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The magnitude and factors related to facility-based maternal mortality in Mozambique

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Summary

Facility based maternal mortality remains as an important public health problem in Mozambique. A number of factors associated to the health system functioning can be described behind the occurrence of these deaths. This paper aimed to evaluate the magnitude of the health facility-based maternal mortality its geographical distribution and to assess the health facility factors implicated in the occurrence of this deaths.

A secondary analysis was done on data from the survey on maternal health needs performed by the Ministry of Health of Mozambique in 2008.

During the study period 2.198 maternal deaths occurred out of 312.537 deliveries. According to the applied model the availability of Maternal and Child Health (MCH) nurses performing Emergency Obstetric Care functions was related to the reduction of facility based maternal mortality by 40%. No significant effects were observed for the availability of medical doctors, surgical technicians and critical delivery room equipment.

Introduction

Maternal death is the death of a woman while pregnant or within 42 days of the termination of pregnancy, irrespective of duration and site of the pregnancy from any cause related to or aggravated by the pregnancy or its management (ICD -10). Although maternal mortality at the global level has decreased by 45% between 1990 and 2013, it continues to be a large burden and a cause of concern worldwide, particularly among the least developed countries.

Data obtained from the 2011 Demographic and Health Survey (DHS) estimated the maternal mortality ratio as 408 per 100 thousands live births in Mozambique (INE & MISAU 2011). In developing countries, the measurement of maternal mortality presents specific challenges because maternal deaths are not only rare but also difficult to identify(Hill et al. 2006). Accurate estimates of the number of maternal deaths in both the community and facility levels are highly important to inform policymakers and reproductive health program implementers (Qomariyah et al. 2009). On the basis of the data obtained from the 2007 general population census, it was estimated that 46% of all maternal deaths in Mozambique occur within a health facility (Saúde 2009). Factors related to health system organisation and the provision of health services have been identified elsewhere to play an important role in maternal deaths within the health facilities **(**(Kongnyuy et al. 2009)**,** (Knight et al. 2013)**,** (Cavallaro & Marchant 2013)**).**

In 2008, the Ministry of Health of Mozambique (MoH) performed a nation-wide maternal health care needs assessment, which included an evaluation of facility-based maternal deaths. In this study, we aimed to perform a secondary analysis of this maternal health care needs assessment. We evaluated the

magnitude of facility-based maternal deaths, its the geographical distribution and health facility influencing factors for maternal death.

Context

In 2007, Mozambique had an estimated population of approximately 20.2 million, with a total fertility rate of 5.8 children per women and an infant mortality rate of 118 per one thousand live births (INE 2009). In addition, 54.6% of all births occur in public health services, while the private sector accounts for 0.2% of births and the remaining 45.2% occurs at the community level (INE & MISAU 2011).

The MCH nurses are the main provider of maternal and child health services at the health facility in the country. They are trained to provide emergency obstetric care (EmOC) services and if needed, they refer patients to medical doctors (General Practitioner and Obstetrician and Gynaecologists) or to the surgical technician known as “Tecnico de Cirurgia,” a mid-level non-physician clinician trained to perform emergency surgical interventions (Pereira et al. 2007). In 2013, the ratio of MCH nurse per population was estimated to be 0.32/1000 inhabitants, which is below the minimum of 1 nurse/1000 inhabitants as recommended by the WHO (Dgedge et al. 2014).

Material and Methods

The survey on maternal health needs included 427 out of a total of 1277 health facilities in the country. Facilities with less than 1 delivery in the previous year were excluded. All of the major facilities, Central, General, Provincial and District Hospitals and the Health Centre Type I were included in the sample:

these facilities were attributed to a probability of selection factor p =1 and the Health Centres Type II (a peripheral and smallest health centre) factor p = 0.4.

Core questionnaires from the Averting Maternal Death and Disability needs assessment toolkit (AMDD 2014) were adapted to the country's context. For this study, we selected the modules related to: the general information on the health facility, including the type of facility, its geographical location and the number of maternity beds; *the availability of material, medication and equipment* for the provision of Emergency Obstetrical Care (EmOC); and *the availability of human resources of maternal health care service and general statistics on Maternal health.*

A group of health care providers were selected and trained for one week in data collection. Fieldwork was conducted from November 2007 to January 2008. An electronic database was designed using SPSS version 17 (SPSS Inc., Chicago, IL USA) and used for both data entry and analysis. The analysis included frequencies, cross tabulation and a report of the percentages, means and medians. As a result, a report was produced to inform the MoH.

A secondary analysis was performed to examine the factors related to health facility-based maternal deaths. Maternal death was considered to be the primary outcome and grouped into different potential influencing factors as the following:

Characteristics of health facility: type of facility according to the national classification of health facilities and size based on the number of maternity beds.

Availability of human resources and provision of signal functions of EmOC: The availability of key staff (Medical Doctors, MCH Nurses and Surgical Technician) for the provision of EmOC signals functions (Box 1) was measured. If a health care provider did not provide or prescribe one of the interventions according to the national norms for his category, then he was classified as non-providing EmOC signal function interventions. According to the national norms, the MCH nurse must offer Basic Emergency Obstetric Care (BEmOC) and the Medical Doctor, and the Surgical Technician must provide the Comprehensive Emergency Obstetric Care (CEmOC).

The workload was measured as a proxy of the number of deliveries per MCH nurse per day. This was classified as low if the health facility had less than three deliveries per MCH nurse per day, medium if the health facility had between three and five deliveries, and high if there were more than five deliveries per MCH nurse per day.

Availability of essential drugs for EmOC: A list of essential medicines for EmOC was formed from the national list of essential medicines in use in the country. As illustrated in Box 2, six categories of drugs were considered for evaluation. The criteria for evaluation of the availability of medicines were set as the following: for antibiotics, at least two antibiotics should be available; magnesium sulphate stands alone; anti–hypertensive drugs, at least one should be available; intravenous solutions, at least one should be available; quinine stands alone and uterotonic drugs, at least one should be available.

The medicine availability was then classified as bad if only zero to two types of medicines were available, regular if three to four types of medicines were

available, good if five medicines were available, and very good if all six types of drugs were available in the health facility.

The availability of delivery kits, resuscitator and aspirator was used as a proxy to measure the availability of critical equipment and equipment for EmOC provision. It was classified as bad if only the delivery kit or some components of the kit were available, regular if the delivery kit and resuscitator were available and good if the delivery kit, resuscitator and aspirator were all available in the maternity.

Modelling

A zero-inflated Poisson model was used to assess the influence of different factors on the mortality. When the quantified data exhibit an excess number of zeros relative to the Poisson distribution, an extension of the ordinary Poisson model, such as the Zero-inflated Poisson or Zero-inflated Negative Binomial has been extensively discussed in the literature (Dankmar et al. 1995), (Bohning 1998), (Famoye & Singh 2006), If the data are correlated by clustering or longitudinal designs, then hierarchical or mixed effects versions of the above models proved to accommodate the sources of heterogeneity present in the data(Hall 2000), (Hall & Zhang 2004). A zero-inflated model assumes that for each observation, there are two potential data-generating processes with different probabilities: one generates the zero and the other generates the Poisson or Negative binomial counts. A Bernoulli model is used to determine which of the two processes was used.

We accounted for excess zeros in the distribution of maternal deaths via health centres and clustering over districts as suggested in Loquiha *et. al.*

(2013)(Loquiha et al. 2013). To control for the size effect and type of services offered, the facilities were divided into two groups, Hospitals and Health Centres.

This model was then extended with the inclusion of random effects to accommodate the district-specific variation. The facility-based maternal mortality ratio was estimated in an indirect manner for each district of the country. The crude maternal mortality ratio estimates provided by the model were plotted on the country map.

Before starting the study, approval was received from the National Ethical Committee for Health of Mozambique.

Results

This survey identifies 312.537 deliveries and 2.198 maternal deaths from the 1st of November 2006 to the 31st of October 2007.

Table 1 summarises the results of the maternal health care services collected in the health facilities. This table presents the information accumulated by the type of health facilities.

Figure 1 shows the maternal mortality estimated by type of health facility. The central hospitals had the highest ratio with 1.701 maternal deaths per 100.000 deliveries. We estimated a national health facility-based maternal mortality of 703 deaths per 100 thousands deliveries.

Map 1 presents the distribution of the estimated facility-based maternal deaths by district. This map shows a concentration of districts with high facility-based

maternal mortality in the southern and central regions of the country compared to the northern region.

In order to control the effect of the size of the health facility and the type of services and resources existing in the health facilities we did aggregate and analyze hospitals on one side and Health Centers and Health Posts on the other side. The Table 2 illustrates the distribution of the different characteristics in the two groups of comparison. In total were included 39 Province and District hospitals accounting for 1.228 maternal deaths and 385 health centers and health posts accounting for 596 maternal deaths.

The Table 3 presents the modelling results. At the level of health centres, an increase in size (number of maternity beds) yielded an increase of approximately 53% in the odds of an institutional maternal death ($p<0.001$). We observed significant regional differences of facility-based maternal mortality ratio in health centres, with the highest mortality rates in the southern region ($p<0.1$).

However, the provincial/district hospitals maternal mortality ratio was higher in the northern and central regions compared to the southern regions ($p <0.05$) with the risk of maternal death being at least 4 times higher than in the south.

The risk of maternal deaths was reduced by approximately 10% with a unit increase in the number of beds in the maternity ward of health centres ($p<0.05$), while increases of 2.6% with a unit increase in beds at provincial/district hospitals was observed ($p<0.1$).

The number of maternal deaths was 68% lower in health centres located outside the district capital compared to the centres located in the District capital ($p=0.0026$).

The risk of maternal death was reduced by 40% in health centres with a high workload if the MCH nurses also perform EmOC signal functions (p=0.0202). No significant effects on maternal deaths were observed for the availability of medical doctors, surgical technicians or delivery room equipment.

Discussion

This study found high facility based mortality ratio that was estimated to be approximately 703 per 100.000 deliveries. The overall magnitude of facilities maternal death is higher in the south region. This is very well represented in the distribution of the estimated facility based maternal mortality mapping. Results also suggests lower performance of hospitals from the central and northern regions. The overall distribution of maternal deaths correspond to the level of data availability in the health facilities from the south region. The pattern of distribution of facility based maternal deaths match with the level of utilization of health services in the country and not the actual distribution of the maternal deaths at the population level. The last population census indicate high maternal mortality in north and centre of the country. Efforts to increase the utilization of the healthcare facilities by the pregnant woman in the north and centre of country are recommended. There is a need of improved quality of care to avoid the preventable death of the woman that manage to come into the health facilities and to ensure accurate mortality report. The number of maternal deaths increases from the lower to upper level of healthcare facilities. This may reflects the delays and later arrival of the woman at the referral facilities due to reference process deficiencies.

The provision of EmOC is considered to be the main intervention at the referral facility to reduce the level of maternal deaths (Paxton et al. 2005), (Kongnyuy et

al. 2009). A systematic evaluation on the interventions for the reduction of maternal mortality performed by Nyamtema et al. suggested the need to ensure the implementation of integrated interventions 24 hours a day and 7 days per week to have significant changes on mortality (Nyamtema et al. 2011). The availability of skilled human resources to manage obstetric complications, the availability of essential drugs, equipment and a conducive environment are factors that have been described as pre-conditions for a facility to offer EmOC services and an intervention performed in a few hospitals in Mozambique have been able to demonstrate this effect (Jamisse et al. 2004). The importance of availability and well distributed skilled attendant to reduce maternal deaths was described elsewhere (Gupta et al. 2011), (Robinson & Wharrad 2001), (Moyer et al. 2013). In this study, we observed that the presence of MCH nurses at the health facility offering continuous EmOC interventions was strongly correlated with the reduction of maternal deaths ($p=0.0202$). However, we did not observe a significant effect on the availability of medical doctors and surgical technicians. This finding might be correlated to the distribution of this type of staff in the sampled health facilities. This suggest the need of continuous investment to improve the availability and deployment of highly qualified MCH nurses that can secure the provision of EmOC services. A recent multi-country survey on maternal and newborn health conducted by the WHO (Souza et al. 2013), emphasize the need of universal coverage of lifesaving interventions and an overall improvement in the quality of maternal care(Cavallaro & Marchant 2013). A systematic review of the factors implicated in the institutional maternal death by Knight et al. indicated that lack of human

resources were the most reported barrier: forty-one of 43 studies referred to this barrier and particularly, the lack of training (Knight et al. 2013).

In this analysis, we found that the availability of drugs and minimal kits for delivery and emergency care was poor. According to our classification, 55% of all health facilities, including 1 central hospital, had poor availability of drugs for emergencies and only 13% were classified as good and 5% were classified as very good. This finding suggest that during the survey, several facilities were experimenting drugs stock outs. However, the result from our model did not show any significant difference of maternal deaths in relation to the drugs availability. Facility-based maternal mortality continues to be notably high in Mozambique and MCH nurses play an important role for its reduction. Further analysis is needed to clarify the relative importance of the different factors related to health system functioning for the occurrence of facility-based maternal deaths.

The authors declare that they have no conflict of interest.

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