Current Set of Emergency Obstetric Care (EmOC) Indicators:

From "Monitoring emergency obstetric care: A Handbook" (WHO, 2009)

Indicator Brief #5:
Caesarean sections as a proportion of all births

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 5: Cesarean deliveries as a proportion of all births

This brief was written to describe the above indicator, the assumptions behind the indicator, methodological issues that have arisen, what we have learned in the 25 years since the indicator was first described, and a few ideas related to the indicator as we go forward.

Background

The cesarean delivery rate (CDR) is a widely used indicator that informs us about access to and utilization of life-saving care for both the woman and her baby when performed for medical indications; it also helps identify inequities in the distribution and delivery of care as well as concerns regarding the appropriateness of care. Very low rates of cesarean delivery (CD) signal poor access to surgical care and are associated with elevated maternal and perinatal morbidity and mortality [1]. Very high rates suggest overuse or overmedicalization, non-medically indicated interventions, and potential financial burdens for health systems and families/individuals. Extremes at either end of the spectrum carry risks of adverse consequences, thus, the importance of monitoring rates and trends to identify underuse and overuse of CD as well as unsafe surgery, aptly labelled a 'triple burden' [2]. In sub-Saharan Africa (SSA), for example, as many as 11 maternal deaths and 100 perinatal deaths occur for every 1000 cesarean deliveries, and almost a quarter of all maternal deaths are women who had a CD [1].

In 2015 the WHO issued a consensus statement that said that maternal and perinatal mortality no longer decrease once CDRs reach 10-15% [3-5]. Concerns regarding the upper threshold are the result of the dramatic increase in CD rates over the last 3 decades. Globally, the current cesarean rate is 21%, with several countries exceeding rates of 50% (the Dominican Republic, Brazil, Cyprus, Egypt, and Turkey). In low- and middle-income countries, rates have accelerated most quickly among women of the highest wealth quintile [6]. In contrast, in the United States, the highest CD rates are among Black women [7] and recent US evidence suggests an association between overmedicalization in childbirth and structural sexism [8].

The increase in CDRs has been the slowest in SSA with an average CDR of 5%; the lowest rates are in Chad, Niger, Ethiopia, Madagascar, and Cameroon [2]. Rates in these countries range between 1.4% and 2.4%. In addition to maternal death, other adverse consequences of underuse include high risks of ruptured uterus, stillbirths, and fistula. Eastern and Western Asia have shown the highest increases, sub-regions with CDRs of 33.7 and 31.7%, respectively.

Access to mode of delivery data and their disaggregation have allowed us to understand that increasingly, countries with low rates also experience overuse, a phenomenon that presents itself among two different segments of the population, often reflecting urban/rural and wealth differentials [2, 9, 10]. Numerous factors drive high rates, including threats of litigation, the increasing contribution of the private sector and financial incentives, the dwindling use of other modes of delivery such as assisted vaginal birth, gaps in medical school training and curricula, patient preferences and medical conditions, sociodemographic characteristics of patients, facility practices and provider preferences. Efforts to curb the increases have not been shown to be sustainable despite mixed success at the project-level [11]. By the same token, efforts to increase CD rates among underserved populations also require solutions of a multisectoral approach (roads and transportation) as well as resources that support the health system [12, 13].

Medical and public health communities know a great deal about the root problems related to unsafe surgery, overuse, and underuse and what the risk factors are for adverse maternal and perinatal consequences. Some solutions require a technical fix, but many solutions lie within the realm of human behavior change and health/economic system change. Despite deeply rooted resistance and barriers to change, we need to continue to monitor trends, increase our understanding of the root problems, and provide increasingly helpful, perhaps more nuanced metrics and interventions to address this triple burden.

Definition and calculation

The benchmark or acceptable range for the estimated proportion of births by cesarean delivery in the population was defined in the 2009 *Handbook* as not less than 5% or more than 15%.

> Numerator: The number of CDs performed in EmOC facilities for any indication during a specific period and defined geographic area
>
> Denominator: The expected number of births during the same period and same geographic area

The denominator is NOT institutional births (a common misunderstanding) but all births. Both numerator and denominator can be adjusted to calculate sub-national estimates. Finally, like many of the other indicators, it is generally calculated among EmOC facilities ***and*** for all facilities (the numerator includes all CDs regardless of the facility's EmOC status).

Assumptions

- In the storyline of the indicators, "cesarean deliveries as a proportion of all births" reflects whether enough women receive a critical life-saving intervention that can reduce both maternal and newborn mortality and morbidity
- Not only can the indicator reflect underuse of the procedure ("too little, too late") but it also can signal overmedicalization ("too much, too soon")
- Stating a range for the CDR provides critical guidance to planners and practitioners
    - Rates above the ceiling level of 15% suggest overuse of CD
    - Rates below 5% indicate an unmet need for CD
- Every woman who needs a cesarean should have one regardless of targets
- CD is a proxy for obstetric surgery in general, given how frequently the procedure is performed
- Using service statistics in the numerator and population projections of expected live births in the denominator makes this indicator population-based
- Users of this indicator understand the difference between a facility-based rate and a population-based rate
- Where CD rates are very low (<3%), it is likely that most cesareans are performed for emergency indications for pregnant women. As the rate rises, more cesareans are performed for fetal indications. The range of 5 – 15% assumes both maternal and fetal indications.
- Cesarean costs represent a significant drain on human and financial resources of health systems and families.

Red flags the indicator can raise (directly or indirectly)

- "Too much, too soon" [14] and high CDRs could be indicative of:
    - A need to review provider practices, clinical decision-making and the quality of care
    - The need to examine whether skilled health personnel are competent and equipped to:
        - use vacuum extraction or forceps, when clinically indicated
        - perform vaginal delivery after a cesarean (VBAC)
    - Inappropriate care, e.g., routine use of CD in cases of stillbirth, policies that restrict ambulation during the first stage of labor [15, 16], non-consent for CD or other procedures conducted at the same time, and "once a cesarean, always a cesarean" (underuse of VBAC)
- "Too little, too late" [14] and very low CDR could be indicative of:
    - A poorly functioning referral system and other access barriers
    - Low utilization of the health system, perhaps driven by distrust or financial and socio-cultural barriers
    - Systemic problems related to facility readiness to perform a cesarean delivery such as a shortage of health professionals with surgical and anesthetist skills, or shortages in equipment and supplies
- Both high and low rates can mask where the opposite is true, which is revealed when data are disaggregated
- Inequities in the provision of emergency care can exist, including structural racism, sexism, and other social challenges
- Poor communication and/or imbalance in power dynamics can undermine health provider cadres' clinical decision-making (e.g., professional opinions not being valued)
- Management-related issues in facilities can also undermine professional practice and relationships (e.g., lack of team work, proactive vs. reactive management, lack of clinical protocols) [17].

Methodological issues

- The current indicator has been applied in a global context where the acceptable range has been between 5 and 15%. Concerns have been expressed that setting a minimal threshold for this indicator could lead to over-interventionist behavior [18]. Opinion surveys of physicians in 96 countries showed a lack of consensus on what the range should be [19]. But more recent evidence from WHO suggests 10—15% [3] or even 20% as the upper threshold. Assuming we continue with this indicator, should we adapt our guidance and refer to 10-15% as a new benchmark, where anything below that is too low?

- The numerator – number of cesareans performed – is reasonably accurate whether counting from paper-based registers or the HMIS. A recent paper compared a paper-based experience with the HMIS and found that the HMIS in Ethiopia undercounted the national number of cesareans by 3.4% [20]. However, in some countries the HMIS may not include the private sector.

- The denominator – expected births – is only as valid and reliable as the data used to estimate it. The data often derive from decennial census estimates of the population (or population projections) and the crude birth rate (CBR), the product of which is technically "live births." If

live births are grossly overestimated, the CDR will be underestimated, and conversely, if underestimated, the CDR will be overestimated. There is no easy well-accepted way to estimate all expected births, including stillbirths.

- The current indicator is simply a rate and tells us only about the magnitude of that rate. Even if the rate falls between 5 and 15% of expected live births, it tells us nothing about quality, accountability, safety, or equity of the procedure.
    - To better understand "too much or too little," we depend on stratification of the CDR by subnational administrative units, managing authority or facility ownership, urban/rural residence, women's wealth quintile (with population-based data) or other variables.
    - For additional insights, we will require additional data and often individual level data, rather than the aggregate data commonly collected in assessments or by the HMIS. For example, currently, no distinctions are made between emergency or elective cesarean deliveries, between primary or repeat cesareans, between cesareans indicated for maternal or fetal indications, or between other subgroups of women. This is something we would like to strive for with (optional "elaborated") indicators to complement the core indicator.

Lessons learned from experience with the indicator

This indicator is one of the more straightforward of the current set and its calculation and interpretation are not very controversial. In general, hospital-based data are considered the standard. When based on EmONC assessments or monitoring efforts, it tracks reasonably well with household survey results despite the differences in methodology (Table 1). Multiple sources for this indicator are helpful in assessing the reliability of assessment and survey results.

Table 1: Cesarean delivery rates according to EmONC assessments and household surveys conducted about the same year

EmONC Assessment	Assessment	DHS	Year of DHS
Cambodia 2020[a]	4.9%	6.3%	2014
Guyana 2010	13.0%	13.3%	2009
Ethiopia 2016[b]	3.0%	2.0%	2016
Ghana 2010[c]	7.0%	11.4%	2011
Malawi 2020	7.8%	6.0%	2015-16
Mozambique 2012[d]	3.0%	3.9%	2011
Senegal 2015-16	4.6%	5.0%	2017
Togo 2013	5.8%	6.5%	2013-14
Zambia 2014	3.6%	4.4%	2013-14

[a] Assessment reflects EmONC network only, subset of gov't/public facilities; however, private hospitals provide substantial EmONC but are not part of the EmONC network. 2014 DHS most recently completed.

[b] DHS estimates based on previous 5 years; assessment based on 12 months of 2015.

[c] MICS survey, not DHS.

[d] Assessment based on 3 previous months (multiplied by 4), not usual 12 months.

According to the 2009 *Handbook*, this indicator, like the others, is usually calculated for all facilities and for fully functioning EmOC facilities (Table 2 below). The differences between the two CDRs reflect the existence of under-performing (potential C-EmOC) facilities, i.e., one or more of the signal functions, often assisted vaginal birth, was not performed. In the case of Cambodia, all cesareans took place in hospitals that were fully functioning at the C-EmOC level. In contrast, the rates differed more dramatically in Malawi indicating that about half of the cesareans were conducted in hospitals that were not fully functioning C-EmOC facilities.

Table 2: CDR rates in all facilities and in C-EmOC facilities surveyed

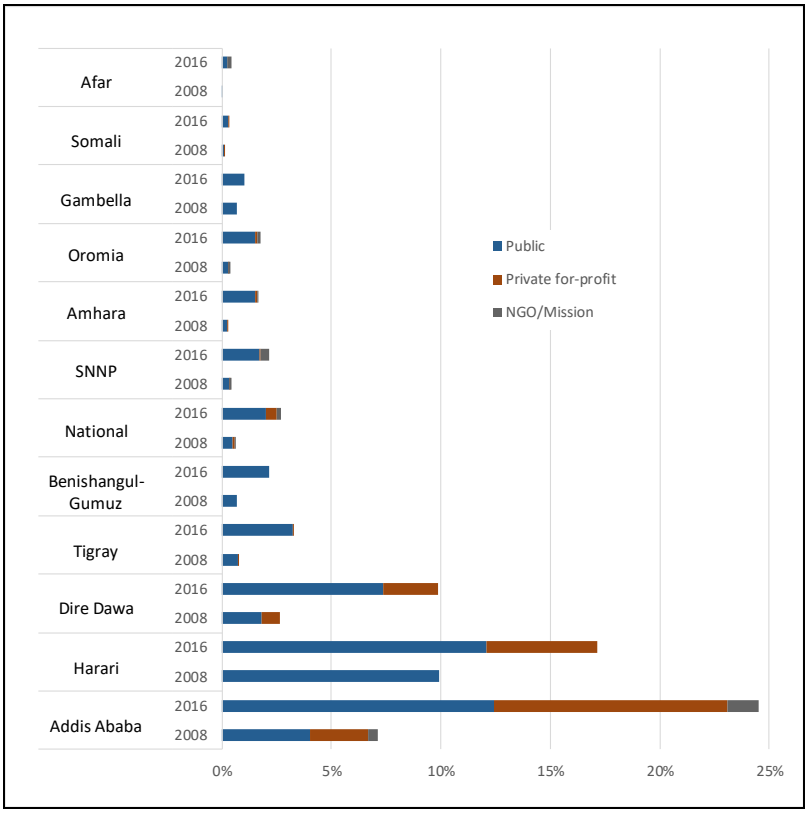
Country and year	CDR among all facilities	CDR among C-EmOC facilities
Cambodia 2020	4.9%	4.9%
Ethiopia 2016	3%	2%
Malawi 2020	7.8%	3.9%
Mozambique 2012	3.0%	2.6%
Zambia 2014	3.6%	2.9%

This indicator becomes problematic when used to assess a single facility or a small administrative unit such as a district or county, since the denominator (expected live births in the catchment area) becomes less trustworthy and cesarean-capable facilities often attract women from neighboring catchment areas. This is an issue that usually arises when the indicators are used to monitor progress at a project level. An example of this problem may be found in Figure 1. It is likely that Dire Dawa and Harari, both small "city states," reflect the utilization of their urban facilities by women who live in surrounding regions.

Another problematic situation can occur using this indicator when data are not captured at all cesarean-capable facilities. If countries with a large private sector that provides substantial childbirth services, the rate is likely to be underestimated if the private sector is not included. The authors of the 2020 Cambodia Final Report on the EmONC Improvement Plan point out that major private hospitals that provide free maternity services should be invited to participate in the national EmONC network. Currently, the national EmONC improvement plan excludes all private hospitals (Table 1 above).

To enhance the population-based indicator, we often rely on additional stratification to inform facility and sub-national program managers and planners about how cesareans are distributed geographically and how managing authority/ownership contributes (see Figure 1). About half of the cesareans performed in Addis Ababa took place in the private for-profit sector. The contribution of the private sector is as high as 80% in some countries (2017 Bangladesh DHS) [1].

Figure 1: Contribution of ownership/managing authority to population-based CDRs, by region (Ethiopia 2016)



Source: Beyene MG, Zemedu TG, Gebregiorgis AH, Ruano AL, Bailey PE. Cesarean delivery rates, hospital readiness and quality of clinical management in Ethiopia: national results from two cross-sectional emergency obstetric and newborn care assessments. *BMC Pregnancy and Childbirth* 2021; 21:571 https://doi.org/10.1186/s12884-021-04008-9.

Going forward – recommendations and ideas for new indicators to consider

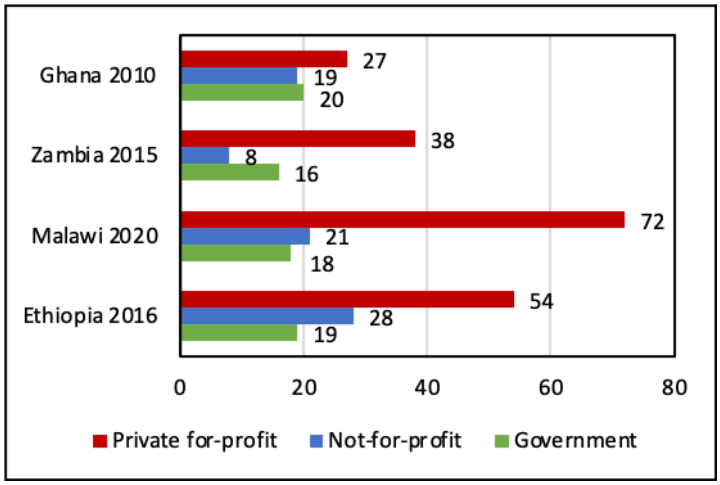
We recommend keeping the indicator "proportion of expected births delivered by cesarean" as a core indicator but modifying the benchmark to align with the WHO range of 10-15%. However, we should add that the expected births are "expected live births," to be consistent with the methodology used.

By adding "elaborated" indicators, we can also focus on appropriate care and better answer whether the right women are getting the right care. Items 1 – 4 below also draw from EmONC assessment experience.

1. **The institutional CDR** (see Figure 2) is the number of CDs divided by the number of institutional births in facilities where CDs are counted. This indicator can highlight the dynamics of overmedicalization, underuse and equitable access. At the individual facility level, it can be indicative of patient case mix, capacity, and provisions as well as clinical management protocols and organizational culture. It is well accepted that institutional rates are difficult to interpret, and population-based benchmarks should not be applied to individual facilities given how much they can vary. That said, facility rates do serve the purpose of raising questions as Figure 2 does below.

Private-for-profit institutions typically have higher institutional CDRs than either government or not-for-profit facilities. Malawi's private for-profit rate is based on just 4 hospitals. This is key information for governments, professional societies, and civil society that have an interest in monitoring the overmedicalization of care.

Figure 2: Institutional cesarean delivery rates by facility ownership/management



We recommend that the guidance address how this indicator can be used at facility level for monitoring purposes and discussion, but we do not recommend it as a core or elaborated indicator given the confusion that has arisen between population-based and facility-level rates.

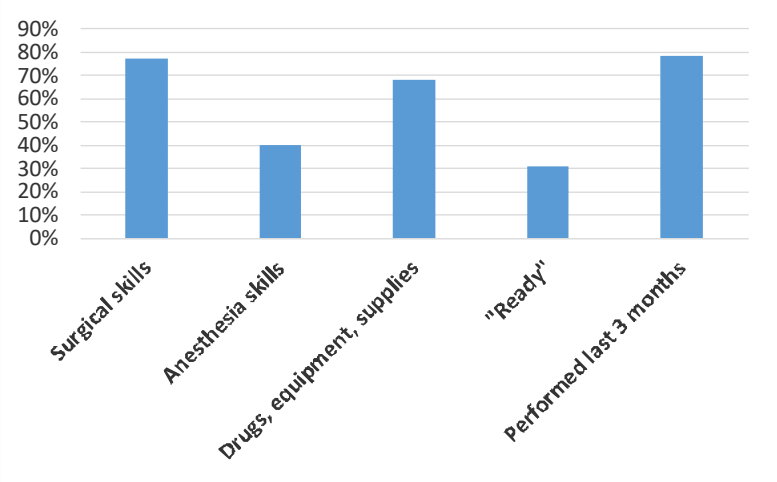
2. **The ratio of caesarean deliveries to instrumental deliveries** highlights the differences in interventions for "assisted delivery" (surgical or instrumental) and allows for comparability across countries; it focuses attention on provider practices and if and where the (re)introduction of instrumental delivery could relieve the over-reliance on surgery, which is costly and with known short- and longer-term risks. See Table 3 below for the wide variation in practice – in Congo, Brazzaville where 27 CDs were performed for each instrumental delivery, to Laos where for every 2 CDs one instrumental vaginal delivery was performed.

   Instrumental or assisted vaginal birth (AVB) can reduce an unknown proportion of cesarean deliveries but its use has tended to decline over time as CD rates have risen. AVB requires well trained and equipped providers who are confident in their skills. The reintroduction of AVB has been promising but sustainability a challenge.

3. **Readiness to perform CD** can be measured in several different ways and is likely to be subsumed under a new indicator that features signal function or general facility readiness. We also recognize that measurement of CD performance in the last three months lacks nuance. We could add to the EmONC assessments a question such as "over the past 3 months, was it ever the case that you had to refer a case for CD due to lack of surgeon, anesthetist, blood or other needed supplies or equipment, or other requirement?" This would be analogous to how some stock-out indicators are operationalized.

Figure 3 suggests one way to assess readiness to perform CDs. Note that CDs are being conducted in suboptimal conditions, lacking anesthetists in particular.

Figure 3: Readiness to perform cesarean delivery, Mozambique 2012



Readiness is defined by availability of surgical and anesthesia skills, and hardware (operating table, functioning cylinder with O_2, functional anesthesia machine, masks for anesthesia, halothane or ketamine in stock or lidocaine or bupivacaine in stock). "Ready" means all 3 components are in place. 100% of hospitals providing CD were open 24/7 (not shown but critical to include).

Source: Ministry of Health of Mozambique, Final Report EmONC Assessment, 2012

Additional possible indicators (4 – 10) that are based on data from individual women could be captured with a chart review or audit of CDs using the current or a revised assessment chart review. The chart review draws on a systematic convenience or random sample of women identified in operating theatre registers in facilities where CD is performed. It captures the quality of record-keeping, clinical case management, maternal and perinatal complications related to surgery, outcomes, and several classification strategies for CDs (indications, elective/emergency, first or repeat, and the Robson classification).

4. **Indications** for CDs are instrumental for understanding the access and utilization gap, especially where cesareans are rapidly increasing as in the private sector.

5. The **Robson classification** has enjoyed considerable popularity globally over the past 20 years as a tool to measure the CDR for 10 mutually exclusive groups of women, defined by 6 basic obstetric characteristics (parity, previous CD, onset of labor, gestational age, singleton/multiple pregnancy, and fetal presentation). WHO considers it the most appropriate system to fit local and international needs [21]. Its purpose is "to optimise the use of caesarean section by identifying, analysing and focusing on interventions for specific groups of particular relevance to each health care facility" [3]. In particular, it is helpful to identify "avoidable" CDs.

   By adding the 10 characteristics to the chart review we are able to determine the relative size of each of the 10 groups. Thus, it is easy to measure the proportion of cesareans that meet the criteria of each group. Our proposal would be to measure **the proportion of cesareans that fall into categories considered low obstetric risk** (Groups 1 and 2).[1] These women are: parity 0, no

[1] This is similar to the NTSV cesarean birth measure adopted by the Centers for Disease Control. NTSV = nulliparous, term, singleton, vertex births. The indicator measures the proportion of "low-risk births" delivered by

previous CD, ≥ 37 wks gestation, have a singleton pregnancy, and fetal cephalic presentation. Group 1 and 2 differ by whether labor was spontaneous or induced/pre-labor CD. Group 1 frequently features disproportionately as the largest group of the 10. To reduce primary (first) cesareans these groups are in particular need of monitoring and, subsequently depending on their size, obstetric norms and practices should be reviewed. It might make sense to also include groups 3 and 4 (they differ from 1 & 2 only because they are multiparous). These four groups often are the focus of special interventions and ACOG considers them of special concern [22], given their impact on the overall CDR (and the increasing relative size of group 5 – women with previous CD).

See Figure 4 for an example of Robson classification groups by managing authority [9]. More than half of the cesareans reviewed from the public sector fell into one of the 4 low risk groups. It would be helpful to set a benchmark or "cut-off" limit to provide guidance for obstetric practice.

To measure the CDR of the specific groups would require a special study that would entail tracking a cohort of women prospectively from admission to discharge. However, of all proposals presented here, we believe greater investment in routine documentation that would enable the monitoring with the entire Robson system or with the NTSV indicator (see footnote 1) would be highly beneficial.

Figure 4: Relative size of 10 Robson groups by managing authority (n=371), Ethiopia 2008 and 2016

Source: Beyene MG, Zemedu TG, Gebregiorgis AH, Ruano AL, Bailey PE. Cesarean delivery rates, hospital readiness and quality of clinical management in Ethiopia: national results from two cross-sectional emergency obstetric and newborn care assessments. *BMC Pregnancy and Childbirth* 2021; 21:571 https://doi.org/10.1186/s12884-021-04008-9

cesarean, patients whose outcomes are shown to be largely influenced by physician factors. 60% of hospital variation is attributed to 1st birth induction rates and women being admitted too early to hospital.

6. **Proportion of CDs conducted for absolute maternal indications [AMI]** is an indicator that highlights the extent of CDs that are truly life-saving. AMI are defined by severe antepartum hemorrhage due to placenta previa or placental abruption, unremitting postpartum hemorrhage, major CPD (including pre-rupture and rupture of the uterus), and transverse lie and brow presentation [23]. Several experts have suggested we should only measure those CDs that save lives [24]. A recent paper from Bangladesh showed that only 1.4% of all CDs were performed for AMI. This study was in an area where the population-based CDR was 35% and institutional delivery 84% [25]. A variation on this indicator would be to measure "emergency" cesareans.

7. **Case fatality rate for women with cesarean deliveries** would be a measure of safety and quality, but like most CFRs, could be measuring the very poor conditions of the woman prior to the CD or on arrival.

8. **Proportion of maternal deaths that underwent a cesarean delivery** would also be an indicator of safety but this would likely come from maternal death audits.

9. **Timing from decision to incision** has been used for measuring the third delay but is frequently subject to missing data. Benchmark is usually set for 30 minutes.

10. We could create a composite score to describe the **appropriate care as it relates to cesarean delivery**. Time frame and mode of verification to be determined. In this case 100% would be the target.
    a. Assisted vaginal birth performed on site
    b. VBAC performed on site
    c. Ambulation encouraged during first stage of labor
    d. Presence of a companion encouraged during labor
    e. Prophylactic antibiotics given prior to CD
    f. Consent provided prior to surgery

Table 3: Percent distribution of institutional deliveries by mode of delivery and country

	Congo-Brazzaville 2012	Ghana 2010	Mozam-bique 2012[1]	Niger 2010	Senegal 2012-13	Zambia 2015	Laos 2010-11	WHO Global Survey[9]	WHO Global Survey Africa[24]
Spontaneous vaginal deliveries	92.7	87.1	94.2	92.5	94.9	94.3	88.9	71.7	88.2
Vacuum extractions	<0.1	0.5	1.1	1.0	0.5	0.5	3.4	2.6	3.0
Forceps deliveries	0.2	<0.1		0.2	0.1	0.1	0.1		
Cesareans	6.9	12.3	4.2	5.9	4.4	5.0	7.3	25.7	8.8
Craniotomies/embryotomies	<0.1	<0.1	0.3	<0.1	0	0	<0.1		
Laparotomies (for ruptured uterus)	0.1	0.1	0.2	0.4	0.1	0.1	0.1		
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total no. of deliveries/interventions	85,038	434,508	161,458	151,787	472,608	475,645	17,891	286,565	81,722
Total assisted delivery rate	7.2%	12.9%	5.3%	7.1%	5.0%	5.6%	10.9%	28.3%	11.8%
Ratio of cesarean deliveries to assisted vaginal deliveries	27.4	22.0	3.8	5.1	7.4	9.0	2.1	10.1	2.9

[1] Mozambique is based on 3 months of data, all others on 12 months.

[9] Souza et al. Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health, *BMC Medicine* 2010; 8: 71.

[24] Shah et al. Cesarean delivery outcomes from the WHO global survey on maternal and perinatal health in Africa, *IJGO* 2009; 107(3): 191-7.

Source: Bailey P, van Roosmalen J, Mola G, Evans C, de Bernis L, Dao B. Assisted vaginal delivery in low and middle income countries: an overview. *BJOG* 2017; DOI: 10.1111/1471-0528.14477.

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