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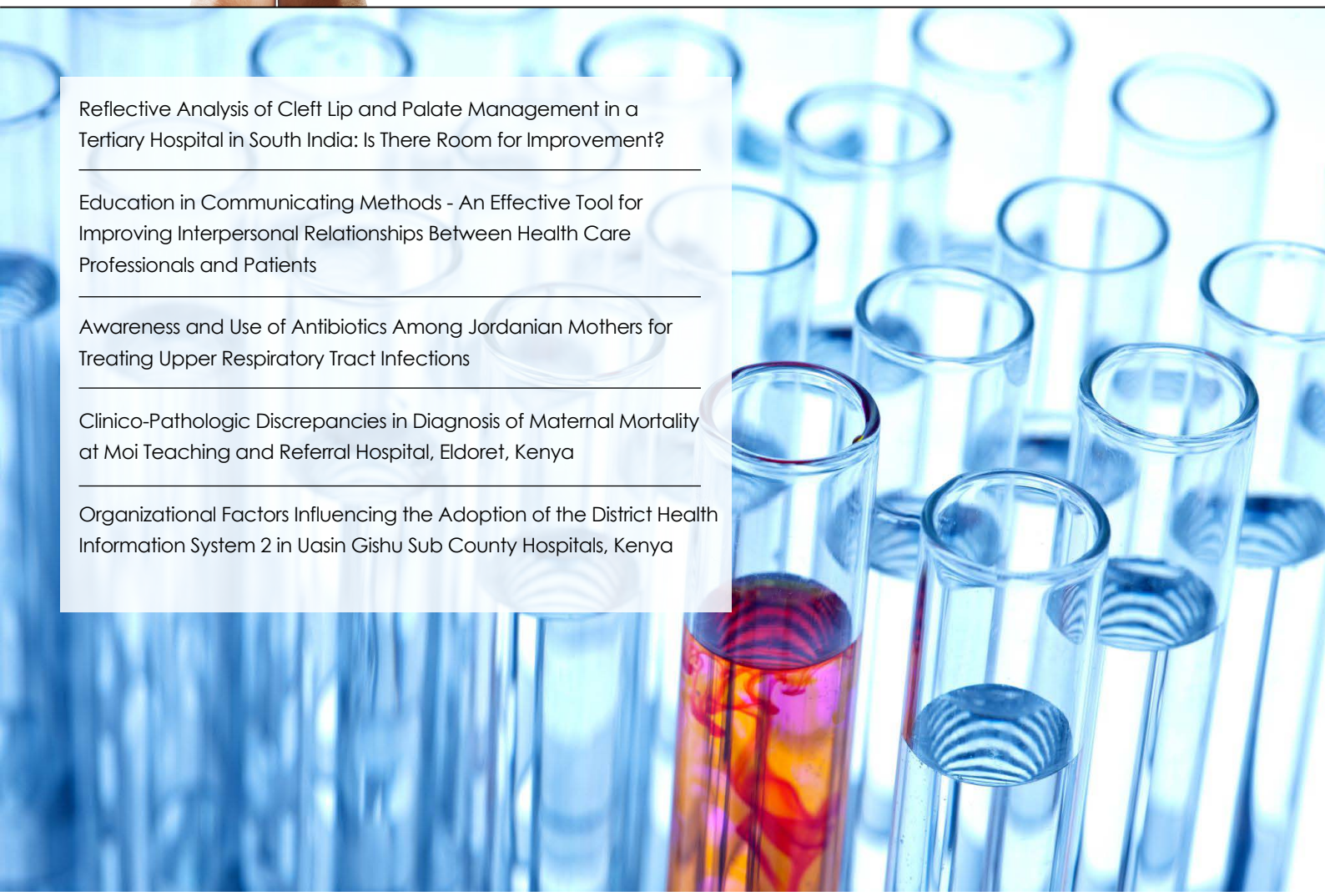
World Journal of Medical Education and Research

An Official Publication of the Education and Research Division of Doctors Academy



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ISSN 2052-1715

World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy

Clinical Practice
DAUIN 20200165

Clinico-Pathologic Discrepancies in Diagnosis of Maternal Mortality at Moi Teaching and Referral Hospital, Eldoret, Kenya

Mohamed O*, Nyongesa P*, Macharia B*, Odunga J*, Marsha J**

Institution
**Moi University, Usain Gishu County, Academic Highway, Eldoret, Kenya*
***Academic Model Providing Access to Healthcare (AMPATH), Eldoret, Kenya*

WJMER, Vol 22: Issue 1, 2020

Abstract

Background: Accurate attribution of causes of maternal mortality is critical in determining the circumstances surrounding maternal death and informs policy changes in standards of care. Clinical Maternal Death Review (CMDR) is a widely accepted method of attribution of cause of maternal death although post-mortem (P.M) examination is regarded as the gold standard. The level of concordance between CMDR and P.M has been shown to vary in different facilities thereby questioning the accuracy of the CMDR process. Objectives: The objective of the study was to determine the concordance between CMDR and P.M attributed causes of maternal mortality as well as the causes of death as attributed by CMDR and PM.

Methods: A descriptive retrospective review of all maternal deaths occurring at MTRH between 1st January 2011 and 31st December 2016 was conducted. Data on demographics, medical and obstetric history, circumstances surrounding death and attributed cause of death was collected from CMDR reports and filled into a data collection form. In patient numbers were then used to match CMDR reports to corresponding P.M reports from which autopsy attributed cause of death was identified. Standardization of diagnoses was done using International Classification of Disease and Health Related Problems 10– Maternal Mortality (ICD10-MM). All data was then entered into STATA for analysis. Categorical data was summarised using frequencies and proportions. Kappa statistic was used to measure concordance.

Results: A total of 200 maternal deaths were reported within the study period. Of these, 162 underwent CMDR with 25 cases having a corresponding PM report and were subjected to concordance testing. Most maternal mortalities 81 (51.9%) occurred in patients aged between 21–30 years, in multi gravid women 44 (49.4%) and at gestations of 22 – 36 weeks 42 (45.2%). The leading causes of death as per CMDR were obstetric haemorrhage 27 (16.7%), non-obstetric complications 24 (14.8%) and hypertensive disorders in pregnancy 23 (14.2%). The cause of death was unknown/undetermined in 45 (27.8%) cases during CMDR. Overall concordance of CMRD to PM was moderate (k statistic: 0.57). Very good level of concordance was seen in the diagnosis of pregnancy with abortive outcomes, obstetric haemorrhage, pregnancy related infections and other obstetric complications. Discordance was seen in the diagnosis of hypertensive disorders in pregnancy, unanticipated complications of management and non-obstetric complications. Unknown/undetermined causes of death during CMDR largely contributed to discordance in diagnoses.

Conclusion: There are difficulties in assigning cause of maternal death during CMDR as demonstrated by the high number of cases reported as having an unknown/undetermined cause. This may lead to underestimation of actual disease burden hence affecting maternal mortality prevention policies.

Recommendations: A systematic approach in conducting CMDR, including the use of formal reporting tools based on the current recommended ICD10-MM should be adopted. Other methods of attribution of underlying causes of death such as Confidential Enquiry into Maternal Death (CEMD) should be explored.

Key Words
Maternal Mortality; Post-Mortem; Confidential Enquiry; ICD MM

Corresponding Author:
Dr Omar Mohamed; E-mail: dr.omar.damnan@gmail.com

Introduction

The United Nations (UN) made a conscious decision in 2002 to include maternal and child mortality reduction as a target for its Millennium Development Goals (MDGs) (MDG Report, 2011). Maternal mortality is high in developing countries. Globally, more than 289,000 women die annually due to pregnancy-related complications, with half of

these deaths occurring in Sub-Saharan Africa[1].

Globally, the maternal mortality ratio (MMR) stands at 210 per 100,000 live births. When this is categorised by region, Africa has the highest with MMR of 546 per 100,000 live births, with Southern Asia, Oceania and the Caribbean, each registering 190 maternal deaths per 100,000 live births; Latin America at 68 per 100,000 live births while Commonwealth and Eastern Europe and the Commonwealth of Independent States (CEE/CIS) encounter 25 maternal deaths per 100,000 live births[2], In a study at Nigeria's Adeoyo Teaching Hospital MMR was found to be 963 per 100,000 live births[3].

In Kenya, the national mortality ratio remains high with an MMR of 510 per 100,000 live births in 2015[4]. Furthermore, the MMR vary in various regions or health facilities with Kenyatta National Hospital (KNH) recording 992 per 100,000 live births in 2004[5]. Kilifi district hospital recorded 250 per 100,000 live births between 2008 and 2010[6]. A retrospective study on maternal mortality at Moi Teaching and Referral Hospital for the period January 2004 – March 2011 found that the MMR stood at 426 per 100,000 live births; however, the study found wide variations in MMR during the period as it was lowest in 2010 (290 /100,000) and 580/100,000 in 2004[7].

The Tenth Revision of the International Classification of Diseases (ICD-10) defines a maternal death as the death of a woman while pregnant or within 42 days of termination of pregnancy, where the adverse event or events is or are not related to accidental or incidental causes[8].

The ICD - MM recommends that maternal death should be classified into two main groups: direct obstetric deaths which result from obstetric complications of the pregnancy state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment or a chain of events resulting from any of these. Indirect obstetric deaths result from previous existing disease or disease that developed during pregnancy and are not as a direct result of obstetric causes but was aggravated by the physiological effects of pregnancy. Most indirect maternal deaths are not reported and often reported as non-maternal and these vary significantly in different countries. During the period of 1992-1993, only half[33] of the over 60 countries reported vital registration figures for causes of maternal death. No indirect causes of death were reported in the period 1997-1999; a confidential inquiry on causes of maternal death in the United Kingdom found that indirect deaths accounted for more maternal deaths than direct causes[9].
Analysis of the burden of obstetric mortality and morbidity that address direct causes of death is important. Indirect causes account for 20% - 25% of maternal deaths and are attributable to illnesses aggravated by pregnancy. They include anaemia, malaria, HIV/AIDS or diseases of the heart, lung, liver, or kidneys. Physical violence and accidents are not included in this group.

This study therefore seeks to elucidate the causes of maternal death at Moi Teaching and Referral Hospital. Information on Clinical Maternal Death Review (CMDR) and post-mortem examination attributed causes of death will be collected. Concordance between the attributed causes as per CMDR and post-mortem (PM) diagnosis will be determined.

Determination of the probable cause of maternal death in most African countries is a great challenge. Post-mortem examination, which is the gold standard in the diagnosis of maternal mortality, in our region is hindered by cultural and religious beliefs. The Clinical Maternal Mortality Death Review (CMDR) is therefore relied upon to attribute causes of maternal death. Lack of standardized approaches to CMDR coupled with inadequate clinical records may lead to skewed attribution of the causes of maternal death. Currently, no audit has been conducted to determine the concordance between CMDR and P.M diagnosis at MTRH. It is therefore prudent to bridge this dearth in knowledge so as to enable reliable maternal mortality (MM) reporting.

Materials and Methods

Study Setting
The study was carried out at the reproductive health and pathology departments of Moi Teaching and Referral Hospital (MTRH). MTRH is the second largest public hospital in Kenya and serves as a referral facility with a catchment population of 40 million comprising western Kenya, some parts of Eastern Uganda, South Sudan and Tanzania.

Study Design
This was a descriptive retrospective study. Data on maternal deaths that occurred from 1st January 2011 to 31st December 2016 was collected. Patient records were reviewed for demographic characteristics, medical and obstetrical history and causes of death.

Study Population
The study population were all cases of maternal mortality at MTRH. The target population comprised of expectant mothers of up to 42 days post-partum who died at the Reproductive Health Department, Accidents and Emergency Department and ICU/CCU of Moi Teaching and Referral Hospital.

Sampling Technique
Purposive sampling was used to review records of all cases of maternal mortality

Sample Size
The sample size involved all cases of maternal deaths with clinical and post-mortem diagnosis for the probable cause of death during the period 1st January 2011 to 31st December 2016.

Data Collection
All pregnant women who had died while receiving care at the hospital were identified from the in-patient database and farewell home records. Patients were also identified from maternal mortality review files. This was done so as to ensure most cases of maternal mortality had been captured. For those who underwent a post-mortem examination, the report was matched to a patient file.

Review of CMDR and P.M Reports
Clinical maternal death reports were reviewed. Data variables collected included socio-demographics (age), Obstetric history (gravidity, parity), pre-existing medical conditions, diagnosis at time of admission, diagnosis at the time of death and attributed clinical cause of death.

Names and dates of all maternal mortalities identified from CMDR were then matched to autopsy reports. For those found, data on autopsy diagnosis was recorded. Both CMDR and PM attributed causes of death were standardized using ICD MM. Results were grouped in different categories based on the primary reported cause of death. When more than one diagnosis was identified, the different diagnoses were classified as: (a) Primary/underlying cause of death; (b) Immediate cause of death; (c) Contributory conditions. The study mainly focused on the primary/underlying cause of death (category a).

Table 1: ICD-MM Maternal Mortality Standardization Tool

Summary of ICD-MM Group Diagnoses		
Groups of underlying causes of death during pregnancy, childbirth and puerperium in mutually exclusive, totally inclusive groups		
Type	Group Name/Number	Examples of Potential Causes of Death
Maternal Death: Direct	1. Pregnancy with abortive outcome	Abortion/miscarriage, ectopic pregnancy and other conditions leading to maternal death and a pregnancy with abortive outcome.
Maternal Death: Direct	2. Hypertensive disorders in pregnancy, childbirth and puerperium	Oedema, proteinuria and hypertensive disorders in pregnancy, childbirth and puerperium
Maternal Death: Direct	3. Obstetric haemorrhage	Obstetric diseases or conditions directly associated with haemorrhage
Maternal Death: Direct	4. Pregnancy-related infections	Pregnancy related, infection-based diseases or conditions
Maternal Death: Direct	5. Other obstetric conditions	All other direct obstetric conditions not included in groups 1-4
Maternal Death: Direct	6. Unanticipated complications of management	Severe adverse events and other unanticipated complications of medical and surgical care during pregnancy, childbirth and puerperium
Maternal Death: Indirect	7. Non-obstetric complications	Non-obstetric complications: • Cardiac disease (including pre-existing hypertension, RHD) • Endocrine conditions • Gastrointestinal conditions • Central nervous system conditions • Respiratory conditions • Genitourinary conditions • Autoimmune diseases • Skeletal diseases • Psychiatric conditions • Neoplasms • Infections not directly associated with pregnancy
Maternal Death: Unspecified	8. Unknown/Undetermined	Maternal death occurring during pregnancy, childbirth and puerperium where the underlying cause is unknown or was undetermined.
Death during pregnancy, childbirth and puerperium	9. Coincidental causes	Death during pregnancy, childbirth and puerperium due to external causes

Data Analysis and Presentation
Descriptive statistics were used to explore and summarize the data. Numeric (continuous/discrete) data such as age was summarised using measures of central tendency (mean) and dispersion (standard deviation). Categorical data was summer sided using frequencies and proportions. Summaries were presented in tables. Level of agreement was used to measure concordance.

Ethical Considerations
All patient information was kept confidential. Only the primary investigator has access to identifiable patient information. Forms used to extract data from patient files were stored in locked cabinets and databases were password protected.

Results
There were 200 maternal deaths that occurred between January 2011 and December 2016, of these, 162 CMDR reports were available for review. There were 56 cases of maternal mortality that underwent post-mortem examination during the time period. However, only 25 cases had both CMDR and PM reports. These were then used to assess the concordance between PM and CMDR attributed cause of death.

Table 2: Demographic Information

Variable	Category	Frequency	Percentage
Age (n=156)	< 20 years	19	12.18
	21 – 30 years	81	51.92
	31 – 40 years	49	31.41
	>40 years	7	4.49
		156	**100.0**

The majority 81 (51.92%) of women who died were aged between 21-30 years. The age of the mothers ranged from 14 to 49 years with a mean of 28.3 (SD 7.3).

Table 3: Obstetric Characteristics

Variable	Category	Frequency	Percentage
Gravidity (n=89)	Primi gravida (<2)	24	26.97
	Multi gravida (2-4)	44	49.44
	Grand multigravida (5-7)	15	16.85
	Grand grand multigravida (>7)	6	6.74
Gestation age (n=93)	<22 weeks	13	13.98
	22 – 36 weeks	42	45.16
	> 36 weeks	38	40.86
Abortion history (n=135)	Yes	29	21.48
	No	106	78.52

Most maternal mortalities occurred in multigravida women 49.44% (44) and at gestations of 22 – 36 weeks 45.16% (42). The ones with a history of abortion accounted for 21.48% (29).

Table 4: Timing of Death

Variable	Category	Frequency	Percentage
Timing of death (N = 162)	Early pregnancy	19	11.7
	Antenatal 20+ weeks Intrapartum Postpartum Unknown	26 18 92 7	16.0 11.1 56.8 4.3
Referred (N = 162)	No Yes	76 86	46.9 53.1
PM request (N = 162)	No Yes	55 97	33.9 59.9
	Not indicated	10	6.2

Underlying Causes of Death per CMDR
This section presents the causes of death as summarized from the Clinical Maternal Mortality Review (CMDR) reports. The total number of clinical maternal mortality review reports was 162.

PM Attributed Causes of Maternal Mortality
In order to obtain PM attributed causes of maternal mortality, corresponding PM results for CMDR reports were searched for.

Of the 162 cases that had undergone CMDR, recorded request for PM was identified for 97 of the case files. Of these, only 25 cases had a corresponding PM report.

Demographic Data of Cases That Underwent PM
Most cases that underwent PM examination were those of women between the ages of 21 and 30 years.

Table 5: Timing of Death

Cause	Frequency	Percentage
Direct Maternal Death	85	52.5
Indirect Maternal Death	25	15.4
Unknown/Undetermined Deaths	45	27.8
Not Indicated	7	4.3
Total	**162**	**100.0**

Table 6: CMDR Attributed Primary Causes of Maternal Death

Diagnosis	Frequency	Percentage
Group 1 - Pregnancy with Abortive Outcomes	13	8.0
Group 2 - Hypertensive Disorders in Pregnancy, Childbirth and Puerperium	23	14.2
Group 3 – Obstetric Haemorrhage	27	16.7
Group 4 – Pregnancy Related Infections	15	9.3
Group 5 – Other Obstetric Complications	7	4.3
Group 6 – Unanticipated Complications of Management	1	0.6
Group 7 – Non-obstetric complications	24	14.8
Group 8 – Unknown	45	27.8
Not Indicated	7	4.3
Total	**162**	**100.0**

Table 7: Age Distribution of Cases That Underwent PM

Variable	Frequency	Percentage
Below 20 Years	2	8.0
21-30 Years	13	52.0
31-40 Years	9	36.0
Above 40 Years	1	4.0
Total	**25**	**100.0**

Obstetric Characteristics of Cases that Underwent PM
Most reports of cases that underwent PM were of women who were primi-gravida at the time of death (56.0%) and most were between 22 to 36 weeks pregnant.

Timing of Death of Cases That Underwent PM
The majority (44.0%) of cases that underwent PM were those of women who were at the antenatal phase of pregnancy at time of death.

Table 8: Obstetric Characteristics of Cases That Underwent PM

Variable	Category	Frequency	Percentage
Gravidity (n=89)	Primi gravida (<2)	14	56.0
	Multi gravida (2-4)	6	24.0
	Grand multigravida (5-7)	3	12.0
	Grand grand multigravida (>7)	2	8.0
Total		**25**	**100**
Gestation Age (n=93)	<22 weeks	7	28.0
	22 – 36 weeks	12	48.0
	> 36 weeks	6	24.0
Total		**25**	**100**

Table 9: Timing of Death of Cases That Underwent PM

Variable	Frequency	Percentage
Early Pregnancy	6	24.0
Antenatal 20+ weeks	11	44.0
Intrapartum	5	20.0
Postpartum	2	8.0
Unknown	1	4.0
Total	**25**	**100.0**

Immediate Cause of Death of Cases That Underwent CMDR

The main causes of maternal mortality among the cases that underwent PM were attributed to hypertensive disorders in pregnancy (28.0%), other obstetric complications (24.0%), and pregnancy with abortive outcomes (16.0%) and non-obstetric complications (16.0%).

Comparison Between CMDR and PM-Attributed Underlying Cause of Maternal Death

In comparison to CMDR, PM attributed more underlying causes of maternal mortality to hypertensive disorders in pregnancy (28% V/s 16%), unanticipated complications of management (8% V/s 0) and non-obstetric complications (16% V/s 8%).

CMDR could not attribute an underlying cause of death to 28% of cases in comparison to PM which was able to make a diagnosis in all cases.

Table 10: Immediate Cause of Death of Cases that Underwent CMDR

Group	Frequency	Percentage
Group 1 – Pregnancy with abortive outcomes	4	16.0
Group 2 – Hypertensive disorders in pregnancy, childbirth and puerperium	7	28.0
Group 3 – Obstetric haemorrhage	1	4.0
Group 4 – Pregnancy-related infections	1	4.0
Group 5 – Other obstetric complications	6	24.0
Group 6 – Unanticipated complications of management	2	8.0
Group 7 – Non-obstetric complications	4	16.0
Total	**25**	**100.0**

Table 11: Comparison between CMDR and PM Attributed Underlying Cause of Maternal Mortality

	Underlying Causes of Maternal Mortality Attributed by:			
ICD-MM Group	**CMDR**		**PM**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Group 1 – Pregnancy with abortive outcomes	4	16	4	16
Group 2 – Hypertensive disorders in pregnancy, childbirth and puerperium	4	16	7	28
Group 3 – Obstetric hemorrhage	1	4	1	4
Group 4 – Pregnancy-related infections	1	4	1	4
Group 5 – Other obstetric complications	6	24	6	24
Group 6 – Unanticipated complications of management	0	0	2	8
Group 7 – Non-obstetric complications	2	8	4	16
Group 8 – Unknown/ Undetermined	7	28	0	0
Group 9 – Coincidental causes	0	0	0	0
Total	**25**	**100**	**25**	**100**

Table 12: Comparison between CMDR and PM Primary Groups of Underlying Cause of Maternal Mortality

	CMDR Primary Cause of Maternal Mortality	PM Primary Cause of Maternal Mortality
1	**Group 8) Unknown**	Group 2) Hypertensive Disorders in Pregnancy, Childbirth and Puerperium
2		Group 2) Hypertensive Disorders in Pregnancy, Childbirth and Puerperium
3		Group 3) Obstetric Haemorrhage – *Rupture of the uterus before onset of labour*
4		Group 5) Other Obstetric Complications – *Obstetric Embolism*
5		Group 6) Unanticipated Complications of Management – *Complications of Anaesthesia*
6		Group 7) Non-Obstetric Complications – *Infectious disease (HIV complications)*
7		Group 7) Non-Obstetric Complications – *Cardiac disease*
8	**Group 3) Obstetric Haemorrhage – *Rupture of the uterus***	Group 2) Hypertensive Disorders in Pregnancy, Childbirth and Puerperium
9	**Group 5) Other Obstetric Complications – *Obstetric embolism***	Group 6) Unanticipated Complications of Management – *Complications of Anaesthesia*

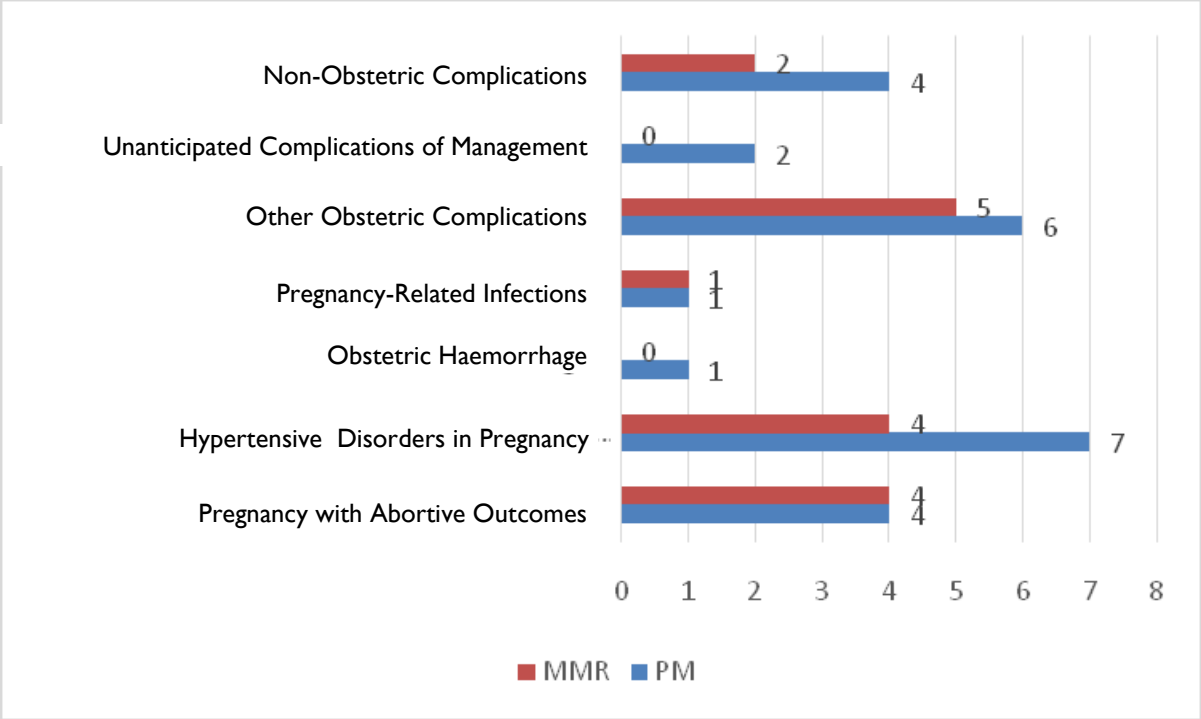

Figure 1: Level of Agreement of CMDR to PM Attributed Causes of Maternal Death

The above figure and table indicates the level of agreement between the clinical and PM diagnosis. Assuming that the PM diagnosis was the gold standard (correct diagnosis) with n=25, the number indicated under MMR indicates the number of cases that had a CMDR diagnosis that was similar to that attributed by PM.

The highest level of agreement was seen in the diagnosis of pregnancy with abortive outcomes and pregnancy-related infection. Discordance was seen in the diagnosis of hypertensive disorders in pregnancy (4/7 (57.1 %) cases diagnosed correctly), Non-obstetric complications (2/4 (50%) cases diagnosed correctly) and other obstetric complications (5/6 (83.3%) cases diagnosed correctly). Overall, concordance was seen in 16/25 (64%) of all cases.

Table 13: Level of Agreement of CMDR to PM Attributed Causes of Maternal Death

CMDR * Post Mortem Cross Tabulation									
Count									
		Post Mortem							Total
		Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	
CMDR	Group 1	4	0	0	0	0	0	0	4
	Group 2	0	4	0	0	0	0	0	4
	Group 3	0	1	0	0	0	0	0	1
	Group 4	0	0	0	1	0	0	0	1
	Group 5	0	0	0	0	5	1	0	6
	Group 7	0	0	0	0	0	0	2	2
	Group 8	0	2	1	0	1	1	2	7
Total		4	7	1	1	6	2	4	25

Table 14: Comparison of PM and CMDR Groups of Primary Causes of Death

Symmetric Measures					
		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement	Kappa	.579	.101	7.622	.0005
N of Valid Cases		25			
a. Not assuming the null hypothesis.					
b. Using the asymptotic standard error assuming the null hypothesis.					

Table 15: Interpretation of Kappa

Interpretation of Kappa						
	Poor	**Slight**	**Fair**	**Moderate**	**Substantial**	**Almost Perfect**
Kappa	0.0	.20	.40	.60	.80	1.0
Kappa	**Agreement**			The Cohen's kappa (κ) is .579. A kappa (κ) of .579 represents a moderate strength of agreement of CMDR attributed cause of maternal mortality to PM. Furthermore, since p = .000 (which actually means p < .0005), our kappa (κ) coefficient is statistically significantly different from zero as such the diagnoses are not by chance.		
<0	Less than chance agreement					
0.01 – 0.02	Slight agreement					
0.21 – 0.40	Fair agreement					
0.41 – 0.60	Moderate agreement					
0.61 – 0.80	Substantial agreement					
0.81 – 0.99	Almost perfect agreement					

Discussion

Demographic Characteristics

This study has shown that the highest proportion of maternal deaths occurred in women aged 22- 30 years of age, in women who had had 2 to 4 prior pregnancies and were at a gestation age of 22 to 36 weeks. These findings are in line with countrywide statistics that put the incidence of maternal mortality to occur between 20 to 29 years ("Kenya 2014 Demographic and Health Survey," n.d.) as well as studies conducted at MTRH where most women who died were found to be multigravida and were at pregnancy gestations under 37 weeks (Yego et al., 2013).

CMDR-Attributed Causes of Maternal Death

Obstetric haemorrhage, non-obstetric complications and hypertensive disorders in pregnancy were the main causes of death as per CMDR. The underlying cause of most of the obstetric haemorrhage cases were post-partum haemorrhage (PPH) and ruptured uterus. The highest proportion of deaths that occurred as a result of non-obstetric complications were due to cardiac disease in pregnancy and infectious disease. This highlights the growing burden of cardiac disease as a major contributor to maternal morbidity and mortality (Mocumbi, Sliwa, & Soma-Pillay, 2016). Eclampsia was diagnosed is 19 out of the 23 cases of maternal death grouped as occurring due to hypertensive disorders. Eclampsia is a severe complication of pre-eclampsia and has been sighted as a leading cause of hypertensive related maternal death at MTRH (Yego et al., 2013).

PM-Attributed Causes of Maternal Death

The highest proportion of cases that underwent PM examination were of women who were primigravid and were at the antenatal period of pregnancy at the time of death (Jashnani, Rupani, & Wani, n.d.). Given that the women die at what is considered a young age and in their first pregnancy, a lot of questions are raised in the family and a PM may be considered a good solution to gain closure.

The leading cause of death attributed to the cases that underwent PM were hypertensive disorders in pregnancy, childbirth and puerperium in 7 cases (28.8%) and other obstetric complications in 6 cases (24.0%). The main cause of other obstetric complications was obstetric embolism.

Possible reasons as to why these cases underwent post-mortem examination may be due to complications in diagnosis of a cause of death during CMDR necessitating a request for PM for more clarification. In the cases of other obstetric complications where obstetric embolism was the main cause, sudden onset of severe symptoms followed by death in a previously asymptomatic woman raises questions by relatives of which a PM can confirm, refute or elaborate the clinical diagnosis (Lucas, 2008).

Concordance Between CMDR and PM Attributed Causes of Maternal Death

Percentage concordance of CMDR to PM attributed cause of mortality was 64%. The calculated kappa score was at 0.57. Both scores indicate moderate agreement of CMDR diagnosis to PM. The highest concordance was in the attribution of pregnancy

with abortive outcomes. This may be explained by the fact that any woman within the reproductive age presenting with per-vaginal bleeding receives a pregnancy test and a pelvic ultrasound to identify the cause of bleeding. Such improvements in access to medical imaging devices and improved clinical skills have led to a decrease in cases of misdiagnosis (Sonderegger-Iseli et al., 2000).

Obstetric embolism, classified under other obstetric complications, was also accurately attributed as a cause of maternal mortality during CMDR. Recognition of the sudden onset of symptoms such as respiratory distress, cough and hypotension may have lead to correct diagnosis. There is however little literature of the burden of obstetric embolism as a cause of maternal mortality in Kenya. Countries such as France, the United States of America and Ethiopia report obstetric embolism as major causes of maternal mortality (Morau, Proust, & Ducloy, 2017). Although mortality rate as a result of obstetric embolism is high, there has been a decrease in case fatality rates in recent times which is attributed to early diagnosis as well as better resuscitative care (Kaur et al., 2016).

Discordance between CMDR and PM attributed causes of maternal mortality was seen in the diagnosis of hypertensive disorders in pregnancy, non-obstetric complications and unanticipated complications of management. Discordance in attributed cause of death was largely due to an unknown/undetermined diagnosis during CMDR. Misdiagnosis of the underlying cause of death during CMDR was seen in two cases. One case of hypertensive disorder in pregnancy was diagnosed as uterine rupture while another of complications of anaesthesia was diagnosed as pulmonary embolism. Delay in presenting to a facility for care is one of the major contributors to maternal mortality as it leads to advancement of the disease state (Thaddeus & Maine, 1994) which can lead to masking of the primary underlying cause by multi-organ failure leading to misdiagnosis or inability to diagnose.

Undiagnosed cardiac disease in pregnancy was in some cases misdiagnosed as acute collapse of unknown cause during CMDR. The case in point was that of a woman referred in for New Born Unit (NBU) services for her premature twins. Having no history of underlying medical conditions as well as an uneventful labour and delivery, thorough examination was not conducted. She later collapsed and died. A PM was conducted and attributed cardiac disease in pregnancy as the cause of death. Studies conducted in LMIC's have shown cardiac disease in pregnancy to be the most important non-obstetric cause of maternal mortality with high rates of adverse outcome being attributed to late diagnosis as a result of a lack in systematic approaches to screening for disease (Mocumbi et al., 2016). The importance of thorough examination of all patients presenting for care to rule out salient underlying medical conditions can therefore not be overemphasized. Establishment of joint obstetric – cardiac clinics may also significantly reduce maternal morbidity and mortality (Sliwa et al., 2014).

Complications of anaesthesia during obstetric surgical procedures was also missed during CMDR. Acute collapse was mainly attributed at CMDR as the cause due to the sudden deaths. Complications of anaesthesia in our region is under-estimated as a cause of maternal mortality and often not mentioned in vital statistics. Systematic reviews of studies conducted in Sub-Saharan Africa have however shown that anaesthesia related complications to be a contributor to maternal mortality with estimated prevalence rates of between 5.2 – 9.8 death per every 1000 anaesthetics (Sobhy et al., 2016). Recognition of complications of anaesthesia as a contributor to maternal mortality as well as pre-operative determination of risk factors for anaesthetic complications and intra-operative close monitoring of fluctuations in vital parameters are necessary in order to reduce the incidence of maternal mortality related to anaesthetic complications.

Seven cases of the 25 that underwent PM had an unknown/undetermined cause of death during CMDR. The diagnoses as per PM were hypertensive disorders in pregnancy, obstetric embolism, haemorrhage due to ruptured uterus, anaesthetic complications, cardiac disease in pregnancy and respiratory tract infections. These cases may have been undiagnosed during CMDR due to masking of underlying cause of disease as a result of late presentation or due to sudden collapse in an asymptomatic patient (Thaddeus & Maine, 1994).

Missed diagnoses at CMDR may have important implications on future research. Most countries in Sub-Saharan Africa base policies on vital statistics on prevalence rates of the main causes of maternal mortality. In our case where the rate of uptake of post-mortem examination is low coupled with findings that the CMDR process did not attribute or misdiagnosed the underlying cause of maternal mortality for a number of cases leads to a conclusion that we may be under-estimating actual disease burdens. Research questions on the impact of missed diagnoses on vital statistics and alternative methods of attribution of cause of maternal mortality may prove beneficial in generating an evidence base for future policies.

Conclusion

Maternal mortality remains to be a major problem at MTRH. A comparison between PM and CMDR attributed causes of maternal mortality puts obstetric haemorrhage, hypertensive disorders in pregnancy, pregnancy with abortive outcomes and pregnancy related infections to be the leading causes of maternal death respectively. Although the CMDR process is relatively reliable, there are difficulties in assigning a cause of maternal death as demonstrated by the high number of cases grouped as having unknown/undetermined causes. Efforts should be made to improve on the overall maternal mortality review cycle. This may be done by adopting a more structured approach in conducting CMDR such as developing a formal reporting tool based on the current recommended ICD10-MM including training of staff on the same (Owolabi et al., 2014). Emphasis on thorough reporting on social demographic characteristics should also be made. The use of a standardized tool both within the hospital and at the national level will also aid in comparison of statistics from different regions thus positively impacting overall maternal mortality reporting.

Limitations

1. Data on social demographic history was not adequately reported on in CMDR and PM reports.
2. Due to the small sample size, the findings are not representative and inference to the population cannot be made.

Recommendations

1. Adoption of a structured and systematic approach in conducting CMDR including the use of formal reporting tools based on the current recommended ICD10-MM should be adopted.
2. Other methods of attribution of underlying causes of death like the Confidential Enquiry into Maternal Death (CEMD) should be explored.

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