

Note

By Clara Menéndez & Anna Lucas

**Tracking Maternal Mortality
Through an Equity Lens:
The Importance of Quality Data**

1. Introduction

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WHO defines maternal death as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

Globally, maternal health is improving. Since 1990 the number of girls and women dying during pregnancy and childbirth has declined¹ from 543,000 to 287,000 per year. But making quality maternal care a reality for all women remains a major global health challenge. Despite being one of the most pressing problems of the global health agenda it is difficult to understand why maternal mortality has received so little serious attention² from the different stakeholders involved (donors, high burden countries, policy makers, health professionals...) until recent times.

The Millennium Development Goals (MDG) agreed in 2000 among countries and development partners to reduce child mortality³ (MDG4) and maternal mortality⁴ (MDG5) have contributed to gain momentum and have accelerated some improvements in access and quality of healthcare through local and global initiatives around the world⁵. However, about 99% of maternal deaths occur in the developing world and most countries⁶ are not on track to meet their targets to decrease the maternal mortality ratio (MMR) by 2015 i.e. the number of maternal deaths per 100,000 live births⁷.

Progress has been made: maternal deaths have declined almost 50 percent since 1990. Progress, however, has been slower than expected and uneven: some regions such as Eastern Asia, Northern Africa, South-Eastern Asia and Southern Asia have reported reductions of 40% or more. Southeast Asia has shown a 53% reduction (1990 to 2008), but is still host to a large number of maternal deaths, while the sub-Saharan region showed only a 26% reduction.

What are those women dying from? According to the estimates available⁸ more than half of the total maternal deaths are due to (35%) haemorrhage (i.e. blood loss), (18%) hypertension (i.e. high blood pressure) and 8% of the maternal deaths are due to sepsis (i.e. blood infection). Unsafe abortions, whose contribution to the overall toll of deaths is difficult to determine by its own nature, account for 9% of maternal deaths. About a fifth of the maternal deaths (18%) are due to indirect causes such as malaria, HIV/AIDS, or cardiac diseases, and 11% to other direct causes (e.g. complications of anaesthesia, c-

section, postnatal depression suicide). In fact, nine countries in sub-Saharan Africa where HIV infections rates among women are typically high have reported increases in maternal mortality over this time period.

The high proportion of maternal deaths due to entirely preventable and treatable causes reflects the limited access to and poor quality of basic maternity care including emergency obstetric care. Moreover, most maternal deaths result from one or more of the so called three delays⁹: in seeking care, in arriving at a health facility, and in receiving appropriate care. Moreover barriers to implementation of evidence-based practices¹⁰ have also conspired towards achieving better maternal health outcomes. Until very recently despite the evidence that placed the greatest risk for women in childbirth and the postpartum period, interventions such as antenatal care or delivery care from traditional health agents, which by themselves do not contribute significantly to reduce maternal mortality, have been prioritized over more practical and strategic approaches based on proved facts such as providing professional obstetric care at childbirth.

Maternal mortality reduction has been getting more attention in the last decade than ever before, which has led to increased commitment and resources and it is also being promoted through a human rights approach. Achieving this vision involves facing challenges on many fronts and at a large scale: from strengthening weak health systems and changing beliefs and practices deeply entrenched in many societies, to improve education levels or putting into place pro-poor policies. Because gender inequality, poverty and lack of education are key determinants of maternal mortality improvements in these areas can help accelerate progress in maternal health.

Finally, maternal mortality is a key indicator of development because the level and the quality of care given to women before, during and after pregnancy, inside and outside the health system, reflects the relative value a given society concedes to women¹¹.

2. Maternal Health and the Equity Gap

Equity is concerned with creating equal opportunities for health and with reducing health differentials to the lowest level possible, by eliminating or reducing those variations which result from factors that are both avoidable and unfair. A possible definition of equity in maternal health could be providing for women a fair opportunity to attain their full health potential as mothers, and not being disadvantaged from achieving it, if it can be avoided¹².

“In most countries, MDG advances are failures from the point of view of inequities. If you look at the distribution, we have decreased maternal mortality, we have increased life expectancy – we have increased almost all outcome indicators – but in none of them has there been a decrease in the inequities.”

Inequities in maternal health between and within countries remain vast. The maternal mortality ratio in developing regions is still 15 times higher than in the developed regions¹³.

The regions that bear the largest burden of maternal deaths in the world record 640 deaths per 100,000 live births (Sub-Saharan Africa) and 280 deaths per 100,000 live births (South Asia) respectively. In contrast high income countries have only 7-15 maternal deaths per 100,000 live births. Most maternal deaths occur in a small number of regions – Sub-Saharan Africa and Southern Asia- and countries. Just 6 countries account for half of all maternal deaths worldwide¹⁴.

Over the last decade both donor and recipient countries have focused on improving national averages – one of the MDGs shortcomings- neglecting inequities within countries where huge inequities persist in access to and use of good-quality maternity care. Thus, despite improvement in almost all outcome indicators (decreased maternal mortality, increased life expectancy...) in none of them has there been a decrease in the inequities. It is the wealthiest segments of society in LMICs that have seen the greatest reductions in preventable mother and newborn deaths. Access to maternal care across social groups and geographic regions within countries is not a reality yet: uneducated women from the poorest households in rural communities and the poorly-served peripheral urban communities are less likely to benefit from life-saving interventions.¹⁵ Although evidence demonstrates that a set of basic interventions can prevent the majority of maternal and newborn deaths, from family planning for birth control to availability and accessibility to pre- and post-natal care and professionally attended delivery, those interventions do not have the necessary reach and quality, especially across the less well-off in LMICs.

The Countdown to 2015¹⁶ initiative, by measuring the magnitude of inequities in maternity care interventions between richer and poorer populations, both within and across countries, has highlighted that those interventions that are more complex tend to be less equitably distributed¹⁷. A woman in the richest fifth of the population from one of the maternal mortality high burden countries¹⁸ studied (54) is 4.6 times more likely to have a skilled attendant when giving birth – the most dangerous moment for mothers- compared to a woman in the poorest fifth of the population. Another indication of the magnitude of the problem is that although the median coverage of skilled birth attendance is slightly more than 60% for the countries studied (54), the coverage between these countries ranges from 10% to 100%, making it the least equitable intervention.

Finally, acknowledging that there are many commonalities in the successful implementation of policies and programs between High Income Countries (HICs) and LMICs – it is a body of knowledge that has been successfully applied for decades in the developed world- there is also an urgent need to adapt effective approaches to meet country-specific and low-resource settings challenges and to bridge the existing data gaps in the areas where most maternal deaths occur. Because each country's response varies depending on local epidemiology, existing coverage, health systems, and capacity.

3. Is Evidence Informing (Maternal Health) Policy?

“Progress is especially happening in countries where governments are using evidence to guide investment and policy decisions, and where stakeholders are working together effectively to create real change for women and children” - Countdown to 2015 (2013 Report)

Reliable and up-to-date information is a necessary component of any strategy aimed at improving health outcomes. Reducing maternal mortality is not an exception. The need for accurate monitoring of maternal mortality has been long recognised both to advocate for more resources and policy attention and to track progress. But the formulation of the MDG5 that set out quantifiable targets (reducing MMR by three quarters from 1990 to 2005) highlighted how challenging it was for a number of countries —namely the countries thought to have the highest mortality burden- to produce timely and accurate data on levels of maternal mortality that can indicate to what extent they achieve progress in reducing maternal deaths.

Measuring maternal mortality accurately is difficult in the absence of comprehensive registration of deaths and of causes of death. While most high-income countries have a nearly complete time series of vital registration data in LMICs many of those who are most vulnerable are never registered at birth or death¹⁹. As a result they live without having an identity and hence throughout their lives states make no provision for them. Beyond the moral question that this situation poses, it reveals the urgent need to improve the mechanisms to understand medical or social causes of death and to put in place preventive measures to avoid future deaths.

In order to address the gap in data availability on maternal mortality, WHO and other UN agencies published, in 1996, the first estimates of maternal mortality, including MMRs, numbers of maternal deaths and lifetime risk of maternal death. Different methodological approaches²⁰ have been used to estimate country-specific trends between 1990 and 2010, depending on the type of data available. Thus maternal mortality trends have been estimated from a variety of data sources from vital statistics when possible, to household or causes of death surveys, censuses, verbal autopsies²¹, surveillance systems or reproductive-age mortality studies²².

Although the availability of maternal mortality data has improved since the 1990s maternal mortality data are still relatively scarce across the developing world. What are the available data for analysis? The last estimates²³ revealed that 27 countries (15%) out of 180 have no nation-

ally representative data using standard methodologies, 88 countries (49%) lack good complete civil registration data but other sources of national data are available and 65 countries (36% countries) with a complete and reliable civil registration system to determine maternal deaths. Remarkably over 80% of all births occur in countries where maternal cause of death data does not exist or are incomplete.

Trends for many countries are model-based because data are not routinely collected. Global and regional estimates of maternal mortality are developed using regression models approach to take into account the frequent underreporting and misclassification of maternal deaths. As a result there is considerable uncertainty in the estimates released. It is worthy of attention that some of the countries showing 40% or more decrease in their MMR over the 1990-2010 period such as Guinea Equatorial (-81%), Vietnam (-76%), Malaysia (-46) or Papua New Guinea (-41%) are among the group of countries lacking nationally representative data on maternal mortality.

The dearth of reliable information on pregnancies and birth outcomes has also equity implications. Disaggregated data and statistics are a prerequisite to ensure that resources, personnel and supplies are equitably allocated across a population. However where data is available, it is often 'distribution blind', failing to capture the socio-economic characteristics (i.e. education level, wealth quintile, location) of individuals. The quantity, quality and use of disaggregated data is critical to inform planning process, monitoring, evaluation and accountability. Better data may also stir the debate on existing measures that should also be considered reviewing such as the asset indices that are used to estimate wealth quintiles. As it has been noted²⁴: *"In countries where 80% of the population is effectively poor, a breakdown by quintiles basically masks this ... because it makes you feel that to prioritise equity you should be focusing on just the bottom one or two quintiles, whereas actually almost the whole population is in need of social protection."*

Available quality cause-of-death data are crucial for health planning, improved decision making and prioritisation in maternal and perinatal health.²⁵ Considering that only a third of the world's countries have a complete registration system with adequate attribution of cause of death, it is imperative that countries with incomplete registration systems take steps to strengthen them. The High-level Commission on Information and Accountability for Women's and Children's Health has included among its 10 recommendations²⁶ one that is specific to improving measurement of maternal and child deaths. It requires that *"by 2015, all countries have taken significant steps to establish a system for registration of births, deaths and causes of death, and have well-functioning health information systems that combine data from facilities, administrative sources and surveys"*.

In order to be effective, however, on top of the data there must be a willingness to use the information²⁷ generated from the data to inform policies to not only improve access to maternal health services, but also the quality of these services. Information should guide actions to improve provision of quality healthcare to prevent future deaths²⁸. However, while some progress has been made in identifying deaths, there is still a significant gap in the implementation of response systems for corrective action. Death reviews, the processes that provide opportunities to examine the circumstances around a mother's or child's death, as well as the immediate and contributing causes leading to it, have not been implemented in many LMICs despite its potential to generate evidence and inform action to improve health.

4. Maternal Death Determination: the Role of R&D

For any health system a sound health management information system and robust data on vital events (pregnancies, pregnancy loss and deaths, births) that allow identifying gaps in antenatal and post-partum care coverage, quality of care and equity, is invaluable. Otherwise how can countries without civil registration plan, allocate resources, implement the necessary policies or programmes or evaluate them? And after decades of working with the limitations of incomplete data what evidence does the international development community have that funds have the desired effects on either mortality or poverty reduction?

The weakness in recording vital statistics is one of the factors that are hindering progress towards improving maternal and neonatal health²⁹. There are critical knowledge gaps that in the short term can only be filled by developing methods to assist countries in bridging vital data gaps for monitoring the situation of women's and children's health. Innovation is necessary to create tools that will lead to better and more effective application of knowledge generated. A scientific approach is needed to identify, and evaluate the most appropriate strategies for scaling up quality data collection in order to strengthen health systems.

Complete Diagnostic Autopsies (CDA) is the current gold standard methodology to inform on cause of death. However conducting CDA is not feasible in many LMICs because of a number of reasons including the large proportion of deaths that still occur outside the health system, insufficient facilities or trained human resources, or cultural or religious barriers about the practice of post-mortem procedures. Several options to monitor maternal mortality have been proposed for areas that lack systems for data collection and analysis: censuses and surveys to measure pregnancy-related deaths a national level, Reproductive Age Mortality Studies (RAMOS) in representative sample areas for direct measurement of deaths, or conducting large maternal mortality surveys using the sisterhood method, registration of births and deaths in sample areas or detailed health and demographic surveillance sites, nationally representative sample vital registration systems with verbal autopsy³⁰ (SAVVY). These systems focus on living women and their families rather than mortality statistics to provide data for evidence-based programmes.

However indirect methods like the verbal autopsy and clinical diagnosis are suboptimal in its accuracy, which depends largely on the quality of the diagnostic criteria, the type of diseases involved, the location of death, and the delay between death and verbal autopsy. Deaths associated with non-specific signs and symptoms are the most problematic

and are an especially common issue for perinatal and neonatal deaths. Assessment of the cause of in-hospital deaths is generally based on the clinician's diagnosis of the disease(s) that led to the fatal outcome. However, such estimations entail frequent misclassification errors. Indeed, when clinical diagnoses have been contrasted with post-mortem findings, rates of major clinical—pathological discrepancies have ranged from 10% to above 30%, especially in the diagnosis of infectious diseases. Despite these key limitations, verbal autopsies are the only source of data for cause of death in many settings, and their practice and improvement should therefore be encouraged.

Figure 1

An autopsy study of maternal mortality in Mozambique: The contribution of infectious diseases

A Includes ten deaths with mycobacterial disease, two kaposi sarcoma, and one malignant lymphoma.

B Clinically severe anaemia with no other cause of death and signs of cardiac failure in the autopsy.

Source: Menéndez C., Romagosa C., Mamudo R., Carrillo C., Saute F., Osman N., Machungo F., Bardají A., Quinto LL., Mayor A., Nanche N., Dobaño C., Alonso PL., Ordi J. 2008. "An autopsy study of maternal mortality in Mozambique: The contribution of infectious diseases," *PLoS Medicine* 5(2): e44.

The aim of the study³¹ was to describe the causes of maternal death in one of the regions with the highest maternal mortality rates. The descriptive analysis of maternal death autopsies performed during 2002 - 2004 in the Central Hospital of Maputo, Mozambique, a tertiary reference level for the whole country found that infectious diseases accounted for more than half

(56%) of the causes of maternal deaths even though there are effective treatments existed for all of them. Being the first cause HIV/AIDS infection (13%), followed by bacterial pneumonia (12%), severe malaria (10%) and bacterial meningitis (7%). Obstetric complications accounted for 38 % of the causes of maternal deaths.

Category	Cause	n	[%]
Obstetric complications	Haemorrhage	23	(16,6)
	Puerperal septicaemia	12	(8,7)
	Eclampsia	12	(8,7)
	Post-caesarean septicaemia	2	(1,4)
	Ectopic pregnancy	2	(1,4)
	Acute fatty liver of pregnancy	1	(0,7)
	Amniotic embolism	1	(0,7)
Nonobstetric conditions	HIV/AIDS-related contidions ^A	18	(12,9)
	Pyogenic bronchopneumonia	17	(12,2)
	Severe malaria	14	(10,1)
	Pyogenic meningitis	10	(7,2)
	Neoplasia	4	(2,9)
	Other septicaemia	3	(2,2)
	Fulminant hepatitis	3	(2,2)
	Decompensated cirrhosis	2	(1,4)
	Mycobacterial disease	2	(1,4)
	Pulmonary hipertension	2	(1,4)
	Anaemia ^B	1	(0,7)
	Digestive haemorrhage	1	(0,7)
	Alveolar proteinosis	1	(0,7)
Unknown	8	(5,8)	
Total		139	(100,0)

In the present scenario of unfeasibility of conducting routinely complete diagnostic autopsies in LMICs, and suboptimal indirect methods such as the verbal autopsy³² or clinical diagnosis, the development of feasible and more straightforward direct methods to ascertain the cause of death has become a research gap to be addressed. The concept of minimally invasive autopsy (MIA) as an alternative to classic complete diagnostic autopsy has been proposed.

MIA includes the use of more acceptable; less invasive imaging techniques such as magnetic resonance imaging (MRI) or computed tomography (CT) scan coupled with the performance of targeted diagnostic biopsies of key organs. Although little experience has been gained with such techniques so far, they have been shown to produce

reliable and comparable results to the complete diagnostic autopsy in developed countries³³. A further advantage of the method is the chance to improve our understanding of the pathogenesis of diseases that need human samples to be studied fully.

However, in its present form, minimally invasive autopsy is not a feasible technique in resource-poor settings. Thus, procedures to make minimally invasive autopsy feasible and acceptable in developing countries need to be defined and standardised, including the use of low-cost and portable imaging devices, the number of organs that need to be sampled, the preferred routes to obtain contamination-free tissue, and the specific pathology and microbiology procedures that can provide relevant information related to the cause that underlies death.

Figure 2

The CaDMIA project aims to design and assess the performance of MIA tools for investigation of infectious causes of death, and to evaluate the acceptability and feasibility of using such tools in different cultural, religious and geographical backgrounds.

A validation exercise is being undertaken to compare the diagnostic reliability of a methodically predefined minimally invasive autopsy device against the gold standard of complete diagnostic autopsy in two tertiary hospitals (in Maputo, Mozambique, and Manaus, Amazonas, Brazil), and to explore the potential use of classic and advanced microbiology techniques to further investigate infectious causes of death in patients of any age. Such a minimally invasive autopsy device would need to balance out the best possible practices with the challenges of working in resource-poor settings, and also consider its future global applicability. In this respect, uncertainties related to the communities' perception and acceptability of such a method, and the feasibility of actually implementing it in basic clinics or even in the community, needs to be explored rigorously. Social sciences research

to complement the validation exercise has started in rural and urban areas in five countries (Mozambique, Gabon, Kenya, Mali, and Pakistan) and should provide the necessary answers and approaches for the future implementation of this method in resource-poor settings.

The confirmation that MIA is an acceptable, feasible, valid and reliable tool to inform on the cause of death in all age-groups would be a major public health achievement. It would allow a more robust surveillance of those infectious diseases with major mortality burden, and consequently, improved health planning and more targeted prioritization of available resources.

It would also strengthen the validity of contemporary and future models and cross-disease burden estimates, which are presently hampered by insufficient inputs of raw data. Such a method could conceivably shed a clarifying light on one of the most fundamental, puzzling, and unresolved epidemiological questions: what do people die from in developing countries?

5. Conclusions

Maternal mortality is concentrated among the most vulnerable women in LMICs, remaining a global health challenge despite the existence of effective interventions to prevent it. Since the 1980s it has been highlighted the role of complications related to or aggravated by pregnancy and childbirth in death rates among women of reproductive age and noted the inadequacy of attention paid to addressing these largely preventable deaths. Despite renewed interest and momentum global health indicators show that maternal health is still the area in which the greatest inequities persist.

One of the factors that conspire towards achieving progress is the absence of quality data on maternal mortality and morbidity. While for developed countries death registries and/or autopsy procedures generally provide very valuable and updated information, for the developing world very little scientifically based information is available on cause-specific mortality rates.

It is not reasonable to conclude that investment in any single area –such as improvement of data collection– will solve all the maternal health challenges ahead, however quality data on maternal mortality and morbidity are a prerequisite to improve maternal health outcomes. Perfect data are not essential for formulating health policies and programmes but better data collection and analysis when used to implement cost-effective action can accelerate progress in maternal health indicators.

Although the availability of maternal mortality data has improved since the 1990s, continued progress in data collection is critical both to advocate for resources and policy attention and to more precisely estimating country-specific trends to track progress in reducing maternal mortality. However the existing methods used to estimate the number and the causes of death are being increasingly questioned and the resulting uncertainty about the real burden of specific causes of death represents a major limitation in terms of prioritisation of effective public policies, evaluation and accountability.

The research community should and must take its commitment by developing alternative methods and validating new approaches to assist countries in filling data gaps aimed to monitoring the situation of women's and children's health. Only in this way both the quality of vital statistics and the determination of cause of death data in low resource settings can be improved. This is one of the contributions that can help more accelerate progress in reducing maternal mortality. It would definitely be a step forward towards ensuring that a fair chance to go through maternity is given to any woman.

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