

Current Set of Emergency Obstetric Care (EmOC) Indicators:
From “Monitoring emergency obstetric care: A Handbook” (WHO, 2009)

Indicator Brief #7:
Intrapartum and very early neonatal death rate

INDICATOR	ACCEPTABLE LEVEL
1. Availability of EmOC: basic & comprehensive facilities	At least 5 EmOC facilities (including at least 1 comprehensive facility) for every 500,000 population
2. Geographic distribution of EmOC facilities	All subnational areas have at least 5 EmOC facilities (including at least 1 comprehensive facility) for every 500,00 population
3. Proportion of all births in EmOC facilities	Minimum acceptable level to be set locally
4. Met need for EmOC: proportion of women with major direct obstetric complications who are treated in EmOC facilities	100% of women estimated to have major direct obstetric complications are treated in EmOC facilities
5. Caesarean sections as a proportion of all births	The estimated proportion of births by caesarean section in the populations is not less than 5% or more than 15%
6. Direct obstetric case fatality rate	The case fatality rate among women with direct obstetric complications in EmOC facilities is less than 1%
7. Intrapartum and very early neonatal death rate	Standards to be determined
8. Proportion of maternal deaths due to indirect causes in EmOC facilities	No standard can be set

Indicator 7: Intrapartum stillbirth and very early neonatal death rate

This brief was written to describe the above indicator, the assumptions behind the indicator, methodological issues that have arisen since it was included in *The Handbook*, what we have learned in the 10+ years since the indicator was first described and a few ideas related to the indicator as we go forward. This is not an endorsement that we should continue with the indicator in its present or in a modified form. We may find that during the re-visioning process other indicators may better serve our interests and needs.

Background

Each year about 2.7 million neonatal deaths occur globally with about 0.7 million occurring during the intrapartum period [1]. One third of stillbirths are related to intrapartum asphyxia while ¼ of neonatal deaths are also preceded by intrapartum asphyxia. Most asphyxia-related deaths can be prevented with appropriate obstetric care and neonatal resuscitation [2].

With the publication of *The Handbook* newborn resuscitation with bag and mask was added as a basic EmOC signal function. At the same time, this indicator was added to the already existing set of UN Indicators. The intrapartum and very early neonatal death rate was designed to be an indicator of the quality of intrapartum care.

ENAP uses the stillbirth rate and the neonatal death rate as core indicators of impact (not quality of care) and they measure both at the population level. A stand-alone intrapartum stillbirth rate is an additional indicator but not tracked at the global level.

Definition and calculation of the indicator

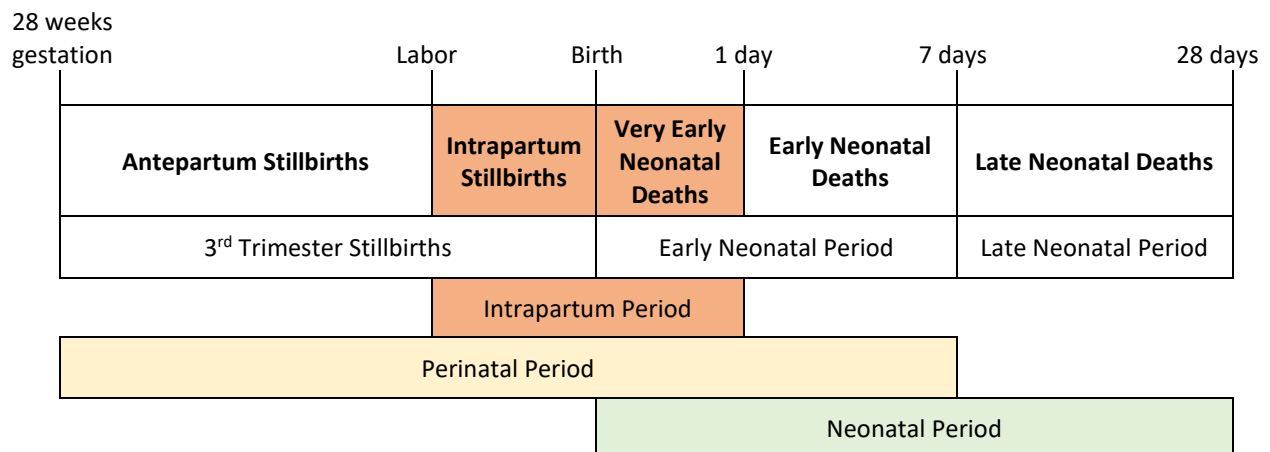
The “Intrapartum and very early neonatal death rate” is the proportion of births that result in an intrapartum stillbirth or a very early neonatal death within the first 24 hours (in EmOC facilities) [3]. Fauveau, who first proposed this indicator in *The Lancet* in 2007, called it the “intrapartum case fatality rate” [4].

Numerator: [Number of intrapartum stillbirths ≥ 2.5 kg] + [number of very early neonatal deaths ≤ 24 h, ≥ 2.5 kg] in EmOC facilities in specified time period

Denominator: Number of women giving birth to babies weighing ≥ 2.5 kg in EmOC facilities in same period

The Handbook also recommends that this indicator, like the others, be calculated in all facilities as well as for EmOC facilities.

Figure 1: Indicator 7 - “Timeline” and whom is measured (darker orange boxes)



Assumptions

- The indicator was designed to shed light on the quality of facility-based intrapartum care from the perspective of the fetus and newborn.
- Most of these deaths are preventable with appropriate intrapartum care, especially neonatal resuscitation and assisted delivery (vaginal and abdominal).
- Data would be reasonably easy to collect from registers in the maternity, OT and special newborn care unit, if not the HMIS.
- Facilities routinely distinguish between antepartum and intrapartum stillbirths.
- Restricting the indicator to babies weighing ≥ 2500 grams makes the indicator more sensitive to possibly preventable deaths. If very small or low birthweight babies are included, the indicator becomes more difficult to interpret (reflecting not only the quality of intrapartum care but also care for small or sick newborns).
- Facilities routinely record birthweight for live births and for intrapartum stillbirths.
- A benchmark would be forth-coming as we gained experience with the indicator.

Red flags that the indicator was designed to raise

- High rates suggest inappropriate/poor quality obstetric or newborn care, particularly with regard to newborn resuscitation.
- Hotspots of high rates, e.g. sector, facility type, regions, could be identified.
- Poor data quality (incomplete and inaccurate data). What skills require additional support and training, e.g. fetal heart rate on admission, birthweight measurement, classification of timing of stillbirth, diagnosis of stillbirth versus live birth? Some countries may need to revise their registers to ensure these data are captured

Methodological issues

- **Definition of stillbirth:** *The Handbook* uses 28 weeks as the lower limit of gestational age, as does WHO for international comparisons. However, some countries use 24 weeks (e.g. Madagascar) or 22 weeks.
- **Recording of antepartum vs intrapartum stillbirths:** Do facilities distinguish and document the two? We have a lot of evidence that the distinction between the two is not well documented in registers; we have less evidence of why they do not record this distinction. Ideally, registers would have a column for “fetal heart beat (FHB) on admission.” Some facilities also include a column documenting the device used to determine FHB.
- **Accuracy of classification of timing of intrapartum deaths:** We also have a lot of evidence that points to problems in misclassification.
 - Antepartum vs. intrapartum stillbirths
 - To improve accuracy, we promote the use of a hand-held inexpensive doptone (an electric fetal heart tone amplifier) or other techniques to measure fetal heart tone on admission. Do facilities have this equipment and are staff trained to use it?
 - Even with routine use of doptone, false positives and negatives occur. Health worker training is critical to high levels of accuracy [5].
 - Very early neonatal deaths (first 24h)
 - Live births are often discharged before 24 hours. We could rephrase the indicator to refer to “very early neonatal death prior to discharge;” this seems to be an increasing practice. Or we could restrict the death to a period of < 6 or 12h.
 - Misclassification between very early neonatal death and intrapartum stillbirth can be common, but since both subgroups are joined in the numerator this does not affect the accuracy of the indicator. However, disaggregation of intrapartum stillbirths and very early neonatal deaths is commonly desired, and therefore, accurate classification is needed.
- **Denominator**
 - Births or deliveries? Births are more precise (includes multiple gestations).
 - If using EmONC assessment data, the number of deliveries and births can differ substantially (more than multiple gestations would explain).
- **Birthweight restriction**
 - Birthweight information is often incomplete, especially for stillbirths.
 - As far as we know, no study has indicated what the best cut-off limit for LBW should be for use with this indicator [4].
- **Gestational age restriction**
 - The problems with gestational age are likely to be similar to those of birthweight.
- **Using the indicator**
 - Some people have expressed the indicator in terms of 1000 births/women delivered, which is typical of rates, while others as a percentage, as is often done for a case fatality rate. We should probably promote the former as it helps remind the user what the denominator is.

- The stability of any rate depends on a large enough number in the numerator. WHO cautions the use of case fatality rates when the numerator is small; this will affect frequency of calculation, whether monthly, quarterly or annually.
- Is this indicator suitable for aggregation at national level given how results vary across facility type and characteristics of the catchment area? The same argument can be made for the direct obstetric case fatality rate. Some researchers argue against such aggregation. A partial solution would be to calculate this rate only at hospital level.
- No benchmark or maximum acceptable level has been set for lack of experience with the indicator, making it difficult to interpret the result.

Lessons learned from experience with the indicator: EmONC assessments

We have 2020 experience from Malawi and Cambodia. Neither country followed the exact guidance set out in *The Handbook*. In Malawi, instead of one rate, two separate rates were calculated: an all-inclusive stillbirth rate and a very early neonatal death rate. Only the very early neonatal death rate was restricted to live births weighing ≥ 2500 grams. About 10% of very early neonatal deaths were missing data on birthweight while only 3% of live births were missing birthweight data. Stillbirths were not weighed nor were they disaggregated into antepartum and intrapartum stillbirths. Rates were based on all facilities and not on EmOC facilities. The shaded final two rows show the results when the two stand-alone indicators were added together as a facility-based “perinatal mortality rate” within 24h postpartum and how the rate varies depending on the denominator of births or deliveries.

Table 1: Malawi 2020 EmONC Assessment (from Table 3.12A and 3.13A, based on all facilities)

	Denominators	Deaths	Rates per 1000
Live births (<24 hours)			
<2500 grams	42,964 LBs	1,751 LBs	40.7/1000 LBs
≥ 2500 grams	453,067 LBs	2,036 LBs	4.5/1000 LBs
BWT unspecified	16,132 LBs	421 LBs	26.1/1000 LBs
Total	512,173 LBs	4,208 LBs	8.2/1000 LBs
Stillbirths			
Total births	520, 662 births	8,489 SBs	16.3/1000 births
Total deliveries	531,717 deliveries	8,489 SBs	16.0/1000 deliveries
VEND + Stillbirths			
Total births	520,662 births	12,697	24.4/1000 births
Total deliveries	531,717 deliveries	12,697	23.9/1000 deliveries

LB=live birth; SBs=stillbirths; VEND=very early neonatal death; BWT=birthweight

Cambodia followed the guidelines more closely than Malawi. They restricted both the numerator and the denominator to births ≥ 2500 grams and added the intrapartum stillbirths to the very early neonatal deaths in the numerator. This assessment was the third of its kind as the table shows. In 2020, 8% of stillbirths were missing birthweight, down from 20% in 2009.

Table 2: Cambodia 2020 EmONC Assessment (from Table 3-17)

	Numerator	Denominator	Rate
2009	590	83,708	7.1/1000
2014	1,286	119,931	10.7/1000
2020	1,683	139,659	12.1/1000

Numerator: intrapartum stillbirths ≥ 2.5 kg + newborn deaths in first 24 hrs, ≥ 2.5 kg

Denominator: number of women giving birth to newborns ≥ 2.5 kg (deliveries, not births)

Based on government facilities, private facilities excluded.

Early experience with the indicator shows that a number of assumptions were breached such as the birthweight restriction (excessive missing values) and the inclusion of **all** stillbirths rather than intrapartum stillbirths only (many stillbirths with unrecorded timing of death). Most countries opted to calculate a facility perinatal mortality rate with the death of live births restricted to 24 or 12 hours. Mozambique attempted to restrict their indicator to intrapartum stillbirths but their final rate of 7.5 probably suffers from under-reporting. When countries calculated the indicator for all facilities vs EmOC facilities, rates were much higher in EmOC facilities than in all facilities. The final 2 rows are shaded because they were not part of an EmONC assessment but they show how much the final rate varied when the BWT restriction was applied.

Table 3: Indicator 7 calculations across EmONC assessments

Country	Notes about calculation (based on all facilities unless noted)	Number of Deliveries	Number of Stillbirths (SBs)	Very early neonatal death (VEND)	Rate per 1000 deliveries
Angola 2007	No BWT restrictions, all SBs	248,187	10,328		42/1000
Guyana 2010	No restrictions, all SBs	12,803	226	65	23/1000
Afghanistan 2010	No restrictions, all SBs	192,627	4,177	1,422	29/1000
Madagascar 2010*	No restrictions, all SBs, fetal death ≥ 24 wk gestation	118,774	13,832	527	121/1000
Mozambique 2012	No restrictions, only intrapartum SBs, VEND occurring in first 12 hrs	161,458	860	345	7.5/1000
Zambia 2014	No restrictions, all SBs	482,109	11,233	1,980	27/1000
Ethiopia 2016	No restrictions, all SBs, based on EmONC facilities only	390,113	15,272	2,113	45/1000
Cusco, Peru 2004 (not an EmONC assessment) Team experienced using Babies Matrix.	Full restrictions BWT, intrapartum SBs	18,282	164		9/1000
	No BWT restrictions	19,191	352		18/1000

*Note: Madagascar included fetal deaths ≥ 24 wks gestation which may help explain their high rate. All other countries used ≥ 28 wks.

Alternatives to the indicator in recent literature

At least two articles have been published that were strongly influenced by this indicator: Goldenberg and colleagues' multi-country study was designed specifically to test the feasibility of this indicator in hospitals in LMICs [5]. Plotkin et. al. proposed a similar indicator based on experience in Tanzania [6].

Goldenberg et. al. answered 4 research questions/objectives: 1) Do hospitals use a doptone consistently? 2) How do perinatal mortality rates compare for women whose fetal heart tones were detected on admission with those women whose FHTs were not detected? 3) What were the outcomes for women without a FHT on admission or whose FHT was undeterminable (the unknown cases)? 4) How did results vary by whether birthweight restrictions were in place?

Their sample consisted of 3,593 neonates from 6 hospitals in 4 countries, consecutive births 2011-2012 over 6 mo. Hospitals were district level hospitals with >1000 deliveries per yr. **RESULTS:** FHTs detected in 96% of women, 2.2% were unknowns (doptone not used or undetermined) and 1.8% doptone used but no FHT detected. Training with doptone was brief and a few errors were made. Among 65 women with absent FHT, 7 were live births. Among 3,448 with audible FHT, 3 were antepartum SBs. Authors deviated from the original indicator and instead of using death <24h, they used "death before discharge." Also, they calculated perinatal mortality rates (including antepartum SBs). PMRs varied dramatically. Overall PMR: 34/1000 births; with FHT present, 13/1000; absence of FHT 938/1000; and unknown 187/1000. When rates were restricted to fetuses and newborns weighing $\geq 2,500$ grams, they were: 22/1000; 9.4/1000; 944/1000 and 111/1000. 543 cases (18%) had LBWT. The grey highlighted rates are more or less comparable to the originally designed indicator. **DISCUSSION:** Stethoscopes are not sufficient for good FHT monitoring; it is hard to distinguish from maternal FHT, thus, amplifiers important. If FHT is audible, then a live birth should be delivered and discharged. Authors think the indicator has good potential – inexpensive and sustainable for program to improve quality. They determined that just over half of the perinatal deaths occurred prior to admission. Thus, about 45% could have been averted with good intrapartum care. **LESSONS LEARNED:** training in doptone should be provided along with training in the use of the indicator. Participants received minimal training; the few misclassifications might have been avoided with more training.

Based on my analysis below: by restricting cases to normal birthweight or more, the overall indicator death rate was reduced by about 25% (12.2/1000 to 9.1/1000). This compares to a reduction of 35% in Goldenberg's overall rate calculations – difference between 34/1000 and 22/1000.

Table 4: Re-analysis of Goldenberg et. al.'s data excluding the antepartum SBs

	Total	Intrapartum SB	VEND	Rate per 1000	Total >2499g	Intrapartum SB >2499g	Early neo death >2499g	Rate per 1000
FHT present	3,445	16	26	12.2	2,968	13	14	9.1
FHT absent	39	32	3	897.4	22	18	2	909.1
Unknown	76	5	6	144.7	43	1	2	69.8
Total	3,560	53	35	24.7	3,033	32	18	16.5

Plotkin and coauthors sought to fill the need for a facility perinatal rate that was defined by data routinely collected through the DHIS2 and would guide initiatives to improve the quality of intrapartum and newborn care. They also considered the indicator to be useful to measure the impact of introduced

quality improvement interventions such as neonatal resuscitation. They defined their indicator as a facility perinatal mortality (FPM) rate; the numerator included fetal intrapartum deaths with heartbeats detected and recorded at admission **and** neonatal deaths occurring prior to discharge. The denominator included all women with positive FHTs on admission. The authors had 2 objectives: 1) Compare sensitivity and specificity of the HMIS data compared to a “gold standard audit” of perinatal deaths; 2) calculate the FPM based on validated HMIS data.

Their study was conducted only in 10 high volume facilities: >365 births per yr, ≥ 5 SBAs). This indicator was designed for each health facility to track its own progress over time. The indicator was also aggregated across all facilities but the comparison across facilities is tricky due to geographical access, catchment area differences and different levels of care (hospitals and health centers). Authors state that the indicator is not suitable as a national or international standardized indicator but recommend it possibly at subnational use in the long-term.

Differences between the FPM and *The Handbook* indicator are: 1) time period for the newborn was “prior to discharge” rather than death during the first 24h, and 2) FPM includes only cases where fetal heart rate was positive on admission. The researchers rejected taking into consideration gestation or birthweight because they wanted facility managers to have a simple feasible indicator. Data collected on these 2 items were not feasible to collect in a routine fashion.

Findings: validation exercise showed high level of agreement (high sensitivity and specificity) between HMIS data and audit. FPM was highest in regional hospital and lowest in the 3 health centers – overall, 2.4%, ranging from 0.3% - 4.2%. By not including gestational age or birthweight, the FPM rate is less sensitive to potentially preventable deaths. They recommend stratification by birthweight where feasible.

Goldenberg and Plotkin’s studies were “special studies” since they were designed specifically to demonstrate the use of a single indicator. In EmONC assessments, the indicator in question is one of many that the assessment produces. In both “special studies,” the research team distributed hand-held Doppler devices at participating facilities and staff underwent training to use them. In Plotkin’s experience in Kagera, Tanzania, the training was 3-4 hours long and included training on the indicator itself and the hand-held Doppler device, each facility received 2 devices and they revised the maternity register to include 2 new columns: type of device used (Doppler or Pinard) and fetal heart rate in beats per minute. In Goldenberg’s experience, training amounted to a single demonstration of the doptone and brief training on the indicator. Authors admitted that the errors made in interpreting the FHT might have been avoided had staff had more training.

Both studies tested an indicator different from the one proposed by *The Handbook*. Although the purpose of the study by Goldenberg and coauthors was to test the feasibility of calculating the indicator adopted by *The Handbook*, they calculated institutional perinatal rates that included antepartum stillbirths. However, they did discuss what proportion of the facility perinatal deaths occurred in the facility and what proportion likely occurred prior to admission. The former is more in line with the indicator in *The Handbook*.

Going forward – thoughts and recommendations

1. What is feasible? As the experience from the EmONC assessments suggests, over time countries have refined the calculation of this indicator and its adaptations. It is certainly feasible to produce a stillbirth rate and a very early neonatal death rate. These can be combined to produce a facility-based perinatal mortality rate (prior to discharge). However, this is a crude indicator of the quality of intrapartum care compared to a similar indicator that excludes antepartum fetal deaths (as described by Plotkin et. al.). If facilities routinely collect information on the timing of the stillbirth, an alternative rephrasing of the indicator that does assess the quality of intrapartum care might be “the proportion of facility perinatal deaths that occur after admission” as suggested by Goldenberg et. al.
2. Increasingly, the reporting of birthweight for live births as well as stillbirths seems to be improving. Where restriction by birthweight is feasible, rates have been shown to be 35-50% lower.
3. In order to promote assessing the fetal heart beat on admission in order to have a more accurate counting of intrapartum stillbirths, we could modify the definition of the indicator so that it is based on women with a positive fetal heart beat on admission. This may be a more long-term goal.
4. Feasibility versus aspiration: The promotion of aspirational indicators (for example, restricting cases to babies weighing ≥ 2500 grams and to infants of women with a positive FHB on admission) will also promote a higher standard of data quality and refinement, which is desirable as quality of care improves and standards are raised.
5. We recommend that the guidance for this indicator make explicit the value of making this a 2-step indicator: step 1 would entail 2 separate rates, the intrapartum stillbirth rate and the very early neonatal death rate, while step 2 could combine the 2. This would ensure that facilities could monitor each one since there is some evidence that changes may not be uniform, i.e. a reduction in intrapartum stillbirths may occur before a reduction in the very early neonatal death rate [7].
6. Rather than set a specific time period (12 or 24 hours after birth), we should refer to neonatal deaths “prior to discharge.”

References

1. Liu L, Oza S, Hogan D, et al. Global, regional, and national causes of under-5 mortality in 2000–15: An updated systematic analysis with implications for the sustainable development goals. *The Lancet*. 2016;388(10063):3027-3035. doi:10.1016/s0140-6736(16)31593-8.
2. Lawn JE, Lee ACC, Kinney M, et al. Two million intrapartum-related stillbirths and neonatal deaths: Where, why, and what can be done? *International Journal of Gynecology & Obstetrics*. 2009;107(Supplement). doi:10.1016/j.ijgo.2009.07.016
3. WHO, UNFPA, UNICEF, AMDD. *Monitoring emergency obstetric care: a Handbook*. Geneva: WHO; 2009. Available at: <https://apps.who.int/iris/handle/10665/44121>.
4. Fauveau V. New indicator of quality of emergency obstetric and Newborn Care. *The Lancet*. 2007;370(9595):1310. doi:10.1016/s0140-6736(07)61571-2
5. Goldenberg RL, McClure EM, Kodkany B, et al. A multi-country study of the “Intrapartum stillbirth and early neonatal death indicator” in hospitals in low-resource settings. *International Journal of Gynecology & Obstetrics*. 2013;122(3):230-233. doi:10.1016/j.ijgo.2013.04.008

6. Plotkin M, Bishanga D, Kidanto H, et al. Tracking Facility-based perinatal deaths in Tanzania: Results from an indicator validation assessment. PLOS ONE. 2018;13(7). doi:10.1371/journal.pone.0201238
7. Centers for Disease Control and Prevention. *2019 Pregnancy Outcomes in Health Facilities in Kigoma Region, Tanzania: Final Report*. Atlanta, GA: Centers for Disease Control and Prevention; 2019. Available at: <https://ghdx.healthdata.org/record/2019-pregnancy-outcomes-health-facilities-kigoma-region-tanzania-final-report>.