Averting Maternal Death and Disability

The United Nations Process Indicators for emergency obstetric care: Reflections based on a decade of experience

A. Paxton a,⁎, P. Bailey b, S. Lobis a

a Averting Maternal Death and Disability (AMDD) Program, Mailman School of Public Health, Columbia University, New York, NY, USA
b Family Health International, Research Triangle Park, NC, USA

Received 15 April 2006; accepted 10 August 2006

Abstract

Objective: The paper reviews the experience with the EmOC process indicators, and evaluates whether the indicators serve the purposes for which they were originally created – to gather and interpret relatively accessible data to design and implement EmOC service programs. Method: We review experience with each of the 6 process indicators individually, and monitoring change over time, at the level of the facility and at the level of a region or country. We identify problems encountered in the field with data collection and interpretation. Result: While they have strengths and weaknesses, the process indicators in general serve the purposes for which they were developed. The data are easily collected, but some data problems were identified. We recommend several relatively minor modifications to improve data collection, interpretation and utility. Conclusions: The EmOC process indicators have been used successfully in a wide variety of settings. They describe vital elements of the health system and how well that system is functioning for women at risk of dying from major obstetric complications.

© 2006 International Federation of Gynecology and Obstetrics. Published by Elsevier Ireland Ltd. All rights reserved.
1. Introduction

Process indicators to monitor progress in the provision of emergency obstetric care have been used intensively for the past decade, accelerating in the last 5 years, throughout Asia, Africa and Latin America. Emergency obstetric care (EmOC) refers to care provided in health facilities to treat direct obstetric emergencies that cause the vast majority of maternal deaths during pregnancy, at delivery and during the postpartum period. Roughly 70% [1] of maternal deaths are a result of hemorrhage, infection, eclampsia, prolonged or obstructed labor, complications of abortion, ectopic pregnancy and ruptured uterus. Reduction in the maternal mortality ratio is one of the Millennium Development Goals (MDGs) hence considerable attention is being paid to the challenge of providing quality care to women who are vulnerable to death and disability, and to monitoring results.

The set of 6 EmOC process indicators, also known as the United Nations (UN) Process Indicators, were developed by Columbia University and UNICEF in the early 1990s and adopted by UNICEF, WHO and UNFPA in 1997 [2]. The process indicators measure aspects of the health system using emergency obstetric services as a “tracer”. Two of the indicators measure availability of EmOC, three measure utilization of these services and one addresses the quality of care provided.

The EmOC process indicators have been used extensively in needs assessments of EmOC capability, often by the Averting Maternal Death and Disability (AMDD) Program or its partners, UNFPA, UNICEF, the Regional Prevention of Maternal Mortality network, CARE International, Save the Children Foundation and others. In addition, programs such as MotherCare and Save the Mothers Projects of the Federation of Gynecologists and Obstetricians made use of some of the process indicators. To our knowledge, by the end of April 2006, the EmOC Process Indicators have been used in at least 44 needs assessments. Ten more needs assessments are in process and at least 3 additional countries are planning to conduct needs assessments within the next 6 months. The EmOC process indicators were also used in 18 AMDD affiliated projects with on-going monitoring. Numerous descriptive articles have been written in which some or all of the process indicators have been used [3–17] as well as more methodological papers [15,18–20].

This paper reflects the experience of AMDD and its partners using the EmOC process indicators in a variety of settings. We will address the question of whether these indicators serve the purposes for which they were originally created, which is to gather and interpret relatively accessible data to design and implement EmOC service programs, large and small, and to monitor progress over time. We will highlight problems we encountered that should be taken into account when the indicators are revised by UNICEF, WHO and UNFPA, as is currently under discussion. Where appropriate, we will suggest changes in data gathering or interpretation, or in the process indicators themselves, and address issues that have been raised in field settings or in the literature.

We will discuss each of the 6 indicators individually, and then address the challenge of monitoring change over time at the level of the facility and at the level of a region or country. In the discussion section we will highlight the strengths and weaknesses of the process indicators and summarize our suggestions for improvements in data collection, and use of the data.

2. Reflections on EmOC process indicators

2.1. Indicator 1: availability of EmOC

2.1.1. Definition and target

The first EmOC process indicator looks at the number of facilities that provide EmOC in relation to the size of the population. It answers the question “do enough functioning EmOC services exist to serve the population?” This indicator is best determined through direct inspection of each facility to see if it qualifies as a comprehensive or basic EmOC facility provided.

The EmOC process indicators have been used extensively in needs assessments of EmOC capability, often by the Averting Maternal Death and Disability (AMDD) Program or its partners, UNFPA, UNICEF, the Regional Prevention of Maternal Mortality network, CARE International, Save the Children Foundation and others. In addition, programs such as MotherCare and Save the Mothers Projects of the Federation of Gynecologists and Obstetricians made use of some of the process indicators. To our knowledge, by the end of April 2006, the EmOC Process Indicators have been used in at least 44 needs assessments. Ten more needs assessments are in process and at least 3 additional countries are planning to conduct needs assessments within the next 6 months. The EmOC process indicators were also used in 18 AMDD affiliated projects with on-going monitoring. Numerous descriptive articles have been written in which some or all of the process indicators have been used [3–17] as well as more methodological papers [15,18–20].

This paper reflects the experience of AMDD and its partners using the EmOC process indicators in a variety of settings. We will address the question of whether these indicators serve the purposes for which they were originally created, which is to gather and interpret relatively accessible data to design and implement EmOC service programs, large and small, and to monitor progress over time. We will highlight problems we encountered that should be taken into account when the indicators are revised by UNICEF, WHO and UNFPA, as is currently under discussion. Where appropriate, we will suggest changes in data gathering or interpretation, or in the process indicators themselves, and address issues that have been raised in field settings or in the literature.

We will discuss each of the 6 indicators individually, and then address the challenge of monitoring change over time at the level of the facility and at the level of a region or country. In the discussion section we will highlight the strengths and weaknesses of the process indicators and summarize our suggestions for improvements in data collection, and use of the data.

2.2. Indicator 2: utilization of EmOC

2.2.1. Definition and target

The second EmOC process indicator looks at the number of women who receive EmOC services in relation to the number of women who need them. It answers the question “do enough women receive EmOC services?” Absolute and relative utilization rates measure the proportion of women who receive EmOC services. It can be determined by comparing the number of women who receive services to the number of women who need them. This indicator is best determined through direct inspection of each facility to see if it qualifies as a comprehensive or basic EmOC facility provided.

The EmOC process indicators have been used extensively in needs assessments of EmOC capability, often by the Averting Maternal Death and Disability (AMDD) Program or its partners, UNFPA, UNICEF, the Regional Prevention of Maternal Mortality network, CARE International, Save the Children Foundation and others. In addition, programs such as MotherCare and Save the Mothers Projects of the Federation of Gynecologists and Obstetricians made use of some of the process indicators. To our knowledge, by the end of April 2006, the EmOC Process Indicators have been used in at least 44 needs assessments. Ten more needs assessments are in process and at least 3 additional countries are planning to conduct needs assessments within the next 6 months. The EmOC process indicators were also used in 18 AMDD affiliated projects with on-going monitoring. Numerous descriptive articles have been written in which some or all of the process indicators have been used [3–17] as well as more methodological papers [15,18–20].

This paper reflects the experience of AMDD and its partners using the EmOC process indicators in a variety of settings. We will address the question of whether these indicators serve the purposes for which they were originally created, which is to gather and interpret relatively accessible data to design and implement EmOC service programs, large and small, and to monitor progress over time. We will highlight problems we encountered that should be taken into account when the indicators are revised by UNICEF, WHO and UNFPA, as is currently under discussion. Where appropriate, we will suggest changes in data gathering or interpretation, or in the process indicators themselves, and address issues that have been raised in field settings or in the literature.

We will discuss each of the 6 indicators individually, and then address the challenge of monitoring change over time at the level of the facility and at the level of a region or country. In the discussion section we will highlight the strengths and weaknesses of the process indicators and summarize our suggestions for improvements in data collection, and use of the data.
surgery and blood. The choice of specific services considered as signal functions relates to the services required to treat the direct obstetric complications. It is critical that signal functions are available 24 h a day, 7 days of the week.

2.1.2. Data quality

The designation of facilities as basic or comprehensive EmOC is based on actual, rather than theoretical functioning. However, despite clear instructions, some evaluation teams do not adhere to this guideline, and consider a facility to have a signal function if the medication or equipment is available, or staff is trained to perform the functions, and/or if the signal function was performed within a timeframe exceeding 3 months. This inflates the reported availability of EmOC because it will include facilities that are supposed to be performing the signal functions but in fact, are not. There are many reasons why this may be so – trained, key staff may not be available in facilities, they may not be comfortable using the equipment or medications, the equipment may not be in good repair or supplies are not consistently available, or women with the clinical indications may not go to the facility.

2.1.3. Field experience

The indicator of EmOC availability has been used extensively throughout the world [21]. The indicator has been proposed for inclusion in the monitoring of progress towards the MDG goal for maternal health [7]. However, despite its utility, several major areas of concern have arisen from the experience of using it:

- Some facilities do not see enough complicated deliveries to perform all signal functions in a 3-month period; therefore, while they may have the capability, technically they do not qualify as EmOC facilities;
- The signal function of assisted vaginal delivery is virtually absent in some countries where it is no longer or seldom taught (parts of Latin American and Africa);
- Facilities that have not performed the basic 6 signal functions are certified as "non-EmOC"; this suggests erroneously that their contribution to the prevention of maternal mortality is negligible;
- Facilities can move in and out of EmOC "designated” status if the assessment is repeated. This makes monitoring the other process indicators difficult over time, as will be discussed in a later section of this paper.
- The minimum recommended number of EmOC facilities and their designation may be too restrictive.

Regarding the first bullet point, there are a number of reasons why a facility may have a low case load and therefore not see one or more of the lower incidence complications (such as eclampsia) during a 3-month period. Medical care may not be sought when women have complications during labor and delivery for various reasons: the complication may not be recognized as life-threatening; a woman’s ability to reach the facility may be impaired due to poor road conditions, lack of transportation, or the prohibitive cost of transport. Her motivation for treatment, or the motivation of her family to seek treatment for her, may be influenced by the perceived (and actual) cost of treatment, the overall status of women, the degree to which institutional health care is a norm, and the quality of care as perceived by the community. A woman and her family may bypass a health center when a problem arises, conditioned by the health center’s frequent closing, providers who are often absent, the lack of medications, or the knowledge that the health center cannot facilitate transportation should that be needed. Cultural traditions or religious norms may lead women to refuse services such as blood transfusions even in the event of an emergency [22]. Communities’ beliefs or fears regarding surgery or the etiology of the complication may hinder care seeking (some complications may be perceived as more dangerous than others) [23]. Despite these potential barriers, if the facility has a reasonable reputation for quality service, women with complications are more likely to seek those services. The EmOC status of a facility, thus, is affected not only by what drugs, supplies, equipment and staff are available, but the management of the facility so that women with emergencies seeking care at night are attended to, the quality of care is reasonable, and the cost, including informal costs, are not too great for the community being served.

For the second concern, that in some countries no facilities would qualify as EmOC because a signal function is virtually never used, the AMDD program proposed a modification. The designation “comprehensive minus 1” (C−1) or “basic minus 1” (B−1) was used where providers are not trained to do assisted vaginal delivery. In one Latin American country, this actually motivated project managers to acquire the equipment and re-introduce this “disappearing art” [24]. The designation B–2 or B–4 (for facilities lacking two or four signal functions) also helped facilities track their own progress towards becoming fully functioning as a basic EmOC facility.

Some colleagues have expressed concern that the criteria for designation of a facility as comprehensive
or basic EmOC is overly rigid and that the contribution of maternities that only have a few signal functions is discounted altogether. This is a valid criticism within the larger goal of reducing maternal mortality, especially in light of how a skilled attendant at birth can prevent certain complications such as postpartum hemorrhage through active management of the third stage of labor, or sepsis through treatment of prolonged pre-labor rupture of membranes and prolonged labor. Also, facilities that do not do all 6 of the basic EmOC signal functions still may treat a significant number of obstetric complications. On the other hand, it is important that policy makers recognize and respond to critical shortages of the full range of services required to treat obstetric emergencies. In addition, a certain volume of cases is needed for a practitioner to maintain competence in various life-saving procedures [25].

One proposal to address the above concern is to provide details on the number and type of signal functions available in all facilities surveyed in a needs assessment or followed prospectively. Tables can show the number of facilities providing each signal function or can show the number of signal functions per maternity, with a range from 0 to 8. Facilities could be reassessed annually or more frequently if need be. This allows planners to examine which signal functions are systematically lacking, why, and in which type of facility, and can lead to plans for upgrading or additional training. The data on signal functions might be summarized as in Fig. 1 adapted from a 2003 needs assessment in Benin [26].

Regarding the question of targets, there seems to be some justification for reconsidering the targets for the mixture of basic and comprehensive EmOC facilities per population. Out of the 24 national or near-national needs assessments examined in a recent publication [21], all but two met the minimum target for comprehensive EmOC facility per 500,000 population. Even countries with high maternal mortality ratios met the minimum target for comprehensive EmOC facilities. However, in these same high MMR countries, very few fully functioning basic facilities were identified. On the other hand, the country with the lowest MMR in the sample, the United States, had no basic EmOC facilities but many comprehensive facilities, with a ratio of one comprehensive facility to 100,000 population.

These findings have implications. One is that the number of comprehensive EmOC facilities to population should be viewed in the context of the total number of EmOC facilities (basic + comprehensive) available to women, not in isolation. Looking at the comprehensive EmOC ratio alone obscures the overall problem of inadequate availability of services for women and the need to improve this situation. Likewise, it appears that as countries increase the number and quality of services for women, policy may not prioritize the basic EmOC facility. In countries that have experienced notable declines in their MMR, many facilities have been upgraded to full comprehensive EmOC status (Thailand, Malaysia, Sri Lanka). Given these various situations, we recommend stating the minimum ratio as 5 EmOC facilities per 500,000 population with at least one of which is a comprehensive EmOC facility. Table 1 shows data from select national level needs assessments that illustrate this recommendation.

To achieve the most accurate picture of the availability of care for women with obstetric

![Figure 1](image-url)
emergencies the inclusion of all facilities in a needs assessment is essential. Some needs assessments exclude the private sector, especially the for-profit segment of the private sector, or they survey only a nonrandom sample of public facilities and therefore underestimate the availability of EmOC in a given country or region. Although authors of needs assessment reports stress that they are only looking at what the surveyed facilities contribute to the indicator, readers often miss its significance. If data from the private sector are missing, health related population-based surveys (such as the DHS) can provide some idea of the magnitude of the role of the private sector by looking at the proportion of institutional births or the population-based cesarean rate by type of facility.

2.2. Indicator 2: geographic distribution of EmOC facilities

2.2.1. Definition/overview

The indicator of EmOC distribution examines whether facilities are equitably distributed by looking at the ratio of facilities to population for sub-national geographical areas. If all the EmOC services are centralized in large urban areas, women with obstetric complications in more remote regions will have difficulty accessing life-saving services. This is the case in Mauritania, a sparsely populated country with fairly good number of comprehensive EmOC services, most of which are located in the capital city, so are of little use to women in remote villages [17].

### Box 2

Geographic distribution of EmOC facilities:
The recommended level is 100% of sub-national areas have the minimum acceptable numbers of EmOC facilities: 1 comprehensive + 4 basic EmOC facilities per 500,000 population.

#### 2.2.2. Field experience

This indicator can be presented either in tables or on maps where sub-national areas are shaded according to the level of coverage. Many countries have found that the mapping of EmOC facilities is useful for planning and advocating where to focus interventions. The project staff of the Malawi Safe Motherhood Project created a map to track the number of signal functions provided by each facility [9]. Maps are useful for drawing attention to underserved areas and recent signal function performance at specific facilities.

In AMDD’s network of experience, the province that encompasses the capital city often has the highest coverage of EmOC facilities, although a large proportion of the population lives elsewhere. A visual display of this information can assist the Ministry of Health to prioritize the upgrading of facilities in underserved areas so that additional facilities will provide all the EmOC signal functions.

When looking at the availability of EmOC facilities by sub-national area, it is also possible to stratify the facilities by ownership to look at the equitable distribution of public vs. private (not-for-profit and for-profit) facilities offering EmOC. This can be particularly important when government facilities offer free services and private facilities require fees for services rendered.

Countries have also used maps showing the availability of EmOC facilities to monitor and evaluate progress in their program activities. Bhutan, for example, over 2 years, was able to increase the number of comprehensive and basic EmOC facilities serving their population by 175%. At the national level, Bhutan has over 500% of the minimum number of comprehensive facilities and over 300% of the minimum number of basic EmOC facilities recommended for their population size [27]. The visual representation of this progress can be seen in the maps in Fig. 2. In a country as mountainous as Bhutan, improving geographic distribution of EmOC is essential to reducing maternal mortality and the Bhutanese government’s decision to exceed the recommended minimum number of EmOC facilities reflects their commitment to improving women’s access to care.

Where this indicator has been used (and in our experience it should be used more often than it is) it

### Table 1

<table>
<thead>
<tr>
<th>Maternal mortality ratio</th>
<th>Country and period of time</th>
<th>Area</th>
<th>Comprehensive + basic (5/500 K pop)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>United States, 2000</td>
<td>National</td>
<td>107%</td>
</tr>
<tr>
<td>230</td>
<td>Nicaragua, 1999–2000</td>
<td>9 of 17 SILAIS</td>
<td>86%</td>
</tr>
<tr>
<td>380</td>
<td>Bangladesh, 1999</td>
<td>National</td>
<td>35%</td>
</tr>
<tr>
<td>420</td>
<td>Bhutan, 2002</td>
<td>National</td>
<td>122%</td>
</tr>
<tr>
<td>690</td>
<td>Senegal, 2000</td>
<td>National</td>
<td>39%</td>
</tr>
<tr>
<td>850</td>
<td>Benin, 2002</td>
<td>National</td>
<td>67%</td>
</tr>
<tr>
<td>880</td>
<td>Uganda, 2002</td>
<td>19 of 56 districts</td>
<td>44%</td>
</tr>
<tr>
<td>1000</td>
<td>Mauritania, 2000</td>
<td>National</td>
<td>31%</td>
</tr>
<tr>
<td>1100</td>
<td>Chad, 2002</td>
<td>38 of 55 health districts</td>
<td>40%</td>
</tr>
<tr>
<td>1200</td>
<td>Mali, 2002</td>
<td>National</td>
<td>38%</td>
</tr>
</tbody>
</table>

Sources: [3–5, 7, 14, 17, 36, 48–50].
has been helpful in highlighting inequities in the distribution of EmOC services. It would be useful in the future to create more complex maps that show facilities' EmOC status, the distance (both in travel time, roads and other measurement units) to communities in their catchment area, their location in relation to population density, and any elements that may inhibit women's access. Maps can also be used to graphically display some elements of financial access such as public transportation or population coverage of health insurance. Geographic Information Systems (GIS) can be useful in

Figure 2  Distribution of emergency obstetric care centers in Bhutan (2000 and 2002). Source: [27].
some settings in creating these maps, although maps may also be created using less sophisticated technology.

2.3. Indicator 3: proportion of expected births delivering in EmOC facilities

2.3.1. Definition and target
Indicator 3 is the proportion of expected births in EmOC facilities, basic or comprehensive, in a given area. This indicator makes no distinction between normal deliveries and pregnancies or births that develop complications. The minimum target for this indicator is 15%, based on the assumption that approximately 15% of pregnancies in any population will develop obstetric complications.

Box 3

Proportion of expected births in EmOC facilities:
The recommended minimum level is 15%.

2.3.2. Data quality
Deliveries are routinely enumerated in health facilities, so this indicator is generally considered valid and reliable, as long as the designation of an EmOC facility is accurate (see Indicator 1).

2.3.3. Field experience
Considerable confusion has surrounded this indicator, especially in terms of:

- the meaning of the indicator’s target; and
- how it differs from other frequently used indicators.

In practice, the target for this indicator (15%) is repeatedly misunderstood and/or challenged. The minimum percentage of births in EmOC facilities was originally set at 15% because if fewer than 15% of births are taking place in EmOC facilities, at least some portion of women with obstetric emergencies are not being seen. However, facilities that deliver 15% or more of a population’s births do not necessarily treat most obstetric complications in the population. These EmOC facility deliveries may still be normal deliveries.

Some interpret this indicator as promoting institutional delivery, although this was not the original intent. Government officials in countries with a clear policy of promoting institutional deliveries do appear to view the indicator as a measure of institutional deliveries, and draw satisfaction from the fact that their country is well beyond 15% births in EmOC facilities, even when the indicator of met need (indicator number 4) is very low. Others confuse the indicator with “births by skilled attendants,” which has a different definition, although there is considerable overlap [28].

When all maternities, those considered comprehensive, basic and those with fewer than six signal functions (“non-EmOC facilities”) are included, this indicator is the same as an institutional delivery indicator. Interpretation of the “births in EmOC facilities” indicator must be done in relation to met need, to gain a picture of utilization of health facilities generally and utilization for obstetric complications. While it is very useful to know what proportion of births take place in EmOC facilities, the target of 15% has not proved useful; we believe that countries should set their own targets for this indicator, based on their policy for maternity care.

2.4. Indicator 4: met need for EmOC: the proportion of pregnant women expected to have complications who are admitted for treatment

2.4.1. Definition and target
The indicator “met need for EmOC” is perhaps the most important measure of use of EmOC services; it addresses the question of whether women who really need EmOC – those with complications – are receiving it. The indicator is defined as follows: the numerator is the number of women with direct obstetric complications seen in EmOC facilities, and the denominator is the number of women expected to develop obstetric complications in the reference population, which is estimated as 15% of expected live births in the population. Because the goal is to treat all obstetric complications in EmOC facilities, the target is 100%.

Box 4

Met need:
The recommended level is 100%.

2.4.2. Data quality
Quality of data is of particular concern with the met need indicator. First, the indicator counts women and not individual complications. If a woman develops or presents with more than one complication, her most life-threatening complication is recorded. Secondly, the indicator really reflects women "seen” rather than treated but we assume that she was treated if records reflect that she was admitted to a facility with a complication or that a complication occurred after she was admitted. This indicator makes no attempt to assess the quality or appropriateness of
clinical management; this is better reflected in another indicator – the case fatality rate – and in special studies, such as clinical audits.

While the definition of these complications is clear on paper, there is always room for interpretation. The definitions are drawn from the WHO manual Integrated Management of Pregnancy and Childbirth and from those used by the FIGO Save the Mothers Projects in the mid 1990s. Complications may be inaccurately reported due to subjective assessments of severity such that from provider to provider within the same facility there may be variation in reporting of complications [29]. In some settings, fear of reprisal or guilt over the occurrence of a severe complication or a maternal death will lead to under-reporting. Also, there are nuances in definition that may be missed in practice such as the following example: if labor is augmented with oxytocin and ends in a normal delivery it is only considered a complication if the oxytocin was given due to prolonged labor preferably determined by a partograph or some other diagnostic tool. Of course, if women develop complications in a facility that go unnoticed, this is both a quality of care and an undercounting problem, and low met need would reflect that low level of appropriate care.

The potential for undercounting or over-counting complications comes from several sources. When information is collected in multiple registers, as it often is, all relevant logbooks and registers should be consulted. Uterine rupture might only be diagnosed in the operating theater and cross checking admission registers with operating theater registers is not always done.

Traditionally, the systematic reporting of obstetric complications takes place more often in patient medical records (which vary in quality) than in routine registers. But once birth registers are modified and staff trained to document obstetric complications, collecting data from the registries is quicker than reviewing individual patient records. It is worth noting, however, that as personnel are trained to register obstetric complications reporting tends to increase and consequently met need increases. Some of this increase, in the early years of a project, may be attributed to more complete reporting. This issue is discussed later in the paper, in the section on Monitoring.

Double-counting can also occur when the same woman is admitted twice in the same pregnancy but this appears to contribute very little to the indicator [30]. Double-counting at the level of the health system is also possible when women are referred from one unit to another. The contributions of the referring facility (patient stabilization) and the receiving facility (definitive treatment) are both important.

How to address this may depend on the health system’s communication system and health information system. If stabilization of patients at a health center entails, for example, the administration of diazepam or magnesium sulfate prior to referral, an argument can be made for having treated a complication at the health center as well as the referral hospital. In practice, however, we recommended that the complication be counted in the facility where she received definitive treatment. We encouraged facilities when they stabilized patients prior to referral to record these women separately so that the referring facility can monitor their contribution to a well functioning referral system. When there is concern about the effect of double-counting referrals, we recommend a special study to determine the magnitude of this practice.

2.4.3. Field experience

After indicator 1, AMDD, partners and governments have found met need to be the most useful in providing information on how the health system in a particular setting is meeting women’s obstetric needs and thereby lowering maternal mortality. Met need is the most proximate measure to maternal mortality in that it measures to some degree maternal deaths that were averted [31]. It can change quickly over time as facilities and providers’ skills (especially diagnostic skills) are upgraded.

Discussion surrounding this indicator has revolved around:

- data quality (see discussion above)
- the use of 15% for the denominator (proportion of pregnancies in which it is expected that serious obstetric complications will develop)
- which, if any, abortion complications to include in met need;
- the target of 100%
- the exclusion of complications treated in "non-EmOC" facilities
- how the indicator of unmet need for major obstetric interventions (UON) differs from met need [32].

Concern has been expressed about the validity and reliability of using the estimation that 15% of pregnancies will experience a serious obstetric complication. This figure has been used for more than 10 years [2,33]. Fifteen percent was recommended by an expert working group but has never been empirically verified, nor is the incidence of complications likely to be constant across populations [20]. Studies that have been used to validate the 15% estimate were not designed for this purpose and do not always use the same set of maternal complications, making comparison difficult. A prospective study of pregnant women carried out in
received treatment for a complication [34], while some experts suggest that 15% is not nearly high enough. As Ronsmans et al. say “The question remains whether these differences are real or are due to varying case definitions, access to care, quality of care, or reporting” [20]. While it is clear that not all populations of pregnant women will develop obstetric complications at a rate of 15% due to the ability of the health system to prevent or treat very early signs of complications, as well as policies and practices relating to abortion, empirical evidence from a variety of countries does suggest that 15% is at least a reasonable order of magnitude.

- Hospitalizations during pregnancy in the United States, a country with low maternal mortality, were 16.7% for obstetric problems and pregnancy loss [35]. These US findings were confirmed with more recent data [36].
- Two studies in rural India have found that 14.4% and 15.2% of deliveries identified serious complications in need of emergency obstetric care although complications of the first half of pregnancy were not included [33,37].

One of the most problematic complications is abortion-related complications. In some countries, a large proportion of obstetric complications treated in facilities is abortion-related. This varies widely depending on countries’ policies and practices regarding access to safe abortion services. The legality of abortion and enforcement of abortion-related laws can affect how abortion-related cases are recorded in health facilities. Voluntary terminations should not be included in the calculation of complications treated, but distinguishing between abortion complications treated and voluntary terminations may at times be difficult. Some believe that met need should focus entirely on the complications of late pregnancy, delivery and the post-partum period. For these reasons, some advocate for the exclusion of abortion complications in the numerator. AMDD has been faithful to the original description of the indicator and included the life-threatening complications of abortions in the numerator of met need. The following case definition of ‘complications of abortion’ has been used to help with classification:

(Derived from WHO and FIGO Save the Mother’s Projects):

- Hemorrhage due to abortion that potentially requires resuscitation with IV fluids and/or blood transfusion
- Sepsis due to abortion, including perforation and pelvic abscess (antibiotic treatment required)
- Note: abortion may be spontaneous or induced

However, in some countries, in addition to calculating met need with life-threatening complications of abortion in the numerator, they calculated a parallel estimate of met need that added all incomplete abortions treated to the numerator, based on the rationale that if they were not treated they could become life-threatening. Met need often increases by 50% or more when all treated abortions are included in the numerator. This complementary calculation helps remind or show policy makers and facility administrators just how many resources go into curative care as opposed to preventing unwanted pregnancies. Recently, the EmOC process indicators inspired the development of a set of indicators to measure safe abortion care [38]. Using this set of indicators in conjunction with the EmOC indicators will begin to resolve the problem of how to assess the extent of abortion complications as well as care and treatment.

The target for met need (100%), of course, represents the ideal, and the actual situation in many countries is far below this. The data in Table 2 show clearly the distance between reality and the overall goal for met need for the selected African countries. Met need never reached 50% and most needs assessments showed met need much lower. It is important to keep in mind that maternal mortality will not be substantially reduced without the adequate treatment of the majority of obstetric complications, so this target is important to keep in view at all times. However, in the context of a particular, time-limited project, a project goal of doubling met need in a 3-year period may be set locally.

Table 2 also shows met need based on all the facilities surveyed, not only those designated as EmOC facilities. The data from several countries such as Benin, Eritria and Gabon show just how many complications are seen by non-EmOC facilities. Met need sometimes doubles when all facilities are included. The exclusion of private facilities can also significantly underestimate met need.

Met need is often confused with other indicators for the need for obstetric care. Unmet obstetric need (UON) is technically more difficult to estimate but is a stricter measure for need since it only considers absolute maternal indications (AMI) or those complications deemed truly life-threatening [32]. These complications include severe antepartum hemorrhage caused by placenta previa, abruptia, or retro-placental hematoma, post partum hemorrhage that requires surgery, major fetopelvic
disproportion (shoulder, transverse or brow presentations), and ruptured uterus. Instead of 15% as the number of pregnancies expected to require medical treatment, the reference point is 1–2% and is determined locally. Little is known about how these two indicators compare with one another or how useful unmet need is in countries with relatively low levels of maternal mortality.

### 2.5. Indicator 5: cesareans as a proportion of all births

#### 2.5.1. Definition and target

The indicator cesareans as a proportion of all births in the population addresses whether this specific life-saving intervention is performed in sufficient numbers. The indicator takes its numerator primarily from operating theater logbooks and the denominator is the estimate of the number of expected live births in the population. The target has been set as a range between 5% and 15% of all births.

<table>
<thead>
<tr>
<th>Country</th>
<th>Area</th>
<th>Period of time reflected by data</th>
<th>Facilities surveyed</th>
<th>Type of facilities surveyed</th>
<th>Met need EmOC facilities</th>
<th>Met need all surveyed facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>National</td>
<td>2002</td>
<td>282</td>
<td>Public and private</td>
<td>23%</td>
<td>48%</td>
</tr>
<tr>
<td>Cameroon</td>
<td>5 out of 10 provinces</td>
<td>2000</td>
<td>487</td>
<td>NA</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>Chad</td>
<td>38 out of 55 health districts</td>
<td>2002</td>
<td>40</td>
<td>Public and private</td>
<td>12%</td>
<td>13%</td>
</tr>
<tr>
<td>Cote d’Ivoire</td>
<td>16 out of 46 districts</td>
<td>2000</td>
<td>360</td>
<td>Public and private</td>
<td>43%</td>
<td>Not available</td>
</tr>
<tr>
<td>Eritrea</td>
<td>Akele Guzai Province</td>
<td>1994</td>
<td>17</td>
<td>Public</td>
<td>9%</td>
<td>23%</td>
</tr>
<tr>
<td>Gabon</td>
<td>National</td>
<td>2001</td>
<td>77</td>
<td>Private</td>
<td>23%</td>
<td>37%</td>
</tr>
<tr>
<td>Gambia</td>
<td>National</td>
<td>2002</td>
<td>47</td>
<td>Public and Private</td>
<td>21%</td>
<td>Not available</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>National</td>
<td>2002</td>
<td>107</td>
<td>Public and Private</td>
<td>27%</td>
<td>Not available</td>
</tr>
<tr>
<td>Kenya</td>
<td>17 Facilities in 3 Districts in the Northeastern Province</td>
<td>2003</td>
<td>17</td>
<td>Public and Private</td>
<td>Not available</td>
<td>3%</td>
</tr>
<tr>
<td>Lesotho</td>
<td>National</td>
<td>2004</td>
<td>70</td>
<td>Public and Private</td>
<td>31%</td>
<td>33%</td>
</tr>
<tr>
<td>Mali</td>
<td>National; 8 Regions and administrative district of Bamako</td>
<td>2002</td>
<td>153</td>
<td>Public and Private</td>
<td>8%</td>
<td>12%</td>
</tr>
<tr>
<td>Mauritania</td>
<td>National; 13 regions (Wilaya)</td>
<td>2000</td>
<td>67</td>
<td>Public and private</td>
<td>Not available</td>
<td>35%</td>
</tr>
<tr>
<td>Morocco</td>
<td>National (16 Regions)</td>
<td>2000</td>
<td>510</td>
<td>Public</td>
<td>34%</td>
<td>37%</td>
</tr>
<tr>
<td>Mozambique</td>
<td>Sofala Province</td>
<td>1999</td>
<td>27</td>
<td>Public</td>
<td>7%</td>
<td>11%</td>
</tr>
<tr>
<td>Niger</td>
<td>National</td>
<td>2000</td>
<td>85</td>
<td>Not available</td>
<td>20%</td>
<td>Not available</td>
</tr>
<tr>
<td>Rwanda</td>
<td>Four Districts</td>
<td>2003</td>
<td>28</td>
<td>Public and NGO/mission</td>
<td>Not available</td>
<td>19%</td>
</tr>
<tr>
<td>Senegal</td>
<td>National</td>
<td>2000</td>
<td>172</td>
<td>Public and NGO/mission</td>
<td>Not available</td>
<td>12%</td>
</tr>
<tr>
<td>Southern Sudan</td>
<td>Yambio and Rumbek Counties</td>
<td>2002–2003</td>
<td>15</td>
<td>Public and NGO/mission</td>
<td>Yambio = 2%,</td>
<td></td>
</tr>
<tr>
<td>Uganda</td>
<td>19 out of 56 districts</td>
<td>2002</td>
<td>197</td>
<td>Public and Private</td>
<td>Not available</td>
<td>Rumbek = 5%</td>
</tr>
</tbody>
</table>

Sources: [3,5,8,10,14,17,51].

#### 2.5.2. Data quality

Record-keeping for cesarean deliveries is generally of better quality than that for obstetric complications. It has a longer tradition of being collected at the health system level and suffers few definitional problems, nor is it likely to be dramatically underreported. Facilities frequently differentiate between elective (scheduled) cesareans and those performed under emergency circumstances but after a trial of labor. To ensure completeness, data collection should include cesareans from all hospitals. The greater the role of the private sector (both
for-profit and not-for-profit) in the provision of obstetric services, the more important it is to include cesareans from private hospitals.

2.5.3. Field experience
Discussion surrounding this indicator has evolved around:
- the target, and
- whether all cesareans should be counted or only a subset.

Some consider the target range of 5–15% arbitrary, not evidence-based, and potentially too high. Historical evidence suggests that maternal mortality ratios below 100 are possible when cesarean rates are about 2%, although such low rates are not the norm [19]. The indications for these cesareans are likely to be unequivocal and are probably performed for maternal reasons in emergency situations, but the indications of many cesareans are ambiguous such as cephalopelvic disproportion, prolonged labor or fetal distress [39]. When the indicator is used in the context of maternal mortality reduction programs, some have suggested that only emergency cesareans performed for maternal reasons should be counted.

In light of the increasing cesarean rates in many regions of the world (beyond the 15% upper limit) and the knowledge that cesarean rates over a certain level do not improve outcomes, concern about excessive use of this procedure is justified [34,35]. Unfortunately, the medical and litigious cultures of countries where rates are highest have had little success in reducing their own rates. Cesarean rates vary widely among practitioners and by the societies in which they work. As Enkin et al. suggest many factors "may be more important than obstetrical factors in determining the decision to operate" [39].

AMDD has worked with the 5–15% range recognizing that the indicator is not specific about indications and many cesareans are for fetal reasons. In view of our overriding objective to keep data collection simple, we have only collected the total number of cesareans, not distinguishing emergency cesareans or another subset of all cesareans. It is important to note that many developing countries have cesarean section rates of <1% of all births (combined with high maternal mortality and high rates of fistula) which are too low in any circumstance. Overall, however, the appropriateness of the surgery is not known, which is important for quality and ultimately for planning and budgeting, but we strongly encourage audits of the indications for a cesarean [40,41].

The concept of absolute maternal indications (AMI) applied to cesarean deliveries could help policy makers and researchers track how many cesareans are performed for non-maternal indications (for example, fetal or perhaps invalid indications). A developing country where fewer than 10% of cesareans are performed for AMI may have a problem with case selection, the recording of indications, or simply underperformance of this life-saving procedure [42].

Baseline data from 15 AMDD project countries and partners show low cesarean delivery rates in most countries. The majority of countries fell under <3% at baseline (all were African or Asian project sites), the 2 Latin American countries were in a range of 3–10%, and only one country (Sri Lanka) registered a rate >10%.

As noted above, in countries where private or social security system facilities perform many cesarean deliveries, these data often were not captured in needs assessments of the public sector undertaken by Ministries of Health. In these situations, the rate of cesarean delivery was lower than estimated and population-based data sources such as the Demographic and Health Surveys are helpful to reveal what is missed when only public sector facilities are surveyed (see Table 3).

2.6. Indicator 6: case fatality rate

2.6.1. Definition and target
The case fatality rate (CFR) indicates whether women who reach an EmOC facility and experience a serious complication are likely to survive. It provides some insight into the quality of emergency obstetric care provided. The numerator is the number of deaths to women with direct obstetric complications recorded in the facility, and the denominator the number of women with direct Table 3 Cesarean rates by selected source and presumed contribution of private sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Needs assessment of MoH system only (%)</th>
<th>National survey (DHS or CDC) (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>El Salvador, 2002/03</td>
<td>11.2</td>
<td>22.0</td>
<td>Assessment excluded private and social security hospitals</td>
</tr>
<tr>
<td>Sofala, Mozambique, 2003</td>
<td>1.2</td>
<td>1.2</td>
<td>No private hospitals exist</td>
</tr>
</tbody>
</table>

Sources: [6,51–53].
obstetric complications seen in the same facility or group of facilities during the same time period. The target is a maximum of 1%.

Box 6

Case fatality rate:
The recommended level is below 1%.

2.6.2. Data quality
The quality of the data for the CFR is a concern. Maternal deaths are underestimated due to misclassification or underreporting and/or fear of retribution or rebuke. This will erroneously deflate the CFR. Likewise, improvements in the reporting of complications are likely to add to the denominator, thus lowering the CFR. In addition, small numerators contribute to volatility in this indicator. Where only one or two maternal deaths take place, researchers question its value. Thus, in general, CFRs are likely to be imperfect measures of quality of care, nevertheless they often informative.

2.6.3. Field experience
The case fatality rate is simple in concept, but challenging in practice. Discussion surrounding this indicator has evolved around:

- whether the CFR should be aggregated across facilities and complication types, and
- interpretation of the indicator.

The CFR is the one indicator that relies entirely on facility data. Fig. 3 shows how much the CFR can vary from hospital to hospital in Lesotho because some hospitals refer their most complicated cases and others have poor records [43].

The indicator may be best used by a facility to monitor its own performance over time; it should never be used uncritically to compare one facility with another. AMDD has used the CFR aggregated across facilities but recognizes that this means mixing facilities with different capabilities to resolve emergencies. In the example from three countries in East Africa (Table 4), aggregated CFRs over time suggest improvement across the project facilities.

Some suggest that an aggregate CFR is meaningless, and that only cause-specific CFRs should be calculated. We agree that cause-specific CFRs can be more instructive at identifying what interventions may be needed and we encourage cause-specific CFRs when a facility has enough deaths to calculate a stable CFR.

In addition to the effects of data quality, the CFR is likely to be sensitive to internal forces and external circumstances. It should reflect the effectiveness of EmOC provider training (accuracy and timeliness of diagnosis, training in the use of protocols and whether their training was competency-based), improved facility management that leads to a heightened sense of readiness to respond to emergencies, better infection prevention and control, improved referral system, and quality improvement activities such as case reviews and criteria-based audits. However, delays seeking and

<table>
<thead>
<tr>
<th>Country</th>
<th>Baseline (%)</th>
<th>2001 (%)</th>
<th>2002 (%)</th>
<th>2003 (%)</th>
<th>2004 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanzania</td>
<td>3.0</td>
<td>3.9</td>
<td>3.6</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>10.4</td>
<td>7.7</td>
<td>7.3</td>
<td>5.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Rwanda</td>
<td>n.a.</td>
<td>2</td>
<td>1.9</td>
<td>1.6</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Source: [45].

*Tanzania represents data from 4 hospitals; Rwanda and Ethiopia from 3 hospitals each.*
reaching medical attention can undermine what can be done for a woman when she finally arrives at a medical facility.

The CFR should be interpreted and understood in the context of other indicators such as met need. For example, when met need increases, it may be that more dire cases are arriving in a facility and therefore more women are dying. Over time and with improved attention to quality of care and management of a facility, the CFR should begin to decrease.

2.7. A word about denominators

A strength of the UN indicators is that they are population-based, with the exception of the case fatality rate. Service statistics provide the numerator data while several demographic estimates are used in determining the denominators. However, these demographic estimates are prone to imprecision and their use to calculate further estimates can lead to further imprecision.

The demographic estimates that are often used for the UN Process Indicators are:

- The population of a specific geographic area
- The crude birth rate of the same area
- The expected number of live births for that same area
- The proportion of pregnancies expected to develop severe complications or 15%.

Population estimates tend to vary widely and censuses occur no more frequently than every 10 years, which means that population projections are used for the years between censuses. The smaller the administrative unit or catchment area, the more difficult it is to obtain estimates of the general population.

An early version of the first indicator was articulated in terms of births instead of population, so that for every 20,000 annual births there should be 1 comprehensive and 4 basic EmOC facilities [44]. (The 20,000 was derived from a population of 500,000 and a crude birth rate of 40/1000.) The decision to use population figures (facilities per 500,000 population) was based on the fact that population is commonly used for planning purposes by governments, and that planning for maternal mortality reduction would be more likely to be incorporated into general planning exercises. A common practice when using the process indicators for monitoring has been to adjust population figures by a known factor that national institutes for statistics or census bureaus provide [30,45].

People with emergencies may not respect administrative borders but go to the closest facility they think can provide good care. Thus, facilities can attend patients who do not reside in their catchment area and vice versa. This flow across borders adds to the imprecision of population estimates. Similarly, populations with significant in or out migration are subject to greater imprecision [9].

The concern for maintaining the integrity of a catchment area can be addressed by verifying the residence of women in birth registries. Unless computerized, this can be time consuming and makes data collection more onerous. This is an example of when a special study could shed light on utilization patterns [9].

Crude birth rates (CBRs) are often multiplied by the population to determine the expected number of live births. In practice, CBRs are taken from the census or population-based surveys such as the Demographic and Health Surveys. Region-specific CBRs are not always available, therefore for practical purposes the national CFR is usually used.

The expected number of live births is the denominator for indicators 3 and 5 while the denominator for met need (indicator 4) is the product of the expected number of live births multiplied by 15% to yield the expected number of complications. Technically speaking for met need, a denominator based on live births is a compromise between accuracy and ease. All deliveries would be more accurate than all live births (so that still births are included), but all pregnancies might be an even more appropriate denominator since one of the complications included in the numerator of met need are severe abortion complications. However, practicality has been the deciding factor.

Only population-based indicators provide an overall perspective about the use of available services. At the cost of losing precision by using the denominators discussed here, we return to the initial purposes for which the indicators were developed – program planning and monitoring. Not only do they serve these purposes but they are inexpensive to use, appealing to program managers, and simple to calculate.

2.8. Using the UN Process Indicators to monitor EmOC services over time

In addition to the usefulness of the UN indicators in a needs assessment as a one-time effort, monitoring changes in the availability, utilization and quality of EmOC services is one of the most important functions of the indicators.

The 3 indicators for utilization (3, 4, and 5) are by definition calculated for EmOC facilities only.
However, periodic reassessment of signal functions (every 3–6 months) means facilities enter and exit the pool of EmOC designated facilities. A changing number of EmOC facilities makes monitoring onerous. EmOC status of maternity facilities can be determined at baseline and some interval beyond baseline (perhaps yearly), and the utilization indicators can be calculated using both EmOC facilities and all facilities. Table 5 with data from Sofala, Mozambique illustrates how this was done. First, data are presented only for the EmOC facilities, the number of which increases over time. Next, data from all project facilities (which represent almost all of the facilities in Sofala Province) are shown. The differences between EmOC facilities and all facilities are noteworthy for two indicators: the proportion of births in facilities and met need, but only at the beginning of the project when few facilities qualified as fully functioning EmOC facilities.

The challenge of determining EmOC status of facilities more often than once a year was immediately recognized in the field. Although projects collected data every 6 months, not all projects collected signal function data every 6 months, or even annually. We also recognize that facility staff can become competitive, and often are highly motivated to show improvements when part of a short-term project. Accuracy may be better in a one-time needs assessment than when using the indicators for monitoring. The inclination for some projects was to "designate" a facility with EmOC status once most of the interventions had taken place – such as clinical training, distribution and training in clinical management protocols, distribution of new equipment, supplies or drugs, remodeling, and quality improvement exercises – rather than adhere strictly to the performance of signal functions in the previous 3 months.

In retrospect we recommend that to minimize the impact of improved data quality on the measurement of utilization, baseline values for monitoring projects' progress should be taken after registers have been redesigned to systematically include obstetric complications and staff have been trained. In Peru, for example, prolonged or obstructed labor simply did not appear among the complications at baseline despite its frequency as an indication for cesarean delivery. AMDD and its partners did use the initial needs assessments as baselines of their monitoring efforts and certainly the recording of complications and maternal deaths improved (increased) due to the training of staff and the attention given to monitoring with the indicators. To help describe the sequencing of activities and to track their possible effect on the UN Process Indicators, project managers could add a timeline showing when certain inputs were made over time. High turnover of staff affects many aspects of a functioning facility and how to fill out facility registries and/or calculate indicators may not be a high training priority. We found that sometimes a single person became the facility point person for filling in registries or the complication column and when that person was absent for several days, no one else did the job. Although relatively simple, the indicators do require some guidance and supervision especially concerning the definitions of complications and some of the nuances of the estimation process such as the inclusion of only direct maternal deaths in the numerator of the CFR, how to handle the referrals, and how to estimate the denominators.

Routine monitoring with the UN Process Indicators is very inexpensive. Low costs, ease in understanding how the indicators are calculated, and apparent usefulness have made them sustainable as a monitoring tool. In project areas in Nicaragua, only a few facilities were targeted, but over time, non-project facilities began to collect the data too,

Table 5: Emergency obstetric care availability, utilization and quality in Sofala, Mozambique

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total project facilities</strong></td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comprehensive EmOC</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Basic EmOC</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Non-EmOC</td>
<td>19</td>
<td>17</td>
<td>10</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td><strong>Data from EmOC facilities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of births in EmOC facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met need</td>
<td>6.7%</td>
<td>12.2%</td>
<td>20.7%</td>
<td>27.7%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Cesarean deliveries as a proportion of all births</td>
<td>1.0%</td>
<td>1.3%</td>
<td>1.2%</td>
<td>1.4%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Case fatality rate</td>
<td>3.5%</td>
<td>3.4%</td>
<td>2.8%</td>
<td>1.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td><strong>Data from all project facilities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of births in facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met need</td>
<td>11.3%</td>
<td>18.1%</td>
<td>23.8%</td>
<td>29.8%</td>
<td>32.8%</td>
</tr>
<tr>
<td>Cesarean deliveries as a proportion of all births</td>
<td>1.1%</td>
<td>1.3%</td>
<td>1.2%</td>
<td>1.4%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Case fatality rate</td>
<td>2.9%</td>
<td>2.4%</td>
<td>2.5%</td>
<td>1.5%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

Source: adapted from [51].
under the guidance of regional ministry personnel. In Morocco and Bangladesh the indicators have been incorporated into the national MIS system. In Mozambique, although UNFPA and AMDD focused exclusively on one province (Sofala), the UN indicators were also used to monitor other provinces where UNFPA and UNICEF provided technical assistance.

Monitoring change in a single health facility has different challenges as the indicators were not designed for this purpose. Nevertheless, some projects (Vietnam, Mali, Ethiopia, Peru, and Nicaragua) had positive experiences monitoring only a few facilities. The indicators can be an important tool for managers and care providers to track their progress over time. This can be done in several ways. If the population size of a facility’s catchment area is known, the indicators can be applied to that catchment area alone. However, distortions in the indicators occur because people wisely do not obey administrative borders if they need emergency care and so numerators may reflect persons from outside the catchment area, or the contrary, when catchment area inhabitants seek care outside the designated monitored area. Single facilities are sensitive to these dynamics. If the catchment area size is not known, but the size of a larger population area is known, the indicators can still be calculated but they will show only how that one facility contributes to the overall indicator.

A final option is to monitor progress in a single facility using only numerator data instead of calculating the process indicators. The data on the number of births, complications, and cesarean deliveries can be graphed monthly on wall charts for all to see. Facility-specific case fatality rates are extremely useful for monitoring if the number of deaths is high. Facility managers should use all these data in monthly staff meetings to encourage providers and address on-going challenges.

Evaluation with the process indicators can be designed to be more rigorous if control areas are established [46], but project managers or public health officials who wish to evaluate a program should consider all their options and resources. Special studies can be developed to look at outcomes of specific interventions such as training competency or compliance with protocols.

2.9. Summary of experience and recommendations

The EmOC process indicators have been used extensively over the past decade in needs assessments for program planning and in monitoring of both small and large EmOC service projects. The indicators rely on the information available in service facilities and thus are challenged by the same data quality issues of any health information system in any developing country. Yet, despite their flaws, they have been useful for the purposes for which they were designed. The indicators are particularly useful when analyzed as a set, as each indicator informs the others and together they shed light on a particular health system’s capacity to respond to obstetric emergencies and likelihood of reducing maternal mortality. The EmOC indicators have assisted program planners in Ministries of Health and nongovernmental organizations to analyze the services available and identify the changes required to improve the services available to women. In several countries, most or all of the indicators have been incorporated into regional or even national level data collection and monitoring activities. In one instance they were used to help estimate drug procurement levels at the national level. They have been used to advocate for policy changes and for greater financial support to women’s care in pregnancy and at birth.

With increased experience, various weaknesses in the definition, data quality or interpretation of the EmOC indicators have been encountered, and ways to improve the monitoring of EmOC capabilities have been piloted. One suggestion based on examination of data collected in a large number of countries is to revise the target for the first EmOC process indicator such that for every 500,000 population there should be at least 5 EmOC facilities, of which at least one is comprehensive. Likewise, in acknowledgement of the contribution of "non-EmOC" facilities to the reduction in maternal mortality, it is suggested that the proportion of births in facilities and met need should be calculated for both EmOC facilities alone, and for all facilities, regardless of EmOC status.

The experience of AMDD and its partners has led to additional suggestions regarding data collection and interpretation of EmOC process indicators for the national, regional or district level:

- Count the number of signal functions performed (in the last 3 months) at all facilities and present data as a continuum of 0 to 8 signal functions in maternity and hospitals. This will inform management of how many and which functions facilities are performing, and, along with showing utilization by EmOC facilities and by all facilities, acknowledges the contribution of facilities that do not meet the requirement of a basic EmOC facility;
- Analyze data on treatment of non-complicated abortions separately for met need and CFR, but retain the truly complicated ones in met need
and the CFR (i.e., those with excessive bleeding or sepsis);
- Use special studies and audits to gain additional understanding of particular aspects of the indicators (e.g., auditing indications for cesareans);
- In countries where one or more indirect causes of maternal death are of great importance, information on the number of cases treated and CFR can be calculated, but separately from the EmOC process indicators. This pertains especially to HIV/AIDS, malaria, viral hepatitis and diabetes;
- As health systems develop, prioritize data collection on complications definitively treated, not those stabilized and referred. While the referring facility should track the number of complications stabilized and referred, these cases should not be double-counted in the calculation of met need.

While the original EmOC process indicators were designed for use in a defined geographic/administrative area, and not for a single facility, they have proved useful at the level of the facility. Facility managers can monitor their signal function provision over time, the number of women who use the facility for normal deliveries and for treatment of complications, the indications for cesareans, and the case fatality rate. Managers may choose to calculate the EmOC process indicators using the catchment area for their facility as the denominator, but AMDD and partners often encourage facility managers to monitor absolute numbers only.

The EmOC process indicators were designed for monitoring improvement in services, and while they are useful for operations research or health systems research, they lack the precision for use in epidemiologic research. They should not be viewed as an approximation of the MMR, although we see a significant correlation between the MMR and met need in all facilities [47]. The EmOC process indicators work well as a tool for identifying what kinds of interventions are needed and they do so following a logical sequence – first by determining if enough facilities are available, if women are using the existing facilities, if the right women are using them, the degree to which key life-saving procedures are performed, and if the quality of treating obstetric emergencies is adequate. In essence, they describe vital elements of the health system and how well that system is functioning for women at risk of dying from major obstetric complications.

Acknowledgments

The field projects discussed in this paper, and the paper itself, were made possible through the support of the Bill and Melinda Gates Foundation to the AMDD Program of Columbia University. The authors thank AMDD’s partners and all the facilities in the projects whose experience with these indicators informed the thinking behind this paper.

References


