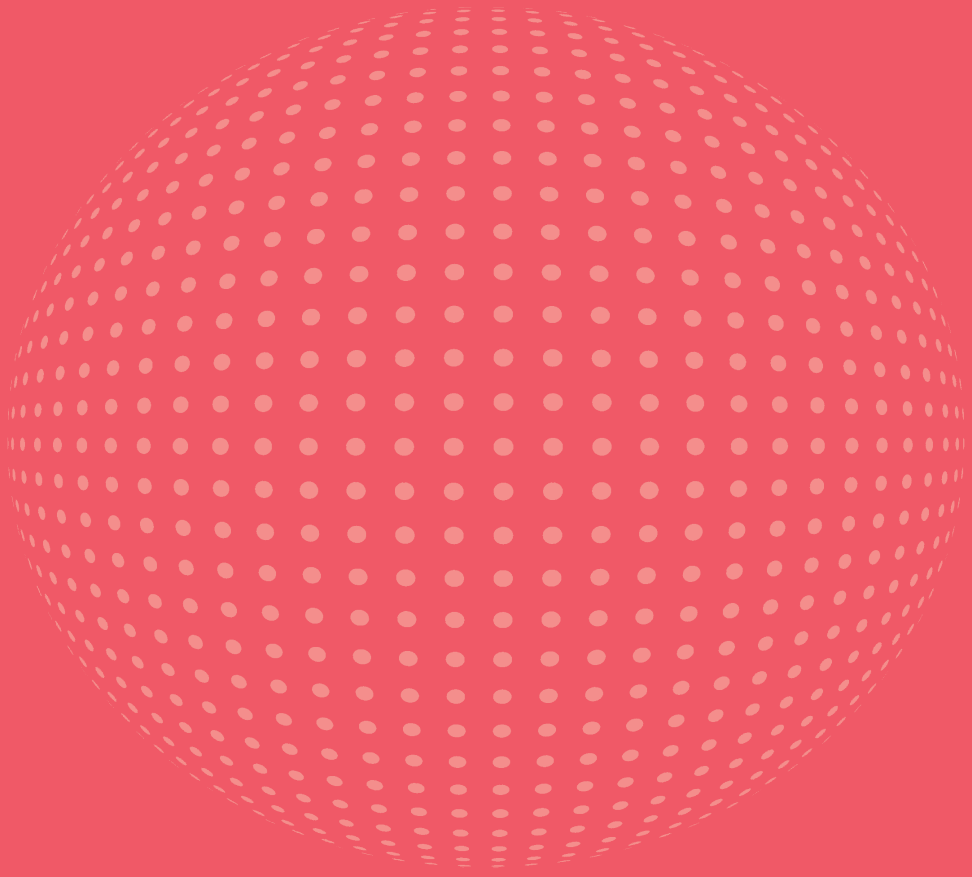
Monitoring emergency obstetric care

a handbook



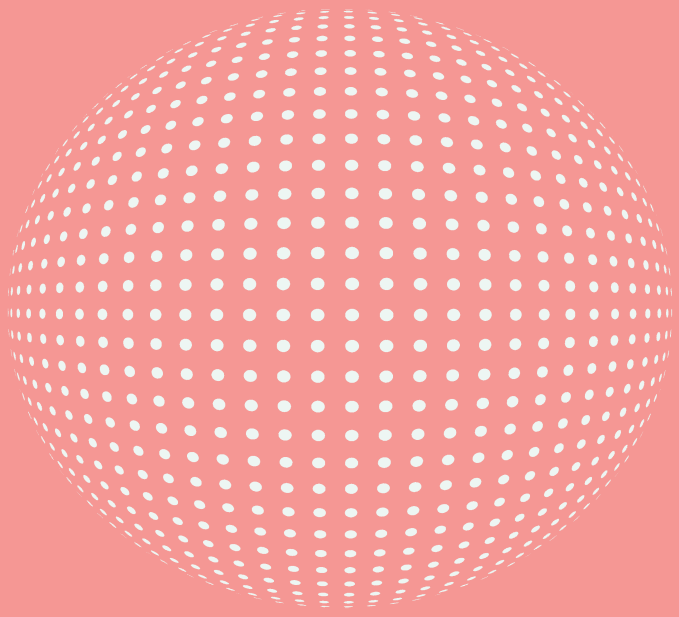
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Abbreviations

AMDD	Averting Maternal Death and Disability Program
EmOC	Emergency Obstetric Care
HIV	Human immunodeficiency virus
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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Preface

Efforts to improve the lives of women and children around the world have intensified since world leaders adopted the United Nations Millennium Declaration in September 2000 and committed themselves to reaching Millennium Development Goals 4 and 5, on child mortality and maternal health. The original targets for these Goals were a two-thirds reduction in the mortality of children under 5 and a three-quarters reduction in the maternal mortality ratio between 1990 and 2015. There is worldwide consensus that, in order to reach these targets, good-quality essential services must be integrated into strong health systems. The addition in 2007 of a new target in Goal 5—universal access to reproductive health by 2015—reinforces this consensus: all people should have access to essential maternal, newborn, child and reproductive health services provided in a continuum of care.

In order to reduce maternal mortality, Emergency Obstetric Care (EmOC) must be available and accessible to all women. While all aspects of reproductive health care including family planning and delivery with the help of a skilled health professional also plays an important role in reducing maternal and neonatal mortality, this handbook focuses on the critical role of EmOC in saving the lives of women with obstetric complications during pregnancy and childbirth and saving the lives of newborns intrapartum. The handbook describes indicators that can be used to assess, monitor and evaluate the availability, use and quality of EmOC.

Whilst this handbook focuses on emergency care, a broader set of indicators should be used to monitor fundamental aspects of reproductive health programmes designed to reduce maternal mortality, ensure universal access to reproductive health care and reduce child mortality.

Executive summary

Reducing maternal mortality has arrived at the top of health and development agendas. To achieve the Millennium Development Goal of a 75% reduction in the maternal mortality ratio between 1990 and 2015, countries throughout the world are investing more energy and resources into providing equitable, adequate maternal health services. One way of reducing maternal mortality is by improving the availability, accessibility, quality and use of services for the treatment of complications that arise during pregnancy and childbirth. These services are collectively known as Emergency Obstetric Care (EmOC).

Sound programmes for reducing maternal mortality, like all public health programmes, should have clear indicators in order to identify needs, monitor implementation and measure progress. In order to fulfil these functions, the data used to construct the indicators should be either already available or relatively easy and economical to obtain. The indicators should be able to show progress over a relatively short time, in small as well as large areas. Most importantly, the indicators should provide clear guidance for programmes—showing which components are working well, which need more input or need to be changed and what additional research is needed.

For a variety of technical and financial reasons, the maternal mortality ratio does not meet these requirements. Consequently, in 1991, UNICEF asked Columbia University (New York City, New York, United States of America) to design a new set of indicators for EmOC. The first version was tested in 1992. In 1997, the indicators were published as *Guidelines for monitoring the availability and use of obstetric services*, issued by UNICEF, WHO and UNFPA (1). These indicators have been used by ministries of health, international agencies and programme managers in over 50 countries around the world.

In June 2006, an international panel of experts participated in a technical consultation in Geneva to discuss modifications to the existing indicators for EmOC and revisions to the *Guidelines*, taking into account the accumulated experience and increased knowledge in the area of maternal health care. The present handbook contains the agreed changes, including two new indicators and an additional signal function, with updated evidence and new resources. In addition, the *Guidelines* were renamed as the Handbook, to emphasize the practical purpose of this publication.

The purpose of this handbook is to describe the indicators and to give guidance on conducting studies to people working in the field. It includes a list of life-saving services, or 'signal functions', that define a health facility with regard to its capacity to treat obstetric and newborn emergencies. The emphasis is on actual rather than theoretical functioning. On the basis of the performance of life-saving services in the past 3 months, facilities are categorized as 'basic' or 'comprehensive'. The section on signal functions also includes answers to frequently asked questions.

The EmOC indicators described in this handbook can be used to measure progress in a programmatic continuum: from the availability of and access to EmOC to the use and quality of those services. The indicators address the following questions:

- Are there enough facilities providing EmOC?
- Are the facilities well distributed?
- Are enough women using the facilities?
- Are the right women (i.e. women with obstetric complications) using the facilities?
- Are enough critical services being provided?
- Is the quality of the services adequate?

The handbook provides a description of each indicator and how it is constructed and how it can be used; the minimum and/or maximum acceptable level (if appropriate); the background of the indicator; data collection and analysis; interpretation and presentation of the indicator; and suggestions for supplementary studies. There is a further section on interpretation of the full set of indicators. Sample forms for data collection and analysis are provided.

Use of these EmOC indicators to assess needs can help programme planners to identify priorities and interventions. Regular monitoring of the indicators alerts managers to areas in which advances have been made and those that need strengthening. Close attention to the functioning of key services and programmes can substantially and rapidly reduce maternal mortality in developing countries.

1. Introduction

Over the past two decades, the international community has repeatedly declared its commitment to reduce the high levels of maternal mortality in developing countries, starting with the 1987 Safe Motherhood Conference in Nairobi, Kenya, followed by the 1990 World Summit for Children at United Nations headquarters, the 1994 International Conference on Population and Development in Cairo, Egypt, the 1995 Fourth World Conference on Women in Beijing, China, 'Nairobi 10 Years On' in Sri Lanka in 1997, and the Millennium Development Goals established by the United Nations in 2000. In 2007, a number of events marked the 20th anniversary of the launching of the Safe Motherhood Initiative, including the Women Deliver Conference in London, England, at which calls were made for renewed commitment, programmes and monitoring. Most importantly, over the past 20 years, consensus has been reached on the interventions that are priorities in reducing maternal mortality (2). Stakeholders agree that good-quality EmOC should be universally available and accessible, that all women should deliver their infants in the presence of a professional, skilled birth attendant, and that these key services should be integrated into health systems.

It became clear early on, however, that it would not be simple to measure progress in this area. The conventional approach was to monitor the number of maternal deaths with 'impact' indicators such as the maternal mortality ratio. In theory, repeated measurements of this ratio over time can be used to monitor trends. This approach has a number of serious drawbacks, both technical and substantive. Maternal mortality is extremely difficult and costly to measure when vital registration systems are weak, and even when systems are strong (3). Even innovative methods present difficulties. For example, the direct 'sisterhood' method provides information for a reference period of 7 years before a survey; thus, the information gathered does not reflect the current situation or progress made recently. Recent advances in sampling procedures for the sisterhood method have, however, greatly increased its efficiency and have decreased costs. These changes allow for larger samples and consequently a shorter reference period and narrower confidence intervals than the traditional approach. Even this method, however, is known to give underestimates of the maternal mortality ratio (4, 5).

Another approach is use of 'process,' 'output' or 'outcome' indicators, to measure the actions that prevent deaths or illness. Widely used process indicators include rates of childhood immunization and contraceptive prevalence. This handbook presents a series of indicators designed to monitor interventions that reduce maternal mortality by improving the availability, accessibility, use and quality of services for the treatment of complications during pregnancy and childbirth. The indicators are based on information from health facilities with data on population and birth rates. There are several advantages to this approach. First, the indicators can be measured repeatedly at short intervals. Secondly, the indicators provide information that is directly useful for guiding policies and programmes and making programme adjustments. It is important to remember that although 'process,' 'output' and 'outcome' indicators are more useful, practical and feasible than impact indicators, for many reasons, these measures cannot substitute for maternal mortality ratios as a direct measure of the overall level of maternal mortality in a population.

The Guidelines for monitoring the availability and use of obstetric services were initially developed by Columbia University's School of Public Health, supported by and in collaboration with UNICEF and WHO. A draft version was issued in 1992, and the guidelines were formally published by UNICEF, WHO and UNFPA in 1997 (1). Since then, they have been used in many countries (Table 1). The present document is a revision of the 1997 version of the guidelines, incorporating changes based on monitoring and assessment conducted worldwide.

Table 1. Selected countries in which emergency obstetric care indicators were used in assessing needs or for monitoring and evaluation (2000–2007)

Region and country	Use of indicators	References
Africa		
Angola	National needs assessment (report in progress)	
Benin	National needs assessment	(6, 7)
Burundi	Needs assessment planned with UNICEF	
Cameroon	Subnational needs assessment	(8-10)
Chad	National needs assessment	(7, 11)
Comoros		(12)
Côte d'Ivoire	National needs assessment	(10, 13)
Eritrea	Needs assessment with partial coverage	(14)
Ethiopia	Programme monitoring and evaluation; needs assessment with partial coverage [1]	(15)
Gabon	National needs assessment	(16, 17)
Gambia	National needs assessment	(17, 18)
Ghana	Subnational needs assessment	(19)
Guinea	Subnational needs assessment	(20)
Guinea Bissau	National needs assessment	(17, 21)
Kenya	Subnational needs assessments [2]	(22-24)
Lesotho	National needs assessment	(25)
Madagascar	Subnational needs assessments	(26)
Malawi	National needs assessment; programme monitoring and evaluation	(27-30)
Mali	National needs assessment; programme monitoring and evaluation	(31, 32)
Mauritania	National needs assessment	(10, 33)
Mozambique	National needs assessment; programme monitoring and evaluation (data not yet analysed)	(34-37)
Namibia	Needs assessment	(38)
Niger	Needs assessment	(10, 39)
Rwanda	Subnational needs assessment; programme monitoring and evaluation	(15, 23, 39-42)
Senegal	National needs assessment	(10, 37, 43)
Sierra Leone	National needs assessment	(44)
Uganda	National needs assessment	(23, 45, 46)
United Republic of Tanzania	National needs assessment; programme monitoring and evaluation	(15, 39, 47-51)
Zambia	National needs assessment	(52)
Zimbabwe	National needs assessment	(53, 54)
Americas		
Bolivia	National needs assessment [3]	(55, 56)
Ecuador	National needs assessment with UNFPA, 2006	
El Salvador	National needs assessment	(56-58)
Guatemala	Needs assessment	(59)
Honduras	National needs assessment	(56, 60)
Nicaragua	National and subnational needs assessments; programme monitoring and evaluation	(61, 62)
Peru	Needs assessments with partial coverage; programme monitoring and evaluation [4]	(63-65)
United States	National needs assessment	(66)

Region and country	Use of indicators	References
Eastern Mediterranean		
Afghanistan	Needs assessments with partial coverage	(67)
Djibouti	National needs assessment	(68)
Iraq	Needs assessment planned	
Morocco	National needs assessment; programme monitoring and evaluation	(62, 69)
Pakistan	Needs assessments with partial coverage; programme monitoring and evaluation	(70-73)
Somalia	Subnational needs assessment	(74)
Sudan	National needs assessment	(23, 75)
Syrian Arab Republic	National needs assessment [5]	
Yemen	Needs assessments with partial coverage	
Europe		
Kyrgyzstan	National needs assessment [6]	
Tajikistan	National needs assessment; programme monitoring and evaluation [7]	(76)
South-East Asia		
Bangladesh	National and subnational needs assessments; programme monitoring and evaluation	(77-79)
Bhutan	Needs assessment; programme monitoring and evaluation	(9, 80)
India	Needs assessments with partial coverage; programme monitoring and evaluation	(9, 81-85)
Nepal	Subnational needs assessment; programme monitoring and evaluation	(37, 86-88)
Sri Lanka	Subnational needs assessment; programme monitoring and evaluation	(62, 89)
Thailand	Needs assessment with partial coverage	(90)
Western Pacific		
Cambodia	Planned	
Mongolia	Planned	
Viet Nam	Needs assessment with partial coverage; programme monitoring and evaluation	(91, 92)

[1] CARE. Unpublished data. 2000.
[2] Doctors of the World. *West Pokot facility needs assessment—maternal and newborn care*. Unpublished data. Nairobi, 2007.
[3] Engender Health Acquire Project. Unpublished data. 2007.
[4] CARE. Unpublished data. 2004: Huancavelica region, Peru.
[5] Ministry of Health and UNICEF, Unpublished data. 2004: Syria.
[6] Ministry of Health of Kyrgyzstan and UNICEF, *Status of Emergency Obstetric Care (EOC) in the Kyrgyz Republic*. Unpublished. 2005.
[7] Ministry of Health of Tajikistan and UNICEF, Unpublished data. Dushanbe, 2005.

In this new edition, the indicators have been revised to reflect 10 years' wealth of experience. Other changes reflect the broadening of programmes; e.g. a signal function on treatment of complications in newborns and new indicators on perinatal mortality and on maternal deaths reported as due to indirect causes, such as HIV and malaria, have been added. These changes were discussed and agreed by an international panel of experts at the technical consultation in June 2006 (93). During the review, it was also decided to change the title. We use the term 'handbook' rather than 'guidelines,' because 'handbook' reflects more accurately the practical nature of this document. Another change made in this edition is replacement of 'essential obstetric care' by 'EmOC'.[1] Over the years, the terminology has been adjusted so that the indicators relate specifically to treatment of the emergency obstetric complications that cause most maternal deaths.

This handbook includes an explanation of the current indicators for EmOC and their implications, suggests supplementary studies that can improve understanding of the situation in a given area, and provides answers to common questions that arise when using the indicators. This is followed by worksheets and tables to illustrate study questions and calculations.

The indicators described can be used at any stage of the design and implementation of EmOC programmes and can be incorporated into routine health management information systems. In many countries, these indicators have provided the framework for more detailed assessments of national needs for EmOC, establishing the availability, use and quality of services and the specific information needed for detailed programme planning, such as equipment inventories.[2] Modules for conducting needs assessments can be found at: www.amddprogram.org.

[1] 'Emergency obstetric care' or 'EmOC' is being used in this document rather than 'emergency obstetric and newborn care' or 'EmONC' because this set of indicators focus primarily on obstetric complications and procedures. While there is one new signal function on neonatal resuscitation and one new indicator on intrapartum care from the perspective of the newborn, the set of indicators do not represent the full range of emergency newborn procedures.

[2] These assessments also include more information on emergency newborn care, and are often called EmONC needs assessments.

1.1 Overview of indicators

In the sections below, we present a series of indicators for monitoring progress in the prevention of maternal and perinatal deaths. Their order is based on the logic that, for women to receive prompt, adequate treatment for complications of pregnancy and childbirth, facilities for providing EmOC must:

- exist and function,
- be geographically and equitably distributed,
- be used by pregnant women,
- be used by women with complications,
- provide sufficient life-saving services, and
- provide good-quality care.

Thus, the indicators answer the following questions:

- Are there enough facilities providing EmOC?
- Are the facilities well distributed?
- Are enough women using the facilities?
- Are the right women using the facilities?
- Are enough critical services being provided?
- Is the quality of services adequate?

The first indicator therefore focuses on the availability of EmOC services. Adequate coverage means that all pregnant women have access to functioning facilities. Once availability is established, questions of use can be addressed. Even if services are functioning, if women with complications do not use them (for whatever reason), their lives are in danger. Finally, the indicators cover the performance of health services. After all, many women die in hospital: some of them die because they were not admitted until their condition was critical; many others, however, die because they did not receive timely treatment at a health facility or because the treatment they received was inadequate.

Table 2 shows the six EmOC indicators issued in 1997, with some minor modifications suggested by the 2006 technical consultation on the basis of the participants' expertise and experience in various countries:

- The recommendation for the mixture of basic and comprehensive EmOC facilities per 500 000 population has been changed from 'at least one comprehensive and four basic EmOC facilities per 500 000 population' to 'at least five EmOC facilities including at least one comprehensive facility per 500 000 population'.
- The minimum acceptable level for indicator 3 was removed, and countries are advised to use their own targets.
- The name of indicator 6 has been updated from: 'case fatality rate' to 'direct obstetric case fatality rate'.

Table 2. The original six emergency obstetric care indicators, with modifications

Indicator	Acceptable level
1. Availability of emergency obstetric care: basic and comprehensive care facilities	There are at least five emergency obstetric care facilities (including at least one comprehensive facility) for every 500 000 population
2. Geographical distribution of emergency obstetric care facilities	All subnational areas have at least five emergency obstetric care facilities (including at least one comprehensive facility) for every 500 000 population
3. Proportion of all births in emergency obstetric care facilities[a]	(Minimum acceptable level to be set locally)
4. Meeting the need for emergency obstetric care: proportion of women with major direct obstetric complications who are treated in such facilities[a]	100% of women estimated to have major direct obstetric complications[b] are treated in emergency obstetric care facilities
5. Caesarean sections as a proportion of all births[a]	The estimated proportion of births by caesarean section in the population is not less than 5% or more than 15%[c]
6. Direct obstetric case fatality rate[a]	The case fatality rate among women with direct obstetric complications in emergency obstetric care facilities is less than 1%

Adapted from reference (1).

[a] While these indicators focus on services provided in facilities that meet certain conditions (and therefore qualify as 'emergency obstetric care facilities'), we strongly recommend that these indicators be calculated again with data from all maternity facilities in the area even if they do not qualify as emergency obstetric care facilities.

[b] The proportion of major direct obstetric complications throughout pregnancy, delivery and immediately postpartum is estimated to be 15% of expected births.

[c] See section 2.5 for a discussion of this range.

These indicators refer to the availability and use of facilities and the performance of health-care systems in saving the lives of women with obstetric complications. The acceptable levels of most of the indicators are specified as minimum and/or maximum and are necessarily approximate. They are based on the best data, estimates, and assumptions currently available. The acceptable levels can be adapted according to countries' circumstances; however, if they are modified, it is important to report the findings in relation to the standard levels suggested here, so that the results can be compared with those from other studies.

These indicators can be used to set priorities for programmes as well as to monitor them. Programme planners and managers responsible for reducing the number of maternal deaths can start at the top of the list and work down. When they reach an indicator for which the country does not meet the acceptable level, appropriate interventions are needed. For example, if a country meets the acceptable levels for the number and distribution of EmOC facilities but not for their use, interventions are needed to understand and improve use.

Table 3 sets out two new indicators that were adopted at the 2006 technical consultation on the guidelines. These reflect the evolution of the maternal health field: indicator 7 reflects the renewed focus on the quality of obstetric care and the association between maternal and neonatal health, and indicator 8 reflects indirect causes of maternal deaths in some countries, such as malaria.

Table 3. New indicators for emergency obstetric care

Indicator	Acceptable level
7. Intrapartum and very early neonatal death rate	Standards to be determined
8. Proportion of maternal deaths due to indirect causes in emergency obstetric care facilities	No standard can be set

These indicators should also be calculated with data for all facilities in the area, if possible.

1.2 Signal functions of EmOC

For the purposes of assessing and monitoring the level of care that a facility is actually providing, it is helpful to use a short list of clearly defined 'signal functions'. These are key medical interventions that are used to treat the direct obstetric complications that cause the vast majority of maternal deaths around the globe. The list of signal functions does not include every service that ought to be provided to women with complicated pregnancies or to pregnant women and their newborns in general; that information is provided in other publications (94-96). The signal functions are indicators of the level of care being provided. Furthermore, some critical services are subsumed within these signal functions. For example, if caesarean sections are performed in a facility, this implies that anaesthesia is being provided. While the signal functions are used to classify facilities on the basis that these functions have been performed in the past 3 months, it is helpful to use a more inclusive list of functions and supplies when assessing need for EmOC in order to plan programmes.

The list of signal functions in this edition of the handbook has been updated with the addition of the new function: 'perform neonatal resuscitation' at basic and comprehensive levels. In addition, the name of the second signal function has been changed from 'administer parenteral oxytocics' to 'administer uterotonic drugs'. The list of signal functions in Table 4 includes a few examples of drugs or equipment that could be used when performing the signal functions; however, the drugs and procedures mentioned are illustrative and not exhaustive. For a complete list of recommended procedures and drugs, please refer to WHO's *Managing complications in pregnancy and childbirth: a guide for midwives and doctors (95) and Managing newborn problems: a guide for doctors, nurses and midwives* (96).

Table 4. Signal functions used to identify basic and comprehensive emergency obstetric care services

Basic services	Comprehensive services
(1) Administer parenteral[1] antibiotics	Perform signal functions 1–7, plus:
(2) Administer uterotonic drugs (i.e., parenteral oxytocin[2])	(8) Perform surgery (e.g., caesarean section)
(3) Administer parenteral anticonvulsants for pre-eclampsia and eclampsia (i.e., magnesium sulfate).	(9) Perform blood transfusion
(4) Manually remove the placenta	
(5) Remove retained products (e.g. manual vacuum extraction, dilation and curettage)	
6) Perform assisted vaginal delivery (e.g. vacuum extraction, forceps delivery)	
(7) Perform basic neonatal resuscitation (e.g., with bag and mask)	
A basic emergency obstetric care facility is one in which all functions 1–7 are performed. A comprehensive emergency obstetric care facility is one in which all functions 1–9 are performed.	

Please refer to the following websites for recommended procedures for each signal function listed above:

- *Managing complications in pregnancy and childbirth: a guide for midwives and doctors*: http://www.who.int/making_pregnancy_safer/documents/9241545879/en/index.html
- Cochrane reviews: http://www.cochrane.org/reviews

Adapted from reference (1).

[1] Injection or intravenous infusion.

[2] A recent WHO technical consultation (November 2008) to develop guidelines for interventions for postpartum haemorrhage, reviewed all available evidence, and identified parenteral oxytocin as the recommended choice of drug for prevention of post-partum haemorrhage. Ergometrin (second line) and misoprostol (third line) as options that could only be used where oxytocin is not available. Oxytocin should therefore be available in facilities to be defined as an EmOC facility.

Table 5 shows which signal functions are used to treat the major direct obstetric complications that cause most maternal deaths. Box 1 lists a number of questions frequently asked about the signal functions, with their answers.

Table 5. Signal functions and related complications

Major obstetric complication	Signal function
Haemorrhage	*Antepartum:* Perform blood transfusion Perform surgery (e.g., caesarean section for placenta praevia) *Postpartum:* Administer uterotonic drugs Perform blood transfusion Perform manual removal of placenta Perform removal of retained products Perform surgery (hysterectomy) for uterine rupture
Prolonged or obstructed labour	Perform assisted vaginal delivery Perform surgery (caesarean section) Administer uterotonic drugs Perform neonatal resuscitation
Postpartum sepsis	Administer parenteral antibiotics Remove retained products Perform surgery for pelvic abscess

Major obstetric complication	Signal function
Complications of abortion	*For haemorrhage:* Perform blood transfusion Remove retained products *For sepsis:* Administer parenteral antibiotics Remove retained products *For intra-abdominal injury:* Administer parenteral antibiotics Perform blood transfusion Perform surgery
Pre-eclampsia or eclampsia	Administer parenteral anticonvulsants Perform neonatal resuscitation Perform surgery (caesarean section)
Ectopic pregnancy	Perform surgery Perform blood transfusion
Ruptured uterus	Perform surgery Perform blood transfusion Administer parenteral antibiotics
Newborn distress (intrapartum)	Perform newborn resuscitation Perform surgery (caesarean section)

Adapted from reference (97).

Box 1. Frequently asked questions about signal functions

- *Why use parenteral administration, rather than oral?* In an emergency, there must be a quick physiological response to antibiotics when needed. In addition, the key life-saving drugs for main complications can only be administered parenteral. Therefore, the definition specifies parenteral rather than oral administration.

- *Why were these items selected as signal functions and not others?* Other items have been discussed as signal functions, such as use of the partograph, active management of the third stage of labour, availability of services 24 h/day, 7 days/week, intravenous fluids, anaesthesia and plasma expanders. Use of the partograph and active management of the third stage of labour are both part of good obstetric practice and should be used for all women in labour to prevent prolonged, obstructed labour and its sequelae, such as obstetric fistula. Availability of services 24 h/day, 7 days/week is a function of management and planning rather than a life-saving skill. Intravenous fluids are implicit in the signal functions that require parenteral drugs. Anaesthesia and plasma expanders are also implicit in the availability of obstetric surgery, e.g. caesarean section. Although the eight original obstetric signal functions do not form an exhaustive list, they were chosen because of the role they play in the treatment of the five major causes of maternal death.

- *Where can I obtain a more complete list of functions and equipment for maternal and newborn health?* The websites of WHO (http://www.who.int/reproductive-health/publications/pcpnc/) (98), the Johns Hopkins Program for International Education in Gynecology and Obstetrics (http://www.jhpiego.org/scripts/pubs/category_detail.asp?category_id=24) (99) and AMDD (http://www.amddprogram.org/resources/DesignEvalMM-EN.pdf) (100) provide links to manuals with more complete inventories of drugs, supplies and equipment for health centres and hospitals.

- *Why don't the signal functions include specific drugs or equipment?* We hope that international standards of care will be used to determine in practice which drugs and types of equipment are used to perform the signal functions. These standards are dynamic and can change over long periods with technological progress. We encourage use of the WHO guidelines of care, the Reproductive Health Library (http://www.who.int/rhl), the Cochrane Collaboration systematic reviews and other international resources. The list of signal functions in Table 4 does include a few examples of drugs or equipment that could be used, but the list of options is not exhaustive.

- *Why use the 3–month reference period as opposed to a longer time?* The 3–month reference period was chosen because it provides a snapshot of the current functioning of a facility. It was also selected because recall is less accurate over longer periods and because skills (such as vaginal delivery with a vacuum extractor, caesarean section or manual removal of the placenta) are more likely to be maintained if they are used frequently. Monitoring the delivery of services and stock outs are considerations for health service planners

- *What should we do when a facility that is being monitored provides basic or comprehensive emergency obstetric care irregularly because of one or two missing signal functions?* This is not a problem in a facility-based survey or a needs assessment, as the technical guideline is to assess the performance of the signal functions in the most recent 3–month period. It becomes an issue when monitoring emergency obstetric care status over time. It is not uncommon for a facility to change its status when it has a small caseload or frequent staff turnover. For pragmatic and programmatic reasons in regional or national monitoring, we recommend annual reclassification. District managers can monitor their own performance more frequently and should be encouraged to do so in order to assess their functioning and to provide data for decision-making to improve services.

- *What do we do if a signal function is performed during the 3–month reference period but not in an obstetric context?* Most of the signal functions are likely to be performed only in an obstetric context, but parenteral antibiotics or anticonvulsants and blood transfusions can be administered in other contexts. In an assessment of an institution's capacity and performance for delivering emergency obstetric care, the signal functions should have been performed in an obstetric context.

1.3 Use of the EmOC indicators

As shown in Table 1, the indicators for EmOC have been used in more than 50 countries to plan programmes and to monitor and evaluate progress in reducing maternal mortality. Some countries have conducted more detailed needs assessments that also include other indicators and information useful for planning safe motherhood programmes. (For sample data collection forms, refer to: http://www.amddprogram.org/). In other countries, more focused needs assessments have been conducted, data collection being limited to the indicators on forms similar to those in Appendix A. The more focused components of needs assessments described in this handbook can be integrated into needs assessments for other health issues, such as prevention of mother-to-child transmission of HIV infection, or for a health system overall. Regardless of whether the EmOC needs assessment is more detailed or more focused, it will yield data that can be used to monitor and evaluate progress in reducing maternal mortality and provide valuable information for health ministries and health managers to shape strategies and activities to improve maternal health outcomes.

In more and more countries, the EmOC indicators have been integrated into routine health management information systems to track progress at district, regional and national levels. While periodic needs assessments and data collection systems set up outside health management information systems may play an important role, integration of the EmOC indicators into health management information systems is a more efficient way of monitoring the availability and use of such care over time. Countries that are intent on reducing maternal mortality should strive to include these indicators into their health management information systems.

2. Indicators for EmOC

Below, the explanation of each EmOC indicator includes a description, the recommended minimum or maximum acceptable level (if appropriate), background information, advice on data collection, analysis, interpretation and presentation, and suggestions for supplementary studies related to the indicator. Worksheets are provided in Appendix A to facilitate the calculations.

2.1 Indicator 1: Availability of EmOC services

Description

The availability of EmOC services is measured by the number of facilities that perform the complete set of signal functions in relation to the size of the population. When staff has carried out the seven signal functions of basic EmOC in the 3-month period before the assessment, the facility is considered to be a fully functioning basic facility. The facility is classified as functioning at the comprehensive level when it offers the seven signal functions plus surgery (e.g. caesarean) and blood transfusion (Table 4).

To determine the minimum acceptable number of basic and comprehensive EmOC facilities for a country or region (depending on the scope of the assessment), begin by dividing the total population by 500 000. This is the minimum acceptable number of comprehensive facilities. Then, multiply that number by 5 to calculate the overall minimum number of facilities, both basic and comprehensive. These numbers should be compared with the actual number of facilities found in order to classify the services as fully functioning basic or comprehensive.

The results of this exercise can also be expressed as a percentage of the minimum acceptable number of basic or comprehensive care facilities. To calculate the percentage of the recommended minimum number of facilities that is actually available to the population, divide the number of existing facilities by the recommended number and multiply by 100. A similar exercise will determine what percentage of the recommended minimum number of comprehensive facilities is available.

Minimum acceptable level

For every 500 000 population, the minimum acceptable level is five EmOC facilities, at least one of which provides comprehensive care.

Background and discussion

To save women with obstetric complications, the health system must have facilities that are equipped, staffed and actually provide EmOC. The composite nature of this indicator tells us not only whether the signal functions were performed recently; it also indirectly tells us about the availability of equipment and drugs and the availability and skill of the staff.

The number of EmOC facilities required to treat complications depends on where facilities are located, where people live and the size and capabilities of the facilities. One could count only facilities where all nine EmOC procedures are performed, but that would give the wrong message, implying that only hospitals with sophisticated equipment and specialist physicians can reduce maternal mortality. A promising intervention is the upgrading of health centres and other small facilities to enable them to provide basic EmOC (36, 65). The ‘health centre intrapartum care strategy’, proposed in the Lancet series on maternal health, suggests that all births take place in a facility; this is likely to be one of the more cost-efficient strategies for reducing maternal mortality, provided that the quality of care is adequate (101).

A health centre that provides basic EmOC can prevent many maternal and perinatal deaths. For some conditions (e.g. some cases of postpartum haemorrhage), basic care will be sufficient. For other complications (e.g. obstructed labour), higher-level treatment is required. Even then, first aid can save lives, because a woman’s condition can be stabilized before she is referred. For example, a woman with obstructed labour cannot be treated in a health centre that provides only basic care: she needs a caesarean section.

The chances of the mother and her newborn of surviving a caesarean section are, however, greatly improved if she does not arrive at the hospital dehydrated and infected. To prevent this, intravenous fluids and antibiotics can be administered at the health centre, especially when the trip to the hospital is long. The WHO guidelines for primary health care, *Pregnancy, childbirth, postpartum, newborn care: a guide to essential practice* (98) recommends that women with complications be given the first dose of antibiotics, oxytocin, or magnesium sulfate (as required) before referral.

In the previous edition of this document, the recommended minimum ratio of EmOC facilities to 500 000 population was one comprehensive and four basic facilities. Since 1997, experience in more than 40 countries has shown that health systems often have at least one comprehensive facility per 500 000 population and sometimes more. Fully functioning basic facilities, however, are much less common. On the basis of this experience, the group decided that the ratio of one comprehensive to four basic facilities might be less important than having at least one comprehensive facility and emphasizing the number of facilities per 500 000 population.

A recent analysis of 24 national or near-national needs assessments showed that all but two countries met the minimum acceptable level of one comprehensive EmOC facility per 500 000 population. The countries included some with high maternal mortality ratios, but they had very few fully functioning basic facilities (102). In the United States (the only country with a relatively low maternal mortality ratio in which the EmOC indicators have been measured), no basic facilities were identified, but there are many comprehensive facilities, with a ratio of one comprehensive facility for 100 000 population (66).

Implicit in the definition of an EmOC facility is that the signal functions be available to women at any hour of the day, every day of the week. If a woman needs a caesarean section at midnight on a Saturday, she should have the same quality of care as a woman requiring the same service at 10:00 on a Wednesday morning. The primary obstacle to the provision of EmOC 24 h/day, 7 days/week in many countries is a lack of essential cadres of health workers (i.e. midwives, practitioners who can operate anaesthetists and laboratory technicians). When facilities are not able to provide the signal functions 24 h/day, 7 days/week, local and other management must search for creative solutions. Some may involve simple rotation of personnel, but others may require a policy review of what cadre of provider is authorized and trained to provide EmOC, or additional budgetary allocations. In some situations, accommodation for health practitioners has been built on hospital grounds to allow continuous service.

Data collection and analysis

This indicator depends on the classification of a facility's EmOC status after direct inspection. Often, a facility is assumed to be functioning, but a visit shows that the reality is quite different. The important distinction between the way a facility is supposed to function and what it actually does is illustrated by a case study in Uganda. In 2003, the need for EmOC was assessed, in order to provide the Government with background for drawing up an operational strategy to reduce maternal deaths. Within the health infrastructure plan in Uganda, district hospitals and health centres IV should be able to provide comprehensive EmOC. The assessment showed, however, that only 21 of the 32 hospitals assessed (65%) were comprehensive, while the other 11 functioned at the basic level. Of the 36 health centres IV visited, only two (6%) functioned at the comprehensive level and another two at the basic level. Health centres III theoretically provide basic EmOC, but only 5 (4%) of the 129 assessed functioned at their intended level. The results—particularly which signal functions were missing—were used to prepare the annual plan for the sector-wide approach, which called for a national effort to improve EmOC (46).

In calculating this indicator, the number of functioning facilities is compared with the size of the population. The most recent census should be used to determine the population size in a given area. If the last census is more than 5 years old, national institutes of statistics are likely to have projections that the government (including the ministry of health) uses for planning. Recent movement of many trained staff into or out of a country might have to be taken into consideration.

The minimum acceptable level for Indicator 1 has been defined in relation to the population rather than births because most health planning is based on population size. If, however, it is judged more appropriate to assess the adequacy of EmOC services in relation to births, the comparable minimum acceptable level would be five facilities for every 20 000 annual births (including at least one comprehensive facility).

If a country has a mix of public and private facilities, a decision must be made about whether to collect data from all of them or to focus on one sector (generally the public sector). Only by including the private sector, however, will there be a complete picture of how well the health system functions and the overall levels of availability, use and quality of care. Because the indicators are based on population estimates (total population, for example), it makes sense that all health facilities (or a representative sample) be selected for the assessment. The more a country relies on private facilities for EmOC, the more important it is to include the private sector. As an illustration of this point, a needs assessment conducted in Benin in 2003 showed that one fourth of facilities providing comprehensive EmOC and almost all the facilities functioning at the basic level were privately operated (7).

Interpretation and presentation

If, in the aggregate, a country or region does not have five EmOC facilities (including at least one comprehensive facility) per 500 000 population, the overall minimum acceptable level of EmOC services is not met. In this case, a high priority is to increase the number of functioning facilities until at least the minimum level is met. This may be done in different ways, e.g. by upgrading existing facilities or building new facilities, or some combination of the two.

If the overall minimum acceptable level of EmOC services is met, it is reasonable to conclude that, in the aggregate, an acceptable minimum number of facilities currently exists. The next step would be to look at the geographical distribution of the facilities (Indicator 2).

We strongly recommend that, in addition to looking at the ratio of facilities to population, data on performance of the signal functions be presented in terms of the proportion of facilities providing each of the signal functions, as illustrated in Figure 1. Such data are extremely useful for planning and setting priorities for interventions. Figure 1 shows that in Benin in 2003, not all hospitals that provided obstetric surgery also had the capacity to transfuse blood. Furthermore, only 9% of health centres but almost 90% of hospitals removed retained products. Today, manual vacuum aspiration is often used to treat complications of abortion by mid-level professionals at health centres and district hospitals (103). This procedure reduces the need for referral, which often entails considerable expense for the family, life-threatening delays and even deaths.

In some countries certain signal functions are virtually missing because they are not included in pre-service training of health personnel or national treatment protocols. If a signal function is systematically absent in a country, it is possible to use the designation ‘Comprehensive minus 1’ or ‘Basic minus 1’ as a temporary measure, while policies are reviewed and programmatic interventions planned to remedy the lack.

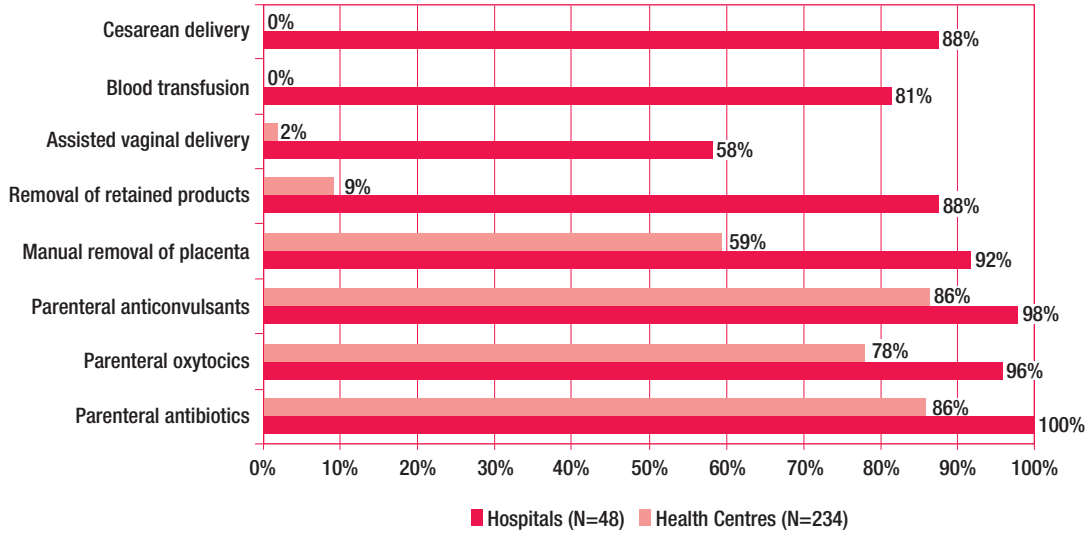
Supplementary studies

Reasons for not performing signal functions

There are a number of possible reasons that a health centre or small hospital does not qualify as a basic EmOC facility. Very often, it is the result of some management problem. When determining a facility’s EmOC status, consider the following for each signal function:

- Is staff at the facility trained and confident in their skills to perform the service?
- Are the cadres of staff working at the facility or the facility itself authorized to perform the signal function?
- Are the requisite supplies and equipment in place and functioning?
- Were there cases for which the use of a particular signal function was indicated?

Figure 1. Proportion of health facilities in which each signal function was performed during the past 3 months, Benin, 2003



From Ministère de la Santé Publique du Bénin, 2003, cited in references (6, 104)

The last explanation refers to the fact that a facility may have a low caseload, with the result that there might have been no need for one of the signal functions during the 3-month period. The question of case load, in turn, could be investigated by determining whether the catchment population is too small given the incidence of the complication in question, if access is a serious problem for reasons related to information, cost, distance, transport or cultural practices, or if bypassing this facility for another, better-functioning facility is common practice.

When data on signal functions are presented as shown in Figure 1, it may be possible to see a pattern at the country or district level, e.g. whether a particular signal function is not being performed. It would be useful to enquire further, for example by discussing the issue with facility staff to learn what they perceive the problems to be. That will not elucidate why women use or do not use a particular facility; that kind of information can be derived only from women in the community. Focus groups are often used to collect this kind of information. Community surveys might also be informative, but they are more difficult and expensive to conduct than focus groups.

2.2 Indicator 2: Geographical distribution of EmOC facilities

Description

The second indicator is calculated in the same way as the first, but it takes into consideration the geographical distribution and accessibility of facilities. It can help programme planners to gather information about equity in access to services at subnational level.

To determine the minimum acceptable number of basic and comprehensive facilities, begin by dividing the subnational (e.g. provinces, states or districts) population by 500 000. This will give you the minimum acceptable number of comprehensive EmOC facilities for the subnational area. Then, multiply that number by 5 to calculate the overall minimum number of facilities, both basic and comprehensive, for the subnational area. To calculate the percentage of the recommended minimum number of facilities that is actually available to the subnational population, divide the number of functioning EmOC facilities by the recommended number and multiply by 100. A similar exercise will determine what percentage of the recommended minimum number of comprehensive EmOC facilities is available.

To determine the percentage of subnational areas that have the recommended number of EmOC facilities (including the minimum number of comprehensive facilities) for their population size, the number of subnational areas with the recommended minimum number is divided by the number of subnational areas and multiplied by 100.

Minimum acceptable level

To ensure equity and access, 100% of subnational areas should have the minimum acceptable numbers of EmOC facilities or at least five facilities (including at least one comprehensive facility) per 500 000 population.

Background and discussion

Facilities that offer EmOC must be distributed so that women can reach them. If facilities are clustered around a capital city or only in large commercial centres, women in more remote regions will experience delay in getting treatment, which might threaten their survival and the survival of their newborns. Table 6 shows the estimated average time from onset of the major obstetric complications to death. It can be seen that the average time to death is 12 hours or more, although postpartum haemorrhage can kill faster. Therefore, lives could be saved at rural health facilities with injectable uterotonics and rehydration with intravenous fluids.

Table 6. Estimated average interval between onset of major obstetric complications and death, in the absence of medical interventions

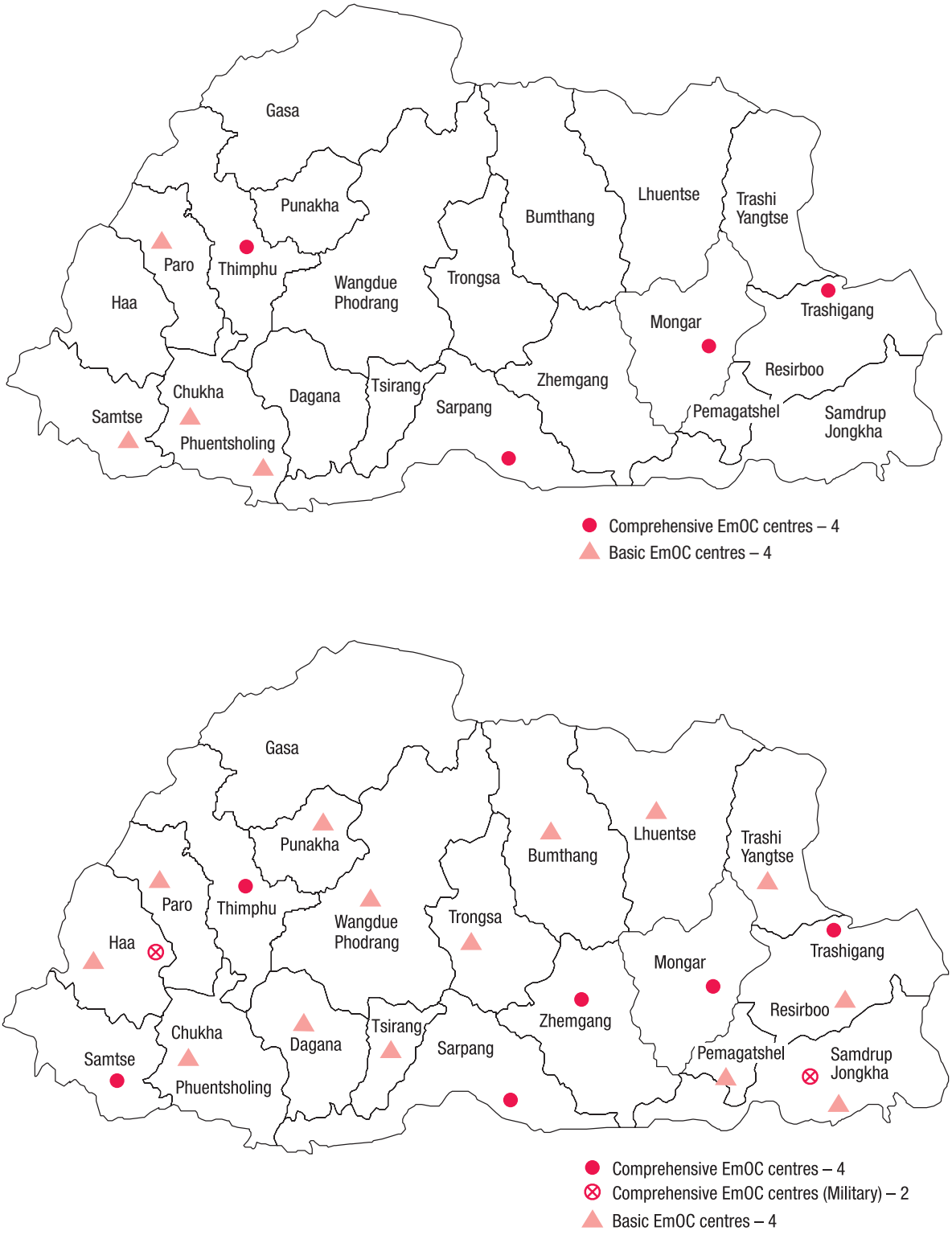
Complication	Hours	Days
Haemorrhage • Postpartum • Antepartum	 2 12	
Ruptured uterus		1
Eclampsia		2
Obstructed labour		3
Infection		6

From Maine, D. *Prevention of Maternal Deaths in Developing Countries: Program Options and Practical Considerations, in International Safe Motherhood Conference*. 1987. Unpublished data: Nairobi.

In view of the urgency of maternal complications, EmOC services must be distributed throughout a country. The distribution can be checked efficiently by calculating the number of facilities available in subnational areas. An analysis at regional, state, provincial, district or other level often reveals discrepancies in health services equity. The ratio of EmOC facilities to the total population is often higher than for smaller geographical areas. In Nicaragua in 2001, for instance, the coverage of the combined populations of nine administrative regions with comprehensive EmOC facilities more than met the required minimum (225%). When the regions were examined individually, however, only four had the minimum acceptable level of comprehensive care (102). A needs assessment in Mauritania in 2000 showed that the number and distribution of facilities providing EmOC were both insufficient. Only eight of the 67 facilities surveyed provided such care (seven provided comprehensive care and one provided basic care). More than half of all the comprehensive EmOC facilities were in the capital city, Nouakchott, and 9 of 13 regions had no facilities (105).

In some situations, especially where the population is widely dispersed and travel is difficult, it may be advisable for governments to exceed the minimum acceptable level. In Bhutan, for example, an assessment of needs for EmOC revealed problems in the geographical distribution of facilities, and the Government promptly upgraded facilities to improve the availability of care (Figure 2).

Figure 2. Emergency obstetric care facilities in Bhutan



From UNICEF, Department of Health Services, and Ministry of Health and Education. *Semi-annual reports to AMDD, Jan–June 2002 & July–Dec 2002. Unpublished data. 2002*: Bhutan, cited in reference (104).

Data collection and analysis

Many of the same issues in data collection that exist for Indicator 1 are also relevant for Indicator 2. One issue is, however, more likely to arise in subnational than in national coverage: How many and what type of EmOC facilities are recommended for populations smaller than 500 000? No one answer fits all situations, but 'prorating' would be advised, e.g. if the population is close to 250 000, three facilities would be acceptable (rounding up is the more conservative response). Whether one of the three should be comprehensive depends on the location and proximity (distance in terms of time) of comprehensive facilities in neighbouring areas.

Emergency obstetric care facilities in subnational areas can also be stratified by management, to determine the distribution of public and private facilities. This analysis can be particularly revealing in an area with private but no government facilities, where government facilities offer free services and private facilities charge user fees, or where government facilities charge and mission hospitals are free.

Interpretation and presentation

If subnational geographical areas do not meet the minimum acceptable ratio, underserved areas should be targeted and resources devoted to improving the availability of services.

The numbers of comprehensive and basic EmOC facilities per subnational population can be presented in either tables or maps on which subnational areas are shaded according to the level of coverage (100% or more and at increments of less than 100%).

Supplementary study

Indicators of access to EmOC include distance and time. As digital mapping and geographical information systems become more widely available, use of this indicator is likely to increase. A reasonable standard for the availability of services can be established, such as having basic and comprehensive facilities available within 2–3 hours of travel for most women. In the past, determining the distance between facilities and where people live was cumbersome; however, geographical information systems make calculations of distance and travel time much easier, and measurement methods will become more consistent (106).

Maps that show the EmOC status of facilities, the distance of communities from basic and comprehensive facilities (both in travel time and in relation to road networks), population dispersion and density and other features that show inequities in terms of access to care can be effective advocacy and planning tools.

2.3 Indicator 3: Proportion of all births in EmOC facilities

Description

Indicator 3 is the proportion of all births in an area that take place in EmOC health facilities (basic or comprehensive). The numerator is the number of women registered as having given birth in facilities classified as EmOC facilities. The denominator is an estimate of all the live births expected in the area, regardless of where the birth takes place.

We strongly recommend a parallel indicator: the proportion of births in all health facilities in the area, or 'institutional births' or 'institutional deliveries'. We recommend this in order to give a more complete picture of the patterns of use of the health system (see Figure 3). The numerator is always service statistics for deliveries in the facilities, while the denominator—the expected number of live births—is usually calculated from the best available data and by multiplying the total population of the area by the crude birth rate of the same area. Other methods for calculating the expected number of live births can also be used.

Minimum acceptable level

No minimum acceptable level is proposed. In the previous edition of this handbook, the minimum acceptable level was set at 15% of expected births. In the intervening years, many governments have committed themselves to increasing the proportion of women who give birth in health facilities, and some are aiming for 100%. Therefore, the minimum target for this indicator should be set by national or local governments.

Background

Indicator 3 was originally proposed to determine whether women are using the EmOC facilities identified by indicators 1 (Availability of EmOC services) and 2 (Geographical distribution of EmOC facilities), and it serves as a crude indicator of the use of obstetric services by pregnant women. In situations where record systems are inadequate to collect data for Indicator 4 (Met need for EmOC), the number of women giving birth in health facilities is almost always available. Use of these data can give administrators a rough idea of the extent to which pregnant women are using the health system, especially when combined with information on which facilities provide EmOC.

The optimal long-term objective is that all births take place in (or very near to) health facilities in which obstetric complications can be treated when they arise. Many countries have made having 100% of deliveries in institutions their main strategy for reducing maternal mortality. As they move closer to that objective, other problems arise. In many countries, health systems are unable to cope with the added patient load without major expansion in facilities and staff, and managers have limited information on how health facilities are functioning. Giving birth in a health facility does not necessarily equate with high-quality care or fewer maternal deaths. Smaller health facilities may not have adequately trained staff, or staff may not have the equipment or the authority to treat life-threatening complications. Many facilities do not function well because of poor management, which should be remedied before the number of births in the facility is increased greatly (107, 108). For these reasons, the EmOC status of health facilities is included in Indicator 3 (Proportion of all births in EmOC facilities), and we recommend that this indicator be calculated and interpreted with the other indicators.

Data collection and analysis

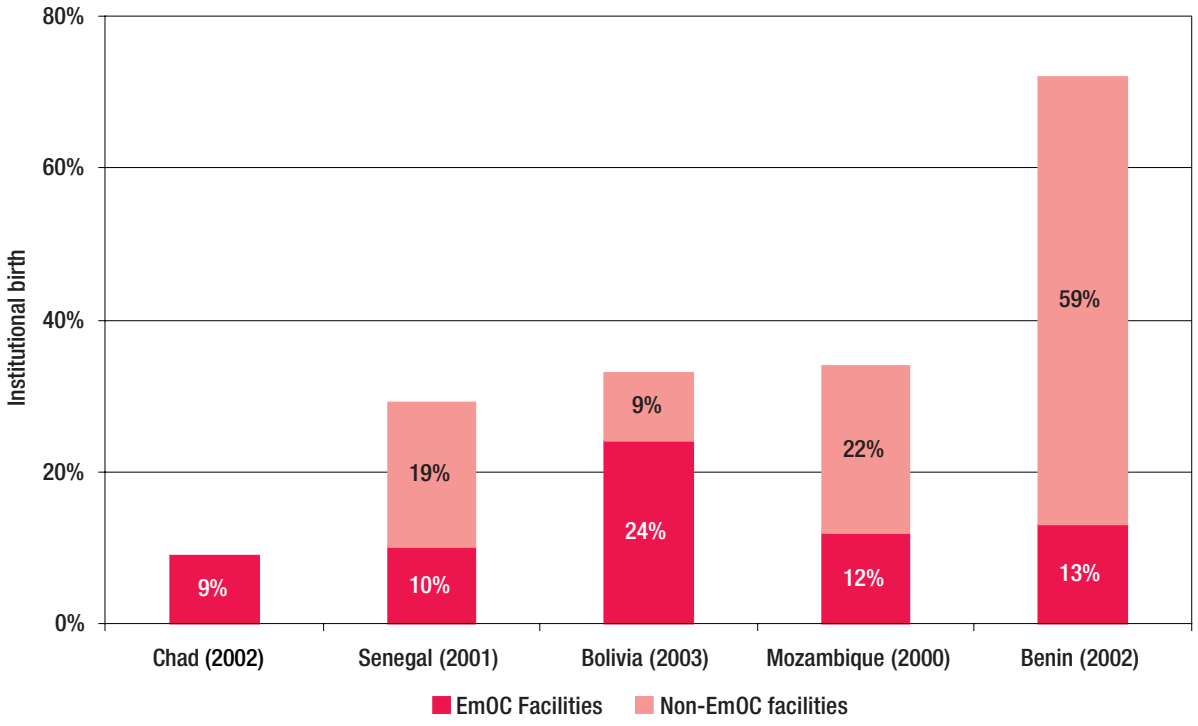
Although the name of the indicator is 'Proportion of births in EmOC facilities,' in practice the numerator is the number of women giving birth and not the number of infants born. We recognize that the number of births will be slightly higher than the number of women giving birth, because of multiple births; however, the extra effort needed to count births rather than women giving birth might not be necessary, nor is it likely to change the conclusions drawn from the results. The numbers of women giving birth in facilities are obtained from health facility record systems and are often collected for monthly reports to the government. The EmOC status of the health facility in which the delivery takes place is available from the results of routine monitoring or needs assessments under Indicator 1.

The total expected number of births in an area is based on information about the population and the crude birth rate. National statistics offices tend to base population projections on the results of their most recent census. They may also have regional crude birth rates. If not, the crude birth rate is often available from national population-based surveys, such as Demographic and Health Surveys. When possible, estimates for the specific geographical area should be used rather than applying the national crude birth rate to all regions. Regions are often selected for interventions or programmes because of special needs and therefore tend to have poorer indicators than at national level. Usually, the birth rate in poorer areas is higher than the national average, so that use of the national average would result in an underestimate of the expected number of births, and the proportion delivered in facilities would therefore be overestimated.

Parallel analysis of the proportion of all births in all the facilities surveyed allows comparison of the proportion of births in EmOC facilities with the proportion of births in all facilities. This indicates the extent to which other facilities provide delivery services. Figure 3 shows that, for example in Chad all the births in facilities were in EmOC facilities, while in Bolivia, Mozambique and Senegal, the proportions of births in non-EmOC facilities added 9–22%. In contrast, in Benin, only a small proportion of institutional births occurred in facilities where most obstetric complications could be treated.

This indicator can also be analysed by level of facility (hospital and non-hospital), by ownership or management (public and private) and by subnational area, in order to determine where women are delivering. Are women more likely to deliver in private or government facilities? Are there more institutional deliveries

Figure 3. Proportions of all births in EmOC facilities and all surveyed facilities



From references (7, 37, 56).

in certain subnational areas? Disaggregating data in this way can provide more specific information about which interventions are most needed, and where.

Interpretation and presentation

Overall, this indicator shows the volume of maternity services provided by facilities. If there appears to be under-use, the reasons should be explored. To increase use, emphasis should be placed on enabling women with complications to use EmOC facilities. The first goal of programmes to reduce maternal mortality should be to ensure that 100% of women with obstetric complications access to functioning emergency facilities.

Supplementary studies

At the local level, additional studies to understand the use of services better are almost always useful. Which groups of women are using the services? Which women are not, and why? Clearly, the answers to these questions have important implications for public health and human rights.

Which women are not coming to the facilities?

Even if the use of health facilities (including EmOC facilities) is fairly high, it is worthwhile investigating which women are not using them. Certain factors strongly affect use of services in a particular area, such as distance to the facility, prevalence of ethnic or religious minority groups, level of education (often an indication of social status), the reputation of the facility and poverty. Information on some of these factors, such as residence, may already be available in health facility records, and records can be reviewed to determine whether women come from all parts of the catchment area or only from the town in which the facility is located. For factors for which information is not routinely recorded, a study can be conducted. For example, students or staff members can be posted in a maternity ward for a few weeks or a month to record relevant information. It would be important, however,

to train and supervise these data collectors to ensure that they follow confidentiality rules, treat patients and their families respectfully and ask for information in an unbiased manner.

Ideally, the profile of the women who use the services can be compared with that of women in the population (national population-based surveys) in order to determine the characteristics of the women who are underrepresented as users of the facility (109).

Why do some women not use the facility?

Once the groups of women who are underrepresented in the facility have been identified, it is important to find out why. One should not assume that they know the reason, even if they have grown up in the region. If the assumption is wrong, any 'corrective action' taken will probably not work (110). Women should be questioned, either through interviews or in focus groups; or studies to compare subpopulations could be conducted, after adjustment for need or statistical control for confounding factors.

Various activities can be used to improve use, depending on the factors that discourage it.

- If focus group discussions show that people lack basic information about obstetric complications, a community education programme would be in order. The precise form of the programme would be determined by local circumstances, but it should be aimed not only at pregnant women but also at the people who influence their decision to seek care, such as other women of reproductive age, partners, mothers-in-law and traditional birth attendants.
- If transport from a village to the EmOC facility is a problem, the community could be mobilized to coordinate the use of existing vehicles.
- If poor roads are a barrier to care, the local government should be approached to improve them. If shortages of supplies or poor overall quality of care make people feel that going to the hospital is not worth the trouble, solutions to the problems should be sought.
- If women are reluctant to use the services because of practices they have previously experienced or have heard about, those practices can be discussed with staff at the facility to determine how the facility norms can be adapted to local customs or desires.
- If the cost of services is an obstacle, medical emergency funds or insurance schemes have proven successful in some places (111).

Who attends births in facilities?

Deliveries in institutions are not necessarily attended by skilled birth attendants (112). Therefore, a study could be carried out to see which cadres of workers are involved in deliveries and their level of competence. Providers could be interviewed to determine their understanding; observational studies would allow on-site verification of practices; and retrospective chart reviews would allow an assessment of those aspects of care that should be documented on charts or patient records.

2.4 Indicator 4: Met need for EmOC

Description

'Met need' is an estimate of the proportion of all women with major direct obstetric complications who are treated in a health facility providing EmOC (basic or comprehensive). The numerator is the number of women treated for direct obstetric complications at emergency care facilities over a defined period, divided by the expected number of women who would have major obstetric complications, or 15% of expected births, during the same period in a specified area. The direct obstetric complications included in this indicator are: haemorrhage (antepartum and postpartum), prolonged and obstructed labour, postpartum sepsis, complications of abortion, severe pre-eclampsia and eclampsia, ectopic pregnancy and ruptured uterus. (For the operational definitions of these direct obstetric complications, refer to Box 2.)

As we did for Indicator 3, we strongly recommend that met need be calculated at all health facilities as well as at EmOC facilities, to provide a more complete picture of the use of the health system and where women are being treated.

Box 2. Operational definitions of major direct obstetric complications

Haemorrhage

Antepartum

- severe bleeding before and during labour: placenta praevia, placental abruption

Postpartum (any of the following)

- bleeding that requires treatment (e.g. provision of intravenous fluids, uterotonic drugs or blood)
- retained placenta
- severe bleeding from lacerations (vaginal or cervical)
- vaginal bleeding in excess of 500 ml after childbirth
- more than one pad soaked in blood in 5 minutes

Prolonged or obstructed labour (dystocia, abnormal labour) (any of the following)

- prolonged established first stage of labour (> 12 h)
- prolonged second stage of labour (> 1 h)
- cephalo-pelvic disproportion, including scarred uterus
- malpresentation: transverse, brow or face presentation

Postpartum sepsis

- A temperature of 38 °C or higher more than 24 h after delivery (with at least two readings, as labour alone can cause some fever) and any one of the following signs and symptoms: lower abdominal pain, purulent, offensive vaginal discharge (lochia), tender uterus, uterus not well contracted, history of heavy vaginal bleeding (Rule out malaria.)

Complications of abortion (spontaneous or induced)

- haemorrhage due to abortion which requires resuscitation with intravenous fluids, blood transfusion or uterotonics
- sepsis due to abortion (including perforation and pelvic abscess)

Severe pre-eclampsia and eclampsia

- Severe pre-eclampsia: Diastolic blood pressure ≥ 110 mm Hg or proteinuria ≥ 3 after 20 weeks' gestation. Various signs and symptoms: headache, hyperflexia, blurred vision, oliguria, epigastric pain, pulmonary oedema
- Eclampsia
- Convulsions; diastolic blood pressure ≥ 90 mm Hg after 20 weeks' gestation or proteinuria ≥ 2. Signs and symptoms of severe pre-eclampsia may be present

Ectopic pregnancy

- Internal bleeding from a pregnancy outside the uterus; lower abdominal pain and shock possible from internal bleeding; delayed menses or positive pregnancy test

Ruptured uterus

- Uterine rupture with a history of prolonged or obstructed labour when uterine contractions suddenly stopped. Painful abdomen (pain may decrease after rupture of uterus). Patient may be in shock from internal or vaginal bleeding

From references (95, 97, 98).

Minimum acceptable level

As the goal is that all women who have obstetric complications will receive EmOC, the minimum acceptable level is 100%. Governments may wish to set interim targets once they have a baseline and they have embarked on interventions to improve the availability and use of such care.

Background

Met need is a more refined measure of the use of EmOC than Indicator 3 (Proportion of all births in EmOC health facilities), as it addresses whether the women who really need life-saving obstetric care receive it.

In order to estimate met need for EmOC, one must first estimate the total need, and then compare the number of women with serious obstetric complications who receive emergency care in such facilities. The total need for EmOC is estimated to be 15% of all births, although there has been considerable discussion about the expected number of complications. Studies have produced a range of results:

- A review of studies in various geographical regions based on various definitions and methods have shown levels of met need as low as 1% (113).
- One prospective population-based study in six West African countries showed that 6% of pregnant women had severe direct obstetric complications (114). The authors reported that their findings were likely to be underestimates because the definitions of the complications that they used were linked to medical interventions that might not have been available at all the participating facilities. In addition, they included only direct obstetric complications occurring in late stages of pregnancy and omitted complications of abortion and ectopic pregnancies.
- A systematic review of the prevalence of severe acute maternal morbidity ('near miss' events) based on disease-specific criteria showed a prevalence of 0.8–8.2% (113). Reviewed studies varied in terms of the range and severity of obstetric complications included and the timing of complications (intrapartum and postpartum periods).
- A prospective study of deliveries in India showed a 17.7% incidence of direct obstetric complications during labour. This study did not include complications occurring during pregnancy (such as complications of abortion), so the actual percentage of women with direct complications was probably higher. The authors concluded that 15.3% of women needed EmOC, and 24% more needed non-emergency medical attention (115). A second study in India showed that 14.4% of deliveries were associated with serious complications, but this study too was restricted to complications around the time of childbirth (116). A study of national data for 1991–1992 in the United States, a country with low maternal mortality, showed a total of 18 hospitalizations for obstetric and pregnancy loss per 100 births (117). These findings were confirmed by more recent data (66). Although the results vary, the technical consultation decided to maintain 15% as an average estimate of the frequency of serious direct complications for the purposes of estimating the need for EmOC.

Data collection and analysis

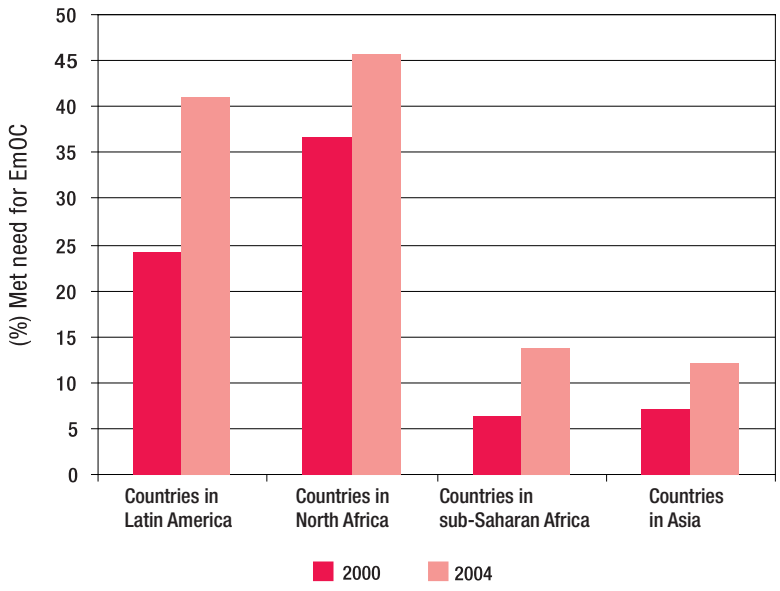
To calculate met need, information is needed on women in these facilities who are treated for the major obstetric complications listed in Box 2. The definitions were derived from WHO (Managing complications in pregnancy and childbirth and Pregnancy, childbirth, postpartum and newborn care) (95,98) and the International Federation of Gynaecology and Obstetrics Save the Mothers Project. Standardization of definitions can be improved by training and supervision. These definitions are critical for training health workers, enumerators or interviewers who collect such data either routinely or as part of an EmOC needs assessment.

Routine maternity record systems in many countries may not register the 'reason for admission' or 'maternal complications', although complications can lead to maternal deaths. Appendix B gives a list of the information needed to calculate the indicators and the types of registers that should be consulted. It also lists items that good registers might include, such as the time of admission and the time of definitive intervention, which are useful for studying the interval between admission and emergency caesarean section as an indicator of hospital efficiency (118).

It is likely that incomplete or poor records will be found when data for calculating met need and some of the other indicators are collected, especially the first time. As periodic collection of such data becomes part of routine programme monitoring, record keeping should improve. The question is what to do when data collection problems are encountered?

Poor records usually bias findings, leading to underestimates of complications in facilities, and this must be taken into account in interpreting the data. In many situations, the level of EmOC being provided is so low that, allowing for substantial under-counting, the results do not change very much. Figure 4 shows actual measurements of met need over several years. If the records show that only 6% of the need for EmOC is being met in an area and the true proportion is assumed to be twice as high, the met need is still only 12%. This sort of change will not alter programming. As record keeping improves, however, met need will increase and the challenge will be to understand the attribution: Is the increase in met need a true increase or is it a function of better data collection? Improved data collection is a success in itself, and longer programme monitoring should help determine if the met need is really increasing.

Figure 4. Increases in met need for EmOC during AMDD-supported projects (2000–2004)



From Bailey, P. Evaluating AMDD *Phase 1: Policy and Service Improvements. In Delivering Safer Motherhood Symposium - Sharing the Evidence*. 2007. London, UK: Unpublished data.

The most variable element in estimating met need for EmOC is likely to be complications of abortion. While it is difficult to gather information on the incidence of unsafe abortions (because they are generally clandestine), the WHO report Unsafe abortion: global and regional estimates of incidence of unsafe abortion and associated mortality in 2003 showed that the frequency of unsafe abortions varies by geographical area, from three per 100 live births in Europe to 29 per 100 live births in Africa (119).

Moreover, recording of abortion complications is highly variable, including inaccuracies in whether the abortion was merely incomplete (which could eventually lead to a complicated abortion) or truly complicated (with haemorrhage or sepsis) at the time of treatment or admission. In some settings, no attempt is made to distinguish between the two. Thus, complications of abortion might actually be over-reported. The definition given in Box 2 covers only those abortion complications that include haemorrhage or sepsis.

It would not be appropriate, however, to exclude abortions from the calculation of met need, as complications of abortion are a major cause of maternal death in some countries and regions. For example, in Latin America and the Caribbean, 12% of maternal deaths are attributable to complications from abortion (120). Given the reporting difficulties, analysts presenting data on met need should state explicitly what types of abortion they have included and consider conducting studies to examine the subject in greater detail. If it is suspected that abortions without serious complications (i.e. without haemorrhage or sepsis) are being recorded as 'obstetric complications', it might be useful to calculate and report met need with and without abortions, for comparison (88).

A frequently asked question is the possibility of over-reporting due to 'double-counting' of women who are admitted to more than one facility, as in the case of a referral, or who are admitted to the same facility more than once during a pregnancy. We recommend that referrals be counted at the facility at which the women receive definitive treatment. A study in Thailand showed that met need was inflated by 16% because of double counting and dropped to 96% once it had been adjusted for (90). If there is concern about double counting and its effect on met need, we recommend that a study be designed to measure the effect. The results of this special study can then be taken into account when interpreting the general findings.

Many health facilities, of course, perform some but not all of the basic EmOC signal functions. As these facilities may well avert some maternal deaths, we recommend that met need in both EmOC facilities and in all the facilities surveyed be calculated. Even when many facilities do not perform a few signal functions, it is still important to find out how many obstetric complications they manage.

Interpretation and presentation

If the minimum acceptable level for this indicator is not met, i.e. is less than 100%, some women with complications are not receiving the medical care they need. This is likely to be the norm where maternal mortality is high. If there are adequate numbers of EmOC facilities, women give birth in those facilities and the met need is less than 100%, the national priority must be to improve use of the facilities by women with complications. Depending on the situation, strategies for meeting this objective could include improving the quality of care at facilities, eliminating barriers to seeking care (e.g. transport or cost) and educating the community to recognize complications and the importance of seeking care. Met need may also be low because obstetric complications are poorly recorded in registers. In this case, it is advisable to study record keeping at the facility (see discussion above and 'supplementary studies' below).

If the met need is close to 100%, one might ask what definition of abortion is used, because it is not uncommon for met need to exceed 100% if all abortions (incomplete, missed, spontaneous, induced) are included in the numerator. If that is not the case, it is reasonable to conclude that most women who need EmOC services are receiving them. As discussed earlier, since the true incidence of complications in the population might be greater than 15%, it is possible that even if met need is 100% there are still women who are not receiving the life-saving EmOC services they need. For this reason alone, the level of met need might be greater than 100%. This should not be inter-

preted as being due to faulty data, e.g. over-diagnosis of complications; it is possible that the geographical distribution of EmOC facilities is uneven, and met need exceeds 100% because women from outside the catchment area come to the facility. Like the question of double counting, a study of who uses the facility could help explain a met need higher than 100%.

When interpreting the indicators, it is helpful to look at indicators 3 and 4 at the same time.

Supplementary studies

While met need for EmOC is a gauge of the level of such care in an area, it does not show what is required, and a low met need cannot indicate where the problem lies. It might be due to under-recording of complications or to one of many factors that affect the use of services, and further investigation is required.

It is important to ensure that women from all the communities in the area are treated at the facility. (See the section on additional studies under Indicator 3 for more ways of exploring this topic.) Studies to address two questions would provide a deeper understanding of who is included in met need and how they affect this indicator:

- How many women have complications after they are admitted to hospital, and which complications are they likely to have once admitted?
- How many women are admitted with signs and symptoms of complications, and which complications are those?

When women with complications are stabilized at a lower-level facility before referral to a higher level of care, we suggest that they be counted only at the facility where they receive definitive treatment. There is no easy mechanism for finding out whether a referred woman reaches her destination. A study of the women referred, their treatment before referral, their compliance with referral and their definitive treatment would elucidate the effect of double counting on met need and would also show how well the referral system functions. In the field, staff at lower levels has argued in favour of counting these women twice, as they claim that they too have treated them, usually by stabilization. To raise morale, programme managers might consider counting them twice, and with a study of referrals they can also document the effect of double counting on met need and make any necessary adjustments.

Several types of study could be used to explore the quality of record keeping at a facility:

- Examine how records are kept. Does someone enter complications into the register 24 h/day, or does the senior nurse document them only once a day from verbal reports by other staff? This practice could lead to serious underreporting. Discussions with staff about recent cases can provide insight into how records are kept.
- Compare the complications recorded in the maternity register with patient charts, operating theatre registers or emergency admissions logbooks. What proportion of serious complications is not reported in the register that is usually used for calculating met need? Which complications appear to be most underreported? How do your findings change when you correct for this underreporting? How often does a diagnosis of complication change between the admissions register and the operating theatre register?
- Examine how abortion complications are recorded by discussing the records and case notes with staff. Are minor complications, or even all incomplete abortions, counted as ‘complications’? Remember, for calculating met need, only serious complications, such as complications of abortion with sepsis and haemorrhage, are counted.
- For more detailed monitoring of abortion complications, we recommend a set of ‘process indicators for safe abortion’, which include 11 signal functions that define basic and comprehensive care. Like the EmOC indicators, the safe abortion indicators measure the availability, distribution, use and quality of safe abortion services (121-123).
- Knowing more about how well and how completely logbooks are kept up can identify problems. Investigate whether staff training or supervision of record keeping reduces underreporting over time, and then disseminate your results.

2.5 Indicator 5: Caesarean sections as a proportion of all births

Description

The proportion of all deliveries by caesarean section in a geographical area is a measure of access to and use of a common obstetric intervention for averting maternal and neonatal deaths and for preventing complications such as obstetric fistula. The numerator is the number of caesarean sections performed in EmOC facilities for any indication during a specific period, and the denominator is the expected number of live births (in the whole catchment area, not just in institutions) during the same period.

Occasionally, hospitals in which caesarean sections are performed lack one of the basic signal functions of EmOC and do not qualify as such a facility. Therefore, as for indicators 3 and 4, we recommend that this indicator be calculated for both EmOC facilities and all facilities.

Minimum and maximum acceptable levels

Both very low and very high rates of caesarean section can be dangerous, but the optimum rate is unknown. Pending further research, users of this handbook might want to continue to use a range of 5–15% or set their own standards.

Background

The proportion of births by caesarean section was chosen as the indicator of provision of life-saving services for both mothers and newborns, although other surgical interventions (such as hysterectomy for a ruptured uterus or laparotomy for an ectopic pregnancy) can also save maternal lives. Of all the procedures used to treat major obstetric complications, caesarean section is one of the commonest, and reporting is relatively reliable (124).

Earlier editions of this handbook set a minimum (5%) and a maximum (15%) acceptable level for caesarean section. Although WHO has recommended since 1985 that the rate not exceed 10–15% (125), there is no empirical evidence for an optimum percentage or range of percentages, despite a growing body of research that shows a negative effect of high rates (126-128). It should be noted that the proposed upper limit of 15% is not a target to be achieved but rather a threshold not to be exceeded. Nevertheless, the rates in most developed countries and in many urban areas of lesser-developed countries are above that threshold. Ultimately, what matters most is that all women who need caesarean sections actually receive them.

The technical consultation for these guidelines noted the difficulty of establishing a lower or upper limit for the proportion of caesarean sections and suggested that a lower limit of 5% is reasonable for caesareans performed for both maternal and fetal reasons. If elective or planned caesarean sections and those performed for fetal indications were excluded, a lower range would be indicated; however, the record system may not always register the indication for the operation and such precision is usually not available. A detailed analysis of the reasons for caesarean section in a hospital would be worthwhile.

Where maternal mortality is high, the rate of caesarean sections tends to be low, especially in rural areas. A recent review of global, regional and national rates of caesarean section showed that the lowest rate (3.5%) was in Africa; in the 49 least-developed countries, the rates ranged from 0.4% in Chad to 6% in Cape Verde (or an average of 2%) (129). Figure 5 shows how low rates of caesarean section in several countries of Asia and in sub-Saharan Africa changed after several years of interventions to improve EmOC.

Despite the clear inverse relation between very high maternal mortality and low rates of caesarean section, this procedure (like any major surgery) carries a risk for surgical or anaesthetic accident, postoperative infection, and even death for the patient (129). A uterine scar increases the risk for uterine rupture in future pregnancies. Where conditions in a facility are particularly precarious, the case fatality rate among women who undergo caesarean sections can be unacceptably high, as found by the Network for Unmet Obstetric Need in Benin, Burkina Faso, Haiti, Mali and Niger in 1998 and 1999.[1] The risks should be weighed against the potential benefits of the surgery. In the

[1] de Brouwere V. Personal communication about case fertility rates for caesareans, 2006.

case of transverse fetal lie, when external version fails or is not advisable, the benefits of surgery definitely outweigh the risks. Without a caesarean section, most women with obstructed labour will either die or be severely maimed (130). A caesarean section is the key intervention for preventing obstetric fistula caused by prolonged or obstructed labour, making this indicator an important means for measuring progress in the prevention of this condition.

Many observers consider that we are experiencing a worldwide epidemic of overuse of caesarean section (131) and that the rates will continue to rise, in view of practitioners' and administrators' fear of litigation, local hospital culture and practitioner style as well as increasing pressure from women in highly industrialized countries to undergo caesarean sections for non-medical reasons (132,133). At the same time, evidence for the negative consequences of caesarean section is increasing: recent studies in countries with high rates suggest that caesarean section carries increased risks for maternal and neonatal morbidity and mortality (126-128).

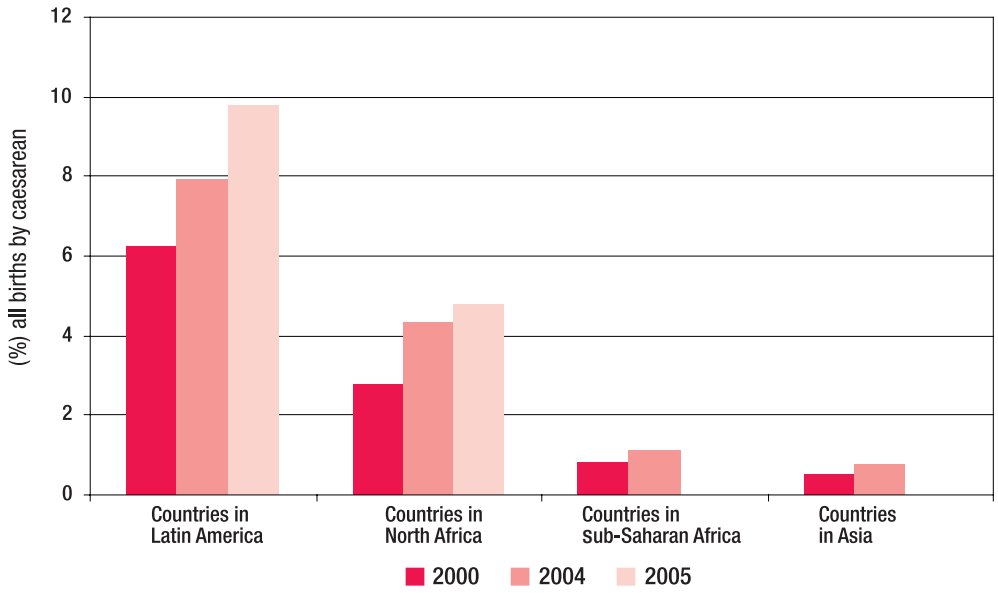
Data collection and analysis

While data on the rate of caesarean sections can be collected in population surveys, such as demographic and health surveys, data for this indicator are collected from hospital records (134), as rates based on service statistics are considered more precise than population-based rates, which tend to be marginally higher than those based on health facility records (124). Facility data are collected routinely from operating theatre logbooks, which are often the most complete records available.

The numerator for this indicator covers caesarean sections performed for all indications, including those for maternal and neonatal reasons, as well as caesarean sections performed in emergencies and those that are planned or scheduled.

Throughout the discussion of the indicators, we have stressed the importance of including data from all types of facilities. In countries or regions where the private sector plays a major role in delivering obstet-

Figure 5. Caesarean sections as a proportion of births in AMDD-supported projects (2000–2005)



From Bailey, P. *Evaluating AMDD Phase 1: Policy and Service Improvements in Delivering Safer Motherhood Symposium - Sharing the Evidence.* 2007. London, UK: Unpublished data.

ric services, the rate of caesarean section will be particularly sensitive to inclusion of such hospitals. For instance, in Latin America and Asia, the proportion of caesarean sections is higher in private than in public facilities. In El Salvador, roughly one-half of all caesarean sections are performed outside the public sector, through the private sector and social security hospitals (135). This raises the possibility that some of these operations are performed (or not) for financial, rather than medical, reasons.

A common misunderstanding of this indicator is that it refers to the proportion of deliveries in a hospital that are performed by caesarean section, i.e. the 'institutional caesarean section rate' or the proportion of deliveries in the facility that are done by caesarean section. The institutional caesarean rate is difficult to interpret, because it depends on the patients in the hospital (Is the hospital a regional referral hospital that receives many complicated cases? Or is it a district hospital, where most complicated cases are referred further?) as well as the skills, preferences and habits of the providers. The population-based indicator recommended here gives an overview of the level of provision of this critical service in a geographical region.

To reduce the possibility that this indicator will mask inequities in access to and use of caesarean section, we strongly encourage authorities to look closely at their data. For instance, in Morocco, Peru and Viet Nam, the national rates of caesarean section are 5–15%, but the national data mask the high rates in major cities and the very low rates in rural areas. The range of patterns is shown in Table 7.

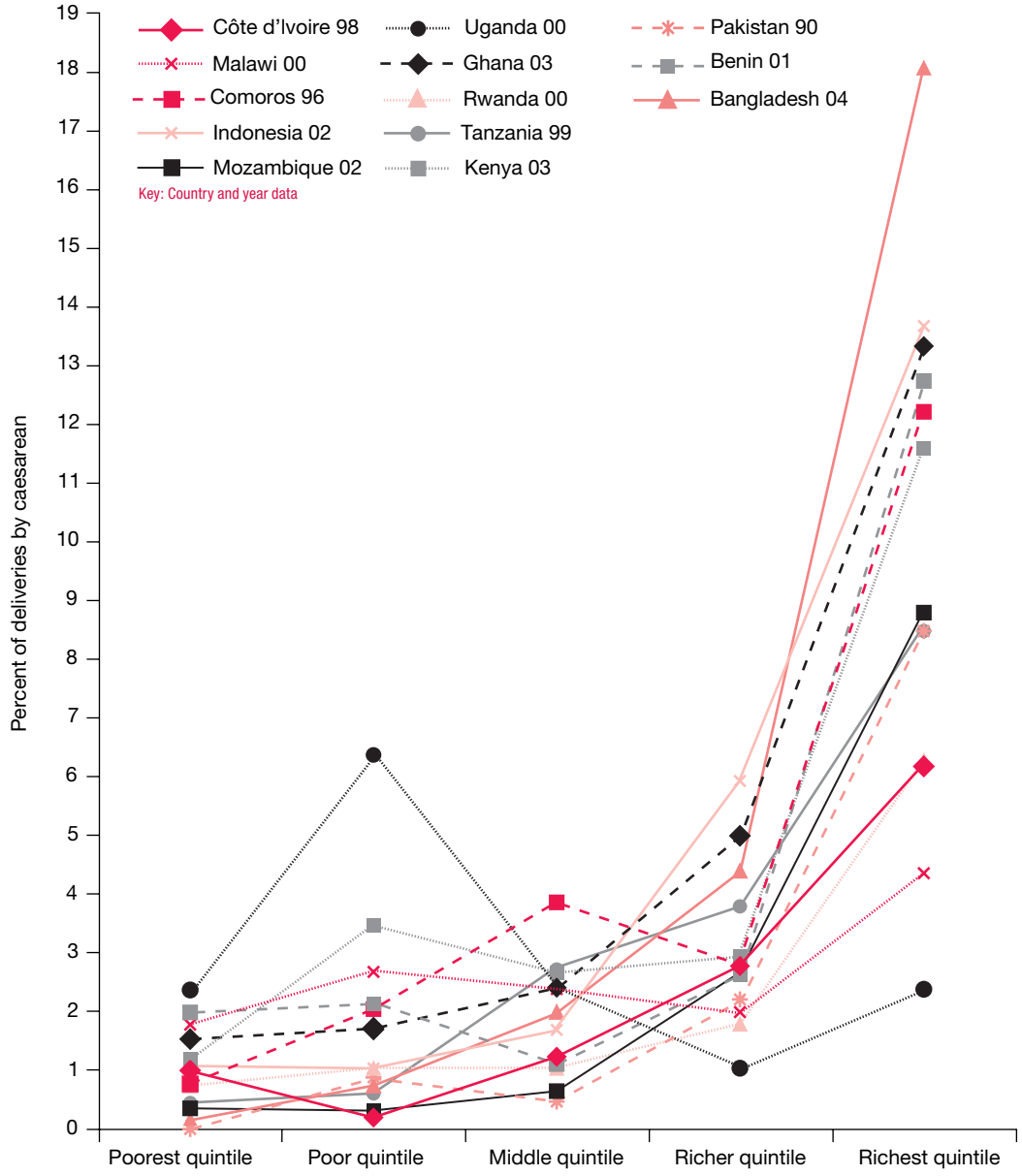
Table 7. Population rates of caesarean section from Demographic and Health Surveys among women who gave birth within three years of the survey

Region	Country	Year	Rate of caesarean section		
			Total	Urban	Rural
Latin America	Dominican Republic	2002	33.1	36.2	27.2
	Peru	2000	12.9	21.0	3.2
South-East Asia	Bangladesh	2004	4.5	13.7	2.2
	Nepal	2001	1.0	5.0	0.7
	Viet Nam	2002	9.9	22.9	7.2
Africa	Ethiopia	2000	0.6	5.2	0.1
	Kenya	2003	4.3	9.5	3.0
	Morocco	2003–2004	5.6	9.3	1.9
	Zambia	2001–2002	2.2	4.4	1.2

From reference (134)

Another example of inequitable access to caesarean section is presented in Figure 6. Ronsmans et al. used demographic and health survey data to show the range of rates by wealth quintile in 13 countries with national rates of 2.0–4.9% (136). This analysis shows that the poorest women have less access to this life-saving procedure.

Figure 6. Rates of caesarean section by wealth quintile in 13 countries with national rates between 2.0% and 4.9%



Reproduced, with permission, from reference (136).

Interpretation and presentation

When less than 1–2% of births are by caesarean section, there is little doubt that pregnant women have poor access to surgical facilities. Rates in this range are common in rural sub-Saharan Africa and in some countries of South Asia (Figure 6 and Table 7). Where caesarean section rates are very low, most are probably done for maternal emergencies; as the rates increase, a greater share may be for fetal emergencies. As the number of caesarean sections increases, the uncertainty between these classifications also increases (137).

Supplementary studies

Who has caesarean section and where?

Studies on caesarean sections should include the proportions of births in urban and rural areas, as well as in smaller administrative or geographical units. Variables that are used to measure equity, such as economic

quintiles, ethnicity and education, can be used to reveal where access to services is limited. Another method for understanding data on caesarean sections is investigating the type of hospital (e.g. public or private) where caesarean sections are performed, as this can indicate how the various components of the health system interact.

Indications for caesarean section

The final responsibility for ensuring that caesarean section is performed only when necessary is with clinicians. The chief medical officer or the head of an obstetrics and gynaecology department in a hospital should review the indications for the caesareans that are performed. One approach is to look at the proportion performed for absolute maternal indications, which would almost certainly lead to the woman's death if untreated, including severe antepartum haemorrhage due to placenta praevia or placental abruption, major cephalo-pelvic disproportion, transverse lie and brow presentation (138). Another approach is to identify caesarean sections that are performed for maternal and for fetal indications, and a third approach is to use the Robson classification system, which relies on the characteristics of women who have had caesarean sections (139). The classification sorts women into 10 mutually exclusive groups on the basis of parity, previous obstetric history, the course of labour and delivery and gestational age (140). It can be used to identify women who have had caesarean sections for reasons other than as a response to an imminent emergency.

Who performs caesarean sections?

When the level of Indicator 5 is under the recommended minimum, poorly functioning health facilities may be a contributing factor. This often results from factors such as postings and transfers of key staff or a real shortage of health professionals trained to perform this life-saving service. Studies can be done to investigate whether this indicator is affected by lack of human resources. For example, an analysis of who is trained and authorized to provide caesarean sections may be informative. In countries where a small group of health professionals, primarily based at facilities in large urban centres, are the only practitioners able to provide caesarean section, a strategy must be devised to address shortages of health professionals in rural areas. One strategy that has been successfully used in Malawi, Mozambique and the United Republic of Tanzania is to train mid-level providers (e.g. clinical officers, assistant medical officers) to perform caesarean sections (141–144). Similarly, in India, a new programme under the auspices of the Government and the obstetrics society is training doctors with a Bachelor's degree in medicine and surgery in comprehensive EmOC, including caesarean section (145).

Quality of care

Training, supervision and leadership by senior physicians are important in maintaining standards. National societies of obstetrics and gynaecology should encourage the use of evidence-based protocols. In facilities at all levels, routine clinical audits can be used to monitor change, improve practice and maintain a good quality of care; several tools exist to facilitate this process (146–148). The infection rate in women who have undergone obstetric surgery is another indicator of the quality of care.

Unmet obstetric need

The indicator 'Unmet obstetric need' is not the same as Indicator 4 (Met need for EmOC) but describes the need for obstetric surgery for absolute maternal indications. Indicator 4 encompasses all the direct obstetric complications treated with the EmOC signal functions, which are both surgical and nonsurgical (e.g. parenteral anticonvulsants, uterotonic drugs). The indicator for unmet obstetric need refers to the need for obstetric surgery, including hysterectomy or laparotomy, in addition to caesarean section. Caesarean section constitutes most obstetric surgical procedures. This indicator focuses strictly on maternal life-threatening conditions for which major obstetric surgery is performed. It is intended to help health personnel answer the questions:

- Are pregnant women receiving the major surgical obstetric interventions they need?
- How many women's needs are unmet?
- Where are those women whose needs are unmet?

Box 3 provides detailed information on this indicator.

Box 3. Indicator of unmet obstetric need

Unmet obstetric need is an estimate of the number of women needing a major obstetric intervention for life-threatening complications who did not have access to appropriate care. This indicator is particularly appropriate for identifying geographical or social inequity in access to hospital care.

The concept

The concept of unmet obstetric need is the difference between the number of women who need obstetric surgery and the number of women who are in fact covered by health services.

Estimated number of absolute maternal indications	–	Observed number of major obstetric interventions performed for absolute maternal indications	=	Estimated number of women who needed but did not receive life-saving care

The indicator is restricted to absolute (life-threatening) obstetric indications that require obstetric surgery (caesarean section, hysterectomy, laparotomy) or internal version and craniotomy. A standard list of such indications was drawn up on the basis of the degree of severity of the indication, the relative stability of its incidence and relatively reproducible diagnosis. It comprises:

- antepartum haemorrhage due to placenta praevia or abruptio placenta;
- abnormal presentation (transverse lie or shoulder presentation, face with persistent mento-posterior position or brow presentation);
- major feto-pelvic disproportion (e.g. mechanical cephalo-pelvic disproportion, small pelvis including pre-rupture and rupture of uterus); and
- uncontrollable postpartum haemorrhage.

In most situations, the incidence of obstetric need is not known precisely. A benchmark can be used to estimate the number of women with absolute maternal indications, which is 1.4% (95% confidence interval, 1.27–1.52), the median for five sub-Saharan African countries, Haiti, Morocco and Pakistan (http://www.uonn.org/uonn/pdf/engintc00.pdf). Multiplied by the number of expected births in an area, this gives the estimated number of women with absolute maternal indications in the area. The second element of the equation—the number of major obstetric interventions actually performed for absolute maternal indications—is the sum of all such interventions performed in the population of women in the area, wherever the intervention took place (private or public sector, in or outside the defined area). The difference between the number of women with absolute maternal indications and the number of major obstetric interventions actually performed for those indications is the unmet need.

Example: In the rural part of district X, 20 000 births are expected in 2007. The number of major obstetric interventions for absolute maternal indications is estimated to be 1.4% (benchmark) x 20 000 = 280 interventions. When all public and private comprehensive emergency obstetric care facilities had been visited, the total number of major obstetric interventions performed for absolute maternal indications was 84. The unmet need was thus 280 – 84 = 196, or an unmet need of 70%. This means that 196 women did not have access to necessary life-saving surgery.

For additional information and forms used to construct this indicator, see the website of the unmet obstetric needs network, www.uonn.org.

2.6 Indicator 6: Direct obstetric case fatality rate

Description

The direct obstetric case fatality rate is the proportion of women admitted to an EmOC facility with major direct obstetric complications, or who develop such complications after admission, and die before discharge. We include all seven major obstetric complications listed in Box 2.

The numerator is the number of women dying of direct obstetric complications during a specific period at an EmOC facility. The denominator is the number of women who were treated for all direct obstetric complications at the same facility during the same period. In general, the denominator for the direct obstetric case fatality rate is the numerator for met need.

Like indicators 3–5, the direct obstetric case fatality rate should be calculated for all facilities, not just EmOC facilities. It is usually calculated at individual facilities and across facilities, especially those of the same type, such as district hospitals.

Maximum acceptable level

The maximum acceptable level is less than 1%.

Background

After determining the availability and use of services, the next concern is quality of care, which is the subject of a growing, complex literature. The set of EmOC indicators includes the direct obstetric case fatality rate as a relatively crude indicator of quality. This should be supplemented with more detailed assessments.

In the earlier editions of this publication, this indicator was simply called the 'case fatality rate'. It has been renamed 'Direct obstetric case fatality rate' for the sake of clarity and because a new indicator has been added for indirect obstetric complications.

Researchers have gained substantial experience with this indicator in the past 10 years. Periodic monitoring (every 6–12 months) has been the norm when the EmOC indicators are used routinely (15, 36, 65). The available data, an example of which is presented in Table 8, indicates that substantial reductions are possible within 3–5 years, if not sooner, with improved quality of obstetric care. The direct obstetric case fatality rate in these studies ranged from almost 2% to 10%, whereas an analysis of application of the EmOC indicators to data from the United States in 2000 showed a direct obstetric case fatality rate of 0.06%. (66)

Table 8. Direct obstetric case fatality rates before and after interventions to improve emergency obstetric care

Setting	Before interventions	After interventions	Reduction
Ayacucho, Peru (2000–2004, five facilities)	1.7%	0.1%	94%
Gisarme, Rwanda (2001–2004, three facilities)	2.0%	0.9%	55%
Mwanza, United Republic of Tanzania (2000–2004, four facilities)	3.0%	1.9%	37%
Sofala, Mozambique (2000–2005, 12 facilities)	3.5%	1.7%	33%
Oromiya, Ethiopia (2000–2004, three facilities)	10.4%	5.2%	50%

From references (15, 36, 65)

Given the range, 1% would appear to be a reasonable maximum acceptable level, falling between the rates for less and more developed countries. The post-intervention rates in Table 8 show that it is possible to reduce a high rate to below 1%; however, countries that reach this benchmark should strive to reduce the rate even further. Sometimes, circumstances beyond the control of hospital managers may make it difficult to achieve a rate below 1%. If few facilities provide basic and comprehensive EmOC, women with complications are likely to arrive at the hospital after a long journey, jeopardizing their survival. There are nevertheless low-cost ways to improve the quality of care and to reduce the direct obstetric case fatality rate progressively.

Data collection and analysis

The direct obstetric case fatality rate can be calculated for any facility that treats complications, experiences maternal deaths and has adequate records on both these events. The same issues in collecting data on major direct obstetric complications for met need apply, although new issues arise for the collection of information on the number of maternal deaths. Maternal deaths are notoriously underestimated because of misclassification or underreporting, sometimes out of fear of rebuke or reprisal (149). Both deaths and complications should be thoroughly sought in all wards where adult women are admitted, not only the obstetric ward.

We encourage calculation of separate cause-specific fatality rates for each of the major causes of maternal death. Treatment of some complications, such as obstructed labour, may improve more rapidly than others, such as eclampsia. Cause-specific case fatality rates indicate where progress has been made and where it has not (36). The number of maternal deaths in a given facility or aggregate of facilities is, however, often too small (e.g. fewer than 20) to calculate a stable rate for each complication. Therefore, in most facilities, only an aggregate direct obstetric case fatality rate will be calculated, and the number of maternal deaths can be small.

There are good reasons for using this indicator for individual facilities, for all facilities to reflect the state of the health system, or for a subset of facilities in that system (see Table 11 in section 2.9). Averaging the rates for all facilities is one crude monitoring measure, but it does not show which facilities contribute most heavily to the direct obstetric case fatality rate and therefore where interventions are most needed. To identify those facilities or regions that need greater attention, data from various types of facilities (or in different areas) can be analysed separately and then combined.

Interpretation and presentation

Direct obstetric case fatality rates do not take into account deaths outside the health system. This does not affect the value of the indicator, because it is used only to measure the performance of the EmOC facility. If the indicators of the availability of facilities, the proportion of births in facilities and met need (indicators 1–5) show that EmOC services are well distributed and well used and the direct obstetric case fatality rates are low, it is safe to say that the maternal care system in the country is working fairly well. If, however, the direct obstetric case fatality rate is acceptable but EmOC coverage or met need is insufficient, the implication is that women who deliver in EmOC facilities are likely to survive but maternal deaths outside health facilities might still be common.

Comparisons of direct obstetric case fatality rates among individual facilities can be difficult to interpret when the facilities are not comparable. For example, it may not be valid to compare the rate in a district hospital with that in a teaching hospital, as women with the most serious complications may be referred to the teaching hospital at the last moment, where they die. This difference would lower the direct obstetric case fatality rate at the district hospital and raise it at the teaching hospital.

The direct obstetric case fatality rate in a facility can exceed the maximum acceptable level for several reasons. In many cases, the quality of care is inadequate; however, there may be other explanations. For example, long delays in reaching EmOC facilities can result in a poor status on arrival; or a facility with a high direct obstetric case fatality rate might be the end-point of

the local referral chain, so that women with the most serious complications are sent there. It is also important to consider the number of women counted in calculating the direct obstetric case fatality rate. If the rate is based on a small number of women, even a single death can create a deceptively large increase. Given the problems of interpreting small numbers, the direct obstetric case fatality rate is most useful at district level or at high-volume facilities where there are many maternal deaths. Therefore, these rates tend to be calculated only at comprehensive EmOC facilities.

The occurrence of some maternal deaths in a facility can indicate that women go there for treatment of complications; conversely, the absence of maternal deaths might indicate that women with serious complications are not brought there or are routinely referred on, even when they should be treated on site. The absence of reported deaths could also suggest that deaths are not being reported. In addition, the numbers of deaths and direct obstetric case fatality rates may increase when efforts are made to improve hospital services and more women come for treatment, from further away. Thus, the direct obstetric case fatality rate must be interpreted in the context of the previous indicators, and studies should be conducted for deeper understanding. By no means should the direct obstetric case fatality rate be a cause for administrative sanctions. That would just increase the likelihood that women with serious complications are referred to another facility rather than treated, or that deaths that occur on site are not reported.

Bar charts or scatter plots can effectively highlight variations in direct obstetric case fatality rates at different levels or in different types of health facility or geographical region. Each type of facility or region can be depicted as a separate graph, or different colours and shading can highlight differences in the same graph.

Supplementary studies

High direct obstetric case fatality rates indicate problems but do not, by themselves, identify corrective actions. They are, however, a good beginning for further studies.

Case studies of women's condition on admission

Information on the condition on admission of women with major complications on admission (e.g. pulse, blood pressure, and temperature) can be collected, for women who survive and those who do not. Better understanding of patients' condition on admission would help differentiate the effect of condition on arrival from the quality of care after arrival.

Delays in diagnosis or treatment

There are many possible reasons for delayed diagnosis or treatment once a woman has reached a facility. For example, patients' families may have to buy drugs and medical supplies from local pharmacies because the hospitals do not have enough. The causes of delays can vary from back-ups in the emergency room, to a gatekeeper who demands a tip, to electricity failures (150).

Studies of 'the third delay' (once women have reached health facilities) and the 'client flow analysis' exercise in the *Tool book for improving the quality of services* (150) are useful models for this type of supplementary study; they systematize the observation and measurement of delays and allow researchers to identify at what stage they are most frequent. The exercises are based on evidence-based standards and expert opinion to determine what constitutes a delay. Another approach is to collect data on the interval between the time a woman with a complication is admitted and when she receives definitive treatment. Good-quality monitoring reveals which delays are the longest and most dangerous, and the direct obstetric case fatality rate can be lowered by reducing those delays.

In the university hospital of Zaria, Nigeria, the interval between admission and treatment was reduced by 57% (from 3.7 to 1.6 hours) between 1990 and 1995. During this time, the case fatality rate (combining direct and indirect causes) decreased by 21%, from 14% to 11% (151).

Reviewing maternal deaths

When a direct obstetric case fatality rate is high or fails to decrease, a study should be conducted. Maternal deaths can be reviewed in health facilities and at district, regional or national level (sometimes

referred to as 'confidential enquiry') to identify gaps in management or clinical service delivery. The WHO publication *Beyond the numbers—reviewing maternal deaths and complications to make pregnancy safer* (148) describes two types of review:

- A facility-based review is a detailed study of the systemic causes of and circumstances surrounding maternal deaths at the facility. The goal is to determine which of the factors that contributed to maternal deaths were avoidable and what could be changed to improve the quality of EmOC at the facility.
- A confidential enquiry into maternal deaths is an anonymous, systematic study of all or a random sample of maternal deaths occurring in a specified area (urban, district, region or national). The researchers look at issues such as substandard care, women's access to care and the availability of medicines and drugs. By aggregating the causes and factors that contribute to maternal deaths in a wider area, evidence can be generated to help decision-makers design and implement systematic solutions for improving EmOC.

Reviewing cases of women who survive life-threatening complications ('near misses')

An alternative, more positive and sometimes less threatening approach to improving quality is to study systematically the care given to women with life-threatening obstetric complications who are saved by the health facility ('near misses'). One benefit of this method is that near misses occur more frequently than maternal deaths and therefore provide more opportunities for studying the quality of care. Another benefit is that such a review provides an occasion to look at what health professionals did correctly to save the woman rather than focus on the problems. This helps to create a more supportive environment in which to discuss aspects of care that could be improved. The WHO publication *Beyond the numbers* (148) gives more detailed information, including operational definitions of near misses and a standard set of criteria with which a near-miss case is identified is being developed by WHO (1,52)

2.7 Indicator 7: Intrapartum and very early neonatal death rate

Description

Indicator 7 is the proportion of births that result in a very early neonatal death or an intrapartum death (fresh stillbirth) in an EmOC facility. This new indicator has been proposed to shed light on the quality of intrapartum care for foetuses and newborns delivered at facilities (153). The numerator is the sum of intrapartum and very early neonatal deaths within the first 24 hours of life occurring in the facility during a specific period, and the denominator is all women who gave birth in the facility during the same period.

Because the objective of this indicator is to measure the quality of intrapartum and newborn care, it is recommended that newborns under 2.5 kg be excluded from the numerator and the denominator whenever the data permit, as low birthweight infants have a high fatality rate in most circumstances.

As for the previous indicators, the intrapartum and very early neonatal death rate should be calculated for all facilities, not just EmOC facilities.

Maximum acceptable level

No standard has been set; a maximum acceptable level may be determined after the indicator has been tested in various circumstances.

Background

Globally, nearly 2 million infants die each year around the time of delivery: 900 000 neonatal deaths, or 23% of all neonatal deaths, and 1.02 million intrapartum stillbirths, or 26% of all stillbirths (154). Good-quality care during intrapartum is therefore crucial for both the mother and her infant. When appropriate, timely care is provided, most maternal and neonatal deaths can be prevented.

A major cause of fetal death intrapartum or immediately postpartum is birth asphyxia, which can result from poorly managed obstetric complications, such as obstructed or prolonged labour, ruptured uterus,

eclampsia or antepartum haemorrhage, *and* the absence of neonatal resuscitation (155). Birth asphyxia can also be a result of preterm birth or congenital malformation, conditions that are not directly related to the quality of care given intrapartum. As we are concerned here primarily with the health system's ability to provide good-quality intrapartum and immediate postpartum care, this indicator focuses on those stillbirths and very early neonatal deaths that could have been averted by the availability and use of good-quality obstetric care and neonatal resuscitation.

Data collection and quality

The operational definitions for this indicator include the following components, as defined by Lawn and colleagues (154):

- *Stillbirths occurring intrapartum or fresh stillbirths:* infants born dead after more than 28 weeks of gestation without signs of skin disintegration or maceration; the death is assumed to have occurred less than 12 hours before delivery; excludes those born with severe, lethal congenital abnormalities.
- *Early neonatal deaths related to intrapartum events:* neonates born at term who could not be resuscitated (or for whom resuscitation was not available) or who had a specific birth trauma. The death must have occurred within 24 hours of delivery.

These two subgroups should not be equated with perinatal deaths. The universally accepted definition of perinatal death is death in the uterus after the 28th week of pregnancy plus deaths of all liveborn infants up to 7 days of life. This new indicator excludes macerated stillbirths and newborns who die after the first 24 h, because mothers and their infants are often discharged at 24 h, if not earlier.

At the technical consultation in 2006, it was suggested that this indicator include only stillbirths and neonates weighing ≥ 2.5 kg, which is the international standard; however, countries may prefer to use 2.0 kg as their threshold. Many small facilities in poor countries might not have data on birth weight, especially of stillbirths. Accurate recording of stillbirths (fresh and macerated) and very early neonatal deaths may be an aspect of current information systems that also will require more attention.

One way of determining whether an intrapartum death occurred during labour is to ascertain whether the fetal heartbeat is recorded on the admission log. In practice, in facilities with high turnover and where mothers stay less than 24 hours after delivery, it may be wise to restrict neonatal deaths to those occurring in their first 6–12 hours (rather than 24 hours), because deaths occurring after discharge will go undetected.

The denominator for this indicator is 'all women giving birth in the EmOC facility', which is the same numerator as for Indicator 3 (Proportion of all births in EmOC facilities). This denominator was chosen to facilitate data collection and is recommended for the sake of international comparability. As information systems improve, the denominator may become births, and the indicator will become a true rate.

Supplementary studies

Testing the indicator

This indicator should be tested, and the results with and without the birth weight restriction should be compared to determine whether 2.0 kg or 2.5 kg is the better threshold. If the birth weight restriction is too onerous in terms of data collection, studies are needed to determine whether no birth weight restriction would affect the death rate. Additionally, a maximum acceptable level for the indicator should be explored and set, if appropriate.

Refining the data

Other studies that would improve understanding of intrapartum and early neonatal care include investigations of whether the fetal heartbeat is recorded routinely at admission and whether stillborns are routinely weighed and documented. It could also be important to study the exact time of early neonatal death, which is rarely recorded with precision.

In facilities with high early neonatal and stillbirth rates, it might be useful to conduct perinatal death audits to gain a better understanding of how to improve the quality of care (156).

2.8 Indicator 8: Proportion of deaths due to indirect causes in EmOC facilities

Description

The numerator of this new indicator is all maternal deaths due to indirect causes in EmOC facilities during a specific period, and its denominator is all maternal deaths in the same facilities during the same period.

Direct causes of death are those 'resulting from obstetric complications of the pregnant state (pregnancy, labour, and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events from any of the above'. Indirect causes of death result from 'previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by the physiologic effects of pregnancy' (157).

Other categories of maternal death (death after 42 days postpartum, fortuitous, coincidental or incidental deaths) are generally not included in the calculation of maternal death rates or ratios, and they are excluded for the purposes of this indicator.

Acceptable level

This indicator does not lend itself easily to a recommended or ideal level. Instead, it highlights the larger social and medical context of a country or region and has implications for intervention strategies, especially in addition to EmOC, where indirect causes kill many women of reproductive age.

Background

A substantial proportion of maternal deaths in most countries are due to indirect causes. This is particularly true where HIV and other endemic infections, such as malaria and hepatitis, are prevalent. Too often, where infectious and communicable disease rates are high, the number of maternal deaths due to direct causes is also high. The causes of maternal deaths are often misclassified in such cases; for example, the death of an HIV-positive woman might be classified as due to AIDS even if it was due to a direct cause such as haemorrhage or sepsis. Most maternal deaths fall into the categories listed in Table 9; we know even less about 'accidental or incidental' causes of death for women in poor countries.

The most recent systematic study of the causes of maternal death was published in 2006 by researchers at WHO, who reviewed the literature since 1990 (120). Table 10 summarizes the proportions of direct and indirect causes of death by world region.

Table 9. Main conditions leading to maternal death

Direct causes	Indirect causes
Haemorrhage	Infections (e.g. malaria, hepatitis)
Hypertensive diseases	Cardiovascular disease
Abortion	Psychiatric illnesses, including suicide and violence
Sepsis or infections	Tuberculosis
Obstructed labour	Epilepsy
Ectopic pregnancy	Diabetes
Embolism	
Anaesthesia-related	

Table 10. Estimates of direct and indirect causes of maternal death by region

Region	Maternal deaths (%)		
	Due to indirect causes	Due to direct causes	Unclassified
Developed countries	14.4	80.8	4.8
Africa	26.6	68.0	5.4
Asia	25.3	68.6	6.1
Latin America and the Caribbean	3.9	84.4	11.7

From references (120).

Data collection and quality

The reporting of maternal deaths and their causes varies widely and is associated with a country's statistical development; nevertheless, all tend to follow some version of the *International Classification of Diseases* (157). In countries with well-developed statistical systems, the source of this information is the vital registration system, but, as stated above, misclassification results in serious under-recording in official statistics in virtually all countries. Where vital registration systems are weak, omission and misclassification lead to under-recording and problems of attribution of cause. Death certificates may never be filled out, or they may fail to indicate whether pregnancy was a recent occurrence; therefore, the fact that the death was a maternal death goes undetected. Multiple causes of death may be listed, but an underlying cause may not be registered.

This is likely to be the case with regard to HIV infection. In many countries with a high prevalence of HIV infection, the number of maternal deaths among HIV-positive women will be underreported, until there is universal HIV testing, serological status is reliably recorded and reported, and discrimination and stigma do not inhibit testing or reporting. On the one hand, HIV infection might be an underreported cause of maternal death. On the other, when the woman's HIV status is known, the cause of death may be reported as AIDS even though the actual cause was a direct obstetric condition.

Although official statistics in resource-poor countries are likely to include underreporting of indirect causes of death, industrialized countries also underreport. In a review of WHO databases on maternal health in 1991–1993, of the 60 countries reporting vital registration figures for causes of maternal deaths, 33 reported no indirect deaths (158).

Collecting data for this new indicator will be difficult; however, the technical consultation considered that it would be useful for governments and international agencies. In a few years, we shall review experience with these new indicators to see whether they are useful and whether they should be modified.

Supplementary studies

A great deal of research remains to be done in the area of indirect maternal deaths, including on the mechanisms by which indirect conditions cause maternal death and programmes that could reduce them. As with the recording of obstetric complications, training staff to comply with national standards of death certificate completion can result in more accurate and complete recording. Reviews of all deaths of women of reproductive age in facilities, especially those who do not die on the maternity ward, could lead to more complete recording. As discussed under Indicator 6, it might be useful to review maternal deaths and near misses to learn how to improve the quality of care.

2.9 Summary and interpretation of indicators 1–8

Table 11 provides a summary of the indicators, how they are calculated, and acceptable levels, when appropriate. One of the benefits of using these indicators is that, when used as a set, they give a full picture of a health system's response to obstetric emergencies. Below, we discuss issues that affect the interpretation of most of the indicators, including distinguishing between 'minimum or maximum' and 'optimum' levels, assessing the generalizability of results and working with incomplete or poor data. The section also provides examples of interpreting sets of indicators and ends with an exercise in interpreting the indicators together.

Minimum or maximum and optimum levels

An important distinction that applies to most of the indicators is the difference between minimum or maximum and optimum levels. By necessity, the minimum or maximum acceptable levels proposed in this manual are approximations. Therefore, if the acceptable level is met for a particular indicator, this does not imply that the optimum level has been reached. For instance, a key assumption in setting acceptable levels is that approximately 15% of pregnant women experience serious obstetric complications. If this is an underestimate—as recent studies indicate it may be—the maximum level for Indicator 5 (15% of expected births are delivered by caesarean section in EmOC facilities) may be low (159, 160). A number of studies have shown, however, that it is difficult or even impossible to measure morbidity accurately from surveys (161). Therefore, we assume (on the basis of the evidence used throughout this manual) that a country that achieves acceptable levels for each indicator has a strong programme for reducing maternal deaths.

Even if the minimum acceptable level for an indicator is met at the national level, however, there may be problems in specific areas. When the level falls below the minimum acceptable, one can conclude that the need for EmOC is not being met in most areas of the country. The general principle is that favourable findings, while reassuring, do not justify complacency; unfavourable findings clearly indicate that action is needed.

Generalizability of results

When subnational areas or facilities are selected for study, the generalizability of the findings may be a concern. Visiting all the facilities in an area, when possible, can have strong programmatic implications, as health managers will be able to design site-specific changes. In section 3.2, on preparation for data collection, the selection of facilities for study comprises two steps: selection of areas and, within these areas, selection of facilities. If these steps are followed (i.e. the worksheet is used), bias is minimized.

If it appears that, due to chance, random selection has produced a bias (for example, most of the facilities selected are concentrated in one area of a certain region), this should be noted, as even biased data are useful if the direction of the bias is known. For instance, suppose that the EmOC facilities in the study were not randomly selected and were therefore much more likely to be located on a major road than a randomly selected group would have been. In this case, it is possible to say with reasonable certainly that hospitals far from major roads are less likely than hospitals on major roads to perform caesarean sections. Therefore, the estimate derived from the biased sample probably presents an unrealistically favourable picture of Indicator 5, and the situation is probably worse than the data indicate. If the information is still not useful for generalization, e.g. if it is not clear which way the bias works, the data may nevertheless be useful for managing or evaluating health services in the area. To use the example above, the data may show that some hospitals are not providing life-saving services such as caesarean section, even though government standards state that they should. This information, by itself, can be used to guide activities to reduce maternal deaths.

Incomplete or poor data

Routine maternity record systems in many countries do not facilitate the collection of data on obstetric complications, maternal deaths, stillbirths and very early neonatal deaths. Often, staff has fallen out of the habit of filling in some of the columns of the maternity register or the admissions and discharge registers. This is a management problem that requires attention over time to ensure complete, accurate record keeping.

Table 11. Emergency obstetric care indicators

Indicator		Description	Numerator	Denominator	Acceptable level
1&2*	Availability of EmOC (national or subnational)	Ratio of EmOC facilities to population and geographical distribution of facilities	No. of facilities in area providing basic or comprehensive EmOC	Population of area divided by 500 000	≥ 5 EmOC facilities per 500 000 population
			No. of facilities in area providing comprehensive EmOC	Population of area divided by 500 000	≥ 1 comprehensive facility per 500 000 population
3	Proportion of all births in EmOC facilities	Proportion of all births in population in EmOC facilities	No. of women giving birth in EmOC facilities in specified period	Expected no. of births in area in same period	Recommended level to be set locally
4	Met need for EmOC	Proportion of women with major direct obstetric complications treated at EmOC facilities	No. of women with major direct obstetric complications treated in EmOC facilities in specified period	Expected no. of women with severe direct obstetric complications in area in same period**	100%
5	Caesarean section as a proportion of all births	Proportion of all births in population by caesarean section in EmOC facilities	No. of caesarean sections in EmOC facilities in specified period	Expected no. of births in area in same period	5–15%
6	Direct obstetric case fatality rate	Proportion of women with major direct obstetric complications who die in EmOC facilities	No. of maternal deaths due to direct obstetric causes in EmOC facilities in specified period	No. of women treated for direct obstetric complications in EmOC facilities in same period	< 1%
7	Intrapartum and very early neonatal death rate	Proportion of births that result in an intrapartum or a very early neonatal death within the first 24 h in EmOC facilities	No. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) and very early neonatal deaths (≥ 24 h; ≥ 2.5 kg) in EmOC facilities in specified period	No. of women giving birth in EmOC facilities in same period	To be decided
8	Proportion of maternal deaths due to indirect causes	Percentage of all maternal deaths in EmOC facilities due to indirect causes	No. of maternal deaths due to indirect causes in EmOC facilities in specified period	All maternal deaths (from direct and indirect causes) in EmOC facilities in same period	None set

* Indicators 1 and 2 involve the same calculations, with data on the corresponding regional population and facility instead of aggregated national data.

** Equal to 15% of expected births in the same area and period.

As stated earlier, in many countries maternity registers do not have a column for 'reason for admission' or 'maternal complications'. When providers want to record maternal complications, therefore, they have to make a note in another column, such as 'remarks', or in the margin. While this may appear to be an administrative detail, it is a strong indication of commitment to improving maternal health. There is often room in registers to add such a column, perhaps by replacing a column used for uncommon events, such as multiple births. Persuading ministries of health (and funders) to add this column is an important step in making these indicators part of health management information systems. (Appendix B lists the items that should appear in facility registers.) As periodic collection of these data becomes part of routine programme monitoring, record keeping should improve.

Data on maternal deaths, stillbirths and very early neonatal deaths are often difficult to collect for some of the same reasons stated above. In addition, because of the sensitive nature of these events, health staff may not record them for fear of reprisal. Interventions geared to improve the working environment should, over time, help health staff feel more comfortable about accurately recording deaths.

As record keeping of complications, maternal deaths, stillbirths and very early neonatal deaths improves, the reported number of complications and deaths in the facility will increase. It is critical to reassure staff that these temporary increases will be appropriately interpreted; that they will not be assumed to be the result of poor or deteriorating patient care. One way of identifying 'recording bias' is to use other indicators in the set as benchmarks, especially those indicators based on services that are reported often and are fairly reliable, such as the numbers of women giving birth and caesarean sections in the facility. Using the indicators as a set can help clarify whether the apparent increase in complications or deaths is due to better reporting or if it is a real increase. For example, if the reported number of women with major complications treated in the facility increases by 150% over 3 years, but the number of women giving birth in the facility increases by 75% and the number of caesarean sections performed increases by 50%, it can be assumed that some of the reported increase in complications is due to better reporting (probably in the range of one half to two thirds). As the community's confidence in the quality of care improves and women with complications are more likely to be brought for treatment, many of the women will require a caesarean section; therefore, the numbers of complications and of caesarean sections should rise together, unless there is a problem that limits the availability of surgery. This example illustrates the kind of exploration of the data that can be useful at local level.

Relation of EmOC indicators to maternal mortality

As noted earlier in this handbook, met need for EmOC and caesarean section as a proportion of all births are closely correlated with maternal mortality ratios, and it is logical that as met need goes up and the direct obstetric case fatality rate declines, the number of deaths in the population due to direct obstetric complications will decline as well. Maternal mortality ratios, however, are difficult to measure, especially in a relatively small area (such as a project area) or over a short period. Nevertheless, methods for capturing the effect of maternal health programmes are continuing to improve. For example, a method for estimating deaths averted, based on the EmOC indicators, has been proposed, although it must be tested (162). A set of tools is available at: http://www.immpact-international.org/index.php?id=67&top=60.

An exercise in interpreting the indicators as a set

Table 12 shows three very different scenarios for EmOC indicators. This exercise shows that such data are directly applicable for programming. Examine the sets of indicators in the three scenarios as if you were an official of the ministry of health in country X, looking at data from various districts of the country. On the basis of the hypothetical data and the acceptable levels, identify priorities for improving the situation for women with obstetric complications.

Table 12. Three scenarios for emergency obstetric care (EmOC) indicators and levels

Indicator	Level
Scenario 1	
Population	950 000
Number of functioning EmOC facilities:	
• basic	2
• comprehensive	1
Geographical distribution of EmOC facilities	Mostly in district capital
Proportion of all births in basic and comprehensive EmOC facilities	10%
Met need for EmOC	8%
Caesarean sections as a percentage of all births	0.7%
Direct obstetric case fatality rate	5%
Scenario 2	
Population	950 000
Number of EmOC facilities:	
• basic	7
• comprehensive	2
Geographical distribution of EmOC facilities	Some urban, some rural
Proportion of all births in basic and comprehensive EmOC facilities	10%
Met need for EmOC	8%
Caesarean sections as a percentage of all births	2%
Direct obstetric case fatality rate	2%
Scenario 3	
Population	950 000
Number of EmOC facilities	
• basic	10
• comprehensive	3
Geographical distribution of EmOC facilities	Some urban, some rural
Proportion of all births in basic and comprehensive EmOC facilities	25%
Met need for EmOC	65%
Caesarean sections as a percentage of all births	12%
Direct obstetric case fatality rate	15%

In Scenario 1, there are far too few functioning EmOC facilities. For a population of nearly 1 million, there should be 10 such facilities, at least two of which are comprehensive, rather than the existing three. Furthermore, the functioning facilities are mostly in urban areas. The other indicators are not very good either (e.g. the direct obstetric case fatality rate is too high at 5%), but clearly the first priority is to see which health facilities can be upgraded to provide appropriate care, especially in rural areas.

In Scenario 2, the number of functioning EmOC facilities is much higher: there are nine; two of these provide comprehensive care, and some are in rural areas.

The proportion of deliveries that take place in these facilities is, however, low (10%), as is the met need (8%). The direct obstetric case fatality rate is not very high (at 2%), but this is not a reason for complacency, because so few women are cared for at these facilities. The highest priority here would be to find out why use is so low, by using a variety of methods: community focus groups, discussions with staff, observation of the services and a review of the record-keeping system.

In Scenario 3, there is more than the minimum number of EmOC facilities (13); three of these are comprehensive (rather than the minimum of two), and they seem to be well distributed in terms of urban and rural areas. The proportion of births in the facilities (25% of all births) and met need (65%) are fairly high. The proportion of deliveries by caesarean section (12%) is towards the high end of the acceptable range (5–15%), and the direct obstetric case fatality rate is very high at 15% (with a maximum acceptable level of 1%). In this situation, the quality of care in the EmOC facilities is the first concern. Clinical audits and direct observation of services would be appropriate. As met need and the direct obstetric case fatality rate are both high in this scenario, it is important to analyse why. For instance, women may present at the health facility very late, which is not related to the quality of the health facility. Maternal death audits and verbal autopsies present opportunities for health managers to understand the relevant issues.

3. Collecting data for the indicators

3.1 Types of data required

Constructing the EmOC indicators proposed in this document requires data on the population, birth rate, and health facility. Table 13 shows how the indicators are composed of such data.

Information on population and birth rates is available in most countries at central level (e.g. the central statistical office). Gathering information on the signal functions, mode of childbirth, obstetric complications and maternal deaths, however, means visiting health facilities and reviewing facility registers. The emphasis is on the EmOC services that a facility actually provides rather than on what it is supposed to be able to provide.

This section lays out the steps for collecting the data necessary for the indicators of EmOC. Table 14 gives a summary of the steps, and each is discussed in detail below. Sample data collection forms are to be found in Appendix A and are discussed here. In addition, suggestions are given about additional data that can be of use in area monitoring

3.2 Preparation

Most of the data necessary for calculating these indicators will be collected in facilities. In a relatively small country, visiting every hospital should not be too difficult, but in a large country it might not be possible. Visiting every health centre that might provide EmOC, although ideal from a programme viewpoint would be difficult even in some small countries. Therefore, in most countries, a subset of potential EmOC facilities will have to be selected for review.

We hope that in a few years the kind of information required for these indicators will be reported routinely to ministries of health, in which case data for all facilities would be compiled and available. If this information is available in a regular health management information system, it is easier to assess the availability of services and make changes and improvements in the health system.

The steps described in this section and the next will help in identifying a group of facilities that gives a reasonably accurate picture of the situation, while at the same time not requiring an unreasonable amount of work. In countries where financial and human resources are constrained, the approach described below will suffice to yield informative data about the maternity care system. Ensuring that the facilities selected for review give a fairly accurate picture of the situation depends largely on avoiding two major pitfalls: systematic bias and the effects of chance variation.

Systematic bias can occur when conscious or unconscious factors affect the selection of facilities for study. For example, the people selecting the facilities might want to present the situation in the most favourable light possible, or they might select facilities that are easily accessible (e.g. on a paved road or near a large town). In either case, the data collected might give an overly favourable impression. The effects of chance are, of course, unpredictable, but they do tend to diminish as the number of facilities studied increases.

Selection is done in two stages: selecting areas of a country for study and then selecting facilities within those areas. Sections 3.2.1 and 3.2.2 present a guide for selecting areas for study at national level. Facilities within those areas are selected at the area level, as described in sections 3.3.1 and 3.3.2.

3.2.1 Determine the number of areas to be studied

Consider a level smaller than ‘national’. The term for this administrative level will vary by country, e.g. state, province, but is referred to here as an ‘area’. In a few countries where the administrative units of ‘provinces’ or ‘states’ are exceptionally large, it may be preferable to define smaller areas, e.g. district or county, for selection into the study. Alternatively, it may be logistically better to select the original administrative units even if they are large, but then select subareas for study at a second stage. As a rough guide, if an area has more than 100 hospitals (public and private), subareas may be selected; the number of subareas

Table 13. Types of data used to construct emergency obstetric care indicators

Type of data	Indicator 1 Availability of EmOC (basic and comprehensive)	Indicator 2 Geographical distribution of EmOC facilities	Indicator 3 Proportion of all births in EmOC facilities	Indicator 4 Met need for EmOC	Indicator 5 Caesarean sections as proportion of all births	Indicator 6 Direct obstetric case fatality rate	Indicator 7 Intrapartum and very early neonatal death rate	Indicator 8 Proportion of maternal deaths due to indirect causes
Existing estimates:								
Population size	x	x	x	x	x			
Crude birth rate of area			x	x	x			
Health facility data:								
EmOC signal functions	x	x	x	x	x	x	x	x
No. of women giving birth			x				x	
No. of women with obstetric complications				x		x		
No. of caesarean sections					x			
No. of maternal deaths due to direct obstetric causes						x		x
No. of maternal deaths due to indirect causes								x
Intrapartum deaths (fresh stillbirths; ≥ 2.5kg) and very early neonatal deaths (≤ 24h; ≥ 2.5kg) in facility							x	

studied should represent at least 30% of the total. For the purposes of the forms, each subarea should be considered an 'area'. Professional help from a statistician should be sought in obtaining national estimates in countries where subareas are selected.

The following guidelines should be used to determine whether to study all areas of a country:

- If a country has 100 or fewer hospitals (public and private), then study all areas.
- If a country has more than 100 hospitals (public and private), then a subset of areas may be selected for study. Select as many subnational areas as possible, but the number selected should be at least 30% of the total number of subnational areas in the country.

In selecting a subset of areas, the aim should be to study as many areas as possible, without compromising the quality of the data collected. For example, if there are 21 administrative areas in a country, 10 might be selected for study. Fewer can be studied if resources are scarce, but the proportion selected should not be less than 30% or a minimum of seven administrative areas.

Table 14. Guide to data collection and forms

Activity	Action	Refer to or use
Simple selection	1. Select areas for study, if not national. 2. Determine a single 12–month period to study and enter on form 2 (Facility case summary form). 3. List all possible facilities in the area that might provide EmOC. 4. If sampling is necessary, select facilities to be visited.	Sections 3.2.1, 3.2.2. Section 3.2.3. Sections 3.3–3.3.2, form 1 and worksheets 1a and 1b
Data collection	5. Conduct site visits to facilities.	Sections 3, 4 and form 2
Data preparation	6. If a sample of facilities was visited, separate them into health centres (or other lower-level facilities) and hospitals by area and then adjust the data for area estimates. 7. If all facilities in an area were surveyed, separate them into three groups by area: • actual comprehensive EmOC facilities • actual basic EmOC facilities • non-EmOC facilities 8. Summarize findings for all indicators disaggregated by classified level of facility (i.e. basic and comprehensive and all surveyed facilities).	Section 3.5, form 3 and worksheets 3a, 3b and 3c or worksheets 3d, 3e and 3f
Calculation and interpretation of indicators	9. Calculate indicators for (each) area (for EmOC facilities and for all facilities). 10. Interpret. 11. Consolidate forms 1–4 (with worksheets) for all study areas if national. 12. Calculate indicators for entire country. 13. Interpret.	Section 3.6 and form 4 Section 3.1 and text on each indicator (section 2) Section 3.7, form 5 and worksheet 5a Section 3.1 and text on each indicator (section 2)

An area is the administrative level or geographic area in the country included in the facility survey; e.g., district, state, province.

3.2.2 Random selection of areas

To avoid bias, described above, the selection of areas within each type must be random. The procedure for random selection is as follows:

Step 1: Make a list of all areas in the country. The list should be in alphabetical order, to minimize the possibility of bias.

Step 2: Assign each area a consecutive number, starting with 1 for the first area on the list.

Step 3: Calculate the 'sampling interval', which will tell you to select every nth area, once the first area has been selected at random. Use the following formula:

Sampling interval =

total number of areas in the country
divided by
number of areas selected

Country W has a total of 21 areas, of which 10 are to be selected for study, giving a sampling interval of 2 (21/10 = 2.1). Sampling intervals should be rounded to the nearest whole number. If, for example, it had been decided that 15 of the 21 areas would be studied, the sampling interval would be 1.4, which would therefore round down to 1, an indication that either fewer areas should be selected for study or all areas should be included in the sample.

Step 4: Identify the first area to be included in the sample by generating a random number that is less than or equal to the sampling interval but greater than zero. This can be done with a random number table (Appendix C). To use the table, look away from the page and touch it with the point of a pencil. The digit closest to where the pencil touches the page is the random number. If the digit is less than or equal to the sampling interval and greater than zero, use it; if not, read from left to right until a digit that satisfies this condition is reached. This number will be the first area selected.

For country W, the sampling interval is 2. Using the random number table, our pencil point falls on the digit 7, at row 22, column 5. This is larger than our sampling interval, so we read from left to right, passing the digits 0, 7 and 0, until we come to 2. Thus, area 2 on the list will be the first area selected.

Step 5: Identify all other areas to be included in the sample by adding the sampling interval to the number of the first area and continue to select areas until the desired number has been reached. As the first selected area is 2 on the list of areas, the next one would be 2 plus 2, or 4, and the next 6, and so on, until 10 areas have been selected.

3.2.3 Determine a nationally uniform 12–month period to be studied

The data collected from facilities will be retrospective, but the 12-month period selected should be a recent one, to ensure that the data will still be available. For comparability of data, it is important that all data collected throughout the country be for the same 12–month period. A decision about which period to use should be made at national level, and it should then be entered on the top of the facility case summary form of form 2 before it is duplicated for use. This will ensure that data collected at all facilities refer to the same period. The 12–month period can be either a calendar year (e.g. 1 January 2010–31 December 2010) or any other 12-month period (e.g. 1 June 2012–31 May 2013).

Once areas have been selected for study, forms 1–4 and all the worksheets should be duplicated and a complete set given to the person coordinating the research in each area.

3.3 Form 1: All potential EmOC facilities in selected areas

The first step in gathering the required data is to make an exhaustive, up-to-date list of all the facilities in each selected areas that may be providing delivery and EmOC services (basic or comprehensive), as defined by the signal functions (Table 4). A facility that may be providing EmOC services is one that is:

- on the ministry of health's list of hospitals and lower-level facilities that should be providing delivery services;

- on a list of private hospitals and lower level facilities that might be providing at least some delivery services; or
- known by the area medical officer as possibly providing delivery services.

The list should be as complete as possible so that no EmOC facility is overlooked; however, care should be taken to avoid double counting. Worksheets 1a and 1b can be used for this purpose and should be used to list all of the various facilities—hospitals, maternities, health centres, clinics and health posts—that may be providing basic or comprehensive EmOC in the area. As each worksheet has space to list only 10 facilities, it is likely that the lists of each type of facility will be several pages long. It is recommended that these lists be in alphabetical order to reduce any bias in the selection process (see 3.3.2 below). Form 1 summarizes the number of facilities listed on worksheets 1a and 1b.

3.3.1 Determine the number of facilities to be reviewed

In a relatively small area, it may be possible to visit every hospital, while in larger areas it will not. Even in small areas, it will often be difficult to visit every lower-level facility that provides delivery services and might be providing basic EmOC. Thus, in most areas, a subset of facilities may be selected for review. To avoid bias, this second stage of selection should also be random. The criteria below can be used to decide whether to study all facilities or to select a subset for review.

It is important to include private sector facilities in this exercise. Therefore, countries may want to conduct the following exercise separately for public and private facilities.

Hospitals (e.g. regional, district, rural, maternity):

- If there are 25 or fewer, study all of them.
- If there are more than 25, a subset can be selected. Select as many as possible, but the number should represent at least 30% and there should not be fewer than 20 facilities.

Lower-level facilities (e.g. health centres, health posts, clinics):

- If there are 100 or fewer, study all of them.
- If there are more than 100, a subset can be selected. Select as many as possible, but the number should represent at least 30%.

Example: In area X, there are 48 hospitals of different levels and types. Although 48 is greater than 25, it is decided that it is feasible to visit all of them. There are also 390 health centres and health posts, but it would be too difficult and costly to visit all of them and a subset of these facilities must be selected for review.

If a subset of either type of facility is to be selected, the number to be visited must be decided. As described above, this number should be as large as possible in order to minimize the effects of chance variation, and should be at least 30% of all facilities of each type. In determining the number of facilities to visit, it is important to strike a good balance between the number of facilities and the quality of the data that will be collected from them. In other words, the number of facilities selected should be as large as possible while still allowing for careful data collection at each facility.

Example: In area X, all 48 hospitals will be visited, and 40% of the health centres and posts will be selected for review. Thus, 156 (0.4 x 390) health centres and posts will be selected. The percentages of selected of hospitals and lower-level facilities in each area should be recorded, so that this can be taken into account when combining the information from all areas. This step is not needed if the same percentage is selected in all areas.

3.3.2 Random selection of facilities

Once the number of facilities to be visited has been decided, the next step is to select the actual facilities. To minimize the chance of bias, this should be done randomly, in a procedure similar to that followed for selecting areas. If all facilities are to be visited, this step will not be necessary. If a subset of both hospitals and lower-level facilities is to be selected, random selection should be carried out separately for each level. The procedure is outlined below. Random selec-

tion will be done with all the lists in worksheet 1a or 1b that have been filled out for the geographical area in question.

Step 1: Assign each facility a consecutive number. In order to minimize the possibility of bias, facilities should be listed in alphabetical order before being numbered.

Step 2: Calculate the sampling interval, which will tell you to select every nth facility once the first facility has been selected at random. Use the following formula:

Sampling interval =

number of facilities in the area
divided by
number of facilities to be selected

Example: In area X, a total of 390 health centres, of which 156 are to be selected for review, produces a sampling interval of 3 (390/156 = 2.5). Sampling intervals are rounded to the nearest whole number.

Step 3: Identify the first facility to be included in the sample by generating a random number that is less than or equal to the sampling interval but greater than zero. This can be done using a random number table (Appendix C). To use the table, look away from the page and touch it with the point of a pencil. The digit closest to where the pencil touches the page is the random number. If the digit is less than or equal to the sampling interval and greater than zero, use it; if not, read from left to right until a digit that satisfies this condition is reached. This number will be the first facility selected.

Example: For lower-level facilities in area X, the sampling interval is 3. Using the random number table, our pencil point falls on the digit 4, in row 12, column 2. This is larger than our sampling interval, so we read from left to right, passing the digits 0, 9 and 6, until we come to 1. Thus, facility 1 on the list of lower-level facilities will be the first area selected.

Step 4: Identify all other facilities to be studied by adding the sampling interval to the number of the first facility. Continue to select facilities until the desired number has been reached. If you come to the end of the list in the selection process, return to the beginning, but do not count those facilities that have already been selected.

Example: Since the first selected facility is 1 on the list, the next one would be 1 plus 3, or 4, and the next 7, and so on. Facility 388 will be the 129th facility selected, and facility 3 will be the 130th (since facility 1 has already been selected and should not be counted in the second pass through the list). Every third facility will continue to be selected in this way until all 156 have been selected.

Once the facilities to be reviewed have been selected, site visits to collect data at each facility can begin.

3.4 Form 2: Review of EmOC at facilities

A copy of form 2 should be used at each facility to record the type and amount of services provided. The information compiled on this form will enable research staff to determine whether a given facility is actually providing EmOC services and, if it is, whether it is functioning at the basic or comprehensive level. Except for data on population size and the crude birth rate, all the information needed to construct the indicators is contained in form 2.

EmOC signal functions

To determine whether the EmOC signal functions were performed in the past 3 months, review facility registers, observe and if necessary interview health workers in the maternity ward and other departments.

- Record whether the signal function has been performed in the past 3 months and, if not, why it has not been performed.
- Consider all the following when determining whether a particular signal function was available:
  - Is staff at facility trained to provide the service?
  - Are the requisite supplies and equipment present? Is the equipment functioning?
  - Were there cases for which the use of a particular signal function was indicated?
  - Are the cadres of staff working at the facility authorized to perform the service?

- If a signal function was not performed in the past 3 months, indicate why not, using the following definitions:
  - Training issues:
    - *Authorized cadre is available, but not trained;*
    - *Providers lack confidence in their skills.*
  - Supplies and equipment issues:
    - *Supplies or equipment are not available, not functional or broken;*
    - *Needed drugs are unavailable.*
  - Management issues:
    - *Providers demand compensation to perform this function;*
    - *Providers are encouraged to perform alternative procedures;*
    - *Providers are uncomfortable or unwilling to perform the procedure for reasons unrelated to training.*
  - Policy issues:
    - *The required level of staff is not posted to this facility in adequate numbers (or at all);*
    - *National or hospital policies do not allow the function to be performed.*
  - No indication:
    - *No woman needing this procedure came to the facility during the period. (Before marking 'No indication', consider the previous options; for example, if a site does not have someone trained to provide a procedure or equipment and drugs, women will not come for the procedure.).*

Number of women giving birth

- This is the number of women with normal vaginal births + the number of women with assisted vaginal deliveries + the number of caesarean sections in the facility.
- If breech deliveries are recorded separately, add these as well, but remember to check that they are not already included in normal deliveries or caesarean sections.
- Remember to count the number of women and not the number of births (i.e. infants).

Number of caesarean sections

- Remember to count all emergency caesarean sections and all planned or scheduled caesarean sections.
- Count caesarean sections performed for neonatal as well as maternal reasons.

Number of women with direct obstetric complications

- In order to be considered a case and to be included in the data, a woman must be pregnant at the time of admission, recently delivered or aborted.
- Include only events of sufficient severity that should be treated with a life-saving procedure or are stabilized and then referred to another facility.
- The patient has a clear diagnosis of any one of the obstetric complications (see Box 2).
- Treatment was started before referral to another facility (including stabilization).
- When diagnosis of complications is not available, use the following criteria for inclusion:
  - Records indicate clear signs or symptoms such as bleeding, high blood pressure, fever with discharge and convulsions.
  - Records indicate definite interventions such as caesarean section, vacuum or forceps delivery, blood transfusion, manual removal of placenta, injection of anticonvulsant or injection of oxytocin.
- Exclude women who were admitted without any diagnosis (or clues leading to a diagnosis as mentioned above) and who received no treatment before being referred to another facility.
- If one patient has two diagnoses, select the more serious one. For example, if a pregnant woman was admitted for haemorrhage and ruptured uterus, the main diagnosis is ruptured uterus. If the interviewer is unsure about the diagnosis, he or she should consult the staff working in the health

facility. Remember to count the number of women with obstetric complications and not the number of obstetric complications.

- Abortion complications include only those with infection or haemorrhage (see case definitions in Box 2).
- Complications of abortion can result from either induced or spontaneous abortion.
- When searching for complications of abortion, the team should look in female ward registers, emergency registers and maternity, labour, delivery, or ward registers.

Number of maternal deaths due to direct obstetric causes

- The WHO definition of 'maternal death' should be used: "The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration or site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental causes."
- Count only maternal deaths that occurred in the facility being studied.
- The definitions of obstetric causes listed in Box 2 should be referred to when filling in this section.
- Maternal deaths can be difficult to find in some facility registers. Therefore, it is very important to look at as many sources as possible (e.g. maternity ward registers, morgue record books, emergency room records).
- Maternal deaths can be a sensitive issue to discuss with health workers. Sometimes it might be helpful to explain that the review is not an audit. In order to make staff feel more at ease, one can point out something positive about their facility (for example, how many women they have been able to treat).

Number of indirect maternal deaths

- Before filling in the form, list the major indirect causes of maternal deaths that are relevant to the country under review, e.g. HIV infection, severe anaemia and malaria.

Number of fresh stillbirths and very early neonatal deaths ≥ 2.5 kg

- Refer to the definitions of fresh stillbirths and very early neonatal deaths above.
- Omit very early neonatal deaths when mothers gave birth outside health facilities (i.e. in the community or at home).
- When the birthweight is unavailable, record the death and state that the birthweight was unknown.

Collecting case summary data

Depending on the size of each facility and the quality of its records, it may be too difficult to collect the necessary information for the entire year directly on form 2. Therefore, two plans are presented.

Plan 1 should be followed whenever possible. This entails completing the grid on form 2 (i.e. recording the number of women giving birth, each type of complication, caesarean section, maternal deaths, intrapartum deaths and very early neonatal deaths) at the facility during each of the 12 months being studied.

Plan 2 can be followed if the facility's patient volume is so large that collecting this information for all 12 months would be too time-consuming (e.g. if there are more than 10 000 deliveries per year). In this plan, a sample of 4 months distributed throughout the year is used and then multiplied by three to estimate the total number for the year. In countries where there are vast seasonal differences in deliveries, it may be important to choose 4 months distributed throughout the year to account for this variation.

3.5 Form 3: Summary of data on EmOC facilities in an area

If the analysis is to be conducted manually and not by computer, after all the sections of form 2 have been completed, the forms should be collected and sorted by geographical area. The next step is to summarize the findings for each area. Form 3 is used for this purpose and has two sections, A and B, only one of which should be completed.

Section A which requests a straightforward summary of the data collected from facilities, should be used only if all facilities in the area were visited (that is, there was no selection of facilities). Facilities should be sorted into three groups on the basis of the entries in the box entitled 'Determination of EmOC status' on form 2. The three groups are facilities that provide comprehensive EmOC, facilities that provide basic EmOC and facilities that do not fully provide either basic or comprehensive services. Worksheets 3a, 3b and 3c are then used to prepare the summary.

Section B should be used if a sample of facilities was chosen. It includes an intermediate step for adjusting the data collected into estimates for all facilities in the area. Worksheets 3d, 3e and 3f are needed to prepare this summary.

Thus, one copy of form 3 will be filled out for each area included in the study, completing either section A or section B (delete the part you do not use).

3.6 Form 4: Calculation of indicators for each area

Once the findings from site visits have been summarized, form 4 can be used to calculate the indicators for each area. This form lays out the steps for using the information summarized in form 3 and includes a summary checklist to determine whether each indicator meets an acceptable level.

While, ultimately, the data on facilities will be aggregated in order to calculate the indicators for the whole country, the area-level indicators provide useful information for setting programme priorities at the area level, and an entire set of completed forms 1–4 should be maintained in the area for this purpose. Secondly, these indicators allow comparisons among study areas at the national level. Using the information obtained for each selected area, researchers can examine differences in the availability of EmOC services, use and performance in different areas of the country. This can have important implications for policy and setting programme priorities.

3.7 Form 5: Calculation of indicators for the country

In order to calculate the EmOC indicators for the country as a whole, researchers must collect copies of all forms 3 and 4 (including worksheets) from each study area. The information needed for this final step is summarized on form 5 and worksheet 5a. The latter summarizes information on the number of EmOC facilities, women giving birth, women with obstetric complications, caesarean sections, maternal deaths (direct and indirect) and intrapartum and very early neonatal deaths in all the areas selected.

The indicators for the country as a whole are determined on form 5. Similarly to form 4 for the calculation of indicators at the area level, a summary checklist of acceptable levels for each indicator is provided.

Once the indicators have been calculated, the last step is interpretation. General notes on the interpretation of EmOC indicators are included under the description of each indicator in the first section of this handbook.

3.8 Monitoring at the area level

Area officials and planners may be interested in greater detail than is required for national monitoring. Therefore, further questions might be added during site visits to facilities. This can be done by attaching an extra sheet to form 2 (Review of EmOC facilities). Some questions that might be of interest are discussed below. It is important, however, that all the data required for the calculation of the indicators be collected uniformly for the whole country. While questions may be added to form 2, none of the existing questions should be modified or deleted. Additional modules useful for conducting a more extensive needs assessment are available at: http://www.amddprogram.org

3.8.1 Level of functioning of facilities

For the purposes of monitoring, it is crucial that only facilities that provide full basic or comprehensive EmOC (i.e. facilities that performed all the designated signal functions in Table 4 in the past 3 months) be included in the first analysis. Area planners might also

be interested in knowing what signal functions the other facilities in the area have performed, and which of them could potentially function as basic or comprehensive EmOC facilities. Tables can be prepared to determine how many facilities did not perform one or more signal functions, and which signal functions facilities they did or did not provide in the past 3 months. Understanding why signal functions were not performed is important. These investigations would be particularly useful if the analysis of EmOC indicators reveals a shortage of facilities. In that case, information about which facilities are close to providing such care can be used in planning which facilities to upgrade. If a particular signal function, such as assisted vaginal delivery, is often not performed, a policy review might be called for in order to ascertain who is trained to do what, at what level of the health system.

3.8.2 Time availability of services

Another factor that area officials might wish to examine is whether obstetric services are available 24 h/day, 7 days/week at facilities that are already fully functioning. For example, a question on the hours per day and days per week that signal functions are actually available might be added to the facility review form (form 2). As obstetric complications are unpredictable, it is important that women have access to life-saving EmOC around the clock. Analyses of local patterns in the availability of signal functions might show that the EmOC coverage is actually lower than the number of facilities would imply. In such cases, expanding the hours when services are available is strongly recommended.

3.8.3 Geographical distribution of services within areas

The geographical distribution of EmOC facilities also affects the accessibility of services. Although the number of facilities in an area might meet or exceed the minimum acceptable level, smaller geographical regions may have too few or no facilities. At the area level, therefore, it may be desirable to locate facilities on a map in order to identify local areas where women do not have access to EmOC, either because facilities do not exist or because the existing facilities are not accessible, e.g. because of poor or nonexistent roads and bridges.

3.8.4 Differences between public- and private-sector facilities

Health planners may be interested in examining differences between facilities that are government-operated and those that are managed by religious institutions, nongovernmental organizations or for-profit organizations. Such differences can have important implications for programming. For example, one might want to know the proportions of women with complications who receiving EmOC in public and in private facilities, or which types of facilities perform more EmOC signal functions. One might also examine differences in case fatality rates in hospital by type of facility. In some situations, access to services and issues of equity can be related to facility ownership and cost of services.

3.8.5 Quality of care at facilities

As discussed earlier, case fatality rates are a crude indicator of the level of performance at EmOC facilities. Area researchers or administrators might therefore wish to collect additional information to gain more insight into the quality of care provided at selected local facilities. One approach is to collect data on the interval between the time a woman is admitted to an EmOC facility and the time she actually receives treatment, as discussed under ‘Supplementary studies’ in the section on direct obstetric case fatality rates.

Detailed case reviews or audits of both maternal deaths and ‘near misses’ can also provide valuable information about the quality of care. Case reviews and audits have the advantage of identifying problem areas within facilities and suggesting possible remedies. Some resources that can be used for studies of the quality of care are:

- EngenderHealth and AMDD. *Quality improvement for EmOC: leadership manual and tool book* (http://www.engenderhealth.org/res/offc/mac/EmOC/index.html) (163). This publication can help health-care providers to identify and solve their own problems. It outlines a continuous, four-step quality improvement process based on participa-

tory principles, with staff involvement and ownership and focusing on clients' rights and needs. It also contains instruments for collecting information and instructions for their use.

- AMDD. *Improving EmOC through criterion-based audit*, 2002 (http://www.amddprogram.org/resources/CriterionBased%20AuditEN.pdf). This manual describes 'criterion-based audit' as a comparison of actual practice with evidence-based standards of care. It is used to improve clinical and managerial practice, to make more rational use of scarce resources and to improve staff morale. The audit cycle includes data collection, analysis, and a plan of action to correct deficiencies, implementation of that plan and repetition of the cycle to measure change. Criterion-based audit can also be used to examine management or the organization of services and human rights in a clinical setting.
- WHO. *Beyond the numbers. Reviewing maternal deaths and complications to make pregnancy safer*, 2004 (http://www.who.int/reproductive-health/publications/btn). This book is directed at health professionals, health-care planners and managers working on maternal and newborn health who wish to improve the quality of care provided. They should be in a position and willing to take remedial action on the basis of the findings of these reviews. The information can be used to improve maternal health outcomes by encouraging health professionals to evaluate current practices critically and to change them if necessary. As action is the ultimate goal of these reviews, it is important that people who can implement the recommended changes participate actively.

3.8.6 Quality of facility records

Area-level officials should examine the method by which the number of women with complications is derived in the facility review forms (form 2). The form offers two plans for arriving at this number (see discussion in section 3.4.1). Some facilities are probably treating more women with obstetric complications than their records indicate, and the final questions on the form ask the reviewer to give an informed opinion about the completeness of the facility's records. Area-level officials might be interested in examining the replies to this question for facilities in their area. If the records for a number of facilities appear to be incomplete, a workshop on facility record keeping could be conducted.

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Appendix A: Forms and worksheets for data collection and calculation of EmOC indicators

Form 1	List of possible EmOC facilities
Worksheet 1a	List of health centres, health clinics and health posts
Worksheet 1b	List of hospitals
Form 2	Review of potential EmOC facilities
Form 3	Summary of data on EmOC facilities in area
Worksheet 3a	Summary of reviews of basic EmOC facilities
Worksheet 3b	Summary of reviews of comprehensive EmOC facilities
Worksheet 3c	Summary of reviews of non-EmOC facilities
Worksheet 3d	Summary of health centres, health clinics and health posts
Worksheet 3e	Summary of hospitals
Worksheet 3f	Area-wide estimates of EmOC
Form 4	Calculation of indicators for areas
Form 5	Calculation of indicators for a country
Worksheet 5a	Amount of EmOC services and number of women giving birth (births), women with complications, caesarean sections, maternal deaths, intrapartum deaths and very early neonatal death

These forms are useful for collecting information. The format can be adapted if necessary. It is important that all the data be collected in order to have a complete picture of the services available and services needed.

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Form 1. Possible EmOC facilities

1. Name of area _____
2. Population of area _____
3. Crude birth rate of area _____
4. Form completed by (list name and title) _____
5. Form completed on (date) _____

Worksheets 1a–1b need to be completed before filling in the total below.

6. Total number of health centres, health clinics and health posts	
7. Total number of hospitals	

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Worksheet 1a. List of health centres, health clinics and health posts

Area (province, region, district, etc.) _____

This worksheet should be used to list all facilities that provide some maternity care but are not hospitals, including health centres, health clinics and health posts. The easiest way to organize this information is to create a table in Excel or another software package.

Facility name	Location	Type of facility (health centre, clinic)	Ownership (government, private, mission)

Total number of facilities that are not hospitals but offer some maternity care

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Worksheet 1b. List of hospitals

Area (province, region, district): _____

This worksheet should be used to list all hospitals that provide maternity care. The easiest way to organize this information is to create a table in Excel or another software package.

Facility name	Location	Type of facility (district hospital, regional hospital)	Ownership (government, private, mission)

Total number of hospitals offering maternity care

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Form 2. Review of possible EmOC facilities

Identification

Facility name	District name (or other subnational area)	Region name (or other subnational area)

Date of data collection			Interviewer
Day	Month	Year	Name

Adapt the following lists of options to the local situation.

Type of facility: (circle one)

1. National hospital 2. Regional hospital 3. District hospital 4. Maternity

5. Health centre 6. Clinic 7. Other: specify_____

Type of operating agency: (circle one)

1. Government 2. Private 3. Nongovernmental organization 4. Religious mission

5. Other: specify_____

EmOC signal functions

Answer the following questions about EmOC signal functions by reviewing facility registers, through observation and if necessary interviewing health workers in the maternity ward and other departments. Record whether the function has been performed in the past 3 months, and if not, why it has not been performed.

Consider all of the following when determining whether a particular signal function was performed:

- Are staff at the facility trained to provide the service?
- Are the requisite supplies and equipment present? Is the equipment functioning?
- Were there no cases for which the use of a particular signal function was indicated?
- Are the cadres of staff working at the facility authorized to perform the service?

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Performance of signal functions

Item	Performed in past 3 months?	If not performed in past 3 months, why?
(a) Administer parenteral antibiotics	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(b) Administer uterotonic drugs (e.g. parenteral oxytocin, ergometrin, misoprostol)	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(c) Administer parenteral anticonvulsants for pre-eclampsia and eclampsia (e.g. magnesium sulfate)	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(d) Perform manual removal of placenta	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(e) Perform removal of retained products (e.g. manual vacuum aspiration, dilation and curettage)	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(f) Perform assisted vaginal delivery (e.g. vacuum extraction, forceps delivery)	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication

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Item	Performed in past 3 months?	If not performed in past 3 months, why?
(g) Perform newborn resuscitation (e.g. with bag and mask)	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(h) Perform blood transfusion	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication
(i) Perform surgery (e.g. caesarean section)	❑ 0. No ❑ 1. Yes	❑ 1. Training issues ❑ 2. Supplies, equipment, drugs issue ❑ 3. Management issue ❑ 4. Policy issues ❑ 5. No indication

Training issues: Authorized cadre is available but not trained, or there is lack of confidence in providers' skills.

Supplies, equipment issue: Supplies or equipment are not available, not functional or broken, or needed drugs are unavailable.

Management issues: Providers desire compensation to perform this function, providers are encouraged to perform alternative procedures, or providers uncomfortable or unwilling to perform procedure for reasons unrelated to training.

Policy issues: Required level of staff is not posted to this facility in adequate numbers (or at all), or national or hospital policies do not allow function to be performed.

No indication: No client needing this procedure came to the facility during this period.

Determination of EmOC status

Use the questions above on the performance of signal functions. Check only one category below.

If **all** questions a–i = Yes, tick	_____ comprehensive EmOC
If **all** questions a–g = Yes, tick	_____ basic EmOC
If **any** questions a–g = No, tick	_____ non-EmOC

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Form 2 (continued)

Facility case summary **Facility name**

Complete the following chart by reviewing facility registers and counting the number of women giving birth, the number of caesarean sections, the number of women with obstetric complications, the number of maternal deaths and the number of intrapartum and very early neonatal deaths.

***Data collection plan 1*:** For facilities in which fewer than 10 000 women give birth per year, data for all 12 months are the most useful.

Data collection plan 2: If more than 10 000 women give birth per year, select 4 months that provide a good distribution of data throughout the year (e.g. months 1, 4, 7 and 10). For more information on plan 2, refer to section 3.4.1 of the handbook.

EmOC indicator data

Month (write the name of a month above each number)													
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total[1]**
No. of women giving birth (normal vaginal, assisted vaginal, breech and caesarean)													
No. of caesarean sections													
Direct obstetric complications													
Haemorrhage (ante- and postpartum)													
Obstructed or prolonged labour													
Ruptured uterus													
Postpartum sepsis													

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Month (write the name of a month above each number)													
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**[1]
Severe pre-eclampsia or eclampsia													
Complications of abortion (with haemorrhage or sepsis)													
Ectopic pregnancy													
Total no. of direct obstetric complications (add each column)													
Other obstetric complications not listed above or not specified; list some of the causes, if specified, in the space below:													

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Year	1	2	3	4	5	6	7	8	9	10	11	12	Total[1]
Maternal deaths from direct obstetric causes													
Haemorrhage (ante- and postpartum)													
Obstructed or prolonged labour													
Ruptured uterus													
Postpartum sepsis													
Severe pre-eclampsia or eclampsia													
Complications of abortion (with haemorrhage or sepsis)													
Ectopic pregnancy													
Total no. of maternal deaths from direct obstetric causes (add each column)													
Other maternal deaths due to direct obstetric causes, other than those listed above or not specified; list some of the causes, if specified, in the space below:													

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Year	1	2	3	4	5	6	7	8	9	10	11	12	Total[1]
Indirect maternal deaths: List causes of indirect obstetric complications and maternal deaths that are relevant for the local context (e.g. HIV, severe anaemia, malaria)													
Indirect maternal death (put relevant cause here)													
Indirect maternal death (put relevant cause here)													
All other indirect maternal deaths													
Stillbirths and neonatal deaths													
Intrapartum deaths (fresh stillbirths) ≥ 2.5 kg													
Very early neonatal deaths (≥ 24 h) ≥ 2.5 kg													

[1] If plan 2 was selected (i.e. only 4 months of data were collected), multiply the total of 4 months by 3 to estimate the data for 12 months.

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Quality of information

Item	Responses
In your informed opinion (e.g. from talking to staff, looking at the record system), what proportion of complications treated in the facility are recorded on this form? *(tick one)*	❑ None ❑ Some (less than half) ❑ Most (more than half) ❑ All
In your informed opinion (from talking to staff, looking at the record system, etc.), what proportion of the maternal deaths that occurred in the facility are recorded on this form? *(tick one)*	❑ None ❑ Some ❑ Most ❑ All

What sources of data were used to complete this form? (e.g. maternity ward register, delivery book, general admissions register, operating theatre register, female ward register, discharge register).

Type of register used	**Yes**	**No**
Maternity ward register		
Delivery register or book		
General admissions register		
Operating theatre register		
Female ward register		
Discharge register		
Other:		
Other:		

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Form 3. Summary of data on EmOC facilities in the area

This form summarizes all the data on facilities within the geographical area that have been entered in **all** sections of form 2. One copy of form 3 should be completed for **each** area.

Name of area	
Population size of area	
Crude birth rate (no. of births per 1000 population) of area	
Expected births in area [(crude birth rate of area ÷ 1000) x Population size of area]	

Complete either section A or section B on the following page. The other section can then be deleted.

If all facilities in the area were visited, complete section A only (and delete section B).

If a subset of facilities in the area were selected, complete section B only (and delete section A).

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Section A:

Use worksheets 3a–c on the following pages to complete the table below.

In a 12–month period	Column 1 **Basic EmOC facilities**	Column 2 **Comprehensive EmOC facilities**	Column 3 **Total no. of EmOC facilities** (column 1+ column 2)	Column 4 **Non-EmOC facilities**	Column 5 **Total no. of facilities surveyed** (column 3 + column 4)
No. of facilities					
No. of women giving birth					
No. of women with complications					
No. of caesarean sections					
No. of maternal deaths from direct obstetric causes					
No. of maternal deaths from indirect causes					
No. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg)					

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Section B:

Use worksheets 3d–f to complete the table below.

In 12–month period:	Column 1 **Basic EmOC facilities**	Column 2 **Comprehensive EmOC facilities**	Column 3 **Total no. of EmOC facilities** (column 1+ column 2)	Column 4 **Non-EmOC facilities**	Column 5 **Total no. of facilities surveyed** (column 3 + column 4)
No. of facilities					
No. of women giving birth					
No. of women with complications					
No. of caesarean sections					
No. of maternal deaths from direct obstetric causes					
No. of maternal deaths from indirect causes					
No. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg)					

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Worksheet 3a. Summary of reviews of basic EmOC facilities

Area: _____

This worksheet summarizes the data collected on form 2 from all **basic EmOC facilities**. Use form 2 to identify all basic EmOC facilities.
Attach additional sheets if necessary.
Excel or another software package can be used for this summary.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Facility	No. of women giving birth	No. of women with complications	No. of caesarean sections	No. of maternal deaths from direct obstetric causes	No. of maternal deaths from indirect causes	No. of intrapartum deaths (fresh still-births; ≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg)
Column totals*						

*If more than one sheet was used, add sheet totals to obtain the overall total.

Total number of basic EmOC facilities listed in column 1 = ☐

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Worksheet 3b. Summary of reviews of comprehensive EmOC facilities

Area: _____

This worksheet summarizes the data collected on form 2 from all comprehensive EmOC facilities. Use form 2 to identify all comprehensive EmOC facilities. Attach additional sheets if necessary. Excel or another software package can be used for this summary.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Facility	No. of women giving birth	No. of women with complications	No. of caesarean sections	No. of maternal deaths from direct obstetric causes	No. of maternal deaths from indirect causes	No. of intrapartum deaths (fresh still-births; ≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 hours; ≥ 2.5 kg)
Column totals*						

*If more than one sheet was used, add sheet totals to obtain the overall total.

Total number of comprehensive EmOC facilities listed in column 1 = ☐

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Worksheet 3c. Summary of reviews of non-EmOC facilities

Area: _____

This worksheet summarizes the data collected on form 2 from all non-EmOC facilities. Use form 2 to identify all non-EmOC facilities. Attach additional sheets if necessary. Excel or another software package can be used for this summary.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Facility	No. of women giving birth	No. of women with complications	No. of caesarean sections	No. of maternal deaths from direct obstetric causes	No. of maternal deaths from indirect causes	No. of intrapartum deaths (fresh still-births; ≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg)
Column totals*						

* If more than one sheet was used, add sheet totals to obtain the overall total.

Total number of non-EmOC facilities listed in column 1 =

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Worksheet 3d. Summary of health centres and other lower-level facilities

Area: _____

This worksheet summarizes data collected on form 2 from all health centres and other lower-level facilities in a geographical area. Use form 2 to identify the EmOC status of the health centres and other lower-level facilities visited. Attach additional sheets if necessary. Excel or another software package can be used for this summary.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Facility	EmOC status (basic, comprehensive or none)	No. of women giving birth	No. of women with complications	No. of caesarean sections	No. of maternal deaths from direct obstetric causes	No. of maternal deaths from indirect causes	No. of intrapartum deaths (fresh still-births; (≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg)
Column totals*							

* If more than one sheet was used, add sheet totals to obtain the overall total

Total number of basic EmOC facilities listed in column 2 =	
Total number of comprehensive EmOC facilities listed in column 2 =	
Total number of non-EmOC facilities listed in column 2 =	

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Worksheet 3e. Summary of hospitals

Area: _____

This worksheet summarizes data collected on form 2 from all hospitals in a geographical area. Use form 2 to identify the EmOC status of the hospitals visited. Attach additional sheets if necessary. Excel or another software package can be used for this summary.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Facility	EmOC status (basic, comprehensive or none)	No. of women giving birth	No. of women with complications	No. of caesarean sections	No. of maternal deaths from direct obstetric causes	No. of maternal deaths from indirect causes	No. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) + No. of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg)
Column totals*							

*If more than one sheet was used, add sheet totals to obtain the overall total.

Total number of basic EmOC facilities listed in column 2 =	
Total number of comprehensive EmOC facilities listed in column 2 =	
Total number of non-EmOC facilities listed in column 2 =	

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Worksheet 3f. Area-wide estimates of EmOC

Area: _____

This worksheet allows conversion of the data from the subset of facilities that were selected for site visits into estimates for the entire area.

If a subset of health centres (and other lower-level facilities) were selected for study:

No. of health centres (or other) visited in area	
Total no. of health centres (or other) in area	
Proportion of health centres (or other) for which data were collected (No. of health centres visited in area ÷ Total no. of health centres in area)	

Use worksheet 3d for the **health centres** (and other lower-level facilities) studied.

	Totals from facilities visited	**÷**	**Proportion of health centres visited** (see chart above)	**=**	**Estimate for area**
Estimated no. of basic EmOC facilities		÷		=	
Estimated no. of comprehensive EmOC facilities		÷		=	
Estimated no. of non-EmOC facilities		÷		=	
Estimated no. of women giving birth in facilities classified as basic and comprehensive facilities		÷		=	
Estimated no. of women giving birth in facilities classified as non-EmOC facilities		÷		=	
Estimated no. of women with complications in facilities classified as basic and comprehensive facilities		÷		=	
Estimated no. of women with complications in facilities classified as non-EmOC facilities		÷		=	
Estimated no. of caesarean sections in facilities classified as basic and comprehensive facilities		÷		=	
Estimated no. of caesarean sections in facilities classified as non-EmOC facilities		÷		=	
Estimated no. of maternal deaths from direct obstetric causes in facilities classified as basic and comprehensive		÷		=	

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	Totals from facilities visited	÷	Proportion of health centres visited (see chart above)	=	Estimate for area
Estimated no. of maternal deaths from direct obstetric causes in facilities classified as providing non-EmOC		÷		=	
Estimated no. of maternal deaths from indirect causes in facilities classified as basic and comprehensive		÷		=	
Estimated no. of maternal deaths from indirect causes in facilities classified as providing non-EmOC		÷		=	
Estimated no. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) and very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in facilities classified as basic and comprehensive		÷		=	
Estimated no. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) and very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in facilities classified as providing non-EmOC		÷		=	

If a sub-set of hospitals was selected for study:

No. of hospitals visited in area	
Total no. of hospitals in area	
Proportion of hospitals for which data were collected above (No. of hospitals visited in area ÷ Total no. of hospitals in area)	

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Use worksheet 3e for the **hospitals** studied.

	Totals from facilities visited	÷	**Proportion of hospitals visited** (see chart above)	=	**Estimate for area**
Estimated no. of basic EmOC facilities		÷		=	
Estimated no. of comprehensive EmOC facilities		÷		=	
Estimated no. of non-EmOC facilities		÷		=	
Estimated no. of women giving birth in facilities classified as basic and comprehensive		÷		=	
Estimated no. of women giving birth in facilities classified as providing non-EmOC		÷		=	
Estimated no. of women with complications in facilities classified as basic and comprehensive		÷		=	
Estimated no. of women with complications in facilities classified as providing non-EmOC		÷		=	
Estimated no. of caesarean sections in facilities classified as basic and comprehensive		÷		=	
Estimated no. of caesarean sections in facilities classified as providing non-EmOC		÷		=	
Estimated no. of maternal deaths from direct obstetric causes in facilities classified as basic and comprehensive		÷		=	
Estimated no. of maternal deaths from direct obstetric causes in facilities classified as providing non-EmOC		÷		=	
Estimated no. of maternal deaths from indirect causes in facilities classified as basic and comprehensive		÷		=	
Estimated no. of maternal deaths from indirect causes in facilities classified as providing non-EmOC		÷		=	
Estimated no. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) and of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in facilities classified as basic and comprehensive		÷		=	
Estimated no. of intrapartum deaths (fresh stillbirths; ≥ 2.5 kg) and of very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in facilities classified as providing non-EmOC		÷		=	

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Form 4. Calculation of indicators for geographic area

Use form 3, section A or B, to calculate the indicators below.

Area: _____

Indicator 1: Availability of EmOC

	Total no. of basic + comprehensive EmOC facilities in area		Population of area				**Indicator 1a** No. of EmOC facilities per 500 000 population	**Is acceptable level met?**
(		÷		) X	500 000	=		Minimum acceptable level ≥ 5 per 500 000 population ☐ Met ☐ Not met

	Total no. of comprehensive EmOC facilities in area		Population of area				**Indicator 1b** No. of comprehensive EmOC facilities per 500 000 population	
(		÷		) X	500 000	=		Minimum acceptable level ≥ 1 per 500 000 population ☐ Met ☐ Not met

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Indicator 2: Geographical distribution of EmOC facilities

This indicator is generally intended for use at the national level. In large areas (e.g. with millions of inhabitants), it is reasonable to calculate the distribution of EmOC facilities for subareas. This can be done by repeating the steps above (in Indicator 1), and then calculating the percentage of subareas meeting the minimum acceptable levels. The minimum acceptable level for this indicator is 100%.

Another option is to lay the facilities in the area on a map that shows roads and topographic areas, to identify problems of access and showing referral systems. This can be done with a geographical information system or another mapping method.

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Indicator 3: Proportion of all births in EmOC facilities and all surveyed facilities

Total no. of women giving birth in EmOC facilities in area		Expected births in area		**Indicator 3a** Proportion of births in EmOC facilities	Minimum acceptable level: targets to be set locally
	÷		=	_____ x 100 = _____ %	☐ Met ☐ Not met
Total no. of women giving birth in all surveyed facilities in area		Expected births in area		**Indicator 3b** Proportion of births in all surveyed facilities	Minimum acceptable level: targets to be set locally
	÷		=	_____ x 100 = _____ %	☐ Met ☐ Not met

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Indicator 4: Met need for EmOC

Indicator 4a

Total no. of women with complications in EmOC facilities in area		Expected births in area				Proportion of women estimated to have obstetric complications who are treated in EmOC facilities	Acceptable level = 100%
	÷	(	X	0.15*	) =	_____ x 100 = _____ %	☐Met ☐Not met

Indicator 4b

Total no. of women with complications in all surveyed facilities in area		Expected births in area				Proportion of women estimated to have obstetric complications who are treated in all surveyed facilities	☐No target ☐Not applicable
	÷	(	X	0.15*	) =	_____ x 100 = _____ %	

* Expected births are multiplied by 0.15 to estimate the total obstetric complications in the population.

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Indicator 5: Caesarean sections as a proportion of all births

Indicator 5a

Total no. of caesarean sections in EmOC facilities in area		Expected births in area (Form 3)		Caesarean sections in EmOC facilities as a proportion of all births	Acceptable level: 5–15%
	÷		=	_____ x 100 = _____ %	☐ Met ☐ Not met

Indicator 5b

Total no. of caesarean sections in all surveyed facilities in area		Expected births in area		Caesarean sections in all surveyed facilities as a proportion of all births	Acceptable level: 5–15%
	÷		=	_____ x 100 = _____ %	☐ Met ☐ Not met

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Indicator 6: Direct obstetric case fatality rate

Total no. of maternal deaths from direct obstetric causes in EmOC facilities in area		Total no. of women with obstetric complications in EmOC facilities in area		**Indicator 6a** Direct obstetric case fatality rate in EmOC facilities	Acceptable level: ≤ 1% ☐ Met ☐ Not met
	÷		=	_____ **x 100 =** _____ **%**	
Total no. of maternal deaths from direct obstetric causes in all surveyed facilities in area		Total no. of women with obstetric complications in all surveyed facilities in area		**Indicator 6b** Direct obstetric case fatality rate in all surveyed facilities	Acceptable level: ≤ 1% ☐ Met ☐ Not met
	÷		=	_____ **x 100 =** _____ **%**	

In addition to the aggregated calculations, the direct obstetric case fatality rate should be calculated for each hospital. The results can be presented as a bar chart: the horizontal axis should be labelled with the facility names, and the vertical axis should be labelled "Direct obstetric case fatality rate (%)". Another way of presenting facility-based results is to give the range of direct obstetric case fatality rates from different hospitals as well as the aggregate direct case fatality rate.

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Indicator 7: Intrapartum and very early neonatal death rate

Total no. of intrapartum deaths (≥ 2.5 kg) + very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in EmOC facilities in area		Total no. of women giving birth in EmOC facilities in area		**Indicator 7a** Intrapartum and very early neonatal death rate in EmOC facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ **x 100 =** _____ **%**	
Total no. of intrapartum deaths (≥ 2.5 kg) + very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in all surveyed facilities in area		Total no. of women giving birth in all surveyed facilities in area		**Indicator 7b** Intrapartum and very early neonatal death rate in all surveyed facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ **x 100 =** _____ **%**	

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Indicator 8: Proportion of maternal deaths due to indirect causes

Total no. of maternal deaths from indirect causes in EmOC facilities in area		Total no. of maternal deaths from all causes in EmOC facilities in area		**Indicator 8a** Proportion of maternal deaths due to indirect causes in EmOC facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ **x 100 =** _____ **%**	

Total no. of maternal deaths from indirect causes in all surveyed facilities in area		Total no. of maternal deaths from all causes in all surveyed facilities in area		**Indicator 8b** Proportion of maternal deaths due to indirect causes in all surveyed facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ **x 100 =** _____ **%**	

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Form 5. Calculation of indicators for a country

Complete worksheet 5a before calculating the indicators below.

Indicator 1: Availability of EmOC services

Indicator 1a

(Total no. of basic + comprehensive EmOC facilities) ÷ (Total population (worksheet 5a; column 3 total)) X 500 000 = No. of EmOC facilities per 500 000 population

Indicator 1b

(Total no. of comprehensive EmOC facilities) ÷ (Total population) X 500 000 = No. of comprehensive EmOC facilities per 500 000 population

Is acceptable level met?

Minimum acceptable level ≥ 5 per 500 000 population

☐ Met

☐ Not met

Minimum acceptable level ≥ 1 per 500 000 population

☐ Met

☐ Not met

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Indicator 2: Geographical distribution of EmOC facilities

No. of areas in country meeting minimum levels (i.e. at least 5 facilities per 500 000 population including at least 1 comprehensive facility)		No. of areas in country		**Indicator 2** Proportion of areas with the minimum acceptable number of EmOC facilities	Acceptable level: 100%
	÷		=	_____ **x 100 =** _____ **%**	☐ Met ☐ Not met

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Indicator 3: Proportion of all births in EmOC facilities and all surveyed facilities

Total no. of women giving birth in all EmOC facilities		Total expected births		**Indicator 3a** Proportion of all births in EmOC facilities	Minimum acceptable level: targets to be set locally
	÷		=	_____ x 100 = _____ %	☐ Met ☐ Not met
Total no. of women giving birth in all surveyed facilities		Total no. of expected births		**Indicator 3b** Proportion of all births in all surveyed facilities	Minimum acceptable level: targets to be set locally
	÷		=	_____ x 100 = _____ %	☐ Met ☐ Not met

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Indicator 4: Met need for EmOC

Indicator 4a

Total no. of women with complications in all EmOC facilities		Total no. of expected births				Proportion of women estimated to have obstetric complications who are treated in EmOC facilities	Acceptable level = 100%
	÷	(	x	0.15*	)	= _____ x 100 = _____ %	☐Met ☐Not met

Indicator 4b

Total no. of women with complications in all surveyed facilities		Total no. of expected births				Proportion of women estimated to have obstetric complications who are treated in all surveyed facilities	☐No target
	÷	(	x	0.15*	)	= _____ x 100 = _____ %	☐Not applicable

* Expected births are multiplied by 0.15 to estimate the total obstetric complications in the population.

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Indicator 5: Caesarean sections as a proportion of all births

Total no. of caesarean sections in all EmOC facilities		Total no. of expected births		**Indicator 5a** Caesarean sections in EmOC facilities as a proportion of all births	Acceptable level: 5–15% ☐ Met ☐ Not met
	÷		=	_____ **x 100 =** _____ **%**	

Total no. of caesarean sections in all surveyed facilities		Total no. of expected births		**Indicator 5b** Caesarean sections in all surveyed facilities as a proportion of all births	Acceptable level: 5–15% ☐ Met ☐ Not met
	÷		=	_____ **x 100 =** _____ **%**	

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Indicator 6: Direct obstetric case fatality rate

Total no. of maternal deaths from direct obstetric causes in all EmOC facilities		Total no. of women with obstetric complications in all EmOC facilities		**Indicator 6a** Direct obstetric case fatality rate in EmOC facilities	Acceptable level: ≤ 1% ☐ Met ☐ Not met
	÷		=	_____ x 100 = _____ %	
Total no. of maternal deaths from direct obstetric causes in all surveyed facilities		Total no. of women with obstetric complications in all surveyed facilities		**Indicator 6b** Direct obstetric case fatality rate in all surveyed facilities	Acceptable level: ≤ 1% ☐ Met ☐ Not met
	÷		=	_____ x 100 = _____ %	

In addition to the aggregated calculations, the direct obstetric case fatality rate should be calculated for each hospital. The results can be presented as a bar chart: the horizontal axis should be labelled with the facility names, and the vertical axis should be labelled "Direct obstetric case fatality rate (%)". Another way of presenting the facility-based results is to give the range of case fatality rates from direct obstetric causes and the mean case fatality rate.

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Indicator 7: Intrapartum and very early neonatal death rate

Total no. of intrapartum deaths (≥ 2.5 kg) + very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in all EmOC facilities		Total no. of women giving birth in all EmOC facilities		**Indicator 7a** Intrapartum and very early neonatal death rate in EmOC facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ x 100 = _____ %	
Total no. of intrapartum deaths (≥ 2.5 kg) + very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in all surveyed facilities		Total no. of women giving birth in all surveyed facilities		**Indicator 7b** Intrapartum and very early neonatal death rate in all surveyed facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ x 100 = _____ %	

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Indicator 8: Proportion of maternal deaths due to indirect causes

Total no. of maternal deaths from indirect causes in all EmOC facilities		Total no. of maternal deaths from all causes in all EmOC facilities		**Indicator 8a** Proportion of maternal deaths due to indirect causes in EmOC facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ **x 100 =** _____ **%**	

Total no. of maternal deaths from indirect causes in all surveyed facilities		Total no. of maternal deaths from all causes in all surveyed facilities		**Indicator 8b** Proportion of maternal deaths due to indirect causes in all facilities	Acceptable level: ☐No standard has been set ☐Not applicable
	÷		=	_____ **x 100 =** _____ **%**	

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Worksheet 5a. Amount of EmOC services

Use forms 3 and 4 to fill in the information below.

Name of area	No. of basic EmOC facilities in area	No. of comprehensive EmOC facilities in area	Population of area	Has the minimum level of EmOC been met? If yes, please tick in column.
Column totals*				

* If more than one sheet is used, add sheet totals to obtain the overall column total.

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Worksheet 5a (continued)

Name of area	Total no. of expected births	Total no. of women giving birth in all EmOC facilities	Total no. of women giving birth in all surveyed facilities	Total no. of women with complications in all EmOC facilities	Total no. of women with complications in all surveyed facilities	Total no. of caesarean sections in all EmOC facilities	Total no. of caesarean sections in all surveyed facilities
Column totals*							

*If more than one sheet is used, add sheet totals to obtain the overall column total.

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Name of area	Total no. of maternal deaths from direct obstetric causes in all EmOC facilities	Total no. of maternal deaths from direct obstetric causes in all surveyed facilities	Total no. of maternal deaths from indirect causes in all EmOC facilities	Total no. of maternal deaths from indirect causes in all surveyed facilities	Total no. of intrapartum deaths (≥ 2.5 kg) and very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in all EmOC facilities	Total no. of intrapartum deaths (≥ 2.5 kg) and very early neonatal deaths (≤ 24 h; ≥ 2.5 kg) in all surveyed facilities
Column totals*						

*If more than one sheet is used, add sheet totals to obtain the overall column total.

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Appendix B: Information on registers and data collection

Signal functions:

To determine whether a facility offers each of the signal functions, data collectors should:

- observe the availability of requisite drugs, supplies, and equipment;
- interview health workers in the maternity ward and other departments; and
- review facility registers (see below).

It is important to consider all the following when determining whether a particular signal function was provided:

- Is staff at the facility trained to perform the service?
- Do the requisite supplies and equipment exist? Are they functioning?
- Were there any cases for which a particular signal function was indicated?
- Are the cadres of staff working at the facility authorized to perform the service?

Other variables:

To collect the data necessary to calculate the EmOC indicators, data from registers in many different rooms or departments at the facility must be reviewed and abstracted. The table below provides an overview of where to look for different variables.

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Registers and other sources to be used to collect data for the EmOC indicators

Information	Registers in maternity ward (including those found in: labour, delivery, pre- and postpartum and neonatal rooms)	Registers in operating theatre (including those for major and minor surgery)	Registers in the female or gynaecological wards (including post-abortion care registers)	Registers in the outpatient department	Registers for inpatients and admissions	Overall administration (including records and registers in the morgue, records office, head health workers' office)
No. of women giving birth	X					
No. of women with obstetric complications	X	X	X	X	X	X
No. of caesarean sections	X	X				
No. of maternal deaths due to direct obstetric causes	X	X	X		X	X
No. of maternal deaths due to indirect obstetric causes	X	X	X		X	X
No. of fresh stillbirths and intrapartum deaths ≥ 2.5 kg	X	X				X
No. of very early neonatal deaths (1st 24 h) ≥ 2.5 kg	X					X

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As can be seen from the table above, the registers in maternity departments should, in theory, contain a lot of the data necessary to calculate the EmOC indicators; however, it is likely that they will not have all of the data needed. Monitoring should help facility managers to perceive the need for maintaining good quality, complete records and will help them to improve record-keeping systems.

Some of the most important columns that should be included in maternity registers are:

- admission time and date;
- mode of delivery (normal vaginal, assisted vaginal, caesarean section);
- obstetric complications (e.g. antepartum haemorrhage, postpartum haemorrhage, obstructed labour, prolonged labour, pre-eclampsia, eclampsia, ruptured uterus, postpartum sepsis, complications of abortion, ectopic pregnancies) (Cases of complications of abortion and ectopic pregnancies will usually be found in other departments in the facility, such as the female or gynaecology ward, operating theatres or outpatient registers.);
- treatment or intervention provided to woman, including time of intervention (e.g. magnesium sulfate administered, oxytocin provided, manual removal of the placenta);
- treatment or intervention provided to newborn, including time of intervention (e.g. resuscitated);
- outcome of mother (e.g. discharged, with time and date, referred to X facility, death); and
- outcome of infant (e.g. discharged, referred to X facility, fresh stillbirth, macerated stillbirth, very early neonatal death).

Note: Cases of complications of abortion and ectopic pregnancies are often found in other departments of the hospital than the maternity, such as the female or gynaecology ward, operating theatres or outpatient or emergency departments.

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Appendix C. Random number table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207	20969	99570	91291	90700
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095	52666	19174	39615	99505
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081	30680	19655	63348	58629
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004	849	74917	97758	16379
5	37570	33975	81837	16656	06121	91782	60468	81305	49684	60672	14110	06927	01263	54613
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053	21916	81825	44394	42880
7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840	63213	21069	10634	12952
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045	18425	84903	42508	32307
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566	58678	44947	5585	56941
10	85475	36857	53342	53988	53060	59533	38867	62300	08158	17983	16439	11458	18593	64952
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595	01547	85590	91610	78188
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847	12234	90511	33703	90322
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272	84115	27156	30613	74952
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358	85104	20285	29975	89868
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977	29372	74461	28551	90707
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900	70960	63990	75601	40719
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255	64835	44919	05944	55157
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030	51132	01915	92747	64951
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350	94738	17752	35156	35749
20	07056	97628	33787	09998	42698	6691	76988	13602	51851	46104	88916	19509	25625	58104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178	30421	61666	99904	32812
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646	21524	15227	96909	44592
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912	17012	64161	18296	22851
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135	10367	07684	36188	18510
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658	32586	86679	50720	94953

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