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A Synopsis of maternal deaths in Zambia based on Maternal Death Review data.

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DECLARATION

I hereby declare that this dissertation is the original work of Douglas Singini. The research Dissertation has not been submitted elsewhere for a degree at this university or any other university.

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APPROVAL

This dissertation of Douglas Singini is approved in partial fulfillment of the requirement for the award of a master of science in Epidemiology (M.Sc. Epi.) by the University of Zambia.

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ABSTRACT

Introduction and background: Maternal Mortality (MM) is defined as those deaths that occur due to complications of pregnancy or child birth and in women dying within 42 days after delivery. The 5th millennium development goal (MDG5) was fashioned to mitigate the burden due to Maternal Deaths. Maternal mortality Ratio (MMRatio) is high in Zambia currently standing at 591/ 100, 000 live births in 2007. This study aimed to aggregate available notified and reviewed maternal deaths in 4 provincial medical offices in Zambia. This descriptive study examined causes of maternal deaths, characteristics of the dead women and features of the facilities they died in, based on Maternal Death Review (MDR) data.

Methods: The study used the 3 tools used during maternal death reviews. These included the notification, health facility and the community interview tools. Data was entered from the completed forms from year 2008 to January 2014 available at the provincial health offices in western, north western, copperbelt and central provinces.

Results and discussion: In the four provinces, 329 notifications were found. Based on the MDR data, Western province had the largest maternal mortality ratio of 166/ 100,000 live births. The lowest MMRatio was for the copperbelt province at 24 deaths per 100, 000 live births. Collectively the bleeding conditions accounted for 48% of all the pregnancy related deaths. There were also deficiencies in the referral system, supplies, skills and equipment in some health facilities. In some cases the diagnosis was missed or the appropriate management was delayed altogether. Notwithstanding, factors outside the health system such as the sparse geographic distribution and poor road communication during referrals were noted.

Conclusion and Recommendation: Gaps in the human resources for health, blood and other supplies and equipment for emergence obstetric care, the low rate of referred patients and competencies by service providers to manage and resuscitate emergencies contributed to the maternal mortality in the 4 provinces.

Factors in the 3 delay model, especially the delay to receive appropriate care in the face of obstetric emergencies, were observed to be an important and common phenomenon. Emergence Obstetric care may need to be scaled up to all Health Posts (HP) and Rural Health Centres (RHC). Maternal Death Review data may be quantified regularly at national level to provide real time feedback to policy makers.

I DEDICATE THIS STUDY TO
THE WOMEN WHOSE LIVES WILL BE SAVED
BY THE INFORMATION
GENERATED IN THIS DISSERTATION.

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AMDD	Averting Maternal Death and Disability Program
ANC	Antenatal Clinic
APH	Ante-Partum Heamorrhage
ARV	Anti-Retroviral Therapy
CI	Confidence Interval
CPD	Cephalo-Pelvic Disproportion
CEMD	Confidential Enquiry into Maternal Deaths
DHIS	District Health Information System
DCMO	District Community medical office
EmOC	Emergence Obstetric care
EmONC	Emergence Obstetric and Neonatal Care
EOC	Essential Obstetric care
ERES	Excellence in Research Ethics and Science
FANC	Focused Antenatal Care
GDP	Gross Domestic Product
GFR	General Fertility Rate
GPI	Gender Parity index
HP	Health Post
ICD 10	International Classification of Diseases
IMMPACT	Initiative for Maternal Mortality Programme Assessment
IMCA	Investigate Maternal Deaths and Act
IRB	Institutional Research Board
MCDMCH	Ministry of Community Development Mother and Child Health
MD	Maternal Death
MDG	Millennium Development Goals
MDR	Maternal Death Reviews
MMRate	Maternal Mortality Rate
MMRatio	Maternal Mortality Ratio
NCCEMD	National Committee on Confidential Inquiries into Maternal Deaths
NPRI	Non pregnancy related infections
PMO	Provincial Medical Office
PNC	Post Natal Care
PPH	Post-Partum Heamorrhage
RHC	Rural health Centre
SAB	Skilled Attendant at Birth
SSA	Sub Saharan Africa
WCBA	Women of Child Bearing Age
WHO	World Health Organization

CHAPTER 1: BACKGROUND

INTRODUCTION

Maternal mortality is defined as those deaths that occur due to complications of pregnancy, child birth and puerperium. Pregnancy-related deaths include all deaths of women in their reproductive ages that occur during pregnancy and those within 42 days after delivery for any gestational age. For every woman that succumbs to maternal death there are many more women that suffer disabilities, infections and other complications of birth. (Ross, Campbell, & Bulatao, 2001)

The direct causes of maternal deaths include medical conditions, hemorrhage, infections and obstructed labour. Indirect causes include conditions such as diabetes, sexually transmitted diseases (STI's) and anemia that predispose women to increases in the risk of complications. Since most maternal deaths occur around the time of delivery, strategies that target this period will particularly reduce maternal mortality. Proximate and more distal societal factors have also been shown to have an impact on women's access to quality health services and general health. The distal factors include accessibility to the health facilities and female education. It has been noticed as well that, rural areas are affected more than urban areas. Other contributing factors are the low status of women in society; early marriage; the poor access to resources; lack of educational opportunities; limited decision making opportunities (Ross, Campbell, & Bulatao, 2001) and high fertility.

Global perspective of maternal mortality

A WHO systematic review of data on maternal deaths published between 2003 and 2009 which included 60,799 cases showed that 73% were due to direct obstetric causes whereas the remaining 27.5% were due to indirect causes. Heamorrhage accounted for 27.1% (CI 19.9- 36.2); hypertensive diseases were 14.0% (CI 11.1 – 17.4) and sepsis 10.7% (CI 5.9- 18.6) of all deaths (Lale Say, 2014). There was

great variation in the regional estimates, however. The study concluded by recommending that the analyses elicited during the review should inform policy makers, stimulate programmes and direct funding to reduce maternal deaths.

The UNFPA and WHO model used to determine estimates in Table 1.2 below used fertility, the quality of health services and the socioeconomic situation of women as important covariates and predictors of the occurrence of maternal mortality (Chou, 2012), (NCCEMD, 2000). This implies that causes of mortality may be more intricately associated with societal factors than just obstetric complications. Lasting reductions in MD would thus need such interventions that will include changes in the distal and proximate determinants.

In the developed world most women use some form of contraception while almost all deaths from obstetric complications are prevented. In the developed countries, the majority of deaths in the reproductive age group are due to side effects of contraceptive use (Khan, Wojdyla, Say, Gulmezoglu, & Van Look, 2006), notwithstanding the fact that the very contraceptive side effects are very rare. In developing countries the situation is the reverse where deaths are primarily due to complications of pregnancy, delivery and puerperium rather than contraceptive side effects.

The causes of death identified in the literature include those shown table 1.1 below. The causes in the table are however restricted to causes identified in a hospital setting such as obstetric and other indirect medical or surgical causes.

TABLE 1.1: CAUSES OF MATERNAL DEATH (Chou, 2012) (childinfo, 2012) (Jennifer E. brown, 2010)

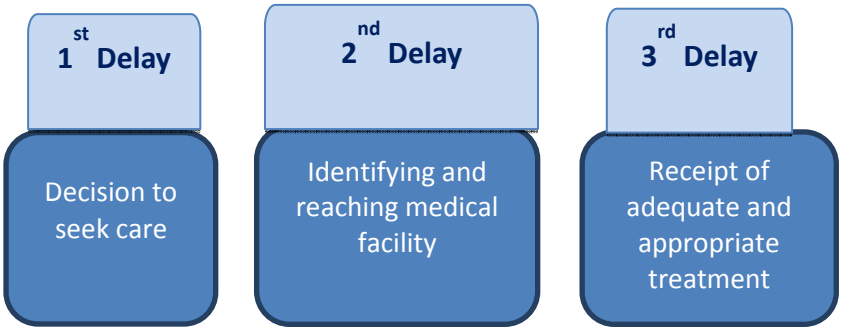
Causes of maternal deaths	
Direct Patient related factors/ complications	• Heamorrhage: ante partum or post-partum • Prolonged/ obstructed labour • Post-partum Sepsis • Unsafe abortion • Pre-Eclampsia/ Eclampsia • Ectopic pregnancy • Ruptured uterus • Hypertensive disorders • Embolism
Indirect causes of MD	• AIDS • Preexisting medical conditions • Accidents

A Review of a broad body of research material by Thaddeus and Maine in 1994 helped them to coin the 'Three delays model', see figure 1.1 below. The model focused on those factors contributing to maternal mortality that were in the interval between onset of obstetric complications and its outcome. The time during motherhood when most complications occurred was observed to be the phase surrounding child birth. The model recognized that different barriers which interact in a complex yet in an interlinked nature preventing women and girls from accessing high quality maternal and family planning services. (Maine, et al., 2007), (Thaddeus & Maine, 1994).

The world health organization has adopted 'the 3 delay model' and grouped the causes of mortality into the 3 types of delays depicted by Thaddeus and Maine in 1994. The first Delay is in deciding to seek care and 2nd delay is in reaching appropriate care and relates directly to the issues of access to care, encompassing factors in the family and the community, including transportation. The third delay (delay in receiving care) relates to factors in the health-care facility. It is indeed the third delay, which is the most critical for programming interventions in the health system. Facilitating access to a health-care facility is futile unless the institution is itself available, well-staffed, well-equipped, and providing good quality care. The 'the 3 delays model' also known as "pathway to survival" adds improved

'recognition of danger signs' as a prerequisite for increasing timely use of skilled delivery care.

Figure 1.1: The Three Delay model



Consequences of maternal morbidity and mortality leads to a reduction in the female population of productive and reproductive age, thus impacting negatively on the growth of society. It also means that fewer women will be able to have children. The families and immediate community of the women that die feel the negative impact too. The greatest impact still is on the child that loses the mother. He will have an increased risk of death and other problems such as protein energy malnutrition (Chou, 2012) (Jennifer E. brown, 2010) (Khan, Wojdyla, Say, Gulmezoglu, & Van Look, 2006).

The burden of maternal mortality can be measured by statistical measures that will depict the rates and ratios of mothers dying at various time periods. These include Maternal Mortality Ratio (MMRatio); Maternal Mortality rate (MMRate) and the Life Time Risk of dying from maternal causes. The lifetime risk of dying from maternal causes is high at 1 in 39 in sub-Saharan-Africa due to high fertility levels. In the more industrialized regions of the world the lifetime risk is 1 in 4,700 (childinfo, 2012). There are several approaches to collecting maternal mortality data. The civil registration system is the routine collection of vital statistics at facility and other institutions mandated to collect such national data. They will record births, deaths and other socioeconomic indicators. In countries where civil registration systems are weak, national household health surveys are carried out to

generate data for monitoring and evaluating policy and for surveillance. Through the sisterhood method adopted by these household surveys, maternal mortality is estimated. Zambia carries out the demographic health survey in 5 year intervals. The latest MMRatio is 398 maternal deaths per 100,000 live births during the seven years preceding the 2013-14 ZDHS (CSO, 2015). Modeling by WHO indicates that there may have been a slight reduction in maternal mortality between 2007 and 2013 (Kassebaum, Bertozzi-Villa, Coggeshall, & et al, 2014). A table showing Zambia's maternal mortality trends as published online in the Lancet online journal is shown in annex 5, page 100 of this dissertation.

Sub Saharan maternal mortality

When a national maternal death review was done in South Africa in 1998, a clear pattern of disease and problems with patient care emerged which included hypertensive conditions; AIDS; obstetric hemorrhage; pregnancy- related sepsis and pre-existing medical conditions (NCCEMD, 2000). Women aged 30 years and older were at greater risk of dying than women younger than 30 years. Grand multiparas (the women that have had 5 or more children) and those in their first pregnancy were at greater risk than the rest of the women of child bearing age. When the recorded causes of death were stratified against the level of the hospital where the death occurred, there was an observed difference in the categorized causes of death.

The leading cause of deaths in level 1 hospitals were obstetric heamorrhage; AIDS in level 2 and hypertensive diseases in level 3 hospitals in South Africa (NCCEMD, 2000). Patient related problems in the South African study included non-attendance and delayed attendance to health institutions. Administrative problems included poor transport and lack of intensive care facilities. In more than 50% of the cases included in the national confidential review of maternal deaths, there were problems in the care given to the women during hospitalization, the majority of which occurred in primary level hospitals. Health-worker related problems included poor initial assessment and diagnosis of cases. The health worker related problems were more prevalent in level 2 hospitals. Nonuse of standard protocols for the

management of obstetric conditions and poor monitoring of patients were also common at all levels of care, (NCCEMD, 2000).

A more recent report on confidential enquiry into maternal deaths (CEMD) study covering the period 2008 to 2010 in South Africa indicated that the maternal mortality was rather on the increase from 152/ 100,000 in the 2005-2007 report to 176/ 100,000 live births in 2010. Non pregnancy related infections (NPRI) such as HIV/AIDS was the top cause of mortality followed by obstetric heamorrhage; complications of hypertension; sepsis and surgical conditions (MoodleyJ, 2012) were also common.

Maternal deaths in the developing world account for more than a quarter of all deaths among women in the child bearing age whereas in the developed world they account for less than 1%. The maternal mortality has reduced from the 1990 estimates by a worldwide average of 47% by the year 2010. However the least reduction according to WHO has been in Sub Saharan Africa. Excluding deaths due to HIV, Sub Saharan Africa accounts for 56 % of the global burden. This implies that the millennium development goal number 5 of reducing MMRatio by 75% will not be achieved by the year 2015 (Chou, 2012), neither in Zambia nor globally.

Kongnyuy et al (2009) conducted a review of maternal deaths in 3 districts in Malawi. He identified four groups of facility factors that influenced adverse maternal outcomes contributing to the women dying. These factors included those due to health workers; administration; Patient family factors and traditional birth attendant factors. Administrative factors included the lack of blood for blood transfusion. The health workers factors included inadequate resuscitation, lack of obstetric life serving skills, inadequate monitoring, incomplete initial assessment and delay in starting appropriate treatment (Kongnyuy, Mlava, & VanDen Broek, 2009)

TABLE 1.2: MATERNAL MORTALITY RATIO (MMR) PER 100,000 LIVE BIRTHS. ESTIMATES FOR THE YEAR 2010,WHO. (Chou, 2012).

Country region	MMR	Range of MMR uncertainty		Number of Maternal Deaths	HIV-Attributed MMR	% change in MMR between 1990 to 2010
		Lower estimate	Upper estimate			
World	210	170	300	287 000	14	-47
Developed regions	16	14	18	22 000	2	-39
Developing regions	240	190	330	284 000	15	-47
Northern Africa	78	52	120	28 000	0	-66
Sub Saharan Africa	500	400	750	162 000	52	-41
Zambia	440	220	790	2600	30.7	-7

The WHO estimates that a significant proportion of the MD is due to HIV/AIDS. The estimate for Zambia has a large confidence interval implying that there is some variability in the sub populations. Zambia has a high MMR which stood at 591 per 100, 000 live births according to the 2007 Demographic and Health Survey and currently estimated to be 398 maternal deaths per 100,000 live births during the seven years preceding the 2013-14 ZDHS (CSO, 2015). The unadjusted MMRatio however was estimated to be as high as 691/ 100,000 live births (Kalumbi J., 2012) in the 2005 DHS.

Maternal Mortality in Zambia

The reduction of maternal mortality by two thirds by the year 2015 from the 1990 level estimates has been framed in the millennium development goal (MDG) 5. Zambia, as a signatory to the resolution, thus resolved to reduce MMRatio to 162/100, 000 live births by the year 2015. The 1990 estimate for maternal mortality in Zambia was 594 deaths per 100, 000 live births. Zambia has made insufficient progress towards the millennium development goal number 5 (Table 2.5). This is due to the observed increase in mortality in the late 1990s while a decline was only observed starting the year 2000. Whilst there is progress towards reduction in the MMRatio, the target of 162 maternal deaths per 100, 000 live births may not be

reached by end of the year 2015. It is also observed from Table 1.2 above that some developing countries in Africa had already met the millennium development goal 5 by 2010 or were otherwise on track.

In Zambia estimates of the maternal mortality have been made using data collected from demographic health surveys that have been done, crudely, every 5 years. The trends in MMRatio estimate are shown below in table 1.3 below. The 1996 estimate includes the 7 years prior to the survey. It is observed that the confidence intervals between the 2013 -14 and 1996 ZDHS do not overlap. This non-overlap is evidence that there has been a significant or marked reduction in the maternal mortality since 1990. Few studies have been done in Zambia that have described the national pattern of causes of maternal mortality in Zambia. In order to document the unreported maternal deaths on the Copperbelt Hadley and Tuba used the Investigate Maternal Deaths and Act (IMCA) approach designed to address deficiencies in the routine reporting system (Hadley & Tuba, 2011). This approach included an identification and investigation of a maternal death followed by recommendations and monitoring of the improvements through the routine health system. (Hadley & Tuba, 2011)

TABLE 1.3 MATERNAL MORTALITY RATIOS (MMR) WITH CONFIDENCE INTERVALS FOR THE SEVEN YEARS PRECEDING THE 1996, 2001-02, 2007, AND 2013-14 ZDHS SURVEYS (PER 100,000 LIVE BIRTHS) (CSO, 2015).

Period for Survey or Estimation	**MMRatio**	**Confidence Intervals**	
2013-14 ZDHS maternal mortality ratio (MMRatio)	398	323	474
2007 ZDHS maternal mortality ratio (MMRatio)	591	450	732
2001-02 ZDHS maternal mortality ratio (MMRatio)	729	586	872
1996 ZDHS maternal mortality ratio (MMRatio)	649	519	780

The confidence intervals for each DHS do not include zero thus these estimates are statistically significant.

The Ministry of health in Zambia had put in place High impact interventions including Focused antenatal Care (FANC) management of HIV/ AIDS and pregnancy, Emergency obstetric and Neonatal care (EmONC), blood availability

and safety, birth preparedness, patient referral and human resources for health. Another strategy used to mitigate the maternal mortality is the application of recommendations derived from findings from maternal death reviews (MDR).

Maternal death reviews (MDR) was an intervention whose focus is to bring to light the causes of maternal deaths, delineating the social and other contributing factors. MDR is a qualitative approach that has an in-depth investigation of the causes of and circumstances surrounding each maternal death and includes methods designed for reviewing deaths that occur in both health-care facilities and communities (WHO, 2004). The lessons learned from such audits are used to institute local interventions. The district medical offices (DMO) and health facilities identify and notify the deaths that occurred in their catchment areas and go ahead to review and respond to patient management and administrative problems locally. The maternal deaths are identified using a case definition of a pregnancy-related death as defined above. The District medical offices (DMO) receive notifications of maternal deaths from the community health workers as well as from health facilities. The district medical offices where the MDR strategy has been successfully implemented follows up all community deaths that have been reported while the hospital follows up all the deaths that occurred in the health facilities. On a quarterly basis the district office calls for a review of all the deaths that have been reported and reviewed in the previous quarter. The district committee in its sitting ranks the causes and contributing factors and then recommends amenable solutions at community through to national level. The minutes and reports from the follow-ups made are sent to the respective provincial offices. The Programme includes a national MDR committee but this has not been functional so that data is only analyzed at district and provincial levels. The national level was thus only notified of the occurrence of a maternal death. The national level was availed the number and causes of death on a quarterly basis. However, other factors pertaining to the circumstances surrounding the death were not reviewed.

Causes of declines in maternal mortality can be attributed to Improvements in health systems or due to factors outside health system (Chou, 2012). Improvements in the mortality were attributed to attendance by skilled personnel; use of

contraceptives; ARV use in HIV positive; supervised health care workers; Proper equipment and supplies; Timely referral and efficient transport and increased Quality obstetric services at referral (childinfo, 2012). Increased physical accessibility to health facilities; Geographic distribution by province and district of facilities capable of offering emergency obstetric care, are factors outside the health care system (Abe & Omo-Aghoja, 2008). Demographic factors include age, home area such as urban or rural areas or female's education are important determinants.

Admission

The date and time of; admission, onset of labour prior to admission, delay in arrival at health facility and delayed transfer to appropriate level of care are measurable factors that have been shown to influence the outcome of delivery.

The dates are useful to calculate time to the event at admission. Certain shifts (night) tend to have more mortality (Mhango, Rochat, & Arkutu, 1986). In remote facilities where the skilled staff may be away for some days for scheduled administrative trips, mortality is higher. The Health facility attended or the Location of the delivery influences the morbidity or mortality.

Hospitalization

During the stay in hospital deviations in duration, date and time of onset of labour; onset of complication; time of delivery; date and time of death in health facility or day of the week woman died have been shown to be significant (Kongnyuy, Mlava, & VanDen Broek, 2009). The time life-saving services are given or the delays of appropriate care in health facility due to unavailable supplies due to health worker inconsistencies have adversely affected delivery processes (Khan, Wojdyla, Say, Gulmezoglu, & Van Look, 2006). On the other hand delayed care in health facility due to absence or slowness of health worker or the delay in correct diagnosis have been documented to affect pregnancy outcomes (Mhango, Rochat, & Arkutu, 1986) (Kassebaum, Bertozzi-Villa, Coggeshall, & et al, 2014). Perinatal deaths are usually surrounded by difficulties in delivery of the baby. The complication in the

perinatal death may stem from an obstetric complication that can also have caused the mothers' death. The pattern of mortality in the developed world is divergently different from those occurring in developing countries and thus interventions for a place such as Zambia should be directed at identified causes of death and their respective determinants.

Appropriate interventions need sound and timely information for decision making, monitoring and evaluation. Quantitative approaches to documenting aggregated data on reviewed maternal deaths has not been done or published. Notwithstanding, there has not been a national or subnational review of maternal deaths that has utilized the MDR data generated by the districts to create an overview, hence this quantitative study of maternal death reviews. This study aims to aggregate all available notified and reviewed maternal deaths in 4 provinces of Zambia to identify causes of death; categorize the contributing factors and the priority health problems identified by the districts. This paper aims to inform and guide policy makers to amenable public health determinants and responses.

CHAPTER 2: RESEARCH FOCUS

STUDY RATIONALE/ STATEMENT OF THE PROBLEM

The country's prosperity, productivity, human rights considerations and growth are intricately connected to women's health. Zambia's maternal mortality continues to be high, estimated to be about 591/100, 000 live births in 2007 using the Zambia Demographic and Health Survey (CSO, 2009) (Chou, 2012) and declined to 398 deaths per 100,000 live births in the 7 years prior to the 2013 -14 ZDHS (CSO, 2015). The districts in Zambia have been reviewing maternal deaths that have occurred in their respective catchment areas since 2007 when the MDR strategy or approach to reviewing maternal deaths was scaled up, but national data has not been quantified. The causes of these deaths have not been documented or published in a recognized journal. There appears to be no data base which has aggregated the causes of maternal deaths in Zambia. Notwithstanding the country has been relying on estimates from WHO to direct policy for the country.

PURPOSE STATEMENT

The study envisioned to provide epidemiologic and characteristics of maternal mortality in the 4 provinces namely copperbelt, central western and northwestern provinces of Zambia. The causes of these deaths are largely preventable by cost effective high impact interventions, (MoodleyJ, 2012). However, the choice of particular interventions that may have the greatest impact depends on sound information at national level about which places are mostly affected and which particular causes are important in those areas. The study will quantitatively estimate the contextual and community factors and actual causes of maternal death based on maternal death review data. The results of the study will inform policy makers, stimulate programmes and direct funding to reduce maternal deaths. In addition the information may be useful in strengthening the surveillance system and provide information on maternal mortality whenever it is required. The study envisaged to stimulate further research on this public health problem.

RESEARCH OBJECTIVES

GOAL/ GENERAL OBJECTIVE

To examine causes of maternal deaths in Zambia, characteristics of the dead women and features of the facilities they died in, based on maternal death review data.

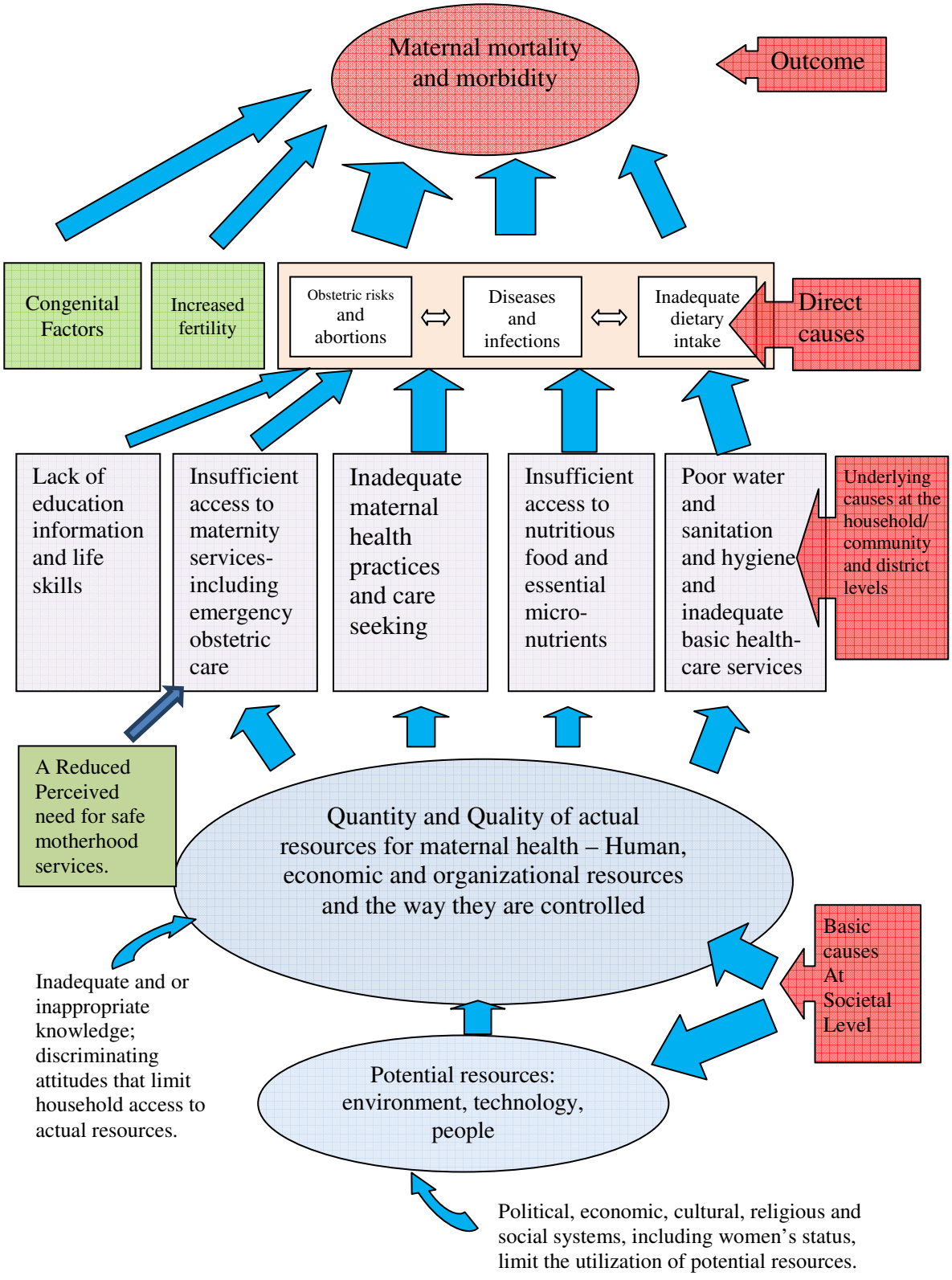
SPECIFIC OJECTIVES

1. To examine recorded causes of maternal mortality based on maternal death review data.
2. To examine sociodemographic, obstetric and care seeking characteristics of women dying during the pregnancy-related period.
3. To assess whether health facilities where the deceased women died were equipped and staffed to handle obstetric emergencies.
4. To estimate MMRatios for the four provinces based on maternal death review data.

CONCEPTUAL FRAMEWORK

The causes and influences leading to maternal mortality are described in the conceptual framework. The outcome, death, is caused by direct causes which are in turn influenced by household, community or district underlying causes. Above all these, societal influences also have a role in maintaining or changing the immediate influences of maternal mortality. The framework that has been used in this study has been adapted and revised from the UNFPA and Initiative for maternal Mortality Programme Assessment (IMMPACT) models.

Figure 2.1 Framework Showing Interactions Of Contextual, Environmental, Demand And Supply Influences On The Proximal And Distal Determinants Of Maternal Mortality. (Adapted from UNICEF and IMMPACT frameworks) (Maine, et al., 2007)



CHAPTER 3: METHODOLOGY

STUDY POPULATION:

The study population consisted of the maternal deaths notified and reviewed in all the districts of 4 provinces; namely Central, Copperbelt, Western and North-western provinces of Zambia.

STUDY SETTING:

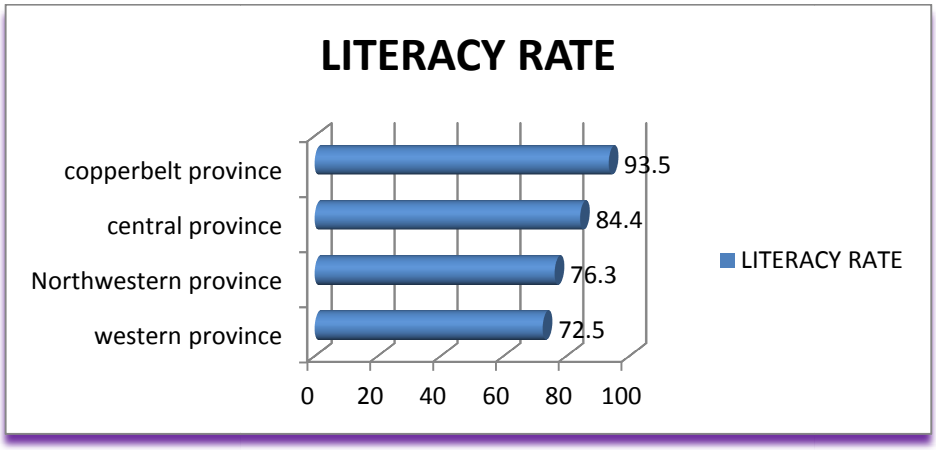
Zambia is a landlocked country located in the southern part of Africa. It is located between 8^{o} and 18^{o} South. The longitudes are between 22^{o} and 34^{o} East. It covers an area of 752,612 square kilometres with a population density of 17.4 persons per square kilometre. The country is administratively divided into provinces which are in turn divided into districts. Four provinces were included in the study, namely Western, Northwestern, Copperbelt and Central provinces. The government health services in all provinces were similar in structure and functioning (Kalumbi J., 2012) (CSO, 2009).

TABLE 3.1 BACKGROUND STATISTICAL INFORMATION FROM THE 4 PROVINCES (Kalumbi J., 2012).

Area	population	Unemployment rate (%)	fertility	MMRatio	
				Observed	Adjusted
Zambia	13, 092, 666	13.0	5.9	836	483
Western province	902, 974	7.7	6.0	1, 387	786
Northwestern prov.	727, 044	10.3	6.8	761	423
Central province	1, 307, 111	12.7	6.3	907	500
Copperbelt prov.	1, 972, 317	22.1	5.0	952	474

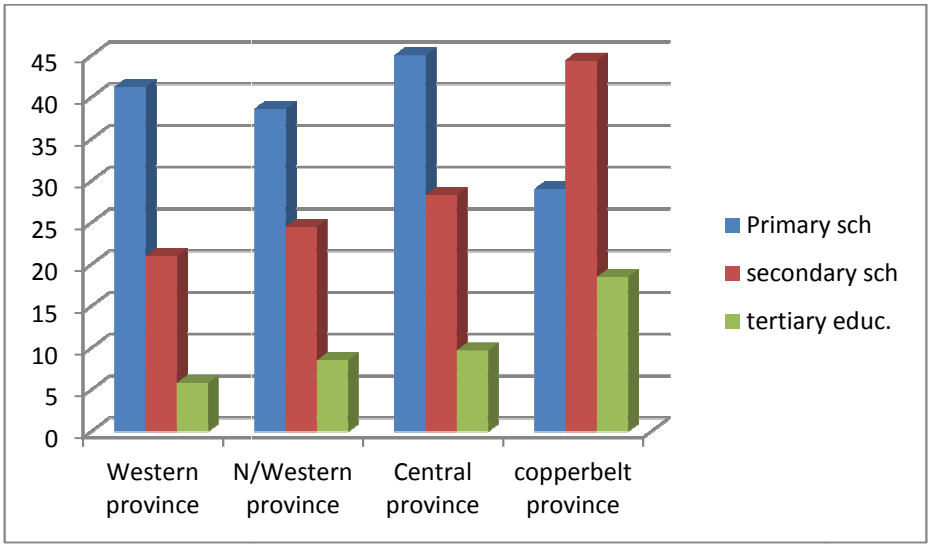
The highest maternal mortality was estimated in western province while the least was in Northwestern province.

Figure 3.1 Literacy rates for adult population (15 years and older) by 4 provinces (Kalumbi J., 2012)



Copperbelt had the best literacy rate at 93.5% of the population at ages 15 years and older.

Figure 3.2 Percentage distribution of the population (25 years and older) that ever attended school by highest education level completed by the 4 provinces, Zambia 2010 (Kalumbi J., 2012)



Western province has the lowest percentage in the secondary and tertiary education categories.

TABLE 3.2 GENDER PARITY INDEX (GPI) AND NET SCHOOL ATTENDANCE FOR PRIMARY AND SECONDARY SCHOOLS. (Kalumbi J., 2012)

Area	Gender Parity Index (♀/♂) for schools		Net school attendance	
	GPI for primary school	GPI for secondary school	Primary school	Secondary school
Zambia	0.99	0.89	71.6	45.5
Rural	0.96	0.75	66.9	33.0
Urban	1.05	1.00	79.6	62.2
PROVINCES				
Western Province	0.98	0.85	67.1	36.6
Northwestern province	0.98	0.80	71.3	42.5
Central province	0.98	0.87	73.0	44.8
Copperbelt province	1.02	0.99	80.2	62.5

The GPI is the gender parity index which is the ratio of girls versus boys attending school. There were more girls attending school versus boys in copperbelt than in western province. Western province had the lowest net school attendance at secondary school level compared to copperbelt province.

TABLE 3.3 NUMBER OF HEALTH FACILITIES IN THE 4 PROVINCES AND THE NUMBER OF BEDS AND COTS.

	Western province	Northwestern Province	Central Province	Copperbelt province
Third level hospitals	0	0	0	3
Second level hospitals	1	1	2	9
First level hospitals	10	10	8	8
Urban health centres	5	6	29	148
Rural health centres	144	135	129	55
Health posts	34	11	36	29
Total Health Facilities	194	163	204	252
Number of beds	2, 136	2, 696	1, 984	4, 560
Number of cots	279	227	195	734

Copperbelt province had more 3rd and 2nd level hospitals and urban health centres than any of the other 3 provinces.

Western province

In terms of poverty in Zambia, western province is second to Luapula province with 80% of the population living in poverty. Only 4 districts out of 7 are connected to the provincial capital by tarred road. The rest of the districts have gravel roads or trails to connect to the provincial capital. During the rainy season the roads are flooded and people have to use boats to reach the provincial centre. Population density is 7.1 persons per square kilometre (Kalumbi J., 2012).

North western province

The province has seen unprecedented growth economically with all districts being connected by tarred roads in the past 5 years. This has also been due to a number of copper mines being opened in the province. This is the most sparsely populated province in the country at 5.8 persons per square kilometre. The poverty level is at 67% of the population (Kalumbi J., 2012).

Central province

The majority of the population (75%) in this province live in rural areas with poverty levels of 61% of the population. All the districts are connected by tarred roads. The economic activities are based on commercial farming and trading around the administrative centres. The main trunk roads connecting the whole country except for 1 province pass through this province. The population density is 13.8 persons per square kilometre.

Copperbelt province

This is richest province in terms of economic activities. The copper and cobalt mines, agriculture, transport and construction are the drivers of the economy. The province is also densely populated with 63 persons living per square kilometre. All the districts are in close proximity to each other with less than an hour's drive

between each adjoining district on all-weather tarred roads. The poverty level is the second lowest in the country at 34% of the population.

SOURCES OF DATA:

The sources of data were community and hospital MDR reports and maternal death notification forms under the Ministry of community development, mother and child health (MCDMCH) in the 4 provinces. The study also examined MDR meeting reports and minutes. This study was conducted using the MDR tools available between January 2008 and January 2014 at the provincial Health offices in the said provinces. The tools included those from public and private health institutions from all reporting districts. The maternal deaths were analyzed by province, but due to paucity of data in central and northwestern provinces the information en mass for the 4 provinces. The standardized tools included:

a) Hospital/ health centre maternal death review form
b) Community based maternal death review tool and
c) Maternal death notification forms.

A total of 471 variables or fields were created to gather data from all the 3 forms. However 126 variables were uploaded onto the data base for the purposes of this dissertation. The table below shows the proportion of variable used from each form. The full list of variables is in annex 4.

TABLE 3.4 UTILIZATION OF VARIABLES PER MDR FORM

MDR Tool/ Form	Number of variables	Number of variables uploaded	Number of variable reported in this study
Notification form	28	28	15
Health Facility form	206	64	64
Community Form	237	34	34
Total	471	126	113

Data from tertiary hospitals could not be included in the dataset as they were using a different approach to discuss maternal deaths or classification system than used in the maternal death review approach.

STUDY DESIGN:

This is a descriptive quantitative case study design of reviewed maternal cases from the 4 provinces in Zambia. The data is derived from cases that were reviewed in the provinces and did not include a comparison group of survivors.

SAMPLING and SAMPLE SIZE:

All reported and reviewed maternal death review forms sent to the provincial health offices during the period of January 2008 to January 2014 were included.
All tertiary hospitals did not review their maternal deaths using MDR tools but only used clinical evidence to discuss and determine the possible causes of the death.

DATA MANAGEMENT:

Data collection

The forms obtained at the provincial health offices were scanned and stored on a laptop computer. Each set of questionnaires for a particular case were then coded according to a codebook (see Appendix) and entered using the Epidata database software. The cases that met the case definition of a pregnancy-related death were included in the analysis.

Data coding and analysis:

The MDR tools use both open and closed ended questions. The closed ended questions were straight away coded and uploaded on to the database. The Process of Qualitative Content Analysis for the open ended questions was used to code the data into categories. The full list of variables in the database is shown in Annex 4.

Statistical Analysis

This step involved running the frequency tables and cross tabulations from the database created. The study was descriptive and findings are presented in terms of

% and frequencies (Bradley, 1993). Data was aggregated and Statistical tests were run using STATA 11 software.

ETHICAL CONSIDERATIONS:

.

Risks/discomforts

The researcher had no contact with cases included onto the database. Only contextual data about the cases was included onto the database.

Protecting data confidentiality

There was an endeavor to ensure anonymity and confidentiality by restricting access to the data on database and laptop. The notification and facility form contained names, however, no names were used in the study material nor were the physical addresses for the cases uploaded on to the data base. Only the researcher accessed the questionnaires while the supervisors accessed the coded data on the database. The scanned records will be destroyed when the study is completed. The computer containing the data was secured with a password.

Approval

Ethical approval was sought from 'Excellence in Research Ethics in Science' (ERES) converge Institutional Review Board (IRB) [ERES Converge IRB] and subsequent permission was sought and granted from the ministry of community development mother and child health.

CHAPTER 4: RESULTS

The findings from the study are illustrated in the figures and tables below in this chapter. The western province had reviewed more women that had died than any of the other 3 provinces. However, this large number of reviewed cases from Western province did not mean that the mortality in this population was higher, table 4.1. The leading direct cause of women dying was obstetric heamorrhage with a median age of 30 years. There were more women dying in level 1 hospitals than in level 2 or rural health centres. Seventy four percent of the women that died were attend by a skilled health care provide in obstetrics during their hospital stay at the time of death.

DEMOGRAPHIC CHARACTERISTICS

The data was derived from all the 3 tools, namely notification, facility and community tools. Table 4.1 shows what proportion of each tool was filled out per province. It was observed that western province had the best reporting rate using the MDR strategy. The paucity in data observed in central and Northwestern provinces limited the grouping of the data into provinces.

TABLE 4.1 FORMS OBTAINED BY PROVINCE. (N= 329)

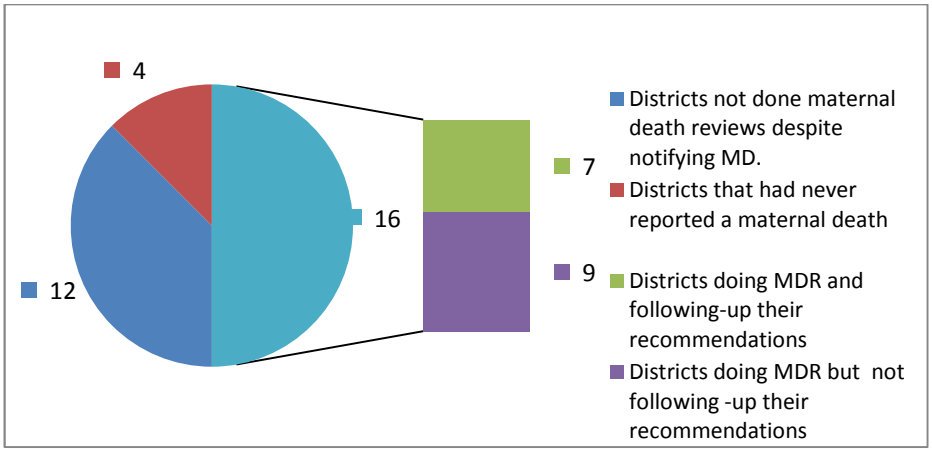
Province	% (N) maternal deaths with notification forms	% (N) Maternal deaths with Health Facility review	% (N) Maternal deaths with Community Review	Total reported maternal deaths per province (N)
Western	100.0 (138)	22.3 (45)	14.5 (29)	(138)
Northwestern	68.8 (44)	23.4 (15)	7.8 (5)	(56)
Copperbelt	67.4 (64)	22.1 (21)	1.5 (10)	(75)
Central	100.0 (60)	0.0 (0)	0.0 (0)	(60)
Total	(296)	(81)	(44)	(329)

The majority of the deaths were reported on notification forms only. We see that there were differences in the reporting of maternal death review data to the provincial centres in the facility and community tools. Central province medical

office (PMO) did not have any health facility or community tools reported to the provincial health office.

A review of the MDR review minutes showed that some districts were not following up the recommendations made during the review meetings.

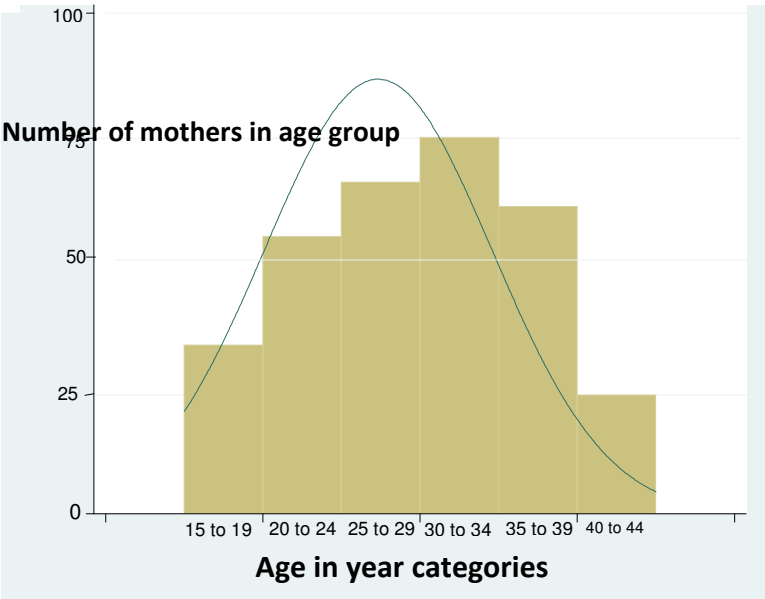
Figure 4.1 Showing the Districts reviewing maternal deaths and those following up the recommendations



The 4 provinces had 32 districts in total in 2013. Of these 32, 4 districts had not notified a MD in the period under review 2008 to 2014. Sixteen districts had notified, reviewed their respective MD and made recommendations. However, it was only 7 districts that reviewed and followed up the recommendations they had made concerning the MD in their catchment areas.

From the bar chart in figure 4.2 the mode and median age was 30 while the mean age was 29.1 years. There were fewer women dying in the extremes of the reproductive age group.

Figure 4.2 Age distribution (n=329)



Mean age: 29.1 years
Min: 16
Max: 45
Standard deviation: 7.1477

The 25th percentile was at age 23 whereas the 75th percentile was 35 years. We see also that the ages were not normally distributed.

Over half of the women that died were married or in otherwise supportive relationships. In a quarter of MD the marital status was not indicated. In terms of schooling, 11% (9) had not attended any formal education while on the other hand 19% (15) had attended primary school.

TABLE 4.2 BACKGROUND CHARACTERISTICS FROM HEALTH FACILITY TOOL (n= 81)

MARITAL STATUS	Percent % (N)
Married	51.9 (42)
Single	17.3 (14)
Missing	30.9 (25)
EDUCATION LEVEL	
No Schooling	11.1 (9)
G1 to G7	18.5 (15)
G8 to G9	7.4 (6)
G10 to G12	2.5 (2)
Tertiary Level (college or University)	2.5 (2)
Missing	58.2 (47)
WOMANS' OCCUPATION	
House wife/ Dependant	29.6 (24)
Peasant Farmer	21.0 (17)
Teacher/ businessman	2.5 (2)
House maid/ Bar Tender	2.5 (2)
None/ missing	44.4 (36)
SPOUSES' OCCUPATION	
Peasant Farmer	56.8 (20)
Businessman/ Fisherman	6.2 (5)
Brick layer/ Security Guard/ carpenter	4.9 (4)
Formal employment (teachers and Agric. Officer)	3.7 (3)
Dependant	1.2 (1)
Driver	1.2 (1)
Car wash attendant	1.2 (1)
None/ Missing	56.8 (46)

A total of 5% of the women were in gainful employment. The information showed that 30% (24) were house wives while a further 21% had been peasant farmers. The majority, 57% (20), of spouses were peasant farmers while only 4% (3) were in formal employment.

UNIVARIATE ANALYSIS

More than half of the MDs were in level 1 hospitals. Post mortem was carried out in 3% of the cases. Half of the mortality (51%) was in level 1 hospitals.

TABLE 4.3 CONTEXTUAL INFORMATION FOR REPORTED PREGNANCY-RELATED DEATHS (N=329)

PLACE OR FACILITY WHERE THE PATIENT DIED	**Percent % (N)**
Health post (HP) or Rural Health Centre (RHC)	19.8 (65)
level 1 hospital	51.4 (169)
level 2 hospital	21.9 (72)
Private clinic/ hospital	0.9 (3)
community	2.7 (9)
On the way	2.4 (8)
Market	0.3 (1)
Missing	0.6 (2)
POSTMORTEM	
No Postmortem done	95.7 (315)
Postmortem done	2.7 (9)
missing	1.5 (5)
LAG TIME BETWEEN DATE OF DEATH AND REPORTING DATE	
Notified in 7 days' time	67.9 (223)
Notified within 8 days up to 30 days	13.9 (46)
Notified between 1 month and 1 year	14.6 (48)
Missing/ Notified after > 1 year	3.7 (12)
HEALTH CARE WORKER REPORTING THE MATERNAL DEATH	
Skilled health workers	74.4 (203)
Trained/ Unskilled health workers	11.0 (30)
Non Health workers/ information officers	9.9 (27)
Missing	4.8 (13)

Two thirds of the institutions managed to report the deaths within the recommended 7 days' time from the day the death occurred.

Parity and gravidity (N=81)

The number of pregnancies ranged from 1 to 11. The gravidity interquartile range was 3 to 6. The highest number of deliveries was 9 while others that died were

reported to have never delivered before, interquartile range of 2 to 5. Most mothers (75%) attended antenatal clinic (ANC) at least once in their last pregnancy.

The causes leading to the death was categorized as a 'direct cause' when an obstetric condition was underlying or 'indirect cause' when the condition was not obstetric in nature. Despite reporting the maternal mortality, no cause was attributed in 9% of the cases.

TABLE 4.4 NOTIFIED CAUSES OF MATERNAL DEATHS (N=329)

OBSTETRIC, MEDICAL AND SURGICAL CONDITIONS CAUSING MATERNAL DEATH (N=329)	**Frequency % (N)**
Direct	
Postpartum Heamorrhage (PPH)/ complications causing PPH	23.4 (77)
APH (Antepartum Heamorrhage)	11.6 (38)
Severe Anaemia	12.6 (41)
Infections/ Septic conditions in pregnancy or puerperium	11.9 (39)
Hypertensive conditions	4.3 (14)
Abortion	3.1 (10)
Malpresentation, Cephalopelvic disproportion (CPD)	2.4 (8)
Peri-operative conditions/ complications	2.4 (8)
Chest conditions	2.1 (7)
Thromboembolic conditions	1.8 (6)
Other contributing obstetric factors (conditions)	1.8 (6)
Indirect causes	
Indirect medical and surgical conditions	4.1 (11)
Infectious conditions not directly affecting pregnancy	2.2 (6)
HIV infection with complications.	6.2 (17)
None/ missing	8.9 (24)

Bleeding obstetric complications, which included antepartum and postpartum heamorrhage and severe anaemia, were reported to account for nearly half of the causes of death. Infections and septic conditions in pregnancy or puerperium were also commonly reported causes of death. HIV infection and AIDS was reported to account for 6.2% (17) of the pregnancy-related mortality. The list of causes of death included in each category is included in the table 4.4.1 below.

TABLE 4.4.1 DISTRIBUTION OF CAUSES OF MATERNAL MORTALITY

OBSTETRIC, MEDICAL AND SURGICAL CONDITIONS CAUSING MATERNAL DEATH	**Frequency % (N)**
Peri-operative conditions/ complications	**2.25 (5)**
cardiac arrest	
Post Op Complications	
DIC post C/S	
unspecified C/S complication	
Cardiac conditions	**3.60 (8)**
CCF/ CCF (congestive cardiac failure) with CVA (Cerebral vascular accident)	
Cardiogenic Shock	
Cardiac Disease with Chest Complication	
Mal presentation CPD	**2.70 (6)**
Hand prolapse	
CPD (Cephalopelvic disproportion)/ obstructed Labour	
Severe Anaemia	**12.61 (28)**
Oesophageal Varices	
Heart Failure secondary to Anaemia	
Anaemia	
Hypovolaemic Shock	
Postpartum Obstetric complications causing severe anaemia	**19.82 (44)**
PPH (postpartum Heamorrhage)	
DIC (disseminated Intravascular Coagulation)	
UFD/DIC (intra uterine foetal death) / (disseminate intravascular coagul.)	
Retained placentae	
6 APH	**14.41 (32)**
Ectopic pregnancy/ raptured ectopic pregnancy	
Placenta Abruption	
Raptured uterus	
Placentae Praevia	
APH (Ante Partum Heamorrhage	
CaCx (Cancer of the Cervix)/ Advanced CaCx	
Abortion	**3.60 (8)**
Septic Abortion/	
Abortion/ Incomplete abortion	
Thrombo embolic conditions	**0.90 (2)**
Pulmonary Embolism	

chorioamnionitis	
Septic conditions	**12.16 (27)**
Peurperal Sepsis	
Peritonitis	
Septic Shock/ Septicemia/ Sepsis	
Spleenic fungal infection/ liver failure	
Meningitis/ peurperal meningitis	
HIV infection with other complications and AIDS.	**5.86 (13)**
Gastroenteritis/ giardia infection	
Cryptococal Meningitis	
ARC secondary to depression (AIDS Related Complex)	
Measles in HIV infection	
HIV with PCP/ PTB/ defaulters	
Chest conditions	**2.25 (5)**
Cough	
Pulmonary Oedema	
MENDELSON syndrome	
Pneumonia R/ Pulmonary oedema	
PIH	**2.25 (5)**
PIH (pregnancy induced hypertension)	
Eclampsia	**4.95 (11)**
Eclampsia	
malaria	**1.80 (4)**
malaria/ complicated malaria	
Others contributing factors (conditions)	**4.50 (10)**
Red Degeneration of fibroid uterus	
acute renal failure	
PUO (Pyrexia of Unknown origin)	
Herbal intoxication	
poisoning/ organophosphorous poisoning	
hyperemesis	
cholera	
sickle cell disease	
DKA (diabetic ketoacidosis)	
severe burns from epileptic	
Missing	**8.56 (19)**
None / missing/ no diagnosis	

The table includes all the identified causes on maternal mortality. There was 1 accidental cause of death in pregnancy due to a fall from a height, while the other 328 case met the ICD 10 case definition of a maternal mortality.

TABLE 4.5 SHOWING ASCRIBED CAUSE OF DEATH BY RELATIVES ACCORDING TO COMMUNITY FORMS (n=44)

CAUSE OF DEATH ASCRIBED BY RELATIVES. (N=44)	Percentage % N
Anaemia, PPH, bleeding, retained	34.1 (15)
Witchcraft, Husband's superstitious activity ('incila'), did not know	18.2 (8)
Seizures swollen feet or legs	9.1 (4)
Fever, Malaria, Venereal disease, Brain infection, infection from husband	9.1 (4)
Health care worker neglect, incompetence, oversight, no action	6.8 (3)
Chest pain, sharp chest pain, cough	6.8 (3)
Backache	2.7 (1)
Delay to go to hospital	2.7 (1)
Herbal medication used to induce abortion	2.7 (1)
Missing	9.1 (4)

In 7% of the cases the family felt the health care provider was negligent. The community perception and health facility reports showed that bleeding conditions were the most prevalent cause of death.

Health outcomes are dependent on the skills or training of the health provider offering the service at the clinic or hospital. Of the 81 that died and were reviewed in the health facility form, we see that 21% of the women were attended to by untrained health workers or family members at the time of death in the health facility.

TABLE 4.6 HEALTH WORKERS ATTENDING TO THE MOTHERS AT THE HEALTH FACILITY ACCORDING TO HEALTH FACILITY FORMS (N=81)

MAIN ATTENDANT AT ADMISSION	Percentage % (N)
Skilled health workers	**67.9 (55)**
Trained Health workers	**17.3 (14)**
Untrained health workers	**12.4 (10)**
Missing/ Not applicable	**2.5 (2)**
MAIN ATTENDANT AT DELIVERY	
Skilled health workers	**48.2 (39)**
Trained Health workers	**21.0 (17)**
Untrained health worker, family member	**18.5 (15)**
Missing/ Not Applicable/ No assistant at delivery	**12.4 (10)**
MAIN ATTENDANT AT TIME OF DEATH	
Skilled health workers	**55.6 (45)**
Trained Health workers	**17.3 (14)**
Untrained health worker, family member	**21.0 (17)**
Missing/ Not Applicable	**6.2 (5)**
PERSON THAT ACCOMPANIED PATIENT WHEN REFERRED TO HOSPITAL	
Community delivery or was not referred	**39.5 (32)**
Relatives, TBA or Friends	**21.0 (17)**
Nurse on duty	**8.6 (7)**
Husband	**1.2 (1)**
Missing	**29.6 (24)**

Two thirds of the women that were admitted by skilled attendants. A lower percentage of deliveries were attended by skilled workers at delivery than at admission. About half of the women were attended by skilled workers at the time of death.

Despite having the right skills set, some equipment is needed to provide to provide emergency obstetric care. A total of 30% of the women were not provided with oxygen.

TABLE 4.7 EQUIPMENT LACKING TO OFFER EMERGENCY OBSTETRIC CARE ACCORDING TO HEALTH FACILITY FORMS (N=81)

EQUIPMENT LACKING (N=81)	**Percentage % (N)**
Oxygen concentrator	23.5 (19)
Oxygen cylinder	6.2 (5)
Sims' speculum	3.7 (3)
Working radio / cellphone network	2.5 (2)
Computerized Axial tomography (CAT scan)	2.5 (2)
Ultrasound machine	2.5 (2)
Manual vacuum aspiration kit	1.2 (1)
Endo tracheal tubes/ Equipment	1.2 (1)
Lighting	1.2 (1)
Intensive care unit	1.2 (1)
Not applicable /Missing	54.3 (44)
SUPPLIES THAT LACKED (N=81)	
Blood for transfusion/ blood giving sets/ fresh blood	13.4 (11)
Resuscitative drugs/ Oxygen supply/ no normal saline	4.9 (4)
GYN and surgical gloves/ no oxytocin	2.5 (2)
Suture materials (thread)	2.5 (2)
Urinalysis testing strips & Magnesium sulphate drug	1.2 (1)
Heamoglobin test reagents	1.2 (1)
Intra venous antibiotics	1.2 (1)
Not applicable/ Missing	72.9 (59)

Some health facilities lacked basic equipment like specula or lighting. Life support or resuscitative equipment as oxygen cylinders or the supply of oxygen was shown to be inadequate in some facilities. In 3% of the cases communication to higher centres had failed.

At times there were delays on the part of the mother to attend the health facility when the complication occurred. The health system has a policy of having a birth preparedness plan yet 5% of the women delayed to seek medical attention despite making the decision.

TABLE 4.8 CAUSES FOR DELAY TO REACH THE HEALTH FACILITY ACCORDING TO HEALTH FACILITY FORMS

REASONS FOR DELAY IN STARTING OFF FROM HOME BEFORE GOING TO THE HEALTH FACILITY **(N=81)**	**Percentage % (N)**
Delay in arriving at health facility (Level 1 Hosp. and Rural health centre)	8.6 (7)
Went to use traditional herbs first	6.2 (5)
Delay in seeking medical care after decision made	4.9 (4)
Delivered at home	2.5 (2)
Delivered on way to health centre	1.2 (1)
Poor health seeking behavior	1.2 (1)
Nobody knew she was pregnant (abortion)	1.2 (1)
Measles self-treatment at home	1.2 (1)
Precipitate labour	1.2 (1)
Not applicable/ Missing	71.6 (58)

In 9% of the cases delayed to arrive at the health facility. However, 6% of the cases sought help by using traditional herbs.

There may be delays in receiving appropriate care despite the client arriving timely at the health facility. The table 4.8 brought about provider and system related issues.

TABLE 4.9 SHOWING THE DELAYS LEADING TO RECEIVING APPROPRIATE CARE ACCORDING TO HEALTH FACILITY FORMS

DELAY or OBSTACLES IN RECEIVING APPROPRIATE CARE (N=81)	Percentage % (N)
Ambulance delayed due to distance (15hrs)	8.6 (7)
Delay in caesarian section	3.7 (3)
Lab delay to have blood available	2.5 (2)
Delay to start antiretroviral therapy (ART)	2.5 (2)
Delayed referral	2.5 (2)
Delayed blood transfusion	2.5 (2)
Delayed to inform the medical doctor	2.5 (2)
Delivered by unskilled staff/ no health care worker atRHC	2.5 (2)
Patient refused to be examined further	1.2 (1)
Delay to start Anti tuberculosis therapy (ATT)	1.2 (1)
Attending to medical condition than the pregnancy related issues	1.2 (1)
Delay to correct the anaemia	1.2 (1)
Delivery at home then taken to traditional herbalist then RHC	1.2 (1)
Delay by MO to travel to RHC to attend the patient	1.2 (1)
Patient was not admitted at first contact with hospital	1.2 (1)
Delayed to give a second laparotomy	1.2 (1)
Delays in taking of regular vital signs	1.2 (1)
Oxytocin repeated but not followed up	1.2 (1)
Male Enrolled nurse reluctant to do midwifery activities	1.2 (1)
Not applicable/ Missing	59.3 (48)

The great distance the ambulance had to travel caused the delay for the women to receive appropriate care in 9% of the cases. The delay to receive caesarian section was observed in 4% of the cases.

The health provider issues that surrounded the death despite the necessary equipment and supplies being available were due over sight or incompetence by the health care provider.

TABLE 4.10 STAFF OVERSIGHT OBSERVED IN THE REVIEWED CASES ACCORDING TO HEALTH FACILITY FORMS

Staff oversight (N=81)	**Percentage % (N)**
Missed or Delay to manage the PPH/ Missed diagnosis	8.6 (7)
Delayed resuscitative measures/ IV fluids not started at RHC.	6.2 (5)
Delayed examination/ vaginal examination and its documentation	4.9 (4)
Available FBC not done despite anaemia/ delayed Hb checking	3.7 (3)
Did not pay attention to changes/ fluctuations in the vitals	2.5 (2)
MO not informed about patient change in condition	2.5 (2)
Patients with genital warts allowed to deliver vaginally	2.5 (2)
Delay by On call Midwife, Lab technician and Medical Officer	1.2 (1)
MO not reviewing patient regularly	1.2 (1)
Antimalarial treatment not given	1.2 (1)
Gave Fansidar instead of quinine	1.2 (1)
Not applicable/ Missing	64.2 (52)

There was a missed diagnosis or delay to attend to an obstetric condition such as postpartum heamorrhage in 9% of the cases. Delayed resuscitative measures were observed in 6% of the cases.

MULTIVARIATE ANALYSIS

In this section variables were cross tabulated. The Diagnosis as reported from the community was cross tabulated with the diagnosis from the health facility. The analysis was done to test the community observations with those observations made from the health facility. We see that in 18 % of the cases superstition of witchcraft was cited as a cause of death.

The study went on to cross tabulate the referral versus the level of health facility the patient died in and stratified it with the diagnosis of the patient. There were 311 women that died in the health facilities. Fifty one percent of the women died in level 1 hospitals.

TABLE 4.11: PERCENTAGE OF WOMEN, WHO DIED FROM SPECIFIC COMPLICATIONS THAT WERE REFERRED FROM THE FACILITY THEY INITIALLY SOUGHT CARE IN (N=311).

Category of cause of death	HP or RHC		Level 1 hospital		Level 2 Hospital		Private hospital		Total	
	% [5]	n[6]	%	n	%	n	%	n	**%**	**n**
Direct										
Postpartum Heamorrhage (PPH)/ complications causing PPH	4	25	48	33	80	15	0	0	**40**	**73**
APH (Antepartum Heamorrhage)	0	5	78	23	100	7	0	1	**69**	**36**
Severe Anaemia	29	7	71	24	50	8	0	0	**59**	**39**
Infections/ Septic conditions in pregnancy or puerperium	50	2	48	27	77	9	0	0	**55**	**38**
Hypertensive conditions	0	4	67	6	67	3	100	1	**50**	**14**
Abortion	0	3	40	5	100	2	0	0	**40**	**10**
Malpresentation, Cephalopelvic disproportion (CPD)	0	4	100	1	100	1	0	0	**33**	**6**
Peri-operative conditions/ complications	0	0	20	5	67	3	0	0	**38**	**8**
Chest conditions	0	0	33	6	100	1	0	0	**43**	**7**
Thromboembolic conditions	0	1	0	3	100	1	0	1	**17**	**6**
Other contributing obstetric factors (conditions)	0	3	0	2	100	1	0	0	**17**	**6**
Indirect causes										
Indirect medical and surgical conditions	50	2	45	11	85	7	0	0	**60**	**20**
Infectious conditions not directly affecting pregnancy	0	2	18	11	80	8	0	0	**38**	**21**
HIV infection/ complications.	0	2	100	3	0	4	0	0	**33**	**9**
None/ missing	0	7	33	9	100	2	0	0	**28**	**18**
	7	67	51	169	75	72	33	3	**45**	**311**

[5] Indicates proportion of referred patients
[6] Shows the total number of both the referred and non-referred patients.

Of the 67 women that died in health post or rural health centres only 7 % of the women were referred to higher levels of care. This may mean that rural health centres felt confident to handle the clients' problem despite it causing the mortality.

Assuming the notifications were an estimate of the maternal mortality in the provinces surveyed, we went ahead to calculate the maternal mortality ratio for each of the 4 provinces. The analysis went on to compare the calculated MMRatio with estimates from the demographic health surveys 0f 2007 and the census estimate of 2010.

TABLE 4.12 MATERNAL DEATHS AND MATERNAL MORTALITY RATIO BY PLACE OF RESIDENCE (N=329)

Place of residence in terms of country and province for the maternal death. (n=329)	Maternal deaths % N	Live births, 2008-2013 [7](according to DHIS)	Estimated MMRatio (per 100,000 live births)	Unadjusted MMRatio[8] (according to Census 2010)
Zambia				691
Copperbelt	17.9 (69)	287, 419	24.0	678
Central	17.9 (59)	143, 613	41.1	715
Western	40.1 (132)	79, 441	166.1	1124
Northwestern	15.2 (50)	80, 852	62.5	605
Luapula and Northern	1.1 (3)	-	-	-
Angola	2.1(7)	-	-	-
Congo DR	2.7(9)	-	-	-

Some of the notified deaths 6% were mothers from other neighboring nationalities. Western province had the highest estimated mortality ratio at 166/ 100, 000 live births. We see that MDR could be catching a small fraction of the maternal deaths.

[7] The live births were obtained from the District Health Information Systems.
[8] The maternal mortality ratio was obtained from data published from the central statistical office (CSO) population obtained from the 2010 census of the population. Unlike the reported data, the figures quoted here are unadjusted.

CHAPTER 5: DISCUSSION

The Study Findings

Obstetric heamorrhage was the leading direct cause of mortality. There were deficiencies in the competences of the health workers, the supplies and medical equipment. The study reviewed 329 maternal deaths for the period January 2008 and January 2014. The Cases were notified from 4 provinces, namely Western, Northwestern, Central and Copperbelt provinces. We see that more cases were notified by western province than any other province despite the small population in the province. The higher number of reviewed cases in western province may not mean a greater burden of maternal mortality but that the province seemed to have been better at reporting and reviewing the maternal deaths.

Collectively the bleeding conditions accounted for half of all the pregnancy related deaths. The high mortality due to heamorrhage could have been due to poor management at facility level and inadequate resuscitation measures when an emergency occurred. Supplies that lacked included blood for blood transfusion, giving sets or availability of fresh blood in some of the cases. In some cases the intention to conceal an abortion or that there was a pregnancy when there was a vaginal bleed, may have led to severe heamorrhage. Bates et al in 2008 reviewed articles from 1970 to 2007 that include themes on maternal deaths and near misses due to heamorrhage and the need for blood transfusion in sub-Saharan Africa. He showed that despite severe heamorrhage being the leading cause of maternal death blood supply was critically inadequate. Twenty of the 37 studies showed a direct association of maternal deaths and lack of blood transfusions (Bates, Chapotera, McKew, & Van Den Broek, 2008). Indeed the use of other clinical approaches to prevent severe anaemia and treat hypovolaemia may reduce the need for supplies of blood for transfusion.

The list of direct causes seen in this study was no different from the one depicted in the literature in other regions of the world. However, the proportion of MD in each category was what was different from the other settings, largely influenced by the disease patterns in those regions such as HIV infections and non-communicable diseases in these other regions. (childinfo, 2012) (Khan, Wojdyla, Say, Gulmezoglu, &

Van Look, 2006) (Oyieke, Obore, & Kigondu, 2006) (Abe & Omo-Aghoja, 2008). Abortion in Southern Asia is rare or under reported due stigmatization or for religious reasons, abortion services are not readily available. There may be intentional under-reporting by the providers because abortions are restricted. Some abortions may have been reported as sepsis or heamorrhage (Lale Say, 2014). An example of this was that in South Africa during the Confidential Enquiry into Maternal Deaths (CEMD), the leading cause of pregnancy related death was non-pregnancy related infections (41%), including HIV infections complicated by TB and Pneumonia (MoodleyJ, 2012). The high proportion of HIV related MD is probably due to the high rates of HIV in the general population. It has also been observed that non-pregnancy related infections, like HIV, and other medical and surgical conditions are not amenable to obstetric interventions but may require other disciplines to address them. The MD due to complications of HIV infection and non-communicable diseases such as diabetes and hypertension can thus be prevented by controlling the HIV/AIDS and these other conditions in the general population.

Relatives attributed witchcraft as a cause of death in the women. However, after cross tabulating the Diagnosis from the health facility with the attributed cause of death from the community members, it appears superstitious activity or witchcraft was attributed to haemorrhagic causes in 6 out of the 8 cases. The suspicion of witchcraft as a cause for deaths during delivery or pregnancy is entrenched in the tradition and culture. Women arriving home after delivery of a new born are greeted with a phrase that has a connotation that 'they have survived.' The relatives to the women that died were describing the symptoms they observed in their patients and not the diagnoses made by the clinicians. This situation could be due to the poor communication the clinicians may have had with the caretakers of the patients that died or the limited understanding of medical terms by the relatives.

Abortions which are inevitable phenomena in some pregnant women may not be stopped, but the MDs due to abortions could have been avoided by prompt post abortion care as obtained in other settings (Chou, 2012). There were also deficiencies in the supplies, skills and equipment to manage severe hypotension in the HP and RHC. Some hypertensive patients were managed at rural health centre level even with

the attendant complexity of managing eclampsia. These hypertensive patients that needed referral were not referred. Similarly, Malpresentation and Cephalopelvic disproportion were managed at rural health centre level yet these patients needed to be referred for manual vacuum aspiration (MVA) or caesarean section respectively. This non-referral of clients that needed referral may mean that the providers at the health post or rural health centre lacked or were deficient in the skills or means to make a diagnosis. In a few cases the diagnosis was missed but the likely diagnoses to explain the events surrounding the death were made at the time of the review. In some cases, however, relatives refused referral due to the bad outcomes experienced in previously referred patients.

In some cases the referral system failed as there was no ambulance available when a complication occurred, or the long distances needed to be covered when an emergency occurred in remote health facilities would limit the time for the women to receive appropriate care. Strengthening the adherence to the referral policy may translate to fewer cases of MD in RHC and HP. In some women complications during home deliveries caused the death as the clients were in poor condition by the time they arrived at the health facility coupled with inadequate resuscitation measures in these facilities. Home deliveries in some women were done to facilitate the use of herbal medication or indeed they may have had precipitated labour. Some women due to ill preparation delayed to go to the health facility despite having decided to deliver at the medical institution.

The study has compared the MMRatios to ones obtained through census data; however, the method used to collect the census 2010 was different than exercised in this study. The estimates from this study were much lower than those estimated by the census data which was probably due to under reporting. It was noted during the provincial visits that some district medical offices were not trained to conduct maternal death reviews in the northwestern and copperbelt provinces and as such were inconsistent in completing the facility or community tools for each reported case. Some districts especially in northwestern were not reporting MDs at all. Another observation made by the provincial maternal and child health officers is that MDR

tended to be restricted to facility MD, while the community deaths may not be picked up by the district and facility reviewers.

Hadley and Tuba (Hadley & Tuba, 2011) observed that routinely collected data through the Health Management information Systems (HMIS) captured 10% of the estimated maternal deaths. This study, however, observed that the provinces notified between 3.5% and 15% of the estimated maternal deaths in the provinces. In order to document the unreported maternal deaths on the Copperbelt Hadley and Tuba used the Investigate Maternal Deaths and Act (IMCA) approach designed to address deficiencies in the routine reporting system that tended to leave out the community deaths. The approach was an extension of the MDR approach which in cooperated community structures that would identify the community deaths when they occurred and would help review and provide light on the circumstances surrounding the death.

Western province had the largest estimated maternal mortality ratio while the lowest MMRatio was estimated for the copperbelt province. The 2010 census report showed that the copperbelt was the more affluent province among the 4 provinces in the study which could explain the reduced MMRatio in this population (Kalumbi J., 2012). Notwithstanding, the data seemed to show consistence where less MD were seen in the copperbelt than in the western province in both this study and the Census. Factors outside the health system such as geographic distribution of the population may have impacted on the maternal outcomes of the pregnancies leading to the MD. The copperbelt province for instance is densely populated with fairly good town planning such that the health facilities are fairly well distributed and the clients have shorter distances to travel to reach any health facility. The good road network too could have enhanced the referral and access to specialized or advanced services such as blood transfusion. Following this information it is possible that raising socioeconomic status of the women may improve the outcomes of the pregnancies as shown in other studies. (Khan, Wojdyla, Say, Gulmezoglu, & Van Look, 2006) (Abe & Omo-Aghoja, 2008)

Some Districts in Northwestern province were not reporting any of the maternal deaths using the MDR tools despite some MD occurring in their catchment areas. It was realized by the provincial maternal and child officer that these districts were not

oriented in the use of the MDR tools. The high turnover and attrition of staff in the remote districts has led to loss of workers vested in the use of MDR tools. However the provincial office endeavored to review some of the deaths by sending its staff to do the reviews in the district. Central province had received notifications of MD from all its districts in the province but no facility or community reviews had been received. The officer responsible for MDR at the Central PMO however reported that the reviews were reportedly done but were kept by the respective district offices. Thus we could not include these unavailable tools in the current study.

Half of the Maternal Deaths occurred in Level 1 hospitals despite these institutions being equipped with instrumentation to offer Comprehensive Emergency Obstetric Care (CEOC). Though this study did not aim to evaluate the emergency obstetric care program, but having observed the facility failures above, system, supply and staffing measures necessary for emergency obstetric care may need to be reviewed at level 1 hospitals. By design RHC and HP are unable to handle emergency complications of pregnancy or delivery but whenever complications occurred the facility would refer such clients needing advanced care.

Limitations and generalizability

The data used in the study was secondary data from MDR forms. The 4 provinces where data was collected were purposively chosen based on ease of access and availability of data. The Data could not be stratified by province as some provinces did not have reviewed data on the health facility of community tools. This limited the subgroup analysis of each province. The fewer cases reviewed at health facility and community levels reduced the power to detect subgroup differences in the MD included in the study. A study to include all the notified cases from the whole country may be needed.

The study was restricted to be a descriptive one as there was no comparison group even by province. There may have been information bias as there were few post mortems and the lack of collaborative information from the unreviewed MDs. There were no MDs that died in tertiary institutions included in this study as the deaths were

classified and discussed clinically such that the case definition and subsequent discussion using MDR tools for a MD were not satisfied. The classification in the tertiary hospitals simply segregated the obstetric conditions from the medical or surgical conditions but highlighted gaps that may have contributed to the death at facility level.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

CONCLUSION

Maternal deaths in western, northwestern, central and copperbelt provinces of Zambia could be prevented by timely and appropriate emergence obstetric care. Obstetric heamorrhage accounted for half of the notified maternal deaths. The women dying were in low obstetric risk group or in the prime of their reproductive lives. The more affluent province in socioeconomic health care delivery terms recorded fewer maternal deaths.

While this and other studies have shown that the poor socioeconomic status of the people are important predictors of maternal mortality, this study showed that there were gaps in the human resources for health, low referral rates by health care providers, lack resuscitative supplies or equipment for emergence obstetric care were observed to surround maternal deaths. The delay to receive appropriate care in the face of obstetric emergencies, were observed to be an important and common phenomenon in the MD in level 1 and level 2 hospitals..

Notwithstanding the wealth of information presented in this study, there is need to have a national study of MDR data in order to get a glimpse of the bigger national picture and show the subgroup differences. To have the bigger picture, the districts not doing the maternal death reviews despite reporting MDs, may need to review the deaths occurring in their respective catchment areas.

RECOMMENDATIONS

- Maternal Death reviewed data may need to be quantified regularly at national level to provide real time feedback to policy makers on what causes of maternal mortality are prevalent and show which policies have worked.

- The referral system may need to be reviewed so as reduce mortality at rural health centre and level 1 hospital caused by non-referral, late referrals, inadequate preparation at referral and the management of referred patients.

- Medical anthropologic studies may be carried out to elucidate the community factors surrounding the maternal deaths especially the community deaths.

- Emergency Obstetric and Neonatal care may need to be scaled up to all Health Posts, Rural Health Centres and level 1 hospitals. This may prevent Maternal Deaths when complications occur in any of these facilities.

- The MCDMCH may need to revise the means by which the MDR strategy is administered, monitored, evaluated and the way information about successful and innovative interventions are disseminated in the districts and provincial offices to improve maternal outcomes.

TIMELINE

	June 2013	July 2013	Aug 2013	Mar 2014	Apr 2014	May 2014	June 2014	July 2014	Aug 2014	Mar 2014	Apr 2014	May 2014	June 2014	July 2014	Aug 2014	Sept 2014	Oct 2014
Proposal submission to ethics committee																	
Data collection from provincial centres.																	
Data compilation / aggregation																	
Analysis/ presentation																	
Submission of the dissertation for marking.																	
Manuscript/ publishing																	

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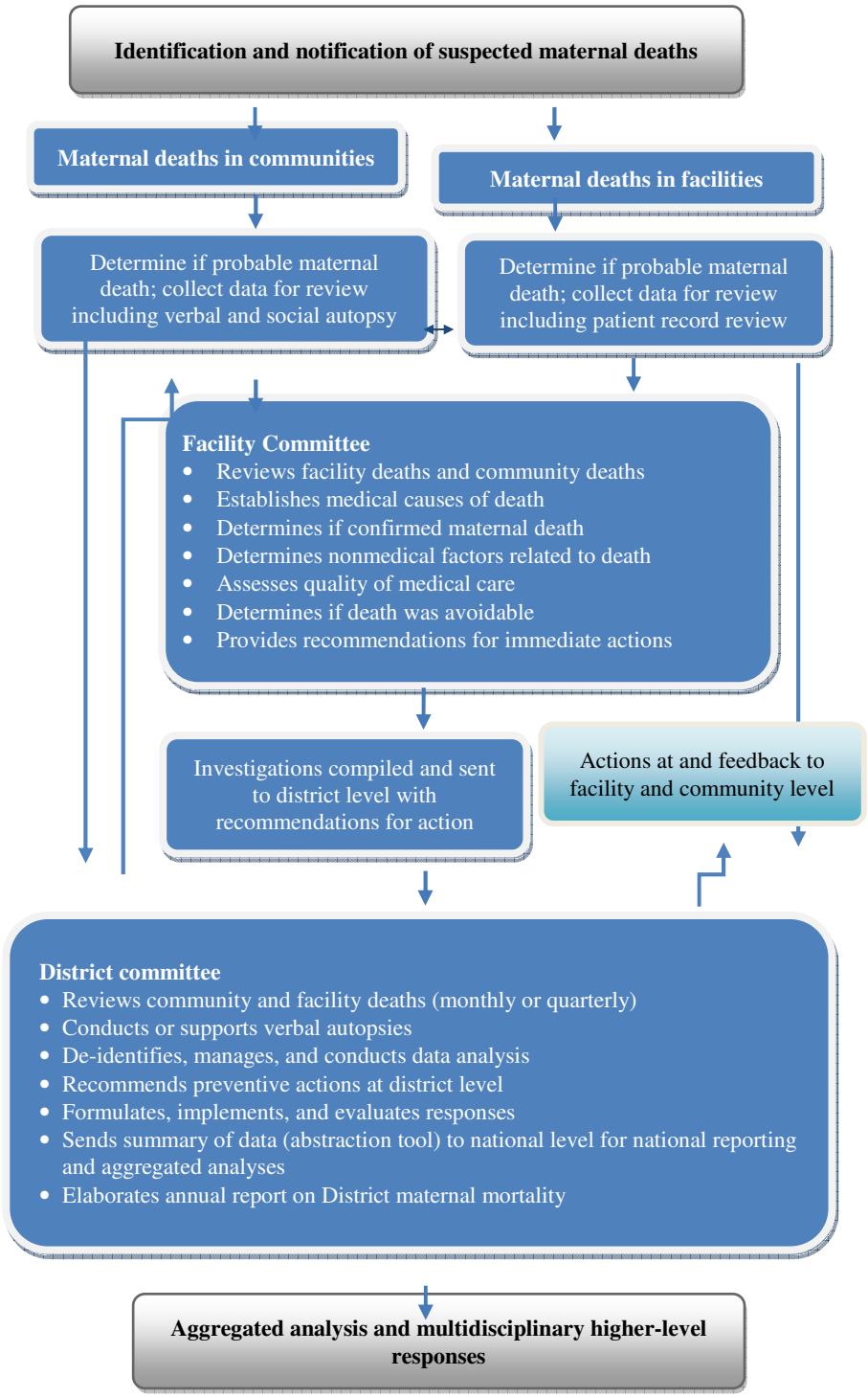
ANNEXES

Annex 1 - Maternal death reviews at district level flow chart.

Figure A1: Maternal Death Review flow chart (adapted from the Zambia MDR guidelines 2013[9]



[9] When a death occurs in the catchment area where the (RHC or HP) facility is, the facility committee investigates the community death and makes recommendations. However, facility deaths need to have a community review.

Annex 2 – MDR Data Collection Instruments

1. MATERNAL DEATH AUDIT AND NOTIFICATION FORM

MATERNAL DEATH AUDIT AND NOTIFICATION FORM

1. This form should be completed for all deaths including abortion and ectopic pregnancy related deaths, in pregnant women or within 42 days after termination of pregnancy, irrespective of duration or site of pregnancy.
2. Complete the form in triplicate within 7 days of a maternal death; the original is sent to the Provincial Health Director, the duplicate is sent to the District Health Director and the other remains in the book at the institution. If the Maternal Death, occurred at home either the Rural Health or the Hospital will send the notification form.
3. Circle "Yes/ "No"/ "Unknown" or the appropriate alternative given.
4. **Please use print letters and write clearly.**

PLACE OF DEATH:
Province:…….District Health Office:…….
*Institution/Home/On the way (# if in institution give details)

Name of institution# …….
Level of care * 1 = HP/RHC: 2 = Hospital: 3 = Hospital:
4 = Level 3 Hospital 5 = Private clinic / hospital. (circle)

Referral from another institutions Y / N*
*(If "Y"), name of referring institution……

2. DETAILS OF DECEASED

Name of Deceased:…… Inpatient No:……
Age (years) or DOB:……. Date of Death……

Address (Physical):
Village/Township:…….Town/District……Chief:……..….
Land Mark:----------

3. CAUSE OF DEATH:
Cause of death (one – specify):……Post-mortem performed Y/N/Unknown

4. THIS FORM IS COMPLETED BY:
Name (print):…….Position:……..
Contact telephone:……Date……./……/201….

Signature:……

2. HEALTH FACILITY DATA COLLECTION INSTRUMENTS

BEYOND THE NUMBERS

MATERNAL DEATH REVIEW FORMS

Health Facility Data Collection Instruments

Adopted for Zambia
From WHO

November 2007

HOSPITAL/ HEALTH CENTRE LEVEL MATERNAL DEATH REVIEW FORM

Name of facility:……

District:……..

Province:……

Date of interview:…….

Facility staff interview
Introduce your self to the respondent and thank him or her for helping the MDR by agreeing to be interviewed. Offer to answer any questions about the purpose and methods of MDR. If there are staff present who would not have written in the notes (e.g. CDEs) but who cared for the woman, give them a code as well. Reassure the respondent that the results of the interview have no punitive consequences.

Annex 2 Part A: Particulars of the deceased

Key data item	**Details**
Code number for deceased	
Age	
Marital status	
Highest Education level attained by deceased	
Occupation	
Occupation of spouse	
Highest Education level attained by spouse	
Relevant past medical history	
Past obstetric history	
Gravidity	
Parity	
Antenatal care attended	Yes / No
Number of ANC visits	
Gestation at time of death	
Died delivered or undelivered	
Place of delivery (specify)	
If delivered, is bay alive or not	
If baby dead, a t what age did baby die	
If baby dead. What was cause of death	
Main attendant at delivery (Doctor, Midwife, tTBA/TBA, self or member of the family, specify	
Referral (If yes and name of referring facility	

Annex 2 Part B: Interview with the respondent

N.B: Additional information should be put on separate sheet of paper.

Checklist	**Details**
Verbatim report Can you tell me what happened from the time *the deceased* arrived at *(health* facility)* until she was referred/ died?	
Respondents Knowledge of the patient	
Were you with *(the deceased*) when she died / was referred?	
If not, how long before *the deceased* death / referral did you see her?	
Who told you about her death /referral	
Was this person with *the deceased* when she died /	

referred?	
Management of patient at health facility	
Who *(designation of staff)* admitted *the deceased?*	
What time was *the deceased* admitted?	
Who (*designation of staff*) was looking after *the deceased* when she died / referred?	
What **condition** was *the deceased* brought in to the facility? (circle all that applies)	-Conscious * Walking * Wheeled in - Unconscious
What were your **findings / diagnosis?**	
Did you feel confident with your diagnosis?	
What was your plan of care for *the deceased?* including referral and consultation	
Were there any **obstacles / delays** in implementing your plan? If yes, what were these?	
Did you have enough team support?	
If you referred the patient, how did you effect the referral?	
Who accompanied the patient	
Symptoms/ Signs before death	
Close to the time of death, did the patient have any of the following problems: *(tick appropriate response)*	
• Convulsions/fits	
• Bleeding from the vagina	
• Long labour (longer than 12 hours)	
• High fever	
• Yellow eyes (jaundice)	
• Severe abdominal pains	
• Sever chest pains	
• Shortness of breath	
• Bleeding from vagina and other sites (Disseminated Intravascular Coagulopathy)	
• Foul smelling products of conception being passed per vagina	
Relevant Factors before arrival at facility Were there any factors before arrival at the facility which affected the woman's condition: *(tick where applicable and specify)*	
• Treatment from tTBA	
• Treatment from untrained TBAs/ Traditional healers	

• Use of herbal medication	
• Mode of transport	
• Other (specify)	
Avoidable factors	
Do you think anything could have been done to avoid death? • Availability of equipment (specify)	
• Availability of supplies *(specify)*	
• Delays in receiving appropriate care *(specify)*	
• Delays in arriving at health centre **(***specify)*	
• Contributing circumstances and events in the community (e.g. untrained TBA attended delivery, cultural belief) (specify)	
• Woman's characteristics (e.g. previous obstetric history) *(specify)*	

Part C : Medical record summary
N.B. Additional information should be put on separate sheet of paper

Annex 2 i. In patient medical record

Date/ time	**Description/condition of patient**	**Action taken**	**Staff designation**	**Staff initial**	**Staff code**

Annex 2 ii: List all investigations done

Date/time	**Investigation**	**Result**	**Action taken**

Annex2 Part D Assessment of medical records

Number of key data items missing (findings not followed by actions or vice versa)	
Legibility	Poor Good
Total number of entries	
Number of entries with signatures	
Number of entries without signatures	

Annex 2 Part E: Summary of antenatal outpatient case records

Item	**Details**
Antenatal care (tick as applicable)	Yes ( ) No ( )
Gestation age at first ANC attendance	
Number of visits	
TT received (tick and applicable)	Yes ( ) No ( )
Iron supplements/ IPT	
Complications discovered during ANC	

Annex2 List Investigations done during antenatal visits

Date/time	**Investigation**	**Result**	**Action taken**

Treatment received	

Name of data collector:
…….

Date of completion:
……

Annex2 Part F Summary of avoidable factors (for official use

Factors	**Importance of factor**	
	Definitely would have avoided death	**Possibly would have avoided death**
Staff oversight/ misguided‡ Action/ non action		
Staff incompetence (lack of skills)		
Service inadequacy		
Events and circumstances in the community		
Woman factors		

† Can mean lapse in care, failure to notice problem in time,
‡ Erroneous where the action is believed to be right but it is wrong

Modified summary table

Annex 2 Part G: Summary of avoidable factors (for official use)

Factors	**Importance of factor**	

	Definitely would have avoided death	**Possibly would have avoided death**	**Comments**	**Way forward**
Staff over sight				
Staff misguided action/ non action				
Staff incompetence				
Service inadequacy				
Events and circumstances in the community				
Woman factors				

3 . COMMUNITY DATA COLLECTION TOOL.

/ /

BEYOND THE NUMBERS

MATERNAL DEATH REVIEW FORMS

Community Data Collection Instruments

Adopted for Zambia
From WHO

November 2007

COMMUNITY BASED MATERNAL DEATH REVIEW TOOL

(Verbal Autopsy)

Introduce yourself and the purpose of the interview and thank respondent/s for helping MDR team by agreeing to be interviewed. Offer to answer any questions about the purpose and methods of the MDR before beginning.

Annex 2 Demographic data

Code number for deceased	
Date of Birth	
Occupation	
What was the highest level of education attained by the deceased? Specify	
Province	
District	
Husbands/Next of kin Particulars	
Occupation	
What was the highest level of education attained by the husband? Specify	

Annex 2 Part A: Interview details

No.	Questions	Staff Code
1	Interviewers initials	
2	Date of interview	
3	Language used (specify)	

Annex 2 Part B: Selection of people to be interviewed

1	Who was looking after/ caring for the woman before her death (specify)	
2	Who was around at the time of the woman's death? Specify)	
3	If the woman was married: Ask was her husband around (that is in the residence)just before she died?	

SECTION 1: BACKGROUND

I would like to begin by getting some background information about the woman

Annex 2 Deceased background information

No.	**Questions**	**Responses**
1.	How long ago did she die?	
2	How old was she when she died?	
3	Where did the death occur? Specify	
4	What do you think was the cause of death?	
5	Do you have a death certificate? (if yes ask permission to look at the death certificate)	
6	Do you know if before she died she had long term medical problem? (use terms commonly understood in the community for these illness e.g. Diabetes (sugar disease) if no go to No.	

	8		
7	Was she on treatment for this illness? If yes specify.		
8	What was her marital status? Specify		
9	Has she ever been to school If yes specify, what was the highest level she attended?		
10	What was her occupation? Specify		
11	Had the woman ever been pregnant Specify No. of: - Pregnancies - Live births - Still births - Miscarriage/ abortion		
12	Was she pregnant when she died If no, skip to No. 19.		
13	How many months was the pregnancy when she died?		
14	What was the outcome of her last pregnancy? Specify		
15	Is the child from this pregnancy still alive? If no, skip to No. 17 & 18		
16	How old is this child? Specify.		
17	If the child died, at what age did the child die?		
18	What was the cause of death for the child?		
19	IDENTIFIED AS MATERNAL DEATH	YES	Continue
		NO	- End

SECTION 2: FAMILY ACCOUNT OF EVENTS AROUND THE WOMAN'S ILLNESS AND DEATH.

Give an introduction explaining that we would like them to tell us what happened from the time the woman started to feel ill to her death.

Try and create a time line based on what they say if story is complicated.

Annex 2 FAMILY ACCOUNT OF EVENTS AROUND THE WOMAN'S ILLNESS AND DEATH.

N.B. Use additional paper if needed

SECTION 3: DEATHS DURING PREGNANCY PRIOR ON SET OF LABOUR – SYMPTOMS/SIGNS

I would like to ask you some questions about the woman's health during her pregnancy

Annex 2 DEATHS DURING PREGNANCY PRIOR ON SET OF LABOUR – SYMPTOMS/SIGNS

No.	Questions	Responses
1	During pregnancy (tick what is applicable) - did she have swelling of legs - Did she swelling of face - Did she complain of blurred vision - Did she have fits - Was she pale - Was she short of breath (dyspnoea) - Did she lose weight - Did she have fever did she have any other complaint? specify)	
2	During her pregnancy did she have her blood pressure checked?	
3	What did she tell you her blood pressure was?	
4	During her final illness was she bleeding from the vagina?	
5	Did the bleeding wet her clothes, the bed and the floor? Specify	
6	Was anything done to stop the bleeding? If yes specify.	
7	Was she in pain while bleeding?	
8	Did she have any other episodes of bleeding during her pregnancy?	
9	Did she have fever during her final illness?	
10	Was she yellow (jaundice) at the time of her death?	
11	Was she short of breath† at the time of death	
12	Had she been ill with any other illness during this pregnancy?	

Now go to section 5

*(Yellow eyes, Palm, Skin)

† *Dyspnoea*

SECTION 4: DEATHS DURING LABOUR, DELIVERY OR WITHIN 42 DAYS AFTER DELIVERY – SYMPTOMS / SIGNS.

Annex 2 DEATHS DURING LABOUR, DELIVERY OR WITHIN 42 DAYS AFTER DELIVERY – SYMPTOMS / SIGNS.

No.	*I would like to ask you some questions about her last delivery (NB Make clear that they should talk about the one that is related to the death in question)*	
1	Where did the deliver take place?	
2	Who assisted her at the delivery? (Specify)	
3	What sort of delivery was it?	
4	How many months pregnant was the woman when labour began?	
5	Was she in good health when labour began?	
6	How long was she in labour for?	
7	Was the placenta delivered?	
8	How long after the birth of the child was the placenta delivered?	
9	Did she bleed heavily after delivery?	
10	Did the bleeding wet her clothes, the bed or the floor?	
11	Was anything done to stop the bleeding?	
12	Was she short of (Dyspnoea), weak and pale after delivery?	
13	Did she die before the baby was born? If yes, skip to No. 16	
14	Did she have fever and abdominal pains?	
15	Did she have foul smelling discharge?	
16	Did she have any fits before she died?	
17	Did the fits stop after the baby was born?	
Question about the woman's health during the last pregnancy:		
	During pregnancy did she:	
18	- have swelling of legs?	
19	- have swelling of face?	
20	- complain of blurred vision?	
21	- Have any fits?	
22	- Was she pale?	
23	- was she short of breath when she carried out regular household activities?	
24	- lose weight?	
25	During her pregnancy, did she have her blood pressure taken?	
26	Did she tell you what her blood	Yes ( ) / No

	pressure results were? If told, what was the result?	( ) *(tick what is applicable*)
27	During her final illness, was she bleeding from the vagina? If no, skip to No. 32	
28	*Did the bleeding wet her clothes, the bed of the floor?*	
29	Was anything done to stop the bleeding? If yes specify.	
30	Was she in pain while bleeding? If no. skip to 32.	
31	Did the pain (bleeding?) start before the labour pains?	
32	Did she have a vaginal examination during her illness?	
33	Did the vaginal examination increase cause bleeding?	
34	Did she have any other episode of bleeding during her pregnancy? If no skip to No. 36	
35	Were they painful?	
36	Did she have fever during her final illness?	
37	Did she have foul smelling discharge during her final illness?	
38	Was she yellow at the time of her death?	
39	Was she short of breath at the time of death?	
40	Has she been ill with any other illness during this pregnancy, delivery or after delivery? If yes, specify.	

Now go to section 5

SECTION 5: HEALTH SEEKING BEHAVIOUR / CONTRIBUTING FACTORS.

Annex 2 HEALTH SEEKING BEHAVIOUR / CONTRIBUTING FACTORS.

No.	Questions	Responses
1	Between the woman falling sick and dying, did she seek or did you take her to see anyone else for treatment?	
2	If yes who did she go to see? (If yes go to question 4)	
3	If no, why not? (if no, go to question 11)	
4	Who was involved in making the decision that the woman should go for treatment?	
5	What prompted her to be sent for treatment?	
6	Once the decision was made to send her for care, did she go straight away?	
7	If no, why not?	
8	How long was the delay?	
9	Was it difficult to find the funds to send her for treatment?	
10	Where did the funds come from for her to go for treatment*?(i.e. who paid)* FILLING IN TABLE	
	I would like to ask some general questions about health seeking behaviour during her pregnancy	
11	Did she ever go for antenatal care during her pregnancy? If no, ship to No. 13	
12	How many times did she go for antenatal care?	

13	Is antenatal or other health card still available? ***If yes, can I see this card?***	
14	Do you know where she was asked to deliver? (Specify)	
15	Apart from ANC visits, did she ever go for health care during her last pregnancy? (If yes, specify)	
16	Did she ever go for postnatal care? If no, go to Q20	
17	Who did she go to see? *(Specify, more than one is possible*)	
18	Did she go for routine visit or for a specific problem?	
19	What was the problem?	

20 Once the decision to seek treatment was made:			
	Health Centre	Level I Hospital	Level 2 Hospital
a. How did she get there?			
b. How long did it take to get there?			
c. If by car/ bus/ cart, did you have to pay for transport? (if yes, who paid and how much?)			
d. When she got to the facility, how long did she have to wait before she was seen?			
e. Whom did she see?			
f. What did they do?			
g. What did they tell you/ her?			
h. How much did you/ Her have to pay?			
i. Did they ask you /her to go and buy anything? If yes, how much did you / her have to pay?			
j. Did they refer you/ her?			
k. If yes, where to? Did you/ she go? (If yes, go to next column)			
l. What did you/ she do			

next?			

SECTION 6: OTHER CAUSES OF INCIDENTAL/ACCIDENTAL MATERNAL DEATHS IN THE COMMUNITY.

Annex 2 OTHER CAUSES OF INCIDENTAL/ACCIDENTAL MATERNAL DEATHS IN THE COMMUNITY.

No.	Questions	Responses
1	Did she die of an accident?	
2	Did she drown to death?	
3	Did she get burned?	
4	Did she get cut which led to her death?	
5	Did she die of poisoning?	
6	Was she strangulated or hanged to death?	
7	Did she fall from height before death?	
8	If any of the above questions 1-6 answer is yes, what was its type?	
9	Was she bitten by a snake?	
10	Was she bitten by a dog or some other animal?	
11	Did she receive any physical injury before death?	
12	Did she have any surgery within 12 months before death?	
13	If yes, what was the reason?	
14	If yes, in which health care facility (specify)	

SECTION 7: SUMMARY OF AVOIDABLE FACTORS (FOR OFFICIAL USE)

Annex 2 SUMMARY OF AVOIDABLE FACTORS (FOR OFFICIAL USE)

FACTORS	IMPORTANCE FO FACTORS			
	Definitely would have avoided death	Possibly would have avoided death	Comments	The way forward
Service Inadequate				
Event and circumstances in the				

community				
Woman factors				

Name of Data Collector:-

Date of Completion:-

Annex 3 – Epi Info questionnaire

AN EPIDEMIOLOGYIC STUDY OF
MATERNAL DETH REVIEWS

MATERNAL DEATH AUDIT AND NOTIFICATION FORM
id number computer <idnum>
mdr study serial {Q1mdr#} ########

PLACE OF DEATH

Province {Q2prov} ##
District {Q3dcmo} ##
Name of institution {Q4inst} ##
Level of care {Q5levl} #
Referal from another institution {Q6ref} #

DETAILS OF DECEASED

Name of deceased {Q7names} __
{Q8namef} _
Inpatient no. {Q9fileno} #####/##
age {Q10age} ##
DOB {Q11dob} <mm/dd/yyyy>
Date of deathe {Q12dod} <dd/mm/yyyy>

PHYSICAL ADDRESS

Village/ township {Q13vill} ####
town/ district {Q14town} ##
Chief {Q15chif} ###
landmark {Q16lmak} ####

CAUSE OF DEATH

Cause of death {Q17cas} ##
Postmortem perfomed {Q18pm} #

FORMS COMPLETED BY

name reporter {Q19repts} __
{Q20reptf} __
position {Q21posi} ##
contact phone {Q22phn} <phonenum>
date reported {Q23datrp} <dd/mm/yyyy>
signed {Q24sign} #

HOSPITAL/ HEALTH CENTRE MATERNAL DEATH REVIEW

Name of facility {Q25faci} ###
district {Q26dist} ###
Province {Q27prov} ##
Date of interview {Q28int} <dd/mm/yyyy>

PART A: PARTICULARS OF THE DECEASED

Code numb of deceased {Q29code} ######
Age {Q30age} ##
Marital status {Q31mar} #
highest edic level {Q32edu} ##
Occupation {Q33occ} ##
occupation of spouse {Q34occS} ##
highest education spouse {Q35eduS} ##
past med history {Q36mHx} ##
past obs history {Q37obsH} ##
gravidity {Q38grav} ##
Parity {Q39pari} ##
Antenatal care attened {Q40anc} #
number of ANC visits {Q41ancV} ##
gestation at time of death {Q42ga} ##
died deliv or not {Q43delv} #
Place of delivery {Q44plc} ##
if delv baby alive? {Q445bab} #
if baby dead age die {Q45babd} ##
if baby dead, cause ? {Q46Bcau} ##
main attendant at delv {Q47att} #
referal {Q48reft} ##

PART B: INTERVIEW OF RESPONDENT

Verbatim report {Q49verb} ##
{Q50verb} ##
{Q51verb} ##
{Q52verb} ##
{Q53verb} ##
were you with deceased, die {Q54you} ###
how long before deceased, die {Q55bef} ###
who told u about death {Q56tld} #
was this person with deceased, die {Q57wit} #
was she referred {Q58refr} #

MANAGEMENT AT HEALTH FACILITY
who admited deceased {Q59adm} ##
what time admitted {Q60tim} ##.##
who looked after at time of death {Q61tdie} ##
condition broght in at facility {Q62cond} #

what findings diagnosis {Q63dia} ##
did you feel confident, diagnosis {Q64fel} #
what was plan of care, ref and consult {Q65pln} ##
were obstacle or delays {Q66dely} #
    which obstacles or delys {Q67dlys} ##
did you have enough support {Q68sup} #
if re,f did effect ref {Q69eff} #
who accompanied patient {Q70acmp} #
symptoms and signs before death {Q71sxsn} ##
relevant factors before arrival at facility {Q72fact} ##
AVOIDABLE FACTORS
availability of equipment {Q73eqip} # equipment {Q74equi1} ## {Q74equi2} ##
availability of supplies {Q75supp} # Supplies {Q76sup1} ## {Q76sup2} ##
delay in receiving care {Q77care} # delay care {Q78dely1} ## {Q78dely2} ##
delay in arriving at HF {Q79arr} # delay arriv {Q80ari1} ## {Q80ari2} ##
contributi circumst {Q81cont} # contri events {Q82evnt1} ## {Q82evnt2} ##
womans xteristics {Q83xtic} # xteristics {Q84xtic1} ## {Q84xtic2} ##

PART C: MEDICAL RECORD SUMMARY

in patient record
{Q85ipd1} <dd/mm/yyyy> descrpt {Q85des} ## action {Q85act} ## staf
{Q85staf} ##
{Q86ipd2} <dd/mm/yyyy> descrpt {Q86des} ## action {Q86act} ## staf
{Q86staf} ##
{Q87ipd3} <dd/mm/yyyy> descrpt {Q87des} ## action {Q87act} ## staf
{Q87staf} ##
{Q88ipd4} <dd/mm/yyyy> descrpt {Q88des} ## action {Q88act} ## staf
{Q88staf} ##
{Q89ipd5} <dd/mm/yyyy> descrpt {Q89des} ## action {Q89act} ## staf
{Q89staf} ##
{Q90ipd6} <dd/mm/yyyy> descrpt {Q90des} ## action {Q90act} ## staf
{Q90staf} ##
{Q91ipd7} <dd/mm/yyyy> descrpt {Q91des} ## action {Q91act} ## staf
{Q91staf} ##

list of investigation done
{Q92ipiv1} <dd/mm/yyyy> invest {Q92inv1} ## result {Q92res1} ## actn
{Q92act1} ##
{Q92ipiv2} <dd/mm/yyyy> invest {Q92inv2} ## result {Q92res2} ## actn
{Q92act2} ##
{Q92ipiv3} <dd/mm/yyyy> invest {Q92inv3} ## result {Q92res3} ## actn
{Q92act3} ##
{Q92ipiv4} <dd/mm/yyyy> invest {Q92inv4} ## result {Q92res4} ## actn
{Q92act4} ##
{Q92ipiv5} <dd/mm/yyyy> invest {Q92inv5} ## result {Q92res5} ## actn
{Q92act5} ##
{Q92ipiv6} <dd/mm/yyyy> invest {Q92inv6} ## result {Q92res6} ## actn
{Q92act6} ##

{Q92ipiv7} <dd/mm/yyyy> invest {Q92inv7} ## result {Q92res7} ## actn {Q92act7} ##

PART D: ASSESSMENT OF MEDICAL RECORDS

Number of key items missing {Q93misk} ##
specify key items missing {Q93misk1} ##
specify key items missing {Q93misk2} ##
specify key items missing {Q93misk3} ##
specify key items missing {Q93misk4} ##
specify key items missing {Q93misk5} ##
legibility {Q94legi} #
total number of enteries {Q95entr} ##
number of entries with signatures {Q96entsg} ##
number of entries without signg {Q97Nsign} ##

PART E: SUMMARY OF ANTENATAL OUTPATIENT RECORDS

Antenatal care {Q98anc} #
gestational age at 1st visit {Q99ancf} ##
number of visits {Q100vist} #
TT received {Q101tt} #
complications dicovered during ANC {Q102comp} ##
inv during ANC
{Q103anc1} <dd/mm/yyyy> invt {Q103inv} ## reslt {Q103res} ## actn {Q103act} ##
{Q104anc2} <dd/mm/yyyy> invt {Q104inv} ## reslt {Q104res} ## actn {Q104act} ##
{Q105anc3} <dd/mm/yyyy> invt {Q105inv} ## reslt {Q105res} ## actn {Q105act} ##
treatment received {Q106trt} ##
name of data collector: {Q107nam} ##
date of compilation: {Q108cmpl} <dd/mm/yyyy>

PART F: SUMMARRY OF AVOIDABLE FACTORS

Staff oversight {Q109ovs} # comments {Q109comm} ## way forward {Q109wayf} ##
misguid no act {Q110noac} # comments {Q110comm} ## way forward {Q110wayf} ##
stf incompeten {Q111incp} # comments {Q111comm} ## way forward {Q111wayf} ##
servic inadequ {Q112inad} # comments {Q112comm} ## way forward {Q112wayf} ##
event/ circum {Q113circ} # comments {Q113comm} ## way forward {Q113wayf} ##
woman factors {Q114wfac} # comments {Q114comm} ## way forward {Q114wayf} ##

End of facility questionnaire.

COMMUNITY BASED MATERNAL DEATH REVIEW TOOL
VERBAL AUTOPSY

Code number for the deceased {Q115code} ##########
date of birth {Q116dob} <dd/mm/yyyy>
occupation {Q116occ} ##
what was highest edu {Q117edu} ##
province {Q118prov} ##
district {Q119dist} ##
husband/ next of kin {Q120kin} __
occupation husband / kin {Q121occh} ##
what highest edu of husband/ kin {Q122eduh} ##

PART A: INTERVIEW DETAILS

Interviewer initials {Q123int} __
date of the interview {Q124intd} <dd/mm/yyyy>
language used {Q125lan}##

PART B: SELECTION OF PEOPLE TO BE INTERVIEWED

who looked after woman, before death {Q126lok} ##
who was around at time of death {Q127ard} ##
if married, was husband around, death {Q128hus} #

SECTION 1: BACKGROUND

how long ago did she die {Q129log} ###
how old was she, died {Q130old} ##
where did death occur {Q131whr} ##
what think cause of death {Q132cas} ##
do you hav death certi {Q133cet} #
    cause of death in certi {Q134casc} ##
do you know any log term med prob {Q135logm} ##
was she on treatment for med cond {Q136trt} #
    specify treatment {Q137trts} ##
what was her marital status {Q138mar} #
has been to sch, highest educ {Q139edu} ##
what was her occupation {Q140occ} ##
had the woman ever been preg {Q141prg} #
    pregnacies {Q142preg} ##
    live births {q143livB} ##
    still births {Q144stlb} ##
    miscarriage/ abortion {Q145abo} ##
was she preg when died {Q146prgd} #
how many months preg when died {Q147monp} ##
what was outcome of last preg {Q148outc} #
is child fro this last preg aliv {Q149chld} #

how old is child {Q150old} ##
if child dead, at what age died {Q151age} ##
what was cause of death in child {Q152cldd} ##
identified as maternal death {Q153md} #

SECTION 2: FAMILY ACCOUNT OF EVENTS AROUND THE WOMANS ILLNESS AND DEATH.

Family account of illness and death {Q154acc1} ##
Family account of illness and death {Q155acc2} ##
Family account of illness and death {Q156acc3} ##
Family account of illness and death {Q157acc4} ##
Family account of illness and death {Q158acc5} ##
Family account of illness and death {Q159acc6} ##
Family account of illness and death {Q160acc7} ##

SECTION 3: DEATHS DURING PREG PRIO TO ONSET OF LAOUR - SYMPTOMS AND SIGNS

During her preg:
    did she hav swelling of legs {Q161swe} #
    did she swell face {Q162fac} #
    did complain blurred vision {Q163vis} #
    did she hav fits {Q164fit} #
    was she pale {Q165pal} #
    was she short of breath, dyspnoec {Q166dys} #
    did she lose weight {Q167wt} #
    did she hav fever {Q168fev} #
    did she hav any other complaint {Q169oth} ##
during preg, hva BP checked {Q170bp} #
what did she tell bp was {Q171bpw} #
during her final illnes, bled fro vagina {Q172pvb} #
did bleeding wet her clothes,bed and floor {Q173pvbb} #
was anything done to stop the bleeding {Q174pvbs} ##
was she in pain while bleeding {Q175pain} #
did she hav any other episodes of bleeding in preg {Q176pvbe} #
did she have fever during last illness {Q177fev} #
was she yellow, jaundiced, at time of death {Q178jau} #
was she short of breath at time of death {Q179dys} #
has she been ill of any other illness in this preg {Q180ill} #

SECTION 4: DEATHS DURING LABOUR, DELIVERY OR WITHIN 42DAYS AFTER DELIVERY -
SYMPTOMS AND SIGNS.

where did the delivery take place {Q181delv} #
who assissted at delv {Q182ass} #
what sort of delivery {Q183delt} #
how many months prge, at labour {Q1184monp} #
was she in good health when labour began {Q185hlt} #

how long was she in labour for {Q186logl} ##
was the placentae delivered {Q187pla} #
how long after birth of the child was placentae delv {Q188plad} ##
did she bleed heavily after delivery {Q189pvbd} #
did bleeding wet clothes, bed or floor {Q190pvbb} #
was anything done to stop bleeding {Q191stpb} #
was she dyspnoeic, weak or pale after delv {Q192dysp} #
did she die before baby born {Q193dbab} #
did she hav fever & abd pains {Q194fev} #
did she hav foul smelling discharge {Q195disc} #
did she hav any fits {Q196fit} #
did fit stop after baby born {Q197sfit} #
during pregnancy did she
    have swelling of legs {Q198leg} #
    hav swelling of face {Q199fac} #
    complain of blurred vision {Q200vis} #
    hav any fits {Q201fit} #
    was she pale {Q202pal} #
    was sh short of breath {Q203brt} #
    lose weight? {Q204wtl} #
during preg was bp taken {{Q205bpt} #
did she tell bp {Q206telp} #
    bp reading {Q206bp} #
during final illness, bleed fro vagina {Q207pvb} #
did bleeding wet clothes, bed or floor {Q208pvbb} #
was anything done to stop the bleeding {Q209stpb} #
        specify {Q209spvb} ##
was she in pain while bleeding {Q210ppvb} #
did pvb start before abd pains {Q211sppv} #
did she hav vag exam during illness {Q212vexm} #
did vaginal exam increase the bleeding {Q213expv} #
did she hav any other pvb during the preg {Q214opvb} #
were they painful {Q215ppvb} #
did she hav feve in her final illness {Q216fev} #
did she have foul smelling discharge, final illness {Q217fdis} #
was she yellow at the time of her death {Q218yel} #
was she short of breath at the time of death {Q219dys} #
has she been ill , other illness {Q220oill} #

SECTION 5: HEALTH SEEKING BEHAVIOUR/ CONTRIBUTING FACTORS.

Between sick and dying did you anyone for trt {Q221otrt} #
if yes who did she see {Q222who} #
if no why not {Q223why} #
who involved in making decision, go for trt {Q224invl} #
what prompted to go for treatment {Q225prmt} #
once decision made, did she go straight away {Q226strt} #
if no , why not {Q227not} #
how long was the delay {Q228dely} #
wasi difficult to find funds for trt {Q229fund} #

where did the funds come from { Q230whop} #
Did she go for any ANC,this preg {Q231anc} #
how many times ANC {Q232anct} #
is anc or other card avail {Q233card} #
Do you know where asked to deliver {Q234delv} #
specify where asked to deliv {Q234sdel} #
apart ANC, did she go for other care {Q235care} #
specify other care {Q235othc} #
ever go for postnatal care {Q236pnc} #
who did she go see for PNC {Q237see} #
did she go for routine or problem {Q238rout} #
what was the problem {Q239prob} ##
once decision to sek trt, facility {Q240faci} #
a.how did she get there {Q241get} #
b.how long did it take {Q242long} ##.##
c.if any vehicle , did you pay {Q243pay} #
how much had to pay {Q243much} ####.##
d. at facility, how much wait {Q244wait} #
e. whom did she see {Q245fsee} #
f.what did they do {Q246do} #
g.what did tel you/ her{Q247tell} ##
h.how much had to pay {Q248fee} ####.#
i.asked to buy any thing {Q249buy} #
how much had to pay for buy {Q249cost} ####.##
j. did they refer you/her {Q250ref} #
k.if yes, referred, where to {Q250refa}
l. what didyou/ she do next {Q251next} #

SECTION 6: OTHER CAUSES OF INCIDENTAL/ ACCIDENTAL MATERNAL DEATHS
IN THE COMMUNITY.

Did she die fro an accident {Q252acci} #
did she drown to deaath {Q253drwn} #
did she get burned {Q254burn} #
did she get cut and died{Q255cut} #
did she die of poisoning{Q256pois} #
was strangulated or hanged to death {Q257hang} #
did she fall from height, died {Q258high} #
what was the type for quest 1-6 {Q259type} ##
was she bitten by snake {Q260snke} #
was she bitten by a dog or animal { Q261dog} #
did she receive physical injury, died {Q262injr} #
did she hav surgery in 12 moons before {Q263surg} #
what was reason for surgery {Q264reas} ##
in which health care facility {Q265faci} #

SECTION 7: SUMMARRY OF AVOIDABLE FACTORS

Service adequate {Q266Dvod} # {Q266Pvod} #

Service adequate {Q266comm} # {Q266comm} # {Q266comm} #
service adequate {Q266fowd} # {Q266fowd} # {Q266fowd} #
event and circumstances in community {Q267Dvod} # {Q267Pvod} #
event and circumstances {Q267comm} # {Q267comm} # {Q267comm} #
event and circumstances {Q267fowd} # {Q267fowd} # {Q267fowd} #
woman factors {Q268Dvod} # {Q268Pvod} #
woman factors {Q268comm} # {Q268comm} # {Q268comm} #
woman factors {Q268fowd} # {Q268fowd} # {Q268fowd} #

data collector {Q269coll} ___
Date of Completion {Q270comp} <dd/mm/yyyy>

end of questionnaire.

Annex 4 - Coded data collection tool

MD AUDIT AND NOTIFIC .FORM	**Code:**			Province:	Distr ict:
id number	<idnum>		gestation at time of death	{Q42ga} ##	
serial ########	{Q1mdr# }		died deliv or not	{Q43delv } #	
PLACE OF DEATH			Place of delivery	{Q44plc} ##	
Province	{Q2prov} ##		if delv baby alive?	{Q445ba b} #	
District	{Q3dcmo } ##		if baby dead age die	{Q45bab d} ##	
institution Name	{Q4inst} ##		if baby dead, cause ?	{Q46Bca u} ##	
Level of care	{Q5levl} #		main attendant at delv	{Q47att} #	
Referal	{Q6ref} #		referal	{Q48reft } ##	
DETAILS OF DECEASED			PART B: INTERVIEW OF RESPONDENT		
Name deceased	{Q7na ms} __		Verbatim report	{Q49verb } ##	
Inpatient no. #####/##	{Q9fil eno}			{50verb} ##	
age	{Q10a ge} ##			{Q51verb } ##	
DOB <mm/dd/yyyy>	{Q11d ob}			{Q52verb } ##	
DOD<dd/mm/yyyy >	{Q12d od}			{Q53verb } ##	
PHYSICAL ADDRESS			were you with deceased, die	{Q54you } ###	
Village/ township	{Q13v ill} ####		how before decesed, die	{Q55bef} ###	
town/ district	{Q14t own} ##		who told u about death	{Q56tld} #	
Chief	{Q15c hif} ###		was person with decesed, die	{Q57wit} #	
landmark ####	{Q16l mak}		was she refred	{Q58refr } #	
CAUSE OF DEATH			MANAGEMENT AT HEALTH FACILITY		
Cause of death	{Q17c		who admited	{Q59adm	

	as} ##		deceased	} ##	
Postmortem	{Q18pm} #		what time admitted	{Q60tim} ##.##	
Completed by ###	{Q19repts}		who looked after at death	{Q61tdie} ##	
position	{Q21posi} ##		condition broght in at facility	{Q62cond} #	
phone<phonenum>	{Q22phn}		what findings diagnosis	{Q63dia} ##	
reported<dd/mm/yyyy>	{Q23datrp}		did feel confident, diagnosis	{Q64fel} #	
signed	{Q24sign} #		what plan of care, ref & cnslt	{Q65pln} ##	
HOSP/ RHC MDR	**FORM**		were obstacle or delays	{Q66dely} #	
Date of interview <dd/mm/yyyy>	{Q28int}		which obstacles or delys	{Q67dlys} ##	
PART A: PARTICULARS DECEASED			did you have enough support	{Q68sup} #	
Code numb of deceased	{Q29code} ########		if re,f did effect ref	{Q69eff} #	
Age	{Q30age} ##		who accompanied patient	{Q70acmp} #	
Marital status	{Q31mar} #		Sympt and signs before death	{Q71sxsn} ##	
highest edu level	{Q32edu} ##		relevant factors befor facility	{Q72fact} ##	
Occupation	{Q33occ} ##		AVOIDABLE FACTORS		
Occup. of spouse	{Q34occS} ##		availability of equipment	{Q73eqip} #	
highest edu spouse	{Q35eduS} ##		equipment	{Q74equi1} ##	
past med history	{Q36mHx} ##			{Q74equi2} ##	
past obs history	{Q37obsH} ##		availability of supplies	{Q75supp} #	
gravidity	{Q38grav} ##		Supplies	{Q76sup1} ##	

Parity	{Q39pari} ##			{Q76sup2} ##	
ANC care attended	{Q40anc}		delay in receiving care	{Q77care} #	
# of ANC visits	{Q41ancV} ##		delay care	{Q78dely1} ##	

	{Q78dely2} ##		actn	{Q92act2} ##	
delay in arriv at HF	{Q79arr} #		Date IPD Inv 3	{Q92ipiv3} <dd/mm/yyyy>	
HF delay arriv	{Q80ari1} ##		invest	{Q92inv3} ##	
	{Q80ari2} ##		result	{Q92res3} ##	
Contribut circumst	{Q81cont} #		actn	{Q92act3} ##	
contri events	{Q82evnt1} ##		Date IPD Inv 4	{Q92ipiv4} dd/mm/yyyy>	
	{Q82evnt2} ##		invest	{Q92inv4} ##	
womans xteristics	{Q83xtic} #		result	{Q92res4} ##	
xteristics	{Q84xtic1} ##		actn	{Q92act4} ##	
	{Q84xtic2} ##		Date IPD Inv 5	{Q92ipiv5} dd/mm/yyyy>	
PART C: MEDICAL RECORD SUMMARY			invest	{Q92inv5} ##	
in patient record			result	{Q92res5} ##	
IPD 1Date	{Q85ipd1} <dd/mm/yyyy>		actn	{Q92act5} ##	
description IPD1	{Q85des} ##		Date IPD Inv 6	{Q92ipiv6} dd/mm/yyyy>	
action IPD1	{Q85act} ##		invest	{Q92inv6} ##	
Staff IPD2	{Q85staf} ##		result	{Q92res6} ##	
IPD 2Date	{Q86ipd1}		actn	{Q92act6	

	<dd/mm/yyyy>			} ##	
description IPD1	{Q86des} ##		Date IPD Inv 7	{Q92ipiv7} dd/mm/yyyy>	
action IPD1	{Q86act} ##		invest	{Q92inv7} ##	
Staff IPD2	{Q86staf} ##		result	{Q92res7} ##	
IPD 3Date	{Q87ipd1} <dd/mm/yyyy>		actn	{Q92act7} ##	
description IPD1	{Q87des} ##		**PART D: ASSESSMENT OF MEDICAL RECORDS**		
action IPD1	{Q87act} ##		Num missing	{Q93misk} ##	
Staff IPD2	{Q87staf} ##		Specify misng	{Q93misk1} ##	
IPD 4Date	{Q88ipd1} <dd/mm/yyyy>		specify mising	{Q93misk2} ##	
description IPD1	{Q88des} ##		Specify misng	{Q93misk3} ##	
action IPD1	{Q88act} ##		specify mising	{Q93misk4} ##	
Staff IPD2	{Q88staf} ##		Specify misng	{Q93misk5} ##	
IPD 5Date	{Q89ipd1} <dd/mm/yyyy>		specify mising	{Q93misk6} ##	
description IPD1	{Q89des} ##		legibility	{Q94legi} #	
action IPD1	{Q89act} ##		total enteries	{Q95entr} ##	
Staff IPD2	{Q89staf} ##		numb signatur	{Q96entsg} ##	
IPD 6Date	{Q90ipd1} <dd/mm/yyyy>		without signg	{Q97Nsign} ##	
description IPD6	{Q90des} ##		PART E: SUMMARY OF ANC OPD RECORDS		
action IPD6	{Q90act} ##		ANC care	{Q98anc} #	
Staff IPD6	{Q90staf} ##		GA 1st visit	{Q99ancf} ##	
IPD 7Date	{Q91ipd1}		Numb of	{Q100vi	

	<dd/mm/yyyy>		visits	st} #	
description IPD7	{Q91des} ##		TT received	{Q101tt} #	
action IPD7	{Q91act} ##		ANC complic	{Q102comp} ##	
Staff IPD7	{Q91staf} ##		Date Inv ANC	{Q103anc1} <dd/mm/yyyy>	
list of investigation done			investt	{Q103inv1} ##	
Date of IPD Inv 1	{Q92ipiv1} dd/mm/yyyy>		reslt	{Q103res1} ##	
invest	{Q92inv} ##		actn	{Q103act1} ##	
result	{Q92res} ##		Date Inv ANC	{Q104anc2} <dd/mm/yyyy>	
actn	{Q92act} ##		investt	{Q104inv2} ##	
Date of IPD Inv 2	{Q92ipiv2} dd/mm/yyyy>		reslt	{Q104res2} ##	
invest	{Q92inv2} ##		actn	{Q104act2} ##	
result	{Q92res2} ##		----	-----	
Date Inv ANC	{Q105anc3}< dd/mm/yyyy>		cause death	{Q132cas} ##	
investt	{Q105inv3} ##		death certi	{Q133cet} #	
reslt	{Q105res3} ##		death in certi	{Q134casc} ##	
actn	{Q105act3} ##		long tem prob	{Q135logm} ##	
Trt received	{Q106trt} ##		trt med cond	{Q136trt} #	
name collector:	{Q107nam} ___		specify trt	{Q137trts} ##	
date compilation:	{Q108cmpl}<dd/mm/yyyy>		marital status	{Q138mar} #	

PART F: SUMMARRY OF AVOIDABLE FACTORS			highest educ	{Q139edu} ##	
Staff oversight	{Q109ovs} #		Her occup	{Q140occ} ##	
comments	{Q109comm} ##		had everpreg	{Q141prg} #	
way forward	{Q109wayf} ##		# pregnacies	{Q142preg} ##	
misguid no act	{Q110noac} #		live births	{q143livB} ##	
comments	{Q110comm} ##		still births	{Q144stlb} ##	
way forward	{Q110wayf} ##		miscar/ abort	{Q145abo} ##	
stf incompeten	{Q111incp} #		was preg died	{Q146prgd} #	
comments	{Q111comm} ##		mon preg died	{Q147monp} ##	
way forward	{Q111wayf} ##		outcm lst preg	{Q148outc} #	
servic inadequ	{Q112inad} #		is child aliv	{Q149chld} #	
comments	{Q112comm} ##		how old child	{Q150old} ###	
way forward	{Q112wayf} ##		age chld died	{Q151age} ##	
event/ circum	{Q113circ} #		cause of death	{Q152cldd} ##	
comments	{Q113comm} ##		Identi MD	{Q153md} #	
way forward	{Q113wayf} ##		**SECTION 2: FAMILY ACCOUNT OF EVENTS**		
woman factors	{Q114wfac} #		Family acc	{Q154acc1} ##	
comments	{Q114comm} ##		Family acc	{Q155acc2} ##	
way forward	{Q114wayf} ##		Family acc	{Q156acc3} ##	
End of facility questionnaire.			Family acc	{Q157acc4} ##	
COMMU. BASED MDR TOOL, VERBAL AUTOPSY			Family acc	{Q158acc5} ##	
Code # deceased	{Q115code} #########		Family acc	{Q159acc6} ##	

date of birth	{Q116dob} <dd/mm/yyyy>		Family acc	{Q160acc7} ##	
occupation	{Q116occ} ##		**SECTION 3: DEATHS DURING PREG PRIOR**		
what highest edu	{Q117edu} ##		swelling legs	{Q161swe} #	
province	{Q118prov} ##		swell face	{Q162fac} #	
district	{Q119dist} ##		blurred Vision	{Q163vis} #	
husb/ next of kin	{Q120kin} ___		hav fits	{Q164fit} #	
occupa husb / kin	{Q121occh} ##		Pale	{Q165pal} #	
edu of husb/ kin	{Q122eduh} ##		dyspnoeic	{Q166dys} #	
PART A: INTERVIEW DETAILS			lose weight	{Q167wt} #	
interviewer initial	{Q123int} __		have fever	{Q168fev} #	
date of interview	{Q124intd} <dd/mm/yyyy>		Oth complnt	{Q169oth} ##	
language used	{Q125lan}##		BP checked	{Q170bp} #	
PART B: SELECTION OF PEOPLE INTERVIEWED			tell bp was	{Q171bpw} #	
who looked after	{Q126lok} ##		bled fro vagina	{Q172pvb} #	
who was around	{Q127ard} ##		wet floor	{Q173pvbb} #	
if husb around,	{Q128hus} #		done bleed	{Q174pvbs} ##	
SECTION 1: BACKGROUND			pain bleeding	{Q175pain} #	
how long died	{Q129log} ###		episod bleed	{Q176pvbe} #	
how old, died	{Q130old} ##		fever during	{Q177fev} #	
where death occur	{Q131whr} ##		jaundiced	{Q178jau} #	

short of	{Q179dys} #		if no why	{Q223wh	

breath			not	y} #	
any other illness	{Q180ill} #		involved making decision,	{Q224in vl} #	
SECTION 4: DEATHS DURING LABOUR, 42DAYS			what prompted for trt	{Q225pr mt} #	
delivery place	{Q181delv} #		did she go straight away	{Q226str t} #	
who assisst delv	{Q182ass} #		if no , why not	{Q227no t} #	
sort of delivery	{Q183delt} #		how long was the delay	{Q228del y} #	
months prge, lab	{Q1184monp } #		difficult find funds for trt	{Q229fu nd} #	
good health lab	{Q185hlt} #		where funds come from	{Q230wh op} #	
how long labour	{Q186logl} ##		any ANC,this preg	{Q231an c} #	
placentae delivrd	{Q187pla} #		how many times ANC	{Q232an ct} #	
long placent delv	{Q188plad} ##		is anc or other card avail	{Q233car d} #	
bled heavily delv	{Q189pvbd} #		where asked to deliver	{Q234del v} #	
bleeding wet flo	{Q190pvbb} #		specify where asked deliv	{Q234sd el} #	
to stop bleeding	{Q191stpb} #		apart ANC, go other care	{Q235car e} #	
dysp, weak pale	{Q192dysp} #		specify other care	{Q235ot hc} #	
die b4 baby born	{Q193dbab} #		ever go for postnatal care	{Q236pn c} #	
fever & abd pains	{Q194fev} #		who go see for PNC	{Q237se e} #	
foul smel dischg	{Q195disc} #		go for routine or problem	{Q238ro ut} #	
fits	{Q196fit} #		what was the problem	{Q239pr ob} ##	
fit stop	{Q197sfit} #		decision to	{Q240fac	

baby born			sek trt, facility	i} #	
swelling of legs	{Q198leg} #		a.how did she get there	{Q241get} #	
swelling of face	{Q199fac} #		b.how long did it take	{Q242long} ##	
blurred vision	{Q200vis} #		c.if any vehicle , did pay	{Q243pay} #	
hav any fits	{Q201fit} #		how much had to pay	{Q243much} ##	
was she pale	{Q202pal} #		d. facility, how much wait	{Q244wait} #	
short of breath	{Q203brt} #		e. whom did she see	{Q245fsee} #	
lose weight?	{Q204wtl} #		f.what did they do	{Q246do} #	
preg bp taken	{Q205bpt} #		g.what did tel you/ her	{Q247tell} ##	
did she tell bp	{Q206telp} #		h.how much had to pay	{Q248fee} ##	
bp reading	{Q206bp} #		i.asked to buy any thing	{Q249buy} #	
bleed fro vagina	{Q207pvb} #		how much had pay/ buy	{Q249cost} ##	
bleeding wet bed	{Q208pvbb} #		j. did they refer you/her	{Q250ref} #	
to stop bleed	{Q209stpb} #		k.if yes, referred, where	{Q250refa}	
specify	{Q209spvb} ##		l. what did u/ she do next	{Q251next} #	
pain while bled	{Q210ppvb} #		**SECTION 6: other CAUSES OF INCIDENTAL/ ACCIDENTAL**		
pvb start b4 pains	{Q211sppv} #		die fro an accident	{Q252acci} #	
vag exam dur ill	{Q212vexm} #		did she drown to deaath	{Q253drwn} #	
VE increase bled	{Q213expv} #		did she get burned	{Q254burn} #	
other pvb	{Q214opvb}		did she get	{Q255cut	

preg	#		cut and died	} #	
were they painful	{Q215ppvb} #		did she die of poisoning	{Q256pois} #	
feve final illness	{Q216fev} #		strangulated or hanged	{Q257hang} #	
Foul disch, final ill	{Q217fdis} #		fall from height, died	{Q258high} #	
Yellow time died	{Q218yel} #		what type for quest 1-6	{Q259type} ##	
short of breath	{Q219dys} #		was she bitten by snake	{Q260snke} #	
other illness	{Q220oill} #		bitten by a dog or animal	{Q261dog} #	
SECTION 5: HEALTH SEEKING BEHAVIOUR			physical injury, died	{Q262injr} #	
anyone for trt	{Q221otrt} #		surgery in 12 mons befor	{Q263surg} #	
Yes, who she see	{Q222who} #		reason for surgery	{Q264reas} ##	

in which health care facility	{Q265faci} #	
SECTION 7: SUMMARRY OF AVOIDABLE FACTORS		
Service adequate	{Q266Dvod1} #	
	{Q266Pvod2} #	
Service adequate	{Q266comm1} #	
	{Q266comm2} #	
	{Q266comm3} #	
service adequate	{Q266fowd1} #	
	{Q266fowd2}#	
	{Q266fowd3} #	
event and circumstances in community	{Q267Dvod1} #	
	{Q267Pvod2} #	
event and circumstances	{Q267comm1} #	
	{Q267comm2} #	
	{Q267comm3} #	
event and circumstances	{Q267fowd1} #	
	{Q267fowd2} #	
	{Q267fowd3} #	
woman factors	{Q268Dvod1} #	
	{Q268Pvod2} #	

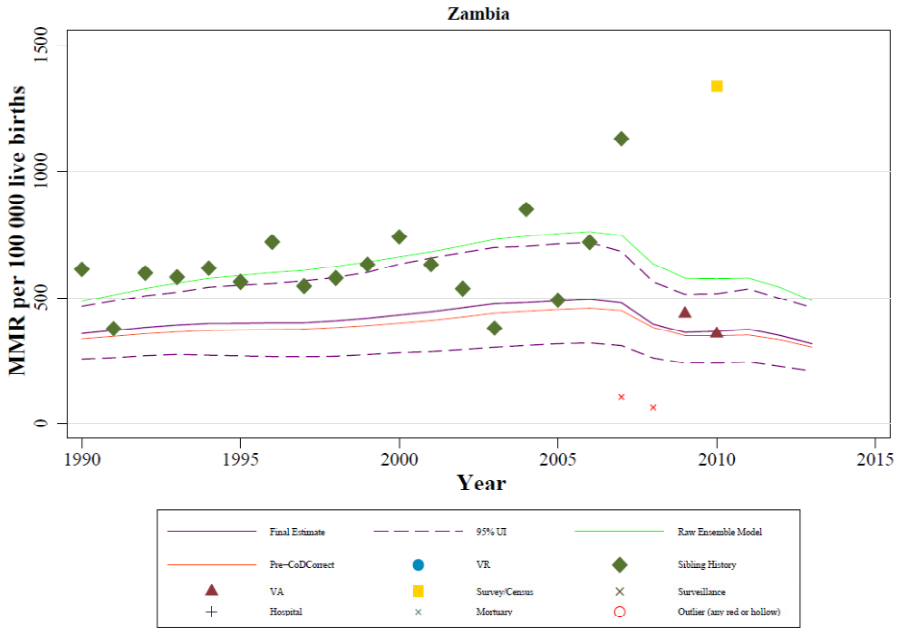
woman factors	{Q268comm1} #	
	{Q268comm2} #	
	{Q268comm3} #	
woman factors	{Q268fowd1} #	
	{Q268fowd2} #	
	{Q268fowd3} #	
data collector {	Q269coll} ___	
Date of Completion	{Q270comp} <dd/mm/yyyy>	
Service adequate	{Q266Dvod1 #	
	{Q266Pvod2} #	

end of questionnaire.

Annex 5 - Levels and trends of maternal mortality in Zambia

The chart shows the Zambia national mortality levels and trends of maternal mortality in Zambia (Kassebaum, Bertozzi-Villa, Coggeshall, & et al, 2014).

Figure A2: Trends and mortality levels in Zambia



Annex 6 – Approvals by ethics and the ministry of community development mother and child health, Zambia.

Annex 7 – Manuscript submitted to the BMC pregnancy and child birth journal.

Title: A Synopsis of maternal deaths in Zambia based on Maternal Death Review data: A descriptive study.

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Key Words: Maternal deaths, Maternal Death Reviews (MDR), Zambia

ABSTRACT
Introduction and background: Maternal Mortality (MM) is defined as those deaths that occur due to complications of pregnancy or child birth and in women dying within 42 days after delivery. The 5th millennium development goal (MDG5) was fashioned to mitigate the burden due to Maternal Deaths. Maternal mortality Ratio (MMRatio) is high in Zambia currently standing at 591/ 100, 000 live births in 2007.This study aimed to aggregate available notified and reviewed maternal deaths in 4 provincial medical offices in Zambia. This descriptive study examined causes of maternal deaths, characteristics of the dead women and features of the facilities they died in, based on Maternal Death Review (MDR) data.
Methods: The study used the 3 tools used during maternal death reviews. These included the notification, health facility and the community interview tools. Data was entered from the completed forms from year 2008 to January 2014 available at the provincial health offices in western, north western, copperbelt and central provinces.
Results and discussion: In the four provinces, 329 notifications were found. Based on the MDR data, Western province had the largest maternal mortality ratio of 166/ 100,000 live births. The lowest MMRatio was for the copperbelt province at 24 deaths per 100, 000 live births. Collectively the bleeding conditions accounted for 48% of all the pregnancy related deaths. There were also deficiencies in the referral system, supplies, skills and equipment in some health facilities. In some cases the diagnosis was missed or the appropriate management was delayed altogether. Notwithstanding, factors outside the health system such as the sparse geographic distribution and poor road communication during referrals were noted.
Conclusion and Recommendation: Gaps in the human resources for health, blood and other supplies and equipment for emergence obstetric care, the low rate of referred patients and competencies by service providers to manage and resuscitate emergencies contributed to the maternal mortality in the 4 provinces. Factors in the 3 delay model, especially the delay to receive appropriate care in the face of obstetric emergencies, were observed to be an important and common phenomenon. Emergence Obstetric care may need to be scaled up to all Health Posts (HP) and Rural Health Centres (RHC). Maternal Death Review data may be quantified regularly at national level to provide real time feedback to policy makers. An emergency Obstetric and neonatal care needs assessment is needed.

BACKGROUND

Maternal mortality is defined as those deaths that occur due to complications of pregnancy, child birth and puerperium. Pregnancy-related deaths include all deaths of women in their reproductive ages that occur during pregnancy and those within 42 days after delivery for any gestational age. For every woman that succumbs to maternal death there are many more women that suffer disabilities, infections and other complications of birth (Ross, Campbell, & Bulatao, 2001).

The direct causes of maternal deaths include medical conditions, hemorrhage, infections and obstructed labour. Indirect causes include conditions such as diabetes, sexually transmitted diseases (STI's), HIV and anemia that predispose women to increases in the risk of complications. Since most maternal deaths occur around the time of delivery, strategies that target this period will particularly reduce maternal mortality.

A Review of a broad body of research material by Thaddeus and Maine in 1994 helped them to coin the 'Three delays model'. The model focused on those factors contributing to maternal mortality that were in the interval between onset of obstetric complications and its outcome. This time during motherhood when most complications occurred was observed to be the phase surrounding child birth. The model recognized that different barriers which interact in a complex yet interlinked nature prevent women and girls form accessing high quality maternal and family planning services. (Maine, et al., 2007), (Thaddeus & Maine, Too far to walk: maternal mortality in context., 1994 April). The causes of these deaths are largely preventable by cost effective high impact interventions, (4). However, the choice of particular interventions that may have the greatest impact depends on sound information at national level about which places are mostly affected and which particular causes are important and associated with those particular places.

The maternal mortality has reduced from the 1990 estimates by a worldwide average of 47% by the year 2010. However the least reduction according to WHO has been in Sub Saharan Africa. Excluding deaths due to HIV, Sub Saharan Africa accounts for 56 % of the global burden. This implies that the millennium development goal number 5 of reducing MMRatio by 75% will not be achieved by the year end 2015 (Chou 2012), neither in Zambia nor globally.

The country's prosperity, productivity, human rights considerations and growth are intricately connected to women's health. As an indication of this realization, the 5th millennium development goal (MDG 5) was fashioned by United Nations to address maternal health. Zambia's maternal mortality is high, estimated to be about 591/100, 000 live births in 2007 using the Zambia Demographic and Health Survey (6) (7) and declined to 398 deaths per 100,000 live births in the 7 years prior to the 2013 -14 ZDHS (8). Modeling however, indicates that there may have been a slight reduction in maternal mortality between 2007 and 2013 (9).

When a national maternal death review was done in South Africa in 1998, a clear pattern of disease and problems with patient care emerged which included hypertensive conditions; AIDS; obstetric hemorrhage; pregnancy- related sepsis and pre-existing medical conditions (10). Women aged 30 years and older were at

greater risk of dying than women younger than 30 years. Grand multiparas (the women that have had 5 or more children) and those in their first pregnancy were at greater risk than the rest of the women of child bearing age that had children. When the recorded causes of death were stratified against the level of the hospital where the death occurred, there was an observed difference in the categorized causes of death (4).

Other patient related problems in the South African study included non-attendance and delayed attendance to health institutions. Administrative problems included poor transport and lack of intensive care facilities. In more than 50% of the cases included in the national confidential review of maternal deaths, there were problems in the care given to the women during hospitalization, the majority of which occurred in primary level hospitals (4).

Maternal death reviews (MDR) is an intervention whose focus is to bring to light the causes of maternal deaths, delineating the social and other contributing factors in both health facility and community maternal deaths. The districts in Zambia have been reviewing maternal deaths that have occurred in their respective catchment areas since 2007 when the MDR strategy or approach to reviewing maternal deaths was scaled up. The lessons learned from such audits have been used to institute local interventions. Maternal Death Reviews provide contextual factors and actual causes of death.

Notwithstanding, there had not been a national or subnational review of maternal deaths that utilized the MDR data generated by the districts to create an overview. This quantitative operational research of maternal deaths based on maternal death reviews was done. This study aimed to aggregate all available notified and reviewed maternal deaths in 4 provinces of Zambia to identify causes of death; categorize the contributing factors and the priority health problems identified by the districts. This paper aims to inform and guide policy makers to amenable public health elements or determining factors.

METHODS

STUDY DESIGN:

This is a descriptive quantitative study design of reviewed maternal deaths from 4 provinces in Zambia.

STUDY POPULATION:

The study population consisted of the maternal deaths reported and reviewed in all the districts of 4 provinces visited during data collection; namely Central, Copperbelt, Western and North-western provinces of Zambia.

SOURCES OF DATA:

The sources of data were community and hospital MDR reports under the Ministry of community development, mother and child health (MCDMCH). The study also examined MDR meeting reports and minutes. This study was conducted by using the MDR tools available between January 2008 and January 2014 at the provincial Medical offices (PMO) in the said provinces. The tools included those received

from public and private health institutions from all reporting districts. The standardized tools or forms included:

Hospital/ health centre maternal death review form
Community based maternal death review tool and
Maternal death notification forms.

A total of 471 variables or fields were used to gather data from all the 3 forms.
SAMPLING:

All reported and reviewed maternal death review forms sent to the provincial health offices during the period of January 2008 to January 2014 were included.

DATA COLLECTION:

The forms obtained at the provincial health offices were scanned and stored on a laptop computer or the coded data was directly loaded on the data base straight from the tool. Each set of the questionnaires (containing the 3 tools) for a particular case were coded according to a codebook generated from literature and the data; and entered using the Epidata database software. The cases that met the case definition of a pregnancy-related death were included in the analysis. The Process of Qualitative Content Analysis for the open ended questions was used to code and categorise the data.

STATISTICAL ANALYSIS

This step involved running the frequency tables and cross tabulations from the database created. The study was descriptive and findings are presented in terms of % and frequencies. The maternal deaths were analyzed by province to estimate the MMRatios.

ETHICAL CONSIDERATIONS

Risks/discomforts
The researcher did not have contact with the human subjects but used secondary data derived from maternal death review records made available from the 4 provinces visited in Zambia. Only contextual data about the cases was included onto the database.

Approval
Ethical approval was sought from 'Excellence in Research Ethics in Science' (ERES) converge Institutional Review Board (IRB). The protocol clearance numbers was 'ERES converge IRB No. 00005948' with approval reference number 2013-july-003. The IRB email address is <eresconverge @yahoo.co.uk>. Subsequent permission was sought and granted from the ministry of community development mother and child health to proceed with the study.

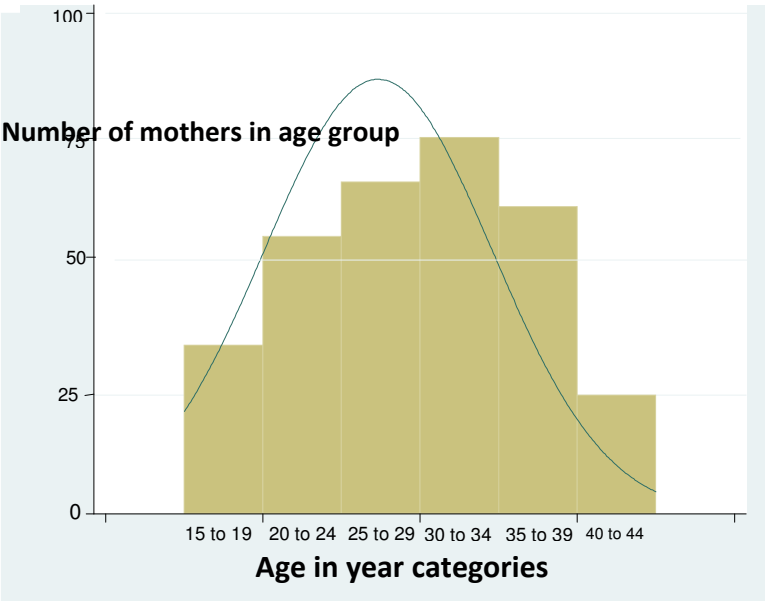
RESULTS

TABLE :1 FORMS OBTAINED BY PROVINCE. (N= 329)

Province	% (N) maternal deaths with notification forms	% (N) Maternal deaths with Health Facility review	% (N) Maternal deaths with Community Review	Total reported maternal deaths per province (N)
Western	68.3 (138)	22.3 (45)	14.5 (29)	(138)
Northwestern	68.8 (44)	23.4 (15)	7.8 (5)	(56)
Copperbelt	67.4 (64)	22.1 (21)	1.5 (10)	(75)
Central	100.0 (60)	0.0 (0)	0.0 (0)	(60)
Total	(296)	(81)	(44)	(329)

The majority of the deaths were reported on notification forms only. We see that there were differences in the reporting of maternal death review data to the provincial centres. Central province medical office (PMO) did not have any health facility or community tools available at the provincial health office.

Figure 1: Age distribution (n=329)



The mode and median age was 30 while the mean age was 29.2 years. The 25th percentile was at age 23 whereas the 75th percentile was 35 years.

TABLE 2: NOTIFIED CAUSES OF MATERNAL DEATHS (N=329)

OBSTETRIC, MEDICAL AND SURGICAL CONDITIONS CAUSING MATERNAL DEATH (N=329)	Frequency % (N)
Direct	
Postpartum Heamorrhage (PPH)/ complications causing PPH	23.4 (77)
APH (Antepartum Heamorrhage)	11.6 (38)
Severe Anaemia	12.6 (41)
Infections/ Septic conditions in pregnancy or puerperium	11.9 (39)

Hypertensive conditions	4.3 (14)
Abortion	3.1 (10)
Malpresentation, Cephalopelvic disproportion (CPD)	2.4 (8)
Peri-operative conditions/ complications	2.4 (8)
Chest conditions	2.1 (7)
Thromboembolic conditions	1.8 (6)
Other contributing obstetric factors (conditions)	1.8 (6)
Indirect causes	
HIV infection with complications.	6.2 (17)
Other Indirect medical and surgical conditions	4.1 (11)
Infectious conditions not directly affecting pregnancy	2.2 (6)
None/ missing	8.9 (24)

Bleeding obstetric complications, which included antepartum and postpartum heamorrhage and severe anaemia, were reported to account for nearly half of the causes of death. Infections and septic conditions in pregnancy or puerperium were also commonly reported causes of death. HIV infection and AIDS was reported to account for 6.2% (17) of the pregnancy-related mortality.

TABLE 3: MATERNAL DEATHS AND MATERNAL MORTALITY RATIO BY PLACE OF RESIDENCE (N=329)

Place of residence in terms of country and province for the maternal death. (n=329)	**Maternal deaths % N**	**Live births, 2008-2013 [10](according to DHIS)**	**Estimated MMRatio (per 100,000 live births)**	**Unadjusted MMRatio [11] (according to Census 2010)**
Zambia				691
Copperbelt	17.9 (69)	287, 419	24.0	678
Central	17.9 (59)	143, 613	41.1	715
Western	40.1 (132)	79, 441	166.1	1124
Northwestern	15.2 (50)	80, 852	62.5	605
Luapula and Northern	1.1 (3)	-	-	-
Angola	2.1(7)	-	-	-
Congo DR	2.7(9)	-	-	-

Western province had the highest estimated mortality ratio at 166/ 100, 000 live births. Some of the notified deaths were mothers from other nationalities.

[10] The live births were obtained from the District Health Information Systems.
[11] The maternal mortality ratio was obtained from data published from the central statistical office (CSO) population obtained from the 2010 census of the population. Unlike the reported data, the figures quoted here are unadjusted.

TABLE4 :HEALTH WORKERS ATTENDING TO THE MOTHERS AT THE HEALTH FACILITY ACCORDING TO HEALTH FACILITY FORMS (N=81)

MAIN ATTENDANT AT ADMISSION	Percentage % (N)
Skilled health workers	**67.9 (55)**
Trained Health workers	**17.3 (14)**
Untrained health workers	**12.4 (10)**
Missing/ Not applicable	**2.5 (2)**
MAIN ATTENDANT AT DELIVERY	
Skilled health workers	**48.2 (39)**
Trained Health workers	**21.0 (17)**
Untrained health worker, family member	**18.5 (15)**
Missing/ Not Applicable/ No assistant at delivery	**12.4 (10)**
MAIN ATTENDANT AT TIME OF DEATH	
Skilled health workers	**55.6 (45)**
Trained Health workers	**17.3 (14)**
Untrained health worker, family member	**21.0 (17)**
Missing/ Not Applicable	**6.2 (5)**

Two thirds (68%) of the women were admitted by skilled attendants. A lower percentage of deliveries were attended by skilled workers at delivery than at admission. About half of the women were attended by skilled workers at the time of death.

TABLE 5; PERCENTAGE OF WOMEN, WHO DIED FROM SPECIFIC COMPLICATIONS THAT WERE REFERRED FROM THE FACILITY THEY INITIALLY SOUGHT CARE IN (N=311).

Category of cause of death	HP or RHC		Level 1 hospital		Level 2 Hospital		Private hospital		Total	
	% [12]	n[13]	%	n	%	n	%	n	**%**	**n**
Direct										
Postpartum Heamorrhage (PPH)/ complications causing PPH	4	25	48	33	80	15	0	0	**40**	**73**
APH (Antepartum Heamorrhage)	0	5	78	23	100	7	0	1	**69**	**36**
Severe Anaemia	29	7	71	24	50	8	0	0	**59**	**39**
Infections/ Septic conditions in pregnancy or puerperium	50	2	48	27	77	9	0	0	**55**	**38**
Hypertensive conditions	0	4	67	6	67	3	100	1	**50**	**14**
Abortion	0	3	40	5	100	2	0	0	**40**	**10**
Malpresentation, Cephalopelvic disproportion (CPD)	0	4	100	1	100	1	0	0	**33**	**6**
Peri-operative conditions/ complications	0	0	20	5	67	3	0	0	**38**	**8**
Chest conditions	0	0	33	6	100	1	0	0	**43**	**7**
Thromboembolic conditions	0	1	0	3	100	1	0	1	**17**	**6**
Other contributing obstetric factors (conditions)	0	3	0	2	100	1	0	0	**17**	**6**
Indirect causes										
Indirect medical and surgical conditions	50	2	45	11	85	7	0	0	**60**	**20**
Infectious conditions not directly affecting pregnancy	0	2	18	11	80	8	0	0	**38**	**21**
HIV infection with complications.	0	2	100	3	0	4	0	0	**33**	**9**
None/ missing	0	7	33	9	100	2	0	0	**28**	**18**
	7	67	51	169	75	72	33	3	**45**	**311**

There were 311 women that died in the health facilities. Of the 67 women that died in health post or rural health centres only 7 % of the women were referred to higher levels of care.

[12] Indicates proportion of referred patients
[13] Shows the total number of both the referred and non-referred patients.

TABLE6: EQUIPMENT AND SUPPLIES LACKING TO OFFER EMERGENCY OBSTETRIC CARE (N=81)

EQUIPMENT LACKING (N=81)	**Percentage % (N)**
Oxygen concentrator	23.5 (19)
Oxygen cylinder	6.2 (5)
Working radio / cellphone network	2.5 (2)
Ultrasound machine	2.5 (2)
Manual vacuum aspiration kit	1.2 (1)
Other single lacking equipment	9.9 (8)
Missing/ Not Applicable	54.3 (44)
SUPPLIES THAT LACKED (N=81)	**Percentage % (N)**
Blood for transfusion/ giving sets/ fresh blood	13.4 (11)
Resuscitative drugs/ Oxygen supply/ no normal saline	4.9 (4)
Oxytocin	2.5 (2)
Urinalysis testing strips & Magnesium sulphate drug	1.2 (1)
Other single stocked out supplies	4.9 (4)
Missing/ Not Applicable	72.8 (59)

Medical equipment was lacking in 47% while medical supplies were stocked out in a commodity in 27% of the cases seen in health facilities. Some health facilities lacked basic equipment like oxygen concentrator 24%. Life support or resuscitative equipment as oxygen cylinders or the supply of oxygen was shown to be inadequate in some facilities. Blood for transfusion, blood giving sets or fresh blood was lacking in13% of the case reviewed at facility level.

TABLE7: CAUSES OF DELAYS TO OFFER EMERGENCY OBSTETRIC CARE (N=81)

REASONS FOR DELAY IN STARTING OFF FROM HOME BEFORE GOING TO THE HEALTH FACILITY (N=81)	
Delay in arriving at health facility (Level 1 Hosp. and Rural health centre)	8.6 (7)
Went to use traditional herbs first	6.2 (5)
Delay in seeking medical care after decision made	4.9 (4)
Delivered at home	2.5 (2)
Delivered on way to health centre	1.2 (1)
Precipitate labour	1.2 (1)
'Nobody knew she was pregnant' (abortion)	1.2 (1)
Measles self-treatment at home	1.2 (1)
Poor health seeking behavior	1.2 (1)
Missing/ Not Applicable	72.0 (58)
DELAY or OBSTACLES IN RECEIVING APPROPRIATE CARE (N=81)	**Percentage % (N)**
Ambulance delayed due to distance (15 in some cases)	8.6 (7)
Delay in caesarian section	3.7 (3)
Lab delay to have blood available	2.5 (2)
Delay to start antiretroviral therapy (ART)	2.5 (2)
Delayed referral	2.5 (2)
Delayed blood transfusion	2.5 (2)
Delayed to inform the medical doctor	2.5 (2)
Delivered by unskilled staff/ no health care worker at Rural Health Centre (RHC)	2.5 (2)
Other single delays or obstacles	13.4 (11)
Missing/ Not Applicable	59.2 (48)
Staff oversight (N=81)	**Percentage % (N)**
Missed or Delay to manage the PPH/ Missed diagnosis	8.6 (7)
Delayed resuscitative measures/ IV fluids not started at RHC.	6.2 (5)
Delayed examination/ vaginal examination and its documentation	4.9 (4)
Available FBC not done despite anaemia/ delayed Hb checking	3.7 (3)
Other unspecified staff over sight	9.9 (8)
Missing/ Not Applicable	66.6 (54)

Causes for delay to reach the health facility were observed in 28% maternal death that managed to attend the health facility. In 9% of the cases there was delay to

arrive at the health facility. However, 6% of the cases sought help by using traditional herbs at home.

The delays to receiving appropriate care according to health facilities 41% of the cases. The great distance the ambulance had to travel caused the delay for the women to receive appropriate care in 7% of the cases. The delay to receive caesarian section was observed in 4% of the cases.

Staff oversight was observed in 33% of the reviewed cases at health facility level. There was a missed diagnosis or delay to attend to an obstetric condition such as postpartum heamorrhage in 9% of the cases. Delayed resuscitative measures were observed in 6% of the cases.

DISCUSSION

The Study Findings

Obstetric heamorrhage was the leading direct cause of mortality. There were deficiencies in the competences of the health workers, the supplies and medical equipment. The study reviewed 329 maternal deaths for the period January 2008 and January 2014. The Cases were notified from 4 provinces, namely Western, Northwestern, Central and Copperbelt provinces. We see that more cases were notified by western province than any other province despite the small population in the province. The higher number of reviewed cases in western province may not mean a greater burden of maternal mortality but that the province seemed to have been better at reporting and reviewing the maternal deaths.
Collectively the bleeding conditions accounted for half of all the pregnancy related deaths. The high mortality due to heamorrhage could have been due to poor management at facility level and inadequate resuscitation measures when an emergency occurred. Supplies that lacked included blood for blood transfusion, giving sets or availability of fresh blood in a few cases. In some cases the intention to conceal an abortion or that there was a pregnancy when there was a vaginal bleed, may have led to severe heamorrhage. Bates et al in 2008 (11) reviewed articles from 1970 to 2007 that include themes on maternal deaths and near misses due to heamorrhage and the need for blood transfusion in sub-Saharan Africa. He showed that despite severe heamorrhage being the leading cause of maternal death blood supply was critically inadequate. Twenty of the 37 studies showed a direct association of maternal deaths and lack of blood transfusions (11). Indeed the use of other clinical approaches to prevent severe anaemia and treat hypovolaemia may reduce the need for supplies of blood for transfusion.

The list of direct causes seen in this study was no different from the one depicted in the literature in other regions of the world. However, the proportion of MD in each category was what was different from the other settings, largely influenced by the disease patterns in those regions such as HIV infections and non-communicable diseases in these other regions. (5) (12) (13) (14). Some abortions may have been reported as sepsis or heamorrhage (15). In the South African Confidential Enquiry into Maternal Deaths (CEMD), the leading cause of pregnancy related death was non-pregnancy related infections (41%), including HIV infections complicated by TB and Pneumonia (4). The high proportion of HIV related MD in South Africa is probably due to the high rates of HIV in the general population. It has also been observed that non-pregnancy related infections, like HIV, and other medical and surgical conditions are not amenable to obstetric interventions but may require other disciplines to address them. The MD due to complications of HIV infection and non-communicable diseases such as diabetes and hypertension can thus be prevented by controlling the HIV/AIDS and these other conditions in the general population.

Abortions which are inevitable phenomena in some pregnant women may not be stopped, but the MDs due to abortions could have been avoided by prompt post abortion care as obtained in other settings (7). There were also deficiencies in the supplies, skills and equipment to manage severe hypotension in the HP and RHC. Some hypertensive patients were managed at rural health centre level even with the attendant complexity of managing eclampsia. These hypertensive patients that

needed referral were not referred. Similarly, Malpresentation and Cephalopelvic disproportion were managed at rural health centre level yet these patients needed to be referred for manual vacuum aspiration (MVA) or caesarean section respectively. This non-referral of clients that needed referral may mean that the providers at the health post or rural health centre lacked or were deficient in the skills or means to make a diagnosis. In a few cases the diagnosis was missed but that the likely diagnoses to explain the events surrounding the death were made at the time of the review. In some cases, however, relatives refused referral due to the bad outcomes experienced in previously referred patients.

In some cases the referral system, table5, failed as there was no ambulance available when a complication occurred or the long distances that needed to be covered through harsh terrain and bush tracks when an emergency occurred in remote health facilities would limit the time for the women to receive appropriate care. Strengthening the adherence to the referral policy may translate to fewer cases of MD in RHC and HP. In some women complications during home deliveries caused the death as the clients were in poor condition by the time they arrived at the health facility coupled with inadequate resuscitation measures in these facilities. Home deliveries in some women were done to facilitate the use of herbal medication or indeed they may have had precipitated labour. Some women due to ill preparation delayed to go to the health facility despite having decided to deliver at the medical institution.

The study has compared the MMRatios, table 3, to ones obtained through census data; however, the method used to collect the census 2010 was different than exercised in this study. The estimates from this study were much lower than those estimated by the census data which was probably due to under reporting. It was noted during the provincial visits that some district medical offices were not trained to conduct maternal death reviews in the northwestern and copperbelt provinces and as such were inconsistent in completing the facility or community tools for each reported case, table 1. Some districts especially in northwestern were not reporting MDs at all. Another observation made by the provincial maternal and child health officers is that MDR tended to be restricted to facility MD, while the community deaths may not have been picked up by the district and facility reviewers.

Hadley and Tuba (16) observed that routinely collected data through the Health Management information Systems (HMIS) captured 10% of the estimated maternal deaths. This study, however, observed that the provinces notified between 3.5% and 15% of the estimated maternal deaths in the provinces when compared to the demographic health survey data.

Western province had the largest estimated maternal mortality ratio while the lowest MMRatio was estimated for the copperbelt province. The 2010 census report showed that the copperbelt was the more affluent province among the 4 provinces in the study which could explain the reduced MMRatio in this population (17). Notwithstanding, the data seemed to show consistence where less MD were seen in the copperbelt than in the western province in both this study and the Census. Factors outside the health system such as geographic distribution of the population may have impacted on the maternal outcomes of the pregnancies leading to the

MD. The copperbelt province for instance is densely populated with fairly good town planning such that the health facilities are fairly well distributed and the clients have shorter distances to travel to reach any health facility. The good road network too could have enhanced the referral and access to specialized or advanced services such as blood transfusion. Following this information it is possible that raising socioeconomic status of the women may improve the outcomes of the pregnancies as shown in other studies. (12) (14)

Half of the Maternal Deaths occurred in Level 1 hospitals, table 5, despite these institutions being equipped with instrumentation and staff to offer Comprehensive Emergency Obstetric Care (CEOC). Though this study did not aim to evaluate the emergency obstetric care program, but having observed the facility failures above, system, supply and staffing measures necessary for emergency obstetric care may need to be reviewed at level 1 hospitals. By design RHC and HP are unable to handle emergency complications of pregnancy or delivery but whenever complications occurred the facility would refer such clients needing advanced care.

Limitations and generalizability

The data used in the study was secondary data from MDR forms. The 4 provinces where data was collected were purposively chosen based on ease of access and availability of data. The Data could not be stratified by province as some provinces did not have reviewed data on the health facility of community tools. This limited the subgroup analysis of each province. The fewer cases reviewed at health facility and community levels reduced the power to detect subgroup differences in the MD included in the study. A study to include all the notified cases from the whole country may be needed.

The study was restricted to be a descriptive one as there was no comparison group even by province. In many respects the study was an operational research. There may have been information bias as there were few post mortems and the lack of collaborative information from the unreviewed MDs. There were no MDs that died in tertiary institutions included in this study as the deaths were classified and discussed clinically such that the case definition and subsequent discussion using MDR tools for a MD were not satisfied. The classification in the tertiary hospitals simply segregated the obstetric conditions from the medical or surgical conditions but highlighted gaps that may have contributed to the death at facility level.
CONCLUSION AND RECOMMENDATIONS

Maternal deaths in western, northwestern, central and copperbelt provinces of Zambia could be prevented by timely and appropriate emergence obstetric care. Obstetric heamorrhage accounted for half of the notified maternal deaths. The women dying were in the low obstetric risk group or in the prime of their reproductive lives. The more affluent province in socioeconomic and health care delivery services recorded fewer maternal deaths.

While this and other studies have shown that the poor socioeconomic status of the people are important predictors of maternal mortality, this study showed that there were gaps in the human resources for health, low referral rates by health care providers, lack resuscitative supplies or equipment for emergence obstetric care

were observed to surround maternal deaths. The delay to receive appropriate care in the face of obstetric emergencies, were observed to be an important and common phenomenon in the MD in level 1 and level 2 hospitals..

Notwithstanding the wealth of information presented in this study, there is need to have a national study of MDR data in order to get a glimpse of the bigger national picture and show the subgroup differences. To have the bigger picture, the districts not doing the maternal death reviews despite reporting MDs, may need to review the deaths occurring in their respective catchment areas. An emergence obstetric and Neonatal care needs assessment is needed.

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