The Sisterhood Method for Estimating Maternal Mortality:

Guidance notes for potential users

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EXECUTIVE SUMMARY

Very few developing countries have comprehensive vital registration systems able to capture a reasonable proportion of maternal deaths. In such settings, population-based surveys have to be used to estimate maternal mortality. But there are major caveats to using such approaches. Even where levels of maternal mortality are high, the actual number of maternal deaths is likely to be relatively small because maternal deaths are rarer than infant deaths for a fixed reference period. Thus, large sample sizes are needed for reliable results: depending on average household size, this may involve visiting 200,000 households, an impossibly large number in any setting and totally unrealistic in small countries.

These problems led researchers to look for alternative, more efficient techniques for measuring maternal mortality. One such approach is the sisterhood method. The sisterhood method was designed to overcome the problem of large sample sizes and thus reduce costs. The method reduces sample size requirements because it obtains information by interviewing respondents about the survival of all their adult sisters.

Many countries have used the method during the past few years. As experience has built up, a number of issues have become apparent which need to be taken into account before opting to use the methodology to measure maternal mortality and particularly for those wishing to evaluate progress towards the reduction of maternal mortality.

Before deciding to undertake a survey to establish the level of maternal mortality, policy-makers and planners should carefully consider why an estimate is needed and what it will be used for. The use of the sisterhood method is appropriate when:

- there is no reliable estimate of the level of maternal mortality;
- an approximate level of maternal mortality is needed for advocacy purposes and to draw attention to the problem;
- resources do not permit any other approach for measuring maternal mortality in the immediate term;
- a starting point is needed for more detailed follow-up of maternal deaths identified during the recent past.

The method is **not** appropriate for:

- measuring progress towards safe motherhood in the short term;
- evaluating programme impact;
- comparing geographic areas (that is, comparing sub-national estimates) or studying trends;
- allocating resources (the estimates are insufficiently precise).

Where national authorities feel there is an imperative need to have an estimate of the maternal mortality ratio and where resources are limited, sisterhood methods provide an appropriate and cost-effective tool. They should, however, be used with care particularly with regard to issues such as sample size, quality of the field work and interpretation and use of the results.

Whatever method countries adopt for measuring maternal mortality, it is important to remember that the absolute value of the maternal mortality ratio is not as important for programme or planning purposes than an analysis of WHY women are dying from pregnancy-related conditions. Is it because they cannot reach appropriate services? Is it because the services do not exist or are they inaccessible for other reasons such as distance, cost, social or cultural barriers? Are women dying because the care they receive in health services is inadequate, inappropriate or substandard? Answering some of these questions is more important than knowing the precise level of maternal mortality.

PREFACE

The goal of reducing maternal mortality has been adopted by a series of international health and development conferences and forms an integral component of the programmes of action following the 1990 World Summit for Children, the 1994 International Conference on Population and Development and the 1995 Fourth World Conference for Women. Many countries have also accepted it as a national goal.

Goal setting requires some ability to determine whether goals are met, in this instance, measures of the level of maternal mortality. In most developing countries, comprehensive national systems of registration of births and deaths and careful attribution of cause of death, are not available. In such circumstances, maternal mortality can be estimated through household surveys using direct estimation techniques. However, large sample sizes are needed and such approaches are, therefore, both complex and costly. Alternative, more cost-effective strategies have been devised to enable countries to make estimates of levels of maternal mortality. One such approach is the sisterhood method.

While sisterhood methods have many advantages including relatively modest sample size requirements, they also have some weaknesses which are rarely clearly understood by those using the results. A recent technical meeting organised by WHO and UNICEF brought together technical experts to examine these issues in detail. The main conclusions of that meeting are presented here.

These guidance notes are intended for health policy-makers and planners who wish to estimate levels of maternal mortality but who may not be familiar with the different approaches available and the strengths and weaknesses of each. They are not intended to provide detailed technical guidance on how to carry out sisterhood studies. Those wishing to undertake such studies are urged to review the reference materials quoted here and to consult national statistics offices for further information.

INTRODUCTION

The 1987 Safe Motherhood Conference in Nairobi, Kenya established a global goal of halving maternal mortality by the year 2000. The goal has also been adopted by a series of international health and development conferences and forms an integral component of the programmes of action following the 1990 World Summit for Children, the 1994 International Conference on Population and Development and the 1995 Fourth World Conference for Women. The goal captured the world's imagination and many countries have also accepted it as a national goal.

Goal setting requires some ability to determine whether goals are met, in other words, before and after measures of the level of maternal mortality. The wording of the safe motherhood goals has tended to be nonspecific: it was not clear whether the maternal mortality ratio, or the rate, or the number of maternal deaths should be halved. Many countries do not know what their maternal mortality level was at the time of the Nairobi conference and few know reliably even now. Perhaps this degree of specificity was never intended by those who set the goal; nevertheless, the effect is that now, as 2000 approaches, many countries want a statistic and feel they must have one in order to measure progress.

MEASURING MATERNAL MORTALITY

Maternal mortality is a crucial though complex measure of a country's overall health and development status. However, few developing countries have been able to establish comprehensive reporting needed and even where such vital registration systems are in place, maternal deaths are often under reported or misclassified as non-maternal. Other data collection approaches such as household surveys can be problematic because maternal deaths are relatively rare events and large sample sizes are needed for precise results. Results from hospital studies are rarely acceptable because either the numerator (the women who died) or the denominator (the births in the facility) or both are not representative of the general population and the maternal mortality ratio is, therefore, biased in unpredictable ways.[1]

Several alternative methods for studying maternal mortality exist including vital registration, reviews of all deaths to women of reproductive age (so-called RAMOS*), longitudinal studies of pregnant women, and repeated household surveys. All these methods rely on accurate reporting of deaths of pregnant women and of the cause of death. This is always difficult even where all deaths are notified and registered because often the persons reporting on deaths to women of reproductive age do not know if the deceased was pregnant when she died; they do not know the medical cause of death; and there may be shame associated with a maternal death, particularly if the woman was not married or if the death was abortion-related. Misclassification of maternal deaths and under reporting of maternal mortality is also common even in developed countries with good vital registration systems.[2]

Very few developing countries have comprehensive vital registration systems able to capture a reasonable proportion of maternal deaths. In such settings, population-based surveys have to be used to estimate maternal mortality. But there are major caveats to using such approaches.

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*   Reproductive Age Mortality Studies

Figure 1   Maternal Mortality Ratios Using Direct[*] Household Surveys - What do the Estimates Really Mean?
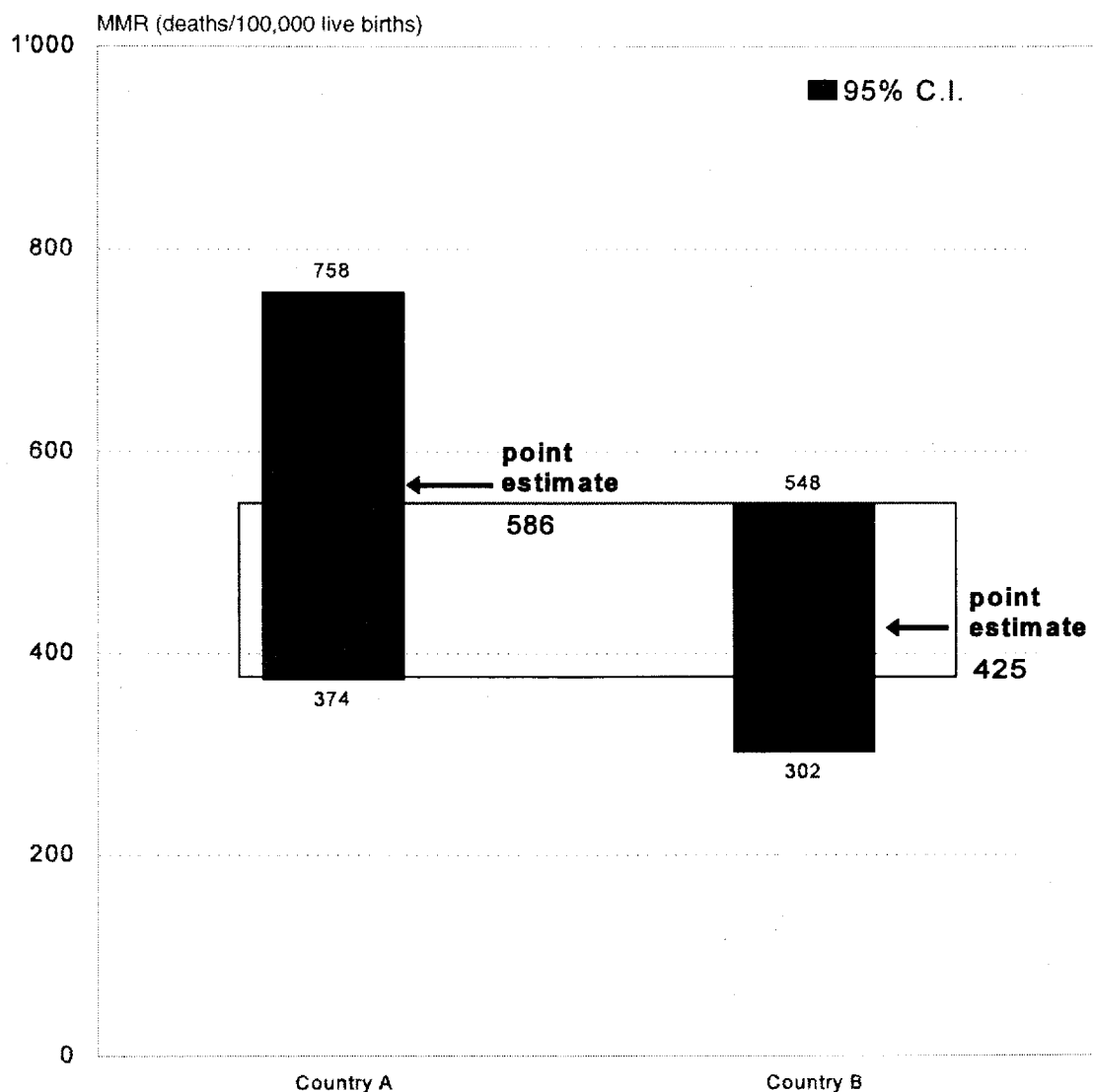
MMR (deaths/100,000 live births)

■ 95% C.I.

758

point estimate

586

548

point estimate

425

374

302

Country A   Country B

Even where levels of maternal mortality are high, the actual number of maternal deaths is likely to be relatively small; maternal deaths are rarer than infant deaths for a fixed reference period. This poses particular problems for household surveys. Very large sample sizes are needed for reliable results and estimates derived using survey techniques will be imprecise if the sample size is inadequate. Thus, household surveys may have very wide margins of error, although this is often not realised because confidence intervals are rarely calculated. It has been estimated that to establish a maternal mortality ratio of 300 per 100,000 live births that is correct to within a 20% margin of error, a sample of 50,000 births is needed. This is likely to involve visiting an impossibly large number of households and may be totally unrealistic in small countries.

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[*]   Household surveys that interview respondents directly rather than those that use indirect approaches such as sisterhood techniques

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The problem of wide confidence intervals is not simply that such estimates are imprecise. They may also lead to inappropriate interpretation of the figures. For example, using the point estimates for maternal mortality may give the impression that the maternal mortality ratio is significantly different in different settings or at different time points. In fact, maternal mortality may be rather similar in both instances because the confidence intervals overlap (see Figure 1).

Because of these problems, household survey techniques that use direct estimation (that is, that interview respondents directly) are not cost-effective. This has led researchers to look for alternative, more efficient techniques for measuring maternal mortality. One such approach is the sisterhood method.

WHAT IS THE SISTERHOOD METHOD?

The sisterhood method was originally developed during the late 1980s. The approach was designed to overcome the problem of large sample sizes and thus reduce costs.[3] It is an indirect measurement technique of the kind frequently used to measure a variety of demographic parameters (such as child or adult mortality), which has been adapted for the measurement of maternal mortality.

Figure 2   **Approximate Sample Size Requirements for Indirect Applications of the Sisterhood Method**
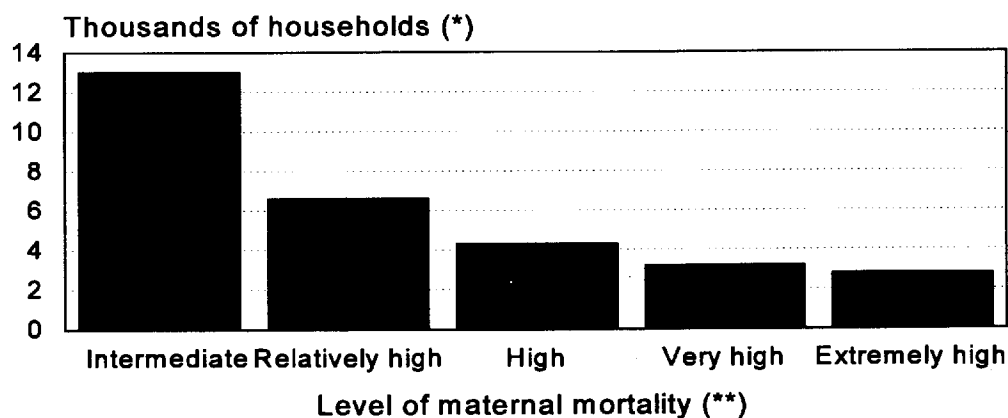
(*)   Assuming 2 adults available for interviewing per household
(**)   Maternal mortality ratios from about 200 per 100 000 live births for "intermediate" level to >1000 for "extremely high" level

SISTERHD/ 1

The method reduces sample size requirements because it obtains information by interviewing respondents about the survival of all their adult sisters. In settings with high levels of maternal mortality (over 500 maternal deaths per 100,000 live births), sample sizes needed can be of the order of 4,000 households or less (Figure 2).*

Because such reports cover deaths occurring over a large interval time, the results generate an overall estimate of maternal mortality for a point centred around 10-12 years before the survey (Figure 3). Insofar as maternal mortality generally changes very slowly, and given that the method was designed to be used in settings where there are no alternative means of generating estimates, a retrospective estimate was not felt to be an overwhelming drawback by those who developed it.[3]

Figure 3   **Time Location of Estimates from Indirect Sisterhood Method**

Respondent age group

Number of years prior to the survey to which estimate refers
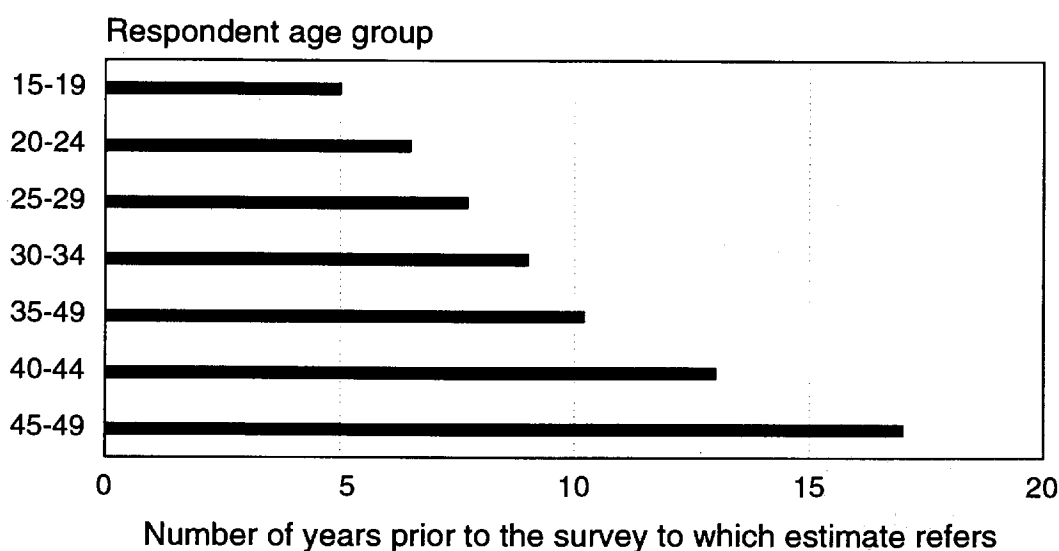
VARIANTS OF THE SISTERHOOD METHOD

There are currently two main variants of the sisterhood method.

The original **indirect sisterhood method**[3] asks respondents four simple questions about how many of their sisters reached adulthood, how many have died and whether those who died were pregnant around the time of death (see Annex 3). The questions can be added to an ongoing study and take very little additional time so the method is particularly cost-effective.

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*   Sample size formula: $n = 4P(1-P)/e^2$ where n = number of respondents; P = proportion of respondents to maternal deaths; and e = maximum error that will be tolerated in the proportion, generally 10%. P = average number of adult sisters per respondent divided by estimated lifetime risk of maternal death. This formula assumes a simple random sampling scheme. To allow for design effect of using more complex sampling schemes, the derived number of respondents should be rounded up to at least the next 1000.

Because the method relies heavily on a number of assumptions about the relationships between fertility and age-specific maternal mortality, it should not be used in settings where levels of fertility are low (Total Fertility Rate below 3), or where there have been recent and marked declines in fertility, or where major migration has occurred. While the method is relatively simple and inexpensive to use, the overall results relate to a point around 10-12 years prior to the survey, a major disadvantage. However, it is possible to calculate estimates for more recent periods by limiting the upper age of the respondents to, say, adults aged below 30 years old. In this case, the overall maternal mortality estimate would relate to a period some seven years prior to the survey. The disadvantage of limiting the upper age of respondents is, however, that larger number of households need to be visited to achieve the desired sample size of adult respondents. Thus, decision-makers need to balance the desire for a current estimate against the additional costs incurred by the necessary increase in sampled households.

A variant of the indirect approach - the **direct method** - is used in Demographic and Health Surveys.[4] This method asks respondents to provide more detailed information about their sisters, including the numbers reaching adulthood, the number who have died, the age at death, the year in which the death occurred and the years since the death (see Annex 4). These questions can also be added to an ongoing survey but require more time than the four questions of the original method. Also, because the questions themselves are more complex and time-consuming to administer, additional efforts need to be directed to the training and supervision of interviewers and to correct mis-reporting.

Table 1 Minimum sample size requirements for use of the maternal mortality module (direct sisterhood method)*

Maternal Mortality Rate (Maternal deaths per 100,000 women of reproductive age)	Number of DHS adult respondents
20	60,500
60	20,100
100	12,000
140	8,600
180	6,700
220	5,500
260	4,600

* Assumes 10 per cent relative error, an average of 1.7 sisters living to adulthood per DHS respondent and the minimum design effect (DEFT = 1.2) found for other DHS mortality estimates.

The direct approach relies on fewer assumptions than the indirect method but requires larger sample sizes than the original method and the information is considerably more complex to gather and analyse. Like the indirect method, the direct approach should not be used in settings where fertility is low (TFR less than 3) or where important migratory flows have

occurred. The direct method does not provide a current estimate of maternal mortality but the larger sample sizes permit the calculation of a ratio for a more recent period of time. For example, the reference point for estimates based on data from 0-6 years before the survey would be 3-4 years before the survey.

Given the nature of the questions asked about the deaths of adult sisters, both methods actually measure pregnancy-related deaths rather than maternal deaths strictly defined (see Annex 2). It is also worth noting that neither variant of the method will be particularly effective at detecting early pregnancy-related deaths because they are based on knowledge of the pregnancy status of the dead sister, something that may well not be known by the responding sibling. On the other hand, all currently available methods of measuring maternal mortality tend to underestimate maternal deaths in early pregnancy, such as those due to ectopic pregnancy or complications of abortion.

Both methods provide estimates of maternal mortality that should be seen as giving orders of magnitude rather than precise ratios since both can have wide margins of error (wide confidence intervals).[5] Neither method provides a current estimate for the year of the survey. For these reasons, sisterhood studies cannot be used to monitor changes in maternal mortality nor to assess the impact of safe motherhood programmes in the short term.

Despite these limitations, the sisterhood method remains an important tool for policy-makers and health planners who want a baseline estimate of maternal mortality. Many countries have used one or the other variant of the method during the past few years. As experience with the sisterhood method has built up, a number of issues have become apparent which need to be taken into account before opting to use the methodology to measure maternal mortality and particularly for those wishing to evaluate progress towards the reduction of maternal mortality. Some of these issues were discussed at a technical meeting of experts organised by WHO and UNICEF in December 1996.[6] Examples of the kinds of problems encountered and the main conclusions of the meeting are described here.

WHEN IS IT APPROPRIATE TO USE A SISTERHOOD METHOD?

Before deciding to undertake a survey to establish the level of maternal mortality, policy-makers and planners should carefully consider why an estimate of maternal mortality is needed and what it will be used for. The use of the method is appropriate when:

- there is no reliable estimate of the level of maternal mortality;
- an approximate level of maternal mortality is needed for advocacy purposes and to draw attention to the problem;
- resources do not permit any other approach for measuring maternal mortality in the immediate term;
- a starting point is needed for more detailed follow-up of maternal deaths identified during the recent past.

The method is **not** appropriate for:

- measuring progress towards safe motherhood in the short term;

- evaluating programme impact;
- comparing geographic areas (that is, comparing sub-national estimates) or studying trends;
- allocating resources.

WHETHER TO USE THE INDIRECT OR THE DIRECT METHOD

Once planners have decided to use a sisterhood method, they should also carefully consider which approach to use.

The original indirect method is *relatively* simple to implement. It involves only four questions so interviewer training and supervision are relatively straightforward, and it is practical to add on to comparatively small scale surveys.

The estimate of maternal mortality using the indirect method is based on reporting by respondents covering a period of some 35 years or more. Thus the overall estimate, derived from pooling the data for all respondents, relates to a period centred some 10 - 12 years before the survey. Some of the deaths contributing to the estimates will have taken place longer than 10-12 years ago; 10 - 12 is the average duration of time elapsed since death. Restricting the upper age limit of respondents, to 30 years, for example, will reduce the time interval accordingly and will result in an overall estimate that is more recent relative to the data collection (some seven years prior to the survey in this case). However, although it is possible, by limiting the upper age of respondents, to obtain overall estimates for a more recent period, this comes at a cost of increasing the number of households that need to be visited to achieve the desired sample size of adult respondents.

The direct sisterhood method requires larger sample sizes and is, therefore, more expensive to implement. Because more questions are asked of each respondent, the interview takes on average 10 minutes longer which adds to the costs of data collection and interviewer training. However, since it is based on more detailed reporting of sibling survival, the method provides information that can be used to check for internal consistency and data quality.

The direct sisterhood method provides a maternal mortality ratio for a narrower time period than the indirect method: the estimates are often presented for the period 0-13 years and the reference point for the most reliable estimate is around seven years before the survey. Estimates for time periods as narrow as seven years can also be calculated and have been published in survey reports. However, the estimate for the most recent 7-year period is usually considerably higher than for the preceding seven years. This conundrum has not yet been explained but may be related to inadequate sample sizes and missing data for the earlier period.[7] The ability to estimate for the shorter, more clearly defined period depends on the assumption - which has been questioned - that siblings can report on their sisters' ages at death and how long ago they died. The former appears to be better reported than the latter.[6]

PRACTICAL ISSUES RELATED TO IMPLEMENTATION

Whichever methodology policy-makers decide to use, there are some things to be careful about when applying the method in the field. Failure to take these issues into account can result in estimates of maternal mortality that are biased.

- Seek advice on the sample size needed for a reliable result. Remember that the original indirect method needs smaller sample sizes than the direct method but gives a more retrospective estimate. Table 2 provides some estimates of sample size requirements for the two approaches compared with household surveys using direct estimation.

Table 2 Number of respondents needed to establish a maternal mortality ratio of 300 per 100,000 live births correct to within 20%

Maternal mortality ratio	Indirect Sisterhood Method	Direct Sisterhood Method	Household Survey
300	4,000*	5,000*	50,000**

* Adult respondents
** Births

- Remember that in order to overcome design bias, larger sample sizes will be required when using complex sampling techniques such as cluster sampling.

- When using the indirect method, ensure that the survey which provides the basis for the sisterhood questions includes appropriate respondents (men and women aged 15-49 years old).

- Carefully pretest the questionnaires and pay attention to translation into local languages, particularly of the term "sister" which is understood differently in different cultures. The term must include sisters born to the same mother only. It is particularly important to ensure that female respondents do not include themselves among the sisters reported as this would inflate the denominator and thus deflate the true maternal mortality ratio.[8]

- Ensure good training and careful supervision of interviewers during data collection.

- Acknowledge that neither the direct nor the indirect method will be able to accurately capture abortion-related deaths and other early pregnancy deaths, such as those caused by ectopic pregnancy.

In summary, each variant of the sisterhood method has specific advantages and disadvantages which potential users should consider before opting for one or the other (Table 3).

USING THE RESULTS

Whatever the approach adopted there are common pitfalls to avoid in interpreting the results. Neither the indirect nor the direct method gives a precise figure and there are always wide margins of error. For this reason, the sisterhood method cannot be used for regular monitoring. Countries should avoid investing the time, effort and resources in conducting sisterhood surveys more than once every decade.

Check data quality

In using the results, consideration should be given to the quality of the data on which they are based. Analysis of some of the direct sisterhood studies by DHS has found that there may be heaping in the reported year of death of the sisters, usually around the end of the decade or at five-year intervals. Alternatively there may be a loss of reported data on the time elapsed since death. Both these factors could distort the results.[6,7] When using the indirect method, investigators should check to ensure that the mean number of adult sisters reported is consistent with the known fertility level in the country. For example, if known levels of fertility in the country indicate that on average, every respondent is likely to have two adult sisters, and the results of the sisterhood survey show that respondents are reporting an average of three sisters each, it is likely that respondents have included themselves among the sisters reported.

Table 3 The sisterhood method: summary of strengths and weaknesses of original indirect and direct variants

	Strengths	Limitations
Original indirect method	▸ Four simple questions can be added to ongoing household survey ▸ Minimal time requirements ▸ Minimal sample size requirements ▸ Simple calculations to estimate ratios ▸ Additional information can be gathered on place/time/cause of death ▸ Can be adapted for use at facility level ▸ Inexpensive	▸ Care needed in the use and understanding of the questions ▸ Provides retrospective estimate (10-12 years prior to the survey) ▸ Not appropriate for use in settings with high levels of migration ▸ Not appropriate for use in settings with declining or low fertility (TFR<3) ▸ Appears to underestimate adult female mortality compared with independent empirical data ▸ Not appropriate for monitoring in the short term
Direct method	▸ Can be added to ongoing multipurpose household survey ▸ Sibling histories permit internal data quality checks ▸ Smaller sample size requirements than household surveys but larger than indirect methods ▸ Can be used to provide more recent estimates than the indirect method ▸ No assumptions required about patterns of fertility ▸ Relatively inexpensive	▸ Data collection more complex and takes longer than for indirect method ▸ Separate time period estimates subject to wide standard errors ▸ Not appropriate for use in settings with high levels of migration ▸ Not appropriate for use in settings with low fertility (TFR<3) ▸ Appears to underestimate adult female mortality compared with independent empirical data ▸ Not appropriate for monitoring in the short term

Consider the effect of confidence intervals

Confidence intervals are the measures used by statisticians to say how precise an estimate is.
Confidence intervals for estimates of maternal mortality should be calculated whenever
possible (although they usually are not).

Figure 4   **The Problem of Using Sisterhood Methods to Measure Progress - Is the
Trend Real?**

MMR (deaths/100,000 live births)
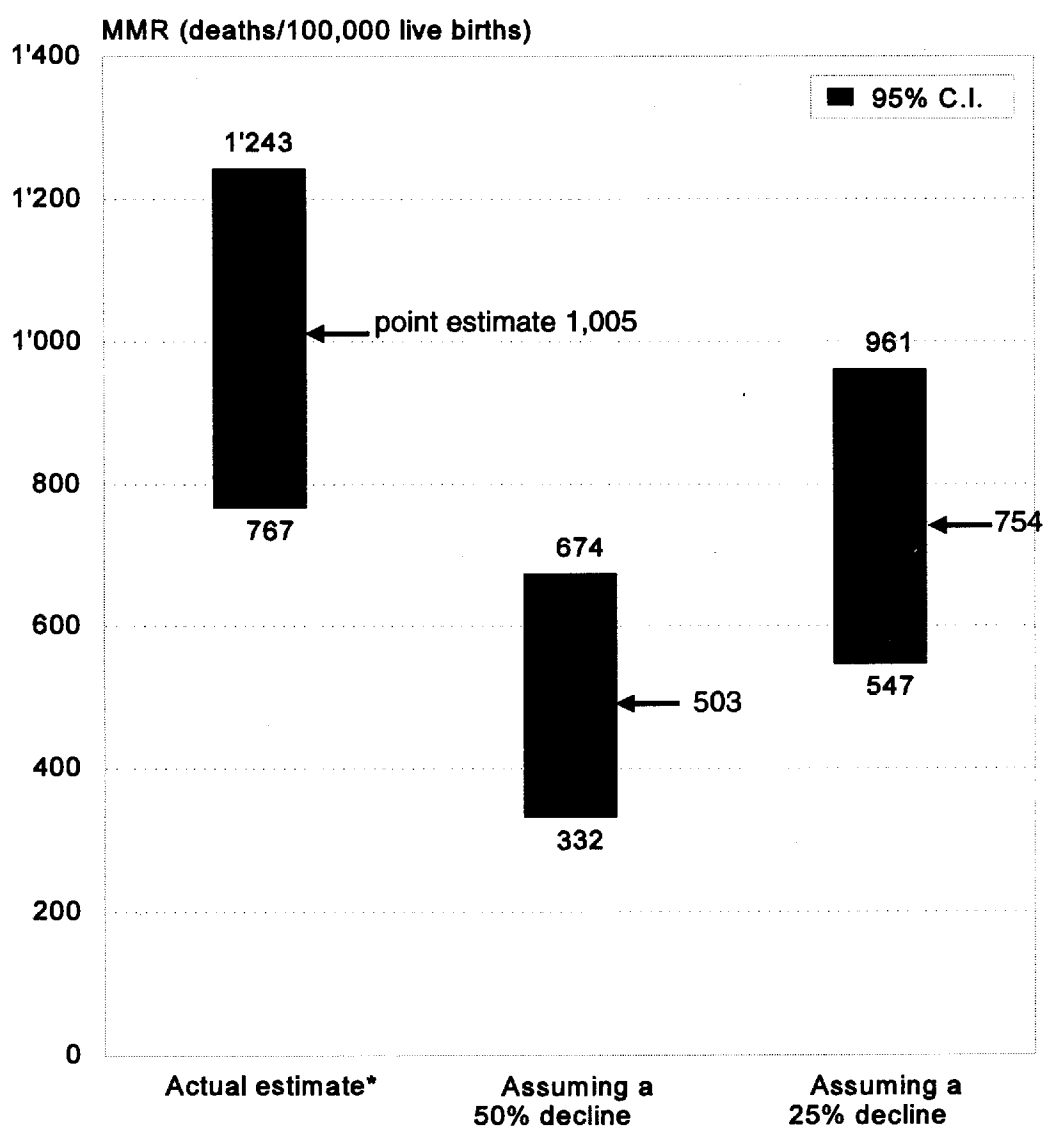
*Data from the Gambia (Graham et al., 1989)
Sample size = 2,163 respondents; 91 maternal deaths identified
Estimate refers to a time period centred approximately 12 years before the survey

For example, a survey result may indicate that maternal mortality in country A is 325 while that in country B is 450. This does not necessarily mean that maternal mortality higher in B than in A. Confidence intervals show that the likely range of the estimate in country A is between 250 and 400 per 100,000 births, while that in country B is between 375 and 525. In other words, there is a large degree of overlap between the two sets of estimates. Using *only* the point estimates (325 and 450) would be misleading and would indicate a degree of precision in the estimates that is unwarranted. Users should always beware of spurious accuracy. It is not appropriate to say that the maternal mortality ratio is a single number, 325 for example. It is much more accurate to say that the maternal mortality ratio is within a range, for example, somewhere between 250 and 400.

While this comparison is between two countries, the same is true of two regions of the same country or two points in time. Because of these wide margins of error it is inappropriate to draw conclusions about trends based on point estimates. Figure 4 shows the maternal mortality estimate derived using the sisterhood method in The Gambia. This shows that a 50% reduction in maternal mortality would be detectable but a 25% reduction would not.

Do not make comparisons across time

Making comparisons across time is rarely appropriate because of wide confidence intervals, as described above. When the data are presented to professional colleagues, the public or the mass media do not overstate their significance. In particular it is important to state that the estimate is for a broad window of time.

Consider whether the estimate is consistent with other data

When interpreting the estimates derived from a sisterhood study, it is important to compare the figures with those obtained from different sources of information. For example, sisterhood modules are often added to demographic or health surveys which also estimate other indicators such as levels of fertility and access to care. How do the figures compare? Is the number of sisters reported similar to what might be expected given other sources of information about fertility? Are the figures for adult mortality comparable to those derived from census data or from alternative sources such as the United Nations population estimates?

A comparison between estimates of adult mortality derived from the DHS direct method and estimates from various external sources suggests that the DHS estimates are more likely to be under- than overestimates of adult mortality. Assuming that maternal deaths are as likely to be under reported as non-maternal deaths, it is possible to assume that maternal mortality is also likely to be underestimated using these data.[7] The reasons for such apparent underestimation are as yet unclear. Of particular concern are the differences between adult mortality estimates derived using the DHS direct sisterhood method and those based on United Nations population projections. Further work is needed to elucidate the reasons for and dimensions of such discrepancies. In the meantime, users of sisterhood study results should compare the mortality levels with other sources in order to judge the overall reliability of the estimates. If comparisons with other data indicate substantial under reporting of adult mortality, adjustments may have to be made to the maternal mortality ratio. This can be done by applying the proportion of deaths which are due to maternal causes estimated using the sisterhood method to the best available estimates of adult female mortality.

Use the estimate to generate debate

Perhaps the most important function of estimates of the maternal mortality ratio (regardless of the method by which the estimate is derived) is to generate discussion among many groups of people - government officials, the medical profession, women's advocacy groups, the press and so on. The inevitable discussion of potential flaws in the data is also useful in terms of developing more insight into the nature of maternal mortality in a given locale - no estimate should be accepted without this type of debate.

IS IT WORTH THE EFFORT TO MEASURE MATERNAL MORTALITY?

Measuring maternal mortality is always expensive and policy-makers need to weigh up the benefits of any particular approach against the opportunity costs. Using the indirect or direct sisterhood method often costs less than other methods. Nevertheless, it still costs something and policy makers must consider those costs. How much will it cost? Are there *any* alternative sources of data? Will the estimate provided be precise enough to meet the need? All population-based methods for estimating maternal mortality are time consuming and costly because they require very large sample sizes. The sisterhood method overcomes the problem of sample size and is relatively simple and cost-efficient. Nonetheless, it is important to bear in mind its limitations.

▸   It is not worthwhile to try and use the sisterhood method (direct or indirect) to estimate mortality in areas where there is high migration (including, for example, where women move to their husband's village when they marry and it is outside the sampled area), in war-torn areas or among refugees. In general, however, such problems are relevant at subnational rather than at national levels.

▸   It is not efficient to use the sisterhood method to estimate maternal mortality in areas where the total fertility rate is low (TFR <3).

▸   Because the estimates are not very precise, it is not worthwhile to repeat the survey often. No more often than once every 10 years is a good practice.

FINDING OUT MORE ABOUT MATERNAL MORTALITY

Monitoring progress

Probably the most important limitation of the sisterhood method is that it cannot provide a current estimate, and therefore cannot be used to monitor current progress towards the goal for the year 2000, nor to measure the impact of new interventions. To help national authorities and health planners in answering questions such as these, WHO and UNICEF are promoting a range of alternative approaches. Process indicators have been developed and guidelines on using are available.[9] Briefly, these process indicators describe the major pathway to reducing maternal mortality in terms of access to essential obstetric care, appropriate utilisation of such services and some aspects of quality of care. An important advantage of these measures is that they are relevant not only for monitoring progress but also permit policy-makers and planners to target interventions to reduce maternal mortality and

morbidity. A further advantage is that they are derived from routine data or as part of programme implementation thus limiting data collection costs.

Finding out why women are dying

While indicators such as these are useful for monitoring programmes, more detailed investigation is needed to diagnose the underlying causes of maternal mortality and identify ways of dealing with them. Health planners can gather invaluable information by conducting small scale analyses of maternal deaths. Ideally, investigators should analyse all maternal deaths, whether they take place in a health facility, at home or between the two. In practice, it may be possible to identify only the deaths occurring in health facilities. There is, nonetheless, much to be learned from an in-depth analysis of these deaths. WHO has developed a guideline on conducting a maternal death case review.[10] This starts out from deaths identified within hospitals or health centres, tracing the path of the woman back through the health care system and into the community. The aim is to help health care providers and community members understand the factors that underlie every maternal death and identify those that could have been avoided.

A recently developed application of the indirect sisterhood method is its use to identify maternal deaths that have occurred within the last year or two and to use these deaths as the starting point for a more detailed analysis of the causes and circumstances surrounding each death. This is a promising technique that makes optimum use of the simplicity of the indirect method to undertake more in-depth diagnostic studies of the phenomenon.[11]

Another innovative way of using the sisterhood method was recently carried out in Nicaragua.[12] Here, the sample was based on health service users. This is an important development that may be appropriate for use in many settings where a large proportion of women make use of services for prenatal or delivery care.

For countries with some form of vital registration system in place, but where maternal deaths are missed because of inadequate attribution of cause of death, WHO's American Regional Office and CDC Atlanta have developed a guideline on epidemiological surveillance of maternal mortality.[13]

CONCLUSIONS

None of the methodologies currently available for measuring maternal morbidity in resource-limited settings can provide a precise value because all are subject to wide margins of error. Sometimes, knowing the maternal mortality ratio accurately is not necessary because everyone is already aware that there is a problem and that something must be done about it. In such cases, national authorities may opt to use recently developed WHO/UNICEF estimates of maternal mortality as a rough guide to the dimensions of the problem in their countries.[14] These estimates can serve as a starting point for action, thus permitting countries to use vital scarce resources for assessing some of the underlying causes and identifying the most appropriate and feasible interventions possible in different settings.

The difficulties of accurately measuring maternal mortality should not lead to the abandonment of all efforts to identify maternal deaths. Energies should be directed towards finding out why the deaths happen rather than in precisely enumerating them in order to

calculate a maternal mortality ratio. Each maternal death matters and each has something to tell in terms of understanding why deaths are happening. The precise value of the maternal mortality ratio is less important than understanding WHY maternal deaths are happening as the first step towards preventing such neglected tragedies. Is it because they cannot reach appropriate services? Is it because the services do not exist or are they inaccessible for other reasons such as distance, cost, social or cultural barriers? Or are women dying because the care they receive in health services is inadequate or inappropriate or substandard? Answering some of these questions is more important than knowing the precise level of magnitude of maternal mortality.

Where national authorities feel there is an imperative need to have an estimate of the maternal mortality ratio and where resources are limited, sisterhood methods provide an appropriate and cost-effective tool. They should, however, be used with care particularly with regard to issues such as sample size, quality of the field work and interpretation and use of the results.

In the long term, increased efforts need to be directed towards improving the coverage and quality of systems of vital registration of births and deaths, along with attribution of medical cause of death.

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ANNEX 1
WHICH METHOD OF MEASURING MATERNAL MORTALITY?
DECISION-MAKING STEPS

1. **Are any national level data available on levels of maternal mortality?** Consider all possible sources, including WHO/UNICEF estimates, sub-national surveys, hospital statistics.

2. **If yes - evaluate these and decide whether they are adequate as a basis for action.** The important things that decision-makers and planners need to know are the medical causes and determinants of maternal deaths, the groups most at risk and the avoidable factors that need to be addressed if maternal mortality is to be reduced.

3. **If no - is a household survey planned for other purposes and could it be used as a vehicle to find out about maternal deaths?** Remember that large sample sizes are needed for reliable estimates of maternal mortality. If the sample size is not adequate for estimating maternal mortality using direct estimation techniques consider adding an indirect sisterhood module to the ongoing survey. In which case, check that current levels of fertility are above TFR 3 and that there have been no marked changes in fertility in the recent past nor major migratory flows.

4. **Is a Demographic and Health Survey planned for the near future?**

5. **If yes, consider including either an indirect or a direct sisterhood module.** But make sure that interviewers are adequately trained. A direct sisterhood study will require larger sample sizes than the indirect and is more complex to administer but can provide a more recent estimate and the methodology permits some data quality checks.

6. **Do currently available resources permit a reproductive-age mortality survey (RAMOS)?** Remember, this is time consuming and may not be able to provide an estimate of the maternal mortality ratio because it may not be able to assess the denominator (live births) even though it may collect data on the numerator (maternal deaths).

7. **If no surveys are currently planned, reconsider whether or not it is really worth the effort and resources to measure levels of maternal mortality.** Do the revised WHO/UNICEF estimates offer a possible starting point for action? Perhaps resources would be better spent on finding out more about the causes of maternal mortality?

8. **Could health service data provide proxy indicators of the magnitude of the problem?** Where such data are available, they need to be analysed in relation to estimates of health service utilisation. How representative a picture would they provide? What data exist on levels of service utilisation or coverage?

ANNEX 2
DEFINITIONS

Maternal death - *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.*[15]

In practice, it is often impossible to determine the exact cause of death of a pregnant or recently pregnant woman particularly when deaths occur outside health facilities. For this reason, WHO and others working in this field often use a broader definition, namely pregnancy-related death. This dispenses with the need to determine cause of death and classifies as pregnancy-related all deaths of women of reproductive age in which the woman was pregnant at the time of death or had recently been so. This is more akin to the definition of infant death which is defined solely in terms of the timing of the death. For all practical purposes, the difference between the two measures is minimal because only a very small proportion of deaths of pregnant or recently pregnant women are unrelated in some way to the pregnancy itself. In other words, the proportion of all deaths among these women that are incidental is very small in almost all settings.

Pregnancy-related death - *the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death.*

Maternal mortality ratio - *ratio of maternal (or pregnancy-related) deaths to total live births expressed per 100,000 live births.*

ANNEX 3
THE ORIGINAL SISTERHOOD METHOD'S FOUR QUESTIONS[3]

1. How many sisters (born to the same mother) have you ever had who were ever-married (including those who are now dead)?

2. How many of these ever-married sisters are alive now?

3. How many of these ever-married sisters are dead?

4. How many of these dead sisters died while they were pregnant, or during childbirth, or during the six weeks after the end of pregnancy?

ANNEX 4
THE "DIRECT" SISTERHOOD METHOD'S QUESTIONS[4]

1. How many children did your mother give birth to?

2. How many of these births did your mother have before you were born?

3. What was the name given to your oldest (next oldest) brother or sister?

4. Is (NAME) male or female?

5. Is (NAME) still alive?

6. How old in (NAME)?

7. In what year did (NAME) die? *OR*
   How many yeas ago did (NAME) die?

8. How old was (NAME) when she died?

For dead sisters only:

9. Was (NAME) pregnant when she died?

10. Did (NAME) die during childbirth?

11. Did (NAME) die within two months after the end of pregnancy or childbirth?