UN/POP/MORT/2003/8
26 August 2003

ENGLISH ONLY

WORKSHOP ON HIV/AIDS AND ADULT MORTALITY IN DEVELOPING COUNTRIES

Population Division
Department of Economic and Social Affairs
United Nations Secretariat
New York, 8-13 September 2003

MEASURING AND ESTIMATING MATERNAL MORTALITY IN THE ERA OF HIV/AIDS *

Wendy Graham and Julia Hussein **

* This document was reproduced without formal editing.

** Dugald Baird Centre for Research on Women's Health, University of Aberdeen, Aberdeen, Scotland, U.K. The views expressed in the paper do not imply the expression of any opinion on the part of the United Nations Secretariat.

A. INTRODUCTION

In this 21st century, safe motherhood remains an elusive goal for many developing countries. The obstacles to progress in reducing the burden of avoidable maternal mortality and severe morbidity include both old and new challenges, and emphasise the reality of no "quick fix" nor "magic bullet". Among the older challenges are some familiar barriers to public health, such as dysfunctional health systems, poverty, and the low status of women. As regards the new challenges, foremost among these is HIV/AIDS.

Global recognition of the magnitude and implications of this modern-day plague broadly coincided with raised awareness of the neglected tragedy of maternal mortality in developing countries (Mahler, 1987; Quinn and others, 1986). Looking back over the lapsed time since then reveals several similarities in the evolution of these two major challenges to global health. The concentration of the burden in developing countries is similar, experiencing annually an estimated 99% of all maternal deaths (WHO/UNICEF/UNFPA, 2001) and a similar proportion of AIDS deaths (1999) (UNAIDS, 2003). The serious difficulties of measuring the burden, especially on a population basis, are comparable for maternal mortality and HIV/AIDS. In terms of reliable evidence of progress in reducing mortality in developing countries from either condition, there is little to celebrate, particularly in sub-Saharan Africa (AbouZahr and Wardlaw, 2001; Buve, Bishikwabo-Nsarhaza, and Mutangagura, 2002). What is perhaps most surprising however in this evolution is the comparatively limited attention given to the relationship between maternal mortality and HIV/AIDS (Graham and Newell, 1999). This has many manifestations. A search of Medline, for example, reveals just 43 papers in the last 10 years with "maternal mortality" and "HIV/AIDS" as key words, compared with over 6200 identified using "child mortality" and "HIV/AIDS".

There are a host of scientific, practical and ethical reasons for acknowledging the relationship between maternal mortality and HIV/AIDS (Berer, 1999). The focus of this paper is specifically on the challenge of measuring maternal mortality in the context of HIV/AIDS. Although there is little empirical evidence on the scale or stage of the HIV/AIDS epidemic at which effects on maternal mortality are significant, "context" here is assumed to be populations with adult prevalence rates (15-49 year olds living with HIV/AIDS) in excess of 1% and thus relates predominantly to sub-Saharan Africa with an estimated prevalence of 8.8% in late 2000 (Morrison, 2001). The first section of the paper explores possible biological or behavioural synergies. The remainder focuses on the implications of the presence of HIV/AIDS for the classification, quality, sources, and interpretation of data on maternal mortality. Finally, a brief descriptive profile of global and regional patterns in maternal mortality is given, along with recommendations on priorities for research and development.

There are two sides or facets to exploring the relationship – the effects of HIV/AIDS on the measurement of maternal mortality and the effects of HIV/AIDS on the risk of maternal mortality. In practice, these effects are totally conflated and thus hard to differentiate – the analogy being two sides to the same coin or currency, as represented in Figure 1. The latter shows that the level of maternal mortality may increase or decrease in the context of HIV/AIDS owing to changes in the numerator of deaths and/or denominator of women or births. These changes, in turn, can be due to real alterations in the risk of maternal death or of exposure. Alternatively they can be measurement artefacts, in other words, the consequences or knock-on effects of HIV/AIDS.

B. BIOLOGICAL OR BEHAVIOURAL SYNERGIES

Figure 2 presents a framework for conceptualising the measurement-risk currency. Taking first the facet representing biological or behavioural relationships, Figure 2 (right) shows this in terms of three overlapping domains. At the core are the maternal deaths among women with HIV/AIDS, grouped into three categories. AIDS can itself be regarded as the cause of maternal death when death occurs in the interval from onset of pregnancy to 42 days postpartum. Relative to a point in time before HIV/AIDS was prevalent or relative to a population without HIV/AIDS, the added effect of this cause would be an increase in the number of maternal

deaths. The innermost domain in Figure 2 also encompasses HIV/AIDS increasing the risk of other causes of maternal death – both direct obstetric, such as puerperal sepsis, or other indirect, such as malaria. Here the proven biological relationship is primarily immuno-suppression, with HIV or AIDS cases unable to withstand infections, but also other complications such as haemorrhage as well as interventions such as caesarean section (Berer, 1999; McIntyre, 1999). In the latest Confidential Enquiry into Maternal Deaths (CEMD) in South Africa, for instance, the proportion of direct obstetric deaths whose primary cause was puerperal sepsis increased from 11% in 1998 to 16% in 2001 (Pattinson and Moodley, 2002). Similarly, the proportion due to indirect infections, including AIDS, increased from 23% to 31% over the same period, and now represents the leading cause of maternal death in this country, where an estimated quarter of pregnant women attending government antenatal clinics are HIV infected.

The second domain of the risk of maternal death shown in Figure 2 relates to all pregnant and parturient women. At this level the burden of HIV/AIDS may exert an effect through the health system in terms of the availability and quality of care as well as uptake (Graham and Newell, 1999). This effect operates irrespective of the HIV or AIDS status of an individual woman. As regards, for example, the availability of care, the acute shortage of health professionals is a key factor - shortages arising both from AIDS mortality and to real and perceived risks of occupational exposure. It is self-evident that such shortages, along with other constraints to health services in the context of HIV/AIDS such as lack of safe blood for transfusions, will affect women needing care for life-threatening obstetric complications. A further consequence is seen in terms of the quality of care received, both owing to the loss of experienced professionals but also the standard of treatment where there is a high degree of HIV/AIDS suspicion, as also indicated in the South African CEMD (Pattinson and Moodley, 2002). Given that an estimated 90% of people living with HIV do not know their status (Morrison, 2001), this question of suspicion is a genuine concern, and may also affect uptake of care. Increasing poverty among families who have lost the principal earner owing to AIDS (Whiteside, 2001) may be a further reason for reduced uptake, particularly given the cost of emergency obstetric interventions.

Finally, turning to the outer domain of the risk of maternal death represented in Figure 2, HIV/AIDS

Opportunities to test such modelling empirically will, however, be seriously limited by the difficulties of measuring maternal mortality reliably. Some of the measurement constraints are peculiar to maternal

death relative to pregnancy, could possibly be used to estimate maternal mortality (Crampin and others, 2003; Nakiyingi and others, 2003; Ng'weshi and others, 2003).

Variations in coding conventions for cause of death can also introduce bias, and this may be aggravated by what some authors have referred to as the "moral and symbolic aspects of AIDS" influencing the reliability of official statistics (Bonciave referred t8os, and can

Vital registration systems which are of sufficient scope and quality for measuring levels and trends in maternal mortality only exist in a small number of countries – representing less than 7% of the estimated annual number of births globally (AbouZahr and Wardlaw, 2001). In a somewhat larger number of countries, registration is often reasonably complete for urban areas. However, this may change in the face of HIV/AIDS as urban cemeteries become full to capacity and sick individuals return to their rural place of origin to die. The issue of high mobility, both among sick adults and their surviving relatives, has emerged as a striking

other key members (Urassa and others, 2001). Indirect estimation using the sisterhood method (Graham, Brass and Snow, 1989;) avoids this particular difficulty as the residential home of the deceased woman is not the sampling unit but rather that of their adult siblings. Similarly, by securing information on more than one woman from each sibling, this approach can rapidly accumulate women years' of risk exposure and thus has smaller sample size requirements than the direct method (WHO and UNICEF, 1997). However, the trade-off for this is the time-location of the resulting estimate, which varies according to the age-group of respondents and can be as long ago as ten years for the original sisterhood method. The Demographic and Health Surveys (DHS) have used a variant of this method for many years now (Rutenberg and Sullivan, 1991), and data are thus available at the national level for about 55 developing countries. These tend to use a reference period of 0-7 years prior to data collection, so making the interpretation of recent trends problematic. Given the average size of DHS surveys, the resulting estimates will also have very wide confidence intervals (Stanton, Abderrahim and Hill, 2000). Sibling-based methods raise a further complication given the high degree of mobility noted earlier among populations facing HIV/AIDS, since the maternal mortality data relate to the respondents' physical location rather than that of the deceased.

All survey-based approaches to maternal mortality estimation have the potential for response bias in a context with HIV/AIDS. Firstly, there is the question of the choice and availability of respondents. In populations with escalating adult mortality owing to HIV/AIDS, those interviewed in household surveys are clearly only the survivors and thus a healthy respondent effect will prevail. This is complicated by the hetero-sexual spread of HIV, which means that both women and their partners may be lost. Secondly, surviving partners may be too sick to respond, and those finally interviewed not necessarily the best informed of the circumstances surrounding a maternal death. Thirdly, several studies have found that verbal autopsy tools used to gauge the primary cause of death have low sensitivity and specificity (Sloan and others, 2001), and therefore misclassification is a common problem. Most such tools focus on identifying direct obstetric causes, and none have been adapted specifically to identify maternal deaths in populations with a high prevalence of HIV/AIDS, although some ascertain HIV-related adult mortality (Kamali and others, 1996). Finally, in such settings, there may be a greater stigma attached to reporting an adult female death from HIV/AIDS than from other causes, and this could potentially lead to over-reporting of maternal deaths (Bicego, 1997).

2. Use and interpretation of maternal mortality data

The challenges of classification and quality are concerns in the generation of primary data on maternal mortality in developing countries. The use and interpretation of these data given a context with HIV/AIDS raises further knotty problems, in terms of the choice of indicators or measures, the use of estimation models, and the interpretation of trends.

a. Indicators

Table 2 sets outs the alternative measures of maternal mortality. The most common indicator is the maternal mortality ratio, which is a measure of obstetric risk – reflecting the probability of dying once pregnant. As such this indicator does not allow for the first of the two conditional probabilities implicit in maternal mortality, namely the probability of pregnancy. In the context of HIV/AIDS, where downward trends are now being observed in some populations in live birth rates (Zaba, and Gregson, 1998), an additional useful indicator is the maternal mortality rate (maternal deaths per 100,000 women aged 15-49). The maternal mortality ratio, on the other hand, uses live births as the denominator, and is ratio rather than a rate since the numerator of maternal deaths includes some cases unrelated to live births. It has been argued that this bias is compensated for by the expected underreporting in the numerator, especially amongst deaths in early pregnancy (AbouZahr, 1998). Given an increased risk of pregnancy wastage (i.e. losses before 24 weeks gestation) and stillbirths among women with HIV/AIDS (Brocklehurst and French, 1998), a denominator based on live births is an underestimate of the population at risk. This would lead to inflation of the maternal mortality ratio, as illustrated in Figure 1, and has implications for monitoring trends.

b. Use of estimation models

In view of the limited population-based sources in many developing countries, demographic estimation models for maternal mortality have been developed

An alternative source of data proposed for examining trends in maternal mortality in selected developing countries is the DHS. As mentioned previously, the DHS now provide data from the sisterhood method for 55 countries, and for many of these the information is available for more than one point in time. However, this source suffers a similar difficulty to the WHO/UNICEF/UNFPA modelling approach in terms of wide

ACKNOWLEDGEMENTS

The authors would like to acknowledge the invaluable feedback received on an earlier draft from colleagues: Colin Bullough, Marie-Louise Newell, Graham Scotland and Basia Zaba.

Thanks are also given to Ann Fitzmaurice and Sohinee Bhatttacharya.

The permission of Dr Paul Van Look to use the unpublished WHO data for 2000 is gratefully acknowledged.

Egypt Ministry of Health ECSP.(1994) *National Maternal Mortality Study. Findings and Conclusions.* Egypt 1992-1993.

Nakiyingi J, and others. (2003). Child survival in relation to mother's HIV infection: evidence from a Ugandan cohort study. *AIDS* (forthcoming).

TABLE 1. ILLUSTRATIVE SAMPLE SIZE REQUIREMENTS FOR ESTIMATING MATERNAL MORTALITY[1]

Measure	Expected magnitude (annual rates)	Births needed[2]

TABLE 3. COUNTRIES CONTRIBUTING THE LARGEST ESTIMATED NUMBER OF MATERNAL DEATHS (1995 [1]) AND INDICATORS OF HIV/AIDS PROFILE

Country	**No. of maternal deaths**	**% of global total**	**Estimated maternal mortality ratio (deaths per 100,000 live births)**	**Prevalence (%) of HIV among adults 15-49 [2]**	**Prevalence of HIV among ANC attenders in major urban areas [3]**

PANEL 1 INTERNATIONAL CLASSIFICATION OF MATERNAL DEATHS (ICD 10)

Maternal death:

PANEL 2 ESTIMATES OF MATERNAL MORTALITY DEVELOPED BY WHO, UNICEF AND UNFPA