Maternal Mortality in 2005

Estimates developed by
WHO, UNICEF, UNFPA and The World Bank

World Health Organization

unicef

UNFPA

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ACRONYMS AND ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
CEMD	Confidential Enquiry into Maternal Deaths
CIS	Commonwealth of Independent States
DHS	Demographic and Health Survey
EUR	dummy variable identifying observations from Europe
GDP	gross domestic product per capita based on purchasing power parity conversion
GFR	general fertility rate
ICD-10	International Statistical Classification of Diseases and Related Health Problems (10th Revision)
MDG	Millennium Development Goal
MENA	dummy variable identifying observations from North Africa and the Middle East
MMR	maternal mortality ratio
MMRate	maternal mortality rate
OECD	Organisation for Economic Co-operation and Development
PMDF	proportion maternal among deaths of females of reproductive age
RAMOS	reproductive-age mortality studies
SKA	proportion of births with skilled attendants
TFR	total fertility rate
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNPD	United Nations Population Division
VRcomplete	dummy variable equal to 1 if registration of deaths is 90% or more complete
WHO	World Health Organization
WP	dummy variable identifying observations from Western Pacific

EXECUTIVE SUMMARY

Improving maternal health and reducing maternal mortality have been key concerns of several international summits and conferences since the late 1980s, including the Millennium Summit in 2000. One of the eight Millennium Development Goals (MDGs) adopted at the Millennium Summit is improving maternal health (MDG5). Within the MDG monitoring framework, the international community committed itself to reducing the maternal mortality ratio (MMR) by three quarters between 1990 and 2015.

In this context, country estimates of maternal mortality over time are crucial to inform planning of sexual and reproductive health programmes and to guide advocacy efforts and research at the national level. These estimates are also needed at the international level, to inform decision-making concerning resource allocation by development partners and donors. However, assessing the extent of progress towards the MDG5 target has been challenging, due to the lack of reliable maternal mortality data – particularly in developing-country settings where maternal mortality is high.

The World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the United Nations Population Fund (UNFPA) have made three previous attempts to develop internationally comparable estimates of maternal mortality (for the years 1990, 1995, and 2000) by using an approach that encompasses different sources of data. However, the exact methodology used by each exercise differed. The development of country, regional, and global estimates for 2005 followed a similar approach, but used improved methodological techniques. Development of this round of estimates involved The World Bank in addition to WHO, UNICEF and UNFPA. A separate analysis of trends was also performed, to assess the likely change in MMR from 1990 to 2005 at the regional and global levels.

Of the estimated total of 536 000 maternal deaths worldwide in 2005, developing countries accounted for 99% (533 000) of these deaths. Slightly more than half of the maternal deaths (270 000) occurred in the sub-Saharan Africa region alone, followed by South Asia (188 000). Thus, sub-Saharan Africa and South Asia accounted for 86% of global maternal deaths.

By the broad MDG regions, MMR in 2005 was highest in developing regions (at 450 maternal deaths per 100 000 live births), in stark contrast to developed regions (at 9) and countries of the commonwealth of independent states (at 51). Among the developing regions, sub-Saharan Africa had the highest MMR (at 900) in 2005, followed by South Asia (490), Oceania (430), South-Eastern Asia (300), Western Asia (160), North Africa (160), Latin America and the Caribbean (130), and Eastern Asia (50).

A total of 14 countries had MMRs of at least 1000, of which 13 (excluding Afghanistan) were in the sub-Saharan African region. These countries are (listed in descending order): Sierra Leone (2100), Niger (1800), Afghanistan (1800), Chad (1500), Somalia (1400), Angola (1400), Rwanda (1300), Liberia (1200), Guinea Bissau (1100), Burundi (1100), the Democratic Republic of the Congo (1100), Nigeria (1100), Malawi (1100), and Cameroon (1000). By contrast, Ireland had an MMR of 1.

The adult lifetime risk of maternal death (the probability that a 15-year-old female will die eventually from a maternal cause) is highest in Africa (at 1 in 26), followed by Oceania (1 in 62) and Asia (1 in 120), while the developed regions had the smallest lifetime risk (1 in 7300). Of all 171 countries and territories for which estimates were made, Niger had the highest estimated lifetime risk of 1 in 7, in stark contrast to Ireland, which had the lowest lifetime risk of 1 in 48 000.

These estimates provide an up-to-date indication of the extent of the maternal mortality problem globally. They strongly indicate a need for both improved action for maternal mortality reduction and increased efforts for the generation of robust data to provide better estimates in the future.

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The separate analysis of trends shows that, at the global level, maternal mortality has decreased at an average of less than 1% annually between 1990 and 2005 – far below the 5.5% annual decline, which is necessary to achieve the fifth MDG, concerning maternal mortality reduction. To achieve that goal, MMRs will need to decrease at a much faster rate in the future – especially in sub-Saharan Africa, where the annual decline has so far been approximately 0.1%. Achieving this goal requires increased attention to improved health care for women, including high-quality emergency obstetric care.

1. INTRODUCTION

Since the late 1980s, improving maternal health and reducing maternal mortality have been key concerns of several international summits and conferences, including the Millennium Summit in 2000 (*1*). One of the eight Millennium Development Goals (MDG) adopted following the Millennium Summit involves improving maternal health (MDG5). Within the MDG monitoring framework, the international community committed itself to reducing the maternal mortality ratio (MMR), and set a target of a decline of three quarters between 1990 and 2015. Thus, the MMR is a key indicator for monitoring progress towards the achievement of MDG5.

Country estimates of maternal mortality are needed to inform planning of sexual and reproductive health programmes and to guide advocacy efforts and research at the national level, particularly within the context of the MDGs. These estimates are also needed at the international level, to inform decision-making concerning funding support for the achievement of MDG5. To be useful for the latter purpose, the country estimates must be internationally comparable.

It has, however, been a challenge to assess the extent of progress towards the MDG5 target, due to the lack of reliable maternal mortality data – particularly in developing-country settings where maternal mortality is high (*2*). WHO, UNICEF, and UNFPA have made three previous attempts to develop internationally comparable global estimates of maternal mortality (for the years 1990, 1995, and 2000) by using an approach that encompasses different sources of data. However, the exact methodology used by each exercise differed (*2–4*).

In 2006, a new maternal mortality working group – which included WHO, UNICEF, UNFPA, The World Bank, and the United Nations Population Division (UNPD), as well as several outside technical experts – was established to work on the new round of estimates of maternal mortality for 2005. Initially, the working group reviewed a set of suggested improvements to the methodologies of previous exercises that had been prepared as part of an external review commissioned by WHO.

Responding to these suggestions and to questions posed by countries following the 2000 round of estimates, the working group revised and improved the previous methods to estimate maternal mortality in 2005. A new set of estimates was then developed, and was based on the improved methodology and new data. The working group also estimated trends of maternal mortality, which had not been possible previously due to the changes in data availability and methodologies used in each previous exercise.

This document reports the global, regional, and country estimates of maternal mortality in 2005, and the findings of the separate assessments of trends of maternal mortality levels since 1990. It summarizes the challenges involved in measuring maternal mortality and the main approaches to measurement, and explains the development of the 2005 maternal mortality estimates and the interpretation of the results. The final section discusses the use and limitations of the estimates, with an emphasis on the importance of improved data quality for maternal mortality estimation. The appendices present data tables of country estimates according to data source and different regional groupings for WHO, UNICEF, UNFPA, The World Bank, and UNPD.

2. MEASURING MATERNAL MORTALITY

2.1 Concepts and definitions

In the *International Classification of Diseases and Related Health Problems, Tenth Revision*, 1992 (ICD-10), WHO defines maternal death as:

> *The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.*

This definition allows identification of maternal deaths, based on their causes as either direct or indirect. Direct obstetric deaths are those resulting from obstetric complications of the pregnant state (pregnancy, delivery, and postpartum), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above. Deaths due to, for example, haemorrhage, pre-eclampsia/eclampsia or those due to complications of anaesthesia or caesarean section are classified as direct obstetric deaths. Indirect obstetric deaths are those resulting from previous existing disease, or diseases that developed during pregnancy, and which were not due to direct obstetric causes but aggravated by physiological effects of pregnancy. For example, deaths due to aggravation of an existing cardiac or renal disease are indirect obstetric deaths.

Accurate identification of the causes of maternal deaths by differentiating the extent to which they are due to direct or indirect obstetric causes, or due to accidental or incidental events, is not always possible – particularly in settings where deliveries occur mostly at home, and/or where civil registration systems with correct attribution of causes of death are inadequate. In these instances, the standard ICD-10 definition of maternal death may not be applicable (*5*).

A concept of pregnancy-related death included in ICD-10 incorporates maternal deaths due to any cause. According to this concept, any death during pregnancy, childbirth, or the postpartum period is defined as a “pregnancy-related death” even if it is due to accidental or incidental causes (Box 1). This alternative definition allows measurement of deaths that are related to pregnancy, even though they do not strictly conform with the standard “maternal death” concept in settings where accurate information about causes of deaths based on medical certificates are unavailable. For instance, in maternal mortality surveys (such as the sisterhood methods), relatives of a reproductive-aged woman who has died are asked about her pregnancy status at the time of death without eliciting any further information on cause of death. These surveys usually measure pregnancy-related deaths rather than maternal deaths.

Complications of pregnancy or childbirth can also lead to death beyond the six weeks postpartum period. In addition, increasingly available modern life-sustaining procedures and technologies enable more women to survive adverse outcomes of pregnancy and delivery, and to delay death beyond 42 days postpartum. Despite being caused by pregnancy-related events, these deaths do not count as maternal deaths in routine civil registration systems. An alternative concept of late maternal death was included in ICD-10, in order to capture these delayed deaths that occur between six weeks and one year postpartum (Box 1). Some countries, particularly those with more developed vital registration systems, use this definition.

2.2 Measures of maternal mortality

The number of maternal deaths in a population is essentially the product of two factors: the risk of mortality associated with a single pregnancy or a single live birth, and the number of pregnancies or births that are experienced by women of reproductive age. The MMR is defined as the number of maternal deaths in a population divided by the number of live births; thus, it depicts the risk of maternal death relative to the number of live births.

By contrast, the maternal mortality rate (MMRate) is defined as the number of maternal deaths in a population divided by the number of women of reproductive age; thus, it reflects not only the risk of maternal death per pregnancy or per birth (live birth or stillbirth), but also the level of fertility in the population. In addition to the MMR and the MMRate, it is possible to calculate the adult lifetime risk of maternal mortality for women in the population (Box 2).

2.3 Approaches for measuring maternal mortality

Although widely-used standardized definitions of maternal mortality exist, it is difficult to measure accurately the levels of maternal mortality in a population – for several reasons. First, it is challenging to identify maternal deaths precisely – particularly in settings where routine recording of deaths is not complete within civil registration systems, and the death of a woman of reproductive age might not be recorded. Second, even if such a death were recorded, the woman's pregnancy status may not have been known and the death would therefore not have been reported as a maternal death even if the woman had been pregnant. Third, in most developing-country settings where medical certification of cause of death does not exist, accurate attribution of female deaths as maternal death is difficult.

Even in developed countries where routine registration of deaths is in place, maternal deaths may be underreported, and identification of the true numbers of maternal deaths may require additional special investigations into the causes of deaths (*6–10*). A specific example of such an investigation is the Confidential Enquiry into Maternal Deaths (CEMD), which was established in the United Kingdom in 1928 (*11*). The most recent report of CEMD (for 2000–2002) identified 44% more maternal deaths than was reported in the routine civil registration system (*11*). Other studies on the accuracy of the

Box 1. Alternative definitions of maternal death in ICD-10

Pregnancy-related death	The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death.
Late maternal death	The death of a woman from direct or indirect obstetric causes, more than 42 days but less than one year after termination of pregnancy.

Box 2. Statistical measures of maternal mortality

Maternal mortality ratio	Number of ***maternal deaths*** during a given time period per 100 000 ***live births*** during the same time-period.
Maternal mortality rate	Number of ***maternal deaths*** in a given period per 100 000 ***women of reproductive age*** during the same time-period.
Adult lifetime risk of maternal death	The probability of dying from a maternal cause during a woman's reproductive lifespan.

number of maternal deaths reported in civil registration systems have shown that the true number of maternal deaths could be up to almost 200% higher than routine reports (*9*).

In the absence of complete and accurate civil registration systems, MMR estimates are based upon a variety of methods – including household surveys, sisterhood methods, reproductive-age mortality studies (RAMOS), verbal autopsies, and censuses. Each of these methods has limitations in estimating the true levels of maternal mortality. Brief descriptions of the methods together with their limitations are shown in Box 3.

Box 3. Approaches to measuring maternal mortality

Civil registration systems	This approach involves routine registration of births and deaths. Ideally, maternal mortality statistics should be obtained through civil registration data. However, • even where coverage is complete and the causes of all deaths are identified based on standard medical certificates, in the absence of active case-finding, maternal deaths may be missed or misclassified; and therefore • confidential enquiries are used to identify the extent of misclassification and underreporting (*11*).
Household surveys	Where civil registration data are not available, household surveys provide an alternative. Limitations of household surveys include the following: • the survey identifies pregnancy-related deaths (not maternal deaths); • because maternal deaths are rare events in epidemiological terms, surveys to measure their levels require large sample sizes to provide statistically reliable estimates and therefore they are expensive; • even with large sample sizes, the obtained estimates are still subject to uncertainty (wide confidence intervals), making it difficult to monitor changes over time.
Sisterhood methods *(12,13)*	Sisterhood methods obtain information by interviewing a representative sample of respondents about the survival of all their adult sisters (to determine the number of ever-married sisters, how many are alive, how many are dead, and how many died during pregnancy, delivery, or within six weeks of pregnancy). This approach reduces the sample size, but: • it identifies pregnancy-related deaths, rather than maternal deaths; • the problem of wide confidence intervals remains, thereby precluding trend analysis; • the originally developed version (***indirect sisterhood*** method) is not appropriate for use in settings where fertility levels are low (i.e. total fertility rate <4) or where there has been substantial migration or other causes of social dislocation; • it provides a retrospective rather than a current maternal mortality estimate (over 10 years prior to the survey);

Box 3. continued

Continued ***Sisterhood methods** (12, 13)*	• the Demographic and Health Surveys (DHS) use a variant of the sisterhood approach (***direct sisterhood*** method) – this approach relies on fewer assumptions than the original method and collects more information than the indirect method (i.e. the age of all siblings, age at death and year of death of those dead, in addition to the information obtained by the indirect method), but requires larger sample sizes and the analysis is more complicated; • the estimates refer to a period approximately five years prior to the survey; and • as in the indirect method, the problem of wide confidence intervals remains (hence, the monitoring of trends is limited) and this approach also provides information concerning pregnancy-related deaths rather than maternal deaths.
***Reproductive-age mortality studies (RAMOS)** (12–14)*	This approach involves identifying and investigating the causes of all deaths of women of reproductive age in a defined area/population by using multiple sources of data (e.g. interviews of family members, vital registrations, health facility records, burial records, traditional birth attendants) and has the following characteristics. • Multiple and varied sources of information must be used to identify deaths of women of reproductive age; no single source identifies all the deaths. • Inadequate identification of all deaths of reproductive-aged women results in underestimation of maternal mortality levels. • Interviews with household members and health-care providers and reviews of facility records are used to classify the deaths as maternal or otherwise. • If properly conducted, this approach provides a fairly complete estimation of maternal mortality (in the absence of reliable routine registration systems) and could provide subnational MMRs. • This approach can be complicated, time-consuming, and expensive to undertake – particularly on a large scale. • The number of live births used in the computation may not be accurate, especially in settings where most women deliver at home.
***Verbal autopsy** (2,15,16)*	This approach is used to assign cause of death through interviews with family or community members, where medical certification of cause of death is not available. Records of births and deaths are collected periodically among small populations (typically in a district) under demographic surveillance systems maintained by research institutions in developing countries. The following limitations characterize this approach. • Misclassification of causes of reproductive-aged female deaths with this technique is not uncommon. • This approach may fail to identify correctly a group of maternal deaths, particularly those occurring early in pregnancy (e.g. ectopic, abortion-related) and indirect causes of maternal death (e.g. malaria). • The accuracy of the estimates depends on the extent of family members' knowledge of the events leading to the death, the skill of the interviewers, and the competence of physicians who do the diagnosis and coding. • Demographic surveillance systems are expensive to maintain, and the findings cannot be extrapolated to obtain national MMRs.

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Box 3. continued

Census (17)	A national census, with the addition of a limited number of questions, could produce estimates of maternal mortality; this approach eliminates sampling errors (because all women are covered) and hence allows trend analysis. • This approach allows identification of deaths in the household in a relatively short reference period (1–2 years), thereby providing recent maternal mortality estimates, but is conducted at 10-year intervals and therefore limits monitoring of maternal mortality. • The training of enumerators is crucial, since census activities collect information on a range of other topics which are unrelated to maternal deaths. • Results must be adjusted for such characteristics as completeness of death and birth statistics and population structures, in order to arrive at reliable estimates.

3. THE DEVELOPMENT OF 2005 ESTIMATES OF MATERNAL MORTALITY

3.1 Sources of country data used for the 2005 estimates

The most recent data on maternal mortality and other relevant variables were obtained through databases maintained by WHO, UNPD, UNICEF, and The World Bank (*18–21*). National estimates of the number of births in 2005 were obtained from the UNPD database (*21*). A total of 171 countries and territories were covered in this exercise; countries and territories with populations under 250 000 were excluded. Data available from countries varied in terms of the source and methods. Countries were classified into eight groups, based on the source and type of maternal mortality data (Table 1).

Table 1. Sources of maternal mortality data used in developing the 2005 estimates

	Source of maternal mortality data	Number of countries/ territories	% of countries/ territories in each category	% of global births covered
A	Civil registration characterized as complete, with good attribution of cause of death	59	35	13.1
B	Civil registration characterized as complete, with uncertain or poor attribution of cause of death	6	4	1.0
C	Direct sisterhood estimates	28	16	15.7
D	RAMOS	4	2	5.5
E	Disease surveillance or sample registration	2	1	32.4
F	Census	5	3	2.2
G	Special studies	6	4	5.4
H	No national data on maternal mortality	61	36	24.5
	Total	**171**	**100**	**99.8**

Group A. Countries with generally complete civil registration system (with at least 90% of deaths estimated to be registered) and good attribution of cause of death (less than 20% of deaths lack accurate cause-identification).

Group B. Countries with generally complete civil registration system (with at least 90% of deaths estimated to be registered) but uncertain attribution of cause of death (between 20% and 30% of deaths lack accurate cause-identification).

Group C. Countries that lack complete registration of deaths, but have estimates based on direct sisterhood methods.

Group D. Countries with estimates based on RAMOS.

Group E. Countries with estimates from sample registration and disease surveillance systems.

Group F. Countries with estimates from census.

Group G. Countries with estimates from special maternal mortality studies.

Group H. Countries with no appropriate maternal mortality data for the period 1995–2005.

Of the total of 171 countries/territories, Group A had the highest number of countries/territories (at 59) while Group E had the lowest (at 2). Group E consisted of only two countries (China and India), but accounted for 32% of global births (since both countries have populations of more than 1 billion).

3.2 Methods used to estimate MMR in 2005 according to data source

Given the variability of the sources of data, different methods were used for each of the eight groups in order to arrive at country estimates that are comparable and permit regional and global aggregation. Therefore, the estimation process described below resulted in the WHO/UNICEF/UNFPA/World Bank country estimates of maternal mortality in 2005 being different from nationally reported estimates. A detailed description of the methodology is reported in a forthcoming publication (*22*).

Group A – complete civil registration and good attribution of cause of death

The MMRs for countries in this group were computed by dividing the average number of maternal deaths for the three most recent years available (or six most recent for countries with population size below 500 000) (*19*) by the estimates of the number of births in 2005 developed by UNPD (*21*). Literature that assesses the completeness of maternal deaths in countries with complete civil registration systems has shown that the number of deaths related to pregnancy might increase up to almost 200% of the reported numbers with active surveillance (*6–10*). Therefore, the calculated estimates were used both as the lower country-specific uncertainty limit and as the point estimate. The upper limit of uncertainty was obtained by multiplying the calculated MMR by two, in order to account for such underreporting. The 2005 maternal mortality estimates for countries in this group are shown in Appendix 1.

Group B – complete civil registration but uncertain attribution of cause of death

For this group of countries, additional analysis of civil registration data indicated that the poor ascertainment of causes of deaths was mainly due to the widespread use of mistaken codes for causes from the ICD-10 codes (*5*). In order to estimate maternal mortality for these countries, reproductive-aged female deaths attributed to ill-defined causes were proportionately redistributed among known causes of female deaths. The adjusted estimates of the number of maternal deaths and UNPD estimates of the number of births in 2005 were used to compute the lower limits of uncertainty of MMR. To account for the additional uncertainty, the computed lower limit of uncertainty of MMR was multiplied by two, in order to obtain the upper limit. The midpoint of the two (lower and upper) uncertainty limits was taken as the point estimate for the 2005 MMR. The 2005 maternal mortality estimates for countries in this group are shown in Appendix 2.

Group C – direct sisterhood methods

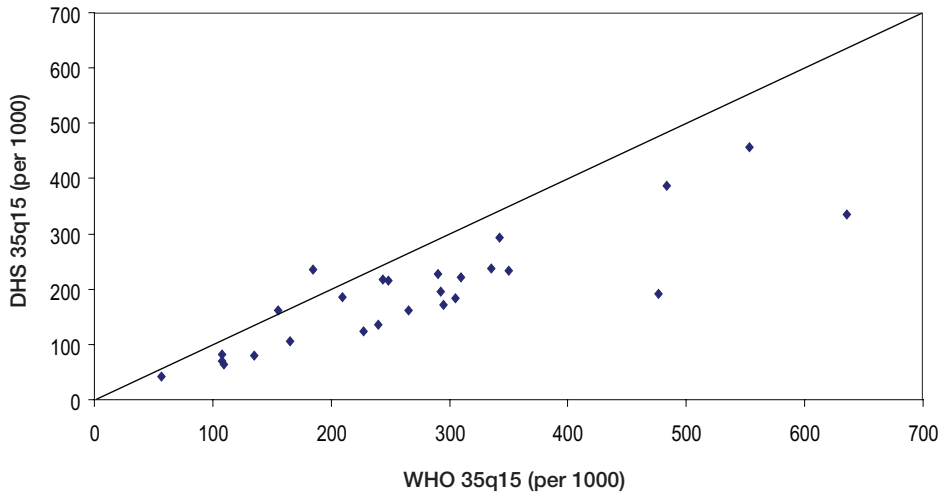
This group consists of countries for which direct sisterhood estimates (from DHS) are the best available sources of maternal mortality, since these countries lack complete registration of deaths. In computing the MMR for this group, the direct sisterhood estimates were not used as our best estimates, because sisterhood studies systematically underestimate the true levels of mortality (*12,23*). This disparity is illustrated in Figure 1, which compares the 2005 WHO estimates of the female probability of dying between ages 15 and 50 years (*19*) with the corresponding sisterhood estimates for all countries in group C. This evidence suggests the need for upward adjusting of the sisterhood data.

Previous studies have shown that the direct sisterhood method may lead to biased estimates of levels of maternal mortality, but not necessarily to biased values of the proportion maternal among deaths of females of reproductive age (PMDF) (*23*). For each country in this group, therefore, the sisterhood estimate of the PMDF was used to derive the 2005 MMR (*24*). The calculated PMDF was adjusted by the age distribution of women in the sample population of the respective countries.

It is known that PMDF is sensitive not only to maternal mortality, but to all other causes as well. Thus, the obtained values will likely be lower than the true values when there are increases in adult mortality due to conflicts and epidemics. To account for the likely inflation of overall female deaths due to

AIDS, the age-standardized PMDFs were adjusted to reflect the proportion of maternal deaths among non-AIDS deaths. The age-standardized HIV-adjusted PMDF was then applied to the 2005 WHO estimate of number of non-AIDS reproductive-aged female deaths (*19*), to obtain the total number of maternal deaths in 2005. The latter was divided by the 2005 UNPD estimates of the number of births to obtain the 2005 MMR. As was done for the 2000 exercise, lower and upper uncertainty limits were calculated from a model relating published standard errors on seven-year sisterhood estimates to the square root of the number of sister-years of observation (*23*). The 2005 maternal mortality estimates for countries in this group are shown in Appendix 3.

Figure 1. Comparison of DHS sisterhood estimates and WHO estimates of female adult mortality



Legend:
35q15 is the female probability of dying between ages 15 and 50
◆ Female adult mortality estimates
The diagonal line sloping downwards from the right represents the line of equality on which all points will lie if estimates from both sources are the same.

Group D – RAMOS

This group comprises countries (Brazil, Egypt, Jordan, and Turkey) that have conducted national RAMOS studies (or have conducted RAMOS studies in selected regions of a country that have been nationally adjusted). The reported MMR was accepted as the lower limit of uncertainty, while the upper limit of uncertainty was the RAMOS estimate multiplied by two. The midpoint of the uncertainty limits was taken as the point estimate of MMR. The 2005 maternal mortality estimates for countries in group D are shown in Appendix 4.

Group E – disease surveillance or sample registration

The two countries in this group had data from a disease surveillance system (China) or a sample registration system (India), with limited evidence of the completeness of the coverage of maternal deaths. It was assumed that these estimates had the same biases as countries with complete records of deaths but with weak ascertainment of cause of death (group B countries). As with the RAMOS estimates, the reported MMR was accepted as the lower uncertainty limit, twice the observed value was taken as the upper uncertainty limit, and the

midpoint of the uncertainty range was taken as the point estimate. The 2005 maternal mortality estimates for countries in group E are shown in Appendix 4.

Group F – census

For countries (Honduras, the Islamic Republic of Iran, Nicaragua, Paraguay, and South Africa) with census estimates, the reported PMDF was applied to the WHO estimates of reproductive-aged female deaths for the respective year to obtain the total number of maternal deaths. The estimated number of maternal deaths was divided by the 2005 WHO estimate of non-AIDS reproductive-aged female deaths to obtain the non-HIV/AIDS PMDF. The latter was then multiplied by the 2005 WHO estimate of non-HIV reproductive-aged female deaths to obtain the total maternal deaths for 2005. The 2005 MMR lower limit of uncertainty was the total number of maternal deaths divided by the 2005 UNPD estimates of the number of births. The upper limit of uncertainty was twice the estimate for the lower limit, and the 2005 MMR was the midpoint of the uncertainty limits. The 2005 maternal mortality estimates for countries in group F are shown in Appendix 4.

Group G – special studies

This group comprises countries (Bangladesh, Malaysia, Myanmar, Saudi Arabia, Sri Lanka, and Thailand) that have conducted special studies on maternal mortality, but these studies do not fit into any of the groups noted earlier. The estimates from these studies were taken as the lower limit of uncertainty. The upper limit of uncertainty was twice the estimate for the lower limit, and the 2005 MMR was the midpoint of the uncertainty limits. The 2005 maternal mortality estimates for countries in group G are shown in Appendix 4.

Group H – no appropriate national maternal mortality data

This group of countries consists of those where available national estimates are not produced according to established methodologies that are comparable with other data sources within the global maternal mortality database, or those where no reliable nationally representative estimates exists. A four-stage procedure was employed to predict the MMR for countries in this group in the absence of empirical data.

1. A statistical model was developed based on data from countries with reliable data concerning the variables described below.

2. The model was then used to estimate the PMDF for each country in the group.

3. The estimated PMDF was applied to the 2005 WHO figures for non-HIV/AIDS reproductive-aged female deaths, to obtain the estimated total number of maternal deaths.

4. The number of maternal deaths divided by the 2005 UNPD estimates of the number of live births gave the point estimate for MMR in 2005. The uncertainty limits were derived from model estimates of the standard error of the forecast. The 2005 maternal mortality estimates for countries in this group are shown in Appendix 5.

The statistical model

The statistical model aimed to obtain out-of-sample PMDF predictions by relating the compiled PMDF from countries with reliable data to socioeconomic and programmatic variables for the appropriate time period. A range of variables shown to be related to maternal deaths was identified as possible predictors (*25–31*) (see Annex 1). The logit functional form of the PMDF was used as the dependent variable to account for the fact that values for this proportion fall between zero and one. Country estimates for these potential predictors were obtained from various published sources (*18,20*). Where variables for 2005 were not available, the most recent estimate for the period 2000–2005 was used. Multiple imputations were employed to predict the missing values for each variable (Annex 1).

Next, the correlation patterns among the variables were examined (Annex 2). Indicators that were highly correlated (such as proportion of births with skilled attendants (SKA) and institutional delivery) were not used in the same model. The results of bivariate regression analysis (between country observations

Box 4. PMDF statistical model for countries in Group H

$$\ln\left(\frac{PMDF}{1-PMDF}\right) = -5.340 - 0.250 * \ln(GDP) + 1.235\ln(GFR) - 1.662 *_{complete}^{VR} - 0.012\ln\left(\frac{SKA}{100-SKA}\right) - 0.662(Eur) - 0.442(MENA) - 0.292(WP)$$

PMDF	=	proportion maternal among deaths of females of reproductive age
GDP	=	gross domestic product per capita based on purchasing power parity conversion
GFR	=	general fertility rate (births per 1000 women aged 15–49)
SKA	=	proportion of births with skilled attendants
EUR	=	dummy variable identifying observations from Europe
MENA	=	dummy variable identifying observations from North Africa and the Middle East
WP	=	dummy variable identifying observations from Western Pacific
VRcomplete	=	dummy variable equal to 1 if registration of deaths is 90% or more complete

This final model was fitted to a sample of 71 non-OECD (Organisation for Economic Co-operation and Development) countries using robust regressions with Huber and biweight iterations.

of PMDF and each predictor) and the correlation matrix guided the selection of independent variables for the model. The independent variables used in the final model were SKA; gross domestic product per capita, based on purchasing power parity conversion (GDP); general fertility rate (GFR); dummy variable for the completeness of registration of adult deaths (VRcomplete); and regional dummy variables.

3.3 Calculation of adult lifetime risk of maternal mortality

In countries where there is a high risk of maternal death, mortality risk among children is also high. Therefore, estimates of the ***adult lifetime risk of maternal mortality*** (which equals the probability that a 15-year-old female will die eventually from a maternal cause) was calculated. These assumed current levels of fertility and mortality (including maternal mortality) do not change in the future.

The adult lifetime risk of maternal mortality can be derived using either the MMR or maternal mortality rate (MMRate). However, a precise estimate of lifetime risk requires knowledge of how the MMR or the MMRate changes within the reproductive lifespan of women. Since such information is not generally available, it can be assumed that neither the MMR nor the MMRate is constant over the reproductive

Box 5. Formula for estimating adult lifetime risk

$$\text{Adult lifetime risk of maternal mortality} = \frac{T_{15} - T_{50}}{\ell_{15}} \text{ x MMRate}$$

where ℓ_{15}, T_{15}, and T_{50} are quantities from a life table for the female population during the period in question (ℓ_{15} equals the probability of survival from birth until age 15, and $(T_{15} - T_{50})/\ell_{15}$ equals the average number of years lived between ages 15 and 50 – up to a maximum of 35 years – among survivors to age 15).

lifespan. Because this assumption is much closer to reality for the MMRate than for the MMR, the adult lifetime risk was calculated using the MMRate as shown in Box 5. This formula yields an estimate of the adult lifetime risk that takes into account competing causes of death. The 2005 country estimates of lifetime risk of maternal mortality are shown in Annex 3, while the regional estimates are presented in Table 2 and in Appendices 6, 8, 10, 12, and 14.

3.4 Global and regional estimates

Global and regional maternal mortality aggregates (according to the MDG, WHO, UNICEF, UNFPA, The World Bank and UNPD regional groupings) were also estimated. The MMR in a given region was computed as the number of maternal deaths divided by the number of live births in the region. Additionally, the adult lifetime risk of maternal mortality was based on the weighted average of $(T_{15} - T_{50})/\ell_{15}$ in a given region multiplied by the MMRate of the region.

3.5 Differences between the 2005 methodology compared with 2000

There were some differences in the methods used for the 2005 maternal mortality estimates compared to those for 2000 (*2*).

- For the 2005 estimates, countries were grouped into eight instead of six groups in the 2000 estimates. In 2005, Group E in the 2000 estimates was divided into Groups E (sample registration/ disease surveillance systems), F (census), and G (special studies), plus Group H for countries with no reliable estimates.

- Slightly different variables were included in the 2000 and 2005 models. In the 2005 model, there were three dummy variables identifying countries of three regions (Europe, North Africa and the Middle East, and West Pacific) while in the 2000 model, there was only one dummy variable (combining countries of Latin America, sub-Saharan Africa, and the Middle East/North Africa).

- In the 2005 model, missing values for predictor variables were replaced using multiple imputation methods.

- The definition and approach for estimating the 2005 lifetime risk of maternal death are in sharp contrast to those for 2000. The lifetime risk of maternal death for the 2005 estimates was defined as the probability of maternal death during a woman's reproductive period (15–50 years), taking into account other causes of death in women of reproductive age. On the other hand, the 2000 lifetime risk was defined as 1.2 times the probability of a newborn female experiencing maternal death, assuming she is not at risk of death from other causes. The factor 1.2 in the latter definition was to account for non-live births but this appeared to be unnecessary since only live births are appropriate for the consideration of lifetime risk. Additionally, the 2000 lifetime risk definition ignores other causes of female deaths during the reproductive period. Thus, the lifetime risk estimates in 2000 are higher than the 2005 estimates. However, both estimates assume that the current rates of fertility and mortality will remain the same throughout the lifetime of the woman and that the risk of maternal death is independent of parity.

4. ANALYSIS AND INTERPRETATION OF 2005 ESTIMATES

4.1 Maternal mortality estimates for 2005

Table 2 and Annex 3 present the estimates of MMR, the range of uncertainty of MMR estimates, the number of maternal deaths, and the lifetime risk by region (MDG regional groupings) or by country. The range of uncertainty suggests that although a point estimate is presented, the true MMR could be somewhere between the lower- and upper uncertainty limits shown in the graphics. Therefore, individual country estimates should not be used for cross-country comparisons.

Of the estimated total of 536 000 maternal deaths worldwide, developing countries accounted for 99% (533 000) of the deaths (Table 2). Slightly more than half of the maternal deaths (270 000) occurred in the sub-Saharan Africa region alone, followed by South Asia (188 000). Thus, sub-Saharan Africa and South Asia accounted for 86% of global maternal deaths. By the broad MDG regions, the MMR in 2005 was highest in developing regions (450), in stark contrast to developed regions (9) and countries of the commonwealth of independent states (51). Among the developing regions, sub-Saharan Africa had the highest MMR at 900 maternal deaths per 100 000 live births in 2005, followed by South Asia (490), Oceania (430), South-Eastern Asia (300), Western Asia (160), North Africa (160), Latin America and the Caribbean (130), and Eastern Asia (50).

By country (Annex 3), India had the largest number of maternal deaths (117 000), followed by Nigeria (59 000), the Democratic Republic of the Congo (32 000), Afghanistan (26 000), Ethiopia (22 000) Bangladesh (21 000), Indonesia (19 000), Pakistan (15 000), Niger (14 000), the United Republic of Tanzania (13 000), and Angola (11 000). These 11 countries comprised 65% of the global maternal deaths in 2005.

A total of 14 countries had MMRs of at least 1000, of which 13 (excluding Afghanistan) were in the sub-Saharan African region (Annex 3). These countries in descending order are: Sierra Leone (2100), Niger (1800), Afghanistan (1800), Chad (1500), Somalia (1400), Angola (1400), Rwanda (1300), Liberia (1200), Guinea Bissau (1100), Burundi (1100), the Democratic Republic of the Congo (1100), Nigeria (1100), Malawi (1100), and Cameroon (1000). By contrast, the MMR in Ireland was 1.

The adult lifetime risk of maternal death (the probability that a 15-year-old female will die eventually from a maternal cause) is highest in Africa (at 1 in 26), followed by Oceania (1 in 62) and Asia (1 in 120), while the developed regions had the smallest lifetime risk (1 in 7300). Of all 171 countries and territories for which estimates were made, Niger had the highest estimated lifetime risk of 1 in 7, in stark contrast to Ireland, which had the lowest lifetime risk of 1 in 48 000.

Appendices 6, 8, 10, 12, and 14 present the MMR, number of maternal deaths, adult lifetime risk, and range of uncertainty for WHO, UNICEF, UNFPA, The World Bank, and UNPD regions, respectively.

Although the methods for the 2000 and 2005 estimates were not the same – and estimates should not therefore be compared for assessing time trends for individual countries – large disparities appeared in the estimates for 11 countries in the new round of estimates. Methodological reasons for these large differences have been provided in Annex 4.

4.2 Estimates of MMR trends

The 2005 maternal mortality estimates are not comparable to the previous estimates for 1990, 1995, and 2000, because of the differences in the methods that were used in each of the exercises (*2–4*). The 2000 report of MMR estimates strongly cautioned against comparing time trends by using the findings of each estimation exercise. This applies to the 2005 estimates as well.

In developing the 2005 estimates, however, attempts were made to analyse changes in global and regional maternal mortality to provide information concerning progress towards achieving the MDG5 target. The methodological details of the trend analysis are described in a forthcoming publication (*22*).

Table 2. Estimates of MMR, number of maternal deaths, lifetime risk, and range of uncertainty by United Nations MDG regions, 2005

Region	MMR (maternal deaths per 100 000 live births)*	Number of maternal deaths*	Lifetime risk of maternal death*: 1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
WORLD TOTAL	400	536 000	92	220	650
Developed regions**	9	960	7 300	8	17
Countries of the commonwealth of independent states (CIS)***	51	1 800	1 200	28	140
Developing regions	450	533 000	75	240	730
Africa	820	276 000	26	410	1 400
Northern Africa*****	160	5 700	210	85	290
Sub-Saharan Africa	900	270 000	22	450	1 500
Asia	330	241 000	120	190	520
Eastern Asia	50	9 200	1 200	31	80
South Asia	490	188 000	61	290	750
South-Eastern Asia	300	35 000	130	160	550
Western Asia	160	8 300	170	62	340
Latin America and the Caribbean	130	15 000	290	81	230
Oceania	430	890	62	120	1 200

* The MMR and lifetime risk have been rounded according to the following scheme: < 100, no rounding; 100–999, rounded to nearest 10; and >1,000, rounded to nearest 100. The numbers of maternal deaths have been rounded as follows: < 1,000, rounded to nearest 10, 1,000–9,999, rounded to nearest 100; and >10,000, rounded to nearest 1,000.

** Includes Albania, Australia, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Serbia and Montenegro (Serbia and Montenegro became separate independent entities in 2006), Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, the United Kingdom, the United States of America.

*** The CIS countries are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, the Republic of Moldova, the Russian Federation, and Ukraine. **** Excludes Sudan, which is included in sub-Saharan Africa.

Briefly, two main approaches were employed for the trend analysis. The first entailed a time-series analysis (random effects regression model) with only reported country MMRs. Maternal mortality ratios derived from PMDF models were excluded in this time-series analysis. It was found that using fixed effects models produced identical findings. The second approach entailed using the 2005 maternal mortality methodology to re-estimate MMRs for 1990. Unlike the first approach, the 2005 methodology was also used to estimate MMRs for countries with no maternal mortality data for 1990. In both approaches, only changes in regional estimates for MMR and number of maternal deaths between 1990 and 2005 were explored.

Both approaches indicated a decline in maternal mortality: 2.5% annual decline in the first approach, as opposed to less than 1% in the second approach. It is important to note that the first approach excluded countries with no maternal mortality data, mostly sub-Saharan African

countries. Table 3 presents the global and regional maternal mortality estimates for 1990 (revised with 2005 methodology) and 2005 (similar tables for the different regional groupings for WHO, UNICEF, UNFPA, The World Bank, and UNPD are shown in Appendices 7, 9, 11, 13, and 15).

Additionally, the global and regional percentage change in MMR between 1990 and 2005, as well as the annual percentage change in MMR (based on the second approach), are also shown in Table 3. Worldwide, there was a 5.4% decline in MMR between 1990 and 2005. Eastern Asia had the largest decline of 47.1%, as opposed to 1.8% in sub-Saharan Africa. Unlike the other MDG regions, sub-Saharan Africa experienced an increase in the number of maternal deaths (from 212 000 in 1990 to 270 000 in 2005) with a concomitant increase in the number of live births (from 23 million in 1990 to 30 million in 2005) resulting in the negligible change in MMR from 1990 to 2005.

Table 3. Comparison of 1990 and 2005 maternal mortality by United Nations MDG regions

	1990*		2005*		% change in MMR between 1990 and 2005	Annual % change in MMR between 1990 and 2005
Region	MMR	Maternal deaths	MMR	Maternal deaths		
WORLD TOTAL	430	576 000	400	536 000	-5.4	-0.4
Developed regions**	11	1 300	9	960	-23.6	-1.8
Countries of the commonwealth of independent states (CIS)***	58	2 800	51	1 800	-12.5	-0.9
Developing regions	480	572 000	450	533 000	-6.6	-0.5
Africa	830	221 000	820	276 000	-0.6	0.0
Northern Africa******	250	8 900	160	5 700	-36.3	-3.0
Sub-Saharan Africa	920	212 000	900	270 000	-1.8	-0.1
Asia	410	329 000	330	241 000	-19.7	-1.5
Eastern Asia	95	24 000	50	9 200	-47.1	-4.2
South Asia	620	241 000	490	188 000	-21.1	-1.6
South-Eastern Asia	450	56 000	300	35 000	-32.8	-2.6
Western Asia	190	8 500	160	8 300	-16.2	-1.2
Latin America and the Caribbean	180	21 000	130	15 000	-26.3	-2.0
Oceania	550	1 000	430	890	-22.2	-1.7

* The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable. The MMRs have been rounded according to the following scheme: < 100, no rounding; 100–999, rounded to nearest 10; and >1,000, rounded to nearest 100. The numbers of maternal deaths have been rounded as follows: < 1,000, rounded to nearest 10, 1,000–9,999, rounded to nearest 100; and >10,000, rounded to nearest 1,000.

** Includes Albania, Australia, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Serbia and Montenegro (Serbia and Montenegro became separate independent entities in 2006), Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, United Kingdom, United States of America.

*** The CIS countries are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, the Republic of Moldova, the Russian Federation, and Ukraine.

**** Excludes Sudan, which is included in sub-Saharan Africa.

5. IS THE FIFTH MDG ACHIEVABLE?

The fifth MDG aims to improve maternal health and targets reducing MMR by 75% between 1990 and 2015 – that is, it seeks to achieve an expected 5.5% annual decline in MMR from 1990. However, as shown in Table 3, maternal mortality (as measured by MMR) has decreased at the global level at an average of less than 1% annually between 1990 and 2005 (using the second approach described earlier). Moreover, on the regional basis, none of the MDG regions achieved 5.5% between 1990 and 2005, although Eastern Asia came close to that goal with a 4.2% annual decline.

To make the achievement of the fifth MDG a reality, MMR will have to decrease at a much faster rate – especially in sub-Saharan Africa, where the annual decline has so far been about 0.1%. The realization of this goal will require increased attention to improved health care for women, including prevention of unplanned pregnancies and unsafe abortions and provision of high-quality pregnancy and delivery care, including emergency obstetric care (*32*).

Data on the second indicator identified for monitoring progress towards achievement of maternal mortality reduction – that is, the proportion of births attended by skilled health personnel (doctor, midwife, or nurse) (*1*) – indicate that the receipt of such care is limited where maternal deaths also constitute a major problem. In Africa, less than 50% of births are attended by a skilled health worker, according to most recent available data (*33*) – despite an increase from 43% to 57% between 1990 and 2005 in all developing regions, as indicated by the 2007 Millennium Development Goals Report (*34*). These figures are far lower than the global target for this indicator, which was set at a special session of the United Nations in 1999. This global target aims to assure that at least 90% of births worldwide be attended by skilled health personnel by 2015 (*35*).

The figures for both indicators identified for measuring maternal mortality suggest that much needs to be done to accelerate progress towards the achievement of MDG5.

6. NEXT STEPS

6.1 Using the 2005 maternal mortality estimates

The estimates of maternal mortality for 2005 provided in this report are the fourth in a series of attempts which have sought to examine the likely global dimensions of the problem of maternal mortality. Several issues should be considered in using these estimates.

First, it should be noted that these findings represent an update of existing information with recent data and methodologies, which have improved since the development of the previous estimates. Therefore and as mentioned above, the figures should not be compared with those from the previous exercises to assess changes in time.

Second, depending on the type of the data source used, primary data for individual countries had to be adjusted for specific characteristics. These characteristics included the extent of potential underreporting of maternal deaths (which is an issue even in highly developed civil registration systems) to obtain MMR estimates that are comparable across study designs. Such adjustment allows the calculation of regional and global aggregates. For this reason, the presented point estimates are usually different from the country-reported figures. Accordingly, country-reported figures are included in the appendices, together with the findings of this exercise.

Third, because of the reasons mentioned within the sections describing the development of the estimates, the calculated point estimates are subject to high levels of uncertainty and not intended to serve as precise estimates. Each point estimate is presented with estimated lower and upper margins. Therefore, the point estimates must be interpreted together with these margins, because the true value of MMR is likely to lie between them. It should also be noted that the estimated uncertainty margins are not confidence intervals in the epidemiological and statistical sense. Because these margins are extremely wide, one must be wary of interpreting small numerical differences in countries as representing real differences in maternal mortality.

However, the estimates are indicative of the extent of the maternal mortality problem, and should draw attention to the need for both improved action for maternal mortality reduction and increased efforts for the generation of robust data for estimating maternal mortality levels.

6.2 Generating better information for estimating maternal mortality

The methodological steps described above, which are used to obtain global maternal mortality estimates, highlight once again the complexities of generating robust data on maternal mortality. The variety of methods used in different settings, and the necessity for reconciling them within one global database, present conceptual and methodological challenges. These challenges must be overcome, in order to enable a better understanding of the progress in achieving MDG5.

The 2005 estimates did not require any adjustment for countries with generally complete civil registration systems and good attribution of cause of death (Group A). However, only one third of all countries/territories fell into this group. For another third of countries/territories, country-reported estimates of maternal mortality had to be adjusted for the purposes of comparability of the methodologies. For the final third of countries/territories, a statistical model was employed to predict maternal mortality levels. Despite being based on established demographic techniques and empirical data from other countries, there is no guarantee that the country-specific point estimates obtained through the statistical model represent the true levels of maternal mortality. The wide lower and upper margins around the estimated figures reflect such uncertainty.

The ability to generate country, regional, and global estimates with higher precision and accuracy would be greatly facilitated if country civil registration systems were further improved. This improvement would obviate the need to conduct special maternal mortality studies (which are time-consuming, expensive, and of limited use in monitoring trends)

or to employ statistical models (that have their own weaknesses). Indeed, countries such as Sweden, the Netherlands, England and Wales, and the USA, which have documented reduction in maternal mortality over several decades, have relied mainly on adequate civil registration systems (*36,37*).

ANNEXES

Annex 1.
List of socioeconomic and programmatic indicators with percentage of missing values

Indicator (acronym or abbreviation, see Annex 2)	% missing
GDP purchasing power parity per capita (GDP)	13
Health expenditure per capita (Health exp)	3
Institutional delivery (Inst delivery)	33
Female labour force participation (FLP)	3
Antenatal care quintile 1 (ANC-Q1)	65
Antenatal care quintile 5 (ANC-Q5)	65
Antenatal care – All (ANC-ALL)	16
Skilled birth attendants quintile 1 (SKA-Q1)	66
Skilled birth attendants quintile 5 (SKA-Q5)	66
Skilled birth attendants – All (SKA-ALL)	4
Maternal and Neonatal Program Effort Index (MNPI)	65
Delivery by doctors quintile 1 (DOC-Q1)	67
Delivery by doctors quintile 5 (DOC-Q5)	67
Delivery by doctors – All (DOC-ALL)	67
Percentage of population living in urban areas (Urban)	0
Contraceptive use (Contraceptive use)	22
General fertility rate (GFR)	0

Annex 2. Correlation matrix showing the associations between all possible indicators (column headings as defined in Annex 1)

Indicator	GDP	Health exp	Inst delivery	FLP	ANC-Q1	ANC-Q5	ANC-ALL	SKA -Q1	SKA -Q5	SKA-ALL	MNPI	DOC-Q1	DOC-Q5	DOC-ALL	Urban	Contraceptive use
GDP	1.00															
Health exp	0.86	1.00														
Inst delivery	0.48	0.24	1.00													
FLP	-0.20	-0.09	-0.32	1.00												
ANC- Q1	0.19	0.10	0.55	0.06	1.00											
ANC- Q5	0.22	0.26	0.50	-0.17	0.66	1.00										
ANC-ALL	0.37	0.23	0.65	-0.06	0.76	0.63	1.00									
SKA -Q1	0.40	0.08	0.85	-0.35	0.58	0.35	0.59	1.00								
SKA -Q5	-0.14	-0.37	0.58	-0.31	0.33	0.52	0.44	0.47	1.00							
SKA -ALL	0.59	0.47	0.88	-0.31	0.59	0.61	0.69	0.72	0.49	1.00						
MNPI	0.38	0.26	0.51	-0.06	0.27	0.25	0.42	0.49	0.40	0.61	1.00					
DOC-Q1	0.14	0.06	0.34	-0.07	0.38	0.07	0.25	0.55	-0.01	0.34	0.14	1.00				
DOC-Q5	0.33	0.44	0.14	-0.10	0.05	0.07	0.18	0.10	-0.16	0.27	0.11	0.57	1.00			
DOC-ALL	0.21	0.22	0.24	-0.09	0.21	0.06	0.23	0.33	-0.06	0.30	0.11	0.86	0.89	1.00		
Urban	0.61	0.50	0.61	-0.40	0.24	0.45	0.46	0.40	0.34	0.69	0.25	0.23	0.39	0.37	1.00	
Contraceptive use	0.39	0.33	0.60	-0.25	0.42	0.31	0.47	0.47	0.34	0.72	0.61	0.34	0.46	0.41	0.50	1.00

Annex 3. Estimates of number of maternal deaths, lifetime risk, MMR, and range of uncertainty (2005)

Country	Group	PMDF (%)*	Number of maternal deaths**	Lifetime risk of maternal death**: 1 in:	MMR** (maternal deaths per 100 000 live births)	Range of uncertainty on MMR estimates	
						Lower estimate	Upper estimate
Afghanistan	H	41	26 000	8	1 800	730	3 200
Albania	H	5	49	490	92	26	300
Algeria	H	10	1 200	220	180	55	520
Angola	H	34	11 000	12	1 400	560	2 600
Argentina	B		530	530	77	51	100
Armenia	H	3	26	980	76	23	250
Australia	A		11	13 300	4	4	9
Austria	A		3	21 500	4	4	7
Azerbaijan	H	4	110	670	82	21	290
Bahamas	A		1	2 700	16	16	33
Bahrain	B		4	1 300	32	21	42
Bangladesh	G		21 000	51	570	380	760
Barbados	A		1	4 400	16	16	31
Belarus	A		16	4 800	18	18	35
Belgium	A		9	7 800	8	8	16
Belize	A		4	560	52	52	100
Benin	H	34	2 900	20	840	330	1 600
Bhutan	H	22	280	55	440	160	970
Bolivia	C	14	760	89	290	160	430
Bosnia and Herzegovina	A		1	29 000	3	3	6
Botswana	H	12	170	130	380	120	1 000
Brazil	D		4 100	370	110	74	150
Brunei Darussalam	H	1	1	2 900	13	3	47
Bulgaria	A		7	7 400	11	11	22
Burkina Faso	C	25	4 300	22	700	390	1 000
Burundi	H	40	3 900	16	1 100	480	1 900
Cambodia	C	16	2 300	48	540	370	720
Cameroon	C	37	5 700	24	1 000	670	1 400
Canada	A		21	11 000	7	7	13
Cape Verde	H	16	32	120	210	68	530
Central African Republic	H	31	1 500	25	980	380	1 900
Chad	C	50	6 900	11	1 500	930	2 000
Chile	A		40	3 200	16	16	32
China	E		7 800	1 300	45	30	60
Colombia	H	10	1 200	290	130	38	370
Comoros	H	25	110	52	400	150	840
Congo	C	53	1 300	22	740	450	1 100
Costa Rica	A		24	1 400	30	30	60
Côte d'Ivoire	H	29	5 400	27	810	310	1 600
Croatia	A		3	10 500	7	7	15
Cuba	A		61	1 400	45	45	90

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

For notes marked with asterisk see page 27.

Annex 3. continued

Country	Group	PMDF (%)*	Number of maternal deaths**	Lifetime risk of maternal death**: 1 in:	MMR** (maternal deaths per 100 000 live births)	Range of uncertainty on MMR estimates	
						Lower estimate	Upper estimate
Cyprus	A		1	6 400	10	10	20
Czech Republic	A		4	18 100	4	4	9
Democratic People's Republic of Korea	H	9	1 300	140	370	110	1 200
Democratic Republic of the Congo	H	43	32 000	13	1 100	480	1 900
Denmark	A		2	17 800	3	3	6
Djibouti	H	25	180	35	650	240	1 400
Dominican Republic	C	15	310	230	150	90	210
Ecuador	H	12	600	170	210	65	560
Egypt	D		2 400	230	130	84	170
El Salvador	H	13	290	190	170	55	460
Equatorial Guinea	H	22	150	28	680	210	1 600
Eritrea	H	32	760	44	450	180	850
Estonia	A		3	2 900	25	25	50
Ethiopia	C	28	22 000	27	720	460	980
Fiji	H	9	41	160	210	55	720
Finland	A		4	8 500	7	7	15
France	A		59	6 900	8	8	16
Gabon	C	28	220	53	520	290	760
Gambia	H	25	360	32	690	250	1 500
Georgia	H	3	32	1 100	66	18	230
Germany	A		29	19 200	4	4	9
Ghana	H	22	3 800	45	560	200	1 300
Greece	B		3	25 900	3	2	4
Guatemala	H	22	1 300	71	290	100	650
Guinea	C	40	3 500	19	910	590	1 200
Guinea Bissau	H	44	890	13	1 100	500	1 800
Guyana	H	10	73	90	470	140	1 600
Haiti	C	24	1 700	44	670	390	960
Honduras	F	10	580	93	280	190	380
Hungary	A		5	13 300	6	6	11
Iceland	A		0	12 700	4	4	8
India	E		117 000	70	450	300	600
Indonesia	C	11	19 000	97	420	240	600
Iran	F	5	1 900	300	140	95	190
Iraq	H	20	2 900	72	300	110	600
Ireland	A		1	47 600	1	1	2
Israel	A		6	7 800	4	4	9
Italy	A		15	26 600	3	3	6
Jamaica	H	11	89	240	170	51	510
Japan	A		70	11 600	6	6	12

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

For notes marked with asterisk see page 27.

Annex 3. continued

Country	Group	PMDF (%)*	Number of maternal deaths**	Lifetime risk of maternal death**: 1 in:	MMR** (maternal deaths per 100 000 live births)	Range of uncertainty on MMR estimates	
						Lower estimate	Upper estimate
Jordan	D		92	450	62	41	82
Kazakhstan	H	3	340	360	140	40	500
Kenya	C	32	7 700	39	560	340	800
Kuwait	A		2	9 600	4	4	8
Kyrgyzstan	H	8	170	240	150	43	460
Lao People's Democratic Republic	H	20	1 300	33	660[1]	190	1 600
Latvia	A		2	8 500	10	10	19
Lebanon	H	6	99	290	150	41	500
Lesotho	C	39	480	45	960	570	1 400
Liberia	H	39	2 100	12	1 200	520	2 100
Libyan Arab Jamahiriya	H	7	130	350	97	28	300
Lithuania	A		3	7 800	11	11	22
Luxembourg	A		1	5 000	12	12	23
Madagascar	C	24	3 600	38	510	290	740
Malawi	C	68	6 000	18	1 100	720	1 500
Malaysia	G		340	560	62	41	82
Maldives	H	20	12	200	120	42	260
Mali	C	33	6 400	15	970	620	1 300
Malta	A		0	8 300	8	8	17
Mauritania	C	41	1 000	22	820	480	1 200
Mauritius	A		3	3 300	15	15	30
Mexico	A		1 300	670	60	60	120
Mongolia	A		27	840	46	46	93
Morocco	C	18	1 700	150	240	140	350
Mozambique	C	25	4 000	45	520	360	680
Myanmar	G		3 700	110	380	260	510
Namibia	C	22	110	170	210	110	300
Nepal	H	22	6 500	31	830	290	1 900
Netherlands	A		11	10 200	6	6	12
New Zealand	A		5	5 900	9	9	18
Nicaragua	F	9	270	150	170	120	230
Niger	H	47	14 000	7	1 800	840	2 900
Nigeria	H	34	59 000	18	1 100	440	2 000
Norway	A		4	7 700	7	7	15
Oman	H	8	41	420	64	18	200
Pakistan	H	15	15 000	74	320	99	810
Panama	H	11	91	270	130	39	410
Papua New Guinea	H	16	820	55	470	130	1 300

[1] Officially reported unadjusted direct estimate of MMR from the 2005 population census is 405 per 100 000 live births

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

For notes marked with asterisk see page 27.

Annex 3. continued

Country	Group	PMDF (%)*	Number of maternal deaths**	Lifetime risk of maternal death**: 1 in:	MMR** (maternal deaths per 100 000 live births)	Range of uncertainty on MMR estimates	
						Lower estimate	Upper estimate
Paraguay	F	11	260	170	150	99	200
Peru	C	14	1 500	140	240	170	310
Philippines	H	11	4 600	140	230	60	700
Poland	B		27	10 600	8	5	10
Portugal	B		12	6 400	11	7	14
Puerto Rico	A		10	2 900	18	18	36
Qatar	B		2	2 700	12	8	16
Republic of Korea	A		63	6 100	14	14	27
Republic of Moldova	A		9	3 700	22	22	44
Romania	A		51	3 200	24	24	49
Russian Federation	A		430	2 700	28	28	55
Rwanda	C	35	4 700	16	1 300	770	1 800
Saudi Arabia	G		120	1 400	18	12	24
Senegal	C	38	4 100	21	980	590	1 400
Serbia and Montenegro [2]	A		16	4 500	14	14	27
Sierra Leone	H	39	5 400	8	2 100	880	3 700
Singapore	A		5	6 200	14	14	27
Slovakia	A		3	13 800	6	6	12
Slovenia	A		1	14 200	6	6	12
Solomon Islands	H	18	34	100	220	65	580
Somalia	H	33	5 200	12	1 400	550	2 700
South Africa	F	6	4 300	110	400	270	530
Spain	A		20	16 400	4	4	9
Sri Lanka	G		190	850	58	39	77
Sudan	H	23	5 300	53	450	160	1 000
Suriname	A		7	530	72	72	140
Swaziland	H	16	120	120	390	130	980
Sweden	A		3	17 400	3	3	7
Switzerland	A		4	13 800	5	5	11
Syrian Arab Republic	H	11	700	210	130	40	370
Tajikistan	H	12	320	160	170	53	460
Thailand	G		1 100	500	110	70	140
The former Yugoslav Republic of Macedonia	A		2	6 500	10	10	20
Timor-Leste	H	42	190	35	380	150	700
Togo	C	23	1 200	38	510	290	750
Trinidad and Tobago	A		8	1 400	45	45	89
Tunisia	H	5	170	500	100	27	380

[2] Serbia and Montenegro became separate independent entities in 2006.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

For notes marked with asterisk see page 27.

Annex 3. continued

Country	Group	PMDF (%)*	Number of maternal deaths**	Lifetime risk of maternal death**: 1 in:	MMR** (maternal deaths per 100 000 live births)	Range of uncertainty on MMR estimates	
						Lower estimate	Upper estimate
Turkey	D		650	880	44	29	58
Turkmenistan	H	6	140	290	130	37	400
Uganda	C	40	8 100	25	550	350	770
Ukraine	A		71	5 200	18	18	36
United Arab Emirates	H	5	25	1 000	37	10	130
United Kingdom	A		51	8 200	8	8	15
United Republic of Tanzania	C	28	13 000	24	950	620	1 300
United States of America	A		440	4 800	11	11	21
Uruguay	A		11	2 100	20	20	40
Uzbekistan	A		150	1 400	24	24	49
Venezuela	A		340	610	57	57	110
Viet Nam	H	8	2 500	280	150	40	510
Yemen	H	26	3 600	39	430	150	900
Zambia	C	37	3 900	27	830	520	1 200
Zimbabwe	H	21	3 400	43	880	300	2 000

* The proportion maternal among deaths of females of reproductive age (PMDF).

** The MMR and lifetime risk have been rounded according to the following scheme: < 100, no rounding; 100–999, rounded to nearest 10; and >1,000, rounded to nearest 100. The numbers of maternal deaths have been rounded as follows: <100, no rounding, 100-999 rounded to nearest 10; 1,000–9,999, rounded to nearest 100; and >10,000, rounded to nearest 1,000.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Annex 4. Countries with large MMR differences between 2000 and 2005

Albania

The higher MMR in 2005 (92), as compared to 2000 (55), is the result of several factors. The first factor is that the estimated number of births decreased by about 13% between 2000 and 2005. The second is that the PMDF predicted from the model increased from 3% to 5% as a result of a slightly lower SKA value for 2005. In addition, there was also a slight increase (about 3%) in the estimated reproductive-aged female mortality for 2005 as compared to 2000.

Botswana

The MMR estimate for 2005 (370) is much higher than the 2000 (100) estimate because WHO estimates a higher number of female deaths from non-HIV/AIDS causes in 2005 compared to 2000. The WHO estimate of the number of reproductive-aged female mortality increased by approximately 155% between the two periods. In addition, estimates of the number of births declined by about 7%.

Democratic People's Republic of Korea

The MMR estimate for 2005 (370) was higher than the 2000 MMR (67). The predicted PMDF in 2005 was higher than in 2000, because the GDP estimate (in purchasing power parity) used in the 2005 model was approximately 75% lower than the estimate of US$ 14 996 used in the 2000 model.

Fiji

Several factors accounted for the disparity between the 2000 (75) and 2005 (210) MMR estimates. First, the estimated reproductive-aged female mortality for 2005 is 11% higher than for 2000. Second, the number of births was lower in 2005 by approximately 7%. Third, there was a slight decrease (approximately 1%) in the estimated SKA in 2000. This decrease was associated with a higher predicted PMDF in 2005 compared to 2000.

Georgia

The MMR estimate in the 2000 report was not based on the complete form of the model estimate for 2000. Based on the model parameters estimated in 2000, the correct 2000 MMR estimate was 73 – not 32 as was reported. The MMR estimate for 2005 (66) is therefore approximately 8% lower than the revised estimate for 2000.

Guyana

The WHO estimate of reproductive-aged female mortality in 2005 was 53% higher than the corresponding estimate for 2000. In addition, the SKA estimate used in the 2005 model was approximately 9% lower than the corresponding estimate in the 2000 model – resulting in a higher predicted PMDF in 2005. The 2005 MMR was 470, while the 2000 MMR was 170.

Liberia

The most important factor affecting the change in the MMR between 2000 (760) and 2005 (1200) was an increase of about 50% in the reproductive-aged female mortality between the two periods.

Papua New Guinea

The MMR in 2005 (470) was higher than the MMR in 2000 (300). The predicted PMDF was higher in 2005 than the PMDF for 2000. The World Bank GDP estimate used in the 2005 model is approximately 31% lower than the estimate used in the 2000 model.

Solomon Islands

The disparity between the 2000 (130) and 2005 (220) MMR estimates was attributed to two factors. First, compared to the GDP estimates used in the 2000 model, the GDP value in the 2005 model was approximately 27% lower. Second, there was a 5% increase in the WHO estimate of reproductive-aged female mortality in 2005, compared to that in 2000.

Tajikistan

The MMR estimate in the 2000 report was not based on the complete form of the model estimates for 2000. Based on the parameters estimated from the 2000 model, the MMR estimate for 2000 was 255 and not 100. The MMR estimate for 2005 (170) is therefore approximately 30% lower than the revised estimate for 2000.

Turkmenistan

The MMR estimate in the 2000 report was not based on the complete form of the model estimates for 2000. Based on the model parameters estimated in that year, the 2000 MMR should have been 128 – and not 31 as was reported. Thus, the MMR estimate for 2005 (130) indicates that there was no change in the MMR estimates for 2000 and 2005.

APPENDICES

Tables for country groups A–H and regional groupings

Appendix 1. Maternal mortality data derived from civil registration: countries and territories with good death registration and good attribution of cause of death (Group A)

Country	Year*	Reported MMR** (maternal deaths per 100 000 live births)
Australia	2003	4
Austria	2005	4
Bahamas	2000	16
Barbados	2000	16
Belarus	2003	18
Belgium	1997	8
Belize	2001	52
Bosnia and Herzegovina	2004	3
Bulgaria	2004	11
Canada	2003	7
Chile	2003	16
Costa Rica	2004	30
Croatia	2005	7
Cuba	2004	45
Cyprus	2005	10
Czech Republic	2005	4
Denmark	2001	3
Estonia	2005	25
Finland	2005	7
France	2003	8
Germany	2004	4
Hungary	2005	6
Iceland	2004	4
Ireland	2005	1
Israel	2003	4
Italy	2002	3
Japan	2004	6
Kuwait	2002	4
Latvia	2004	10
Lithuania	2005	11
Luxembourg	2005	12
Malta	2005	8
Mauritius	2003	15
Mexico	2003	60
Mongolia	2003	46
Netherlands	2005	6
New Zealand	2003	9
Norway	2003	7
Puerto Rico	2001	18
Republic of Korea	2004	14
Republic of Moldova	2004	22
Romania	2005	24
Russian Federation	2004	28
Serbia and Montenegro***	1997	14
Singapore	2003	14
Slovakia	2004	6
Slovenia	2005	6
Spain	2005	4
Suriname	2000	72
Sweden	2002	3
Switzerland	2004	5
The former Yugoslav Republic of Macedonia	2005	10
Trinidad and Tobago	2000	45
Ukraine	2004	18
United Kingdom	2004	8
United States of America	2003	11
Uruguay	2001	20
Uzbekistan	2004	24
Venezuela	2002	57

* Reference year for the most recent reported number of maternal deaths. The number of births in 2005 reported by the UNPD was used in computing the MMR.

** The averaged reported maternal deaths of the three most recent years (or six most recent for countries with population size below 500 000) divided by the number of births in 2005 reported by the UNPD was taken as the estimate for 2005.

*** Serbia and Montenegro became separate independent entities in 2006.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 2. Maternal mortality data derived from civil registration: countries and territories with good death registration but uncertain attribution of cause of death (Group B)

Country	Year*	2005 MMR** (maternal deaths per 100 000 live births)
Argentina	2003	77
Bahrain	2001	32
Greece	2004	3
Poland	2004	8
Portugal	2003	11
Qatar	2004	12

* Reference year for the most recent reported number of maternal deaths.

** Ill-defined causes of female deaths were proportionately redistributed among known causes of deaths to obtain an adjusted number of maternal deaths. The number of births in 2005 reported by the UNPD was used in computing the adjusted MMR. The adjusted MMR was taken as the lower uncertainty limit, while the upper limit is the lower limit multiplied by 2. The 2005 MMR is the midpoint of the uncertainty limits.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 3. Maternal mortality data derived from the direct sisterhood method: reported and adjusted estimates (Group C)

Country	Year of survey	Year of DHS-maternal deaths*	DHS- reported MMR (maternal deaths per 100 000 live births)	Adjusted MMR (adjusted maternal deaths per 100 000 live births)**
Bolivia	2003	1998–2003	229	290
Burkina Faso	1998/1999	1994–1998	484	700
Cambodia	2005	1999–2005	472	540
Cameroon	2004	1998–2004	454	1 000
Chad	2004	1998–2004	1 099	1 500
Congo	2005	1999–2005	781	740
Dominican Republic	2002	1993–2002	178	150
Ethiopia	2005	1999–2005	673	720
Gabon	2000	1994–2000	519	520
Guinea	2005	1996–2005	847	910
Haiti	2000	1995–2000	523	670
Indonesia	2002/2003	1998–2003	307	420
Kenya	2003	1993–2003	414	560
Lesotho	2004	1995–2004	762	960
Madagascar	2003/2004	1999–2003	469	510
Malawi	2004	1998–2004	984	1 100
Mali	2001	1995–2001	582	970
Mauritania	2000/2001	1995–2001	747	820
Morocco	2003/2004	1994–2003	227	240
Mozambique	2003	1994–2003	408	520
Namibia	2000	1991–2000	271	210
Peru	2000	1994–2000	265	240
Rwanda	2005	2000–2004	750	1 300
Senegal	2005	1999–2005	401	980
Togo	1998	1993–1998	478	510
Uganda	2000/2001	1992–2001	505	550
United Republic of Tanzania	2004	1995–2005	578	950
Zambia	2001/2002	1995–2001	729	830

* Reference period for maternal deaths used in the DHS.

** The observed PMDF (age-standardized HIV-adjusted) was applied to the 2005 WHO estimate of number of non-AIDS reproductive-aged female deaths to obtain the total number of maternal deaths in 2005. The latter was divided by the 2005 UNPD estimates of the number of births to obtain the 2005 MMR. Adjusted MMRs have been rounded according to the following scheme: 100–999, rounded to nearest 10; and >1,000, rounded to nearest 100.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 4. Maternal mortality data derived from studies in Groups D–G

Country	Group	Source	Year of study	Reported MMR (maternal deaths per 100 000 live births)	Adjusted MMR (maternal deaths per 100 000 live births)*
Bangladesh	G	Special study	2000	380	570
Brazil	D	RAMOS	2005	74	110
China	E	Disease surveillance system	2005	30	45
Egypt	D	RAMOS	2000	84	130
Honduras	F	Census	2001	**	280
India	E	Sample registration system	2001–2003	301	450
Iran	F	Census	1995–1996	**	140
Jordan	D	RAMOS	1996	41	62
Malaysia	G	Special study	1996	41	62
Myanmar	G	Special study	1999	255	380
Nicaragua	F	Census	2005	**	170
Paraguay	F	Census	2002	**	150
Saudi Arabia	G	Special study	2000	12	18
South Africa	F	Census	2001	575	400
Sri Lanka	G	Special study	2004	39	58
Thailand	G	Special study	2005	**	110
Turkey	D	RAMOS	2005	29	44

* Adjusted MMRs have been rounded as follows: < 100, no rounding; and 100–999, rounded to nearest 10.

** MMR was not available in these studies.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 5. Maternal mortality data derived from model (Group H)

Country	Year	Model-based MMR (maternal deaths per 100 000 live births)*
Afghanistan	2005	1 800
Albania	2005	92
Algeria	2005	180
Angola	2005	1 400
Armenia	2003	76
Azerbaijan	2005	82
Benin	2005	840
Bhutan	2005	440
Botswana	2005	380
Brunei Darussalam	2000	13
Burundi	2005	1 100
Cape Verde	2005	210
Central African Republic	2005	980

* MMRs have been rounded according to the following scheme: < 100, no rounding; 100–999, rounded to nearest 10; and >1000, rounded to nearest 100.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 5. continued

Country	Year	Model-based MMR (maternal deaths per 100 000 live births)*
Colombia	2005	130
Comoros	2005	400
Côte d'Ivoire	2005	810
Democratic People's Republic of Korea	2005	370
Democratic Republic of the Congo	2005	1 100
Djibouti	2005	650
Ecuador	2005	210
El Salvador	2005	170
Equatorial Guinea	2005	680
Eritrea	2005	450
Fiji	2005	210
Gambia	2005	690
Georgia	2005	66
Ghana	2005	560
Guatemala	2005	290
Guinea Bissau	2005	1 100
Guyana	2005	470
Iraq	2005	300
Jamaica	2005	170
Kazakhstan	2005	140
Kyrgyzstan	2005	150
Lao People's Democratic Republic	2005	660[1]
Lebanon	2005	150
Liberia	2005	1 200
Libyan Arab Jamahiriya	2005	97
Maldives	2005	120
Nepal	2005	830
Niger	2005	1 800
Nigeria	2005	1 100
Oman	2005	64
Pakistan	2005	320
Panama	2005	130
Papua New Guinea	2005	470
Philippines	2005	230
Sierra Leone	2005	2 100

* MMRs have been rounded according to the following scheme: < 100, no rounding; 100–999, rounded to nearest 10; and >1000, rounded to nearest 100.

[1] Officially reported unadjusted direct estimate of MMR from the 2005 population census is 405 per 100 000 live births.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 5. continued

Country	Year	Model-based MMR (maternal deaths per 100 000 live births)*
Solomon Islands	2005	220
Somalia	2005	1 400
Sudan	2005	450
Swaziland	2005	390
Syrian Arab Republic	2005	130
Tajikistan	2005	170
Timor-Leste	2005	380
Tunisia	2005	100
Turkmenistan	2005	130
United Arab Emirates	2005	37
Viet Nam	2005	150
Yemen	2005	430
Zimbabwe	2005	880

* MMRs have been rounded according to the following scheme: < 100, no rounding; 100–999, rounded to nearest 10; and >1000, rounded to nearest 100.

Figures have been computed to ensure comparability; thus they are not necessarily the official statistics of countries, which may use alternative rigorous methods.

Appendix 6. Estimates of MMR, number of maternal deaths, lifetime risk, and range of uncertainty by WHO regions, 2005

Region	MMR (maternal deaths per 100 000 live births)	Number of maternal deaths	Lifetime risk of maternal death: 1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
Africa	900	261 000	23	450	1 500
Americas	99	16 000	420	62	170
South-East Asia	450	170 000	74	290	630
Europe	27	2 900	2 300	17	64
Eastern Mediterranean	420	66 000	61	170	850
Western Pacific	82	20 000	680	40	170
World	**400**	**536 000**	**92**	**220**	**650**

Appendix 7. Comparison of 1990 and 2005 maternal mortality by WHO regions

	1990*		2005			
Region	MMR	Maternal deaths	MMR	Maternal deaths	% change in MMR between 1990 and 2005	Annual % change in MMR between 1990 and 2005
Africa	910	205 000	900	261 000	-1.5	-0.1
Americas	130	21 000	99	16 000	-25.4	-2.0
South-East Asia	650	253 000	450	170 000	-30.6	-2.4
Europe	39	4 800	27	2 900	-30.2	-2.4
Eastern Mediterranean	380	55 000	420	66 000	10.8	0.7**
Western Pacific	120	37 000	82	20 000	-30.1	-2.4
World	**430**	**576 000**	**400**	**536 000**	**-5.4**	**-0.4**

* The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable.
** The unexpected increase in the region could be attributed to increases in countries affected by conflicts (e.g., Afghanistan)

Appendix 8. Estimates of MMR, number of maternal deaths, lifetime risk, and range of uncertainty by UNICEF regions, 2005

Region	MMR (maternal deaths per 100 000 live births)	Number of maternal deaths	Lifetime risk of maternal death: 1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
Sub-Saharan Africa	920	265 000	22	470	1 500
Eastern and Southern Africa	760	103 000	29	440	1 100
Western and Central Africa	1 100	162 000	17	490	1 800
Middle East and North Africa	210	21 000	140	93	430
South Asia	500	187 000	59	300	770
East Asia and Pacific	150	45 000	350	80	270
Latin America and Caribbean	130	15 000	280	81	230
Central and Eastern Europe and the Commonwealth of Independent States	46	2 600	1 300	27	110
Industrialized countries	8	830	8 000	8	15
Developing countries	450	534 000	76	240	720
Least developed countries	870	247 000	24	460	1 400
World	**400**	**536 000**	**92**	**220**	**650**

Appendix 9. Comparison of 1990 and 2005 maternal mortality by UNICEF regions

	1990*		2005			
Region	MMR	Maternal deaths	MMR	Maternal deaths	% change in MMR between 1990 and 2005	Annual % change in MMR between 1990 and 2005
Sub-Saharan Africa	940	206,000	920	265 000	-1.5	-0.1
Eastern and Southern Africa	790	85,000	760	103 000	-3.9	-0.3
Western and Central Africa	1 100	121 000	1 100	162 000	-0.7	0.0
Middle East and North Africa	270	26 000	210	21 000	-21.1	-1.6
South Asia	650	238 000	500	187 000	-22.0	-1.7
East Asia and Pacific	220	80 000	150	45 000	-30.3	-2.4
Latin America and Caribbean	180	21 000	130	15 000	-26.0	-2.0
Central and Eastern Europe and the Commonwealth of Independent States	63	4 400	46	2 600	-27.5	-2.1
Industrialized countries	8	960	8	830	-8.3	-0.6
Developing countries	480	574 000	450	534 000	-6.3	-0.4
Least developed countries	900	201 000	870	247 000	-2.5	-0.2
World	**430**	**576 000**	**400**	**536 000**	**-5.4**	**-0.4**

*The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable.

Appendix 10. Estimates of MMR, number of maternal deaths, lifetime risk, and range of uncertainty by UNFPA regions, 2005

Region	MMR (maternal deaths per 100 000 live births)	Number of maternal deaths	Lifetime risk of maternal death: 1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
Arab states (Middle East & North Africa)	280	24 000	97	110	570
Asia and the Pacific	340	233 000	110	200	540
Europe and the Commonwealth of Independent States	47	2 600	1 200	27	110
Latin America and the Caribbean	130	15 000	280	81	230
Sub-Saharan Africa	920	260 000	22	460	1 500
All in UNFPA list (131 countries)	440	535 000	79	240	710
Non-UNFPA list (40 countries)	9	1 000	6 900	8	19
World	**400**	**536 000**	**92**	**220**	**650**

Appendix 11. Comparison of 1990 and 2005 maternal mortality by UNFPA regions

	1990*		2005			
Region	MMR	Maternal deaths	MMR	Maternal deaths	% change in MMR between 1990 and 2005	Annual % change in MMR between 1990 and 2005
Arab states (Middle East & North Africa)	320	24 000	280	24 000	-11.6	-0.8
Asia and the Pacific	430	322 000	340	233 000	-19.4	-1.4
Europe and the Commonwealth of Independent States	64	4 300	47	2 600	-27.6	-2.2
Latin America and the Caribbean	180	21 000	130	15 000	-26.0	-2.0
Sub-Saharan Africa	940	204 000	920	260 000	-2.5	-0.2
All in UNFPA list (131 countries)	470	575 000	440	535 000	-5.9	-0.4
Non-UNFPA list (40 countries)	10	1 300	9	1 000	-11.2	-0.8
World	**430**	**576 000**	**400**	**536 000**	**-5.4**	**-0.4**

* The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable.

Appendix 12. Estimates of MMR, number of maternal deaths, lifetime risk, and range of uncertainty by The World Bank regions and income groups, 2005

Region and income group	MMR (maternal deaths per 100 000 live births)	Number of maternal deaths	Lifetime risk of maternal death: 1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
Region*					
East Asia and Pacific	150	45 000	340	82	270
Europe and Central Asia	42	2 600	1 400	25	99
Latin America and the Caribbean	130	15 000	280	81	230
Middle East and North Africa	200	15 000	160	92	380
South Asia	500	187 000	59	300	770
Sub-Saharan Africa	900	270 000	22	450	1 500
Income group**					
High income	9	1 000	6 700	8	17
Upper middle income	91	9 000	540	65	150
Lower middle income	180	74 000	270	94	300
Low income	650	451 000	40	350	1 000
World	**400**	**536 000**	**92**	**220**	**650**

* The regions exclude high income countries.
** Income groups were based on 2005 gross national income per capita estimates: low income, US$ 875 or less; lower middle US$ 876 – US$ 3,465; upper middle US$ 3,466 – US$ 10,725; and high US$ 10,726 or more.

Appendix 13. Comparison of 1990 and 2005 maternal mortality by The World Bank regions and income groups

	1990*		2005			
Region and income group	MMR	Maternal deaths	MMR	Maternal deaths	% change in MMR between 1990 and 2005	Annual % change in MMR between 1990 and 2005
Region**						
East Asia and Pacific	220	80 000	150	45 000	-30.6	-2.4
Europe and Central Asia	57	4 500	42	2 600	-26.7	-2.1
Latin America and the Caribbean	180	21 000	130	15 000	-26.0	-2.0
Middle East and North Africa	250	20 000	200	15 000	-21.4	-1.6
South Asia	650	238 000	500	187 000	-22.0	-1.7
Sub-Saharan Africa	920	212 000	900	270 000	-1.8	-0.1
Income group***						
High income	11	1 300	9	1 000	-18.8	-1.4
Upper middle income	58	6 400	91	9 000	57.1	3.0
Lower middle income	210	104 000	180	74 000	-17.0	-1.2
Low income	730	464 000	650	451 000	-11.4	-0.8
World	**430**	**576 000**	**400**	**536 000**	**-5.4**	**-0.4**

* The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable.
** The regions exclude high income countries.
*** Income groups were based on 2005 gross national income per capita estimates: low income, US$ 875 or less; lower middle US$ 876 – US$ 3,465; upper middle US$ 3,466 – US$ 10,725; and high US$ 10,726 or more.

Appendix 14. Estimates of MMR, number of maternal deaths, lifetime risk, and range of uncertainty by United Nations Population Division regions

Region	MMR (maternal deaths per 100 000 live births)	Number of maternal deaths	Lifetime risk of maternal death: 1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
Africa	820	276 000	26	410	1 400
Asia	320	242 000	120	180	510
Europe	13	930	5 700	12	26
Latin America and the Caribbean	130	15 000	290	81	230
Northern America	10	460	5 100	10	21
Oceania	180	910	250	52	480
More developed regions	11	1 500	5 900	11	23
Less developed regions	450	534 000	76	240	720
Least developed countries	870	247 000	24	460	1 400
World	**400**	**536 000**	**92**	**220**	**650**

Appendix 15. Comparison of 1990 and 2005 maternal mortality by United Nations Population Division regions

	1990*		2005			
Region	MMR	Maternal deaths	MMR	Maternal deaths	% change in MMR between 1990 and 2005	Annual % change in MMR between 1990 and 2005
Africa	830	221 000	820	276 000	-0.6	0.0
Asia	400	331 000	320	242 000	-19.5	-1.4
Europe	23	2 100	13	930	-46.1	-4.1
Latin America and the Caribbean	180	21 000	130	15 000	-26.3	-2.0
Northern America	8	350	10	460	31.0	1.8
Oceania	210	1 100	180	910	-16.9	-1.2
More developed regions	17	2 500	11	1 500	-35.3	-2.9
Less developed regions	480	574 000	450	534 000	-6.3	-0.4
Least developed countries	900	201 000	870	247 000	-2.5	-0.2
World	**430**	**576 000**	**400**	**536 000**	**-5.4**	**-0.4**

* The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable.

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