ASSESSING FACTORS OF LOW USE OF RAPID SMS IN NYARUGENGE DISTRICT

By

Ephrem NKUNZABO

Student Registration: 216335868

A dissertation Submitted in Partial Fulfillment of Requirements for Masters of Science in Health Informatics

In the College of Medicine and Health Sciences,

School of Public Health

Department of Health Informatics

Supervisor: Professor Michael Law

November 2016

DECLARATION

Names of the Student: **Ephrem NKUNZABO**

Title of the project: **"Assessing factors of low use of Rapid SMS in Nyarugenge District"**

"I do hereby declare that this report submitted in partial fulfillment of the requirements for the degree of Master in Health Informatics, at College of Medicine and Health Sciences, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

Date and Signature of the Student

………………………………………………………………..

DECLARATION OF THE AUTHORITY TO SUBMIT THE THESIS

I, Professor Michael Law

In my capacity as a supervisor, I do hereby authorize Ephrem NKUNZABO, to submit his final thesis.

Date: ………………………………………………….

Signature: …………………………………………..

Professor Michael Law

DEDICATION

To Almighty God, who created, and guided me to accomplish this work

To my family of their love and support

To all people who contributed to the success of this study.

ACKNOWLEDGEMENT

I would like to offer special thanks: To Prof Michael Law, who accepted to be my supervisor. To Mr HINDA Ruton, who accepted to be my co-supervisor. To e-Health program at the School of public Health and all lecturers for their knowledge and skills that they gave me in order to achieve my level of education. To my classmates, workmates for their contribution and encouragement.

ABSTRACT

Background: Today, the interest in using mobile phones for health care provision is increasing. Mobile and wireless devices support medical and public health practice as in Rwanda, where Rapid SMS system helps in tracking pregnant women and children less than two years of age. It is used by Ministry of Health (MoH) to collect data from the level of the community through the use of Animatrices de Sante Maternelle (ASMs), who are in charge of maternal health and are provided cell phones so as to be able to provide better information on risks and to avoid delays that caused maternal death. However, reporting trends are still low in many districts of the country, whereby it does not go beyond 43% during the period of 2013-2015 in Nyarugenge District. The study assessed factors of low maternal health reporting in Nyarugenge District after analyzing reporting statistical and survey data.

Methods: This was a descriptive and cross-sectional study in which statistical and survey parts were used. Statistical data about antenatal care, registered pregnancies, high risk pregnancies, expected and high risk expected deliveries were collected from HMIS in RBC, during the period of 2013-2015. Survey data were collected using the questionnaires answered by 247 ASMs and 10 in-charge of community health in Health centers. Survey data entry was made using Epi-data and analysis was conducted using STATA and Excel.

Results: Reporting trends showed at their low, and different factors were associated between them to prove how they cause the low reporting about maternal health reporting including lack of trainings (n=199, 81%), lack of phones (n=189, 76.5%), lack of financial incentives (n=73, 30%), remoteness (n=55, 22%) and long distances to cover (n=167, 68%)

Conclusion: The analysis revealed potential factors to the low Rapid SMS reporting on maternal health. Lack of trainings, lack of phones, lack of motivation fee, remoteness and long distances to be covered by the ASMs visiting pregnant women were assessed to be the major factors. Interventions such as regular trainings, provision of phones to the ASMs and replacement of the old ones, provision of motivation fee and the search for how pregnant women may be involved in reporting could be part of the effective strategies to address the low Rapid SMS reporting trends about maternal health.

Key words: Maternal health, Low reporting, Rapid SMS, Nyarugenge District, Factors,

LIST OF SYMBOLS AND ABBREVIATIONS/ACCRONYMS

ANC: Antenatal Care

ASM: Animateur de Sante Maternelle

BAN: Body Area Network

CHW: Community Health Workers

CMHS: College of Medicine and Health Sciences

C4C: Connect4Change

CoIA: Commission on Information and Accountability

CCM: Community Case Management

DHS: Demographic and Health Survey

DH: District Hospital

DHIS: District Hospital Information System

EMR: Electronic Medical Records

EHR: Electronic Health Records

E-Health: Electronic Health

EmOC: Emergency Obstetric Care

IMR: Infant Mortality Rate

HRSA: Health Resources and Services Administration

HMIS: Health Management Information System

HC: Health Center

HIV: Human Immuno Deficiency Virus

ICDC: International institute for communication and Development

ICD: International Classification of Diseases

ICT: Information Communication Technology

ITU: International Telecommunication Union

MoH: Ministry of Health

MDGs: Millenium Development Goals

MCH: Maternal And Child Health

MMR: Maternal Mortality Rate

M-Health: Mobile Health

NISR: National Institute of Statistics of Rwanda

PMTCT: Prevention from Mother to Child Transmission

RBC: Rwanda Biomedical Center

RURA: Rwanda Utility Regulatory Agency

SMS: Short Message System

SIM: Subscriber Identity Module

SPH: School of Public Health

PNC: Post Natal Care

UR-CMHS: University of Rwanda, College of Medicine and Health Sciences.

UNHCO: Uganda National Health Consumers Organization.

UNICEF: United Nations for Children's Fund.

WHO: World Health Organization

LIST OF FUGURE

LIST OF TABLES

TABLE OF CONTENTS

CHAPTER ONE. INTRODUCTION

1.1. Definitions of key concepts relevant to the study

As my study is about to assess the factors of low use of Rapid SMS in Nyarugenge District, I gave some definitions on key terms that will be used throughout the whole study.

ASMs: Animatrices de Sante Maternelle: Community health workers in charge of maternal and child health in their village.

Rapid SMS: a technology platform tool that aids CHWs in tracking pregnant women and children under two years of age. It is a tool used by MoH to collect data from the level of the community through the use of CHWs provided cell phones in all districts. It was introduced to provide better information on risks and to avoid delays that caused maternal deaths. All pregnant women are registered and followed by CHWs with regular reports being sent via SMS (Health, 2011).

Community health worker: Frontline health care workers who, in the developing world, are frequently the primary source of health information and care in rural and low resource environments. The World Health Organization (WHO) further defines a health care worker as anyone whose focus or activity is to improve health, including providers (e.g., doctors, nurses, and midwives) as well as technicians and managers (Erb, 2012).

m-Health: The use of mobile phones to improve the quality of care and enhance efficiency of service delivery within healthcare systems is known as mobile health, or mHealth, and is a sub-field of the broader field of electronic health (eHealth). WHO has defined mHealth as the "provision of health services and information via mobile technologies such as mobile phones and Personal Digital Assistants (PDAs) (Lemaire, 2011)

1.2. BACKGROUND

Today, the interest in using mobile phones for health care provision and tracking is increasing. Much of the evidence for the effectiveness of m-health comes from work conducted in developing countries (Consulting, May 2009). Mobile and wireless devices support medical and public health practice and research and their use is gaining attention as they help connect people, reducing delay across the chain of health decisions, and positively affect millions of the underserved population (Carole Deglise, 2012). With the continuous growth of mobile network coverage and unprecedented penetration of mobile devices in the developing world, several mobile health initiatives are being implemented in developing countries (Jody Ronck, 2011).

Mobile phones have been used to improve the quality of access to health care service delivery in many ways (Somani Patnaik et al., 2008). Applications have been developed that assist healthcare workers in diagnosing and treating the patients, such as the use of phone-based treatment algorithms and SMS reminders to follow up on clients laboratory results and other services (Talaria, 2004).

RapidSMS is a mobile health initiative to improve maternal and child health (MCH), customized to allow interactive communication between a CHW following mother-infant pairs in the community, a national centralized database and the health facility in case of an emergency alert (UNFPA, 2008)

RapidSMS is a toolset for rapidly building SMS (text message) services for data collection, streamlining complex workflows, and group coordination using basic mobile phones, and can present information on the internet as soon as it is received (MoH, The use of RapidSMS, 2012). So far RapidSMS has been customized and deployed with diverse functionality: remote health diagnostics, nutrition surveillance, supply chain tracking, registering children in public health campaigns, and community discussion. It was designed to be customized for the challenges of governments, multilateral, international, and non-government organizations, and development practitioners: working effectively in spite of geographical remoteness of constituents, limited infrastructure (roads, electricity), and slow data collection (due to paper-based records, slow courier systems (Mutjaba Hussain, 2006)

In India, SMS systems have been used to reduce newborn mortality rate after by tracking newborns and timely home visits by Community health workers. In Nigeria, the system was designed to identify regional disparities in real- time and facilitate prompt responses, and by its data, it is possible to understand local and regional level variations in service output (WHO, 2015).

In the East-Timor, the Liga Inan (Mobile Mums) project which started in 2013 is using mobile phones to connect expectant mothers and health providers, in order to improve a healthy pregnancy and birth. Midwives register expectant mothers, track their progress, know when they go into the labor, and make arrangements for making delivery. Mothers continue to receive automated health promotional information via SMS through the first six weeks of the newborn's life (Lincetto, 2013).

In South Africa, Dokoza system is an innovative-cost effective interactive real-time mobile system for fast-tracking and improving critical services to the broader majority. Initially, the system was designed for HIV/AIDS and TB treatment, with the view to including other diseases. SMS and cell phone technology are used for information management, transactional exchange and personal communication (Auses, 2012).

In Senegal, social workers use mobile phones and the internet to gather and transmit data about specific vulnerable children. Children are monitored through SMS traffic from mobile phones and smart phones. This child protection data system is a tool for case management and referral and it facilitates the provision of family welfare service and family reintegration (Unicef, 2013)

In Zambia and Malawi, Project Mwana is an ICT-based project which focuses on Maternal and Newborn Child Health (MNCH), by securing delivery of HIV test results from the lab to health clinics by SMS, appointment reminders for newborn children and free-text chart for health clinic workers and community health workers, to strengthen communication and patient tracing (Stewart, 2010).

In Ghana, voice-based educational messages to improve maternal and child health are provided. VOTO mobile partnered with Savannah Signatures roll out mobile messaging to women in Northern Ghana during and after pregnancy. Each mother receives two calls a week in her own language with information on the stage of her pregnancy with information to keep her and her

baby health. The information is also intended to counteract those traditional beliefs that often prevent women from accessing medical help, even in life-threatening situations. Every voice subscriber can also opt-in to receive the information via SMS. Through redialing the toll-free number from which they receive the messages, mothers can re- listen to the previous, contact a live mid-wife with urgent questions, or register from the service. These also allows listeners who were too busy to hear the message the first time around, outside of mobile coverage, or out of battery the chance to catch up on their own time (Mattila, October 2011)

In Kenya, a randomized trial found that a simple intervention, in which health workers received text messages on malaria case management, produced 25% increase in the number of children with fever correctly treated for malaria (Mattila, October 2011).

In Uganda, the International institute for communication and Development (IICD) and its Connect4Change (C4C) Consortium partners support the Uganda National Health Consumers Organizations (UNHCO) to implement a program to provide better access to maternal and child health information. During the program, various ICT-based solutions are being used targeting men and women of reproductive age, pregnant mothers, health workers, and community resource persons. These include:

- SMS campaigns sensitizing communities about maternal and child health issues. Text and voice messages are being sent twice a month.
- Text messages from UNHCO are being sent to registered numbers (community members and resource person) using the same platform to collect feedback on how health service delivery can be improved.
- In addition to text messages, all centers are being used to access client satisfaction of the participants on the SMS platform with the services they receive.
- Reminders are being sent through SMS to pregnant women about their antenatal care appointments at health facilities.
- Incentives of airtime credit are given out to the participants, to encourage more participation.

- Trainings take place in the use of digital tools to develop user-friendly information/education/communication materials based on experiences/testimonials captured in the communities for showing at health facilities (Kiria, 2012).

In Rwanda, the system helps in tracking pregnant women and children less than two years of age. It is defined as a tool used by Ministry of Health (MoH) to collect data from the level of the community through the use of CHW provided cell phones in all the districts. It was introduced to provide better information on risks and to avoid delays that caused maternal death. The aim is for all pregnant women to be registered and followed by CHW with regular reports being sent via SMS. They follow-up on all registered risky pregnancies and are provided with reminders through SMS sent from the central hub. After delivery by the mothers in the community, CHWs do follow up in their households (Nguimfack, 2012)

The purpose of this study is to assess the factors of low use of Rapid SMS in Nyarugenge District, in terms of reporting for maternal health. We selected this district as it is among the others with low Rapid SMS use in the country, while it is situated in the heart of Kigali, the capital city of Rwanda, which does not qualify it to be among the Districts with low Rapid SMS use. As a result, we aimed at answering the following questions:

1. What are the factors affecting Rapid SMS reporting in Nyarugenge District?
2. What can be done to improve Rapid SMS reporting in the District?
3. What could be changed about the Rapid SMS system to increase the use by end-users and policy makers?

1.3. PROBLEM STATEMENT

Nyarugenge District is located in Kigali City, where a variety of people from diverse backgrounds and professions are found. There are a number of potential factors which might influence Rapid SMS use in Nyarugenge. For example, the District has several rural areas and some villages are too wide and located in mountains which are difficult to access. This is a barrier to CHWs to reach the place and some pregnant women get still unattended and unrecorded in the system. Another reason behind the problem of identification of the pregnant women in the District is their availability because during the day, they are busy with the different survival works which cause them not to be found easily. Only women with defined addresses and

settings are reached by CHWs. These are some factors which will be analyzed in order to find out the reasons why the District has the lowest Rapid SMS reporting pattern level compared with other districts in the country because 43% of ASM and 38% Binomes are currently using the system(DHIS,2015).

In addition, most of the CHWs are not complying with the period of reporting which in not supposed to exceed 14 days (MoH, Health achievements, 2011-2012)

1.4. RESEARCH OBJECTIVES

1.4.1. Overall objective

The overall objective of this research was to assess the factors related to the low use of Rapid SMS in Nyarugenge District. To carry out this study, data with respect to Rapid SMS reporting on pregnant women in all HCs in Nyarugenge District will be analyzed to assess the reporting trends in the District, from 2013 to 2015.

1.4.2. Specific objectives

1. To assess factors affecting RapidSMS reporting trends about maternal health.
2. To propose the strategies that can improve RapidSMS reporting.
3. To assess end-user perceptions of RapidSMS by CHWs and the in-charge of community health.

1.5. RESEARCH QUESTIONS

1. What are the factors affecting RapidSMS reporting about maternal health?
2. What can be done to improve RapidSMS reporting in Nyarugenge District?
3. What could be changed about the RapidSMS system to increase the use by end-users and policy makers?

1.6. HYPOTHESIS

There is a relationship between low Rapid SMS reporting and economic, technical, infrastructure geographic and reporting factors.

1.7. SCOPE OF THE STUDY

The study was carried out in Kigali City, Nyarugenge District.

The study focused on this aspect: the predictors of low Rapid SMS reporting. The target population was ASMs, who are CHWs in charge of maternal health and the in-charge of community health, who are the end-users of Rapid SMS system. Statistical data were taken from the reports of Rapid SMS which are kept in RBC, while survey data were collected by using a questionnaire whose questions were answered by the ASMs and the in-charge of community health in health centers.

1.8. LIMITATIONS OF THE STUDY

Rapid SMS is a system which has been customized and deployed with diverse functionality such as: remote health diagnostics, nutrition surveillance, supply chain tracking, registering children in public health campaigns, community discussion, so on and so forth.

Limitations of this study were as follows:

Financial: the limitation resulted from the lack of sufficient financial means to go in all health centers because of the need of transport fee. The printing of questionnaires also required money.

Data: as this research was a secondary analysis, data for all variables proposed in its framework were not found easily.

Some ASMs did not respond to the survey questions.

1.9. ORGANIZATION OF THE PROJECT

• **Chapter 1**: This chapter defines terms, describes the background and the problem statement, states the scope of the project, its objectives, research questions, hypothesis, significance, scope and limitations of the research.

• **Chapter 2**: This chapter gives a review of the theoretical concepts on which this research is based.

• Chapter 3: This chapter deals with methodology used to conduct research about factors of low Rapid SMS use in Nyarugenge District.

• **Chapter 4**: This chapter is about data presentation and analysis of factors of using RapidSMS

• **Chapter 5**: This chapter gives the general conclusion and recommendations of the research

1.10. THEORETICAL REVIEW/CONCEPTUAL FRAMEWORK

The study variables were both independent and dependent variables. Independent variables are those variables that manipulate the value of dependent variable which must be one and the dependent variable will be value of independent variables which are many. The figure of conceptual framework below shows the details.
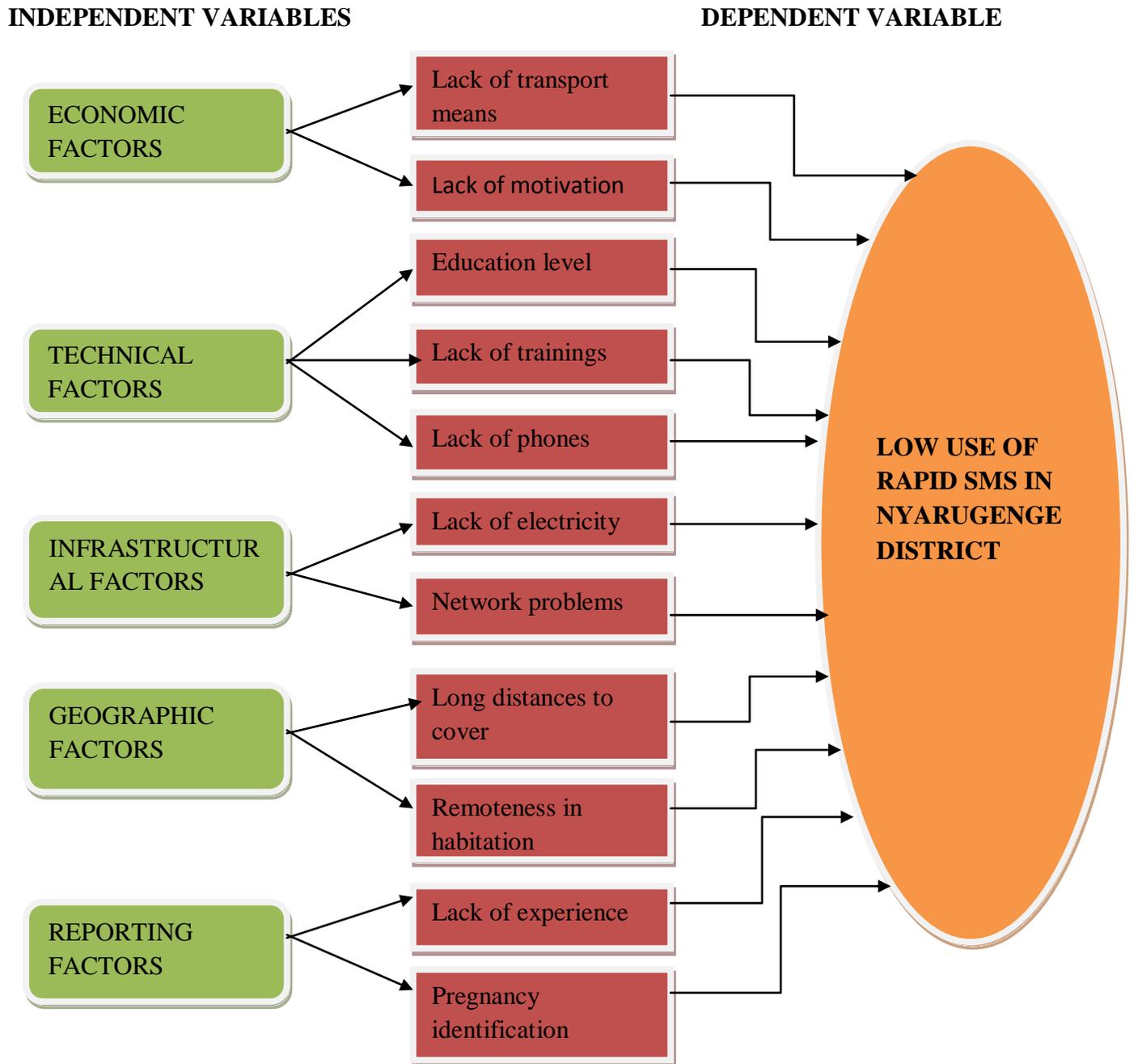
Figure1. Conceptual framework, 2016

CHAPTER TWO. LITERATURE REVIEW

2.1. RAPID SMS TECHNICAL DESIGNS

2.1.1. Rapid SMS-MCH system design, development and implementation

Under Rapid SMS, an innovative SMS-based technology developed by UNICEF, the Rwanda Ministry of Health designed a Rapid SMS MCH system, which helps to establish a communication and alert system, support documentation of pregnancies in the community, increase health facility contact through antenatal care till maternal delivery.

Rapid SMS-MCH system serves as a tool to be used by CHW for registration of new pregnancies in their respective community and effective monitoring throughout the pregnancy up to delivery and post-partum. Each community has a CHW in charge of Maternal and Child health. The task of CHW in pregnant women is to sensitize them about needs to attend antenatal care, and provide support and referral to the health centre for antenatal care, particularly in case of life threatening event (danger signs). CHWs register new pregnancies in the system, and report all danger signs. For a normal pregnancy, the Rapid SMS-MCH system will send automated reminders at specific date for clinical appointments, including delivery. In case of danger signs, an emergency alert-system is triggered, and provides immediate feedback to the CHW, advising on immediate action.

2.1.2. Rapid SMS system application design

Rapid SMS is an open source SMS application platform written in Python and Django (MoH, RapidSMS , 2015). The SMS-based project was developed to track the pregnancy lifecycle; enabling instant reporting of pregnancy related event and timely notification for emergencies, alerting health facilities, hospital and ambulances. The programmers developed the first version of the SMS-based application which was temporally running on a simple desktop computer linked to a modem with a Subscriber Identity Module (SIM) card and short code number obtained from Rwanda's Utility Regulatory Agency (RURA). The Rwandan Ministry of Health covers SMS cost within the framework of this project (RapidSMS Documentatio, 2016)

2.1.3. Description and functionalities of the system

The system allows a two-way flow of information. A registered CHW creates and send an SMS to the system using a short code telephone number. The message received by the server will immediately trigger a specific feedback to the sender. For each registered pregnancy, the system will send automated reminders of forthcoming antenatal care visit and due date of delivery to the CHWs. But it is important to note that the reminder SMS is sent to the CHW's phone and not the patient's phone. In case of danger signs (hemorrhage, in labor and at home, and unknown serious condition) during pregnancy and reported to the CHW by a pregnant woman at village level, the CHW sends an emergency SMS alert to the system. Consequently a message is generated and sent simultaneously to the driver of nearest ambulance vehicle and the manager of facility for immediate intervention. This SMS includes the danger sign reported, the name of the village and telephone number of health worker who sent the original message. Another SMS is sent to the CHW indicating immediate action to manage the danger sign and prepare pending ambulance arrival. The system incorporates features enabling continuous technical monitoring to recognize and record, in an error-log, inconsistencies such as wrong SMS formatting or logic mistakes indicating that a reporter may be having difficulties with reporting. Upon reception of such messages, the system replies to the reporter with suggestions of how to revise and resend the message with the correct format. The error log contributes to facilitate supervision of CHWs. It is a very useful source of information for the supervisors who use them to provide feedback to the CHWs.

2.1.4. Rapid SMS reporting system

The CHWs, ASM and Binomes, are in charge of reporting in the Rapid SMS system.
ASM are responsible for sending all SMS related to pregnancy, new born care, postnatal care, and vaccinations up to 12 months of age.
Binomes are responsible for sending all SMS related to CCM, nutrition, non-immunized children, and children with disabilities (UNICEF, User Training Manual, CHWs and Supervisors, 2013)

2.1.5. Events reported through Rapid SMS

Pregnancy tracking

- Registration of confirmed pregnancy (at health center), including height and weight of pregnant mother.
- Antenatal care visits
- Delivery outcomes
- Risk results
- Red alert result reports
- Death reports

Child health

- Monthly child health visits tracking growth, vaccinations and basic health up to 12 months.
- Death reports

Newborn

- New born care visits within the first 42 days of life.
- Initiation of breastfeeding within the first hour of life and exclusive breastfeeding for the first 6 months.
- Death reports

Postnatal care

- Post- natal home visits after home delivery (Day 1), and refer to hospital for examination.
- Post- natal home visits after assisted health facility delivery (Day 1, Day 3 and Day 28).

Community case management (CCM)

Cases of the main childhood killer diseases treated or referred (diarrhea, malaria and pneumonia).

Nutrition

Growth monitoring (height and weight of child every month between 2 and 24 months).

Early initiation of breastfeeding within 1 hour and exclusive breastfeeding for the first 6 months.

2.1.6. Rapid SMS Web User interface

A password protected Web user interface gives access to aggregated and disaggregated data and enables individual patient history tracking as well as output of reports. The password protected web user interface presents an overview of the system's outputs including individual and aggregated reports, statistics, and system administration, log of reminders and activity of CHWs. Data can be filtered at three levels: national, district and health facility level. A user working in a health facility at district level will be assigned an account, granting him/her permission to view and possibly modify data only from his health facility's catchment area.
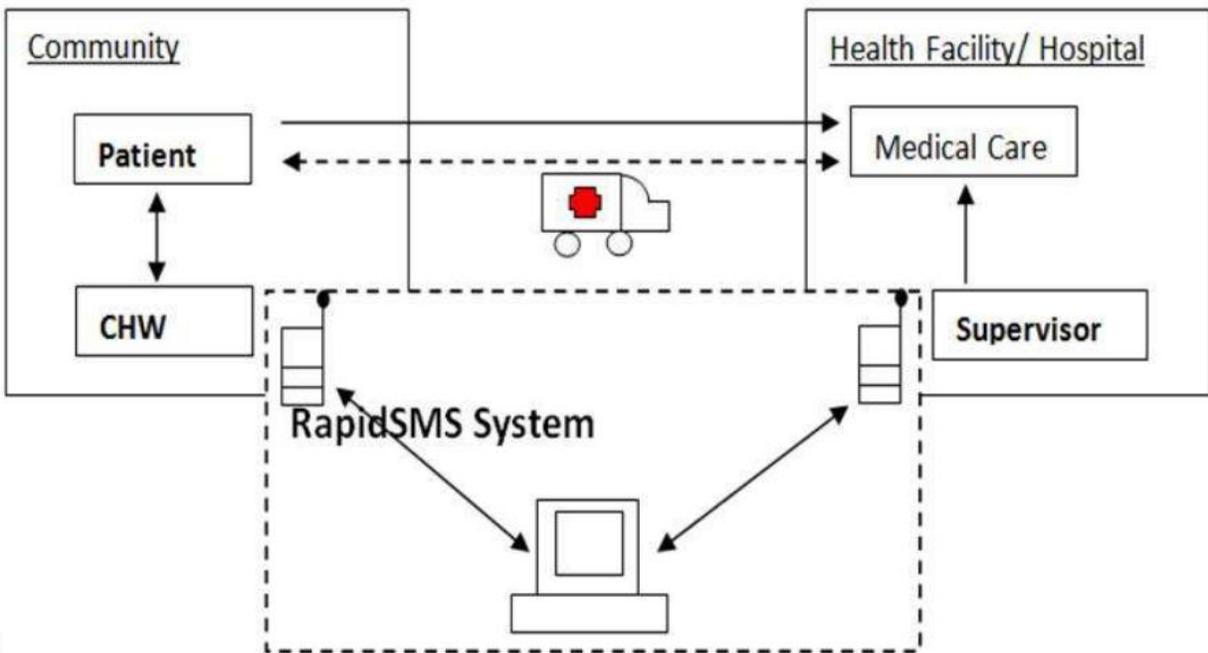
Figure1:**Maternal health care configuration at sector level**
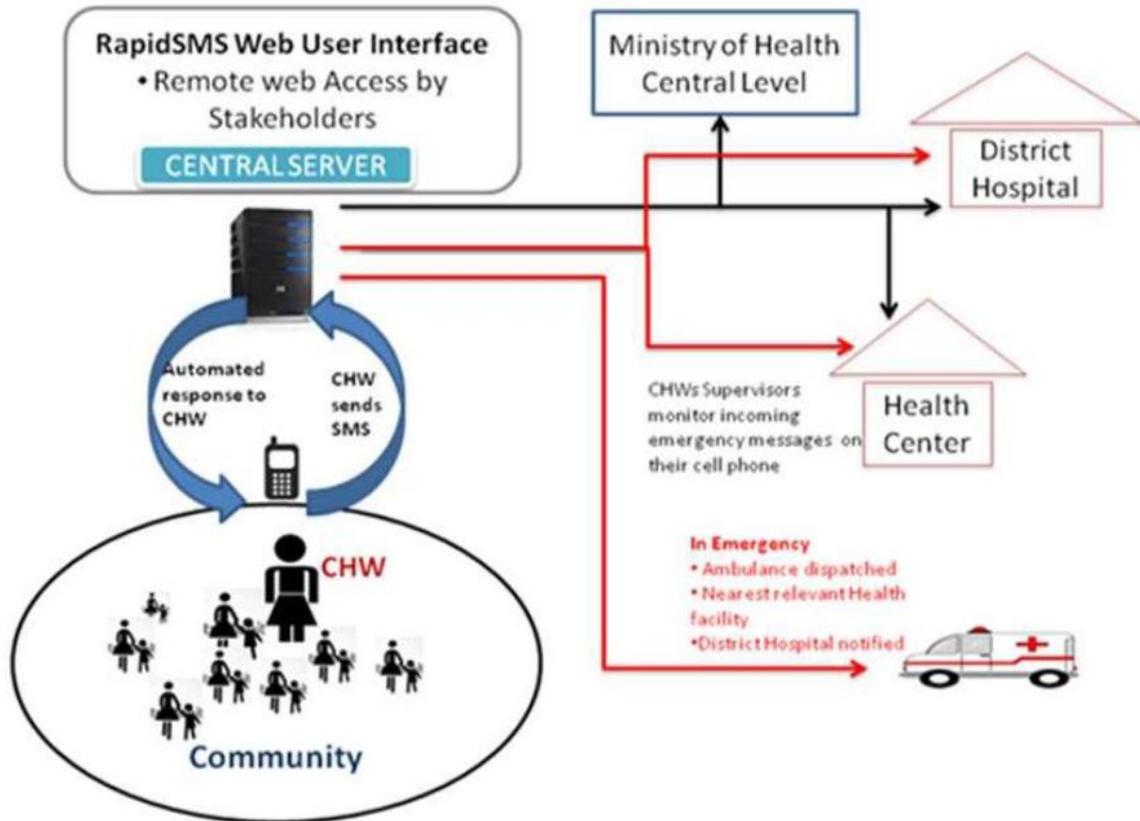
Figure 3: RapidSMS system information flow
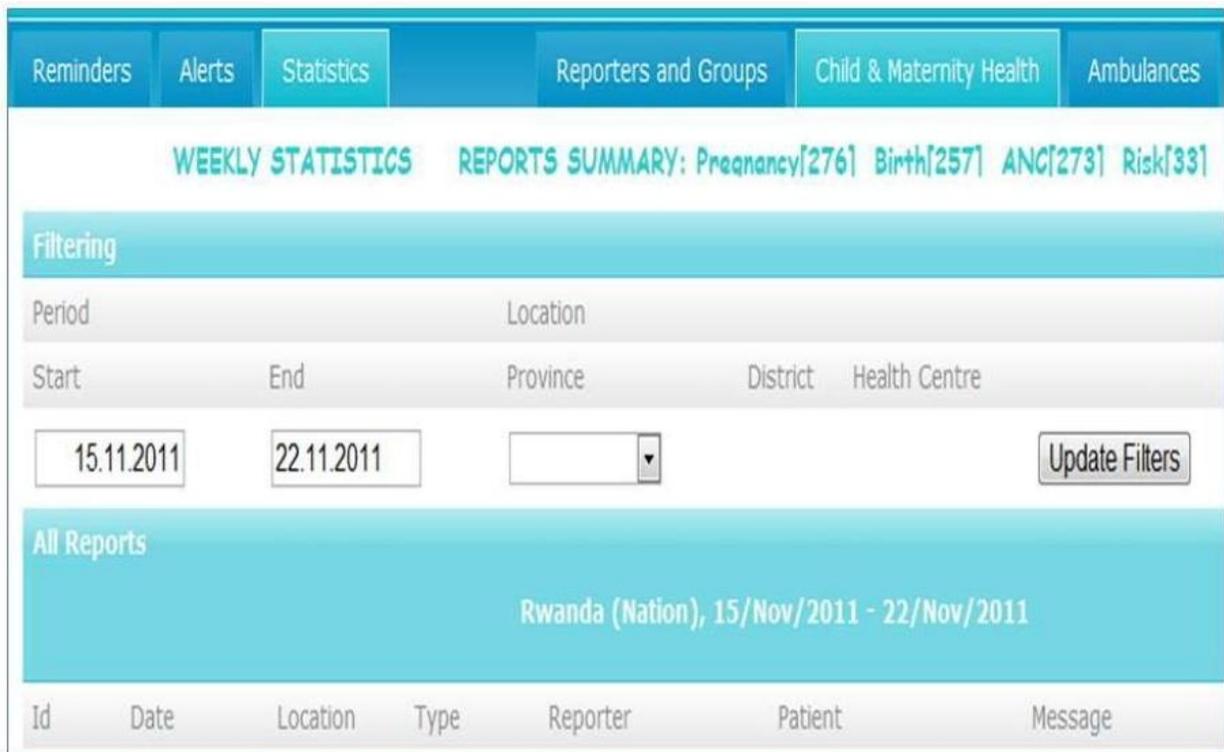
Figure 4: Rapid SMS web user interface

Rapid SMS framework was created by programmers working directly on actual project implementations with end users — not by an isolated software firm working from specifications. The resulting software is practical, flexible, and simple enough to meet real world needs.

Rapid SMS is not constrained to any particular kind of mobile device: any mobile phone that can send and receive text messages can interact with Rapid SMS. End users never need a specific device or to install any software on their phone. Rapid SMS is focused on commonly available, existing infrastructure to allow for replicability and scalability.

2.1.7. Rapid SMS appropriateness

When you need a large-scale (enterprise), robust solution

- Collected data can be accessible to many people in many locations via the internet.
- Thousands of users can interact with your system simultaneously.

When you need customizable solution

- Certain actions can be triggered in specific circumstances.
- Rapid SMS can integrate with existing software tools and services.

When your end users only have very basic phones (text/voice)

- End users do not need "smartphones" or Java-enabled phones or computers to interact with Rapid SMS.
- End users can use their own handsets — no need to procure any mobile phones.

When you need a scalable solution

- A single Rapid SMS system can handle one village or one country.
- Rapid SMS can use GSM modems for small volumes and can integrate with mobile network operators or 3rd party solutions for large volumes.

2.1.8. Free and open source

Rapid SMS code is freely available under the New BSD license: anyone may modify and redistribute the code.

Software developers from Senegal, Mali, Nigeria, Kenya, Uganda, Canada, UK, and USA have contributed to the growing code base.

Nearly 200 software developers and implementers discuss Rapid SMS on the Rapid SMS mailing-list. The list's online archives are a great way to become familiar with Rapid SMS (https://www.rapidsms.org/about/).

2.2. ICT IN IMPROVING WOMEN'S AND CHILDREN'S HEALTH

2.2.1. Introduction

When applied to health systems, information and communication technologies can transform health systems globally, improve quality of care and save lives by making it possible to monitor and diagnose patients remotely, center treatment and support on the patient, sound alerts to disease outbreaks, and educate community health workers and others from a distance (Shekar, 2012).

Maternal health is a fundamental building block of public health, and maternal health outcomes are a leading indicator of how well the system performs. Countries with weak health systems and poor health infrastructure struggle to provide sufficient services to pregnant women. Maternal health is doubly important and determines whether the mother delivers safely and whether the newborn is healthy. One study in Bangladesh found that a child whose mother dies has only a 24% chance of living to age 10, while a child whose mother survives has an 89% chance of remaining alive (Vladar, 2015).

Indeed, neonatal conditions are by far the leading cause of death for children under five years old. There is a direct correlation between country infrastructure and maternal mortality rates. Nearly all maternal deaths (99%) occur in developing countries, 87% occur in sub-Saharan Africa and South Asia 12, and 65% occur in 11 countries – Afghanistan, Bangladesh, the Democratic Republic of the Congo, Ethiopia, India, Indonesia, Kenya, Nigeria, Pakistan, Sudan, and Tanzania (Hollier, 2012)

As in other areas of global health, maternal health relies heavily on access to timely and reliable data. Technology can help open bottlenecks in data on maternal health and improve the delivery of service. Systemic e-Health and m-Health interventions are capable of closing existing gaps in care across the maternal health continuum (Abhay Bang et al., 2010)

Given the critical importance of the Millennium Development Goals to reduce child mortality and improve maternal health MDG 4 and 5), the United Nations established in January 2011 a high-level commission to improve global reporting, oversight and accountability for women's and children's health-the Commission on Information and Accountability for Women's and Children's Health (CoIA). CoIA seeks to increase the likelihood that pledges for women's and children's health are honored and that resources are spent in the most effective way to save lives.

The deployment of information and communication technologies (ICTs) and the development of electronic health (e Health)1 applications for reproductive, maternal, neonatal, and child health (RMNCH) have gained momentum and interest over the past several years among the healthcare workers community, hospitals, clinics, and patients. Today, doctors exchange medical images, diagnostics, and second expert advices without borders, while eminent specialists offer consultations and training online to hundreds of colleagues all over the world (ITU, 2013).

2.2.2. Mobile-cellular services subscription.

The mobile industry in Sub-Saharan Africa continues to scale rapidly, reaching 367 million subscribers in mid-2015. Migration to higher speed networks and smart phones continues apace, with mobile broadband connections set to increase from just over 20% of the connection base today to almost 60% by the end of the decade. Falling device prices are encouraging the rapid adoption of smart phones, with the region set to add more than 400 million new smart phone connections by 2020, by which time the smart phone installed base will total over half a billion. In Rwanda, mobile –cellular services accounted at 71.23% of population in 2015 (RURA, 2015)
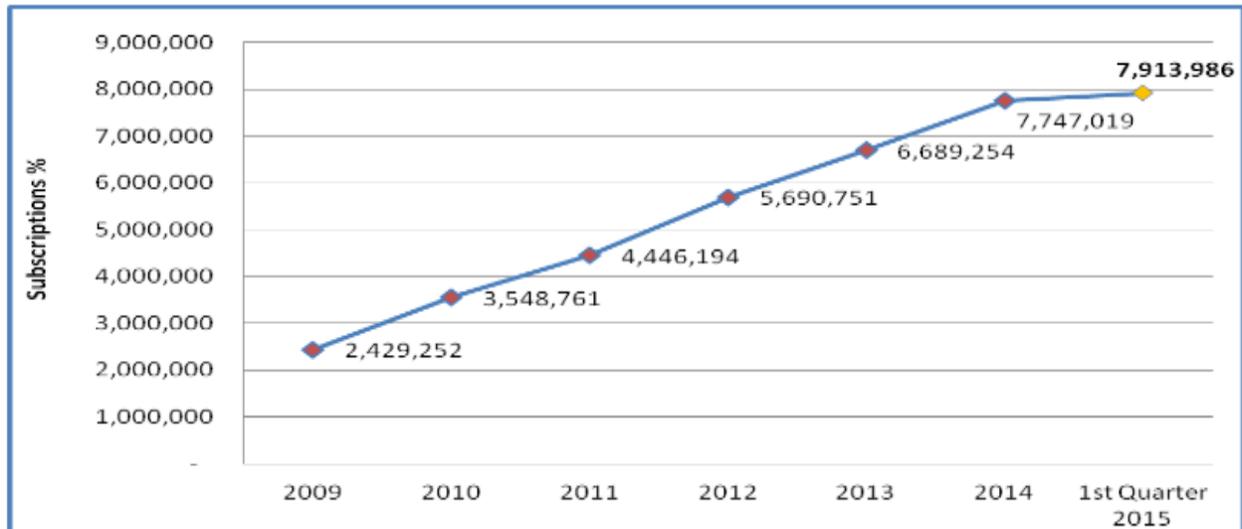
Figure 2: **Mobile subscription in Rwanda (MINIYOUTH, 2014)**

2.2.3. Mobile phone applications in healthcare

Mobile phones are useful tools for collecting data and overcoming delays in data gathering, transmission and data entry, so they can replace an existing paper-based system (Shihab A. Hameed, 2005).

2.2.4. Rapid SMS in Healthcare

EID TAT in USA

SMS printers are used to improve early infant diagnosis (EID) turnaround times (TAT) enabling early initiation of pediatric ART. Currently installed at 33 sites, results are received directly from the zonal facility following sample analysis and data entry. This has reduced the early infant diagnosis turnaround time to below one month (2 weeks average) (Anirban Chatterjee et al., 2009)

Ebmonitor

Is a system to help monitor Ebola outbreak cases in West Africa. The software uses SMS (text messages) to report the numbers of patients or cases directly to Public Health Specialist based in United States and empower Community health workers to provide timely information for action (USAID, 2014).

Liga Inan (Mobile Moms) in Timor-Leste

The Liga Inan ("Mobile Moms") Project is using mobile phones to connect expectant mothers and health providers in Manufahi District, Timor-Leste to improve the likelihood of a healthy pregnancy and birth. Midwives register expectant mothers, track their progress, know when they go into labour, and make arrangements for attending the delivery. Mothers continue to receive automated health promotional information via SMS through the first six weeks of the newborn's life. Midwives also have the ability to create a network of women, and write her own messages in her own style (MAMA, 2013).

Nigerian Birth Registration

Since January 2011 the National Population Commission of Nigeria has been implementing decentralized monitoring using the mobile-phone based platform Rapid SMS. The system was designed to identify in real-time, centre-by-centre birth registration disparities, and prompt and facilitate appropriate action (Olusesan Ayodeji, Makinde et al., 2016).

Projet Mwana in Malawi and Zambia

As an Information and Communication Technology (ICT) project, Project Mwana focused on Maternal and Newborn Child Health (MNCH) aimed to facilitate several key ideas, including: Secure delivery of HIV (Dry Blood Spot, or DBS) test results from the lab to health clinics by SMS, which we've named "Results160″ Appointment reminders for newborn children, or "RemindMi" (Mi = mothers & infants), and Free-text "chat" for health clinic workers and Community Health Workers, to strengthen communication and patient tracing. The software uses SMS (text messages) to deliver HIV test results for infants directly to health clinics and enhance communication within the clinics (UNICEF, Project Mwana: Using mobile technology to improve early infant diagnosis of HIV, 2010)

The Pamoja project in Tanzania

The Pamoja SMS project supports implementation and expansion of high quality HIV prevention, care and treatment services at facilities. Twice a week, SMS messages and emails are sent to health workers in Pamoja-supported sites, encouraging them to handle service delivery differently (e.g. decentralization, task shifting, integration of services, mentoring) and provide

important updates in key services. The goal is to improve access to quality care by improving local capacity for long term sustainability (Africare, 2015).

mTrac in Uganda

mTrac is a government led initiative to digitize the transfer of Health Management Information System (HMIS) data via mobile phones. The initial focus of mTrac is to speed up the transfer of HMIS Weekly Surveillance Reports (covering disease outbreaks and medicines), provide a mechanism for community members to report on service delivery challenges, and empower District Health Teams by providing timely information for action (Kochi, 2012).

CHAPTER THREE. RESEARCH METHODOLOGY

3.1. STUDY DESCRIPTION

The study was descriptive and cross-sectional, and was about to carry a quantitative research about the factors of low Rapid SMS reporting in Nyarugenge District. The research needed to assess factors of low Rapid SMS, after analyzing the statistical data of reporting trends from 2013 to 2015 as one part and survey data as the other part of the study. The hypothesis of the research was that there was a significant relationship between low Rapid SMS reporting and economic, technical, geographical, infrastructural and reporting factors. Nyarugenge District is the area where research was conducted. Situated in Kigali City, it has 10 Health Centers and 1 District Hospital. There are three CHWs per Village, but two of them (Binomes) are in charge of ordering and distributing medicines and one (ASM) is in charge of maternal and infant health..

3.1.1. Study design

This is a descriptive study in which quantitative research methodology was used. It was to search for reasons of low Rapid SMS reporting patterns in the District

3.1.2. Study site

The study was conducted in all Health Centers of Nyarugenge District, Kigali City. The District has 10 Health Centers: Biryogo, Butamwa, Cor-Unum, Gitega, Kabusunzu, Muhima, Mwendo, Rugarama, Nyarurenzi and Kanyinya. The study involved a survey part which was done from HCs and a statistical study of data from RBC.

3.1.3. Study population

The population of this study was composed of the in-charge of community health and ASMs, CHWs who are in charge of maternal and child health.

3.1.4. Proposed interventions

Rapid SMS started in Musanze District in 2009 and spread into other districts later on. Nyarugenge District started to use Rapid SMS in 2013. The district has a good number of people who are literate, as it ranks the second with the level of literacy rate of 86.7% in the country (NISR, 2015) and technology has evolved. This research will suggest the ways in which the Rapid SMS system may be generalized and communication to be by individual pregnant women who know reading and writing (Woman-Centered), after being registered by a CHW. Their

partners and other close family members should also participate in the communication. This is in line of searching for how the reporting patterns may rise within the District.

3.2. SELECTION OF STUDY POPULATION

Nyarugenge District has 10 Health Centers and 3 CHWs divided as it follows, per village:

2 Binomes (a male and female, they are in the village and are in charge of treatment of the newborns in the village)

1 ASM (Animatrice de Santé Maternelle, or Community Health Matron). She is in charge of maternal and child health from pregnancy till 2 months. As my study was about reporting on maternal health, the ASMs in all Health Centers of Nyarugenge District were recruited for they are the ones in charge of maternal and child health, so they are responsible of SMS reporting on maternal health.

The in-charge of community health (1) was recruited from the Health Centers.

3.2.1. Inclusion criteria
Research included the in-charges of community health who were met at the Health Centers, where they were given the questionnaire to fill the answers to the questions, just after a short presentation and explaining the purpose of the study. The ASMs also participated in the study and they answered the questions on the questionnaire.

3.2.2. Exclusion criteria
Midwives, Binomes, and Directors of Health Centers did not need to be included in the research, except by talking to them asking for some help or guide.

3.2.3. Sampling
This study used a convenience sampling. Nyarugenge District was selected for the study. We selected all health centers in a District. The ASMs and in-charge of Community health were met at the Health Centers.

3.2.4. Study procedures

3.2.4.1. Procedures at enrolment
We enrolled research participants by health centers.

3.2.4.2. Sample size

The study involved ASMs and the in-charge of community health in all health centers.

Table1. Sample size distribution

Sectors	Health Center	ASM
1.Nyarugenge	Biryogo	36
2.Gitega	Rwampara	50
3.Nyakabanda	Kabusunzu	27
4.Mageragere	Nyarurenzi	19
5.Kanyinya	Kanyinya	20
6.Mageragere	Butamwa	25
7.Kigali	Mwendo	48
8.Nyamirambo	Rugarama	9
9.Kimisagara	cor-unum	48
10.Muhima	Muhima	68
TOTAL		**350**

Source: Nyarugenge District Health Report, 2016

The table above shows a number of the ASMs that were needed to participate in my research, plus 10 Community Health in-charges. The sample size was: 350 ASMs and 10 Community health in-charges.

3.2.5. Data collection

-Reports analysis: Statistical data from 2013 to 2015 about Rapid SMS reporting on maternal health were from the reports kept in RBC.

-**Answering a questionnaire:** There were questionnaires reserved for the in-charge of community health apart and ASMs apart. The questionnaires were given to them and they answered the questions in a written format. The questionnaires were written in English and translated into Kinyarwanda.

3.2.6. Data entry and data analysis

After collecting data, they have been cleaned, then analyzed. The following softwares were used such as:

➢ MS Word for text treatment

➢ MS Excel for crude tables, graphs and stocking data

➢ Epi Data software: For data entry

➢ STATA software: For statistical analysis.

3.3. ETHICAL CONSIDERATIONS

3.4.1. Confidentiality

Data were kept confidentially and anonymously.

3.3.2. Informed consent

Respondent have been provided with a written consent before interviews were to be conducted. The participants themselves decided to take part in the study upon request and explanation by the researcher.

Before the execution of data collection, the purpose of the study was explained to the participants using the information sheet and granting them that the results to the study will not be used for other purposes different from its objectives. Respondents have been granted that they will access the study findings after analysis if they wish.

3.3.3. Ethical approval

The permission to carry out the study has been obtained from the Ethical Research Committee of University of Rwanda, College of Medicine and Health Sciences, as well as the Directors of Health Centers. The consent has also been obtained from all participants before data collection.

3.4. TIMETABLE

The study has been conducted within four months: June, July, August, September and October 2016. The following is the calendar of the study:

May: Writing a request for the Ethical approval

June: Ethical approval grant

July-September: Search for consent forms and data collection

October: Data entry and analysis

CHAPTER FOUR. RESULT ANALYSIS

This chapter summarizes the project findings based on data collected on the field. It illustrates the analysis of the statistical variables about activity and inactivity states of the ASMs, and their reporting trends on antenatal care and pregnancy. The statistical data have been taken from Rwanda Biomedical Center reports about Rapid SMS reporting on maternal health. It also includes survey data analysis of the variables compiled from questionnaires whose questions have been answered by the ASMs, Community Health Workers in charge of maternal and child health.

4.1. STATISTICAL DATA ANALYSIS

4.1.1. Inactivity and activity states of the ASMs

Data for this study showed that the active ASMs are on the lower percentage proportion compared to that of the inactive. Inactive ASMs are many. The term active and inactive stand for the reporting and non-reporting schemes for a certain period of time, which is 14 days, due to the fact that all Rapid SMS messages sent and received are recycled on the central server managed by Rwanda Biomedical Center, and all messages are indicated in terms of the numbers.

Table 2. **ASMs activity and inactivity (in %)**

HEALTH CENTER	INACTIVE	ACTIVE
BIRYOGO	57	43
BUTAMWA	56	44
COR-UNUM	32	44
GITEGA	55	45
KABUSUNZU	53	47
KANYINYA	57	43
MUHIMA	57	43
MWENDO	52	48
NYARURENZI	57	43
RUGARAMA	54	48

Figure 3:ASMs activity and inactivity
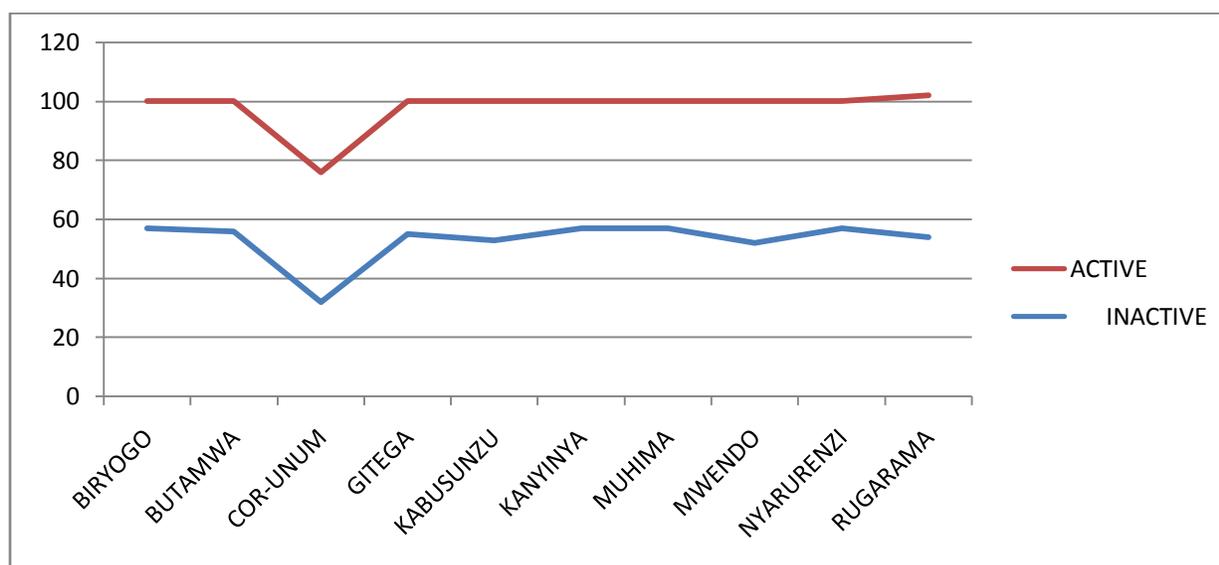
4.1.2. Rapid sms antenatal care report

The table below shows the data of reporting about antenatal care, during the period of 2013-2015 in all health centers in Nyarugenge District. Rugarama and Mwendo reveal themselves as the first health centers in reporting. The health center of Cor-Unum of Kimisagara Sector has a zero reporting trend because it is a new health center. Rapid SMS has started to be used in 2013, and the new health centers have not immediately adapted to it.

Table 3. **Rapid SMS antenatal care report**

HEALTH CENTER	ANC1	ANC2	ANC3	ANC4
BIRYOGO	254	421	541	251
BUTAMWA	242	412	450	123
COR-UNUM	212	142	321	157
GITEGA	242	542	458	358
KABUSUNZU	362	541	650	458
KANYINYA	458	651	415	410
MUHIMA	23	651	652	325
MWENDO	213	784	781	235
NYARURENZI	451	422	425	412
RUGARAMA	756	651	458	321
TOTAL	**3213**	**5217**	**5151**	**3050**

Figure 4. **Rapid SMS antenatal care report**
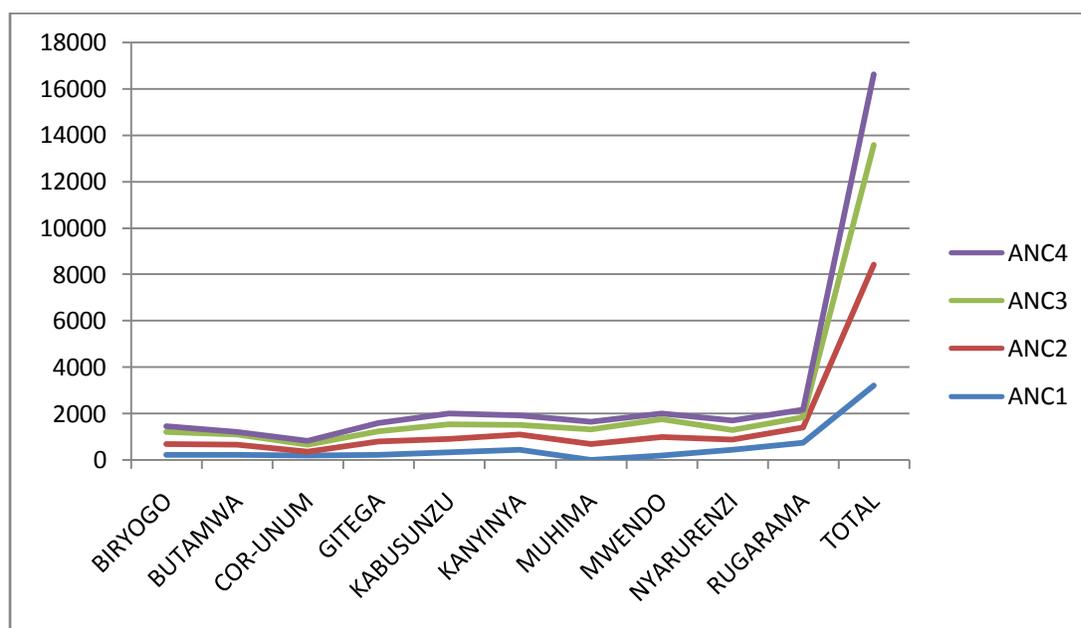
4.1.3. Rapidsms pregnancy report statistics

Data for the study showed that the health centers of Rugarama and Mwendo are well in reporting about pregnancy. Pregnancy reporting is about the registration of the new pregnant mothers in Rapid SMS system, reporting about any problems or complications which may arise during pregnancy period and delivery time.

Table 4. Rapid SMS pregnancy report

HEALTH CENTER	REGISTERED PREGNANCY	HIGH RISK REGISTERED PREGNANCY	EXPECTED DELIVERY	HIGH RISK EXPECTED DELIVERY
BIRYOGO	535	74	489	67
BUTAMWA	235	42	212	40
COR-UNUM	218	125	231	287
GITEGA	348	54	324	52
KABUSUNZU	125	10	118	9
KANYINYA	457	80	419	77
MUHIMA	268	36	237	30
MWENDO	498	77	470	69
NYARURENZI	390	54	367	52
RUGARAMA	742	123	672	111

Figure 5: **Rapid SMS pregnancy report**
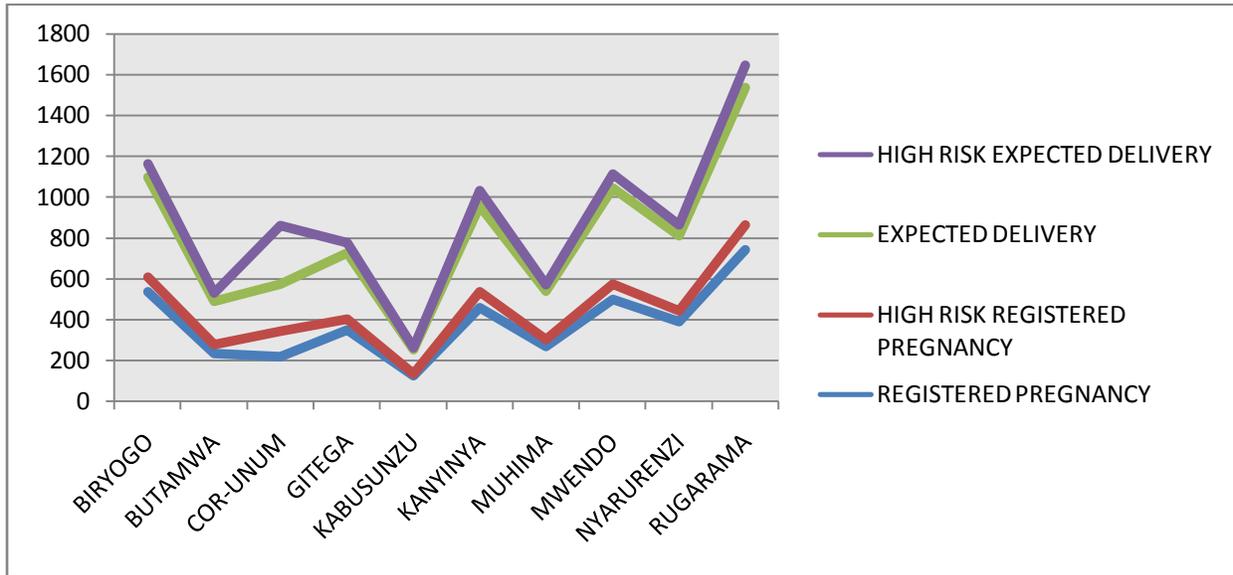
The reporting about registered pregnancy and expected delivery is well, due to the following reasons: ASMs register pregnant women from the health centers, after they have come for testing. ANC is high in Nyarugenge District (92%), which may indicate the number of expected delivery.

4.2. SURVEY DATA ANALYSIS

4.2.1. Research participants

Table 5. Participants to the study

Participants	Frequency	Percentage
Answered a questionnaire	247	71%
Did not answer the questionnaire	103	29%
Total	**350**	100

The participants who were supposed to participate in this research are CHWs who are in charge of maternal health in Nyarugenge District. Their number is 350 ASMs, and 247 (71%) are the

ones who participated fully in this research by answering the questionnaire. 103 (29%) did not return the questionnaires.

4.2.2. Participants age

Table 6. Participants by age

Age range	Frequency	Percentage
18-25	20	8.5
26-30	62	25.2
31-35	116	46.96
36-40	48	19.43
TOTAL	**247**	**100**

The results of the age of participants to the study shows that 8.5 % were aged between 18-25 years, 25.5 % between 26-30 years, 46.96% between 31-35 years and 19.43 aged between 36-40 years.

4.2.3. Participants Health Center
Table 7. Participants by HC

Name of HC	Frequency	Percentage
Biryogo	20	8
Butamwa	24	10
CorUnum	9	4
Kabusunzu	25	10
Kanyinya	16	6
Muhima	26	11
Mwendo	47	19
Nyarurenzi	17	7
Rugarama	29	12
Rwampara	34	14
TOTAL	**247**	**100**

The results to the study showed that at least the participation in research was in all health centers in Nyarugenge District.

4.2.4. Participants' education level

Table 8. Participants by Level of education

Level	Frequency	Percentage
P1-P3	3	1
P4-P6	34	14
S1-S3	150	61
S4-S6	60	24
TOTAL	**247**	**100**

The level of education for participants in this study showed that some of them had not completed primary studies (P1-P4: 1% and P4-P6: 14%). The study also showed that 61% have finished O'Level studies, and 24 % only completed secondary studies.

4.2.5. Participants' experience

The following table describes in detail the proportion of participants to the study by length of time in their given respective functions.

Table 9. Participants by experience

Experience	Frequency	Percentage
One year	21	9
Two years	123	50
Three years	87	35
More	16	6
TOTAL	**247**	**100**

A large number of respondents has the experience of more than one year: 50% have the experience of two years and 35% have the experience of three years, only 6% are more than 3 years in experience.

4.2.6. Experience with Rapid SMS
The following table shows the experience of CHW in utilization of Rapid SMS system.

Table 10. Participants with experience with Rapid SMS

Range of Experience	Frequency	Percentage
Less than 5 Months	12	5
More than 5Months	91	37
1Year	144	58
TOTAL	**247**	**100**

The results to the study show that 144 (58%) participants have the experience of more than 1 year using Rapid SMS system, 91 (37%) have the experience of more tha 5 months and only 12 (5%) have not yet spent 5 months using Rapid SMS. Let's remember that Rapid SMS has started in 2013 in Nyarugenge District.

4.2.7. Trainings in Rapid SMS

The following table indicates the proportion of the participants who have been trained to use the Rapid SMS system. Let's remember that the hypothesis includes the lack of trainings in the factors which may bring about the low Rapid SMS reporting pattern.

Table 11. Participant with trainings in Rapid SMS

Trainings	Frequency	Percentage
Yes	48	19
No	199	81
TOTAL	**247**	**100**

The results to the study showed that most of the ASMs have not been trained to use the Rapid SMS system. 199 (81%) to have not been trained, but some number 48 (19%) showed that have been trained.

4.2.8. Reporting period about pregnant women by CHWs

Period	Frequency	Percentage
Weekly	104	42
Monthly	143	58
TOTAL	**247**	**100**

The results to the study show that the period to visit pregnant women is by week and month. 104 CHWs (42%) visit weekly and 143 (58%) visit monthly.

4.2.9. Participants with electricity problems

Table 12. Participants with the problem of electricity

Electricity problem	**Frequency**	**Percentage**
Yes	91	37
No	156	63
TOTAL	**247**	**100**

The results reveal that some CHWs face the problem of electricity. This hardens their work due to down batteries in their phones, and the recharge will also be hard searching for where to find electricity. Luckily, those with such a problem are not many, because only 91 (37%) reported it, while 156 (63%) did not.

4.2.10. Participants with Network problems

Network sometimes imposes itself as a problem to reporting while using Rapid SMS.

The participants who encounter this problem are in a good number, because 92 of them (37%) reported to have it, but it is for sometimes. And 155 (36%) do not have this problem of networks

Table 13. **Participants with a network problem**

Network Problems	Frequency	Percentage
Yes	92	37
No	155	63
TOTAL	**247**	**100**

4.2.11. Ways of women's pregnancy identification by CHWs

The following table shows ways in which the ASMs identify pregnancy in women. Three ways are possible: by visiting the families, by a report of woman's partner or a relative, and by health centers. Identification by health center is the most prominent way, after a woman has been tested and the pregnancy confirmed by a HC. The results show that identification by HC is a way opted by many CHws whereby 119 of them (48%) use it. Family visits and partners or relative report are also used, but this study shows they are used equally 65 (26%)

Table 14. **Pregnancy identification ways**

Way	Frequency	Percentage
Family visits	65	26
Partner's report	65	26
From H.C	119	48
TOTAL	**247**	**100**

4.2.12. Problems encountered by CHWs during visits of pregnant women

During visits of pregnant women, ASMs encounter some problems which hinder them to accomplish well their task. 55 (22%) reported to encounter remoteness, which is coupled with long distances to cover 167 (68%) reported to have such a problem, and 25 (10%) said they have a problem of transport fees.

Table 15. **Problems during visits of pregnant women**

Problems	Frequency	Percentage
Remoteness	55	22
Long distances	167	68
Lackof transport means	25	10
TOTAL	**247**	**100**

4.2.13. Data inputting in the system

Table 16. **Effort to input data**

The table below shows the proportion of the ASMs in terms of effort used in data inputting within the phone while using Rapid SMS. By effort, the study wanted to mean the friendliness and understanding required to use the system. 162 (66%) of the respondents said they don't have a problem in data inputting, while 85 (34%) claimed to use some efforts to input data.

Effort to input data	Freq	Percentage
Yes	85	34%
No	162	66%
TOTAL	247	100%

4.2.14. The problem of the lack phones

The table below shows the proportion of ASMs with the problem of lack of phones. On the number of respondents which is 247, 189 (76.5%) claimed to have never been given the phones, except SIM Cards only. 58 (23.5%) only are the ones who reported to have been given the phones, but many of them also claim for the replacement of the broken down ones, because MoH does not provide with them the new phones to replace the old ones.

Table 17. **Lack of phones for reporting**

Lack of phones	Frequency	Percentage
Yes	189	76.5
No	58	23.5
TOTAL	**247**	**100**

4.3. ANALYSIS OF WHAT CAN BE DONE TO INCREASE REPORTING PATTERNS ABOUT MATERNAL HEALTH

The following table aimed at investigating what can be done to increase the reporting about maternal health in Rapid SMS. A big number of ASMs 215 (87%) agree with the fact that women may be involved in the reception and sending of messages concerning them. 27 (11%) wrote that partners may be involved, while only 5 (2%) reported that a number of CHWs may be increased.

Table 18. Factors which may increase Rapid SMS reporting

What can be done	Frequency	Percentage
Increase the number of ASMs	5	2
Women receiving and sending SMS	215	87
Partners receiving and sending SMS	27	11
TOTAL	**247**	**100**

4.2.16. Analysis of data from the in-charge of community health

The following table analyzes the challenges faced by CHWs in utilization of Rapid SMS system, as the in-charge of community health in all HCs in Nyarugenge District affirm. CHWs are under their control, this is why they really know the problems CHWs face daily. As the District has 10 HCs, 10 in-charge of community health participated in this study, because each HC has one in-harge of community health. The major problems found were lack of phones (30%), remoteness (20%), long distances (20%) and lack of trainings (20%).

Table 19. **Analysis of data from the in-charge of community health**

Challenges	Frequency	Percentage
Remoteness	2	20
Long distances	2	20
Lack of transp. And motivation fees	1	10
Lack of trainings	2	20
Lack of phones	3	30
TOTAL	**10**	**100**

CHAPTER FIVE. DISCUSSION

This study was conducted in order to assess factors related to the low use of Rapid SMS in Nyarugenge District. Due to the fact of being among the Districts with low Rapid SMS reporting rate while it is in a Capital city, Nyarugenge District has been chosen as the area where this study was to be conducted. Results of the study revealed some factors which are behind the low use of Rapid SMS in reporting for maternal health by the ASMs, who are Community Health Workers in charge of maternal health.

5.1. STATISTICAL DATA DISCUSSION

5.1.1. Inactivity and activity states of the ASMs

Data for this study showed that the active ASMs are on the lower percentage proportion compared to that of the inactive. Inactive ASMs are many. The term active and inactive stand for the reporting and non-reporting schemes, due to the fact that all RapidSMS messages sent and received are recycled on the central server managed by Rwanda Biomedical Center, and all messages are indicated in terms of the numbers.

5.1.2. Rapid sms antenatal care report

The table below shows the data of reporting about antenatal care, during the period of 2013-2015 in all health centers in Nyarugenge District. Rugarama and Mwendo reveal themselves as the first health centers in reporting. The health center of Cor-Unum of Kimisagara Sector has a zero reporting trend because it is a new health center. Rapid SMS has started to be used in 2013, and the new health centers have not immediately adapted to it

5.1.3. Rapid sms pregnancy report statistics

Data for the study showed that the health centers of Rugarama and Mwendo are well in reporting about pregnancy. Pregnancy reporting is about the registration of the new pregnant mothers in Rapid SMS system, reporting about any problems or complications which may arise during pregnancy period and delivery time.

The reporting about registered pregnancy and expected delivery is well, due to the following reasons: ASMs register pregnant women from the health centers, after they have come for

testing. ANC is high in Nyarugenge District (92%), which may indicate the number of expected deliveries.

5.2. SURVEY DATA DISCUSSION

5.2.1. Study population

Participants of this study were ASMs. These are female community health workers in charge of maternal health at the cell level.

The community health worker programs have been implemented as a strategy to respond to the human resource problems for health. For maternal and child health, CHWs appear to be most beneficial when addressing existing health conditions instead of potential conditions ((Meera Viswanathan et al, 2009). The CHW programs care for different health areas using cell phone communications under the Rapid SMS system (Ivy Mushamiri et al., 2015).

The ASMs who participated into this study were chosen according to their distribution in all health centers of Nyarugenge District.

5.2.2. Education

The participants to this study show that most of ASMs at least stepped in secondary studies (S1-S3), while a small number shows those who had primary studies.

Just as the roles of CHWs are varied, the requirements around their education and training should also be wide ranging. In 2006, HRSA reported on a survey of 900 employers of CHWs nationwide. The survey showed that only a little over half (53 percent) of employers of CHWs have an education requirement, 21 percent require a secondary school credential (high school diploma or GED), and 32 percent require a bachelor's degree. At the time of the HRSA survey, the majority of CHWs had less than a two-year college degree and 7.4 percent had less than a high school education. Paid CHWs were more highly educated than the volunteer force, but the median credential for both groups was "some college." (Randall R. et al, 2013).

5.2.3. Experience

Most of the participants to this study had between 2 and 3 years of experience as ASMs, and an experience of more than one year in using Rapid SMS system. In the World Health Organization Report about global health experience to deliver health Millenium Goals byinvolving CHWs, it has been noted that CHWs experiences help in performing in different activities ((Unicef, Community Health Workers, 2004).

The length of CHWs experience is an important factor to evaluate their performance, due to the skills they gradually gain the performance of different tasks ((Zulliger, 2009).

5.2.4. Trainings in using Rapid SMS

Trainings is among the key factors in the performance of different activities by CHWs. The results to this study showed that a good number of the ASMs have not been trained in utilization of Rapid SMS.

In Hawai, a State located in the Pacific Ocean, a study showed that the challenges to hinder the trainings of CHWs included lack of finances, specific topics or subjects and some trainers who can give the trainings (Kapheim, 2014)

In Sub-Sahara African region, challenges of trainings of CHWs were found to be;

-Coordinating curriculum and implementation of trainings program between training providers including NGOs, Civil society organizations and governments,

-Curriculum which do not engage CHWs to their daily activities,

-Lack of consultation to the CHWs in terms of getting their conceptions to the trainings given to them, so as to improve content quality and delivery ((Cindil Redick et al., , 2014).

5.2.5. Period to visit pregnant women

The period to visit pregnant women is a factor to reporting, due to some events of needs and problems which are always found in pregnant women during their pregnancy state. The results to this study showed that most ASMs report monthly. The reporting period also indicates the time

when ASMs makes a visit to the woman, because the report is given when a pregnant woman is found with some needs.

Home visits by CHWs could be effective in identifying pregnant women in the community before they have presented to the health system, by which the improvement of antenatal care rises, HIV testing and prevention of mother-to-child transmission (PMTCT) are accomplished (Irene A. Lema et al., , 2014).

ASMs should undertake home visits regularly so as to ensure the good conditions of women's pregnancy, to talk to them with their partners and report to any matter arising (Monica Okuga et al, 2014).

5.2.6. Electricity problems

Rapid SMS is cell phone application which is used by the ASMs to report about maternal and child health, from partum till post-partum period. Still, a number of the ASMs reside and work in remote areas in villages .

The cell phones used are not spared by the problem of electricity, which interferes in the accomplishment of SMS-reportings by CHWS. This study showed that a small number of respondents (37%) only are the ones who are in such a problem, because the District has some villages and mountainous areas do not have electricity yet.

5.2.7. Network problems

The same cell phones used by ASMs to report for maternal and child health may face a problem of networks, while sending and receiving SMS. The results to this study showed that a number of respondents don't have a network problem.

5.2.8. Pregnancy identification ways

The ways of identifying pregnancy in women has also an important part in utilization of Rapid SMS,. The results to this study show the proportions in the three main ways through which pregnancy may be identified. The study showed that most of the ASMs identify pregnancy just at when the Health Center has confirmed it. This may constitute a factor of low use of the system, for a number of pregnancy cases may be known late. As Irene A. Lema said, home visits may be

done regularly, because they may be effective in identifying the new pregnant women easily (Irene A. Lema et al., , 2014).

This study showed that family visits and partners report have the equal and lower chance in identification of pregnant women, which can hinder the satisfactory use of Rapid SMS system.

The lack of home visits revealed itself as a factor to delivery in women without a skilled attendant, and even fewer mother and babies have postnatal contact with providers who can deliver interventions that save lives (Deborah Sitrin et al., 2013).

In 2000, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) released a Joint Statement recommending home visits as a strategy to reduce neonatal deaths, based on evidence from research studies demonstrating home visits by trained community-based workers can improve key newborn care practices, care-seeking, and, in high mortality settings, reduce newborn mortality (Unicef, Home visits for the newborn child: A strategy to increase survival, 2004).

5.2.9. Problems during visits of pregnant women

This study shows the proportions of the problems encountered by the ASMs during visits of the pregnant women. Most of them reported long distances to cover as a major constraint during those visits. Some other problems like remoteness and lack of motivation fees also impose themselves as problems which hinder the regular visits of the women. The Ministry of Health has done a lot in funding the CHWs in general, including financing the income generating projects for them. For this, some ASMs in this study did not claim for motivation fees (Cathy Mugen et al., 2011).

5.2.10. Data inputting in the system

Most of the participants to this study claimed that they don't have a problem with inputting data into Rapid SMS system, although some others claim to have the problem.

Lack of trainings and experience are the factors which hinder the phone user-friendliness by the ASMs.

5.2.11. The problem of the lack phones

A good number of participants to this study claimed the lack of phones as one of the major factors which hinder the use of Rapid SMS system. They said that the new ASMs are never given phones, except SIM cards which carry the application. Others said there is lack of replacement of the broken down phones. So, all of these are factors to the low use of Rapid SMS.

As this study aimed at assessing the factors of low use of Rapid SMS in Nyarugenge District, the ASMs have reported the factors which can serve as a base for improving the use of the system in maternal health reporting. Most of the ASMs presented their view of involving pregnant women in the reception and sending of the SMS concerning them, while others suggested that women partners may also be involved.

The view of the ASMs to involve pregnant women in reporting may not be a unique method in Nyarugenge District in particular, and Rwanda in general. In the East-Timor, Midwives register expectant mothers, track their progress, know when they go into the labor, and make arrangements for making delivery. Mothers continue to receive automated health promotional information via SMS through the first six weeks of the newborn's life.

In Ghana, voice-based educational messages to improve maternal and child health are provided. VOTO mobile and each mother receives two calls a week in her own language with information on the stage of her pregnancy with information to keep her and her baby health.

CHAPTER SIX. CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary, discussion and conclusion of the study.

As participants played a role in assessing factors of low use of Rapid SMS in Nyarugenge District, it has been assessed that the problem of lack of phones poses itself as a major factor to the low use of the system.

6.1. CONCLUSION

Rapid SMS has been adopted as a technology platform tool that aids CHWs in tracking pregnant women and children less than two years of age. It is a tool used by MoH to collect data from the level of the community through the use of CHWs provided cell phones in all districts. It was

introduced to provide better information on risks and to avoid delays that caused maternal deaths. All pregnant women are registered and followed by CHWs with regular reports being sent via SMS. CHWs should report regularly, whereby an active CHW should not exceed 14 days without reporting.

In Nyarugenge District, the Rapid SMS reporting pattern about maternal health is low. This study aimed at assessing the factors of this low reporting. The District was found to be low in reporting about maternal health, and due to the fact that this District is in the heart of Kigali City as a capital city of the Country, it seemed necessary to investigate the causes of lowness in Rapid SMS reporting, which is also found in the other Districts found in villages.

At this point, it is important to recall the research questions of this study:

The stated objectives have been set to answer the following questions:

1. How are Rapid SMS reporting about maternal health in Nyarugenge District?
2. What can be done to improve Rapid SMS reporting in Nyarugenge District been low like other districts while it is located in the heart of Kigali City?
3. What could be changed about the Rapid SMS system to increase the use by end-users and policy makers?

6.1.1. Rapid SMS reporting trends

This study analyzed Rapid SMS reporting trends about maternal health, whereby reports on 4 times of antenatal care, registered pregnancy, high risk pregnancies, expected delivery and high risk expected delivery were analyzed. The reporting statistics reveal whether the ASMs are active or inactive. During the period of 2013-2015, the reporting statistics showed that the ASMs are inactive in the District. The health centers of Mwendo and Rugarama showed to be well in reporting, according to the data in the study. Registered pregnancies and expected delivery cases have a good trend of reporting.

6.1.2. Problems encountered in using Rapid SMS

Rapid SMS report should not exceed 14 days without being sent. Different factors have been assessed as hindering the use of the system, which has been manifested in the low reporting.

1. Technical factors: which include lack of trainings and phones. Most of the participants to this study claimed to have not been trained, and the phones have not been provided to them, except SIM cards with the application on them.
2. Infrastructural factors: lack of electricity. Nyarugenge District has village and mountainous areas, which have not electricity yet. The participants from those areas claimed to have the electricity as a problem, because it requires them to go distances looking for where to recharge their phones
3. Geographic factors: Remoteness and long distances. As said below, Nyarugenge District has remote parts and the participants claimed long distances to cover while visiting pregnant women. Some parts have scattered homes in bushy mountains.
4. Reporting factors: ways of pregnancy identification: ASMs are required to make visits at home in order to identify the new pregnancy cases. Most of the participants in this study said that they get to know a new pregnancy case when it has been confirmed at the HC, which brings about the late identification by an ASM.

6.1.2. Opportunities that can enable the improvement of Rapid SMS use in the District

Rapid SMS is an application that is used on the cell phones, and the end-users are CHWs. CHWs are the ones to send reports for any complication in pregnancy and any problem which can affect women and children's lives. Messages from central servers come to the cell

phones of the CHWs, reserved to the pregnant women, what they should do and how they should behave, remembering them the dates of ANC checks, etc

As the study also wanted to assess at what can be done in order to ameliorate the use of Rapid SMS in terms of reporting about maternal health, most of the participants to this study showed their interests in how pregnant women may be involved in sending reports about their status, and then receiving warning messages by them.

6.1.3. Points of area for future research

The future study in Rapid SMS reporting should look at how pregnant women may be involved in the reception of messages, instead of one ASM to receive all messages for all pregnant women at the village level.

6.2. RECOMMENDATIONS

The results of this study revealed that there are factors which hinder the improvement in Rapid SMS use in Nyarugenge District, in terms of reporting for maternal health. Rapid SMS reporting should be done regularly, and reporting patterns should be well.

To achieve this, the following recommendations can be set:

To the Health Sector Policy planners:

-To provide cell phones to the new ASMs and replace the old and broken ones.

-To provide solar energy charges to the ASMs who are in areas without electricity.

-To organize the regular trainings for the ASMs, with the revised curriculum, so as to help the to gain practical knowledge and skills, which will help them accomplish their daily activities.

-To think about how to increase the motivation fee, for ASMs and other CHWs have many activities to accomplish

To the ASMs

-Home visits should be done regularly by the ASMs, in order to identify the new pregnancies which need to be reported. The method of identification of pregnancy after the confirmation by Health Centers should be disfavored.

To the researchers

-Researchers should continue research on RapidSMS use on how pregnant women may be involved in the reception of the messages concerning them.

APPENDICES

Appendix1. The informed Consent

    A. Description

This Informed Consent form is for CHWs and the in-charge of community health in HCs of Nyarugenge District, who will be invited to participate in the research. The title of our research is **"ASSESSING FACTORS RELATED TO THE LOW RAPID SMS USE IN NYARUGENGE DEISTRICT".**

Principal investigator: NKUNZABO Ephrem

Institution: University of Rwanda, College of Medicine and Health Sciences.

A.1. English Form

I am NKUNZABO Ephrem, a Student at Universiy of Rwanda/College of Medicine and Health Sciences. I am doing research on **"ASSESSING FACTORS RELATED TO THE LOW RAPID SMS USE IN NYARUGENGE DEISTRICT".**

I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. I assure you that, whether you like to participate or not, you will continue your activities as always and nothing will change.

The results from this research will help all of those who use Rapid SMS to strengthen their reporting activities.

You will not be given any money or gifts to take part in this research.

We will not be sharing the identity of those participating in the research and the information that we collect from this research will not be shared or given to anyone.

If you have any questions you may ask them now or later, even after the study has started. If you wish to ask any questions later, you may contact any of the following:

-NKUNZABO Ephrem, Phone number: 0788778006, e-mail: nephremos2020@yahoo.fr

-HINDA Ruthon

-Prof. Michael Law

GUSOBANURA IMPAMVU Y'UBUSHAKASHATSI

Nitwa NKUNZABO Ephrem, nkaba ndi umunyeshuri muri Kaminuza y'u Rwanda/Koleji y'ubuvuzi n'ubumenyi bw'ubuzima. Ndimo gukora ubushakashatsi mu karere ka Nyarugenge, ngamije kureba **IMPAMVU ZITUMA IKORESHWA RYA RAPID SMS RIRI HASI MU KARERE KA NYARUGENGE.** Maze kubabwira icyo ngamije, ndabasaba kuba mwamfasha mu ruhare rwanyu mu gukora ubu bushakashatsi. Ntabwo uyu munsi aribwo mwahita mwemera cyangwa muhakana gutanga ubufasha. Mushobora kugira uwo mubaza usobanukiwe n'ubushakashatsi, mbere yo gufata icyemezo.

Kumpa ubufasha muri ubu bushakashatsi ni ubushake bw'umuntu ku giti cye, kandi ndabizeza ko gutanga ubufasha cyangwa se kutabutanga ntacyo bizahindura ku mikorere yanyu ya buri munsi.

Ibizava muri ubu bushakashatsi bizafasha abakoresha porogaramu ya Rapid SMS mu kunoza inshingano zabo zigendanye no gutanga amakuru mu buryo bwihuse kandi ku gihe.

Nta mafaranga cyangwa se ibindi bihembo bigenewe umuntu uzemera gutanga ubufasha muri ubu bushakashatsi.

Nta mwirondoro w'abazatanga ubufasha muri ubu bushakashatsi tuzashyira ahagaragara, kandi n'ibizava muri ubu bushakashatsi ntibizabonwa n'uwo ari we wese.

Muramutse mufite ibibazo mwabibaza nonaha cyangwa se ikindi gihe, ndetse n'igihe ubushakashatsi bwatangiye ntibyababuza kugira icyo mubaza. Mushobora kwifashisha aba bakurikira mu bibazo mwagira:

-NKUNZABO Ephrem. Telefoni igendanwa: 0788778006

-HINDA Ruthon: 0788494257

-Dr Michael Law

Certificate of Consent (Icyemezo cy'uko uwifuzwa kugira uruhare mu bushakashatsi abyemera)

I have read the foregoing information, (or it has been read to me). I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction.

I consent voluntarily to participate as a participant in this research

Name of the participant……………………………………………………………………………

Signature of the participant…………………………..........

Date……………….............................

Name of the Researcher……………………………………………………………………..

Signature of the Researcher……………………………………………

Date…………………………………

Njyewe ubwanjye nisomeye amakuru yose agendanye n'ubushakashatsi bugiye gukorwa (Cyangwa se nayasomewe). Nashoboye kubaza ibibazo kandi nashoboye gusubizwa neza mu buryo buhagije.

Ku bw'ubushake bwanjye, ndemera kugira uruhare muri ubu bushakashatsi ntanga amakuru mu byo mbazwa.

Amazina y'ubazwa………………………………………………………………………………

Umukono…………………………...

Italiki……………….............................

Amazina y'ubaza…………………………………………………………………..

Umukono………………………………………………………………

Italiki…………………………………

Appendix2. Research Questionnaire (Imbonerahamwe yo kwifashisha mu gukora ubushakashatsi)

I sincerely request your kind cooperation by responding this questionnaire. The purpose of this questionnaire is to collect data which will help us to assess the factors of low RapidSMS reporting in Nyarugenge District. I would advise you to carefully read the questions before ticking your answers or providing your comments. Your answers will be analyzed in total confidentiality and will be used for research purpose only. However, your name is not compulsory.

Ndabasaba ubufasha musubiza ibibazo byabajijwe muri iyi mbonerahamwe y'ubushakashatsi. Ikigamijwe ni ugukusanya amakuru yadufasha kumenya **IMPAMVU ZITUMA ITANGWA RY'UBUTUMWA BUGUFI MURI RAPID SMS RIRI HASI MU KARERE KA NYARUGENGE**. Mwabanza mugasoma mwitonze ibibazo byabajijwe mbere yo kubisubiza. Ibyo musubiza bizanononsorwa mu ibanga kandi nta kindi bizakoreshwamo kinyuranye na gahunda y'ubu bushakashatsi. Umwirondoro wanyu si ngombwa ko ugaragazwa.

I. **Questionnaire for CHWs (Imbonerahamwe y'ubushakashatsi igenewe abajyanama b'ubuzima)**

I.1. Binary questions (Ibibazo byo gusubiza wuzuza)

A. Participant identification (Demographics)

(Umwirondoro)

1. Name (Optional):

Amazina (Kuyashyiraho ni ubushake)

2. Age *(Imyaka):*

-18-25 years *(hagati ya 18-25)* ☐   26-30 years *(hagati ya 26-30)* ☐

-31-35 years *(hagati ya 31-35)* ☐   36-40 years *(hagati ya 36-40)* ☐

3. Level of education

    Amashuri yize

- P1-P3 *(Icyiciro cya mbere cy'amashuri abanza)*

- P4-P6 *(Icyiciro cya kabiri cy'amashuri abanza)*

-S1-S3 *(Icyiciro cya mbere cy'amashuri yisumbuye)*

-S4-S6 *(Icyiciro cya kabiri cy'amashri yisumbuye)*

-A1 *(Icyiciro cya mbere cy'amashuri makuru)*

-AO (*Icyiciro cya kabiri cy'amashuri makuru)*

B. Information about experience as a CHW and RapidSMS usability and friendliness

4. How long have you been CHW?

    Mumaze igihe kingana iki muhawe inshingano zo kuba umujyanama w'ubuzima?

    - One year *(Umwaka umwe)*

    -Two years *(Imyaka ibiri)*

    -Three years *(Imyaka itatu)*

    -More than three years *(hejuru y'imyaka itatu)*

5. How long have you been using RapidSMS as a CHW?

    (Nk'umujyanama w'ubuzima, umaze igihe kingana iki ukoresha RapidSMS?)

Indicate time here (months or years) *(Uzuza hano igihe umaze uyikoresha, amezi cg imyaka)*

<div style="border:1px solid black; width:200px; height:60px;"></div>

6. Have you been trained to use RapidSMS? *(Mwigeze mufata amahugurwa yo gukoresha RapidSMS)*

Yes *(yego)*

<div style="border:1px solid black; width:200px; height:60px;"></div>

No (*Oya*)

<div style="border:1px solid black; width:200px; height:60px;"></div>

C. Information about reporting period
   (Amakuru ku gihe raporo itangirwaho)

7. Which is the Reporting period about pregnant women
   (*Ese ni ryari mukunze gutangira amakuru agendanye n'ubuzima bw'umubyeyi?*)

-Month *(Ukwezi)*

<div style="border:1px solid black; width:150px; height:50px;"></div>

-Week *(Icyumweru)*

<div style="border:1px solid black; width:150px; height:50px;"></div>

8. Do you ever have the problems of electricity for the phones recharge?

Mujya mugira ikibazo cy'umuriro (kuba aho mutuye nta mashanyarazi ahari, …) mu gu sharija telefoni mukoresha?

Yes (Yego)

<div style="border:1px solid black; width:150px; height:50px;"></div>

No (Oya)

<div style="border:1px solid black; width:150px; height:50px;"></div>

9. Do you ever encounter the Network problems in using RapidSMS?

Mujya muhura n'ingorane z'imbaraga z'amajwi (reseau) mu gukoresha telefoni ngendanwa za Rapid SMS?

Yes (Yego)

Non (Oya)

D. Information about identification and visits of pregnant women
(*Amakuru yerekeranye no kumenya ababyeyi batwite n'isurwa ryabo*)

10. At what time do you identify and record a pregnant woman?

I visit families and I go across her *(Menya ko umugore atwite iyo ndimo nsura imiryango)*

Her partners, relatives or friends come to report to me *(Abo bashakanye, abo mu muryango we cyangwa inshuti ze baza kumbwira*

I get information from the HC when she comes for her first ANC
(Mumenyera ku kigondera buzima iyo aje kwisuzumisha)

Any other way? Specify
(Haba hari ubundi buryo mumenyamo ko umubyeyi atwite? Mwabuvuga)

11. How many times do you visit pregnant women? *(Ni mu gihe kingana iki musura ababyeyi batwite?*

-Weekly *(Buri cyumweru)*

-Monthly *(Buri kwezi)*

E. Information about the problems encountered in visits

Ingorane zigaragara mu gikorwa cyo gusura

12. What are problems do you face while doing visits to the pregnant women*? (Ni izihe ngorane mukunze guhura nazo mu gihe musura ababyeyi?)*

-Remoteness in habitation *(Gutura kure)*

-Long distances to be travelled *(Kugenda ingendo ndende*)

-Low transport means *(Uburyo buke bwo kubageraho*)

F. Information about the information flow

13. How would you suggest making more flow of information fast?

Ni ubuhe buryo mwumva bwajya bwifashishwa mu gutanga amakuru vuba?

-Increase number of CHW *(Kuzamura umubare w'abajyanama b'ubuzima)*

-To involve pregnant women in sending and receiving messages (*Kureka ababyeyi batwite nabo bakajya bahabwa ubutumwa bubagenewe)*

-To involve pregnant women partners in sending and receiving messages *(Kureka abagabo b'abagore batwite nabo bakajya bahabwa ubutumwa bugenewe abagore babo)*

I.2. Long-answer questions (Ibibazo byo gusubiza mu magambo yawe)

1. When did RapiSMS started in your village*? (Ni ryari RapidSMS yatangiye gukoreshwa mu mudugudu wanyu?*

………

………

………

2. How have you been prepared to use the system (Equipment, tools, training, etc) *(Ese mwateguwe mute mu gukoresha iyo gahunda (mu guhabwa ibikoresho, amahugurwa n'ibindi?)*

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

3. Is it worth the effort of inputting data into RapidSMS? *(Ese mubona bibasaba imbaraga mu kwandika ababyeyi n'abana muri RapidSMS?)*

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

4. How many women do you follow with RapidSMS today*? (Ubu ni nk'abagore bangahe muri gukurikirana mwifashishije porogaramu ya RapidSMS none?)*

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

5. What are the problems or constraints that limit you in the application of RapidSMS (personal, familial, technical,…?) Explain

(Ni ibihe bibazo bibabera inzitizi mu gukoresha RapidSMS (bijyanye n'umuntu bwite, bituruka ku muryango, bya tekiniki n'ibindi). Sobanura)

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

6. What are the problems or constraints that you find hindering the regular reporting in RapidSMS? Feel free!

(Ni ibihe bibazo cyangwa se inzitizi mubona zituma hatabaho gutanga ubutumwa muri RapidSMS mu buryo bwa buri munsi? Ntugire impungenge n'imwe mu kugaragaza inzitizi ituma hatabaho itangwa ry'ubutumwa mu buryo bwa buri gihe uko bikwiye!)

……
……
……

II. **Questionnaire for the in-charge of community health at health centers** *(Imbonerahamwe y'ubushakashatsi igenewe abashinzwe ubuzima rusange mu bigondera buzima)*

1. Experience as the in-charge of community health *(uburambe mufite mu buzima rusange)*

……
……
……..

2. When has RapidSMS been introduced in your health center? *(Ni ryari RapidSMS yatangiye gukoreshwa mu kigondera buzima mukoramo?)*

……
……
…….

3. Has RapidSMS been introduced before or after you were in these responsibilities? *(Ese RapidSMS yatangiye mbere cyangwa nyuma y'uko wari ufite izi nshingano?)*

……
……
…….

4. What are the key challenges you notice being faced by CHWs in the system of Rapid SMS and hinder the required reporting pattern? *(Ni izihe ngorane mubona abajyanama b'ubuzima bahura nazo mu gukoresha RapidSMS, zituma badashobora gutanga amakuru ku gihe?)*

………
………
………

………
………
………

5. According to your experience, what do you find as a reason of low reporting in the Rapid SMS system in the District? *(Mukurikije uburambe mufite, mubona ari izihe mpamvu nyamukuru zituma itangwa ry'amakuru muri RapidSMS riri hasi mu Karere kanyu?)*

………
………
………

Thank you to be part of this study

Tubashimiye kuba mwemeye kugira uruhare muri ubu bushakashatsi

Appendix3. Ethical clearance approval

Appendix 4. Protocol amendments request for change of the title

University of Rwanda — COLLEGE OF MEDICINE AND HEALTH SCIENCES

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 12ᵗʰ July, 2016
No 285 /CMHS IRB/2016

NKUNZABO Ephrem
School of Public Health, CMHS, UR

Re: Protocol Amendment Request of change of the title

Dear NKUNZABO Ephrem

We thank you for submitting your request for research protocol amendments in the project titled *"The Impact Of Rapid SMS On Maternal And Child Health: Case Study: Nyarugenge District"*.

After reviewing your protocol, the amendments have been approved with a change in title from *"The Impact Of Rapid SMS On Maternal And Child Health: Case Study: Nyarugenge District"* to *" Assessing factors related to the low use of rapid SMS IN Nyarugenge District"*.

Please note that the ethical approval dates and expiry dates remain the same.

We wish you success in this important study.

For Professor Kato J. NJUNWA
Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

Jean Bosco Gahutu
Vice - Chairperson
IRB, CMHS-UR

Cc:
- Principal College of Medicine and Health Sciences, UR
  University Director of Research and Postgraduate studies, UR

EMAIL: researchcenter@ur.ac.rw   P.O. Box: 3286, Kigali, Rwanda   WEBSITE: http://cmhs.ur.ac.rw/

Appendix5. MoH letter granting the authorization to collect data

REPUBLIC OF RWANDA

Kigali,
N °20/...32.5.2..../DGPHIS/2016

1 1 JUL 2016

MINISTRY OF HEALTH
P.O. BOX 84 KIGALI
www.moh.gov.rw

NKUNZABO Ephrem
University of Rwanda
College of Medicine and Health Sciences
School of Public Health Department of Health Informatics
Telephone number: 0788778006

RE: Data Request for the evaluation of the RapidSMS

Reference is made to your letter dated 7th June 2016, requesting RapidSMS data from January 2013 to October 2015 for your thesis entitled "The Impact of RapidSMS on maternal and child health, cases study: NYARUGENGE District.

The Ministry of Health has approved your request, HMIS team will share with you the requested data, in order to complete your Masters of Health Informatics, please share with us the protocol or concept note for your research to make sure we provide the needed information.

Sincerely

Dr. Agnes BINAGWAHO
Minister of Health
Cc:
- Honorable Minister of State in Charge of Public Health and Primary Health Care
- Permanent Secretary/MOH
- Director General of Rwanda Biomedical Center (RBC)

Appendix 6. Letter requesting data collection from RBC

NKUNZABO Ephrem   Kigali, 20th July 2016

UNIVERSITY OF RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

DEPARTEMENT OF HEALTH INFORMATICS

Director General
RWANDA BIOMEDICAL CENTER
KIGALI-RWANDA

Dear Sir/Madam
R.E.: Request for the access to the RapidSMS data

I humbly write this letter to you requesting for the access to the RapidSMS data which can be found from the Institution under your control.

In fact, Dear Sir/Madam, I am a student in the School of Public Health under College of Medicine and Health Sciences, at the level of Masters of Health Information, and I am doing a research about RapidSMS reporting in Nyarugenge District. I would like to announce to you that the Ministry of Health has granted me with the permission to do this research and access data I may need, as the letter I attached to this request shows.

Hoping that my request will be under your favorable response, I would like, Dear Sir/ Madam, to thank and wish you a prosperous work,

NKUNZABO Ephrem

REFERENCES

Abhay Bang et al. (2010). *The Potential of Technology to transform Maternal and Newborn Health.* Port-au-Prince.

Anirban Chatterjee et al. (2009). *Implementing services for Early Infant Diagnosis (EID) for HIV:a comparative descriptive analysisof national programs in four countries.* New York: Biomed Central.

Carole Deglise, L. S. (2012). SMS for disease control in developing countries. *A systematic review of mobile health applications* , 2-9.

Cathy Mugen et al. (2011). *Community performance-based financing health.* Kigali.

Cindil Redick et al., . (2014). The Current State of CHW Training Programs in. 5-6.

Consulting, V. W. (May 2009). Health Information Systems in Developing Countries. 2-12.

Deborah Sitrin et al. (2013). *Reaching Mothers and Babies with Early Postnatal Home Visits: The implementation realities of Achieving High Coverage in Large-Scale programs.* Iran.

Erb, N. (2012). *Community Health Workers: Discussion paper.* Washington D.C: Consumer Health Foundation.

Health, M. o. (2011). The Use of RapidSMS in Nutrition. *The Use of RapidSMS in Nutrition* , 1-23.

Hollier, L. (2012). *Maternal Mortality and Morbidity Task Force and Department of State Health Services.* Texas.

Irene A. Lema et al., . (2014). *Community Health Workers to Improve Antenatal Care and PMTCT uptake in Dar es Salam, Tanzania: A Quantitative performance evaluation.* Dar es Salam.

ITU. (2013). *ICT Applications ICT for Improving Information and Accountability for Women ' s and C h i l d r e n ' s H e a lt h.* New York: ITU.

Ivy Mushamiri et al. (2015). Evaluation of the impact of a mobile health. 7-8.

Jody Ronck, e. a. (2011). Health information as healthcare. *The role of mobiles in unlocking health data and wellness* , 14-15.

Kapheim, M. G. (2014). *Best Practice Guidelines for Implementing and evaluating Community Health Worker programs in Health Care settings.* Sinai: Sinai Urban Health Institute.

Kiria, P. E. (2012). The role of mobile phones in Uganda's health service delivery. *Featuring C4C project partners* , 8-15.

Kochi, E. (2012). MOBILE PROGRAMS Framework Foundations. In E. Kochi, *MOBILE PROGRAMS Framework Foundations* (pp. 2-8). Washington.

Lemaire, j. (2011). *Scaling up mobile health.* Washington.

Lincetto, O. (2013). Antenatal care. *Antenatal care , 2*, 51-62.

Mattila, M. (October 2011). Mobile technologies for Child protection. *Mobile technologies for Child protection* , 2-15.

Meera Viswanathan et al. (2009). Outcomes of Community Health Worker Interventions. *Evidence Report/Technology Assessment* , 14-15.

MoH. (2015). RapidSMS . *RapidSMS Rwanda Documentation* , 7-8.

MoH. (2012). *The use of RapidSMS.* Kigali.

Monica Okuga et al. (2014). *Engaging community health workers in maternal and.* Kampala: Umea University, Sweden.

Murthy, M. V. (2003). Mobile based Primary Health Care System for Rural India. *Mobile based Primary Health Care System* , 2-3.

Mutjaba Hussain, M. L. (2006). Clinical Decision Support System for Mother and Child Health. *Clinical Decision Support System for Mother and Child Health* , 2-5.

Nguimfack, J. (2012). Designing and Implementing an Innovative SMS-Based Alert System (RapidSMS-MCH) to Monitor Pregnancy and Reduce Maternal and Child Deaths in Rwanda . *Designing and Implementing an Innovative SMS-Based Alert System (RapidSMS-MCH) to Monitor Pregnancy and Reduce Maternal and Child Deaths in Rwanda* , 2-6.

Of, Auses. (2012). C n d : c c *. *Causes of newborn death: Complicatins during childbirth* , pp. 1-2.

Randall R. et al. (2013). The Evolution, Expansion, and Effectiveness of Community Health Workers. 11-12.

(2016). *RapidSMS Documentatio.* Kigali.

Report, M. o. (2011-2012). *Health achievements.* Kigali: Ministry of Health Annual Report.

RHEA. (2011). *RapidSMS Integration Technical Design Document* . Kigali: Pivot access ltd.

RURA. (2015). *STATISTICS AND TARIFF INFORMATION IN TELECOM SECTOR AS OF MARCH 2015.* Kigali.

Shekar, M. (2012). *ICT for Health in Africa.*

Shihab A. Hameed, A. H. (2005). An Efficient Emergency, Healthcare, and Medical Information. *An Efficient Emergency, Healthcare, and Medical Information* , 1-2.

Somani Patnaik et al. (2008). *Evaluating the Accuracy of Data Collection on Mobile Phones: A study of forms, SMS and Voice.* New Delhi.

Stewart, D. a. (2010). *Causes of maternal and child deaths.* Washington: World Health Organization.

Talaria, s. (2004). SMS healthcare& pharmaceuticals. *SMS healthcare& pharmaceuticals, Reducing costs&improving patient care services* , 5-12.

UNFPA. (2008). *Maternal mortality reduction in Rwanda.* Kigali: UN Rwanda.

UNICEF. (2011). *Case Study on Narrowing the Gaps for Equity Project Mwana : Using mobile phones to improve early infant.* Lusaka.

Unicef. (2004). Community Health Workers. *What Works for Children in South Asia* , 10-11.

Unicef. (2004). *Home visits for the newborn child: A strategy to increase survival.* Geneva.

Unicef. (2013). *Innovative Approaches to Maternal and Newborn Health Compendium of Case Studies.* New York: Unicef.

UNICEF. (2013). User Training Manual, CHWs and Supervisors. *User Training Manual, CHWs and Supervisors* , 10-11.

Vladar, E. K. (2015). child mortality; child survival; maternal death; parent death. Atlanta.

WHO. (2015). *Medic Mobile for Antenatal Care.* Washington.

Zulliger, H. P. (2009). *How effective are Community Health Workers.* Chicago: Johns Hopkins Bloomberg School of Public Health.