



MATERNAL MORTALITY IN ERITREA –  
IMPROVEMENTS IN ASSOCIATION  
WITH THE CENTRALIZATION  
OF OBSTETRIC SERVICES  
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### Prolog

To spend a whole year as a medical doctor at an Institute for Advanced Study is still a rare event in countries where German is spoken (as opposed e.g. to the USA), but I am now more convinced than ever that I can only recommend it to my best colleagues. I was

personally motivated to hope for it ever since I was at the University of California at Berkeley in 1975, where I experienced a busy head of a large clinic, Professor Charles Epstein MD, who was also President of the American Society of Human Genetics, going to a similar institution at Stanford University for an academic year. He was seen in the Bay Area only occasionally for weekends, otherwise concentrated on his project in Palo Alto, and – yes, this is a prerequisite for leaving a busy clinical service – had a deputy heading his program back home. After his return he was the boss again, but he had been able to work on a project that his busy everyday clinical life would have never allowed him to pursue. I therefore had the same ambition on my “to achieve list” when I became the head of the Obstetrics and Gynecology Department at the University of Basel in 1995, but unfortunately I have to admit that I was not able to pursue it for 15 years as Chair of this very busy place with more than 2,000 deliveries, 3,000 surgeries, and 60,000 outpatient consultations a year. When it was finally possible for me after my time in Freiburg, however, the interdisciplinary contact at the Wiko turned out to be so valuable that I think maybe there should be more encouragement for medical doctors with great clinical responsibilities to consider or be considered for such a sabbatical, and if it can’t be a whole year, shorter periods of a few months might be an alternative. The secret of the Wiko was well summarized by Professor Dr. Wolfram Hogrebe from the University of Bonn (*Forschung und Lehre* 8/2005) with the characterization “No duties – only opportunities”, but certainly the project summarized in brief here would not have been possible without Wiko – thank you!

### Synopsis of my Wiko-Project

Within the last 15 years, maternal mortality was reduced significantly in Eritrea. During this time German charity activities were directed successfully towards helping to centralize obstetric services.

### Abstract

To reduce maternal mortality and to move more effectively toward achieving Millennium Development Goal (MDG) 5, it is important to learn from positive national experiences and to try to isolate significant factors of the success. Maternal mortality in Eritrea is still high, but within the time period since the country’s independence in 1991, the Eritrean

government has received support from two German nongovernmental organizations – the Hammer Forum and Archemed – to improve maternal health. This support has focused on prenatal care, contraception counseling, post-abortion care, and most notably the centralization of obstetric and neonatal services in the capital, Asmara, and subsequently in the second biggest city, Keren, against the background of 231 health facilities for ca. 5 million inhabitants. It is now possible to tentatively evaluate the effect of this approach. National data show that the maternal mortality ratio has declined from 998 per 100,000 live births in 1995 to 486 in 2010. Although the positive effect of skilled birth attendants in the periphery is well documented, the centralization of obstetric services in Eritrea seemed to be a major factor for the country's considerable progress towards achieving MDG 5.

## 1. Introduction

The maternal mortality ratio (MMR), which is defined as the total number of deaths of women while pregnant or within 42 days of the end of pregnancy per 100,000 live births, is a widely accepted parameter to assess the quality of obstetric services in a country [1], although the measurement is a challenge for countries that have high rates of deliveries that do not take place in hospitals and inaccurate data on causes of maternal deaths. In such cases, sophisticated statistical modeling techniques can be used to estimate MMR [2]. According to the best possible estimates, there were around 350,000 maternal deaths worldwide in 2008 [3, 4], of which most were preventable.

Reaching the targets of Millennium Development Goals (MDG) 4 and 5 (a two-thirds reduction in mortality of children under 5 years and a three-quarters reduction in maternal mortality and universal access to reproductive health, respectively) would equate to saving the lives of 4 million children and about 190,000 women [5]. Of the 4 million newborn deaths and 3.2 million stillbirths each year, most are attributable to the death of the mother, inadequate care in the critical hours and days after birth, and poor maternal health; therefore, prevention of a mother's death is also the most important intervention for the health of a child [6]. There has been overall progress in reducing the mortality rates among children aged under 5 years and maternal deaths; however, the "Countdown to 2015" global movement – which tracks progress in 68 countries where more than 95% of all maternal and child deaths occur – found that, of these, only 19 countries are on track, while 12 countries (including some currently on track) have seen their progress

slow since 2000 [1]. For MDG 5, globally and in most of the countries included in the Countdown project, the improvements are insufficient – particularly in Sub-Saharan Africa.

One way to make progress in reducing maternal and perinatal mortality is to carefully analyze a country's activities in these areas and to learn from positive examples by identifying in a scientific way the factors that most likely had the highest beneficial impact, thus making possible the potential transfer of these experiences to other countries.

Hence we examine the example of Eritrea, where two German nongovernmental organizations (NGOs) – Archemed and the Hammer Forum – have been active in this country since 1995 when the first children were flown out of the country for surgery in Germany and where later medical activities were supported within the country through the 2003 creation of a neonatology ward next to the obstetric facility in the capital city, Asmara. From 2004 to 2010, the number of deliveries in the country's biggest newly built obstetric service increased from 7,000 to 9,200; and the neonatal ward, which was originally planned for 16 children, now has an average of 40 newborns. We wanted to examine in greater detail the development of maternal mortality in Eritrea within the last 15 years and what the most important factors influencing the observed changes might have been.

## 2. Activities towards centralization of obstetric services and auxiliary activities

During the 15-year time period from 1995 to 2000 looked at here, the Eritrean government initiated the following strategies with support from the Hammer Forum and Archemed:

- More than 100 associate nurses and nurse midwives were trained and deployed.
- The new Orotta Medical School in the capital, Asmara, was established and its first 31 doctors graduated in 2009. Since all the acting senior medical doctors were still trained in Ethiopia, mostly in Addis Abeba before Eritrea's independence in 1991, a new curriculum was developed in cooperation between the local senior doctors and our NGO, especially after some US medical doctors (from George Washington University and Physicians for Peace) had to discontinue their service over the last two years because of some previous tension between the two governments.
- Because there were only 15 fully trained obstetricians/gynecologists in the country (6 in Asmara), a postgraduate training program was developed. The duration of the curriculum is currently three years; the first exams are scheduled for 02/2012.

- Because of the high total fertility rate of 4.84 (by comparison, Germany has 1.4) and a birth rate of 33.6 per 1,000 (9.62), planned parenthood activities were another emphasis, with the aim to improve contraceptive knowledge and the spacing of pregnancies and to reduce unsafe abortions.
- The Eritrean government introduced and universally applied a community female genital cutting elimination project (“Vision Eritrea”), especially in the subzones of the Northern Red Sea Zone, from January 2008 to June 2010 with a coordinated campaign, peer groups, and the local authorities, especially schoolteachers with whom major successful information and attitude-forming events were conducted [7].
- Ultrasound evaluations during pregnancy were introduced and staff teaching was intensified.
- The German charity activities helped to train medical teams for high-risk obstetrics as well as neonatology by coordinating at least two team assignments per year from Germany, with highly qualified neonatal nurses, 4 neonatologists, 2 pediatricians, and 3 obstetricians from university and other major departments. Furthermore, the German charity organizations also organized regularly transports of medical equipment and medicine from Germany.

This experience in Asmara also led to the current project to build up a similar facility in Keren, planned for about 2,000–3,000 deliveries. About two million people live in the northern region around Keren. The central government fully supports this new building designed by architects from Berlin. In this second biggest hospital of the country, the maternity facility is currently not only far away from the surgical facility where caesarean sections can be performed; there is also only one fully trained obstetrician and one neonatologist, respectively, so that the regular help from the German colleagues is highly appreciated. The hospital is a major driver for fertility control, offering contraceptive counseling, and also a major contributor to the fight against female genital mutilation. The new building project of a perinatal center is also intended to give a positive signal for the other provincial cities outside the capital, Asmara.

### 3. Results of activities

A household study to assess the maternal mortality ratio was conducted [6] on a normally representative sample of population including a total of 42 communities (7 randomly selected from each of 6 zones). After appropriate training, members of these communities

visited a total of 46,684 households in a house-to-house survey identifying a total of 248 deaths of women in the reproductive age group (15–49 years), of which 41 most likely were maternal deaths.

There was an overall decline in MMR in Eritrea from 998 per 100,000 live births in 1995 to 486 per 100,000 in 2010. The household survey of the nationally representative sample revealed a maternal mortality ratio of 752 for the period 2002–2003 with a lifetime risk for maternal mortality of 1 in 28 for the whole country. There was, however, wide zonal variation in MMR, e.g. from 46 per 100,000 in the zone Zoba Maakel to 1,261 in Zoba Southern Red Sea. 16% percent of all maternal deaths occurred during childbirth, while 36% occurred within two months after termination of pregnancy, about half (48%) around childbirth itself. The increase in the percentage of institutional deliveries occurred only significantly after the opening of the new obstetric facility in Asmara in 2005 [6].

In parallel to these developments in centralizing obstetric services in order to achieve a decline in MMR, auxiliary activities took place and other major changes in prenatal care have been seen between 1995 and 2010, e.g.

- whereas in 1991 only 19% of pregnant women received at least one prenatal care visit during their pregnancy, this figure increased to 89% in 2010. Access to comprehensive emergency obstetric care increased from 43% in 2006 to 84% in 2010, probably because of the obvious increasing popularity of coming for deliveries to the central facilities.
- The immunization rate increased from under 40% of children immunized against measles or three doses of DPT to more than 95% in 2010, and the prevention of mother-to-child transmission of HIV increased from 4% in 2004 to 29% in 2006. The under-5 mortality rate decreased from 150 per 1,000 live births in 1990 to 58 in 2010, similar to the decline we had observed in Ethiopia [8].
- Counseling about contraception and safe post-abortion care was intensified during this time period, and the “Reproductive Health Plus Project” [7] was implemented with its main emphasis on stopping the traditional practices of FGM through awareness campaigns by teachers, students and peer groups using videos and the training of reproductive health promoters, traditional birth attendants, community working groups, and educators. Comparative knowledge, attitude, and practice surveys conducted at the beginning and at the end of the project clearly indicated a significant change in the practice of FGM, which decreased among five- to ten-year-old girls from 73% in 2007 to 35% in 2010 [7].

Because of this list of auxiliary activities, the efforts to centralize obstetric services improvement of MMR, it is scientifically impossible to dissect exactly which part of the observed success is due to exactly which activity, but we propose that some considerations are possible for hypothesis generation.

## Discussion

Academic medicine in the past has probably not participated enough in the tedious work of analyzing in a scientific way national performance data in areas like perinatal medicine, because the primarily hypothesis-driven literature has only lately increased its recognition of this as an important area of research and medicine [9, 10]. It has even been speculated that maternal health and reproductive rights in general could have been low on the agenda in the past because they were conceived as “female” and therefore “secondary” issues in some regions of the world. Recently, however, it is more and more recognized that a “... substantial increase in education, especially of women, and the reversal of the gender gap ...” can be a major factor in the social and economic progress of countries [11]. Many factors influence the MMR development in a country; e.g. Galadanski et al. [12] reported in their study of obstetric quality assurance in Nigeria that there was a close correlation between the MMR and the equipment status and hygiene conditions of the hospitals, so there is never a monocausal relationship between any intervention and overall outcomes; nevertheless we think that some conclusions can be drawn from the developments in Eritrea, especially regarding centralization of obstetric and neonatal services.

Eritrea is a suitable country to study hypotheses such as the one that centralization of obstetric services improves MMR in low-income countries, because it is small with only 5,291,370 inhabitants (census 2008), of whom 80 % live in rural areas. After the 30 years of armed struggle with Ethiopia there are only 110–125 physicians for the total of 5.3 million people in the country or three medical doctors per 100,000 population (compare with 293 per 100,000 in the USA). There are 12 nurses per 100,000 population (937 in Germany) and three midwives per 100,000 [10]. The life expectancy in Eritrea is 59.9 years (79.1 years in Germany) and the average age of the population is 18.1 years (43.4). More than 50 % of the medical doctors are guest physicians from Cuba, China, or India. The staffing shortage, which is intimately linked to training and postgraduate education, has to be given high priority because severe understaffing, just like lack of equipment, makes severe dilemma situations for the health care workers unavoidable. Julie Livingston and

Steven Feierman, together with participants at a workshop at the Institute for Advanced Study in Berlin in May 2011, addressed the obstacles to the improvement of health systems and possible interventions in Africa by saying [13]: “Consider a hospital with no oxygen, patients lying two in a bed, a nurse to patient ratio of 30 to 1, a half-stocked pharmacy, and a lab lacking reagents. How does one doctor in such a setting?” (See also the conference report of Steven Feierman and Julie Livingston, p. S. 308).

One of the main activities of the government in Eritrea was to centralize obstetric services, because our hypothesis was that skilled birth attendants in the periphery are important, but most useful in centralized services, because here they can provide maximal safety with the lowest cost for emergency equipment per user and bring the individual health care provider more often out of those dilemma situations described above. In Eritrea there are currently 231 health facilities, 160 health stations, 48 health centers, 17 hospitals, and 6 maternal and child centers. In 1991, when the country gained independence, there were 16 hospitals, 4 health care centers, and 106 health stations. Primary-level health stations focus on immunizations, antenatal care, epidemic disease control, etc.; secondary-level hospitals on general medicine and obstetric care, minor surgical procedures, dental services, etc.; and a tertiary national referral hospital currently exists only in Asmara.

There are numerous and obvious reasons why centralized perinatal centers have a very important role in improving mother and child health in any country, in particular:

1. Health workers from obstetrics and neonatology can work closely together.
2. Fragile newborns, who are known to react adversely to low temperatures and mechanical irritation, need only short transports when the delivery room is adjacent to the neonatal service as in Asmara and soon in Keren.
3. Expensive and perishable commodities such as blood products and instruments for cesarean section and other surgeries can be better stored.
4. It is easier to staff perinatal centers with specialists, because costs per patient fall.
5. Follow-up care of sick babies and mothers, including nutrition and vaccination programs, becomes easier.
6. Contraception counseling can be offered in a structured way, providing knowledge about its benefits to childbearing women after delivery.

A central perinatal facility, however, cannot just be planned on paper and implemented easily everywhere. Any center has to be accepted and trusted by the public, and we have invested a lot of effort in this acceptance issue successfully in Eritrea as shown by (1) the

increase in deliveries in the hospital of the newly built facility in the capital Asmara from 5,500 to 9,000 over the years and (2) by the dramatic increase, since building the new perinatal center, in the survival of premature and sick newborns in Asmara. The rewarding experience was that “word got around” about the quality of the new perinatal facility and its family-friendly design; acceptance of the new medical center in the population and demand for it grew steadily.

Non-governmental organizations (NGOs) can pursue concepts that may differ in certain aspects from those of more government-dependent organizations such as the UN or WHO, e.g. strengthening the central obstetric facilities, even though an emphasis on the empowerment of the services in the periphery might be politically higher on the agenda. We feel that even skilled birth attendants usually are lost in the field in cases of real obstetric and newborn emergencies, because in many of the typical obstetrical emergency situation, such as PPH or eclampsia, suddenly specialized facilities and skills are necessary to prevent death. It has been shown that there is a correlation between the percentage of births attended by a skilled birth attendant and the number of babies who die in their first month of life [15] and the WHO has incorporated the percentage of births attended by skilled birth attendants into its menu of key indicators [16], but high-resource countries have stronger health systems in general, so that there is not only a greater number of skilled professionals but also better provision of emergency obstetric care in centralized facilities than in the periphery without equipment. Therefore the skilled birth attendants are often not sufficient to prevent maternal death, but they have to be backed up by facilities that e.g. allow for fast cesarean sections or medical and surgical interventions.

In their analysis of studies of routine prenatal care, José Villar and Per Bergsjø [17] have concluded that obstructed labor can be anticipated in multiparas based on obstetric history and that in suspicious situations hospital delivery should be secured. A staged approach for obstructed labor and similarly postpartum hemorrhage in low-resource settings with emergency transport and many other logistical problems, however, might be impractical, so that the ideal situation is that most deliveries should take place in facilities that have the appropriate backup for emergency obstetric interventions in the first place. This is especially relevant for Eritrea, where from 01 to 06/2010 ca. 50 % of the maternal mortality was due to atonia, whereas according to the World Health Report 2005 severe bleeding (hemorrhage) normally accounts for 25 % of the etiologies. On the one hand, misoprostol can be applied even in rural areas by skilled health care workers, and in many randomized studies on oral and sublingual misoprostol for prevention of postpartum

hemorrhage this regimen was associated with significant decreases in the rate of acute postpartum hemorrhage and mean blood loss [18, 19, 20]. The drug's low cost, ease of administration, stability, and positive safety profile make it a good option for resource-poor settings and the WHO has recommended it for that purpose [21], but on the other hand, in cases of severe PPH, other things such as fresh frozen plasma, blood transfusion, and possibilities for surgery have to be available quickly to save lives. In Africa, sick people and pregnant women in labor or with complications are usually transported by donkey, rarely by car, truck, or bus, and only occasionally by an ambulance, and this can be life-threatening in cases of severe preeclampsie/eclampsia, bleeding, or obstructed labor. Therefore deliveries in facilities that have the backup for emergencies provide much greater safety than do efforts at triaging in accordance with risk factors beforehand.

Another important lesson from analyzing more or less successful developments in the perinatal performance of a country is the recognition that it is necessary to rigorously assess what kind of a partner the ruling government is, because these administrators can be either prohibitive or very helpful. In our Eritrea project, the close cooperation between NGOs and the government is meanwhile based on a long tradition of trust and intensive cooperation on all levels, and therefore projects like the intended centralization of obstetric services could be achieved in a combined effort. After the success with centralization in the Asmara and Keren region, the subsequent plan now is to have a network of adequately equipped centers throughout the country, including some selected regional hospitals.

Another example of the Eritrean central government's positive influence on health care development in the country is that in 2003 the Eritrean Ministry of Health organized a broad-based campaign to identify children who had not been immunized against measles and provided boosters for children who had already received at least one dose of the measles vaccine. This campaign for children aged 9 months to 15 years was launched in collaboration with a wide variety of local actors, including local administrators, community and religious leaders, youth and women's associations, and community health workers. A subsequent evaluation confirmed that coverage reached 98.3 % of the targeted group and the result is that measles no longer poses a major threat to children in Eritrea, and no deaths from measles have been reported between 2006 and 2008.

In Eritrea the key strategies used to reduce maternal and perinatal deaths included provision of quality antenatal care and skilled assistance during delivery, postpartum home visits, care of the newborn, expansion and equitable distribution of emergency

obstetric and neonatal services, provision of post-abortion care, strengthening the transport and communication systems, capacity building, and especially centralization of services. The WHO, UNICEF, UNFPA, and the World Bank estimated for Eritrea a 69% reduction in MMR from 1990 to 2008, with an average annual reduction of 6.6%. This makes this small country one of the few countries in Africa that is on track to achieve MDG 5 [22].

A study of the 11 comprehensive emergency obstetric care facilities in Eritrea found that they were all grossly understaffed – a problem also reported from other places in Africa, such as South Africa, where “some district hospitals had not had a visit from an obstetrician or pediatrician in years because of their own work load” [23] – but that the compliance with clinical standards and supplies was optimal in the Eritrean health facilities. As a consequence, the total case fatality rate of 0.65% was low.

The same study revealed that in Eritrea a total 45.6% of obstetric admissions and 19.5% of maternal deaths were attributed to abortion complications [24]. This is even higher than the rate of 13% for maternal deaths due to unsafe abortion found by the WHO worldwide (47,000 cases in 2008). Of the estimated 21.6 million unsafe abortions in 2008, almost all occurred in low-income countries. This is a sensitive point that we often have to address with the government in good faith. The successes obtained in Eritrea in perinatal health through centralization of obstetric services and a complex list of other activities have encouraged the drivers of this progress to carefully monitor this development and to identify areas where further progress toward achieving the MDGs 4 and 5 is possible. Careful analyses of the effects of helping women have healthy, wanted pregnancies [25] have shown social and economic gains far beyond the health sector, including higher educational attainment and labor productivity, as well as greater accumulation of household wealth, which helps to reduce poverty overall.

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The results of this project are also described in the following articles:

“Maternal mortality in Eritrea: Improvements associated with centralization of obstetric services.”

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In summary, the improvement of maternal health and the aim to make progress toward MGM5 to improve maternal mortality is not easy in low-resource settings, especially in many parts of Africa, but proper evaluation of successful developments in some countries such as Eritrea suggests that coordinated efforts of governments with NGOs, including a list of pre- and perinatal activities, can result in sustainable achievements, but a key factor seems to be a centralization of obstetric services as achieved in Eritrea.

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