ENSIGN COLLEGE OF PUBLIC HEALTH, KPONG EASTERN REGION, GHANA

USEFULNESS OF THE "NEW" DELIVERY ROOM REGISTER IN PREDICTING FACTORS (CLINICAL AND NON-CLINICAL) ASSOCIATED WITH NEONATAL OUTCOMES IN THE EASTERN REGION OF GHANA

By

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A Thesis submitted to the Department of Community Health in the Faculty of Public Health in partial fulfillment of the requirements for the degree

MASTER OF PUBLIC HEALTH

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Declaration

I hereby declare that, this submission is my own work towards my MPH degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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Dedication

This research work is first and foremost dedicated to the Almighty Allah for granting me the ability to go through this work successfully. It is also dedicated to my wife Mrs. Safuratu Musah and children Hanif Yussif, Zainudeen Yussif, Hafiz Yussif and Rakiatu Yussif who have been so supportive and understanding to me through their constant prayers and kind support. To Dr. Henry Nagai, Dr. Richard Amenyah, Dr. Patience Cofie, Mrs. Deborah Kwablah, Mr. Willams Kwarah and Ms. Reina M. Der I say thank you for all the support. Finally, to the entire ENSIGN College of Public Health family including both academic and administrative staff I say thank you and may the Almighty Allah richly bless you.

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I am equally grateful to Dr. Emmanuel Amoah, Dr. Joceline Asibey, the medical superintendents of the various health institutions, health workers and health information officers for granting me the opportunity to conduct such useful and interesting exercise.

(Yussif Ahmed Abdul Rahman, June 2017)

Definition of Terms

Terms	Definition
Anemia:	Anemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs. Hb <8g/dl was used to define anemia in this study.
Neonatal mortality	The probability of dying during the first 28 completed days of life. The rate is expressed as the number of deaths within the first 28 completed days of life per 1000 live births.
Institutional neonatal mortality	Neonatal deaths within 28 days of birth within health facilities
Stillbirths	The birth of a dead viable baby (gestational age ≥22 weeks, weight ≥500 gm and body length ≥25 cm). For international purposes WHO recommends the use of the following parameters: gestational age ≥28 weeks, weight ≥1000 gm and body length ≥35 cm. Often termed 'third-trimester stillbirth'.
Fresh stillbirths	The birth of a dead baby with no signs of maceration/ disintegration of the skin, where the death is assumed to have taken place during labor and the process of delivery
Preterm	A baby born <37 completed weeks of gestation
Macerated stillbirth	A baby born between 32 completed weeks and before completion of 34 weeks (between 32 weeks 0 days and 34 weeks 6 days OR 32 to <34 completed weeks gestation).
Data Accuracy	Data accuracy refers to whether the data values stored in an object are the correct values. To be correct, a data values must be the right value and must be represented in a consistent and unambiguous form. In this study, a liberal application of it used so long as the value can be reasonably and correctly placed or interpreted.
Data Consistency	Data Consistency refers to the usability of data; ie the data is constant in time and capable of using and showing them in different ways without changing their structure.
Data Validity	Data validity refers to the reliability and repeatability of the data

Abbreviation/Acronyms

AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
CHPS	Community Health Planning and Services
CIFF	Children's Investment Fund Foundation
DHIMS II	District Health Information Management System II
EPI	Expanded Programme on Immunization
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
GSS	Ghana Statistical Service
JICA	Japan International Cooperation Agency
LBW	Low Birth Weight
MAF	Millennium Development Goal Acceleration Framework and Country Action Plan: Maternal Health
MDG	Millennium Development Goals
MEBCI	Making Every Baby Count Initiative
MLGRD	Ministry of Local Government and Rural Development
PATH	Program for Appropriate Technology in Health
PMTCT	Prevention of Mother-To-Child Transmission (of HIV-AIDS)
RDQA	Routine Data Quality Audit
SDG	Sustainable Development Goals
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Abstract

Neonatal deaths account for 40% of deaths under the age of 5 years worldwide (Lawn et al. 2005). This contributed greatly to the inability of the global effort to achieve the UN Millennium Development Goal 4 of reducing childhood mortality by two-thirds by 2015. Aside newborn death being a human right issue, it constitutes a major bottleneck in Ghana's inability to meet the MDG4 and to improve child survival. The GHS has embarked on series of interventions aimed at reducing facility specific neonatal mortality by 35% by 2018 including revision of the delivery room registers. This study assessed the effectiveness and usefulness of the "new" delivery room register in identifying clinical and socioeconomic factors that contribute to neonatal outcomes in Ghana through the review of the GHS delivery room register A cross-sectional method was used to gather data on demography of mothers and their babies, births outcomes, associated clinical and socio-economic factors as captured in the delivery room register covering the period of September 1st, 2016 to December 31st, 2016. The data quality from the delivery room register was found to be high (95%) and appreciable although there is still room for improvement. Overall facility specific NMR was 34.79 per 1000 births (95% CI: 34.75, 34.82) with considerable variation across the different types of facilities in the region. This study also found six (6) factors associated with neonatal death. These factors include LBW, gestation, sex, blood group of mother, parity and age of the mother. To make the register more effective and more useful, there is the need for GHS to develop a comprehensive guide that explains the use of the register. GHS and key stakeholders in newborn should also consider the training of providers on the use of the register. The

RHD should also consider further research on facility-specific neonatal mortality as well as factors influencing birth outcomes in the region.

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Chapter 1

1.0 Introduction

Neonatal Mortality is the death of newborns during the first 28 days of their lives (0-27). WHO estimates that 130 million infants are born each year worldwide. Of these newborns, 1 4 million die in the first four (4) weeks of life. three-quarters of these deaths occur in the first week, and more than one-quarter occur in the first 24 hours. Neonatal deaths account for 40% of deaths under the age of 5 years worldwide (Lawn et al. 2005). It is therefore imperative to understand the driving factors of this unfortunate deaths as well as how the available tools within the health systems are able to measure these factors around neonatal deaths.

1.1 Background Information

Ghana has always been at the forefront of the implementation of the global initiatives to address the problem of the high child mortality, including the MDG Acceleration Framework (MAF) and Country Action Plan: Maternal Health, initiatives of the accelerated phase of WHO's Expanded Programme on Immunization (EPI) with introduction of new and additional vaccines, and projects supported by the Global Fund to Fight AIDS, Tuberculosis and Malaria (GHS 2014c). Despite these efforts, not much improvement is recorded in tackling neonatal mortality.

Currently, Ghana is being supported by many donors and stakeholders in its bid to address neonatal mortality. Noticeable among them are USAID, UNICEF, CIFF, JICA among others. The Children's Investment Fund (CIFF), is currently sponsoring a collaborative effort between Program for Appropriate Technology in Health (PATH) and Ghana Health Services (GHS) to implement an initiative dubbed making every baby

count initiative (MEBCI) in Brong Ahafo, Eastern, Ashanti and Volta Regions of Ghana. These four regions bear the highest brunt of the neonatal mortality rates in Ghana (GHS 2014a).

1.2 Problem Statement

In 2014, GHS through its bottleneck analysis identified inadequate documentation as a challenge that does not enable the health system appropriately estimate and properly identify factors accounting for newborn deaths at the facility level. It has since reviewed its registers to enable it to properly document birth outcomes along with its associated factors (clinical and socioeconomic). The revised registers have been printed and distributed to health facilities. There are indications that majority of health facilities have started using these registers since August 2016. This proposal aims at assessing the utility of these registers and conducting a preliminary analysis of the data to explore the extent of neonatal deaths and factors contributing to the deaths as captured in the facility registers.

1.3 Rationale of Study

Although the Ghana Health Service conducted bottleneck analysis of newborn deaths in Ghana in 2014 and reviewed the delivery room registers through series of activities including development, pretesting and rolling out of the "new" delivery register, its implementation on a large scale has not yet been reviewed. It is, therefore, necessary to conduct a study of this kind to assess the usefulness of the "new" delivery room register in capturing data related to newborn and its associated factors with delivery outcomes. Additionally, a study of this kind presents an opportunity to establish the current facility specific neonatal mortalities together with the associated factors that drive them.

1.4 Hypothesis/Conceptual framework

If the “new” delivery room register captures adequate and good quality data related to newborn, then the "new" delivery room register will be useful and can be used to estimate facility specific neonatal mortality and its associated clinical and non-clinical factors.

1.5 Research Questions

This study, therefore, seeks to answer the following specific question related to neonatal mortality in the Eastern Region of Ghana:

i. How effective and useful is the “new” delivery room register in predicting factors associated with neonatal (outcomes or deaths) at the facility level in Ghana?
ii. What is the quality of the data from the “new” delivery room register?
iii. How does the facility specific neonatal mortality of the different types of health facilities compare in the Eastern Region of Ghana?
iv. What are the factors associated with the facility-specific neonatal mortality rates in the Eastern Region of Ghana?

1.6 General Objective(s)

The overall goal is to assess the effectiveness and usefulness of the “new” delivery room register in identifying clinical and socioeconomic factors that contribute to neonatal outcomes in Ghana through the review of the GHS delivery room register.

1.7 Specific Objectives

The following specific objectives will guide the conduct of the research:

i. To assess the effectiveness and usefulness of the new delivery room register in predicting neonatal outcomes (or deaths) in Ghana
ii. To assess the data quality (completeness, consistency, accuracy, validity and reliability) of the "new" delivery room register being used in Ghana
iii. To estimate the facility specific neonatal mortality rate in the Eastern Region of Ghana using data from the delivery room register
iv. To identify factors associated with birth outcomes within the health facilities in the Eastern Region

1.8 Profile of Study Area

The Eastern Region occupies a land area of 19,323 square kilometers and constitutes 8.1 percent of the total land area of Ghana. It is the sixth largest region in terms of land area (MLGRD 2016). The population of the region stands at 3,028,597 with 1,486,714 male and 1,541,883 female (GSS 2016). The age structure and the sex composition of the region follow the national pattern. It shows a youthful structure that is characteristic of a developing country such as Ghana (GSS 2015).

The region has four main geographical features, namely (MLGRD 2016):

- The Kwahu scarp with an elevation of 2,586 feet above sea level.
- The Atiwa-Atwaredu Ranges near Kibi, reaching an elevation of 2,400 feet.
- The Akuapem highland attaining an elevation of 1,530 feet which is the southern extension of the Togo-Atakora mountain ranges and
- The isolated hills/mountains dotting the relatively low-lying plains to the south, notably the Krobo and the Yogaga mountains.

The region has a total of 372 health facilities made up of one regional hospital, 23 district hospitals, 3 polyclinics, 247 health centers/clinics, 91 CHPS compounds and 8 maternity homes (GHS 2003). The GHS as part of its implementation of MEBCI in the eastern region is covering 36 of all the facilities in the region. These 36 facilities are the high volume delivery facilities in the region and they are made up 24 district level hospitals, 10 big health centers, and 2 polyclinics. The revised delivery room register was rolled out in the eastern region in August 2016 in all the 36 MEBCI facilities. The 36 MEBCI facilities were used as the sampling frame for this study.

1.9 Scope of Study

Geographically, this study is restricted to health facilities managed by the government, quasi-government and faith-based organizations within Eastern Region of Ghana. The study focused on data related to newborn using the "new" delivery room register, clinical and non-clinical within the maternity sections of the sampled health facilities in the Eastern Region. It also includes interaction with midwifes who fill the "new" delivery room register after newborn services provision. An attempt was also made to include the health information officers within the sampled facilities and also at the regional health directorate.

1.10 Organization of Report

This report is made up of six (6) chapters. Chapter one contains the introduction, which dilates on the background to the study, statement of the problem, the objectives of the study, research questions, objectives of the study, profile of study area, scope of the study, limitations and the organization of the report.

Chapter Two reviews related literature on neonatal outcomes and its associated factors. Chapter Three explains the methodology employed in this study and the kind of analysis performed. Furthermore, Chapter Four presents the results from the analysis. Chapter Five is devoted discussion of the findings. Finally, chapter six presents the conclusions and recommendations of this study.

Chapter 2

2.0 Literature Review

Being newborn is not a disease, however, lots of children lose their lives in the first four weeks of life (neonatal deaths), most of which happens during the first week (early neonatal deaths). WHO estimates that 130 million infants are born each year worldwide. Of these newborns, 1.4 million die in the first four (4) weeks of life (World health organization 2006). Lawn JE and her colleagues corroborated this through their research in 2005 that, three-quarters of neonatal deaths occur in the first week, and more than one-quarter occur in the first 24 hours. Neonatal deaths account for 40% of deaths under the age of 5 years worldwide (Lawn et al. 2005). This contributed greatly to the inability of the global effort to achieve the UN Millennium Development Goal 4 of reducing childhood mortality by two-thirds by 2015. The sustainable development goal (SDG) 3 which deals with health, has the following target for neonatal mortality (target 3.2): "By 2030, end preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-five mortality to at least as low as 25 per 1000 live births" (Goals & Goals 2015).

Ghana has over the years implemented a number of initiatives to address the problem of the high child mortality, including the MDG Acceleration Framework (MAF) and Country Action Plan: Maternal Health, initiatives of the accelerated phase of WHO's Expanded Programme on Immunization (EPI) with introduction of new and additional vaccines, and projects supported by the Global Fund to Fight AIDS, Tuberculosis and Malaria(GHS 2014c). The reality, however, is that little focus is placed on neonates and

newborn health care and survival leading to little improvement in neonatal mortality rates over the years. Neonatal mortality has declined marginally by only 3 percent over the 15-year period preceding the 2014 GDHS survey (from 30 to 29 deaths per 1,000 live births). The 2014 GDHS estimated that as much as 2.9 million newborn deaths occur each year(GSS 2015). Aside newborn death being a human right issue, it constitutes a major bottleneck in Ghana's inability to meet the MDG4 and to improve child survival.

Currently, the Children's Investment Fund is sponsoring a collaborative effort between Program for Appropriate Technology in Health (PATH) and Ghana Health Services (GHS) to implement an initiative dubbed making every baby count initiative (MEBCI) in Brong Ahafo, Eastern, Ashanti and Volta Regions of Ghana. These four regions bear the highest brunt of the neonatal mortality rates in Ghana (GHS 2014a). The main goal of the intervention is to ensure that 90% of all babies born receive essential newborn care by 2018 with the ultimate target of reducing facility specific neonatal mortality in Ghana by 15% by 2018 (CIFF 2014). Previous studies have shown that, newborn deaths occur as a result of severe malformation of the fetus, prematurity (preterm birth), obstetric complications before or during birth, difficulty adapting to extra-uterine life, or because of harmful practices after birth that lead to infections (World health organization 2006). The primary causes of newborn deaths in Ghana are infections (32%), asphyxia (23%), and prematurity and low birth weight (27%) (GSS 2015).

Preterm Births: Preterm birth also known as premature birth is defined as babies born alive before 37 weeks of pregnancy are completed (WHO, 2015). There are sub-categories of preterm birth, based on gestational age: extremely preterm (<28 weeks) very preterm (28 to <32 weeks) (WHO 2015). More than a third of newborn deaths are

the result of complications associated with preterm (premature) births (CP & Howson, MV Kinney 2012). Some of these can be addressed before birth through family planning, screening for infections, nutrition supplements and other services as well as the use of antenatal steroids. After birth, premature baby needs immediate care and support to survive. Health workers present when the baby is born can help the mother establish exclusive breastfeeding, and can support her to keep the baby warm through skin-to-skin contact. A brilliantly effective technique for this, especially for preterm babies, is known as kangaroo mother care (WHO 2003).

Low birth weight (LBW): Low birth weight (LBW) is defined as a birth weight of a baby less than 2,500 g (5 pounds 8 ounces) regardless of gestational age. Over 60% of neonatal deaths are associated with low birth weight (Katz et al. 2013).

Birth Complications: Nearly a quarter of newborn deaths are the result of complications at labor and delivery – technically called intrapartum-related deaths or birth asphyxia. The most important way to reduce these deaths is through improved care during labor, including caesarean section if needed. If babies are born and do not breathe, then health workers need to resuscitate immediately. As many as 10% of newborn babies require some type of assistance to begin breathing, meaning that the health worker must be knowledgeable, skilled and prepared to recognize that the baby is not breathing, and immediately begin the steps of neonatal resuscitation. Lack of oxygen can also result in long-term disabilities. Skilled health workers can act quickly to stimulate breathing or air to the lungs, including the use of a bag and mask. Lack of oxygenated blood flow to the

brain – from failure to breathe at birth – can also result in long-term disabilities (CP & Howson, MV Kinney 2012).

Infection: A third of newborn deaths are due to infections acquired by the baby during labor and delivery or after birth (GHS 2014a). Preventive measures such as maternal tetanus immunization, screening and treatment for syphilis can reduce the risk. Clean birth practice, hygienic care for the umbilical cord and exclusive breastfeeding reduce the risk of infections; health workers play a crucial role in ensuring these practices are followed. Early identification of severe infections and prompt and complete treatment with antibiotics dramatically increase the chance of survival (Simon Wright, Kirsten Mathieson, Lara Brearley & Jacobs 2014).

Still Births: During pregnancy, preventing or treating malaria, syphilis and other conditions is important to prevent stillbirths. Skilled care at birth can reduce the number of stillbirths, and comprehensive emergency obstetric care, including caesarean if needed, reduces stillbirths by 75% (Yakoob et al. 2011)

Health System Challenge: The demands to prevent the death of newborns and babies (<28 days old), as well as stillbirths, puts on the health system are quite different from those involved in delivering life-saving child health interventions, such as immunization, bed net distributions or family planning. Ensuring the attendance of a skilled and equipped health worker during and after a birth is evidently not an intervention that can be scheduled for a convenient time: midwives and other skilled birth attendants must be

available 24-hours-a-day, seven-days-a-week. To ensure good-quality healthcare at birth, a health system needs competent healthcare providers backed by supportive supervision, monitoring and data analysis for quality improvement.

Furthermore, understanding the number and causes of death is key to tackling the burden of 2.8 million neonatal deaths (Lawn et al. 2005) and 2.6 million stillbirths (Cousens et al. 2009) each year. Yet many resource-poor settings lack effective Civil Registration and Vital Statistics (CRVS) systems for births, deaths and causes of death. Each year, half of the world's babies do not receive a birth certificate; most neonatal deaths and almost all stillbirths have no death certificate, let alone information on causes and contextual factors contributing to these deaths (Lawn et al. 2005) Many countries have limited capacity for capturing neonatal deaths beyond the health facility level, especially those whose births are not registered, and very few countries have a system for tracking stillbirths at all despite increasing demand for data. Ghana like many other developing countries is not exceptional. Ghana Health Service through its bottleneck analysis identified documentation of records for newborn as inadequate. The delivery registers use to document neonatal outcomes does not yield adequate information on factors influencing neonatal and newborn outcomes (GHS 2014b).

Sociocultural factors associated with neonatal mortality: some of the indirect factors reported to be associated with neonatal deaths include sex of the baby, poverty, educational level, maternal age, maternal size, and parity. Girls have a well-described biological survival advantage in the neonatal period (Ulizzi L1 2002). Health care coverage is documented to be associated with neonatal outcomes (Lawn JE , Blencowe H, Pattinson R, Cousens S 2011). From a study in Ugandan, only 21% (15 of 71) of

severely ill babies completed referral as advised. The most common reason for not completing referral (90%) was lack of money (Peterson et al. 2004).

It can thus be concluded that factors that influence neonatal outcomes are well documented and can be said to be a combination of both clinical and non-clinical. Proper documentation of delivery processes is a critical step in understanding and predicting causes and factors that influence neonatal outcomes. In Ghana inadequate documentation of delivery is a key challenge that GHS is taking steps to address and has radically revised the primary data collection tool for delivery (delivery room register). It is however not yet known to what extent the revised tool is able to predict factors that are associated with neonatal outcomes.

Chapter 3

3.0 Methodology

3.1 Research Methods and Design (Study methods and design)

A cross-sectional study was used to gather data on the demography of mothers and their babies, births outcomes, associated clinical and socio-economic factors. Data was extracted from the revised delivery room register covering the period of September 1st to December 31st, 2016.

3.2 Data Collection Techniques and Tools

Two data collection tools were used for this study. 1) data extraction tool to extract data from the delivery room register and 2) routine data quality assessment (RDQA) tool – adapted from MEASURE Evaluation (Evaluation 2010). The data extraction tool was used to extract data from the "new" delivery room register whilst the data quality assessment and usefulness questionnaire was administered to 1 provider in each of the sampled facilities.

3.3 Study Population

Primarily this study does not include direct engagement with the main study population (mothers and their newborn babies). It rather involves extraction of their data from the new delivery room register. The only population interacted with for this study comprised health workers (midwifes, health information officers and medical superintendents) from the sampled health facilities.

3.4 Study Variables

This study focused on fifteen (15) variables related to newborns and their mothers. Only one dependent variable was studied with the remaining 14 variables being independent. Nine (9) of the variables are for the mother whilst the remaining 6 are for the baby. Table 1 below shows the list of variables included in this study.

Table 1: List of Variables Studied

Variables	Type of variable
Variables related to the mother	
Maternal Age	Independent
Maternal Educational Level	Independent
Parity	Independent
Hemoglobin level of mothers	Independent
ANC Visits	Independent
Cervical Dilation	Independent
Temperature	Independent
Pulse	Independent
Blood Group of mothers	Independent
Variables related to the baby	
Gestational Age at birth	Independent
Baby's Weight	Independent
Baby's Length	Independent
Baby's Head Circumference	Independent
Baby's Sex	Independent
Birth Outcome (Dead/Alive)	Dependent

3.5 Sampling

This research was carried out in the Eastern Region of Ghana. The 37 MEBCI facilities (1 Regional Hospital, 24 District Hospitals, 10 Health Centers and 2 Polyclinics) served as the sampling frame for this study. Multiple sampling techniques were used to sample three facilities for this study. The Koforidua Regional Hospital was selected purposively since it is the only regional and referral facility in the region. The remaining 36 facilities were grouped into two strata (strata 1 = district hospitals and strata 2 = health centers and

polyclinics). The sample to size approach was used to select a representative sample from each strata using simple random technique using Microsoft Excel 2013. All the facilities eligible for sampling were assigned a unique sequential number and keyed into MS Excel 2013. The "RAND" function was then executed once to sample the facilities.

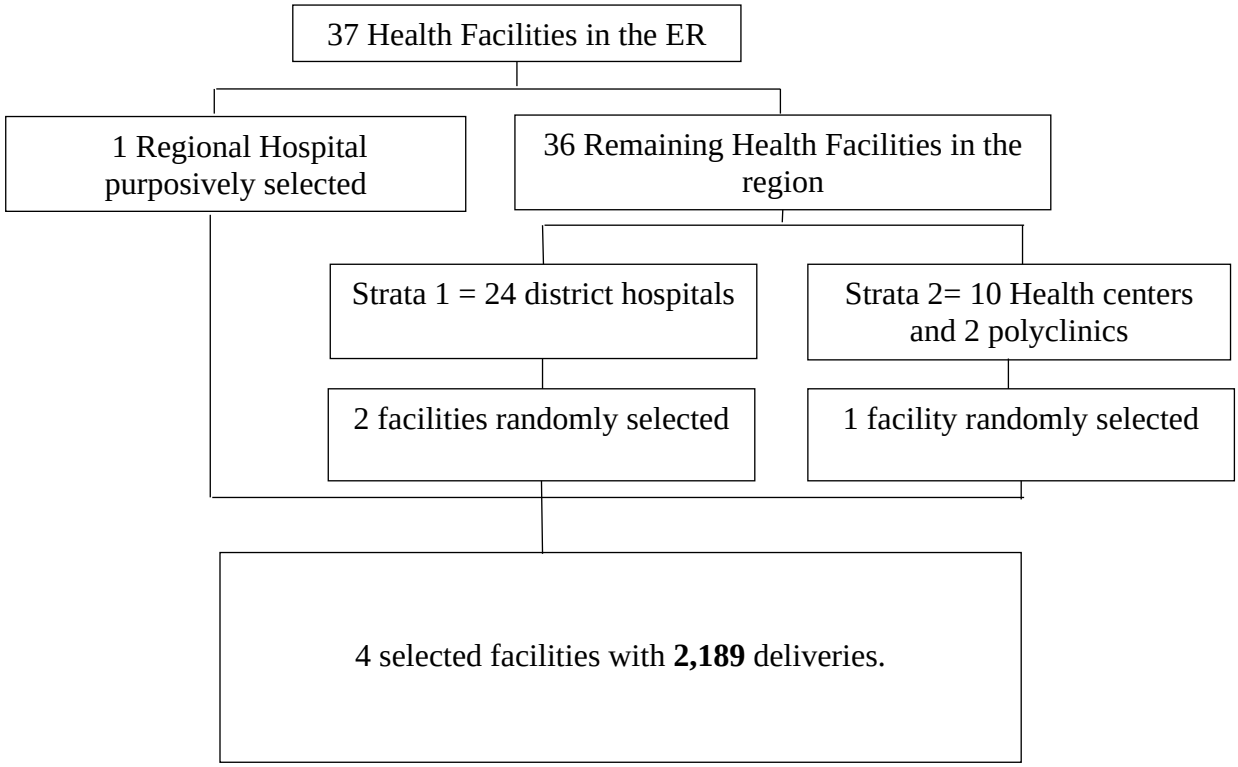

Fig 1: Sampling schematic diagram

Table 2: Summary results of sampling process

Category	Number	Sample Size	Approach	Selected	Ownership	# of deliveries
Regional Hospital	1	1	Purposive	Koforidua Regional Hospital	GHS	1,140
Hospitals	24	2	Simple Random	St. Dominic's Hospital, Akwatia	FBO	754
				Asesewa Gov't Hospital	GHS	265
Health Centers	10	1	Simple Random	Asuboi H/C	GHS	30
Polyclinic	2					

3.6 Pre-testing of data collection tools

A day's pre-testing exercise to assess and validate the effectiveness of the tools was done in Atua Government Hospital (a non-sampled facility) in the eastern region. The pre-testing provided at first-hand the key strengths and weaknesses of the tool. These were noted and the required corrections were made.

3.7 Data Collection and Handling

Data from the "new" delivery room registers covering the period of September 1st to December 31st, 2016 from the sampled facilities was retrieved. All deliveries (2,189) that occurred within the four-month period were extracted for data entry. Clinical and socioeconomic data related to those deliveries were extracted and used to establish the factors associated with neonatal outcome. The retrieved registers were examined for completeness, consistency, accuracy and validity using the RDQA tool.

The facility manager and one staff (midwife from the delivery room) from each of the sampled facilities were interviewed during the examination of completeness, consistency, accuracy and validity of the data in the delivery room register. The interview with the facility managers and staff provided responses to questions of the MEASURE Evaluation

RDQA tool. In all four (4) facility managers and four (4) midwifes were involved in this study.

Data quality checks were conducted at various stages in the field. The researcher checked each record at the end of each data collection day for completeness and for the data quality. Problems identified were resolved as much as possible on the field before data entry. Data entry was done in Microsoft access. Individual identifiers like names and address were left out. Double data entry process was employed after which the raw data was then organized, bearing in mind the research questions for which the tool was designed. Data cleaning, range and consistency checks were done before being transferred into Stata 14.0 software for the analyses.

Two Research Assistants (RA) with requisite experience in health systems were recruited and trained to assist with the data extraction and data entry.

3.8 Data Analysis

Data for all of the 2,189 deliveries was extracted and included in this analysis. Univariate analysis was performed as means of summarizing the data using means, standard deviation and proportions. A student t-test was performed on means for identified groups. Bivariate analysis was conducted to test for association using Chi-square test whilst multivariate analysis and logistic regression analysis was employed to measure the variability of the identified factors in predicting neonatal outcomes. The odds ratio was used to express the likelihood of birth outcome for all the identified factors including.

3.9 Ethical Consideration

Ethical clearance was sought from the ENSIGN College of Public Health Institutional Ethical Review Board and Ghana Health Service Ethics Review Committee. Permission was obtained from the regional health directorate and from each of the sampled facility leadership. Only the facility manager and one staff (midwife) from each of the sampled facilities were directly involved in this study. Informed consent (Appendix 1) were sought from the managers of each of the facilities and each of the respondent staff (midwife) to the RDQA tool, and their right to withdraw from the study at the start, during or after was assured. The managers were also assured of their right in acting on behalf of the sampled facility to stop the data extraction or decline participation at any time. The other aspect of the data collection involves extraction of data from the delivery room register, efforts were made to protect the anonymity of patients of the sampled facilities and the facility itself. All individual level identifiers were left out to ensure anonymity of individuals whose data was extracted from the registers within the sampled facilities as well as that of staff who responded to the RDQA tool. No names were recorded during the data extraction for this study. Each data extracted was assigned a unique identifier for identity protection and confidentiality. Names of the facilities were also not used in analysis, rather, facility classification was used. Data from this research was for the purpose of the thesis work. The PI ensured strict adherence to this protocol during the conduct of this study. Data extracted and information gathered during this study was password protected and restricted to only the PI and the Supervisor. External access was only to be granted with express permission from GHS, Supervisor and PI.

Consent to participation was established through signature after all the study procedures, benefits, potential risks, compensation and the right to volunteer to participate or otherwise were fully explained to the respondents. Adequate contact information for further clarification was made available to each participant of the sampled facilities.

No known conflict of interest situation established during the design and conduct of this study. However, should any potential conflict of interest arise after the conduct of the study, necessary steps will be taken with guidance from the Supervisor to address its effect.

3.10 Limitations of Study

The period for neonatal mortality starts from 28weeks of gestation to the first 28days of life. The new delivery room register only captures pre-discharge data which in most cases covers only about 48hrs after delivery. Given the fact that this is a cross-sectional study, the available data from the new delivery room does not cover the entire neonatal mortality period. Based on this observation and for the purposes of this study, calculations for the neonatal mortality only covers the period of 28 weeks of gestation till the discharge of the baby from the hospital.

Chapter 4

4.0 Results

4.1 Background Information

Between September 1st, 2016 and December 31st, 2016, a total of 2,189 deliveries occurred in the 4 health facilities selected for this study. As much as 52% (1,140) of the deliveries occurred in the Koforidua Regional hospital with an average of 400 deliveries each month. The two district level hospitals sampled, one faith-based and the other public, together yielded 46.5% (1,019) of the deliveries whilst only 1.4% (30) of the deliveries occurred at the health center. Table 3 below gives a summary of the demographic characteristics of the mothers delivering at the selected facilities during the period covered by the study.

Table 3: Demographic Characteristics of Mothers Prior to Delivery

Demographics Characteristics of mothers prior to delivery within the sampled facilities for 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Type of Health Facilities					
Characteristics	**HC**	**DH-GHS**	**DH-FB**	**RH**	**Total**	**%**
Maternal Age (n=2,167)						
<20	8	60	75	110	253	12%
20-35	21	169	581	868	1,639	76%
>35	1	36	92	146	275	13%
Sub total	**30**	**265**	**748**	**1124**	**2167**	**100%**
Maternal Educational Level (n=1,992)						
No Edu	2	45	20	50	117	5.9%
Primary	8	73	54	103	238	11.9%
JHS	19	84	386	500	989	49.6%
SHS	1	13	113	177	304	15.3%
Tertiary	0	16	103	225	344	17.3%
Total	**30**	**231**	**676**	**1,055**	**1,992**	**100.0%**

Maternal Age: The mean age of all the expectant mothers was 27.9 years with a minimum age of 11 years and a maximum of 54 years. Majority of the expectant mothers 75.6% (1639/2163) fell within the age bracket of 20 to 35 years.

Maternal Educational Level: Out of the 2,198 expectant mothers, data related to the educational level of expectant mothers was available for 1,992 mothers (91%). About 6% (117/1,992) had no formal education whilst majority (61%) of the mothers had only primary or JHS education. Only 17.3% (344/1992) had tertiary education. These were mostly teachers, nurses and those who attended vocational tertiary schools.

Table 4: Clinical Characteristics of Mothers Prior to Delivery

Demographics and Clinical Characteristics of mothers prior to delivery within the sampled facilities for 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Type of Health Facilities					
Characteristics	**HC**	**DH-GHS**	**DH-FB**	**RH**	**Total**	**%**
Parity (n=2,185)						
Nullipara	6	86	216	366	674	30.8%
Primipara	10	61	197	332	600	27.5%
Multipara	6	33	166	218	423	19.4%
Grand Multipara	8	85	173	222	488	22.3%
Total	**30**	**265**	**752**	**1138**	**2185**	**100.0%**
Previously Lost a baby? (n=2,130)						
No	28	225	511	709	1,473	69.2%
Yes	2	37	214	404	657	31%
Total	**30**	**262**	**725**	**1,113**	**2,130**	100%
Hemoglobin level of mothers (n=2,161)						
<8g/dl	5	75	103	209	392	18%
8-11g/dl	16	89	351	483	939	43%
>11g/dl	9	97	298	426	830	38%
Total	**30**	**261**	**752**	**1,118**	**2,161**	**100%**
ANC Visits (n=2,168)						
None	6	36	126	151	319	15%
1-4	15	90	251	270	626	29%
>4	9	139	374	701	1,223	56%
Total	**30**	**265**	**751**	**1,122**	**2,168**	**100%**
Blood Group of mothers (n=1,843)						

Demographics and Clinical Characteristics of mothers prior to delivery within the sampled facilities for 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Type of Health Facilities					
Characteristics	**HC**	**DH-GHS**	**DH-FB**	**RH**	**Total**	**%**
O+	17	96	293	485	891	48%
O-	0	3	15	32	50	3%
A+	1	52	122	183	358	19%
A-	0	1	4	17	22	1%
AB+	1	5	24	35	65	4%
AB-	0	0	1	4	5	0%
B+	10	64	132	210	416	23%
B-	0	2	18	16	36	2%
Sub Total	**29**	**223**	**609**	**982**	**1,843**	**100%**
Gestational Age at birth (n=1984)						
<37	15	36	100	170	321	16%
>=37	13	189	602	859	1,663	84%
Sub Total	**28**	**225**	**702**	**1,029**	**1,984**	**100%**

Table 4 above gives a summary of the some of the clinical characteristics of the mothers delivering at the selected facilities during the period covered by the study. The findings related to these factors are elaborated below.

Gestation History: Data associated with gravida and parity were also extracted from 2,148 and 2,185 respectively out of 2,198 expectant mothers. The average gravida was 2.98 (range of 1 to 15). About a third of the expectant mothers were nullipara (never carried a pregnancy beyond 20 weeks), meaning they are either in their first pregnancy or their previous pregnancies never traveled beyond 20 weeks. About a fifth of the mothers were found to have carried three or more pregnancies beyond 20 weeks of gestation (grand multipara). About 31% of the mothers have ever lost a baby prior to their current pregnancy.

Anemia: About 18% (392) of the expectant mothers were found to be anemic (Hb<8g/dl) with considerable variations across the facility types (min 14% and max 29%). It is interesting to note that, the minimum level of anemia among expectant mothers is recorded with faith-based district level hospital whilst the maximum is recorded within the public district level hospital. Interestingly the faith-based district level hospital also recorded the highest percentage of mothers whose Hb was more than 11g/dl.

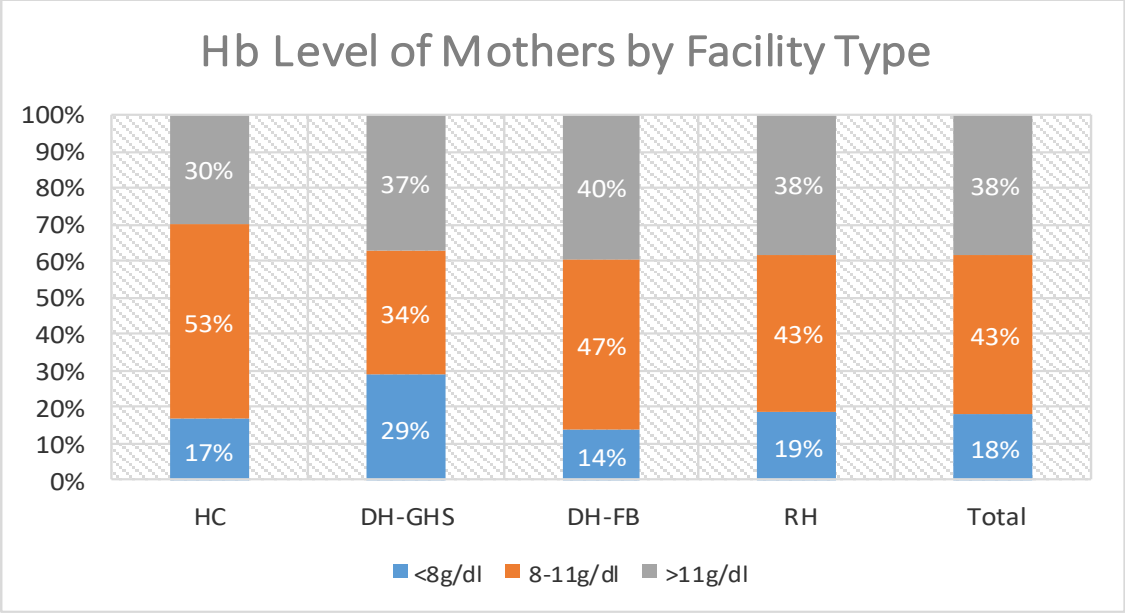

Fig 2: Percentage of Hb level of mothers by facility types

ANC Visits: About 15% of the expectant mothers never visited the health facility for antenatal care prior to delivery whilst close to a third of them had ANC attendance of 1 to 4 visits. ANC attendance of more than 4 visits prior to delivery is higher (62%) among mothers who attend the regional hospital and much lower (30%) among mothers who attend the health center.

Blood Group: As expected, the dominant blood group among the pregnant mothers is O+ with 48% followed by B+ and A+ in that order with 23% and 19% respectively. It is instructive to note that, contrary to the expectation that, A+ should be more than B+, the reverse is the case among the pregnant women in this study. The blood groups AB- and A- are the rarest among the pregnant mothers.

4.2 Variables contained in the new delivery room register associated with neonatal outcomes (or deaths)

A review of the new delivery room register showed a detailed and complex register. It has as much as 86 variables used to document details of both mother and baby. It covers data from the admission of the expectant mother in the maternity ward through delivery and ends at the discharge of mother and baby from the hospital. These variables for purposes of this study are classified as Administrative, non-clinical and clinical. Table 5 below shows a summary of the variables found as well as those included in this study. The majority of the variables (83%) were clinical in nature. Twenty-five (25) out of the 86 variables from the "new" delivery room register were purposively selected for this aspect of the study.

Table 5: Summary of variables in the "new" delivery room register

Variables Classification	variables in the new Register	%	Study Variables
Administrative	6	7%	**2**
Non-Clinical	9	10%	**4**
Clinical	71	83%	**19**
Total	86	100%	**25**

4.3 Data quality (accuracy, completeness, consistency, validity and reliability) of the "new" delivery room register being used in Ghana

Figure 2 below shows results of data quality audit of data contained in the "new" delivery room register using the MEASURE Evaluation data quality audit tool. Two facilities had 81-90 percent accuracy whilst the other two had 91-100 percent accuracy. The assessment also revealed the need for improvement in all the 5 dimensions of data management as shown in the spider diagram below. These areas of improvement impact negatively on the completeness and accuracy of the data if measures are not put in place to improve it.

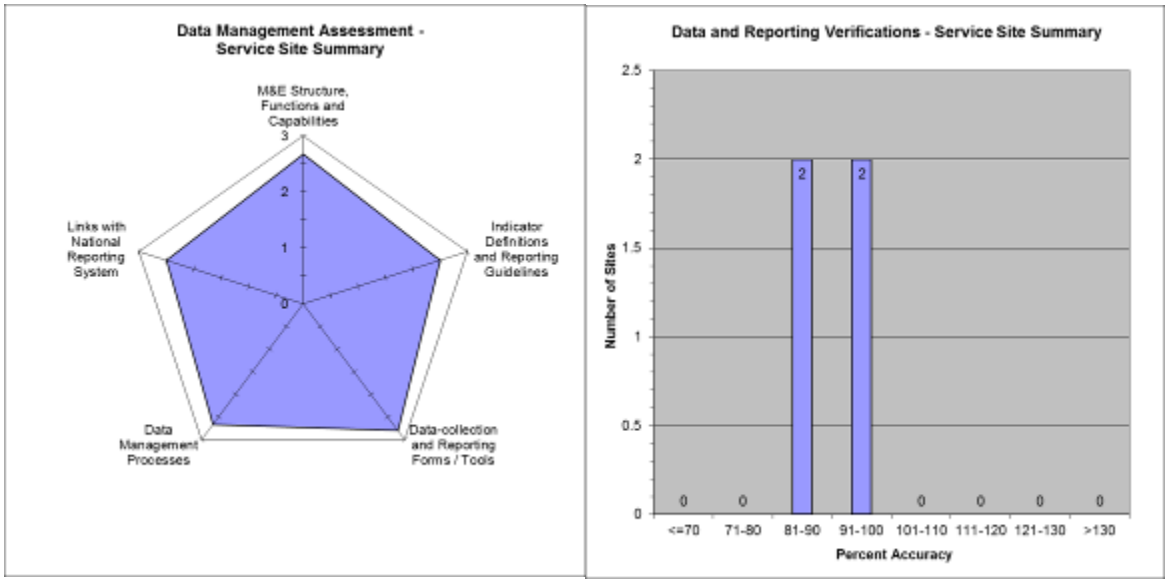

Fig 3: Data quality assessment results (accuracy)

Review of the registers shows that the first two pages of the "new" delivery room register is dedicated to definitions and guidelines in filling the register. The definitions and guidelines show two limitations. First, the guide does not capture how to use the register to document twin gestation Secondly the guide does not explicitly explain how to record data in the variables that are not structured in nature.

The national reporting system for all health service statistics is the DHIMS II and the link between the "new" delivery room register and DHIMS II is the "Form A". Review of the current state of "form A" shows two key observations. Firstly, the form A captures the

summary of service statistics from the delivery room register and therefore lends itself to errors related to tallying and transposition. The second observation is that the form A is yet to be updated to capture the new variables introduced in the "new" delivery room register.

Table 6 below shows the summary of data completes measured as part of this study. Fifteen basic yet very important variables were examined for their level of completeness in the new delivery room register. The overall completion was 95% with considerable variations across board. Data from the health center was more complete (99%) compared to the other categories. Data from the regional hospital and the public district hospital were the least complete (94%). Data associated with the pulse of the expectant mother was found to be the least completed (88%) followed by educational level and gestational age with 91% each.

Table 6: Summary of data completeness for 15 selected variables in the "new" delivery room register

Data Completeness for seven basic but very important variables							
	Totals			Types of Health Facilities			
Variables	**N**	**n**	**Total %**	**HC**	**DH-GHS**	**DH-FB**	**RH**
Maternal Age	2189	2,167	**99%**	100%	100%	99%	99%
Maternal Educational Level	2189	1,992	**91%**	100%	87%	90%	93%
Parity	2189	2,185	**100%**	100%	100%	100%	100%
Hemoglobin level of mothers	2189	2,161	**99%**	100%	98%	100%	98%
ANC Visits	2189	2,168	**99%**	100%	100%	100%	98%
Blood Group of mothers	2189	1,843	**84%**	97%	84%	81%	86%
Gestational Age at birth	2189	1984	**91%**	93%	85%	93%	90%
Baby's Weight	2189	2111	**96%**	100%	97%	98%	95%
Baby's Length	2189	2067	**94%**	100%	88%	96%	95%
Baby's Head Circumference	2189	2162	**99%**	100%	98%	99%	99%
Cervical Dilation	2189	2137	**98%**	100%	99%	100%	96%
Temperature	2189	2042	**93%**	100%	92%	97%	91%
Pulse	2189	1934	**88%**	97%	91%	96%	82%
Baby's Sex	2189	2146	**98%**	100%	99%	99%	97%
Birth Outcome	2189	2149	**98%**	100%	98%	99%	97%
Average	**2189**	**2073**	**95%**	**99%**	**94%**	**96%**	**94%**

Data inconsistency was quite conspicuous during the review of the data. Whereas some providers will write a number for a variable like gestational age (e.g. 36, 40 etc.) others will describe it with text (e.g. full term, twin gestation etc.). Such inconsistency in filling the register was widespread (>50%) of the variables examined. It was, however, possible to validate and properly classify about 95% of all the data from the variables selected. Those that could not be properly classified were treated as missing data. Data from two variables on the register (lie/presentation and occupation) were considered unreliable and invalid. The entire dataset associated with these two variables were therefore excluded from this analysis.

4.4 Facility specific neonatal mortality rate and its association with both non-clinical and clinical factors

The neonatal mortality rates (NMR) were as follows: overall facility specific NMR was 34.79 per 1000 births (95% CI: 34.75, 34.82). NMR for health center level facility was 0 per 1000. That of district level hospitals were 20.03 per 1000 births (95% CI: 19.99, 20.05) for faith-based hospital and 30.53 per 1000 births (95% CI: 30.50, 30.56) for public district level hospital. As was expected, the regional hospital being the referral health facility, has the highest NMR rate of 46.64 per 1000 live births. The rates for fresh stillbirth (FSB), birth asphyxia and macerated stillbirth (MSB) were 12.99 per 1000 births, 1.39 per 1000 births and 15.31 per 1000 births respectively.

Out of the five non-clinical factors examined (Table 7 below), the neonatal death rate is strongly association ($p<0.01$) with gestational age and birth weight. Of the 75 deaths recorded, 64 (85%) had gestational of the pregnancy recorded out of which 34 (56%) had

their gestational age less than 37 weeks. This translates to NMR of 114.29 per 1000 births (95%CI: 114.05, 114.51) from pregnancies with gestational age less than 37 weeks.

Similarly, 67 (89%) out of the 75 deaths had the weight of the babies recorded. About half (34) of them were underweight (<2500 grams). The NMR among this subgroup was alarmingly 99.71 (95%CI: 99.61, 99.80) per 1000 births of babies weighing less than 2500 grams. The association between the weight and NMR was strong.

Contrary to what other studies suggest, this study found no association (p=0.586) between neonatal mortality and gender of the baby likewise educational level of the mother. Table 6 below shows details of the neonatal mortality and its associated factors.

Table 7: Facility-specific neonatal mortality rates and its associated factors

Neonatal Mortality Rate and its association with Non-Clinical factors from 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Outcomes of Birth							
Variables	**Pre-disch. Deaths**	**FSB**	**B. Asp.**	**MSB**	**Alive babies**	**Total**	**NMR**	**95% CI**
Health Facility Category (n=2,1,44)								
HC	0	0	0	0	30	30	0.00	-
DH-GHS	8	0	1	3	254	262	30.53	30.50, 30.56
DH-FB	15	7	0	5	734	749	20.03	19.99, 20.05
RH	52	21	2	25	1,063	1,115	46.64	46.60, 46.66
Total	**75**	**28**	**3**	**33**	**2,081**	**2,156**	34.79	**34.75, 34.82**
Gestational Age (n=1,961, p<0.001)								
<37	36	13	1	19	279	315	114.29	114.05, 114.51
>=37	28	12	2	10	1,618	1,646	17.01	16.78, 17.24
Total	**64**	**25**	**3**	**29**	**1,897**	**1,961**	**-**	**-**
Birth Weight (n=2,091, p<0.001)								
<2500g	34	8	0	13	307	341	99.71	99.61, 99.80
>=2500g	33	17	1	19	1,717	1,750	18.86	18.76, 18.95
Total	**67**	**25**	**1**	**32**	**2,024**	**2,091**	**-**	**-**
Gender of baby (n=2,118, p=0.586)								
Ambiguous	0	0	0	0	3	3	0.00	-0.06, 0.05

Neonatal Mortality Rate and its association with Non-Clinical factors from 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Outcomes of Birth							
Variables	**Pre-disch. Deaths**	**FSB**	**B. Asp.**	**MSB**	**Alive babies**	**Total**	**NMR**	**95% CI**
genitalia								
Female	36	16	1	16	992	1,028	35.02	34.96, 35.10
Male	33	9	2	16	1,063	1,096	30.11	30.05, 30.20
Total	**69**	**25**	**3**	**32**	**2,058**	**2,127**	**-**	**-**
Educational level of mother (n=1,958, p=0.338)								
No Edu	6	2	0	2	109	115	52.17	51.95, 52.40
Primary	7	2	0	3	230	237	29.54	29.31, 29.54
JHS	32	11	1	16	945	977	32.75	32.53, 33.00
SHS	6	4	0	0	297	303	19.80	19.58, 20.02
Tertiary	9	2	0	6	328	337	26.71	26.48, 27.00
Total	**60**	**21**	**1**	**27**	**1,909**	**1,969**	**-**	**-**

Table 8 below, examines the NMR and its association with four (4) selected clinical factors. These include the state of the perineum, parity, single or twin delivery, the blood group of the mother. NMR was found to be associated with only the perineum variable. Fifty-five (55) out of the 75 deaths recorded had data on the state of the perineum. About 87% (48/55) of the deaths had the perineum intact and this translates to NMR of 40.71 (95%CI: 40.30, 41.12) per 1000 births among mothers with their perineum intact. The study did not also find an association between NMR and several other clinical variables including Hepatitis B, Syphilis, HIV, previous loss of a baby, hemoglobin level among others.

Table 8: Facility Specific NMR and its association with clinical factors

Neonatal Mortality Rate and its association with Clinical factors from 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Outcomes of Birth							
Variables	**Pre-disch. Deaths**	**FSB**	**B. Asp.**	**MSB**	**Alive babies**	**Total**	**NMR**	**95% CI**
Perineum at the time of admission(n=1,815, p=0.001)								
CS*	1	0	0	1	21	22	45.45	45.05, 45.86
Episiotomy	0	0	0	0	145	145	0.00	-0.40, 0.40

Neonatal Mortality Rate and its association with Clinical factors from 2,189 total deliveries extracted between September 1st, 2016 and December 31st, 2016.

	Outcomes of Birth							
Variables	**Pre-disch. Deaths**	**FSB**	**B. Asp.**	**MSB**	**Alive babies**	**Total**	**NMR**	**95% CI**
Intact	48	14	2	26	1,131	1,179	40.71	40.30, 41.12
Tear	6	3	0	2	463	469	12.79	12.38, 13.20
Total	**55**	**17**	**2**	**29**	**1,760**	**1,815**	**-**	**-**
Parity (n=2,153, p=0.157)								
Nullipara	17	5	1	11	645	662	25.68	25.64, 25.71
Primipara	18	7	1	6	574	592	30.41	30.37, 30.44
Multipara	16	7	0	6	399	415	38.55	38.52, 38.59
Grand Multipara	24	9	1	10	460	484	49.59	49.59, 49.62
Total	**75**	**28**	**3**	**33**	**2,078**	**2,153**	**-**	**-**
Single or Twin (n=1,979, p=0.226)								
Single	49	21	2	21	1,810	1,859	26.36	26.15, 26.60
Multiple	5	0	0	4	115	120	41.67	41.45, 41.87
Total	**54**	**21**	**2**	**25**	**1,925**	**1,979**	**-**	**-**
Blood group of mother (n=1,819, p=0.081)								
O+	23	8	1	9	858	881	26.11	25.71, 26.51
B+	11	5	0	5	394	405	27.16	26.76, 27.56
A+	14	8	1	3	342	356	39.33	38.92, 39.72
AB+	1	0	0	1	63	64	15.63	15.23, 16.02
O-	3	3	0	0	47	50	60.00	59.60, 60.40
B-	2	0	0	1	34	36	55.56	55.15, 55.95
A-	2	1	0	1	20	22	90.91	90.51, 91.31
AB-	1	1	0	0	4	5	200.00	199.60, 200.40
Total	**57**	**26**	**2**	**20**	**1,762**	**1,819**	**-**	**-**

* Although CS is not an option under perineum, we found health workers writing CS under the perineum variable for pregnancies that went through a cesarean session.

4.5 Factors associated with birth outcomes (dead/alive)

For purposes of this study, a birth outcome is limited to the baby being dead or alive after delivery. Table 9 below shows the odds ratios associated with each of the factors examined using newborn survival as the outcome variable from a logistic regression model. The result explains about 15% of the variability in the neonatal outcomes (Appendix A shows details of the logistic regression model). A goodness of fit test on the model yielded a significant result with p-value >0.05 (p=0.9628). The model predicted for 8 factors influencing the outcome of the birth. Four (4) out of the 8 factors were

statistically significant. They include the gestational age, birth weight, baby's sex and age of the mother.

Gestational age of the pregnancy is found to be the lead factor that can influence the outcome of pregnancy. Pregnancies with a gestation less than 37 weeks (preterm) are 9.9 times more likely to result in a negative (death) outcomes compared to those 37 weeks or more. The weight of the baby is also a strong factor that influences the survival of the baby. The odds of a baby weighing less than 2500 grams resulting in a negative birth outcome (death) is 3.2 times that of a baby who weighs 2500 grams or more.

Although blood group as a whole did not show any influence, its differential as shown in the table below shows a staggering effect in predicting the outcome of delivery using O+ as a reference point. A pregnant woman with blood group AB- is 10.2 times more likely of having a negative (dead) outcome compared to that of O+. The odds the baby dying from a mother with A- and O- are 3.48 and 3.4 respectively compared to O+ mother. B- on the other hand, showed a protective result compared to O+. Pregnant women with blood group B- are 74% less likely to result in negative outcome compared to O+.

Results of the logistic regression model of this study suggest that pregnancy of a baby girl is also protective against negative outcome compared to that of a baby boy. Pregnancy of female babies was 32.3% less likely to result in a negative outcome compared to males.

The next influencing factor the model suggests is the age of the mother. A teenage pregnant woman (age less than 20 years) is 2.8 times more likely to result in a neonatal death compared to an older woman.

The next influencing factor is the parity of the mother. Although it is not a significant factor, the model suggests that a pregnant woman who has had one or more births before the index child is 1.15 times more likely to result in a neonatal death compared to the one who has never been pregnant or never carried a pregnancy beyond 20 weeks before.

Finally, this study used the PMTCT as a proxy measure for the HIV status of the mother and hence its inclusion in the model. Although the PMTCT variable yielded no significant results, it, however, shows that a pregnant woman who is HIV positive is 1.03 times more likely to result in a negative outcome compared to those who are not.

Table 9: Predicting neonatal outcome using logistic regression

Birth outcome factor	OR	p-value
Gestation (<37wks, ref. >37wks)	9.879825	0.000
Low Birth Weight <2500g, ref. >=2500g)	3.194665	0.005
Blood Groups (ref. O+)		
O-	3.41921	0.126
A+	2.000644	0.11
A-	3.483318	0.256
AB+	1	0.000
AB-	10.24881	0.058
B+	1.008502	0.986
B-	0.7424805	0.797
Baby Sex (Female, ref. male)	0.3232673	0.01
Parity (1+, ref. para 0)	1.1514	0.423
Age of mother (<20yrs, ref. 20+yrs)	2.809529	0.008
Mother on PMTCT*	1.033169	0.936

* Mother on PMTCT, in this case, is used as proxy for the mothers HIV status

Chapter 5

5.0 Discussion

Usefulness of the "new" delivery room register: the "new" delivery room register is comprehensive and complex in nature. The 86 variables register captures the details of both mother and baby from admission stage in the maternity ward through delivery and ends at the discharge of mother and baby from the hospital. At the moment it contains a considerable amount of gaps in filling it. These gaps can be attributed to inadequate variable definition and guide as well as inadequate orientation for staff who fill the register. Two of the data management dimensions that require improvements are: 1) the indicator definitions and reporting guidelines and 2) its links to the national reporting system. Workload and time constraints appear to be other reasons why there exist gaps in the current register. Such gaps if not checked, has the potential of affecting the validity of the data from the register.

Definition and reporting guidelines of the "new" delivery room register do not clearly explain how to use the register to capture twin gestation. As a result, health workers use their own judgment when confronted with twin gestations. In most cases, they squeeze the available space to capture the twin outcome. Figure 3 below shows evidence of such practice. Furthermore, because the guide does not address how to record data for the unstructured variables on the register (e.g. No. of ANC visit), recording of data in such variables is therefore dependent on the understanding and judgment of the health worker. This results in inconsistency and invalidity of the data (figure 3 below rightmost picture).

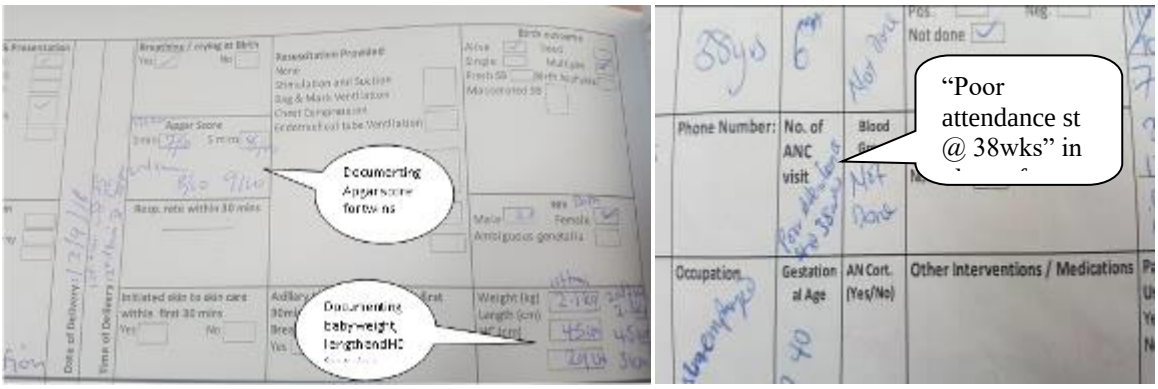

Figure 4: Documenting twin babies using the register

Data quality: Data completeness is about 95% on average. The incompleteness of the data is skewed towards referred cases. This can also be attributed to inadequate information by the referring facility. This could well be the reason why the regional hospital is among the lowest in terms of data completeness since they bear the brunt of the referral cases. It is, therefore, necessary to review and improve on the referral forms to capture the relevant information during the referral process. Furthermore, comments from some of the midwifes suggests that filling the register is time consuming and where the workload is high, priority is given to saving lives until such a time that the workload reduces. This is possibly another reason why there are gaps in the register.

All the variables included in this study were valid. There were, however, two other variables that were considered invalid due to the level of variation, inconsistency and inaccuracy in the data associated with those two variables. The two variables were those used to capture information regarding the lie/presentation of the baby as well as the occupation of the mother. Data for the lie/presentation was considered invalid because by application, these are two separate variables combined in one. Lie options of the fetus include longitudinal, transverse lie, and oblique lie and that of presentation include

cephalic and breach presentations. With the combination of these two on the register, health care providers ticked one or the other. This led to about 70% completion rate of lie variable and 27% for presentation. Hence the need to exclude it from the analysis. Occupation variable, on the other hand, had over 200 distinct items that require greater subjectivity in grouping them hence the need to exclude it from this analysis.

Having excluded the two variables stated above, the accuracy of the data from the registers ranged from 81% to 100%. This is encouraging. Working with the data, however, takes a lot of time to properly classify each record due to lack of consistency in recording information especially the variables that are not structured. It also requires a technical appreciation of the newborn discipline to be able to properly understand some of the data due to the varied nature of the responses. It is, therefore, necessary to consider a review of the guide and formal training of midwifes regarding the use of the new delivery room registers. A long-term solution to this is computerization of the health care delivery system within the hospitals to minimize the paper-based systems.

Facility specific neonatal mortality rates: overall facility specific NMR was 34.79 per 1000 births (95% CI: 34.75, 34.82). NMR for health center level facility was 0 per 1000. This is expected since they do not have a medical doctor at post and therefore often refer all pregnancies that show signs of complications. For the district hospitals, the NMRs were 20.03 per 1000 births (95% CI: 19.99, 20.05) for faith-based district hospital and 30.53 per 1000 births (95% CI: 30.50, 30.56) for public district level hospital. The regional hospital has the highest NMR rate of 46.64 per 1000 live births.

The rates for fresh stillbirth (FSB), birth asphyxia and macerated stillbirth (MSB) were 12.99 per 1000 births, 1.39 per 1000 births and 15.31 per 1000 births respectively.

The Ghana newborn strategy document (2014 to 2018) has a goal that targets a 35% reduction in institutional neonatal mortality rate by 2018. Review of available literature, however, shows that aside routine service statistics data from the DHIMS 2, there exist no facility level study of this nature hat estimates institutional neonatal mortality rate. The finding of this study could, therefore, pass as among the first estimates of institutional neonatal mortality rate for the eastern region.

Previous studies suggest that more than a third of newborn deaths are the result of complications associated with preterm (premature) births (CP & Howson, MV Kinney 2012). This is confirmed by findings of this study which found much more than what previous studies suggested. More than half (56%) of the deaths accounted for by preterm births.

Over 60% of neonatal deaths are associated with low birth weight (Katz et al. 2013). This study also found that 50.7% of the neonatal deaths were associated with low birth weight (weight below 2500 grams). This finding is a little less that what Katz et al reported in 2013 (60%) but still significantly higher than what was reported by Ghana Statistical services in 2015 (27%) in the GDHS.

The GSS suggests that asphyxia accounts for about 23% of neonatal deaths in Ghana% (GSS 2015). This study, however, found only about 4% of the neonatal deaths accounted for by asphyxia. This could be as a result of improvement in managing and reviving asphyxiated babies using the helping baby breath (HBB) skills. This is one of the skills that MEBCI is rolling out in the Eastern region by equipping providers with three key skills (HBB, ECEB and IPC).

Factors associated with birth outcomes: the study identified 6 factors that influence the neonatal death within the facilities. These factors are both clinical and non-clinical. The clinical factors include blood group of mother, parity and PMTCT whilst the non-clinical factors include gestation, the weight of the baby, the age of mother and sex of the baby. This finding is consistent with previous researches as some of them have been reported in many other studies. CP and Howson reported that more than a third of newborn deaths are the result of complications associated with preterm (premature) births (CP & Howson, MV Kinney 2012), Katz also reported that over 60% of neonatal deaths are associated with low birth weight (Katz et al. 2013) and Ulizzi reported in his research that girls have a well-described biological survival advantage in the neonatal period (Ulizzi L1 2002). The added finding from this study regarding factors associated with the newborn survival is the effect of blood group, parity and age of the mother.

Chapter 6

6.0 Conclusions and Recommendations

6.1 Conclusions (summary of key findings with figures)

Usefulness of the "new" delivery room register: the "new" delivery room register is comprehensive and detailed enough to document pre-discharge information of mother and baby throughout their stay in the hospital. The registers are in full use and health care providers are using it largely based on their understanding. There exist quite some gaps attributable to inadequate variable definition and guide as well as inadequate orientation for staff who complete the register. The register at the moment does not explicitly show how to address multiple baby birth outcomes (e.g. twins).

Data quality: Data quality dimensions measured including completeness, accuracy and validity of the data from the register. The data quality was found to be high and appreciable although there is still room for improvement. It requires much more time to validate and classify most of the variables. The areas that require improvement are associated with referred cases. Workload and time constraints are other factors that appear to affect the data quality.

Facility specific neonatal mortality rates: overall facility specific NMR was 34.79 per 1000 births (95% CI: 34.75, 34.82). NMR for the regional hospital higher than that of the lower level facilities. Deaths associated with preterm births was much higher (56%) than what previous studies suggested (more than a third). About 50.7% of the neonatal deaths are associated with low birth weight (weight below 2500 grams) according to this study

and this is a little lower than what was reported by Katz et al in 2013, yet significantly higher than that of the GDHS in 2015 (data). The neonatal deaths accounted for by asphyxia is much lower than the GDHS report and could be a result of recent efforts in the region to properly manage asphyxia in newborns including MEBCI.

Factors associated with birth outcomes: in addition to what has been widely reported to be among factors associated with newborn survival, this study also found three more factors associated with neonatal survival. They include blood group, parity and age of the mother.

6.2 Recommendations

Usefulness data quality of the "new" delivery room register: to make the register more effective and more useful, there is the need for GHS to develop a comprehensive guide that explains the how and what of the register. There is also the need for GHS and its newborn partners including UNICEF, PATH, JICA among others to provide an orientation for midwifes and nurses who complete this form to improve the consistency, accuracy and completeness of the register. There is also the need for GHS to explore the need for an online data register so that all providers can complete the form online in real time.

Facility specific neonatal mortality rates: the study suggests, neonatal deaths accounted for by asphyxia is much lower than the GDHS 2014 report. Although this is a welcoming news and could be a result of recent efforts in the region to properly manage asphyxia in newborns including MEBCI, there is the need for further investigation with much focus on birth asphyxia to establish the veracity or otherwise of this observation. The research unit of the Eastern Regional Health Directorate should consider this as part of their research activities.

Factors associated with birth outcomes: Blood group, parity and age of mother were also found to predict birth outcomes (dead/alive). A prospective study to further investigate this observation is therefore recommended. The monitoring and evaluation unit of the child health division under Ghana Health Service should consider this research topic.

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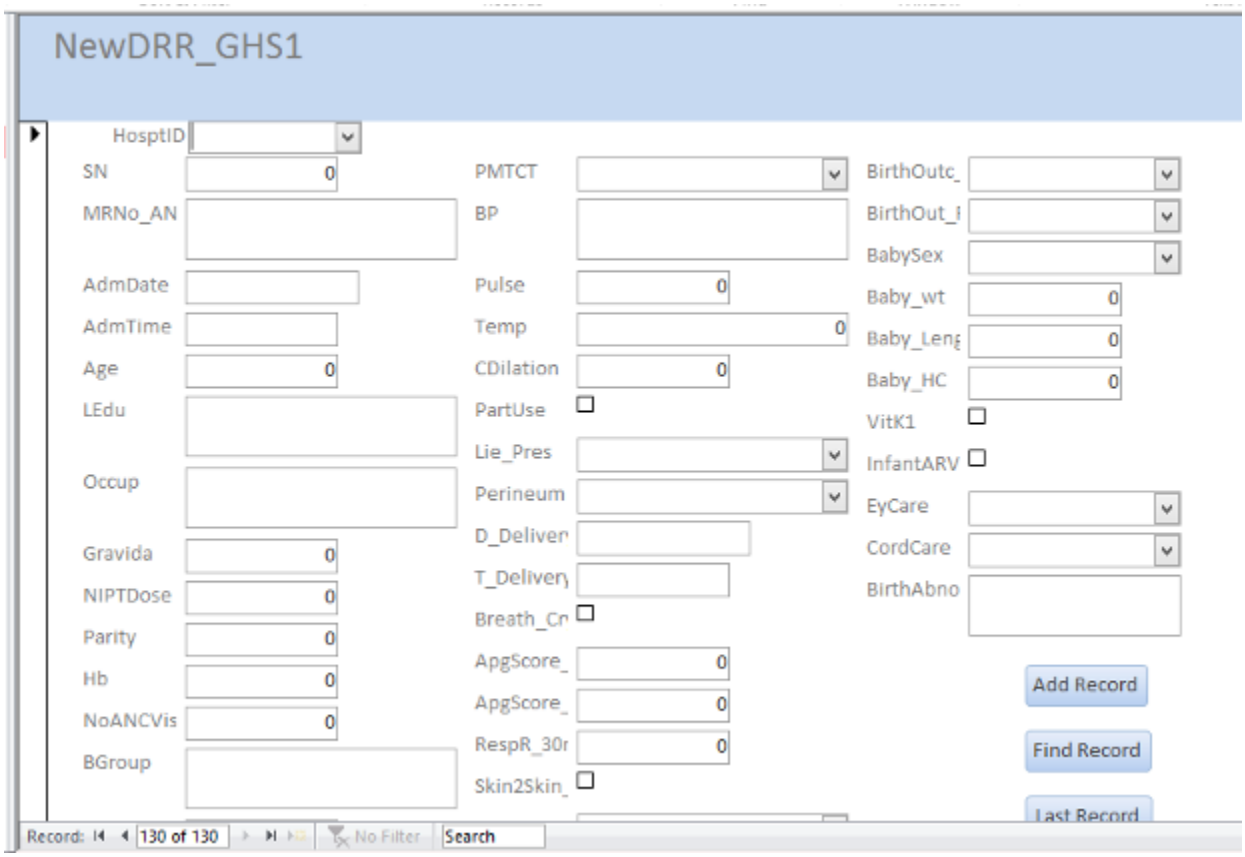
Appendices

Appendix A: Output of the Logistic Regression

```
. logit newOutcome2 i.gestation i.LowBWt1 i.newBG i.babySex paraGrp AgeGrp PMTCTEncoded outcomeType , or

note: 5.newBG != 0 predicts failure perfectly
      5.newBG dropped and 58 obs not used

note: 3.babySex != 0 predicts failure perfectly
      3.babySex dropped and 2 obs not used

Iteration 0:   log likelihood = -173.02214
Iteration 1:   log likelihood = -153.29127
Iteration 2:   log likelihood = -147.50008
Iteration 3:   log likelihood = -147.42066
Iteration 4:   log likelihood = -147.42034
Iteration 5:   log likelihood = -147.42034

Logistic regression                             Number of obs     =      1,480
                                                LR chi2(13)       =      51.20
                                                Prob > chi2       =     0.0000
Log likelihood = -147.42034                     Pseudo R2         =     0.1480
```

newOutcome2	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gestation						
<37weeks	9.879825	5.925041	3.82	0.000	3.04982	32.00548
LowBWt1						
<2500g	3.194665	1.309902	2.83	0.005	1.430241	7.135783
newBG						
O-	3.41921	2.744704	1.53	0.126	.7089905	16.48964
A+	2.000644	.8683795	1.60	0.110	.8544873	4.684183
A-	3.483318	3.830502	1.13	0.256	.4036006	30.06314
AB+	1	(empty)				
AB-	10.24881	12.57659	1.90	0.058	.9249987	113.5549
B+	1.008502	.4792379	0.02	0.986	.3973636	2.559563
B-	.7424805	.861426	-0.26	0.797	.0764048	7.215215
babySex						
Female	.3232673	.1421915	-2.57	0.010	.1365069	.7655419
Ambiguous genetalia	1	(empty)				
paraGrp	1.1514	.202523	0.80	0.423	.8156537	1.625348
AgeGrp	2.809529	1.091685	2.66	0.008	1.311856	6.017012
PMTCTEncoded	1.033169	.4205252	0.08	0.936	.4652768	2.2942
outcomeType	.5506524	.3709322	-0.89	0.376	.1470579	2.061895
_cons	.0008548	.0010774	-5.61	0.000	.0000723	.0101087

Appendix B: New DRR Data extraction template



Appendix C: MEASURE Evaluation RDQA Tool

Routine Data Quality Assessment (RDQA)

Checklist to Assess Program/Project Data Quality

Number of Regional Aggregation Sites	1
Number of District Aggregation Sites	1
Number of Service Delivery Sites	4

Version: Jan 2010

Important notes for the use of this spreadsheet:

1. In order to use the Routine Data Quality Assessment tool you will need to ensure that your 'macro security' is set to something less than 'high'. With the spreadsheet open, go to the 'Tools' pull-down menu and select 'Macro', then 'Security'. Select 'medium'. Close Excel and re-open the file. When you open the file the next time you will have to select 'Enable Macros' for the application to work as designed.

2. On the START Page (this page), please select number of intermediate aggregation sites (IAS) and Service Delivery Points (SDPs) that you plan to review from the dropdown lists above. IAS are typically the district level health unit of the Ministry of Health.

B – INSTRUCTIONS FOR USE OF THE RDQA

1. Determine Purpose

The RDQA checklist can be used for:

 Initial assessment of M&E systems established by new implementing partners (or in decentralized systems) to collect, manage and report data.

 Routine supervision of data management and reporting systems and data quality at various levels. For example, routine supervision visits may include checking on a certain time period worth of data (e.g. one day, one week or one month) at the service site level, whereas periodic assessments (e.g. quarterly, biannually or annually) could be carried out at all levels to assess the functioning of the entire Program/project's M&E system.

 Periodic assessment by donors of the quality of data being provided to them (this use of the DQA could be more frequent and more streamlined than official data quality audits that use the DQA for Auditing) but less frequent than routine monitoring of data.

 Preparation for a formal data quality audit.

The RDQA is flexible for all of these uses. Countries and programs are encouraged to adapt the checklist to fit local program contexts.

2. Level/Site Selection

Select levels and sites to be included (depending on the purpose and resources available). Once the purpose has been determined, the second step in the RDQA is to decide what levels of the data-collection and reporting system will be included in the assessment - service sites, intermediate aggregation levels, and/or central M&E unit. The levels should be determined once the appropriate reporting levels have been identified and "mapped" (e.g., there are 100 sites providing the services in 10 districts. Reports from sites are sent to districts, which then send aggregated reports to the M&E Unit). In some cases, the data flow will include more than one intermediate level (e.g. regions, provinces or states or multiple levels of program organizations).

3. Identify indicators, data sources and reporting period. The RDQA is designed to assess the quality of data and underlying systems related to indicators that are reported to programs or donors. It is necessary to select one or more indicators – or at least program areas – to serve as the subject of the RDQA. This choice will be based on the list of reported indicators. For example, a program focusing on treatment for HIV may report indicators of numbers of people on ART. Another program may focus on meeting the needs of orphans or vulnerable children, therefore the indicators for that program would be from the OVC program area. A malaria program might focus on providing insecticide-treated bed nets (ITN) or on treating people for malaria – or on both of those activities.

4. Conduct site visits. During the site visits, the relevant sections of the appropriate checklists in the Excel file are filled out (e.g. the service site checklist at service sites, etc). These checklists are completed following interviews of relevant staff and reviews of site documentation. Using the drop down lists on the HEADER page of this workbook, select the appropriate number of Intermediate Aggregation Levels (IAL) and Service Delivery Points (SDP) to be reviewed. The appropriate number of worksheets will automatically appear in the RDQA workbook (up to 12 SDP and 4 IALs).

5. Review outputs and findings. The RDQAoutputs need to be reviewed for each site visited. Site-specific summary findings in the form of recommendations are noted at each site visited.

The RDQA checklists exist in MS Excel format and responses can be entered directly into the spreadsheets on the computer. Alternatively, the checklists can be printed and completed by hand. When completed electronically, a dashboard produces graphics of summary statistics for each site and level of the reporting system.
The dashboard displays two (2) graphs for each site visited:

- A spider-graph displays qualitative data generated from the assessment of the data-collection and reporting system and can be used to prioritize areas for improvement.
- A bar-chart shows the quantitative data generated from the data verifications; these can be used to plan for data quality improvement.

In addition, a 'Global Dashboard' shows statistics aggregated across and within levels to highlight overall strengths and weaknesses in the reporting system. The Global Dashboard shows a spider graph for qualitative assessments and a bar chart for quantitative assessments as above. In addition, stengths and weakness of the reporting system are displayed as dimensions of data quality in a 100% stacked bar chart. For this analysis questions are grouped by the applicable dimension of data quality (e.g. accuracy or reliability) and the number of responses by type of response (e.g. 'Yes - completely', 'Partly' etc.) are plotted as a percentage of all responses. A table of survey questions and their associated dimensions of data quality can be found on the 'Dimensions of data quality' tab in this workbook.

6. Develop a system's strengthening plan, including follow-up actions. The final output of the RDQA is an action plan for improving data quality which describes the identified strengthening measures, the staff responsible, the timeline for completion, resources required and follow-up. Using the graphics and the detailed comments for each question, weak performing functional areas of the reporting system can be identified. Program staff can then outline strengthening measures (e.g. training, data reviews), assign responsibilities and timelines and identify resources using the Action Plan tab in this workbook.

C – BACKGROUND INFORMATION – RDQA

Country:	
Name of Program/project:	
Indicator Reviewed:	
Reporting Period Verified:	

Assessment Team:	**Name**	**Title**	**Email**
Primary contact:			

M&E Management Unit at Central Level							
Name of Site		**Facility Code**					**Date (mm/dd/yy)**
1-							
Regional Level Aggregation Sites							
Name of Site		**Facility Code**			**Region**	**Region Code**	**Date (mm/dd/yy)**
1							
District Level Aggregation Sites							
Name of Site		**Facility Code**	**District**	**District Code**	**Region**	**Region Code**	**Date (mm/dd/yy)**
1							
Service Delivery Points (SDPs)							
Name of Site		**Facility Code**	**District**	**District Code**	**Region**	**Region Code**	**Date (mm/dd/yy)**
1							
2							
3							
4							

Data Verification and System Assessment Sheet - Service Delivery Point		
Service Delivery Point/Organization:		
Region and District:		
Indicator Reviewed:		
Date of Review:		
Reporting Period Verified:		
Component of the M&E System	**Answer Codes:** Yes - completely Partly No - not at all N/A	**REVIEWER COMMENTS** (Please provide detail for each response not coded "Yes - Completely". Detailed responses will help guide strengthening measures.)
Part 1: Data Verifications		
A - Documentation Review:		
	Review availability and completeness of all indicator source documents for the selected reporting period.	
1	Review available source documents for the reporting period being verified. Is there any indication that source documents are missing?	
	If yes, determine how this might have affected reported numbers.	
2	Are all available source documents complete?	
	If no, determine how this might have affected reported numbers.	
3	Review the dates on the source documents. Do all dates fall within the reporting period?	
	If no, determine how this might have affected reported numbers.	
B - Recounting reported Results:		
	Recount results from source documents, compare the verified numbers to the site reported numbers and explain discrepancies (if any).	
4	Recount the number of people, cases or events during the reporting period by reviewing the *source document*s. **[A]**	
5	Enter the number of people, cases or events reported by the site during the reporting period from the site *summary report*. **[B]**	
6	**Calculate the ratio of recounted to reported numbers. [A/B]**	
7	What are the reasons for the discrepancy (if any) observed (i.e., data entry errors, arithmetic errors, missing source documents, other)?	
C - Cross-check reported results with other data sources:		
Cross-checks can be performed by examining separate inventory records documenting the quantities of treatment drugs, test-kits or ITNs purchased and delivered during the reporting period to see if these numbers corroborate the reported results. Other cross-checks could include, for example, randomly selecting 20 patient cards and verifying if these patients were recorded in the unit, laboratory or pharmacy registers. To the extent relevant, the cross-checks should be performed in both directions (for example, from Patient Treatment Cards to the Register and from Register to Patient Treatment Cards).		
8	List the documents used for performing the cross-checks.	
9	Describe the cross-checks performed?	
10	What are the reasons for the discrepancy (if any) observed?	

Part 2. Systems Assessment			
I - M&E Structure, Functions and Capabilities			
1	There are designated staff responsible for reviewing aggregated numbers prior to submission to the next level (e.g., to districts, to regional offices, to the central M&E Unit).		
2	The responsibility for recording the delivery of services on source documents is clearly assigned to the relevant staff.		
3	All relevant staff have received training on the data management processes and tools.		
II- Indicator Definitions and Reporting Guidelines			
The M&E Unit has provided written guidelines to each sub-reporting level on …			
4	,,, *what* they are supposed to report on.		
5	… *how* (e.g., in what specific format) reports are to be submitted.		
6	… *to whom* the reports should be submitted.		
7	… *when* the reports are due.		
III - Data-collection and Reporting Forms and Tools			
8	Clear instructions have been provided by the M&E Unit on how to complete the data collection and reporting forms/tools.		
9	The M&E Unit has identified standard reporting forms/tools to be used by all reporting levels		
10	….The standard forms/tools are consistently used by the Service Delivery Site.		
11	All *source documents* and *reporting forms* relevant for measuring the indicator(s) are available for auditing purposes (including dated print-outs in case of computerized system).		
12	The data collected on the source document has sufficient precision to measure the indicator(s) (i.e., relevant data are collected by sex, age, etc. if the indicator specifies desegregation by these characteristics).		
IV- Data Management Processes			
13	If applicable, there are quality controls in place for when data from paper-based forms are entered into a computer (e.g., double entry, post-data entry verification, etc).		
14	If applicable, there is a written back-up procedure for when data entry or data processing is computerized.		
15	….***if yes***, the latest date of back-up is appropriate given the frequency of update of the computerized system (e.g., back-ups are weekly or monthly).		
16	Relevant personal data are maintained according to national or international confidentiality guidelines.		
17	The recording and reporting system avoids double counting people *within* and *across* Service Delivery Points (e.g., a person receiving the same service twice in a reporting period, a person registered as receiving the same service in two different locations, etc).		
18	The reporting system enables the identification and recording of a "drop out", a person "lost to follow-up" and a person who died.		
V - Links with National Reporting System			
19	When available, the relevant national forms/tools are used for data-collection and reporting.		
20	When applicable, data are reported through a single channel of the national information systems.		
21	The system records information about where the service is delivered (i.e. region, district, ward, etc.)		
22	….if yes, place names are recorded using standarized naming conventions.		

Part 3: Recommendations for the Service Site

Based on the findings of the systems' review and data verification at the service site, please describe any challenges to data quality identified and recommended strengthening measures, with an estimate of the length of time the improvement measure could take. These will be discussed with the Program.

	Identified Weaknesses	Description of Action Point	Responsible(s)	Time Line
1				
2				
3				
4				

Part 4: DASHBOARD: Service Delivery Point