ የቀጠሮ ቀኖ ነገ ስለሆነ እባኮትን ክትትል ወደ ሚያደርጉበት የጤና ተቋም ይሂዱ።**

2. The system directly sends health information messages two times (every 15 days) every month during pregnancy period.

   This is the voice message service specially prepared for mothers
   ይህ በልዩ ሁኔታ ለእናቶች የተዘጋጅ የድምፅ መልእክት አገልግሎት ነው።

   During 1st trimester

How are you, if you want to know about the danger signs that can occur during the 1st three months of pregnancy please press "0".

ጤና ይስጥልኝ በመጀመሪያዎቹ ሦስት የእርግዝና ወራት ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ይፈልጋሉ እባኮትን "0"ን ይጫኑ።

For bleeding press "1"

ለደም መ ፍሰስ "1"ን ይጫኑ።

- *If you have vaginal bleeding with abdominal cramp, pelvic pain, nausea and vomiting you need medical care please go to the health facility where you used to follow your pregnancy.*
- **የደም መፍሰስ ከሆድ ቁርጠት፣ ከማህፀን ህመም፣ ከማቅለሽለሽ እንዲሁም ከማስመለስ ጋር ካሎት የህክምና እርዳታ ስለሚያስፈልጎት የእርግዝና ክትትሎን ወደ ሚያደርጉበት ጤና ተቋም ይሂዱ።**

For nausea and vomiting press "2"

ለማቅለሽለሽ እና ለማስመለስ "2"ን ይጫኑ

- *To decrease nausea and vomiting during morning time and after you eat food please eat easily digested foods in small amount 4 - 6 times a day.*
- *However, nausea and vomiting symptoms become continuous, cause difficulty of eating and dizziness you need medical care please go to the health facility.*
- **ጠዋት ጠዋት እንዲሁም ምግብ ከተመገቡ በኋላ ማቅለሽለሽ እና ማስመለስን ለመቀነስ ቀለል ያሉ ምግቦችን በአነስተኛ መጠን በቀን ውስጥ ከ4-6 ጊዜ ይመገቡ።**
- **ነገር ግን ማቅለሽለሽ እና ማስመለሱ ተከታታይ ከሆነ፣ ምግብ አላስበላ ካሎት እና የድካም ስሜት ከተሰማዎት ወደ ጤና ተቋም ሄደው የህክምና እርዳታ ያግኙ።**

For fever press "3"

ለትኩሳት *"3"ን ይጫኑ*

- *If you have fever with pain or burning when urinating or chills or sweating or cough please go to the health facility and gate medical care.*
- *In addition to the medical care you got please take rest, drink plenty of water, and don't hold your urine void frequently.*
- **ትኩሳት ከሽንት ሲሸኑ ማቃጠል ወይንም ህመም፣ ከማንቀጥቀጥ ፣ ከማላብ ወይንም ከሳል ጋር ካሎት እባኮትን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**
- **ከህክምናው በተጨማሪ በቂ እረፍት ያድርጉ፣ ንጹ የመጠጥ ውሃ በብዛት ይጠጡ፣ የውሃ ሽንቶትን አይያዙ ቶሎ ቶሎ ይሸኑ ።**

<u>During 2nd trimester</u>

How are you, if you want to know about the danger signs that can occur during the 2nd three months of pregnancy please press "0".

ጤና ይስጥልኝ ከአራት እስከ ስድስት የእርግዝና ወራት ውስጥ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ይፈልጋሉ እባኮትን “0” ይጫኑ።

For bleeding press “1”

ለደም መ ፍሰስ “1”ን ይጫኑ።

- *If you have painless vaginal bleeding during this time please go the health facility and gate medical care.*
- **ሕመም የለሽ የደም መፍሰስ ካለብዎ የህክምና እርዳታ ስለሚያስፈልጎ ወደ እርግዝና ክትትል ወደ ሚያደርጉበት የጤና ተቋም ሄደው የህክምና እርዳታ ያግኙ።**

For severe headache press”2”

ለከፍተኛ እራስምታት “2”ን ይጫኑ።

- *If you have severe headache not relived by simple analgesics, dizziness, blurring of vision and swelling of hands and/or face you need to go to health facility and check your blood pressure.*
- *In addition to medical care gate rest, avoid stress full condition, check your blood pressure often.*
- **በራስ ምታት ማስታገሻ መድሀኒት የማይሻል ከፍተኛ የራስምታት ከአይን እይታ መዛባት፣ ከራስ ማዞር፣ ከእጅና ፊት እብጠት ጋር ካሎት ወደ ጤና ተቋማት በመሄድ የደም ግፊቶን ይለኩ የህክምና እርዳታም ያግኙ።**
- **ከህክምና በተጨማሪ በቂ እረፍት ያድርጉ፣ እራስን ከሚያስጨንቁ እና ከሚረብሹ ነገሮች እራቁ በየጊዜው የደም ግፊትዎን ይለኩ።**

For fever press “3”

ለትኩሳት *“3”ን ይጫኑ*

- *If you have fever with pain or burning when urinating or chills or sweating or cough please go to the health facility and gate medical care.*
- *In addition to the medical care you got please take rest, drink plenty of water, and don’t hold your urine void frequently.*
- **ትኩሳት ከሽንት ሲሸኑ ማቃጠል ወይንም ህመም፣ ከማንቀጥቀጥ ፣ ከማላብ ወይንም ከሳል ጋር ካሎት እባኮትን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**
- **ከህክምናው በተጨማሪ በቂ እረፍት ያድርጉ፣ ንጹ የመጠጥ ውሃ በብዛት ይጠጡ፣ የውሃ ሽንቶትን አይያዙ ቶሎ ቶሎ ይሸኑ ።**

For loss of fetal movement press “4”

ለፅንስ እንቅስቃሴ መቋረጥ “4”ን ይጫኑ።

- *If you feel fetus stops moving around and kicking, fewer than 10 kicks in a day or the baby is moving a lot less than usual please go the health facility and gate medical care.*
- **የፅንሱ እንቅስቃሴ መቆም ወይንም እንቅስቃሴው በቀን ከ10 ጊዜ ካነሰ ወይንም ከተለመደው እንቅስቃሴ ከቀነሰ ወደ ጤና ተቋም በመሄድ ምርመራ ያድርጉ።**

For premature onset of contraction “5”

ካለጊዜው ስለሚከሰት ምጥ “5”ን ይጫኑ።

- *If you have contractions, painful or painless, abdominal cramps with or without diarrhea, increase in or change in color in vaginal discharge please go to the health facility where you used to follow your pregnancy and gate medical care.*
- **ህመም ያለው ወይንም የሌለው ምጥ፣ የሆድ ቁርጠት ከተቅማጥ ጋር ወይንም ያለተቅማጥ፣ ከብልት የሚወጣ ፈሳሽ መጠን መጨመር እና ከለር መቀየር ከተከሰተበ የእርግዝና ክትትል ወደ ሚያደርጉበት የጤና ተቋም ይሂዱ።**

During 3rd trimester

How are you, if you want to know about the danger signs that can occur during the 3rd three months of pregnancy please press “0”.

ጤና ይስጥልኝ በመጨረሻው ሦስት የእርግዝና ወራት ውስጥ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ይፈልጋሉ እባኮትን “0”ን ይጫኑ።

For bleeding press “1”

ለደም መፍሰስ “1”ን ይጫኑ።

- *If you have vaginal bleeding with or without abdominal pain please go to the health facility you need to gate medical care.*
- **ደም መፍሰስ ከሆድ ህመም ጋር ወይንም ውጪ ካለቦ ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**

For severe headache press”2”

ለከፍተኛ እራስምታት “2”ን ይጫኑ።

- *If you have severe headache not relived by simple analgesics, dizziness, blurring of vision, swelling of hands and/or face you need to go to health facility and check your blood pressure.*

- *In addition to medical care gate rest, avoid stress full conditions, checked your blood pressure often.*
- **በራስ ምታት ማስታገሻ መድሀኒት የማይሻል ከፍተኛ የራስምታት ከአይን እይታ መዛባት፣ ከራስ ማዞር፣ ከእጅና ፊት እብጠት ጋር ካሎት ወደ ጤና ተቋማት በመሄድ የደም ግፊቶን ይለኩ የህክምና እርዳታም ያግኙ።**
- **ከህክምና በተጨማሪ በቂ እረፍት ያድርጉ፣ እራስን ከሚያስጨንቁ እና ከሚረብሹ ነገሮች እራቁ በየጊዜው የደም ግፊትዎን ይለኩ።**

For fever press "3"

ለትኩሳት *"3"*ን ይጫኑ

- *If you have fever with pain or burning when urinating or chills or sweating or cough please go to the health facility and gate medical care.*
- *In addition to the medical care you got please take rest, drink plenty of water, and don't hold your urine void frequently.*
- **ትኩሳት ከሽንት ሲሸኑ ማቃጠል ወይንም ህመም፣ ከማንቀጥቀጥ ፣ ከማላብ ወይንም ከሳል ጋር ካሎት እባኮትን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**
- **ከህክምናው በተጨማሪ በቂ እረፍት ያድርጉ፣ ንጹ የመጠጥ ውሃ በብዛት ይጠጡ፣ የውሃ ሽንቶን አይያዙ ቶሎ ቶሎ ይሽኑ ።**

For loss of fetal movement press "4"

ለፅንስ እንቅስቃሴ መቋረጥ "4"ን ይጫኑ።

- *If you feel fetus stops moving around and kicking, fewer than 10 kicks in a day or the baby is moving a lot less than usual please go the health facility and gate medical care.*
- **የፅንሱ እንቅስቃሴ መቆም ወይንም እንቅስቃሴው በቀን ከ10 ጊዜ ካነሰ ወይንም ከተለመደው እንቅስቃሴ ከቀነሰ ወደ ጤና ተቋም በመሄድ ምርመራ ያድርጉ።**

For premature onset of contraction "5"

ካለጊዜው ስለሚከሰት ምጥ "5"ን ይጫኑ።

- *If you have contractions, painful or painless, abdominal cramps with or without diarrhea, increase in or change in color in vaginal discharge please go to the health facility where you used to follow your pregnancy and gate medical care.*

- **ህመም ያለው ወይንም የሌለው ምጥ፣ የሆድ ቁርጠት ከተቅማጥ ጋር ወይንም ያለተቅማጥ፣ ከብልት የሚወጣ ፈሳሽ መጠን መጨመር እና ከለር መቀየር ከተከሰተቦ የእርግዝና ክትትል ወደ ሚያደርጉበት የጤና ተቋም ባፋጣኝ ይሂዱ።**

For convulsion press"6"

ለራስን መሳትና መንቀጥቀጥ "6"ን ይጫኑ።

- *If you experience nausea and vomiting, headache, abdominal pain and then convulsion please go to the health facility as soon as possible.*
- **ማቅለሽለሽ ፣ማስመለስ፣ ራስምታት፣ ሆድ ህመም በማስከተል እራስን መሳት እና ማንቀጥቀጥ ካለቦ በፍጥነት ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**

For sudden leakage of fluid from vagina "7"

ያለጊዜው የእንሽርት ውሃ መፍስስ "7"ን ይጫኑ።

- *If you have spontaneous leakage of amniotic fluid with fever, offensive smell and cloudy vaginal discharge and lower abdominal pain when touched, please go to the health facility where you used to follow your pregnancy.*
- **የእንሽርት ውሃ መፍሰስ ከትኩሳት፣ መጥፎ ጠረን ያለው የብልት ፈሳሽ እና የሆድ ቁርጠት በታችኛው የሆድ ክፍል ካሎት የእርግዝና ክትትል ወደ ሚያደርጉበት የጤና ተቋም ባፋጣኝ ይሂዱ።**

3. The system directly sends health information messages every week during postpartum period.

<u>During 1st week of postpartum</u>

How are you, if you want to know about the danger signs that can occur during the 1st week after delivery in the mother please press "0", in the newborn babies press "1"

ጤና ይስጥልኝ ከወሊድ በኋላ በመጀመሪያው ሳምንት ውስጥ በአራሷች ላይ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ከፈለጉ እባኮትን "0"ን ይጫኑ፣ በተወለዱ ህፃናቶች ላይ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ከፈለጉ "1"ን ይጫኑ።

❖ If the mother press zero she can get information about the danger signs that can occur in mothers. The messages are described below.

For bleeding press "1"

ለደም መ ፍስስ "1"ን ይጫኑ።

- *If you have sudden and profuse bright red vaginal bleeding, passing large clots of blood for more that 7 days after birth, pain or swelling in the abdomen, faintness, breathlessness please go to health facility where you deliver your baby as soon as possible.*
- **ድንገተኛ ብዙ የረጋ ወይንም ያረጋ ደም ከወለዱ ከሰባት ቀን በላይ መፍሰስ፣ የሆድ ህመም ወይንም ማበጥ፣ትንፋሽ ማጠር እና እራስን መሳት ካለቦ የህክምና እርዳታ ስለሚያስፈልጎ ወደ ጤና ተቋም ሄደው የህክምና እርዳታ ያግኙ።**
- **ከህክምናው በተጨማሪ ደም ሊተኩ የሚችሉ ምግቦችን ይመገቡ**

For fever press "2"

ለትኩሳት *"2"*ን ይጫኑ

- *If you have fever, shivering, abdominal pain and/or offensive vaginal loss please go to the health facility where you deliver your baby.*
- *In addition to medical care take rest, change frequently your underwear or modase, and douche your vagina frequently using water and salt.*
- **ትኩሳት፣ ማንቀጥቀጥ፣ የሆድ ህመም ከመጥፎ ጠረን ካለው የማህፀን ፈሳሽ ካሎት እባኮትን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**
- **ከህክምናው በተጨማሪ በቂ እረፍት ያድርጉ፣ የውስጥ ሱሪዎን ወይንም ከማሕፀኖ የሚወጣውን ደም እና ፈሳሽ ለመቀበል የሚጠቀሙበትን ጨርቅ ወይንም ሞዴስ ቶሎ ቶሎ ቀይሩ እንዲሁም ማህፀኖን ቶሎ ቶሎ በጨው እና በውኃ ይታጠቡ።**

For obstetric fistula press "3"

ለሽንት ወይንም አይነምድር መቆጣጠር አለመቻል "3"ን ይጫኑ

- *If you experience difficulty of controlling your urine (Urinary Incontinence) please go to the health facility where you deliver your baby.*
- **ሽንቶን ወይንም አይነምድሮን መቆጣጠር ካልቻሉ ወደ ጤና ተቋም በመሄድ የህክምና እርታ ያግኙ።**

For headache press "4"

ለእራስምታት "4"ን ይጫኑ።

- *If you have headaches with, nausea, vomiting, epigastric or hypochondrial pain, feeling faint, convulsions, and swelling of hand and/or feet please go to where you deliver your baby.*

- *In addition to medical care gate rest, avoid stress full conditions, checked your blood pressure often.*
- **የራስ ምታት ከማቅለሽለሽ ፣ ማስመለስ፣ የጨጓራ ህምም፣ ራስ ማዞር፣ ማንቀጥቀጥ እና እጅና ፊት እብጠት ጋር ካሎት ወደ ጤና ተቋማት በመሄድ የደም ግፊትዎን ይለኩ የህክምና እርዳታም ያግኙ።**
- **ከህክምና በተጨማሪ በቂ እረፍት ያድርጉ፣ እራስን ከሚያስጨንቁ እና ከሚረብሹ ነገሮች እራቁ በየጊዜው የደም ግፊቶን ይለኩ።**

❖ If the mother press One she can get information about the danger signs that can occur in newborn babies. The messages are described below.

For Respiratory tract infections press "1"

ለመተንፈሻ አካል ህመም "1"ን ይጫኑ

- *If your baby has fast breathing, fever, severe chest in- drawing please takes your baby to the health facility.*
- **የተወለደው ሕፃን ቶሎ ቶሎ መተንፈስ፣ ሲተነፍስም ደረቱ በከፍተኛ ሁኔታ ወደ ውስጥ መግባት እና መውጣት፣ ትኩሳት ካለው ባፋጣኝ ወደ ጤና ተቋም ይውሰዱት።**

Eye infection press "2"

ለአይን ህመም "2ን ይጫኑ።

- *If your baby has swelling of the eyelids, redness of the inside part of the eye, or discharge from the eye clean the baby eye with clean water take him to the health facility.*
- **ህፃኑ የአይኑ ውስጠኛው ክፍል መቅላት፣ ማበጥ እና ከአይኑ የሚወጣ ፈሳሽ ካለ አይኖቹን በንፁ ውኃ ማጥፅዳት እና ወደ ጤና ተቋም ይውሰዱት።**

Sepsis press "3"

በደም ውስጥ ስለተሰራጨ ህመም "3"ን ይጫኑ

- *If your baby has fever or feels cold please take the baby to the health facility.*
- **የተወለደው ሕፃን ከፍተኛ ትኩሳት ወይንም መቀዝቀዝ ካለው ባፋጣኝ ወደ ጤና ተቋም ይውሰዱት።**

Not pass meconume after 24 hours after born press "4"

የመጀመሪያውን አይነምድር አለማውጣት"4"ን ይጫኑ።

- *If your baby not passes meconume (the1st dark stole) after 24 hours after born please take your baby to the health facility where you deliver.*
- **ህፃኑ ከተወደ ከ24 ሰዓት በኃላ የመጀመሪያውን ጥቁር አይነምድር ካላወጣ ወደ ጤና ተቋም ይውሰዱት።**

Gastrointestinal tract infection press "5"

ለሆድ ህምም "5"ን ይጫኑ።

- *If your baby has watery or dark green stools with mucus or with blood please take your baby to the health facilities where you deliver and breastfeed frequently.*
- **እንደ ውኃ የቀጠነ ወይንም ጥቁር አረንጓዴ ቀለም ያለው አይነምድር ከንፍጥ ወይንም ከደም ጋር ካለው ውደ ጤና ተቋም ይውሰዱት። ጡቶትንም ቶሎቶሎ ያጥቡት።**

Gastrointestinal tract obstruction press "6"

የምግብ መተላለፊያ አካል መዘጋት "6"ን ይጫኑ።

- *If your baby has persistent vomiting; vomiting with a swollen abdomen please take your baby to the health facility as soon as possible.*
- **ህጻኑ ተከታታይ የሆነ ማስመለስ ከሆድ እብጠት ጋር ካለው ባፋጣኝ ወደ ጤና ተቋም ይውሰዱት**

<u>During 2nd week of postpartum</u>

How are you, if you want to know about the danger signs that can occur during the 2st week after delivery in the mother please press "0", in the newborn babies press "1"

ጤና ይስጥልኝ ከወሊድ በኋላ በሁለተኛው ሳምንት ውስጥ በእናቶች ላይ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ከፈለጉ እባኮትን "0"ን ይጫኑ፣ በተወለዱ ህፃናቶች ላይ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ከፈለጉ "1"ን ይጫኑ።

❖ If the mother press zero she can get information about the danger signs that can occur in mothers. The messages are described below.

For bleeding press "1"

ለደም መ ፍሰስ "1"ን ይጫኑ።

- *If you have sudden and profuse bright red vaginal bleeding, passing large clots of blood for more that 7 days after birth, pain or swelling in the abdomen, faintness, breathlessness please go to health facility where you deliver your baby as soon as possible.*

- **ድንገተኛ ብዙ የረጋ ወይንም ያረጋ ደም ከወለዱ ከሰባት ቀን በላይ መፍሰስ፣ የሆድ ህመም ወይንም ማበጥ፣ትንፋሽ ማጠር እና እራስን መሳት ካለቦ የህክምና እርዳታ ስለሚያስፈልጎ ወደ ጤና ተቋም ሄደው የህክምና እርዳታ ያግኙ፡፡**
- **ከህክምናው በተጨማሪ ደም ሊተኩ የሚችሉ ምግቦችን ይመገቡ**

For fever press "2"

ለትኩሳት *"2"*ን ይጫኑ

- *If you have fever, shivering, abdominal pain and/or offensive vaginal loss please go to the health facility where you deliver your baby.*
- *In addition to medical care take rest, change frequently your underwear or modase, and douche your vagina frequently using water and salt.*
- **ትኩሳት፣ ማንቀጥቀጥ፣ የሆድ ህመም ከመጥፎ ጠረን ካለው የማህፀን ፈሳሽ ካሎት እባኮትን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ፡፡**
- **ከህክምናው በተጨማሪ በቂ እረፍት ያድርጉ፣ የውስጥ ሱሪዎን ወይንም ከማሕፀኖ የሚወጣውን ደም እና ፈሳሽ ለመቀበል የሚጠቀሙበትን ጨርቅ ወይንም ሞዴስ ቶሎ ቶሎ ቀይሩ እንዲሁም ማህፀኖን ቶሎ ቶሎ በጨው እና በውኃ ይታጠቡ፡፡**

For breast pain "3"

ለጡት ህመም *"3"*ን ይጫኑ

- *To prevent breast pain breastfeeding frequently day and night, avoid tight bras, avoid sleeping on stomach.*
- **የጡት ህመምን እንዳይከሰት ለማድረግ ጠዋት እና ማታ ቶሎ ቶሎ ጡት ማጥባት፣ የሚያጣብቁ የጡት ማስያገር‌ያዎችን አለመጠቀም እንዲሁም በደረት አለመተኛት**
- *However, if you have breast pain, redness in one area of the breast, swollen, hot to touch, fever, flu-like symptoms please go to the health facility and get medical care.*
- **ነገር ግን የጡት ህመም፣ የጡት የተወሰኑ ክፍሎች መቅላት፣ ማበጥ፣ ማቃጠል፣ ትኩሳት ካለቦ ወደ ጤና ተቋም በመሄድ ህክምና ያድርጉ፡፡**
- *In addition to medical care massage the breasts before breastfeeding, increase maternal fluid intake, apply cold compress or warm pack to breasts after feeds, bed rest.*
- **ከህክምናው ባሻገር ከማጥባቶ በፊት ጡቶን ይሹት፣ ውኃ በብዛት ይጠጡ፣ ጡት ካጠቡ በኃላ ቀዝቃዛ ወይንም ሙቅ ውኃ በጨርቅ በማድረግ ያድርጉበት እንዲሁም በቂ እረፍት ያድረጉ፡፡**

For headache press "4"

ለእራስምታት "4" ን ይጫኑ፡

- *If you have headaches with, nausea, vomiting, epigastric or hypochondrial pain, feeling faint, convulsions, and swelling of hand and/or feet please go to where you deliver your baby.*
- *In addition to medical care gate rest, avoid stress full conditions, checked your blood pressure often.*
- **የራስ ምታት ከማቅለሽለሽ ፣ ማስመለስ፣ የጨጓራ ህምም፣ ራስ ማዞር፣ ማንቀጥቀጥ እና እጅና ፊት እብጠት ጋር ካሎት ወደ ጤና ተቋማት በመሄድ የደም ግፊቶን ይለኩ የህክምና እርዳታም ያግኙ፡፡**
- **ከህክምና በተጨማሪ በቂ እረፍት ያድርጉ፣ እራስን ከሚያስጨንቁ እና ከሚረብሹ ነገሮች እራቁ በየጊዜው የደም ግፊቶን ይለኩ፡፡**

For depression press "5"

ለድብርት "5"ን ይጫኑ

- *If you experience, feeling overwhelmed and anxious, sleeping too much or too little, worrying about everything all the time, problems of concentrating and guilty feelings go to the heath facility and gate psychiatric care .*
- **የስሜት መረበሽ፣ እንቅልፍ ማጣት ወይንም ማብዛት፣ ስለሁሉም ነገር መጨነቅ እንዲሁም የጥፋተኝነት ስሜቶች የሚሰሙሽ ከሆነ ወደ ጤና ተቋማ በመሄድ የስነልቦና ህክም ማግኘት ይኖርብሻል፡፡**

For deep vein thrombosis press "6"

ለእግር ህመም "6"ን ይጫኑ

- *To prevent this problem don't sleep all the time try to walk and do exercise which can help you to have good blood circulation around your leg.*
- *If you have pain in the calf that feels like cramping and can spread to the foot and ankle, skin is warm in the affected area and may turn bluefish in color go to health facility and gate medical care.*
- **ሙሉ ጊዜዎን ከመተኛት ተቆጥበው ቤቶ ውስጥ ዞር ዞር እያሉ የእግር እንቅስቃሴዎችን በማድረግ በእግሮት አካባቢ የደም ዝውውር እንዲቀላጠፍ በማድረግ ይህን ህመም እንዳይከሰት ማድረግ የችላሉ፡፡**

- **የቁርጥማት ስሜት ታፋዎ አካባቢ ተነስቶ ወደ ቁርጭምጭሞ እና እግሮ የሚሰራጭ፣ የተጎዳው እግር ክፍል ማቃጠል እና ቀለሙን መቀየር የሚታይቦ ከሆን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**

❖ If the mother press one she can get information about the danger signs that can occur in newborn babies. The messages are described below.

For Respiratory tract infections press "1"

ለመተንፈሻ አካል ህመም "1"ን ይጫኑ

- *If your baby has fast breathing, fever, severe chest in- drawing please takes your baby to the health facility.*
- **የተወለደው ሕፃን ቶሎ ቶሎ መተንፈስ፣ ሲተነፍስም ደረቱ በከፍተኛ ሁኔታ ወደ ውስጥ መግባት እና መውጣት፣ ትኩሳት ካለው ባፋጣኝ ወደ ጤና ተቋም ይውሰዱት።**

Eye infection press "2"

ለአይን ህመም "2"ን ይጫኑ።

- *If your baby has swelling of the eyelids, redness of the inside part of the eye, or discharge from the eye clean the baby eye with clean water take him to the health facility.*
- **ህፃኑ የአይኑ ውስጠኛው ክፍል መቅላት፣ ማበጥ እና ከአይኑ የሚወጣ ፈሳሽ ካለ አይኖቹን በንፁ ውኃ ማጥፅዳት እና ወደ ጤና ተቋም ይውሰዱት።**

Tetanus press "3"

ለመንጋጋ ቆልፍ "3"ን ይጫኑ።

- *Avoid applying of traditional things in the umbilicus of the new born baby. If your baby has generalized muscle spasms and convulsions, breathing difficulty please take him to the health facilities.*
- **ህመሙ እንዳይከሰት ሕፃኑ እንብርት ላይ በባህላዊ መንገድ የሚደረጉ ነገሮችን ያስወግዱ።ህፃኑ መላው ሰውነቱ የመድረቅ እና መገተር አንዲሁም ማንቀጥቀጥ እና ራስን መሳት፣ ለመተንፈስ መቸገር ከታየበት ባፋጣኝ ወደ ጤና ተቋም ይውሰዱት።**

Umbilicus infection press "4"

ለእንብርት ኢንፌክሽን "4"ን ይጫኑ።

- *If your baby has draining pus umbilicus or umbilical redness, swelling extending to skin please take him to the health facility.*
- **የህፃኑ እንብርት ካበጠ፣ ከቀላ እና መግል የሚወታው ከሆን ባፋጣኝ ወደ ጤና ተቋም ውሰዱት።**

Gastrointestinal tract infection press "5"

ለሆድ ህምም "5"ን ይጫኑ፡፡

- *If your baby has watery or dark green stools with mucus or with blood please take your baby to the health facilities where you deliver and breastfeed frequently.*
- **እንደ ውኃ የቀጠነ ወይንም ጥቁር አረንጓዴ ቀለም ያለው አይነምድር ከንፍጥ ወይንም ከደም ጋር ካለው ውደ ጤና ተቋም ይውሰዱት፡፡ ጡቶትንም ቶሎቶሎ ያጥቡት፡፡**

3rd week of postpartum

How are you, if you want to know about the danger signs that can occur during the 2st week after delivery in the mother please press "0", in the newborn babies press "1"

ጤና ይስጥልኝ ከወሊድ በኋላ በሶስተኛው ሳምንት ውስጥ በእናቶች ላይ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ከፈለጉ እባኮትን "0"ን ይጫኑ፣ በተወለዱ ህፃናቶች ላይ ሊከሰቱ ስለሚችሉ የጤና ችግሮች ማወቅ ከፈለጉ "1"ን ይጫኑ፡፡

- If the mother press zero she can get information about the danger signs that can occur in mothers. The messages are described below.

For breast pain "1"

ለጡት ህመም *"1"*ን ይጫኑ

- *To prevent breast pain breast feeding frequently day and night, avoid tight bras, avoid sleeping on stomach.*
- **የጡት ህመም እንዳይከሰት ለማድረግ ጠዋት እና ማታ ቶሎ ቶሎ ጡት ማጥባት፣ የሚያጣብቁ የጡት ማስያዣያዎችን አለመጠቀም እንዲሁም በደረት አለመተኛት፡፡**
- *However, if you have breast pain, redness in one area of the breast, swollen, hot to touch, fever, flu-like symptoms please go to the health facility and get medical care.*
- **ነገር ግን የጡት ህመም፣ የጡት የተወሰኑ ክፍሎች መቅላት፣ ማበጥ፣ ማቃጠል፣ ትኩሳት ካለቦ ወደ ጤና ተቋም በመሄድ ህክምና ያድርጉ፡፡**
- *In addition to medical care massage, the breasts before breastfeeding, increase maternal fluid intake, apply cold compress or warm pack to breasts after feeds, bed rest.*
- **ከህክምናው ባሻገር ከማጥባቶ በፊት ጡቶን ይሹት፣ ውኂ በብዛት ይጠጡ፣ ጡት ካጠቡ በኋላ ቀዝቃዛ ወይንም ሙቅ ውኃ በጨርቅ በማድረግ ያድርጉበት እንዲሁም በቂ እረፍት ያድረጉ፡፡**

For depression press "2"

ለድብርት "2"ን ይጫኑ

- *If you experience, feeling overwhelmed and anxious, sleeping too much or too little, worrying about everything all the time, problems of concentrating and guilty feelings go to the heath facility and gate psychiatric care .*
- **የስሜት መረበሽ፣ እንቅልፍ ማጣት ወይንም ማብዛት፣ ስለሁሉም ነገር መጨነቅ እንዲሁም የጥፋተኝነት ስሜቶች የሚሰሙሽ ከሆነ ወደ ጤና ተቋማ በመሄድ የስነልቦና ህክም ማግኘት ይኖርብሻል።**

For deep vein thrombosis press "3"

ለእግር ህመም "3"ን ይጫኑ

- *To prevent this problem don't sleep all the time try to walk and do exercise which can help you to have good blood circulation around your leg.*
- *If you have pain in the calf that feels like cramping and can spread to the foot and ankle, skin is warm in the affected area and may turn bluefish in color go to health facility and gate medical care.*
- **ሙሉ ጊዜዎን ከመተኛት ተቆጥበው ቤቶ ውስጥ ዞር ዞር እያሉ የእግር እንቅስቃሴዎችን በማድረግ በእግሮት አካባቢ የደም ዝውው እንዲቀላጠፍ በማድረግ ይህን ህመም እንዳይከሰት ማድረግ የችላሉ።**
- **የቁርጥማት ስሜት ታፋዎ አካባቢ ተነስቶ ወደ ቁርጭምጭሞ እና እግሮ የሚሰራጭ፣ የተጎዳው እግር ክፍል ማቃጠል እና ቀለሙን መቀየር የሚታይቦ ከሆን ወደ ጤና ተቋም በመሄድ የህክምና እርዳታ ያግኙ።**

❖ If the mother press One she can get information about the danger signs that can occur in newborn babies. The messages are described below

For Respiratory tract infections press "1"

ለመተንፈሻ አካል ህመም "1"ን ይጫኑ

- *If your baby has fast breathing, fever, severe chest in- drawing please takes your baby to the health facility.*
- **የተወለደው ሕፃን ቶሎ ቶሎ መተንፈስ፣ ሲተነፍስም ደረቱ በከፍተኛ ሁኔታ ወደ ውስጥ መግባት እና መውጣት፣ ትኩሳት ካለው ባፋጣኝ ወደ ጤና ተቋም ይውሰዱት።**

Gastrointestinal tract infection press "2"

ለሆድ ህምም "5"ን ይጫኑ፡፡

- *If your baby has watery or dark green stools with mucus or with blood please take your baby to the health facilities where you deliver and breastfeed frequently.*
- **እንደ ውኃ የቀጠነ ወይንም ጥቁር አረንጓዴ ቀለም ያለው አይነምድር ከንፍጥ ወይንም ከደም ጋር ካለው ውደ ጤና ተቋም ይውሰዱት፡፡ ጡቶትንም ቶሎቶሎ ያጥቡት፡፡**

Neonatal Jaundice press "3"

በጨቅላዎች ላይ የሚከሰት ቆዳ ቀለም መቀየር "3"ን ይጫኑ፡፡

- *If your baby has yellowish, discolorations of the skin please take the baby to the health facility.*
- **የህፃኑ ቆዳ ቀለም ወደ ቢጫነት የተቀየረ ከሆን ወደ ጤና ተቋም ይውሰዱት፡፡**

Annex 2: Interview guide questions

1. Who are involved during development of the system?
2. When and where does it piloted?
3. Did you conduct post pilot evaluation or testing?
4. What was the challenges encounter during development and implementation?
5. What is the status of the project now a day?
6. What are the software development methodology, techniques and tools used?
7. What are the hardware and software platforms required during implementation?
8. What are the functionalities of the system?

Declaration

I, the under signed, declare that this project is my original work and has not been presented for a degree in any other university, and all source of materials used for the project have been fully acknowledged.

Declared by:

Name: _____Signature: _____Date:_____

Confirmed by Advisors:

Name: _____Signature: _____Date:_____

Name: _____Signature: _____Date:_____