Part III.E
Newborn Health

- Proportion of hospitals and maternity facilities that are designated as "Baby-Friendly"
- Percent of audience who know about the warning/danger signs of newborn complications
- Percent of pregnant women with at least two doses of tetanus toxoid immunization
- Percent of home births with clean cord care
- Percent of newborns attended during the postnatal period by a health care provider
- Percent of live births with low birth weight
- Number of neonatal tetanus cases
- Neonatal mortality rate (NMR)
- Perinatal mortality rate (PMR)
- Birth weight specific mortality rate (BWSMR)

Newborn Health

The goal of many programs in developing countries is to improve maternal and newborn health and survival. Until recently, however, newborn health has been relatively neglected in both the international child and safe motherhood movements, and few programs have focused specifically on improving newborn survival. A prime reason that newborn health has received such low priority is the general lack of awareness of the sheer numbers of early infant deaths. WHO estimates that each year more than 8 million infants die in the first year; of these, almost two thirds (5 .1 million) die in the first month, and of these, two thirds die within the first day (McCarthy, Lawn, and Ross, 2001). Virtually all of these deaths occur in developing countries. Although post-neonatal mortality has declined substantially, neonatal deaths have declined slightly and hence represent a growing proportion of the overall number of infant deaths (Espeut, 1998).

A second factor has been the perception that sophisticated technologies are required to significantly reduce newborn mortality. On the contrary, most newborn deaths in developing countries can be prevented by interventions already widely used. The most common causes of mortality – infections, asphyxia and birth injuries – can be prevented by simple cost-effective interventions that also benefit the mother. These interventions include antenatal malaria prevention and treatment, tetanus toxoid immunization, the detection and management of sexually transmitted infections, and access to a clean and safe delivery (WHO, 1996a). Furthermore, providing all infants with an "essential package of newborn care" (see Table III.E.1) including appropriate resuscitation, warmth, cleanliness and hygiene, clean cord care, and early exclusive breastfeeding also increases survival and reduces the proportions of surviving infants with disability (WHO, 1996b; WHO, 2001a).

Compared to other programmatic areas in Part III of this *Compendium*, newborn health is one of the least developed. Operations research studies have identified which interventions are likely to effectively reduce newborn mortality, but how these services should be scaled up, by whom, and at what cost must still be determined. The evaluation of these programs is therefore also in its infancy, and many new data-gathering tools, analytical approaches, and indicators need to be developed and tested. Because of the close link between maternal and newborn health, however, many process indicators appropriate for newborn health have already been used extensively in safe motherhood programs. (See Figure III.E.1) Indeed, separating maternal and newborn health indicators into two distinct parts may appear a false dichotomy when the antecedents of a poor pregnancy outcome, and the program interventions required to address these, may be the same for both mothers and babies. However, our purpose in doing so is to acknowledge growing awareness of the importance of newborn health and to highlight the fact that despite the many parallels between maternal and newborn health programs, important differences influence the way that programs are monitored and evaluated. These differences arise, not only because program interventions may vary, but because interventions that benefit both mothers and babies may differentially affect mortality. For example, because of their greater impact on newborn survival, interventions such as immunizing pregnant mothers against tetanus and detecting and treating STIs are more likely to be monitored in newborn health programs than in safe motherhood programs.

Methodological Challenges of Evaluating Newborn Health Programs

Some of the challenges of evaluating newborn health programs are similar to those for safe motherhood: the need to consider two outcomes, the large number of proximate determinants, and the difficulties of attributing causality to certain interventions because services are "bundled." Even though newborn deaths are more frequent than maternal deaths and therefore easier to count, the several measurement challenges include, but are not limited to, the following:

- **Countries define births, deaths, and "newborn period" in different ways, making valid international comparisons difficult.**

Meaningful use of any indicator is only feasible when standard definitions are used and applied. The first challenge for managers of newborn health programs is the lack of a generally agreed-upon definition of the "newborn period." In some settings "newborn" may refer to infants up to a few days of age and in other settings to infants up to several weeks of age. In this *Compendium,* the term newborn refers to the neonatal period (i.e., the first 27 completed days of life).

A second challenge is the different ways of aggregating newborn deaths according to the timing of the death. Typically, deaths are aggregated in the first month or first week of life or as fetal deaths (stillbirths and reported as described in Table III.E.2).

Many countries, however, define and record births and deaths in ways that may differ from the standard definitions of fetal, perinatal, and neonatal deaths recommended by the WHO in ICD 10. (See Table III.E.2). Some countries, for example, only record a baby as a live birth if the baby survives beyond 24 hours (McCarthy, Lawn, and Ross, 2001). The definition of a perinatal death is particularly problematic, not only because legal reporting requirements may vary between countries, but because the two standard international definitions have different gestational age and weight criteria. (See indicator **Perinatal Mortality Rate**.)

Further difficulties may also arise because national birth and death criteria may be differently interpreted and applied in different settings, and thus live births may be misclassified as fetal deaths and vice versa. This problem may occur because of an individual's lack of training or experience (this is true of deaths that occur in facilities as well as at home) or because of the way institutions and public health authorities choose to interpret and apply national birth and death criteria. Changes in medical practice may also alter the way practitioners systematically classify deaths, and managers need to be aware of this situation when they introduce programs to improve the quality of newborn health services at a facility level.

- **Ideally, all deaths (including fetal, perinatal, and neonatal) should be counted, but in practice, counting neonatal deaths is often the only feasible approach.**

In any program, the types of deaths to be counted depend on the program objective, the measurement method chosen, and the resources available. Ideally, program staff should record information on all neonatal, perinatal, and fetal deaths in order to derive a complete picture of pregnancy outcome. Having a complete picture is important because the causes of stillbirths and neonatal deaths are often the same, and the distinction between a stillbirth and a neonatal death may in practice be a very fine one. Just examining one rate or the other may underestimate the true level of mortality in the newborn period. Counting all deaths will provide a measure of the impact of interventions on etiologies that cause both fetal and neonatal deaths and will reveal the changes in the epidemiology of newborn deaths. Modern technologies, for example, may improve delivery outcome but increase neonatal mortality because fetal deaths are displaced from the antepartum to the post partum period. Reporting neonatal, perinatal, and stillbirth rates together will also permit more valid comparisons across programs and settings. Realistically, however, few programs will be able to achieve this goal. In most developing countries, the majority of births and deaths occur at home (WHO, 1996b). Few countries have sufficiently well-developed vital registration systems that can provide valid and reliable information on all births and deaths in the community. Health information systems can only provide information on facility births and deaths and, in most settings, are also poorly developed. Most community-based programs, if they have the capacity to measure mortality at all, will generally only be able to collect valid data on neonatal deaths for reasons explained below.

- **The quality of newborn mortality data is poorer than the quality of data for other ages.**

Evaluators require information on all births **and** deaths so that they may derive valid measures of newborn health outcome. As mentioned above, few developing countries have sufficiently developed vital registration systems to provide this data and, in many settings, reporting is very incomplete. Institutional barriers leading to underreporting may include cost, distance to the registration office, and a lack of awareness of the importance of birth and death registration. Social and cultural barriers may also make it difficult to collect valid data.

There are also major biases in the way deaths are reported. Even in countries with well-developed registration systems, a bias exists towards the reporting of larger, older babies, whereas deaths of very small babies early in the neonatal period are often omitted. Fetal deaths are much less likely to be reported than deaths of live births (WHO, 1996b).

- **Survey estimates of newborn mortality may not be suitable for short-term monitoring.**

Prospective studies would provide the most reliable mortality rates but are too expensive for regular reporting purposes. In practice, the most reliable estimates of neonatal mortality are derived from large scale surveys that rely on the retrospective report of deaths in early infancy. Surveys focusing on live births provide estimates of neonatal mortality, but perinatal mortality estimates require complete pregnancy histories. Because many population-based surveys focus on obtaining demographic indicators that use live births in the denominator, there has been relatively less experience with the use of pregnancy histories (which collect information about stillbirths). The reliability of any survey estimate depends on the completeness of reporting, and underreporting is generally more pronounced for deaths in early infancy. Because of the relatively small numbers of deaths recorded in this type of survey, national neonatal mortality rates are usually presented for a period of five years before the survey, and sub-national estimates are presented for ten years before the survey. The lack of precision in the estimates may sometimes make it very difficult to assess the significance of small changes between surveys (Rutstein, 1999).

- **Measuring perinatal and neonatal morbidity is very difficult.**

Estimates of newborn morbidity are important for designing effective program interventions. As with safe motherhood, however, existing estimates of newborn morbidity are usually derived from facility data and are unlikely to reflect the true burden of morbidity in the community unless all births and deaths are institutional. Although community members can learn to diagnose illness in a sick newborn (Bang et al., 1999), illness is often difficult to recognize because babies usually present with relatively non-specific symptoms, such as poor feeding and lethargy. Assigning a cause of death may be difficult because many different diseases may present with the same symptoms, and many babies die at home before ever reaching medical attention. Few facilities have adequate diagnostic facilities when ill babies do eventually present for care.

- **New program indicators are required at the individual, community, and facility level.**

Much of the discussion on the challenges of monitoring and evaluating newborn health has so far focused on newborn mortality because of the relative lack of experience with process indicators for newborn health. Although mortality indicators clearly have their place and provide the only direct measure of the objective of most programs, process indicators need to be developed to measure the wide range of interventions required to improve newborn health and survival.

Process indicators are required for measuring the availability, accessibility, quality, and demand for services at the facility level where the provision of newborn health services has historically been overlooked. A recent national survey in Kenya, for example, showed that over one third of hospitals lacked even the most basic equipment for resuscitation (MOH, NCPD, and ORC Macro, 2000). (See Part II.H.2a Service Provision Assessment on quality of newborn care services and service delivery.)

In addition to monitoring at the facility level, indicators are also required for monitoring and evaluating interventions at the individual and community level. Many infants become ill and die before ever reaching medical care. It is particularly important to develop indicators that help programs understand community knowledge, attitudes and behaviors in response to newborn illness and to determine which interventions are the most effective.

The Maternal and Newborn Health Framework

The maternal and newborn health conceptual framework (see Figure III.E.1) from which many indicators in this manual were developed illustrates the links between maternal and newborn health from before pregnancy to after delivery. The framework also shows where interventions can promote and improve health status as well as reveal the levels (family, community, and services) at which the impact of these interventions should be measured. The framework does not address some of the system-level determinants – the social, cultural, economic, political, and legal factors that clearly also influence maternal and newborn health. The indicators included in this section of the *Compendium* relate directly to newborn health and newborn health care. Many other indicators that also affect newborn health such as birth timing (**Contraceptive Prevalence Rate**) and nutrition (**Percent of Women of Reproductive Age with Anemia**), appear in other sections of the *Compendium*.

The Selection of Indicators

Most indicators in this section of the *Compendium* are intended for use at the national level or in the context of large-scale programs, but many can be used in other contexts. Using the same criteria applied to the safe motherhood selection, a small expert group currently working in newborn health programs in wide consultation with other experts and organizations working in newborn health selected these indicators.

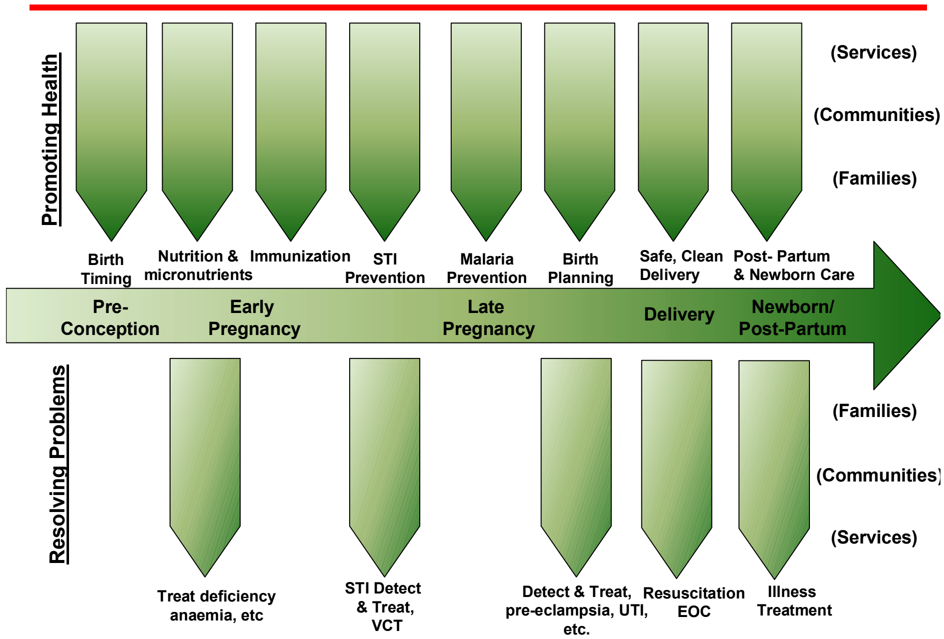
The indicators measure predominately health outcomes and impacts because these are the newborn health program indicators most widely used to date. We are aware that some programs cannot measure these outcomes, and for these programs, our selection will be less useful. However, in contrast to safe motherhood, some programs, even at an NGO level, may encounter sufficient numbers of deaths to derive stable estimates of newborn mortality. Moreover, these programs are particularly well placed to contribute much-needed research on the relationship between community behaviors and newborn health outcomes.

The relative absence of newborn health process indicators reflects the very recent development of newborn health as a distinct programmatic area. An urgent need clearly exists for research to develop our understanding of how best to monitor and evaluate newborn health programs, but until further work validates proposed indicators, many can only be termed "experimental" and do not meet this *Compendium's* criteria. Nevertheless, we include a small number of indicators that have been field tested by certain groups but not yet widely adopted. They are the **Percent of Home Births with Clean Cord Care** and the **Percent of Audience who Know about the Warning/Danger Signs of Newborn Complications**.

These indicators are included because of the need to stimulate debate and discussion on appropriate newborn health indicators, even though we recognize that these two indicators may not meet all the criteria for a good indicator (WHO, 1997) and that neither are particularly intended for national level use. In addition, the decision to include the **Percent of Newborns Attended during the Postnatal Period by a Health Care Provider** provoked considerable debate because of the lack of consensus on the timing and objectives of postnatal care. We retain the indicator because it is in widespread use, and one objective of the *Compendium* is to promote standardization of definitions and concepts.

In the next few years, as awareness of the problem of newborn mortality grows, no doubt those working in newborn health will move toward consensus on the indicators appropriate for monitoring national level programs. This set of indicators represents one small step in that direction.

Figure III.E.1 MATERNAL & NEWBORN HEALTH FRAMEWORK



Adapted from Al Bartlett, USAID.

Table III.E.1

WHO Essential Newborn Care Package

1. Cleanliness: clean delivery and clean cord care for the prevention of newborn infections (tetanus and sepsis)
2. Thermal protection: prevention and/or management of neonatal hypothermia and hyperthermia
3. Early and exclusive breastfeeding
4. Initiation of breathing, resuscitation
5. Eye care: prevention and management of ophthalmia neonatorum
6. Immunization (BCG, Oral polio, Hepatitis B)
7. Management of newborn illness
8. Care of the preterm and/or low birth weight newborn

Source: WHO (1996b)

Table III.E.2
Standards and Reporting Requirements Related to Perinatal and Neonatal Mortality

Stillbirth

A stillbirth is the death of a fetus weighing 500g or more, or of 22-weeks gestation or more, if weight is unavailable. Because gestation and birth weight are often unavailable for early fetal losses, for international comparisons, the WHO recommends including only deaths of fetuses weighing at least 1000g, (or of 28-weeks gestation or more if weight is unavailable).

The terms stillbirth and fetal death are sometimes used interchangeably. This text chooses the term stillbirth because it is most widely recognized.

Neonatal Mortality Rate (NMR)

$$\frac{\text{\# of neonatal deaths (deaths of live births within the first 28 completed days of life)}}{\text{\# of live births}} \times 1000$$

Early Neonatal Mortality Rate (ENMR)

$$\frac{\text{\# of early neonatal deaths (deaths within the first 7 completed days of life)}}{\text{\# of live births}} \times 1000$$

Late Neonatal Mortality Rate (LNMR)

$$\frac{\text{\# of late neonatal deaths (deaths within 7-27 completed days of life)}}{\text{\# of live births}} \times 1000$$

Perinatal Mortality Rate (PMR)

$$\frac{\text{\# of stillbirths + \# of early neonatal deaths}}{\text{Total \# of births (stillbirths + live births)}} \times 1000$$

Note: The day of birth is counted as Day 0, so that “within 1 week” includes babies 0-6 days old and “within 1 month” includes babies 0-27 days old.

Source: ICD10 (WHO, 1992)

Indicator

Proportion of Hospitals and Maternity Facilities That Are Designated as "Baby Friendly"

Definition
The proportion of hospitals and maternity facilities that have been accredited as "Baby Friendly" according to the ten UNICEF/WHO criteria related to breastfeeding and newborn care

To be designated as "Baby Friendly," the hospital must:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff;
2. Train all health care staff in skills necessary to implement this policy;
3. Inform all pregnant women about the benefits and management of breastfeeding;
4. Help mothers initiate breastfeeding within an hour of birth;
5. Show mothers how to breastfeed and how to maintain lactation, even if they should be separated from their infants;
6. Give newborn infants no food or drink other than breast milk, unless medically indicated;
7. Practice "rooming in" by allowing mothers and infants to remain together 24 hours a day;
8. Encourage breastfeeding on demand;
9. Give no artificial teats, pacifiers, dummies, or soothers to breastfeeding infants; and
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or birthing center.

This indicator is calculated as:

$$\frac{\text{\# of hospitals and maternity facilities accredited as "Baby Friendly"}}{\text{The total number of maternities and hospitals that handle deliveries}}$$

Data Requirements
The number of maternities meeting BFHI criteria; the total number of maternities and hospitals

Data Source(s)
UNICEF/WHO/Wellstart Baby Friendly Hospitals Initiative internal self-assessment and external evaluation instruments

Purpose and Issues
The Baby Friendly Hospitals Initiative (BFHI) is a joint UNICEF/WHO/Wellstart initiative aimed at increasing breast-feeding rates and encouraging global standards for maternity services in hospitals and maternities. Facilities first conduct a self-assessment; then independent assessors appointed by the national BFHI committee or UNICEF country offices evaluate them according to the above criteria. These same bodies aggregate information on the numbers and proportions of facilities acquiring "Baby Friendly" status for national and global reporting (WHO, UNICEF, and Wellstart International, 1999).

Whereas this indicator provides useful information on the availability of baby-friendly services in a given country, we cite several caveats in its use. First, the number of facilities achieving "Baby Friendly" status may be presented more often than the proportion because of difficulties in ascertaining the total number of maternities required for the denominator. The number of facilities is clearly affected by country size. For example, by December 2000, 6312 hospitals in China (or 47 percent of all eligible facilities) had achieved "Baby Friendly" status compared to 232 (or 66 percent of all eligible facilities) in Kenya. Ascertaining the number of maternities in the private sector is particularly difficult, and in many cases, private facilities may not be represented in national estimates.

Second, the listing of facilities recorded as "Baby Friendly" may be out of date because periodic reaccredidation to maintain standards is voluntary and depends on the interest and motivation of each individual facility. The date of acquiring "Baby Friendly" status and whether reaccredidation has occurred are not routinely recorded.

Indicator

Percent of Audience Who Know about the Warning/ Danger Signs of Newborn Complications

Definition
Community knowledge and awareness of the warning/ danger signs of newborn complications

The "audience," the intended population for the program, will usually be mothers in the case of newborn babies. Husbands or other household members known to influence decisions about care seeking, as well as other health care providers (such as traditional birth attendants), may also need to know about signs of newborn illness.

"Know" refers to the percentage who can spontaneously name the warning/danger signs of newborn complications, (for example, the percentage of mothers who can name at least three commonly recognized signs of newborn illness).

This indicator is calculated as:

$$\frac{\text{\# respondents who know the warning/ danger signs of newborn complications}}{\text{Total \# of respondents}} \times 100$$

Data Requirements
Response to knowledge questions asked in surveys

Data Source(s)
Population-based survey, preferably with a representative sample of the audience

Purpose of Issues
The purpose of this indicator is to assess community knowledge and awareness of the warning/danger signs of newborn complications in order to plan and monitor the impact of BCC program efforts at a community level.

Because most babies are born at home or are discharged from the hospital in the first 24 hours, increasing community awareness of the danger signs of newborn complications is of critical importance for improving newborn survival. More babies die in the first week of life than at any other time in childhood, and those who become ill shortly after birth may deteriorate and die very rapidly. The warning signs of newborn illness may not be recognized, because they are often much less pronounced than those in an older child or adult. Community members can, nevertheless, learn to recognize signs and symptoms of newborn illness (Bang et al., 1999).

The limitations of assessing community knowledge of signs and symptoms of newborn illness are similar to those outlined for obstetric complications. (See indicator **Percent of the Audience Who Know About the Danger/Warning Signs of Obstetric Complications.**)

A major limitation with newborn complications is that little consensus exists on which signs and symptoms the general public can use to improve the early diagnosis of serious illness at the community level. Algorithms shown to be sensitive and specific in clinical settings are too complex for use by the general public (McCarthy, Lawn, and Ross, 2001). More simple measures are less specific and will lead to larger numbers of newborns receiving unnecessary treatment. However, having some healthy babies over-treated is preferable to having some sick babies being under-treated and dying as a result. Danger signs that have been proposed include:

- Breathing difficulty, irregular or fast (>60 minute);
- Feeding poorly (less than half of usual consumption);
- Jaundice, pallor, bleeding;
- Convulsions, spasms, jitters;
- Fever temperature greater that 38°C or low temperature less than 36°C; and
- Vomiting green, no stool in 24 hours of life, swollen abdomen.

(McCarthy, Lawn, and Ross, 2001).

Programs aimed at raising community awareness of neonatal illness should carry out formative research to determine what signs of illness are already recognized in the community and how to adapt general recommendations to a specific setting. More fundamental research is required to reach consensus on which signs and symptoms caretakers in different settings can consistently recognize.

Indicator

Percent of Pregnant Women with at Least Two Doses of Tetanus Toxoid Immunization

Definition
The proportion of pregnant women receiving at least two doses of tetanus-toxoid vaccine (TT2)

This indicator is calculated as:

$$\frac{\text{Total TT2 + TT3 + TT4 + TT5}}{\text{Total \# of live births}} \times 100$$

Where TT2, TT3, TT4, TT5 refer to the 2nd, 3rd, 4th, or 5th dose of tetanus-toxoid vaccine administered (WHO, 1999a and c).

Data Requirements
From service statistics:
Number of doses of TT2 + TT3 + TT4 + TT5 given to pregnant women in a reference period (usually a year)

From population-based surveys:
Number of women giving birth during a reference period (e.g., five years) who report receiving at least two doses of tetanus-toxoid during their last pregnancy and number of live births in the same reference period

The number of live births serves as a proxy for the number of pregnant women.

Where data on the numbers of live births for the denominator are unavailable, evaluators can calculate total estimated live births using census data for the total population and crude birth rates in a specified area. *Total expected births = population x crude birth rate*

In settings where the crude birth rate is unknown, the WHO recommends using 3.5 percent of the total population as an estimate of the number of pregnant women (number of live births or pregnant women = total population x 0.035) [WHO, 1999a and c.]

Data Source(s)
Service statistics; population-based surveys

Purpose and Issues
This indicator measures the percentage of women and births protected against tetanus at the time of delivery among clients in a given program or among the general population.

Neonatal tetanus is usually fatal. A woman immunized with at least two doses of tetanus toxoid according to the WHO schedule[1] develops antibodies that protect her infant against tetanus in the first two months of life. Tetanus-toxoid immunization is therefore an integral part of the ANC package offered to women in most developing countries.

Many national HIS routinely collect this indicator to provide TT2+ coverage estimates for women attending facilities for ANC. Most large population-based surveys also collect data on self reported TT2+ coverage.

Note: Variations in the methods used to measure TT2+ coverage, as well as in the definition of the numerator and denominator, give rise to differences in the magnitude and reliability of the estimates obtained. For example, service statistics record the total number of doses of a vaccine in the previous *12 months*, whereas surveys tend to record the total number of women who report receiving at least two vaccinations during their *last pregnancy in a reference period that may be up to five years.*

Service statistics have the disadvantage that they may be incomplete or inaccurate (WHO, 1999a). They are also subject to a selection bias and are not representative of the general population, particularly when ANC coverage is low. However, they provide the only way of monitoring coverage on an annual basis and may be more reliable than self-reported data are.

[1] Given at least four weeks apart with the second dose administered before the 36th week of pregnancy.

Surveys provide the only means of obtaining population-based coverage, but because surveys rely on self-reporting, they are subject to recall bias that is likely to increase with the length of the recall period.

Both approaches, however, underestimate the true extent of TT2+ coverage because both exclude doses of vaccine administered at times other than specified in the definition of the numerator even though the doses offer protection. For example, the doses for the childhood or mass-immunization campaign are omitted.

Promoting clean delivery and cord care practices as well as ensuring that women are adequately immunized against tetanus prior to birth can prevent transmission of neonatal tetanus. TT2+ coverage should also be reported as well as the number of neonatal tetanus cases and the proportion of live births with a skilled attendant (as a proxy for clean births).

For prevention of neonatal and maternal tetanus, WHO recommends giving women a series of five doses of tetanus-toxoid vaccine with a minimum interval between each dose. Each dose increases the level and protection against tetanus. Each dose counts as a dose towards a five-dose schedule even if given before the recommended interval. A woman who receives five doses of tetanus toxoid is fully immunized and is protected against tetanus throughout her childbearing years.

Table III.E.3 WHO Recommended Tetanus-Toxoid Series

TT Dose	Given	Level of Protection	Duration of Protection
TTI	At first contact	NIL	None
TT2	Four weeks after TTI	80%	3 years
TT3	At least 6 months after TT2	95%	5 years
TT4	At least one year after TT3	99%	10 years
TT5	At least one year after TT4	99%	30 years

Indicator

Percent of Home Births with Clean Cord Care

Definition
The coverage of clean cord care at the time of home delivery, either from use of a clean delivery kit or a new blade to cut the cord (KPC, 2000)[2]

This indicator is calculated as:

$$\frac{\text{\# of home births with a clean delivery kit or clean blade}}{\text{Total \# of home births}} \times 100$$

Clean births kits typically include at least soap, a new razor blade, cord ties, and a plastic sheet.

Data Requirements
Number of home births with a clean delivery kit or clean blade in a defined geographical place and time, based on self-reports of women with children 0-23 months and number of home births in the same place and time period

Where data on the numbers of live births for the denominator are unavailable, evaluators can calculate total estimated live births from the total population and crude birth rate in a specified area. *Total expected births = population x crude birth rate.*

This indicator is most appropriate in settings where facility births are rare. If facility births occur in significant numbers, then evaluators should adjust the denominator accordingly.

Data Source(s)
Population-based survey (national, regional, district)

Purpose and Issues
This indicator measures the coverage of clean-delivery and cord-care practices at birth for deliveries that take place outside a facility.

Tetanus and sepsis are two leading causes of maternal and neonatal morbidity in the developing world. These deaths result from contamination from an unclean environment but could be prevented with improved hygiene and cord care at the time of delivery. Use of clean home delivery kits and a new blade for cutting the umbilical cord have been shown to reduce the incidence of simple cord infection, but no studies have assessed the impact on mortality or more serious infections because of the need for very large sample sizes (Tsu, 2000). Clean cord care is one of the key elements in the Essential Newborn Care Package (WHO, 1996a).

Two caveats warrant mention. First, surveys that rely on a women's recall of events at the time of delivery are subject to a recall bias likely to increase with the length of the recall period. Furthermore, if a woman was attended by a TBA, she may be unaware whether a clean delivery kit was used or how the cord was cut. A courtesy bias may affect the response if respondents are aware that programs are known to be promoting certain delivery practices.

The many elements to clean cord care and a number of alternative or complementary indicators include the following:

- Percent of births in which cord was cut with a new blade on a clean surface;
- Percent of the intended audience who know the importance of clean cord care;
- Percent of the intended audience who intend to observe clean cord care at their next birth; and
- Percent of the intended audience who express satisfaction with the use of clean cord care at their last delivery (Koblinsky et al., 1995; Tsu, 2000).

In addition to including beneficial practices, some programs may wish to monitor the reduction in potentially harmful practices that encourage the spread of tetanus. For example:

- Percent of babies whose cord stump was treated with dung or ashes.

[2] Available online at: http://www.childsurvival.com/kpc2000/kpc2000.cfm

Indicator

Percent of Newborns Attended during the Postnatal Period by a Health Care Provider

Definition
The percent of newborns attended by a health care provider during the postnatal period

This indicator is calculated as:

$$\frac{\text{\# of newborns attended during the postnatal period by a health care provider}}{\text{Total \# of live births}} \times 100$$

The postnatal period begins one hour after the birth of the placenta and ends 6 weeks later (WHO, 2001b). Although not officially defined, for the purposes of this indicator, the postnatal period can be roughly divided into 3 stages: (1) immediate postnatal period (first 2 hours after birth), (2) early postnatal period (from 2 hours to 12 hours after birth), and (3) late postnatal period (from day 2 to day 40).

Data Requirements
Numbers of newborns who are attended during the postnatal period (the numerator should specify whether newborns are seen for the first or subsequent visit); all live births in the same period

The indicator should be calculated specifying the stage of postnatal period (for example: percent of newborns attended within the first two days of birth).

Data Source(s)
Service statistics; population-based surveys

Routine HIS may collect data for this indicator to obtain estimates of postnatal coverage. Routine health service data generally lacks information on pregnancies or births that take place outside the public sector, for example in homes or in private sector facilities, and therefore should serve to estimate a denominator.

Where data on the numbers of live births for the denominator are unavailable, evaluators can calculate total estimated live births using census data for the total population and crude birth rates in a specified area. *Total expected births = population x crude birth rate*

Purpose and Issues
The main purpose of an indicator for postnatal care is to provide information on the use of postnatal services and to provide a measure of access to services for newborns in the postnatal period.

More deaths occur in the early postnatal period than at any other time of life. Relatively little attention has focused on developing postnatal services, however, and no clear recommendations on the optimal frequency, timing, content and delivery of postnatal care exist. Consensus is beginning to emerge in a number of areas. For example:

- Ideally, all women and newborns should be seen together in the postnatal/partum period to permit the early detection and treatment of complications that occur commonly after birth and to provide preventive care to both mother and baby (WHO, 1998a; WHO, 2001a).
- Preventive care for mothers should include vaccination against tetanus; provision of vitamin A and iron; and counseling on appropriate newborn care, hygiene, breastfeeding, malaria prevention and nutrition. Preventive care for babies should include early BCG, polio, and hepatitis immunization (WHO, 1998b; WHO, 2001a); and
- In the absence of problems, postnatal visits should take place at 6-12 hours, 3-7 days, and 4-6 weeks. The major priority is for a visit in the first 24 hours. (WHO, 1998a).

Many routine HIS and population-based surveys collect data on postnatal care coverage. Annual statistics are only possible through HIS. Surveys of PNC coverage every three to five years are sufficient. More frequent measurement is inappropriate because sampling errors make it difficult to assess whether small changes are real or due to chance variation.

Postnatal care coverage should respond to program interventions aimed at increasing coverage in the short term.

Several additional points concerning the interpretation of this indicator are worth emphasizing.

First, the lack of an agreed-upon operational definition of postnatal care makes valid international comparisons difficult. Postnatal care is a package of services and not one single intervention. Because the content and quality of care are likely to vary between settings, similar coverage rates do not necessarily reflect similar levels of care**.**

Second, postnatal coverage rates should make explicit whether care was provided principally for the mother or baby, or both mother and baby, because this detail may be difficult to determine retrospectively. The current DHS questionnaire, for example, asks about postpartum care for the mother, but not for the baby, and routine HIS may not make such distinctions.

Third, postnatal care coverage should ideally be stratified by the age of the baby after birth to get a better measure of access to services in the immediate postnatal period. Routine HIS usually collects data on postnatal coverage without specifying when this visit took place.

Finally, surveys relying on a woman's recall of events are subject to a recall bias likely to increase with the length of the recall period.

Indicator

Percent of Live Births with Low Birth Weight

Definition
Low birth weight (LBW), which is defined as a body weight at birth of less than 2,500 grams (g)

This indicator is calculated as:

$$\frac{\text{\# of births} <2500\text{g}}{\text{Total \# of live births}} \times 100$$

LBW has two main causes: preterm birth and intrauterine growth retardation (IUGR). LBW is often used as a proxy indicator to quantify the magnitude of IUGR in developing countries because valid assessment of gestational age is generally not available.

Preterm birth: The term preterm birth is used for infants born before 37-weeks completed gestation. Most, but not all, premature newborns in developing countries weigh less than 2500g.

Intrauterine growth retardation (IUGR): a condition in which fetal growth has been impaired. In developing countries, maternal under-nutrition and maternal ill health including malaria, anemia and acute and chronic infections (e.g., STIs) are major causes.

Data Requirements
Number of newborns with a birth weight less than 2,500g in a defined time period (e.g., 12 months) and number of live births in the same time period

Data Source(s)
Population-based surveys; health services data

Routine HIS may collect data for this indicator to obtain estimates of LBW for facility births.

Purpose and Issues
Approximately 1 in 6 newborns, or 17 million babies, are born every year with low birth weight. Low birth weight is the single most important predictor of newborn well-being and survival. Because maternal under-nutrition is a major determinant of LBW, high rates of LBW should be interpreted not only as an indicator of newborn under-nutrition, morbidity, and mortality, but also as an indicator of maternal well being. One of the goals of the World Summit for Children is to reduce the incidence of low birth weight to less than ten percent (ACC/SCN, 2000a).

In developing countries, approximately two thirds of LBW is caused by IUGR, and the remaining one third is due to preterm birth, although some preterm babies also have IUGR. By contrast, in developed countries, the majority of low birth weight is due to preterm birth.

Low-birth-weight babies are ten times more likely to die than babies weighing over 3 kg. They are also more likely to have impaired cognitive development and to develop acute illnesses such as diarrhea and pneumonia in early infancy (ACC/SCN, 2000a).

Obtaining reliable estimates of low birth weight in the general population is difficult. In many developing countries, the majority of births occur at home and babies are not weighed; thus, the data that are available come from a relatively small proportion of facility births.

Many household surveys collect data on birth weight, but since the weights reported are mainly from facility births, these data are also subject to selection bias. Some household surveys (such as the DHS) ask mothers to state whether their baby was smaller than average or very small; and at an aggregate level these data may be used to estimate incidence of low birth weight at a national level. Regional estimates are also possible if the sample size is sufficiently large (Boerma et al., 1996).

This indicator measures one of the major objectives of safe pregnancy/neonatal interventions: to prevent low birth weight. However, since low birth weight is due to many complex factors, changes in low-birth-weight incidence occur slowly. Estimates every five years are probably reasonable and consistent with the schedules of many large surveys (e.g., the DHS). Evaluators must recognize that this indicator will be slow to change, even with well-executed interventions.

Several caveats pertain to LBW. First, aggregate figures of low-birth-weight incidence may hide important differentials between sub-groups at risk. Second, heaping of birth weight recording in multiples of 500g is common and affects the incidence of low birth weight. Heaping is particularly a problem with survey data but also affects facility data to some degree.[3] Third, survey data rely on women's reports of their infant's birth weight and are subject to recall bias. Validation studies from the United States suggest that mothers are able to recall their baby's weight accurately, but we are not aware of similar large-scale studies conducted in developing countries.

[3] Heaping occurs when respondents do not know the exact weight. Estimated weights are often reported on certain preferred weights, such as multiples of 100 or 500 grams.

Indicator

Number of Neonatal Tetanus Cases

Definition
The number of neonatal tetanus (NT) cases in a given year, in a defined population, including both suspected and confirmed cases

A suspected case: any neonatal death between 3-28 days of age in which the cause of death is unknown; or any neonate reported as having suffered from neonatal tetanus between 3-28 days of age and not investigated.

A confirmed case: any neonate with a normal ability to suck and cry during the first 2 days of life; and who between 3-28 days of age cannot suck normally and becomes stiff or has convulsions (i.e., jerking of the muscles) or both.

The basis for case classification is entirely clinical and does not depend on laboratory confirmation. NT cases reported from hospitals are considered confirmed (WHO, 1999a).

Data Requirements
Number of neonatal tetanus cases or deaths

Data Source(s)
Population based NT mortality surveys; neonatal tetanus surveillance systems; and population-based surveys (TT2+ coverage, number of live births)

Purpose and Issues
Neonatal tetanus is a major public health problem in the developing world. Each year approximately half a million infants and almost 50,000 mothers die from tetanus acquired around the time of delivery. Current efforts focus on eliminating NT by 2005 in the 57 countries still reporting the disease. (The Expanded Program of Immunization, EPI, defines elimination of tetanus as a reduction in the incidence to fewer than 1 case per 1000 live births in every district of every country) [WHO,1999a].

Because the case fatality is very high in most developing countries, the number of neonatal tetanus cases is often based on actual or estimated numbers of NT deaths.

In countries with tetanus toxoid immunization coverage (TT+) of over 90 percent and a clean delivery rate over 80 percent, the number of neonatal tetanus cases is taken as the number of neonatal tetanus deaths reported.

In countries with lower coverage, an estimate of the number of NT cases is based on an estimate of NT deaths calculated from the number of live births, the neonatal tetanus mortality rate (NTMR), TT2+ coverage, and vaccine efficacy (VE).

Some countries occasionally conduct NT mortality surveys, although most countries with a high proportion of neonatal tetanus deaths carry out routine surveillance in "high risk" areas. Unfortunately, surveillance systems function poorly, and neonatal tetanus continues to be seriously underreported. Community-based NT mortality surveys, for example, suggest that routine surveillance systems detect only two to eight percent of all cases (WHO, 1994b). For this reason, WHO recommends using the following calculation in most settings.

$$\text{\# of NT deaths in 1 year} = \text{Live births} \times \text{NTMR} \times (1 - \text{TT2+} \times \text{VE})$$

Where:

NTMR = the baseline Neonatal Tetanus Mortality Rate (mortality rate in unvaccinated cases);

TT2+ = Tetanus-toxoid-immunization coverage; and

VE = Vaccine efficacy (estimated as 0.95).

The NTMR used is the latest value reported in each country where a nationwide survey was undertaken; if no surveys were conducted, a rate of 1, 5, 10, 15 cases per 1000 live births is allocated on the basis of the NTMR reported in countries with similar risk factors. In Latin America the WHO Regional Office (AMRO) uses a correction factor for the sensitivity of the surveillance system to adjust for the numbers of reported neonatal tetanus deaths (WHO, 1994b).

Countries with NT surveillance systems assess their progress annually. Demographic surveys, providing neonatal mortality at 4-14 days on a 3-5 year basis, serve to evaluate surveillance data.

A number of caveats warrant mention. First, this indicator reflects the overall magnitude of the problem of neonatal tetanus deaths but does not offer a precise estimate because of serious underreporting from surveillance data and because of the many assumptions inherent in the WHO calculation. Second, because this indicator is reported as a number rather than as a proportion, countries with lower rates of NT deaths but larger populations will rank ahead of countries with proportionately higher deaths rates. Third, aggregate figures at a national level may disguise pockets of high risk in certain subgroups (for example in rural populations or low-caste groups).

Surveillance systems reporting the number of NT cases should also give the percent completeness of reporting (number of NT reports received/the number of reports expected in the same time period). Neonatal-tetanus deaths should also be reported in conjunction with TT2+ coverage and the proportion of live births with a skilled attendant (as a proxy for proportion of clean deliveries).

In countries where NT is a recognized problem, population-based surveys may provide information on levels and trends of neonatal mortality. These surveys provide information on neonatal mortality at 4-14 days, which is a sensitive indicator of NT mortality (Boerma et al., 1996).

Indicator

Neonatal Mortality Rate (NMR)

Definition
The number of neonatal deaths per 1000 live births

A neonatal death is defined as a death during the first 28 days of life (0-27 days).

$$\frac{\text{\# of neonatal deaths}}{\text{Total \# of live births}} \times 1000$$

The NMR is often broken down into early and late mortality rates. The Early Neonatal Mortality rate (ENMR) is calculated as follows:

$$\frac{\text{\# of neonatal deaths 0-6 days}}{\text{Total \# of live births}} \times 1000$$

The late neonatal mortality rate (LNMR) is calculated as follows:

$$\frac{\text{\# of neonatal deaths 7-27 days}}{\text{Total \# of live births}} \times 1000$$

Data Requirements
Number of neonatal deaths in a given population and reference period and number of live births in the same population and reference period

Data Source(s)
Vital registration; population-based surveys; services statistics

Where data on the numbers of live births for the denominator are unavailable, evaluators can calculate total estimated live births using census data for the total population and crude birth rates in a specified area. *Total expected births = population x crude birth rate*

Routine HIS may collect data for this indicator to obtain estimates of the NMR for facilities. Facility data are not recommended for estimating the NMR for the general population, because in many settings, many neonatal deaths and live births occur outside the health system, which will cause substantial selection bias.

Purpose and Issues
The NMR is a key outcome indicator for newborn care and directly reflects prenatal, intrapartum, and neonatal care. In addition, as infant mortality rates decline, the proportion of infant deaths that occur in the neonatal period typically increases. The NMR differs from the perinatal mortality rate in that it focuses only on deaths among live births and covers a longer period after birth. Information on live births is generally thought to be easier to obtain than information on non-live births and is more widely available, because many population-based surveys such as the DHS typically only collect information on live births. Early neonatal deaths are more closely associated with pregnancy-related factors and maternal health, whereas late neonatal deaths are associated more with factors in the newborn's environment.

In many countries, vital registration data are not sufficiently complete to allow reliable estimation of the NMR. The standard techniques for collecting data on live births and neonatal deaths in population-based surveys have been widely applied in programs such as the WFS and DHS. Data quality is an important issue; common problems include omission of deaths, particularly very early neonatal deaths, and heaping of the reported age at death on 7, 28, or 30 days.[4] Heaping on these digits is particularly problematic because it will lead to the misclassification of early neonatal deaths as late neonatal death (7 days) or late neonatal deaths as post-neonatal deaths (28 and 30 days).

Evaluators typically calculate NMR at a national or international level. They may also obtain sub-national

[4] Heaping occurs when respondents do not know the exact age at death. Estimated ages at death are often reported on certain preferred ages, such as 7, 28, or 30 days, leading to a distorted age distribution of deaths in which too many deaths are reported at these preferred ages, and too few at the ages just before and after.

estimates if sample sizes are sufficiently large. The NMR is sometimes calculated at a facility level to monitor the outcome of delivery and newborn care in health facilities. Reliable estimates for individual facilities can only be obtained for very large facilities with large numbers of deliveries and neonatal admissions.

The NMR may respond fairly quickly to programmatic interventions, for example, immunizing all pregnant women in areas of high tetanus prevalence. However, survey-based estimates are generally subject to relatively large sampling errors, so it is impossible to detect changes over short periods of time unless the changes are quite large. Also, survey-based estimates are often based on a five-year period prior to the survey. Therefore, we recommend collecting survey-based estimates of the NMR not more than every three to five years.

One limitation of note is the NMR's sensitivity to changes in the quality of data. For example, a rise in the NMR may indicate deterioration in newborn health outcomes, or it may indicate an improvement in the reporting of neonatal deaths. Therefore, assessing data quality is essential to analysis.

Also, evaluators should interpret comparisons of facility-based estimates of the NMR very carefully because the NMR in a facility is very sensitive to the case mix of deliveries and neonatal admissions. One should not interpret a higher NMR in one facility as suggesting that the quality of neonatal care is worse in this facility because the NMR may rise or fall in response to changes in the case-mix. Additionally, improvements in prenatal and intrapartum care and advances in medical technology may increase the NMR because babies who may otherwise have been stillbirths may survive delivery only to die in the neonatal period. For these reasons, we recommend that evaluators break down facility-based estimates of the NMR by birth weight (see **Birth Weight Specific Mortality Rate**) and by admission status (direct admission or transfer-in) as a proxy for case mix.

Indicator

Perinatal Mortality Rate (PMR)

Definition
The number of perinatal deaths per 1000 total births

A perinatal death is a fetal death (stillbirth) or an early neonatal death.

The perinatal mortality rate is calculated as:

$$\frac{\text{\# of perinatal deaths}}{\text{Total \# births (still births+ live births)}} \times 1000$$

A stillbirth is the death of a fetus weighing 500g or more, or of 22-weeks gestation or more if weight is unavailable (ICD 10).

An early neonatal death (END) is the death of a live newborn in the first 7 days (i.e., 0-6 days) of life.

Great variation exists both between and within countries on how the stillbirth component of perinatal mortality is recorded, particularly for early stillbirths that occur at 22- to 27-weeks gestation. For international comparisons, WHO suggests including only deaths of fetuses weighing at least 1000g, or of 28-weeks gestation or more if weight is unavailable. Presentations of the PMR should include a clear statement of the definition of perinatal mortality used.

In practice, in most developing countries accurate data on birth weight or gestational age are difficult to obtain.

Data Requirements
Number of perinatal deaths in a given population in a given reference period (i.e., 12 months) and number of births (live births + stillbirths) in the same population and reference period

Data Source(s)
Population-based surveys; vital registration; service statistics

Routine HIS may collect data for this indicator to obtain estimates of the PMR for facilities. Facility data are not recommended for estimating the PMR for the general population because in many settings, many perinatal deaths and live births occur outside the health system, which will cause substantial selection bias.

Purpose and Issues
The PMR is a key outcome indicator for newborn care and directly reflects prenatal, intrapartum, and newborn care. It has also been proposed as a proxy measure of maternal health status and mortality, but a recent study has cast doubt on its use as a proxy for maternal mortality (Akalin et al., 1997).

Because the PMR includes both fetal deaths and deaths in the first week of life, it avoids conflicting judgments as to whether a fetus exhibited signs of life and variations in administrative practice regarding whether or not a death should be counted. In many countries, however, vital registration data are not sufficiently complete to allow reliable estimation of the PMR. Techniques now exist for collecting data on stillbirths, live births, and early neonatal deaths in population-based surveys (pregnancy histories) and applied in surveys including the DHS. However, there has been relatively less experience with pregnancy histories than with birth histories because of concerns about the quality of retrospectively reported pregnancy histories. Common problems with data quality include:

- Omission of stillbirths and early neonatal deaths;
- Difficulty in obtaining accurate information on gestational age or birth weight leading to the misclassification of stillbirths as late spontaneous abortions; and
- Heaping of the reported age at death of live births on 7 days, leading to the misclassification of early neonatal deaths as late neonatal deaths.[4]

[4] Heaping occurs when respondents do not know the exact age at death. Estimated ages at death are often reported on certain preferred ages, such as 7, 28, or 30 days, leading to a distorted age distribution of deaths in which too many deaths are reported at these preferred ages, and too few at the ages just before and after.

Prospective population-based surveys of pregnant women provide better quality data, but are expensive to undertake.

Evaluators typically calculate the PMR obtained from large population-based surveys at a national level and may aggregate data across countries to obtain a global or UN subregion statistic. Evaluators may also obtain sub-national estimates if sample sizes are sufficiently large.

The early neonatal component of the PMR may respond relatively quickly to programmatic interventions, for example, following the introduction of elements of the WHO "Essential Newborn Care Package." The stillbirth component may decline more slowly because it depends more on interventions that influence primarily maternal health and on the availability of technologies such as cesarian section. Survey-based estimates are generally subject to relatively large sampling errors, so detecting changes over short periods of time is impossible unless the changes are quite large. Also, retrospective survey-based estimates are often based on a five-year period prior to the survey. Therefore, evaluators should collect survey-based estimates of the PMR not more than every three to five years.

The following caveats bear mention. The PMR is sensitive to changes in the quality of data. For example, a rise in the PMR may indicate deterioration in perinatal outcomes, or it may indicate an improvement in the reporting of perinatal deaths. Therefore, an assessment of data quality is an essential component of analysis. In this context, evaluators often find it useful to separate the PMR into its two components: stillbirths and early neonatal mortality. Data quality is generally more problematic for stillbirths than for early neonatal deaths, because the problems of obtaining gestational age and ambiguity over the definition of stillbirths and fetal deaths are much less likely to be reported than deaths of live births (WHO, 1996b).

Evaluators should interpret facility-based estimates of the PMR with caution. The PMR in a facility is very sensitive to the types of deliveries occurring in the facility. Consequently, it may rise or fall in response to changes in the complexity of deliveries in the facility. In small facilities, the PMR will be very unstable because of the small number of deliveries and perinatal deaths; thus, the PMR is ineffective for monitoring change over time within the facility.

Indicator

Birth Weight Specific Mortality Rate (BWSMR)

Definition
The Birth Weight Specific Mortality Rate (BWSMR) is a stratification of a newborn mortality rate by birth weight grouping. (See indicator **Neonatal Mortality Rate – NMR.)** For example, the Birth Weight Specific Neonatal Mortality Rate for births over 2,500g is calculated as:

$$\frac{\text{\# of neonatal deaths weighing over 2,500 g at birth}}{\text{Total \# of live births weighing over 2,500 g at birth}} \times 100$$

And for births under 2,500g is calculated as:

$$\frac{\text{\# of neonatal deaths weighing under 2,500g at birth}}{\text{Total \# of live births weighing under 2,500g at birth}} \times 100$$

Evaluators can calculate birth weight specific mortality rates for perinatal deaths and stillbirths on the same basis.

Data Requirements
Number of deaths in a particular birth weight grouping and total number of births in the same weight grouping

Data Source(s)
Service statistics

HIS may collect data for this indicator in highly developed systems.

Purpose and Issues
As discussed in the preceding sections, birth weight is one of the most sensitive predictors of infant survival and is also a good predictor of maternal health and well-being. The mortality rate for low birth weight babies is much higher than for those with a normal birth weight. Stratifying newborn deaths by birth weight helps to determine the cause of death and therefore to identify where interventions are needed. For example, deaths of very small babies are more likely related to maternal causes predisposing to intrauterine growth retardation and preterm birth, whereas deaths of normal birth weight babies are more likely to be related to intrapartum asphyxia and poor obstetric care. In the first case, interventions should focus on the mother (improving nutrition and reducing antenatal infection) and, in the second case, should focus on improving the quality of delivery care. Evaluators can obtain additional information by stratifying birth weight by time of death (see Table III.E.4).

Evaluators can collect this type of indicator only in settings where all babies are weighed. It is therefore most appropriate for use in health facilities but has served in some community settings as part of a maternal and perinatal health care surveillance system (McCarthy, Lawn, and Ross, 2001).

One useful application of this type of disaggregation is to examine the number of intrapartum deaths in normal birth weight babies. If the quality of obstetric care is good (and women are not presenting very late in labor), then very few intrapartum deaths should occur because deliveries are expedited rapidly. The proportion of stillbirths in babies of normal birth weight may serve as a proxy indicator for intrapartum asphyxia and quality of delivery care.

Table III.E.4 Potential Causes of Death for Specific Age and Birth Weight Categories

Weight	Fetal Death	Intrapartum Death	Early Neonatal Death	Late Neonatal Death
Less than 2500g	Maternal infection, e.g. syphilis, other STIs Medical complications APH Hypertensive disease	Complications of preterm labor/IUGR Asphyxia	Complications of preterm labor/IUGR Infections	Infection, ARI Late complications of prematurity Tetanus
2500g and Above	Maternal infection, e.g. syphilis, other STIs, malaria Medical complications APH Hypertensive disease	Asphyxia and birth trauma Maternal infection	Asphyxia and birth trauma Infection	Infections, ARI Tetanus

This chart is a simplified representation of the BABIES (**B**irth weight, **A**ge at death, **B**oxes, **I**ntervention, **E**valuation **S**ystem). A more detailed explanation of this matrix and technique for interpreting the results appears in *The Healthy Newborn: A Reference Manual for Program Managers* (McCarthy, Lawn, and Ross, 2001).