

WHO/RHT/98.29
Distr.: General



WHO/UNICEF/UNFPA Asia Region Consultation on Maternal Mortality Estimates

Bangkok, Thailand
8-11 June 1998



Division of Reproductive Health
World Health Organization



United Nations Children's Fund



United Nations Population Fund

ACKNOWLEDGEMENTS

The World Health Organization is grateful for the financial support provided by UNFPA UNICEF and USAID in the development of this document.

The Division of Reproductive Health also wishes to thank the governments of the following countries for their unspecified financial support, which has made the reproduction of this document possible:

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Cover design: Máire Ní Mhearáin and WHO Documents Layout

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1. Inauguration

On behalf of Dr Uton Muchtar Rafei, Regional Director for the WHO South-East Asia Region, Dr Samlee Plianbangchang, Director, Programme Management inaugurated the Consultation. In his opening address, Dr Samlee welcomed everyone to this important consultation on maternal mortality estimates, and expressed his appreciation to the Institute for Population and Social Research of Mahidol University for agreeing to host the meeting. He also expressed his thanks to the co-organizers of the meeting, UNICEF and UNFPA, for their efforts in preparing for and carrying out the consultation. He noted that this kind of interagency and inter-regional collaboration will set an important precedent for future work in this critical area.

Dr Samlee stated that the World Health Assembly in May this year had appointed a new Director-General of WHO, Dr Gro Harlem Brundtland. He quoted an extract from one of her statements to the Assembly upon her election. She said, "We need to get our statistics right and keep them right through research and constant update". Dr Samlee acknowledged his full support for her statement and reiterated that we need to get our statistics right, and that this in turn means we need to support countries as they seek to improve their capacities for data collection, analysis and interpretation.

He noted that this meeting was most important since strong public health action needs a firm foundation of good data for planning and management. He also emphasized that reducing maternal mortality is a common goal for all countries, and expressed his concern about having a sound technical basis for assessing the extent of the problem, for planning and monitoring programmes, and for evaluating their impact.

Dr Samlee reviewed some of the problems with current data collection methods. He noted that because of such problems and because of the lack of comparability between estimates of maternal mortality derived from these very different sources, WHO and UNICEF embarked on an ambitious effort to develop global estimates of maternal mortality. He stated that the results of this undertaking caused some controversy and sensitivities, and that the WHO Regional Office for South-East Asia had organized a meeting in November 1996 to discuss the issues and to address the concerns expressed by countries. The report of that meeting was widely disseminated and its conclusions generally endorsed.

He noted that similar conclusions had emerged during the technical consultation on Safe Motherhood held in Sri Lanka in October 1997. Technical experts and agency representatives agreed that while the development of estimates was an important initiative, it would be advisable to establish mechanisms for increased regional and country participation in the process. WHO therefore organized a series of workshops during 1998 in order to ensure regional and national involvement in the development of new estimates for 1995.

Dr Samlee emphasized the utmost importance of this undertaking and stressed that the task we are embarking upon is difficult and complex. He noted that there are no simple solutions and no easy answers, that we have to walk a difficult path between what we would like to measure and what we can do given the resources at our disposal. We have to balance conflicting needs of various people with varying purposes, remembering that the needs of programme implementers and policy makers may not necessarily coincide. Dr Samlee asked

that everyone keep in mind the utmost importance of national capability and capacity building. For this, he noted that agencies may have to critically review their support to Member States for improvement of national health information systems in which maternal mortality information is a component. In conclusion, Dr Samlee wished everyone a pleasant stay in Bangkok and every success in their deliberations at this important consultation.

After his inaugural address, Dr Samlee requested that the participants as well as the agency representatives and technical experts attending the meeting introduce themselves. National participants represented 19 countries from the three WHO Regions. In addition, representatives from five international agencies, four technical advisers and one observer attended the consultation. A list of participants is provided in Annex 1. After the introductions were completed, Dr Samlee announced the appointment of Dr (Mrs) S. Selvaraju, Deputy Director (Family Health), Division of Family Health Development, Ministry of Health, Malaysia as chairperson; Dr Siripon Kanshana, Director, Bureau of Health Promotion, Department of Health, Ministry of Public Health, Thailand as co-chairperson; and Dr Pem Namgyal, Chief, Health Information, Research and Epidemiology, Health Division, Ministry of Health and Education, Bhutan as rapporteur

2. Introduction

In 1996 WHO and UNICEF published revised maternal mortality estimates for the year 1990. These estimates were widely disseminated and used by international agencies and others. For example, they were reported in WHO's *World Health Report*, in UNICEF's *Progress of Nations* and *State of the World's Children*, in UNFPA's *State of the World's Population* and in the wall chart on *Basic Social Services for All 1997* produced by the United Nations Population Division. The estimates generated considerable comments from national governments, most of which focused on the differences between these figures and those officially reported by the governments themselves.

In October 1997, an international technical consultation on Safe Motherhood took place in Sri Lanka. The objective was to share lessons learned over the past ten years of the Safe Motherhood Initiative and to identify the way ahead for the coming decade. The issue of measuring maternal mortality and monitoring progress was the subject of both plenary and working group sessions. There was consensus among the participants that given the difficulties of measuring maternal mortality, increased efforts should now be directed to measuring process indicators such as those recently issued by UNICEF, WHO and UNFPA¹.

The meeting also provided an opportunity for feedback on the revised WHO/UNICEF 1990 estimates of maternal mortality. The feedback focused on a number of issues:

- < there was not enough participation in the development of the revised estimates by regional and country representatives;
- < there were concerns about some of the input data used for the model and the country classifications; and

¹ UNICEF/WHO/UNFPA (1997) *Guidelines for Monitoring the Availability and Use of Obstetric Services*

- < there were concerns about adjustment factors applied to sisterhood survey results.

2.1 Rationale, objectives and method of work

Following further discussions among countries, agencies and WHO Regional Office staff, it was agreed that a number of intercountry workshops should be organized during 1998 in order to ensure full regional and national participation in the development of new estimates for 1995. The first such consultation, co-organized by WHO, UNICEF and UNFPA, was hosted by WHO's Regional Office for the Americas (Pan American Health Organization) in Washington in April 1998. This meeting for the countries of the Asia regions was the second such consultation.

The aim of the consultation was to facilitate an exchange of experiences in relation to maternal mortality measurement and estimation and to increase understanding in relation to the methodological and interpretation issues involved. Specifically, the consultation objectives were to:

- < provide a forum for the exchange of views on previous estimates of levels of maternal mortality;
- < increase the understanding of participants in relation to the difficulties involved in measuring maternal mortality and the problems associated with using the maternal mortality ratio as an indicator of progress;
- < add to the knowledge of participants regarding different measurement approaches and their limitations;
- < identify the particular issues of concern in individual country settings and the most appropriate ways of addressing them;
- < examine and evaluate approaches for developing 1995 estimates of maternal mortality based on country inputs and model-based approaches;
- < reach consensus on ways of presenting the estimates to a variety of diverse constituencies; and
- < consider alternative approaches to monitoring progress using process indicators.

Ms Carla AbouZahr, Scientist, Division of Reproductive Health, WHO Geneva, provided some background information and described the method of work for the consultation (Agenda provided in Annex 2). She noted the significance of the maternal mortality ratio as an indicator of socioeconomic development and reminded participants that substantial reduction in levels of maternal mortality is a goal of major global, international and national conferences such as Health for All (HFA), the 1990 World Summit for Children (WSC), the 1994 International Conference on Population and Development (ICPD), and the 1995 Fourth World Conference on Women (FWCW). She noted that the goal of maternal mortality reduction had generally been phrased in terms of achieving significant reductions from 1990 baseline levels.

However, in the absence of vital registration systems with complete coverage of events coupled with good attribution of cause of death through medical certification of deaths, maternal mortality was extremely difficult to measure accurately. Even where such systems were in place, active follow up and analysis of deaths of women of reproductive age were needed in order to comprehensively ascertain maternal deaths. Few developing countries currently had such capabilities and, as a general rule, settings where maternal mortality was highest were precisely those where the ability to measure it was most limited.

It was against this background that WHO and UNICEF had developed 1990 estimates of maternal mortality. The WHO/UNICEF revised 1990 estimates, which were originally issued in 1996, had generated considerable discussion around a number of key issues, namely, the ways in which countries had been classified, the use of household survey data and its adjustment, and the use and manner of presentation of the estimates. This consultation would provide an opportunity to address these concerns with a view to the development of new estimates for 1995. Ms AbouZahr welcomed the increased involvement of UNFPA in this process.

Dr Tessa Wardlaw, Division of Policy and Planning, UNICEF, New York, briefly described the history of UNICEF's involvement in estimating levels and trends in maternal mortality which had accelerated following inclusion of maternal mortality reduction among the 1990 World Summit for Children goals. She pointed out the importance of setting a baseline since the goal is phrased relative to a 1990 level. In response to country requests, UNICEF field offices were asking for support for surveys to generate maternal mortality data. Yet, given the expense involved in conducting household surveys to measure maternal mortality, the question was increasingly posed as to whether or not this was an appropriate use of limited resources. She observed that the maternal mortality ratio (maternal deaths in a given period per 100,000 live births over the same period) is not a practical indicator to monitor progress in the short term.

In order to properly classify a maternal death it was necessary to know not only the age at which the woman died (as is required for infant and under-five mortality), but also the cause of death, the pregnancy status at the time of death, and the timing of death (within 42 days of the termination of pregnancy). All three elements were difficult to measure and subject to high levels of misclassification and underreporting. Household surveys were commonly used to measure maternal mortality but required very large sample sizes and produced estimates with wide confidence intervals. The recently developed indirect method - the sisterhood approach - required smaller sample sizes but generated estimates that were retrospective and that also had wide margins of error.

Dr Wardlaw concluded that measuring maternal mortality itself was of limited use in monitoring progress in the short term. She also pointed out that the effort involved in trying to measure the level generally provided no guidance on the interventions needed to reduce it in a given setting. An alternative to measuring the ratio directly, or the impact of programmes, was to monitor the processes known to reduce maternal mortality, in other words, to focus on process measures for monitoring purposes. Process indicators had a number of advantages over impact indicators, for example, they:

- < provided information on what actions are needed to improve the situation,
- < were less expensive to measure, and

< reflected changes immediately and thus permitted feedback to programme activities in a short period.

For these reasons, UNICEF, in collaboration with WHO and joined by UNFPA, developed a series of process indicators and recently issued a set of guidelines on the data collection, analysis and interpretation of the indicators². However, process indicators did not solve the problem of generating a realistic idea of the magnitude of the problem at country level. She illustrated the weakness of the data available using an extract from the WHO maternal mortality database showing inconsistent data, year-on-year fluctuations and total lack of national data in some instances³. UNICEF and WHO therefore jointly decided that there was a need to conduct a systematic review of the data and to attempt to generate estimates for some 90 countries with no or very weak data.

Since the WHO/UNICEF 1990 estimates were first published in the 1996 edition of *Progress of Nations*, UNICEF and WHO had kept a systematic record of country concerns with the idea of taking these into account in a subsequent revision. This consultation would provide an opportunity to share these concerns more widely and encourage more systematic discussion of the concerns and the constraints involved in estimating maternal mortality both globally and nationally.

Mr Richard Leete, Senior Technical Officer, Technical and Policy Division, UNFPA, New York, noted that despite progress in many countries, maternal mortality remains unacceptably high in much of the developing world, especially so in the poorest countries. UNFPA placed great emphasis on improving maternal health as a key component of reproductive health in its country programmes. The Fund supported a number of complementary measures, including expanded access to quality family planning services and information, prevention of abortion and management of complications arising from unsafe abortions, management of complications of pregnancy and delivery, training, research, IEC and advocacy. For many countries, fully reliable estimates of maternal mortality will only become available in the long run. UNFPA was happy to join WHO and UNICEF in seeking to improve the measurement of maternal mortality, especially through country capacity building, although its priority remains on programmes to reduce its high levels.

2.2 Country statements

Participants from each country were asked to provide an opening statement which addressed the two most important obstacles to recording and reporting maternal deaths in their countries and what outcomes they expected from the Consultation. Their opening statements and some of the other issues that arose during subsequent discussions are summarized below.

2.2.1 Obstacles to recording and reporting maternal deaths

The statements of national participants showed that there was a wide variation among countries relative to the existence and completeness of vital registration and health

² UNICEF/WHO/UNFPA (1997) *Guidelines for Monitoring the Availability and Use of Obstetric Services*

³ WHO (1991) *Maternal mortality ratios and rates: A tabulation of available information* (WHO/MCH/MSM/91.6)

information systems. Several countries reported that they had no vital registration system, and for many countries resource limitations made household surveys to measure maternal mortality prohibitive. In some settings, maternal mortality was reported to be still measured on the basis of institutional data which was biased and for which the direction of bias was difficult to assess. Several countries reported having undertaken sisterhood methods but it was noted that there were questions about how to interpret the results.

Inadequate coverage of vital registration was acknowledged to be a constraint in many countries. Even where systems existed, there were errors in cause of death reporting, particularly at community level and due to lack of medical certification. Where medical certification existed, inadequate training and orientation of doctors often limited the accuracy and completeness of the reporting. In general, there was noted to be poor understanding of the definitions related to maternal mortality and of the correct ways in which to classify the causes of death. Hence, for a number of countries, misclassification was common. In general it was also noted that deaths were better recorded than births but that classifying causes of death was extremely difficult.

Several countries reported considerable efforts in relation to data collection, particularly at the facility level, but pointed out that this imposed burdens on already overworked staff, especially midwives who had to complete many PHC forms. Moreover, there was absence of feedback and appropriate analysis and use of the data which further contributed to its incompleteness and inaccuracy. Very often, the person reporting the death of a reproductive-aged woman and the people responsible for collecting the information did not understand the importance of what they were doing. This also contributed to underreporting and misclassification. A number of countries reported that it was particularly difficult to appropriately identify indirect maternal deaths. Several countries reported that medical records often contained information that was not transferred to the death certificate, also contributing to misclassification. It was noted that the increasing role of the private sector posed additional challenges with regard to the proper identification and reporting of maternal deaths.

Several countries reported that they had multiple sources of information on maternal mortality using different methodologies and that each of these gave different results. For some countries the variations were quite wide, whereas for others there were much smaller differences between the various estimates. A number of countries noted that, since the derivation of the 1990 global estimates, interest and concern has been stimulated to take a closer look at their own national estimates of maternal mortality, and to identify ways of capturing maternal deaths that had previously been missed, such as linkages between different information sources (vital registration and medical records, and other triangular techniques).

2.2.2 Participants' expectations

In terms of their expectations from the Consultation, participants wanted an increased understanding of measurement issues, to learn about different approaches for measuring and interpreting maternal mortality data and the use of process indicators for monitoring trends and programme effectiveness, better understanding of indirect methods for measuring maternal mortality, ideas on how to improve their data, to better understand the various definitions and how to correctly classify causes of death, and information on alternative and

more cost-effective methods to estimate maternal mortality. They also wanted to know how to improve their health information and vital registration systems. Participants were especially eager to hear about the experiences of other countries and to share their own experiences with others.

Participants also wanted to better understand the process of developing the 1990 global estimates and expressed the need for countries to be involved in the development of new estimates so as to generate a sense of ownership in the outcome. They wanted to learn about quality of care indicators and how to interpret the results of different methodologies, such as sisterhood. Many participants expressed the need for technical advice about the interpretation of results.

They wanted to exchange experiences on rapid reporting and assessment, especially at community level, and to discuss other indicators for measuring poor maternal health, such as perinatal mortality and “near misses”. Participants requested information about appropriate surveillance systems in order to generate information about the circumstances leading to or causing maternal deaths, so that this could provide input into improving services.

A number of participants suggested that it was important not overemphasize the *numbers* but to arrive at a consensus in terms of moving forward on assessing and monitoring maternal health. Countries requested advice on the most appropriate approaches for monitoring progress in countries with small populations where the numbers of maternal deaths were likely to be very low. Participants also wanted to know how they could improve the understanding of policy makers in terms of interpretation of different data and the use of data to change policies.

2.2.3 Country presentations including specific national issues

Participants were provided with other opportunities to discuss their country situations relative to estimating maternal mortality as well as their concerns and the issues needing to be addressed by the health system to improve maternal health. Besides their opening statements as highlighted above, participants provided inputs on the first day of the meeting at a poster session, as well as after presentations throughout the consultation. In addition, the fourth day of the consultation was used exclusively to obtain country inputs and to discuss specific national issues and needs. The various aspects of country situations summarized below have been based on the inputs of participants at all these sessions.

Bangladesh is a large country where there are relatively good transport systems and physical access to services is relatively easy. Public health goals include increasing safe motherhood coverage, trained attendance at delivery, and access to emergency services. Although a health information system is in place for reporting maternal deaths, it is well accepted that there are major problems of underreporting and misclassification. In addition, some 20-30% of the population is transient and extremely difficult to catch in any type of enumeration. Many maternal deaths are not reported or difficult to identify because they are abortion or violence-related. Since the publication of the global 1990 estimates, considerable effort has been spent to reconcile the differences with existing national data. However, the cost of obtaining accurate maternal mortality data is considered to be prohibitive. Technical support is required in order to improve the existing data systems in the country.

The **Royal Government of Bhutan** carried out a nationwide survey in 1994 and estimated the maternal mortality ratio to be around 380 per 100,000 live births. This figure has been accepted by the government and is now the basis of the eighth five-year plan (1997/2002) projections. In the global 1990 estimates, Bhutan had a projected MMR of 1600 per 100,000 live births. The government made it clear that this is a very large difference from national estimates and decided to use only the country data. Some of the issues involved are:

- < that the population of Bhutan itself is so small that even if the whole country is surveyed, it would probably not give an accurate estimate of the MMR;
- < that the process for the introduction of comprehensive vital registration, especially with regard to death certification, and the strengthening of the existing health information system have already been initiated; and
- < that perhaps the real strategy for Bhutan's situation regarding maternal mortality is to have an appropriate surveillance system to know the real number of maternal deaths and investigate, on a limited scale, the circumstances leading to or surrounding the deaths in order to improve services and prevent such deaths wherever possible.

Cambodia is currently undergoing health sector reform and this has had major implications for the routine health information and vital registration systems. Previously, each province was required to report their data to the Central Bureau of Health where it was collated. With decentralization, this system is no longer functional. The health information system (HIS) in the country is not able to capture all deaths, especially since 80% of women deliver at home. The nationals are now reviewing the HIS and developing a community-based surveillance system. In addition, the definition of maternal death is not yet fully understood. Participants noted that technical support was required to assist the country in further developing its HIS.

China considers maternal mortality an important issue in the country. In order to improve data generation on maternal deaths, a coordination-monitoring group was established covering all 30 provinces, municipalities and autonomous regions. This group has undertaken monitoring since January 1989, with 247 monitoring centres established covering 100 million population, using cluster sampling with districts and counties as the basic units for urban and rural areas. Special forms for reporting maternal deaths and live births have been developed, and data collection in the sample areas is carried out through both the vital registration system and the MCH network. The initial study found considerable underreporting of maternal deaths and rural/urban differences in levels of mortality. The surveillance system to monitor maternal deaths and the circumstances leading to them appears to function relatively effectively in urban areas where there is a good MCH network, good communication, and skilled supervision. However, it is more difficult in rural areas and the training of supervisors is expensive. There is a need for a guide on the appropriate use of the ICD classification which could be used to train MCH workers.

Since 1987 **Indonesia** has undertaken national household surveys and since 1992 has integrated a national health survey with the national socioeconomic survey. Vital registration however is relatively weak, especially in terms of maternal mortality. Since 1991 they have tried to develop local area monitoring for MCH which includes minimum essential safe motherhood indicators. However, the figures for MMR from these various estimates are

considered debatable. Technical assistance is required for further developing local area monitoring for maternal health indicators.

The **Islamic Republic of Iran** maintains a system of vital registration called the vital events horoscope which functions through local health houses. Coverage in rural areas is approximately 85% and, given the present difficulties, it would be extremely difficult to extend this further. However, the government is aware that this system is likely to underreport maternal mortality and therefore decided to include questions on maternal deaths in the census. It was hoped that this would also provide information permitting the generation of estimates for urban and rural areas and for the various provinces, as well as for identifying the causes of maternal deaths and high-risk population groups. In the census, a question was asked about any deaths in the household over the previous 12 months. In the second stage follow up, reported deaths were investigated in detail in order to identify deaths of reproductive aged women (10-50 years). These deaths were investigated using verbal autopsy techniques and by a panel comprising personnel from the Ministry of Health and Medical Education, who reviewed the verbal autopsy reports and identified maternal deaths. A number of problems were encountered in tracing the reported deaths due to missing information or because of movement of households.

The **Republic of Korea's** vital registration system has virtually complete coverage of registration of birth and death events. However, the main reasons for the difficulties in estimating levels of maternal mortality are a low rate of medical certification of deaths (54%) and misclassification of cause of death. In recent years, maternal health services have improved dramatically, and complete information on birth and health services have become available through the National Health Insurance System, which began coverage of the whole population in 1989. Currently, 99.7% of deliveries take place at medical and health facilities and 99.6% of pregnant women receive antenatal care. Building upon this important source of information, the government recently undertook a national maternal mortality survey linking health insurance data with that of vital registration. The resulting maternal mortality ratio for 1995/1996 of 20 per 100,000 live births is now regarded as the best estimate for the country.

In **Laos** there is inadequate surveillance due to lack of technical facilities, poor communication and too many forms. In addition, the forms available are not standardized for reporting maternal deaths. The government is trying to improve surveillance by revising the existing forms and training staff. There is a need for technical support in terms of guidance on the methodologies to identify maternal deaths and to ascertain cause of death.

In **Malaysia** a relatively complete vital registration system has supported the calculation of the maternal mortality ratio since 1940. All deaths are required to be reported prior to burial. However, there are problems of ascertaining all maternal deaths since deaths are generally not medically certified. The health information system is generally good and this promoted the development of confidential enquiries since 1990. Reports of death are provided regularly but not always in a timely manner, and efforts are now underway to improve the timeliness of maternal death reporting. Malaysia is also currently using a range of process indicators for programme monitoring. A major issue is the extent to which it is possible to increase the collaboration of the private sector in reporting maternal deaths. The country is currently experimenting with rapid reporting systems for other adverse maternal outcomes such as perinatal mortality and "near misses". However, the training and resource implications of such approaches are considerable.

Almost 95% of the deliveries in *Maldives* take place at home. Although the country is small, the population is scattered over hundreds of islands that make communication and referral difficult. Although atoll level data is sent to the centre on a monthly basis, there are still problems such as duplicate reporting and certifying the correct cause of death. There is a need to strengthen this aspect through more training and a need for technical support to strengthen surveillance. Maldives has also undertaken atoll team problem solving which is covering almost the entire country and which has helped improve health services, especially for MCH. They use a maternal protocol to evaluate the situation but forms are not always completed for each maternal death.

A vital registration system is in place in *Mongolia* and coverage is almost complete. However, the quality of reporting requires constant vigilance, and current resource constraints and health sector reforms make this particularly difficult. Reporting is especially difficult during the winter and among remote populations.

The vital registration system in *Myanmar* is fairly good although it needs to be improved due to various problems in the system including underreporting. There is also a need to improve the health facilities for the care of pregnant women. At present, all data are sent to district hospitals, which is difficult for the hospitals in border areas. Data from the Ministry of Health and population department are sent to the Central Statistical Office (CSO) to publish. Technical support is needed for more reliable estimates. It was noted that it would be useful to send one person from the CSO to meetings such as this in addition to participants from health departments.

The vital registration system in *Nepal* is far from complete, and hospital and other health facility records are inadequate, giving very low rates of facility deliveries in the country. The infrastructure is generally poor and there are insufficient resources to improve the health information system. Government demands for a precise estimate of MMR are considerable, although it is increasingly acknowledged that it is more important to develop and implement programmes and gather the necessary programme monitoring data. Small-scale studies have indicated the need for decentralization of care to the periphery. Demographic and health surveys were undertaken in 1991 and again in 1996 using direct sisterhood methods, but appropriate interpretation of the results is difficult.

Pakistan has data from both national estimates as well as estimates from public and other hospitals. The Pakistan Demographic Survey of 1988 estimated an MMR of 270 per 100,000 live births, but a recent 1997 UNICEF estimate put the MMR at 400 per 100,000 live births. Pakistan is making tremendous efforts to reduce the MMR and is confident that it can do so through intensified efforts for better nutrition, reduced parity and better awareness. Pakistan also suggested that sentinel surveillance in public hospitals might be a solution to monitor maternal deaths rather than conducting expensive surveys.

Papua New Guinea is a country with 10,000 islands and 900 languages. Only 53% of women deliver in health facilities, but there is no facility for referral. Currently there is no vital registration system and only voluntary reporting of vital events. It has been suggested that extension of ANC services might in itself provide some of the vital information required to monitor maternal deaths. Analyzing each maternal death is considered important to learn about what maternal health interventions are needed. There is a need to get emergency obstetric care within reach of the women. Technical assistance is especially needed for improving the communication facilities.

The importance of maternal mortality measures is well recognized in the *Philippines*, especially information about the proportion due to specific causes, for example abortion. The most recent DHS provided an MMR estimate of approximately 209. However, different figures for MMR from the various sources of data cause confusion in the country.

A relatively complete vital registration system is in place in *Sri Lanka* and information on the cause of death is required before burial. Apart from this source, information about maternal deaths is gathered from health facilities which routinely report maternal deaths. Delivery coverage is high, at over 90%. Four different sources of information exist, from passive reporting of deaths through the vital registration system to more active case finding by linking all vital registers and health facility information. However, technical support is needed to improve data quality and to ensure complete coverage.

Thailand has very good vital registration and health information systems. More than 95% of births occur in hospitals and more than 98% of deaths are certified. The newly estimated MMR (1995/96) is 44.1 per 100,000. In the past some amount of under-estimating of maternal mortality was due to indirect causes of death being overlooked. The 1990 estimate is not acceptable to Thailand as the difference is too large when compared to the national estimate. Active surveillance of maternal deaths is being done although there are problems with the quality of data. The maternal service coverage needs to be extended to all mothers, particularly in remote areas.

In *Viet Nam* there is a vital reporting system but the coverage is relatively poor, particularly in rural areas where most of the population live. In addition, there are relatively high levels of home delivery and a lack of understanding among health care workers about the correct classification of deaths of women of reproductive age. In practice it appears that only direct obstetric deaths occurring around the time of labour and delivery are adequately captured. There is concern that over-reliance on health facility information gives misleading results, and there is a need to improve community-based surveillance and reporting of maternal deaths. Training in the use of ICD-10 is also needed as well as the development of data quality assurance mechanisms.

3. Regional experiences in maternal mortality measurement

Dr Y.C. Chong, Regional Adviser in Health Information from the WHO Western Pacific Regional Office (WPRO), presented experiences in maternal mortality measurement in countries of the Region. He noted that the maternal mortality ratio as an impact indicator for health status was inappropriate in the majority of small island countries in the Region because of the small numbers involved. There were considerable variations in levels of the ratio in the Region largely accounted for by differences in demographic and social situations and in access to health care. Data collection problems were common, with underreporting and misclassification due to weak information support systems and lack of vital registration. He stressed the importance of working with developing countries to improve services and explore the use of process indicators for programme monitoring and for assessing progress.

Dr Suniti Acharya, Regional Adviser, Maternal and Child Health from the WHO South-East Asia Regional Office (SEARO), provided information about experiences in

countries of the Region. She noted that, over the last decade, all countries had reported significant decreases in infant mortality largely due to successful implementation of the expanded programme on immunization, as well as through control of diarrhoeal diseases and acute respiratory infections. But infant mortality remained high in some countries. While some countries in the Region had made significant progress in increasing access to maternal health care and trained attendance at delivery, others lagged behind. The maternal mortality ratio remained above 200 per 100,000 live births in seven countries.

Dr Acharya noted that it might be appropriate to review the country classifications used in the development of the WHO/UNICEF revised estimates for 1990. Some Member States had expressed their concerns about these estimates and had requested the Regional Director to convene a special meeting to discuss and resolve this issue. The Regional Consultation on Health Indicators, held in November 1996, was felt by all to have been an important meeting that provided a good forum for critical information exchange. It led to a deeper understanding of technical issues in the rational use of health indicators, including the measurement and definition of maternal mortality. It also provided an opportunity for in-depth discussion about and clarification on the revised WHO/UNICEF estimates, thus responding to country concerns.

Outputs of the consultation included a framework for the rational use of impact and process indicators and interpretation of health indicators, identification of gaps and weaknesses in national health information systems, and ways to strengthen them. It had been agreed during the meeting that countries should continue to use data considered best for planning purposes, whereas WHO should use data available from all sources in WHO publications such as the *Regional Health Report*.

4. Early approaches to global estimation of maternal mortality

Ms Carla AbouZahr described WHO's first attempts to estimate global levels of maternal mortality prior to the establishment of the Safe Motherhood Initiative in 1977. WHO had identified the need for global and regional estimates of the dimensions of the problem as a basic prerequisite if the international health and development community were to be stimulated to action and if national authorities were to be sensitized to the implications of the problem.

Given the paucity of data available in developing countries, it was acknowledged that modelling techniques would be needed to produce global estimates of the magnitude of the problem. From the start it had been recognized that even in developed country settings there were problems with misclassification and underreporting. In the first modelling strategies, therefore, countries were classified into three groups - developed countries with good vital registration and complete cause of death attribution; developing countries with Reproductive Age Mortality Studies (RAMOS) of maternal mortality; and developing countries with no national data on maternal mortality. Developed country data were adjusted by 50% and then used along with the few reliable developing country figures which had used RAMOS techniques to estimate a model of maternal mortality using a simple regression of female life expectancy at birth. The coefficients were then used to develop a prediction data set with female life expectancy as the major independent variable. This approach was used twice, to

develop estimates roughly applicable to the period 1983 and again in 1988. In view of the lack of sophistication of the model, individual country estimates were never disseminated (though they formed the basis for the calculation of regional and global estimates). The second estimation for the period around 1988 produced results rather similar to the first round as shown in the tables appended (Annex 3).

As interest in maternal mortality grew and innovative methodologies for calculating it were applied in developing countries (notably the sisterhood method), the WHO database became ever more complex. It was increasingly difficult to determine which of the several estimates of maternal mortality in a particular country was the most appropriate. In addition, WHO's regular exercises to evaluate progress towards Health for All indicated that even within countries a number of different figures were in regular use and that it was difficult if not impossible to form a judgement as to which figure was most appropriate or most comparable with data from other countries. Furthermore, by 1994, it was clear that unless there were some baseline figures for 1990, it would be impossible to ascertain the extent to which the goals of international conferences were met in the year 2000. The problems were compounded by the fact that different funding and technical support agencies tended to use different data sets, thus additionally complicating matters within and between countries. As interest in the problem of maternal mortality increased, there were frequent requests from countries for technical and financial support for carrying out studies of maternal mortality levels. Yet given the costs involved, WHO and UNICEF advised that this was not the most appropriate use of scarce resources and that efforts should be directed, rather, into the development and implementation of programmes to reduce maternal mortality and into the use of process indicators for monitoring progress.

It was in this context that WHO and UNICEF agreed to jointly support the development of a set of estimates for all countries for the baseline year 1990. It was hoped that the availability of such estimates - even if they were model-based and thus inevitably subject to wide margins of error - would help alleviate the pressures to carry out large scale mortality studies. The agencies agreed that four underlying principles should guide this work:

- < openness and transparency in terms of methodology,
- < use of existing national data as far as possible,
- < application of a systematic approach in all countries (developing and developed), and
- < use of the same set of data by all multilateral agencies of the United Nations system.

A review group consisting of the agencies most intimately concerned with maternal mortality in addition to WHO and UNICEF, namely UNFPA, UNDP, and the World Bank, and technical experts from the Population Council, MotherCare, Family Health International, the London School of Hygiene and Tropical Medicine, and the Dugald Baird Centre for Research on Women's Health, oversaw the process. Professor Kenneth Hill of Johns Hopkins University was asked to provide technical support to the process.

The initial strategy used by Professor Hill was essentially that already developed by WHO, namely modelling the maternal mortality ratio directly on the basis of female life expectancy. However the review group considered that the individual country data so derived were neither internally consistent nor coherent. In particular, the estimates for Latin America were considerably higher than was felt appropriate, whereas estimates for Asia and Africa

were lower than expected. Furthermore, modelling maternal mortality on the basis of female life expectancy was considered inappropriate given that UN estimates of female life expectancy in developing countries are themselves modelled on the basis of infant and child survival data. In addition, as the work progressed, there was evidence that some of the more recently developed approaches for measuring maternal mortality, such as the sisterhood method, appeared to underestimate adult female mortality and, therefore, maternal mortality as well. Because of these problems the group agreed to an alternative strategy, namely modelling the proportion of deaths among women of reproductive age (15-49 years) due to maternal causes. This approach had a number of distinct advantages, of which the most significant was that it permitted the use of a wider range of national data including data from developing countries with complete registration of deaths but incomplete attribution of cause of death and from countries that had used sisterhood approaches. The proportion maternal of deaths of women of reproductive age was available from sisterhood studies and it was assumed that even if the methodology underestimates total adult mortality there was no reason to suppose that this bias was greater for maternal deaths than for other causes of adult death.

5. 1990 estimates of maternal mortality

The background to and objectives of the 1990 global maternal mortality estimates were reviewed by Professor Kenneth Hill from Johns Hopkins University. He noted that the exercise was intended to produce national estimates of maternal mortality while making optimal use of national data, whether from vital registration, censuses, surveys or other sources. An initial strategy to model the maternal mortality ratio was abandoned in favour of modelling the proportion maternal of deaths of women of reproductive age. The advantages of this strategy were better use of good registration data, and use of the more reliable characteristics of sisterhood data (proportion of deaths pregnancy-related versus level of mortality).

The proportion maternal was modelled using multiple regression with independent variables, both almost universally available and having an intuitive link to maternal mortality. The model was fitted to observations from both developed and developing countries. The independent variables used were the general fertility rate, the proportion of deliveries with a medically trained attendant, and dummy variables to distinguish good from poor attribution of cause of death, developing from developed country, and historical from contemporary observations. The resulting model explained a high proportion of variance.

Country estimates were obtained by a variety of approaches, depending on data availability. For developed countries, observed maternal deaths were inflated by 50%. For developing countries with complete death registration, the PMDF was estimated from the model and applied to registered deaths; for countries with sisterhood data, the observed PMDF was applied to adult female deaths from UN population projections; for RAMOS countries, the recorded MMR was used; in the remaining 60 or so cases, the PMDF was estimated from the model and applied to UN population projection deaths.

Finally, a review of sisterhood estimates of adult mortality was presented. Though not entirely conclusive, the often large increases in adult mortality over time indicated by

sisterhood data raise questions about data accuracy, and detailed comparisons of sisterhood estimates with alternative estimates of adult female mortality for these countries also suggest that the sisterhood method underestimates overall mortality.

6. Definitions of maternal mortality

Dr M.J. Wysocki, Regional Adviser, Health Situation and Trend Assessment from the WHO South-East Asia Regional Office (SEARO), provided a brief presentation on definitions related to maternal mortality. He reviewed the ICD-10 definitions of maternal death, late maternal death, pregnancy-related death, direct obstetric death, and indirect obstetric death. He also discussed the denominators used in calculating maternal mortality rates and ratios. The ratio should use live births in the denominator and the rate should use women of reproductive age. He stressed that in view of the confusions that have arisen around the terminology, it was advisable to always state clearly what denominators were being used when presenting maternal mortality data. Dr Wysocki noted that underreporting of maternal deaths is common in countries of the South-East Asia Region, mostly because deaths due to indirect causes are missed.

7. Setting the context – why do we need data on maternal mortality?

Dr Wendy Graham, Director, Dugald Baird Centre for Research on Women's Health, Aberdeen University, UK, discussed the need for maternal mortality data, noting that the interest in maternal mortality must be located in the wider context of safe motherhood, with its concern for mortality and serious morbidity and disability and, in turn, in the wider context of reproductive health. From these broader perspectives, maternal mortality estimates were just one type of measure of one dimension of safe motherhood. The intended use of maternal mortality data had many implications for measurement. Data were needed for advocacy, for assessing the level of the problem and identifying the areas and groups with special needs, for assessing the relative importance of different determinants, and for studying progress both in terms of long term monitoring of trends and specific programme impact.

Alternative sources of data for generating estimates of maternal mortality were available. Most maternal mortality data were generated through special studies such as household surveys, surveillance and active case finding in vital registration systems. These sources could also provide useful information to address not only the levels of the problem but also other needs, such as to establish the relative importance of different determinants. Both quantitative and qualitative methods were appropriate, the latter, providing particularly useful in-depth analyses of maternal deaths.

Dr Graham concluded by drawing attention to four key conclusions:

- < The intended uses of information should drive data collection rather than the data driving its use.

- < No single source of data on maternal mortality could ever present a complete and reliable picture and it is therefore important to use multiple sources.
- < The degree of emphasis given to a particular method tended to depend on the intended uses of the data.
- < Information for action could be obtained from examining individual maternal deaths and not just the aggregated statistics.

8. National maternal mortality data – methodological considerations

Participants concurred that different techniques were available for measuring maternal mortality. Where vital registration systems existed and where there was a system for classifying cause of death, maternal mortality could be derived. However, it was important to note that in the absence of active identification of possible maternal deaths, for example, through record linkage of births and other pregnancy outcomes with deaths of women of reproductive age, there would invariably be major problems of misclassification and underreporting of maternal deaths. Direct data collection methods such as household surveys required very large sample sizes and had major cost implications. Indirect techniques such as the variants of the sisterhood method represented a more cost-effective alternative but require care in interpreting the results.

8.1 Vital registration systems

Dr Iqbal Alam of the UN Statistics Division (UNSD) summarized the work of the Division in relation to the improvement of vital registration systems. He emphasized that the integrity of national data was the responsibility of the countries themselves. The UN Statistics Division requested national authorities to provide information about the coverage and quality of their vital registration systems and discussed any inconsistencies with them. Nonetheless, data from some countries were weak and were therefore issued in *italics* in UNSD publications. He emphasized the need for the allocation of additional resources to improve national vital registration systems and pointed out the lack of commitment at high levels to this issue. In general, there was inadequate understanding about the importance and value of vital registration systems. UNSD would be issuing guidelines on the principles of and recommendations for these systems. Dr Alam pointed out that few of the countries represented at this meeting had complete vital registration systems, i.e. 90% coverage or more.

8.2 Cause of death attribution for maternal deaths

Drs Steve Lwanga and Wendy Graham presented a summary of the methodological issues involved in correct attribution of maternal deaths. The definition used in the *International Statistical Classification of Diseases and Related Health Problems (Tenth Revision)* was complex and potentially confusing. Maternal mortality involved several

classification levels with the main distinction being between definition of a maternal death according to medical causes versus according to time of death. For example, a death due to postpartum haemorrhage could be called a direct obstetric death, a maternal death, or a pregnancy-related death. There was potential for omission or misclassification at all these levels. What was and was not classified as a maternal death made a huge impact on all mortality indicators.

There were three main groups of problems in relation to reporting and recording of maternal deaths.

- i. **Omission** - maternal deaths could be missed completely, for example when death occurred early in pregnancy, where pregnancy had been concealed, or in cases of abortion or cases of medical mismanagement.
- ii. **Misclassification of cause of death** – misclassification could happen between maternal and non-maternal deaths; indirect and direct causes of death; immediate and underlying causes of death; primary and secondary diagnoses; obstetric and incidental causes; specific causes, such as haemorrhage and ruptured uterus.
- iii. **Ill-defined signs and symptoms** – the deaths were captured by the vital reporting system but in the absence of adequate information regarding cause of death they were grouped into an undifferentiated category.

Studies from around the world had found a large percentage of maternal deaths missed for these reasons. For example, the proportion of deaths missed ranged from a low of 22% in England and Wales, to around 70% in Egypt, Jamaica, and Puerto Rico (see Table attached in Annex 4).

Following the discussion, it was agreed that experience showed that there were major difficulties involved in assigning medical causes of maternal deaths and that these difficulties were experienced by many grades of health care staff. Specific efforts were needed to address the problem of indirect maternal deaths which were particularly prone to misclassification. Simple guidelines and training initiatives were needed to improve the situation. Research was needed to evaluate the feasibility and effectiveness of introducing a box on death certificates for recording pregnancy-related deaths.

8.3 Survey methods using direct estimation

Dr Wendy J. Graham and Dr Cynthia K. Stanton of Macro International, Inc., Maryland, USA, presented information about survey methods for generating the maternal mortality ratio (MMR). They noted the following features of the MMR which were important to understand.

- < The interplay between the MMR and fertility was complex and not immediately visible. For example, the MMR reflected only the obstetric risk, i.e. the risk of death in relation to a specific pregnancy. It did not reflect reductions in the number of maternal deaths due to declining fertility. In practice, a decline in general fertility greater than the decrease in the maternal mortality rate could result in an increased maternal mortality ratio despite the fact that few maternal deaths had occurred.
- < The maternal mortality ratio was not an age-standardized indicator and was therefore less comparable across countries than the total fertility rate or infant mortality rate (IMR).
- < Because the MMR was expressed per 100,000 events, it gave a misleading impression of accuracy.
- < Focusing on MMR alone ignored the fact that many women faced this risk several times in their lives.
- < MMR was a *cause-specific death rate* and was therefore more demanding to collect than other routinely used health indicators. The IMR, for example, was a *time of death* indicator and did not require knowledge about the cause of infant death. The newly developed ICD-10 definition of pregnancy-related mortality did not require knowledge about the cause of death and was, therefore, similar to the IMR in that it was a time of death indicator only.
- < Because of these characteristics of MMR, it was advisable to use other indicators in addition to the ratio such as the maternal mortality rate (maternal deaths per 100,000 women of reproductive age), the proportion maternal of deaths of women of reproductive age, and the life time risk of a maternal death.

Two main types of community-based studies of maternal mortality were discussed. Reproductive age mortality studies (RAMOS) were generally considered to provide the best data on maternal mortality in settings with complete and accurate vital registration systems. The defining characteristic was the relevance of multiple sources of information to identify all deaths of reproductive age women, for example hospital records, civil registration, community groups, religious leaders, traditional birth attendants and word of mouth. Once the death of a reproductive age women had been identified, a combination of approaches including verbal autopsy and review of health facility records as well as interviews with health care providers was used to ascertain if the cause was maternal. In general, a review panel consisting of obstetricians and other health care providers was used for the official confirmation of the cause of death. The major advantage of this approach was that it provided information on cause of death as well as on health care behaviours. The major disadvantages

were that the method was time consuming, relatively expensive, and difficult to undertake at the national level where there were large numbers of female deaths that required investigation. It was pointed out that while there were many studies described as RAMOS, in practice the quality of the field work often varied considerably.

Population-based surveys for direct estimation used random sampling techniques to identify all deaths within a household over the past 1-2 years and to identify any such deaths which might have been due to maternal causes. In general these asked about the deaths in a previous period of time (retrospective) but they could also be used in prospective studies to identify deaths occurring in the 1 or 2 years following the start of the survey. The major disadvantage of such approaches was that very large sample sizes were needed to identify an adequate number of deaths for a reliable estimate. A further disadvantage of prospective studies was that they raised ethical questions regarding the treatment of cases with complications.

8.4 Sisterhood methods and using results from sisterhood surveys

There were two main variations of the sisterhood method - the original method developed by Dr Wendy J. Graham and colleagues, and the demographic and health survey (DHS) adaptation which was often called the direct sisterhood method.

The original sisterhood method was an indirect estimation technique recommended for use with population surveys or censuses in areas where there was deficiency of data or where no data were available. The data requirements were minimal (follow-on questions posed to adults) and the statistical calculations involved were extremely simple. The disadvantage was that the estimate generated using this approach related to a time period of approximately 12 years prior to the survey. Sisterhood methods using this indirect technique had been conducted in approximately 30 countries to date, very often at subnational levels. The advantages of the method were that it was relatively easy to implement, the sample size requirement was relatively small (3000-6000 responses), and it did not require computer programming skills or highly skilled field staff. The major weaknesses of the method were that the estimate was not current, it was difficult to define the reference period, the precision of the estimate was often unclear, and there were few options for data quality checks.

The DHS adaptation of the sisterhood approach was usually called the direct sisterhood method. This consisted of an additional module added to women's individual questionnaires within a normal household study. The data requirements were more demanding than for the original sisterhood method, and included a listing of all siblings in chronological order. The major strengths of this approach were that it provided a more recent estimate than the original sisterhood method as well as a specific reference period. Because of the relatively large amount of information collected from each respondent, it allowed for a substantial number of data quality checks. If a demographic and health survey was planned in a specific country, it was relatively easy to add the sisterhood module to the basic questionnaire. The major weaknesses of this approach were that it required a larger sample size and that it generated estimates with large standard errors. The approach also added complexity to data processing. There was evidence of underreporting of adult deaths in the recall period but it remained unclear by how much the estimate should be adjusted for comparison.

8.5 Some innovative approaches

In view of the resource implications of conducting special surveys for estimating maternal mortality, a number of innovative strategies were discussed. For example, where there was relatively good access to and use of health facilities, this could serve as the basis for undertaking a sisterhood study rather than the usual random sampling. This approach was recently used in Nicaragua and the results compared favourably with those obtained using the more traditional community-based sample.

A further adaptation of the sisterhood method was its use as the basis for case identification of recent maternal deaths in a community by adding a simple additional question to confirm whether a reported death of a sister occurred within the previous 3-5 years. Where such a case was reported, a more experienced interviewer subsequently returned to the household to conduct an in-depth interview in order to ascertain the circumstances surrounding the death. This could be an efficient strategy since the first stage of the survey did not require such experienced interviewers and thus resources could be directed to ensuring adequate population coverage. Such two-stage approaches to gathering data could be added on to DHS type surveys.

A possible way to assess the ability of a survey tool (questionnaire) to detect recent maternal deaths was to use "seeding". This involved identifying maternal deaths at local health facilities in the recent past and seeding the relatives of the deceased woman into the community sample to ascertain completeness of the reporting of the event.

9. Development of 1995 estimates of maternal mortality

Mr R. Leete introduced this topic by emphasizing the importance of capacity building in countries and of trying to ensure ownership by countries of estimates produced and/or published by international organisations. The country presentations had demonstrated the considerable recent progress made by countries in their health reporting systems, as evidenced by the rich range of data on maternal mortality now available for many Asian countries. However, given the poor quality of data for some countries, and their non-availability for others, model-based estimates would still be required for such countries. This meant that inevitably different approaches would need to be adopted for different countries. He considered that it did not matter if international data are not all produced by the same methodology, especially given that fully reliable figures would only be available in the long-run whatever source or methodology is used.

Mr Leete noted that while process indicators were very important for the design and evaluation of programmes aimed at reducing maternal mortality, an indicator of the level of maternal mortality was also necessary to assess programme performance, as well as to monitor progress in the achievement of UN Conference goals. There were basically three main options that could be considered in compiling a new global set of MMR estimates, namely:

- < using latest country estimates where available and of acceptable quality (such as determined from civil registration, RAMOS, sisterhood or other survey methodologies);
- < using the same, or similar, methodology as for the 1990 estimates with, or without modifications to country classifications or to the model structure; or
- < using new model based, or analytical, approaches.

Apart from technical problems associated with the existing model, Mr. Leete considered that any methodology used to estimate maternal mortality ratios that relied on estimates of numbers of reproductive age deaths, such as that used for the 1990 estimates, was unlikely to yield consistent and robust figures. The model used for the 1990 set of estimates was an important and useful innovation. However, as had been the case with the development and evolution of model life tables, it was necessary to try to move forward and develop improved and more transparent modelling approaches, preferably in conjunction with country experts. In the end, whatever estimation method was used, it was crucial to evaluate carefully model-based estimates prior to publication so as to ensure that they were broadly consistent with other population and health-related data.

9.1 Basis for country classifications

The categorization of countries in the maternal mortality modelling process was reviewed by Professor Ken Hill. Two types of categorization were distinguished: that related to data availability for maternal mortality prediction purposes, and that related to modelling of the PMDF.

In the model, there were two dichotomous dummy variables, developed/developing country and a data quality dummy, that crudely represented country locations on a continuum. More flexibility would be introduced by considering continuous variables. Further modifications could include:

- < replacing the developed/developing country dummy by a development indicator such as adult female literacy;
- < replacing the data quality dummy with an objective indicator that would depend on the proportion of deaths medically certified or the proportion of deaths recorded as being of unknown cause.

In the application of the model, countries with RAMOS type data were treated differently. Consideration could be given to expanding this categorization to include all countries with satisfactory active case evaluation (ACE). Further improvement could be made by putting emphasis on the improvement of adult mortality estimates underlying the UN Population Division projections.

9.2 Adaptation of existing models and possible new modelling strategies

Mr. Hakkert noted that one of the puzzling features of the WHO/UNICEF model was the apparent contradiction between a very high R^2 (93.9 %) and large relative deviations between observed and fitted values in some important cases, such as the Category B and C countries. In fact, the high R^2 was somewhat misleading in that over 90 % of the variance was explained by the variation of the proportion maternal of deaths of females (PMDF) between the 5 basic country data groups. In the future, he suggested using a different goodness-of-fit criterion, such as the mean square relative deviation. He agreed with the proposal by Professor Hill to use a continuous variable to differentiate countries by level of development. In addition, he noted that the coefficients of the less developed countries (LDC) and pre-1970 data (PRE70) variables were very similar suggesting that, prior to 1970, the relationship between the dependent and independent model variables was similar to now in the developing countries. At the low levels of maternal mortality now found in the developed countries (and possibly in some low mortality developing countries), other factors came into play, that the model could only account for in the form of a dummy variable. This suggested the following changes:

- < elimination of the contemporary developed country data maintaining the historical data;
- < simplification of the model by eliminating the LDC and PRE70 dummies;
- < inclusion of a continuous development indicator;
- < in low mortality Category B countries, progressive interpolation between the model and the observed values, with the same 50 % correction applied to developed countries.

Referring to the issue of potential collinearity between the independent variables, Mr. Hakkert noted that in projection methods this concern is less justified than in explanatory models. If the relationships between the independent variables are constant over time, it is not a problem. Otherwise, there are robust methods to deal with it. Leaving out important variables to avoid multi-collinearity may ultimately be a less satisfactory solution. Mr. Hakkert agreed with the concern of other speakers, about the use of projected numbers of reproductive age deaths to convert the predicted PMDF into a maternal mortality ratio. The ratio for Nepal, for instance, was nearly halved if, instead of this projected number, the UN model life tables for South Asia were used. There was little factual basis for preferring one over the other. It would be desirable to look into the alternatives, such as estimating the MMR directly (as was attempted previously) or estimating the maternal mortality rate.

The current model provided useful base-line estimates, but there was a danger that its successive outcomes would be used for national programme evaluation, something for which it was not designed. National estimates might vary erratically due to the variation of the reestimated coefficients, even if the explanatory variables themselves remained constant. It would be desirable to have a fixed coefficient model by which countries could evaluate their progress in terms of a more comprehensive set of explanatory variables. The outcome should be strongly correlated with the maternal mortality ratio, but to highlight that it was

conceptually distinct it should receive a different name, for example, Maternal Mortality Risk Indicator. One way to go about its construction would be to start with a set of process indicators. For each of these, a regression equation could be constructed, similar to the present one for the trained attendant at delivery (TRATT). The final indicator would be the average of the outcomes of the equations that can be computed for any particular country.

In the ensuing discussion it was pointed out that it was important not to misrepresent the objectives and characteristics of the model which were:

- < to be able to predict maternal mortality for a high proportion of countries of the developing world; and
- < to make use in the modelling process of all national information deemed to be of acceptable accuracy, or, lacking any relevant data of acceptable accuracy, to use internally-consistent estimates obtained from agencies of the United Nations.

These objectives had immediate implications for the form chosen for the model. In accordance with the first objective, the only independent variables which could be considered for inclusion in the model were those available for the vast majority of countries. This limited the choice of variables drastically. The second objective was instrumental in determining the form of the model. Registration of deaths in developing countries suffered from two errors relevant to the measurement of maternal mortality. First, coverage of births and deaths might be incomplete. In such circumstances the registration data were deemed to be unusable because of uncertain coverage. Second, cause of death might be poorly reported (say because a high proportion of deaths were not attended by a physician or other competent professional) even if all deaths were registered. In such circumstances, where the number of deaths of women of reproductive age was known accurately, but direct measures of maternal mortality were possibly inaccurate (almost certainly under-reported) because of poor cause of death attribution, it was considered important to use the accurate information (female deaths of reproductive age) relevant to maternal deaths, and use a model to estimate the proportion of such deaths that were truly maternal. This strategy of working with the proportion maternal also fitted conveniently with evaluations of adult mortality estimates derived from data on survival of sisters. In most countries where the Demographic and Health Surveys project had collected data on survival of sisters, alternative data to use in consistency checks of the level of mortality had been weak or non-existent. Thus it had not been possible to evaluate systematically the data. However, in a few cases, usable data did exist: in Guatemala, where adult death registration was believed to be complete; in the Philippines, where registered deaths could be evaluated relative to change in population age structure between two censuses; and in Senegal, where retrospective deaths reported in the 1988 census could be evaluated vis-à-vis intercensal population change. For all three countries, for both males and females, survival of sibling data seemed to underestimate true adult mortality. In view of this finding, it was considered preferable to use the proportion maternal from sisterhood data both in the model estimation and in the prediction phase, applying the observed proportion maternal to estimates of adult female mortality from UN agency population estimates and projections.

10. Evaluating, using and presenting the 1995 estimates

Ms Carla AbouZahr provided an overview of the issues to take into consideration in presenting estimates developed using modelling strategies such as that used for the 1990 estimates. The following suggestions were presented:

- < For small countries, random errors made the calculation of the maternal mortality ratio very difficult to interpret. Therefore, absolute values should be used rather than the ratio for small countries.
- < In order to promote more careful analysis and interpretation of maternal mortality data, national and international agencies should regularly publish additional measures of maternal mortality alongside the ratio. For example, it would be appropriate to issue tabulations with the proportion maternal of deaths of women of reproductive age, the maternal mortality ratio, the rate (deaths per 100,000 women of reproductive age) and the lifetime risk of maternal deaths as well as absolute numbers of deaths.
- < Model-based estimates should be published with confidence intervals.
- < Data derived using household surveys should be published with confidence intervals when possible.
- < Data derived from sisterhood surveys should list the relevant time period for the data and should, if possible, give indications of standard errors.
- < For presentation purposes, countries should be grouped into homogenous groupings in order to facilitate comparisons across similar sets of data and to discourage comparisons between countries with estimates derived using different approaches.

A proposed format for presentation of maternal mortality data, showing reported national data alongside adjusted/estimated data separately for groups of countries, with the countries having been grouped according to specific country classification criteria, was presented and is provided in the Table in Annex 5. Consideration should also be given to presenting country estimates in broad groupings of maternal mortality.

11. Monitoring maternal mortality reduction

Dr Tessa Wardlaw described a series of process indicators jointly issued by UNICEF, WHO and UNFPA⁴. Briefly, these process indicators described the major pathway to reducing maternal mortality in terms of access to essential obstetric care, appropriate utilization of such services and some aspects of quality of care. An important advantage of these measures was their relevance not only for monitoring progress but also in terms of permitting policy-makers and planners to better target interventions to reduce maternal

⁴ UNICEF/WHO/UNFPA (1997) *Guidelines for monitoring the availability and use of obstetric services*

mortality and morbidity. A further advantage was that they were often derived from routine data or as part of programme implementation, thus limiting data collection costs.

The application of this series of process indicators in Bangladesh was presented. The Bangladesh programme of action for maternal mortality reduction focused on reducing the delays in access to quality maternal health care through community education and information, decentralization of essential obstetric care and upgrading essential obstetric care facilities to ensure quality of care for the management of obstetric complications.

A range of official sources of health information was available in Bangladesh, including the census, vital registration (with incomplete coverage), routine health information, and special surveys such as Demographic and Health Surveys. The Bangladesh Bureau of Statistics had produced an estimate of maternal mortality using the sample vital registration system (covering a population of 500,000) of 560 per 100,000 live births. This compared favourably with the WHO/UNICEF estimate of 850 per 100,000 (confidence interval 595-1139).

In view of the discrepancies in maternal mortality ratios derived from different data sources, it was decided to focus on the use of process indicators rather than trying to measure maternal mortality itself. The series of indicators promoted by UNICEF/WHO/UNFPA was assessed during a 1995 baseline survey of health facilities offering essential obstetric care. This found major shortcomings in both the numbers and distribution of essential obstetric care facilities and only 5% of anticipated complicated cases were effectively reaching the facilities available. Only 4.7% of expected caesarean deliveries were, in fact, being performed and case fatality rates ranged from 1.7% to 3.3%, compared with a projected minimal acceptable level of 1%. The process indicators had increased awareness of the problems of access to and quality of maternal health care and, because they were generated at the facility level, they provided immediate and programmatically operational feedback. They were now being used for tracking programme implementation and significant increases in performance had already been recorded.

Advantages of the process indicators were noted at facility, community and national levels. At facility level, there had been an increase in user confidence as a result of the ability of the health workers to interpret the data and initiate corrective action themselves. At community level, the indicators were being used as the basis for dialogue and generating community action. At the national level, the indicators provided the basis for regular tracking of progress and for programme adjustment.

12. Action-oriented local data collection – audit, case review, confidential enquiry, surveillance

Dr Wendy Graham opened this section of the meeting by noting that there were two complementary approaches for identifying weaknesses in the maternal health care system: focusing on adverse outcomes (maternal deaths) and focusing on the system itself (staff skills, equipment and supplies). The session on process indicators focused on the latter; this session addressed the former approach as would situation analysis strategies such as the WHO Safe Motherhood Needs Assessment.

The purpose of case reviews or audits of maternal deaths was *not* to provide estimates of levels and trends in maternal mortality, but rather to provide in-depth information on a small number of adverse events. There were some limitations to focusing only on maternal deaths; deaths were rare events, they were culturally sensitive and represented only the extreme outcome in a longer causal chain. Examining deaths alone could result in a tendency to focus on curative rather than preventive interventions. Other outcomes could also be considered for case reviews – acute complications, long-term sequelae, perinatal deaths or morbidities – and there were also some advantages in considering positive outcomes which could help boost staff morale.

There were several different approaches to gathering in-depth information on maternal deaths. These varied according to the frequency of data collection (routinely or on an *ad hoc* basis) and the source of the data (health facility or in the community). A maternal death review was the only approach that covered all these dimensions and its main strength was the inclusion of both facility and community perspectives on the circumstances surrounding each death (see Table below).

Table: *Alternative approaches to gathering in-depth information on maternal deaths*

Approach	Routine	Ad hoc	National	Local	Facility	Community
Verbal autopsy	X (demographic surveillance)	X (surveys)	X	X	-	X
Audit	X	-	-	X	X	-
Confidential enquiry	X	-	X	-	X	-
Maternal death review	X	X	X	X	X	X

The maternal death review was a qualitative, in-depth investigation of the causes of and circumstances surrounding a small number of maternal deaths occurring at selected health facilities. Its purpose was to create awareness of the avoidable factors involved in maternal deaths, to critically evaluate health service performance, to promote communication between stakeholders, and to stimulate capacity-building through an inclusive and participatory learning process. The steps involved were described in the WHO field-testing document *Maternal death review guidelines*. In conducting a case review it was important to pay particular attention to the composition and remit of the review team and to the skills and training of data collectors. When done with care, qualitative methods such as the case review provided an essential complement to more quantitative methods.

13. Working groups – Looking back, moving forward (enhancing national capacities for data generation, analysis and interpretation)

The working group session provided opportunities for groups of countries to exchange experiences and discuss options for strengthening their health information systems in relation to maternal health and improving data quality, analysis and use. A general observation was that the quality of data in most of the participating countries was not good. Even where vital registration systems were in operation, only a small proportion of adult deaths were medically certified. While some countries were experimenting with lay reporting systems and verbal autopsies, it was acknowledged that these gave only imperfect results and that they lacked both sensitivity and specificity. Several participants observed that even within countries, there were often different data reported using different sources and that it was often difficult to reconcile these differences.

Some countries reported attempts to assess data quality but that these were generally only partial and intermittent. In countries with vital registration systems, validity and reliability checks were occasionally undertaken and there was increasing use of triangulation of reporting systems with two or more sources of information on pregnancy outcomes being compared. Malaysia, Republic of Korea, Sri Lanka and Thailand are now using triangulation techniques to improve maternal death ascertainment. In general, however, active case evaluation through techniques such as triangulation, special studies, reproductive age mortality studies (RAMOS) or other special studies remained the exception rather than the rule.

Several participants observed the lack of regular and effective feedback mechanisms with the result that data generation was increasingly viewed as an extraneous and superfluous imposition rather than as an activity that is useful for improving client management and service delivery. Several participants noted that not only was assessment of data quality rarely undertaken, but that when it was done it was usually by evaluators external to the system. This was another factor impeding the development of a sense of ownership and shared responsibility for data quality.

A number of suggestions were made for improving data quality in relation to maternal health:

- < support increased attention to data quality by introducing regular evaluation processes;
- < incorporate maternal death as a data point in the death certificate;
- < make maternal death a notifiable event (legislation and training);
- < promote increased awareness among decision makers on the importance of good quality data; and
- < use multiple assessment procedures.

Participants agreed that in the long run the most effective and reliable source of data would be through the vital registration system. However, in the short term it was necessary to rely on other data sources. As a general rule, use of multiple information sources and different data collection methods and assessment techniques improved the knowledge base and permitted a more complete analysis of the situation.

14. Alternative data collection approaches

On the fourth day of the consultation, opportunity was provided for participants to further elaborate their national situations relative to maternal mortality. Considerable confusion had been expressed over the terminology used to describe alternative approaches to gathering data. Dr Wendy Graham provided information to help alleviate some of this confusion. She noted that, to overcome this, it is most important that a clear description of the approach be given, regardless of the word chosen to summarize it.

Dr Graham presented a framework for classifying approaches. Using just two axes, frequency of data collection and starting point (base) for collection, was obviously a simplification and did not enable an adequate classification of all approaches. It did however bring out the key differences. Each country may wish to use such a framework to provide a simple description of the approaches they use to detect maternal deaths.

The main difference along the “starting point” axis was between population-based approaches which, in theory, were less prone to selection biases and thus were more representative of the general population than sources which depended on the population coming forward with information (vital registration and health services). Community-based approaches could be regarded as active reporting, in that data were actively sought by going out into the community, while the alternative and more selective approaches could be regarded as passive. In some settings, countries had systems with more than one starting base for identifying maternal deaths, i.e. “multiple bases”.

Demographic surveillance was one approach characterized by continuous data collection in the community. In some countries, several sentinel surveillance sites were set up to reflect the total national picture, while in other countries just one large area was covered. These systems required long-term commitment and funds, since the major benefit is the potential for gathering longitudinal data and thus linking together information on women’s reproductive histories. Most of these systems were designed to gather data on multiple outcomes (e.g. maternal and child health outcomes, health service utilization, etc.) and for multiple uses. The very act of gathering data in the community in this intensive fashion often meant that a significant “Hawthorne” effect occurred, such that the process of data gathering acted as an intervention and thus the surveillance population became “atypical” of the rest of the population. Significant resources needed to be spent not only on the collection process but also on the efficient handling and effective use of the huge amount of data generated. One of the major issues with demographic surveillance systems was the use of non-health trained data collectors versus health personnel. Both options had advantages and disadvantages. In the former case, there were also important ethical issues to consider.

Dr Graham noted that some countries had a significant mobile population, often of displaced or marginalized groups. This particular situation required that attention be given to devising reporting systems which encompassed this population, since most of the usual approaches missed them.

15. Conclusions and next steps

A number of issues were raised during the presentations and subsequent discussions throughout the consultation. The most important of these are summarized below:

1. Wide variation in country situations existed relative to the availability of data from vital registration and health information systems.
2. While a rational global approach to estimate maternal mortality was important, at the same time, countries had their own data which should be given recognition by international agencies.
3. Misclassification was a common factor in the underreporting of maternal deaths. At country level there were problems in understanding and applying the definition of maternal mortality.
4. It was difficult to monitor short-term maternal mortality using the maternal mortality ratio. It was however appropriate to use the ratio for long-term monitoring. In addition, countries could consider monitoring other adverse outcomes such as perinatal deaths and “near misses”.
5. Most countries expressed some concern about the country classifications the model used for the 1990 estimates.
6. There was much to be learned from each maternal death. These could be identified in different ways, through facility-based audits and case reviews, surveillance or through innovative uses of survey methods. For example, the sisterhood method could be used to identify recent maternal deaths which could then be followed up in a second stage effort to gather detailed information about the circumstances surrounding each death. This information could then be used to assess and improve programme interventions.
7. Many sources of data on maternal deaths existed. If only public health facility-based data were used to estimate mortality, then the deaths that occurred in private facilities and in the community would be missed. There was no one perfect data collection method to gather data and therefore various sources had to be pooled to get the whole picture. Discrepancies in data derived from various sources using different methodologies should be carefully evaluated and used to improve reporting systems.
8. The discrepancies between the 1990 global estimates and country data should be used to stimulate efforts to improve national data collection, international reporting and global estimates.
9. Meetings such as this one provided a good opportunity for the exchange of information and experiences and should be used to promote understanding among all parties involved in assessing, monitoring and evaluating maternal health.
10. When using classification systems such as ICD-10, it was essential to have sufficient diagnostic capacity within countries. All involved in reporting deaths needed training and skills to ensure accurate recording and appropriate classification.

11. Suggestions have been made for a prompt for pregnancy status to be put on death certificates.
12. Although community-based survey methods for measuring maternal mortality were expensive, they could represent the only option for countries without other data sources. They should not, however, be attempted too often. Where prospective studies were undertaken, there were important ethical issues to be considered, such as provision of treatment when needed.
13. Countries were often requested to provide data on several indicators for monitoring international goals. Model-based estimates were necessary where no reliable data existed. Where reliable data were available, the country estimate should be used.
14. There should be a review of the progress made in maternal and child health care, both at the national and international level. Where further resources and efforts were needed, these should be supported through collaborative activities.
15. Process indicators should be used in preference to outcome indicators for monitoring progress and evaluating programmes. Ideally, such process indicators should be conceptually clearly linked to the outcome of interest, should be generated at the local level and should have clear implications for action in terms of case management or programme performance.
16. Qualitative approaches such as facility-based audits and case reviews could provide essential information about the underlying causes and avoidable factors associated with maternal deaths (and other adverse outcomes such as perinatal deaths and “near misses”). Such approaches could generate information that was useful for decision-making. This kind of information was more useful from a programming point of view than simply knowing the level of maternal mortality.
17. The source of information and the methodology used to generate it should be determined by the intended uses to which it would be put. There was little advantage in investing heavily in efforts to accurately determine the maternal mortality ratio because the ratio alone provided no information on the causes of death, the avoidable factors or the activities that need to be undertaken to address the problem.

The participants recognized:

- < the discrepancies between the WHO/UNICEF 1990 MMR estimates and country data;
- < the imprecision of some of the input data and limitations of the variables used in the model and the need to review the structure of the model including the specificity and the sensitivity of the model in predicting MMR;
- < that the original model and results were not reviewed by a wide audience, but that this series of regional workshops has provided for inputs from regions and countries;
- < the need to review and update the classification of countries;

- < the need to strengthen the development and use of process indicators for tracking progress of maternal health, especially at national and subnational levels;
- < the need for global estimates to assist international agencies respond to their mandates for global monitoring and evaluation; and
- < the need to assess and improve the quality of data at national and subnational levels.

Within the context of the issues discussed and the concepts clarified during this meeting, the participants formulated a number of suggestions to be considered by the countries themselves and by the agencies involved in developing global estimates of maternal mortality. These were as follows:

1. Country data should be utilized for those countries with good reporting systems.
2. Agencies should continue to support countries and mobilize additional resources in their efforts to develop and/or strengthen reporting and evaluation systems, including vital registration and routine health information systems.
3. Reclassification of countries and the development of criteria to assess country reporting systems should be undertaken through a consultative process with Member States.
4. Other approaches including process indicators and qualitative methods needed to be used to measure programme impact and not merely outcome indicators.
5. Lessons for the improvement of access to and quality of care could be drawn from information about individual maternal deaths.
6. WHO should refine the methodologies for estimating MMR and other existing indicators to be used where no adequate data are available from countries. In developing future global MMR estimates, country MMRs should be used where appropriate for international monitoring and other programme-related purposes. Model-based estimates should be used where no appropriate country MMRs were available, in consultation with countries where appropriate.
7. Multilateral and partner agencies should coordinate and minimize their demands on countries with regard to reporting on health indicators.

In conclusion, Ms Carla AbouZahr thanked the Institute for Population and Social Research of Mahidol University for agreeing to host this meeting and thanked Dr Aphichat Chamrathirong for the excellent arrangements. She also thanked the technical advisers for their inputs and the co-organizers of the meeting, UNICEF and UNFPA, reasserting the importance of this kind of interagency and inter-regional collaboration which set an important precedent for future work in this critical area. In particular, she thanked the country representatives for their excellent contributions and for their patience during what were often long and complicated discussions. In closing she drew attention to several issues that had arisen during the discussions:

- < Measuring maternal mortality was difficult and complex and there was less experience in this domain than for other health indicators such as infant or child mortality. Strengthened efforts would be required to improve national capacities to measure the indicator adequately.
- < It was important to distinguish the different purposes for which maternal mortality estimates were needed; different needs had different requirements in terms of methodologies, precision and periodicity.
- < Country ownership of information was of key importance but there were different levels of "ownership" ranging from governments to health care providers, planners, managers, and, not least, women themselves; all had an interest in the best quality data possible.
- < Good decision making and planning were dependent on high quality information; poor data would result in poorly designed programmes.
- < As a technical agency, WHO had a responsibility in relation to setting norms and standards including those related to monitoring and evaluation of health status and programmes.

16. Closure

Dr M.J. Wysocki read the concluding statement of Dr Samlee Plianbangchang. On Dr Samlee's behalf, he thanked the participants for their valuable contributions to the outcome of the meeting, the chairperson and co-chairperson for their able leadership in conducting the meeting to its successful conclusion, and the rapporteur for his painstaking efforts in recording the proceedings. He gratefully acknowledged Dr Apichart's support in hosting and facilitating the consultation as well as the support from the secretariat.

Dr Wysocki noted the important role of women in health development, and the importance of women's health in this process, and stated that everyone is very much concerned with the death of women during pregnancy and child birth. He noted that experience had told us that the deaths of women during this period would be reduced and women's health improved through overall development, with a particular contribution from education. He stated that deaths of women during pregnancy and child birth were still unacceptably high in the developing world and noted that reducing maternal mortality was of high priority. To plan for such mortality reduction, he pointed out that we needed to know the real situation, yet we could only estimate the maternal mortality rate or ratio.

Dr Wysocki noted that this Consultation provided an opportunity to come to a certain level of common understanding of the issues, and of the methods for estimating MMR, and that this common understanding should be a good basis to continue working together in this challenging area. He noted that more scientific research was needed, research which was multisectoral and multidisciplinary, involving also experts in sociology and anthropology, among other disciplines.

On behalf of Dr Samlee, Dr Wysocki stated that, unless and until the gap between the reality of the situation and the statistics available on maternal mortality could be significantly narrowed, plans to effectively reduce these deaths would be very difficult to formulate. Therefore, the task before all the participants was difficult but challenging. Given the common concern about women's health, he was sure collaboration would continue and even be enhanced in the future. Once again, he thanked the participants, secretariat and technical experts for their valuable time, and wished all a safe journey home.

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Annex 2

Agenda

Day 1 - Monday 8 June 1998

Time	Topic	Presenter
8.00-9.00	REGISTRATION	
9.00-9.45	Welcome and introduction of participants, nomination of Chair(s) and rapporteur(s)	Dr Samlee, DPM SEARO
9.45-10.15	Coffee/tea and group photograph	
10.15-10.45	Rationale, objectives and method of work	WHO/UNICEF/UNFPA
10.45-12.30	Country statements (5 minutes each)	
12.30-13.30	Lunch	
13.30-14.00	WPRO experiences in maternal mortality measurement	WPRO
14.00-14.30	SEARO experiences in maternal mortality measurement	SEARO
14.30-14.45	Early approaches to global estimation of maternal mortality	Carla AbouZahr
14.45-15.15	Coffee/tea	
15.15-16.00	1990 estimates of maternal mortality	Ken Hill Johns Hopkins University
16.00-16.30	Definitions of maternal mortality	WHO/SEARO
16.30-17.30	Poster session - Country presentations on maternal mortality data	Country representatives
Evening	Dinner reception to be arranged (tentative)	

Day 2 - 9 June 1998

Time	Topic	Presenter
9.00-9.30	Setting the context - why do we need data on maternal mortality?	Wendy Graham
9.30-10.30	National maternal mortality data - methodological considerations vital registration cause of death attribution for maternal deaths	UNSD WHO/HQ HST & Wendy Graham
10.30-11.00	Coffee/tea	
11.00-12.00	Survey methods using direct estimation Sisterhood methods and using results from sisterhood surveys	Wendy Graham Cindy Stanton DHS
12.00-13.30	Lunch	
13.30-14.00	Introduction to developing 1995 estimates	Richard Leete
14.00-15.00	Development of 1995 estimates of maternal mortality - basis for country classifications	Ken Hill
15.00-15.30	Coffee/tea	
15.30-16.15	Adaptation of existing models and possible new modelling strategies	UNFPA
16.15-17.00	Evaluation, use and presentation of the estimates	Carla AbouZahr

Day 3 - 10 June 1998

Time	Topic	Presenter
9.00-9.45	Monitoring maternal mortality reduction process indicators	Tessa Wardlaw
9.45-10.45	Action-oriented local data collection - audit, case review, confidential enquiry, surveillance	Wendy Graham
10.45-11.15	Coffee/tea	
11.15-12.30	Working group sessions - Looking back, moving forward - enhancing national capacities for data generation, analysis and interpretation	Wendy Graham
12.30-13.30	Lunch	
13.30-15.00	Feedback from group discussions	
15.00-15.30	Coffee/tea	
15.30-16.30	Conclusions and next steps	
16.30-17.00	Closure	WHO/UNICEF/UNFPA

Day 4 - Thursday 11 June 1998 8.30-12.30


Informal sessions for WHO secretariat and country representatives to discuss specific national issues.

Annex 3

Early estimates of maternal mortality


Regional results 1983 and 1988

	Maternal deaths 1983 000s	Maternal deaths 1988 000s	MMR 1983	MMR 1988
World	500	509	390	370
Africa	150	169	640	630
Asia (excl Japan)	308	310	420	380
LAC	34	25	270	200
Developed countries	6	4	30	26


 Initials/MTG7

Maternal mortality in Asia 1983 and 1988

	Maternal deaths 1983 000s	Maternal deaths 1988 000s	MMR 1983	MMR 1988
Eastern (excl Japan)	12	30	55	120
Southern	230	224	650	570
South- eastern	52	42	420	340
Western	14	12	340	280

 Initials/MTG8

	Maternal deaths OLD 000s	Maternal deaths NEW 000s	MMR OLD	MMR NEW
Eastern (excl Japan)	30	24	120	95
South- central	(224)	227	(570)	560
South- eastern	42	56	340	440
Western	12	16	280	320



Initials/MTG/12

Annex 4

Under-reporting of maternal deaths

Developing countries				
Reported # (Ratio)	Adjusted # (Ratio)	% More	Methods of case finding	Author/Country Year(s)
56 (48)	193 (108)	245	Multiple sources	Walker, Jamaica 81-83
(half)	21	100	Hospital record checks	Szmoisz, Argentina 1990
100	208	108	Death certificate review	Laurenti, Brazil 1988
17	41	141	Death certificate review	Illia, Argentina 1989
(half)	433 (114)	100	Study of maternal deaths	Bobadilla, Mexico 88-89
(66)	(116)	76	Hospital discharge records	Silava, Brazil 1988

Developed countries				
Reported # (Ratio)	Adjusted # (Ratio)	% More	Methods of case finding	Author/Country Year(s)
8 (?)	16 (12.4)	100	Linkage	Dye, USA (WV) 85-89
16	32	100	Linkage	Jocums, USA (TN) 75-76
22	30	37	Linkage	Rubin, USA (GA) 89-91
34 (6.5)	57 (10.9)	68	Linkage	MMWR, USA (WA) 77-84
17	36	112	Manual matching	Beneditti, ISA (WA) 77-81
373	510	37	Voluntary reporting	Rochat, USA 80-85
20 (9.7)	54 (21.9)	170	Survey of physicians	Bouvier-Colle, France 88-89
173	238	38	CEMD	CEMD, UK 1998-90
58 (7.4)	76 (10.0)	31	Multiple sources	Hogberg, Sweden 80-88

Annex 5

Proposed framework for presentation of maternal mortality data

Reported national data

Country	# of maternal deaths	Maternal deaths as % of deaths of women aged 15-49	Maternal mortality rate (maternal deaths per 100,000 women aged 15-49)	Maternal mortality ratio (maternal deaths per 100,000 live births)	Lifetime risk of maternal death

Estimated/adjusted data (including confidence intervals where possible)

Country	# of maternal deaths	Maternal deaths as % of deaths of women aged 15-49	Maternal mortality rate (maternal deaths per 100,000 women aged 15-49)	Maternal mortality ratio (maternal deaths per 100,000 live births)	Lifetime risk of maternal death

Estimated/adjusted data

Group A countries	# of maternal deaths	Maternal deaths as % of deaths of women aged 15-49	Maternal mortality rate (maternal deaths per 100,000 women aged 15-49)	Maternal mortality ratio (maternal deaths per 100,000 live births)	Lifetime risk of maternal death
Group B countries					
Group C countries					
Group D countries					
Group E countries					