

Anaesthesia and safe motherhood

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Summary

The challenges of obstetric care in the developing world are enormous. Many fit young mothers die or suffer disabling birth injuries from preventable complications of pregnancy that are easily treated with basic facilities. Maternal mortality rates in excess of 1% have been recorded in a number of countries. Access to Caesarean section is a particular problem, with rates lower than 1% being commonplace. The provision of appropriate anaesthesia services is of international concern.

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Every year, an estimated 500 000 women die as a result of pregnancy or childbirth. Whilst the chances of a woman dying during pregnancy are now one in 30 000 in some parts of northern Europe, this risk is as high as one in six in the poorest parts of the world [1]. Overall, the number of women dying has not changed in the last 20 years, the majority of deaths occurring in sub-Saharan Africa or Southern Asia. Deaths of these essentially young fit women are largely avoidable and are a tragedy for their family and existing children. They are also a shocking reminder of the discrepancies in healthcare around the world. This article will consider why mothers die during pregnancy and childbirth, some of the initiatives taken to improve maternal mortality over the last 20 years, and the crucial role of anaesthesia in improving outcomes.

Why mothers die

The maternal mortality ratio (MMR) is described as the ratio of maternal deaths to live births, the lifetime risk of maternal death being the probability of maternal death during a woman's reproductive life. Official figures probably underestimate MMR as deaths due to childbirth may be wrongly attributed, denominator data are lacking and death registration systems poorly developed [2]. Even in countries where audits of maternal deaths are well-developed, there is significant under-reporting [3].

Figures from 2000 estimate the global MMR at 400 per 100 000 live births, which is the same as in Victorian Britain. The global lifetime risk of maternal death is one in 74, but these figures vary enormously around the world [4]. The MMR approaches 1000 per 100 000 in

sub-Saharan African (1 in 16 lifetime risk of maternal death), a staggering 1800 per 100 000 in remote areas of Afghanistan and Sierra Leone (1 in 6 lifetime risk of maternal death) and 520 per 100 000 in South Central Asia (Fig. 1). The MMR in the UK is 12 per 100 000 with the lifetime risk of maternal death 1 in 9000 [5]. The equivalent of a 1% maternal mortality as seen in sub-Saharan Africa would equate to one mother dying every week in a typical unit with 5000 deliveries per year.

The methodology used by the UK Confidential Enquiry into Maternal and Child Health has been adopted by the World Health Organization (WHO) to promote the investigation of maternal deaths and improve maternal mortality world wide. Maternal deaths are those that are causally and temporally related to pregnancy and may be described as 'direct' when resulting from conditions that are unique to pregnancy, occurring during the peripartum period, or indirect when arising from diseases previously existing or developing during pregnancy that are aggravated by the pregnant state [5].

The majority of maternal deaths are from direct causes and occur most commonly around the time of delivery or in the first 24 h after delivery [1]. The most common causes of maternal death worldwide are haemorrhage, hypertensive diseases and sepsis, with a smaller proportion due to obstructed labour [1, 6]. These latter deaths also highlight the high incidence of serious disability as a result of pregnancy. For every maternal death in the developing world, it is estimated that 30 women suffer morbidity during childbirth, such as chronic anaemia, infertility, stress incontinence, vaginal fistulae, chronic pelvic pain,

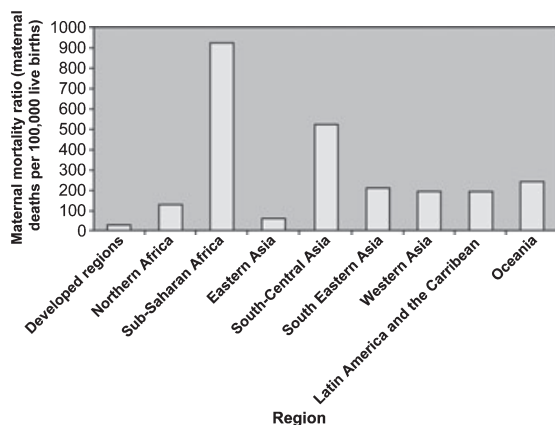


Figure 1 Maternal mortality estimates by WHO/UN regions: 2000. Redrawn from data from [4].

emotional depression and physical exhaustion [7, 8]. In some regions of the world, deaths related to unsafe abortion are very high, although under-reporting is common.

A substantial proportion of maternal deaths take place in hospital [1]. Mothers may arrive in a moribund state too late for successful intervention or have developed complications due to delayed diagnosis and intervention. Others develop complications during a normal delivery, possibly iatrogenic. Confidential enquiries from a diverse range of countries suggest that substandard care is a contribution to more than one-third of maternal deaths. Overall, obstetric haemorrhage remains the most common cause of maternal death worldwide, causing an estimated 166 000 deaths per year, half of them in sub-Saharan Africa. These deaths from maternal haemorrhage should be avoidable, but they depend on access to timely and competent healthcare. It is vital to improve in-hospital care to make an impact on maternal mortality [1, 9].

The numbers of maternal deaths due to indirect causes are difficult to estimate in the developing world as poor health care systems lead to diagnostic uncertainty, and there is also significant under-reporting. For instance, HIV testing is unavailable to many women in areas of high prevalence, so it is difficult to estimate its impact on maternal mortality. However, HIV infection is known to worsen outcomes from pregnancy and is thought to have reversed improvements in maternal mortality in some regions. In Uganda the overall MMR is around 900 per 100 000 but is reported as 1300 per 100 000 in HIV-infected mothers [1]. Other important causes of indirect maternal death are malaria, tuberculosis and anaemia; overall, these indirect causes contribute to less than 20% of all maternal deaths [10].

The Safe Motherhood Initiative

A global campaign to raise awareness about the numbers of mothers dying during pregnancy and childbirth was launched in 1987 during the Safe Motherhood Conference in Nairobi, sponsored by the United Nations Population Fund (UNFPA), the World Bank and WHO [11]. The Safe Motherhood Initiative has now become firmly established in every region of the world.

The original aims of the safe Motherhood Initiative were to improve antenatal, delivery and post partum care. Funding from donors, UN agencies and governments were initially aimed at only two aspects of care: antenatal care and training of traditional birth attendants. These strategies have been largely ineffective and global maternal mortality is largely unchanged over the last 20 years. Antenatal care improves neonatal outcomes but does not identify the woman who develops life-threatening complications with little or no warning. Traditional birth attendants, trained or untrained, are not able to manage life-threatening emergencies such as haemorrhage, eclampsia or sepsis. The emphasis more recently has been on integrated health systems; trained birth attendants working in health centre-based care, with improved access to emergency obstetric care in suitably equipped and staffed hospitals [11–13].

The Millennium Development Goals

The Millennium Development Goals (MDG) launched in 2000 reaffirmed the importance of tackling the inequalities in maternal health. MDG 5 is to improve maternal health and reduce maternal mortality by 75% between 1990 and 2015. Some countries have shown substantial improvements in maternal mortality through a combination of increased skilled attendants at delivery, improved access to emergency obstetric care [14] and by early treatment of sepsis by increased access to over-the-counter antibiotics [9]. Lack of a skilled birth attendant is associated with increased MMR [15] but fewer than 46% of deliveries are attended by a skilled attendant in sub-Saharan Africa. Maternal mortality has risen during the last decade [13]. The WHO Partnership for Maternal, Newborn and Child Health was launched in 2005 to co-ordinate attempts to achieve the MDGs. There are 129 country, organisational and honorary members, but disappointingly, no representative of a national or international anaesthesia organisation [16].

The contribution of anaesthesia

Anaesthetists are an integral part of the obstetric team and participate in the management of over 50% of parturients

in a typical obstetric unit in the UK [17]. Many of these interventions will be related to the provision of analgesia for normal labour, a provision out of the reach of the majority in the developing world (see acute pain p38 in this supplement).

Anaesthetists have knowledge of acute physiology and are adept at fluid management, invasive monitoring and other aspects of intensive care. In the UK they are an integral part of the team managing obstetric complications, including the critically ill mother with obstetric haemorrhage, sepsis or eclampsia. Many mothers need more than basic obstetric care [9]. In the developing world, many women present to secondary institutions with life-threatening complications; additional lives could be saved if the anaesthetic provider was skilled at recognising the need for, and was able to carry out, prompt and effective resuscitation. The anaesthetic provider should have a leading role in the provision of basic intensive care. It is likely that the lack of trained anaesthesia personnel is a limiting factor in the provision of care for the critically ill mother in developing countries.

Anaesthesia is required for Caesarean section. Although the WHO recommends a Caesarean section rate of between 5 and 10%, in reality Caesarean section rates are below 1% for the poorest populations in 20 countries, most of them in sub-Saharan Africa [18]. This is in part due to a lack of anaesthesia provision, particularly in rural areas. In India, whereas 70% of district hospitals have a medically qualified anaesthetist, only 22% of the rural hospitals have an anaesthetist. Anaesthesia is included in the undergraduate curriculum in India, but medical officers are discouraged from practising anaesthesia. Government policies do not encourage doctors to train as anaesthetists – there are few training positions, remuneration and working conditions are poor, and most doctors prefer to work in private practice in urban areas or migrate [19]. Medical migration in sub-Saharan Africa means that medically qualified anaesthetists are a rarity, and the majority of anaesthesia is administered by anaesthetic officers with up to 1–3 years training, but even then, they are few in number compared to the population size [20].

Innovative strategies have been suggested to address this shortage of anaesthetists, particularly in rural areas. For instance, in some parts of rural India, obstetricians initially give anaesthesia, which is then maintained by a medical officer or nurse. Some obstetricians perform Caesarean section under local anaesthesia [19]. These strategies may not be associated with improved maternal outcomes.

Non-medical anaesthesia providers have been trained in Bangladesh for several years and are being trained in

Nepal. Where no anaesthesia provision exists in remote areas, mortality is likely to be lower when trained personnel are provided, although aspects of their training, working facilities and supervision may be less than ideal [19]. In most of sub-Saharan Africa, medical anaesthetists are only found in larger urban hospitals. The vast majority of anaesthetics are administered by non-physician anaesthetic providers working alone, unsupervised, and often with limited training. With the current social and economic constraints, this situation is unlikely to change and therefore the focus should be on improving the skills of these providers.

The importance of training is clear when considering outcomes from surgery. Emergency Caesarean section is the commonest major surgical procedure in Africa [21]. There have been a few reports which indicate that the peri-operative mortality is extremely high, estimated as high as 1–2% [22–26]. Most of these deaths are avoidable and one-third of deaths are directly attributable to anaesthesia, mainly due to airway problems. Another significant cause is access to blood for transfusion. A publication from Togo showed that there were 12 deaths associated with anaesthesia for 318 cases over a 6-month period [27]. The majority of the 306 Caesarean sections involved were performed under general anaesthesia. There were three cases of aspiration, one unrecognised oesophageal intubation, one pulmonary oedema and one postoperative hypoxia resulting from inadequate reversal. There has been a marked increase in the use of spinal anaesthesia since this article was written. The remaining deaths were due to lack of availability or affordability of blood products.

Anaesthesia was the cause of 5% of direct maternal deaths in the latest South African maternal mortality report (25% airway related). Previous reports suggested lack of anaesthesia provision as a contributing factor in a large number of cases, most deaths occurring in the rural areas which have limited availability of trained anaesthetists [10]. The AAGBI recommends minimal standards during anaesthesia, including the availability of monitors – ECG, pulse oximeter and capnography. Only 6% of anaesthetists in Uganda had the even most basic facilities to deliver safe anaesthesia for obstetric anaesthesia (spinal needles, blood for transfusion, oxytocic agents, antihypertensive agents or magnesium sulphate), let alone anaesthesia monitors [20]. It is likely that this lack of facilities makes a significant contribution to high peri-operative maternal mortality.

In developed countries, many of the improvements seen in the safety of obstetric anaesthesia have been attributed to the steady replacement of general anaesthesia by regional techniques. Observational studies of operative mortality in Zimbabwe [25] and Malawi [24]

would suggest that spinal is safer than general anaesthesia, but it is recognised that spinal anaesthesia is also associated with mortality from high spinal block when administered by inadequately trained practitioners. Spinal anaesthesia is also unsafe in shocked patients. South African data [10] would tend to urge caution, as nine of 28 anaesthetic-related deaths in 1998 occurred with the use of spinal anaesthesia. The conclusion is that while spinal anaesthesia may be safer than general anaesthesia, it still requires a skilled and careful practitioner with appropriate facilities for its inherent safety to be realised.

The solutions

Mothers die as a result of poorly functioning healthcare systems, particularly in rural areas, and this is clearly illustrated in the essay 'Lamula's story' in this supplement. Families may be slow to recognise and seek help for complications of pregnancy, birth attendants are untrained, access to healthcare is hindered by poor transport, and high cost of healthcare may be an additional barrier [2]. Once secondary health care is accessed, the facilities may be inadequate at all levels (district and referral), particularly access to skilled practitioners, equipment, drugs and blood for transfusion. There are cumulative delays at every stage, and even if the mother survives, the outcomes for baby are dire – neonatal deaths far outweigh maternal deaths (4 million annually), and are inextricably linked to inadequate perinatal care [13]. One of the commonest causes of neonatal death is birth asphyxia.

The tragedy of maternal mortality in sub-Saharan Africa has as its basis complex social, economic and political factors, underpinned by a lack of resources. These factors are difficult and slow to resolve and are not specific to maternal health.

There are no simple solutions and interventions are required at every level, including community level (trained birth attendant, access to antibiotics, injectable oxytocics and oral misoprostol). However, most mothers die in hospital; it is crucial that resources are directed at health centres and hospitals as well as community programmes. A lack of trained staff, essential medicines and equipment is the most significant barrier to improved healthcare.

Government and donor agencies must recognise the crucial role of anaesthesia in providing emergency obstetric care in hospitals. There needs to be a commitment to train and provide on-going supervision for adequate numbers of anaesthesia providers who have the appropriate facilities and equipment with reliable access to supplies of drugs. Only then will in-hospital maternal mortality rates fall.

References

- 1 Ronsmans C, Graham W. Maternal mortality: who, when, where and why. *Lancet* 2006; **368**: 1189–200.
- 2 Sombie I, Meda N, Ky-Serbo O. Maternal mortality in rural Burkina Faso. *British Medical Journal* 2005; **331**: 779.
- 3 Graham W, Hussein J. The right to count. *Lancet* 2004; **363**: 67–8.
- 4 Department of Reproductive Health and Research. *Maternal Mortality in 2000. Estimates developed by WHO, UNICEF, UNFPA*. Geneva: Department of Reproductive Health and Research, World Health Organization, 2004. http://www.who.int/reproductive-health/publications/maternal_mortality/_mme.pdf [accessed 3 June 2007].
- 5 *Why Mothers Die. Report on Confidential Enquiries into Maternal Deaths in the UK*. London: RCOG Press, 2004.
- 6 Khan KS, Wojdyla D, Say L, Gulmezoglu AM, Van Look FA. WHO analysis of causes of maternal death: a systematic review. *Lancet* 2006; **367**: 1066–74.
- 7 World Health Organization. Reducing maternal deaths: the challenge of the New Millennium in the African Region. <http://www.afro.who.int/whd2005/brochures/reducing-maternal-deaths.pdf> [accessed 30 May 2007].
- 8 World Health Organization. *Make Every Mother and Child Count*. Annual Report 2005. Geneva: WHO, 2005. <http://www.who.int/whr/en/index.html> [accessed 4 June 4th 2007].
- 9 Costello A, Azad K, Barnett S. An alternative strategy to reduce maternal mortality. *Lancet* 2006; **368**: 1477–9.
- 10 Rout C. Maternal mortality and anaesthesia in Africa: a South Africa perspective. *International Journal of Obstetric Anaesthesia* 2002; **11**: 77–80.
- 11 Starrs AM. Safe motherhood initiative: 20 years and counting. *Lancet* 2006; **368**: 1130–2.
- 12 Filippi V, Ronsmans C, Campbell OMR, et al. Maternal health in poor countries: the broader context and a call for action. *Lancet* 2006; **368**: 1535–41.
- 13 Lawn JE, Tinker A, Munjanja SP, Cousens S. Where is maternal and child health now? *Lancet* 2006; **368**: 1474–7.
- 14 The Millennium Development Goals Report 2006. New York: United Nations, 2006.
- 15 Buor D, Bream K. An analysis of the determinants of maternal mortality in sub-Saharan Africa. *Journal of Women's Health* 2004; **13**: 926–38.
- 16 World Health Organization. Partnership for maternal, newborn and child health. <http://www.who.int/pmnch/en> [accessed 30 June 2007].
- 17 The Association of Anaesthetists of Great Britain and Ireland, The Obstetric Anaesthetists Association. *Guidelines for Obstetric Anaesthesia Services*. London: AAGBI, OAA, 1998, revised 2005.
- 18 Ronsmans C, Holtz S, Stanton C. Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. *Lancet* 2006; **368**: 1516–23.
- 19 Mavalankar D, Rosenfield A. Maternal mortality in resource-poor settings: policy barriers to care. *American Journal of Public Health* 2005; **95**: 200–3.

- 20 Hodges SC, Mijumbi C, Okello M, McCormick BA, Walker IA, Wilson IH. Anaesthesia services in developing countries: defining the problems. *Anaesthesia* 2007; **62**: 4–11.
- 21 Nordberg E. Surgical operations in eastern Africa: a review with conclusions regarding the need for further research. *East African Medical Journal* 1990; **67** (3 Suppl.): 1–28.
- 22 Heywood AJ, Wilson IH, Sinclair JR. Perioperative mortality in Zambia. *Annals of the Royal College of Surgeons (England)* 1989; **71**: 354–8.
- 23 Hansen D, Gausi SC. Anaesthesia in Malawi: complications and deaths. *Tropical Doctor* 2000; **30**: 146–9.
- 24 Fenton PF, Whitty CJW, Reynolds F. Caesarean section in Malawi: prospective study of maternal and perinatal mortality. *British Medical Journal* 2003; **327**: 587–90.
- 25 McKenzie AG. Operative mortality at Harare Central Hospital 1992–94: an anaesthetic view. *International Journal of Obstetric Anaesthesia* 1998; **7**: 237–41.
- 26 Tomta K, Ouro-Bang'na Manan AF, Ahouangbevi S, Chobli M. Deaths associated with anaesthesia in Togo, West Africa. *Tropical Doctor* 2005; **35**: 220–2.
- 27 Tomta K, Maman FO, Agbétra N, Baeta S, Ahouangbévi S, Chobli M. Mortalité maternelle: implication anesthésique au CHU de Lomé (Togo). *Sante* 2003; **13**: 77–80.