

The Landscape of Cesarean Section in Sub-Saharan Africa and South and Southeast Asia



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Acronyms and Abbreviations

ANC	antenatal care
CEmOC	comprehensive emergency obstetric care
DHS	Demographic and Health Survey
FBO	faith-based organization
LMIC	low- and middle-income country
NPC	nonphysician clinician
SBA	skilled birth attendant
SPA	Service Provision Assessment
WHO	World Health Organization

Executive Summary

Cesarean sections can be lifesaving interventions, but they also entail risks for both mothers and babies. Therefore, such surgical deliveries should only be performed for women who need them. Many women in low- and middle-income countries (LMICs) who need a cesarean to treat delivery complications have difficulty accessing surgical care. At the same time, high and rising cesarean rates among some groups of women in these settings indicate that many receive unnecessary interventions, putting them at higher risk of morbidity and mortality. LMICs may therefore concurrently experience a double burden of preventable morbidity and mortality resulting from both underuse and overuse of cesarean sections among different groups of women. Additionally, whether cesarean deliveries are medically necessary or not, evidence suggests that many in LMICs are performed in settings where minimum standards of safety and quality cannot be met, further increasing the mortality and morbidity risks for both mothers and newborns.

This report seeks to assess the landscape of cesarean sections in LMICs using recent, comparable, nationally representative survey data. We analyzed data from Demographic and Health Surveys (DHSs) conducted in 34 countries in Sub-Saharan Africa and 10 in South and Southeast Asia between 2002 and 2016. Estimates of cesarean section rates were based on the most recent live births in the survey recall period, and all information about the delivery (location, assistance, and mode) is based on women's self-report. Additional data were available about the circumstances surrounding women's cesarean section in Bangladesh (DHS) and facility-level care provision in Tanzania from the Service Provision Assessment (SPA). These two countries are presented as case studies, accompanied by an in-depth review of time trends in the level and provision of cesarean sections.

A. Multicountry Analysis

1. Where do cesarean sections occur?

National cesarean section rates ranged widely, from 1.5% of births in Chad to 33.8% in the Maldives. Cesarean section rates were higher for urban populations than for rural populations in all countries; the narrowest urban-to-rural ratio was in Swaziland (1.1), and the widest was in Ethiopia (19.2). The percentage of births occurring in health facilities ranged from 12.1% in Ethiopia to 97.2% in the Maldives, with a median across the countries in this analysis of 66.4%. In most of these 44 countries, **cesarean section rates in nonpublic facilities were higher than in public facilities** (median ratio, nonpublic-to-public, 1.5); Namibia had the highest ratio (3.6) and Vietnam the lowest ratio (0.1—i.e., nonpublic facility cesarean section rates were one-10th those of public facilities).

2. Who performs cesarean sections?

We categorized the person with the highest level of medical training from women's responses about who assisted with their delivery into three categories: doctor/nonphysician clinician (including the cadre of medical/clinical officer); nondoctor skilled birth attendant (SBA), such as a nurse or midwife (according to World Health Organization and country-level definitions); and all non-SBAs (lower level medical professionals and traditional birth attendants). The percentage of women who

reported that the highest cadre assisting their cesarean section was not an SBA was minimal and most likely an error. Countries varied widely in **the percentage of cesarean deliveries assisted by nondoctor SBAs**; this phenomenon **was more common in countries of Sub-Saharan Africa (and particularly at public-sector facilities)** than in South and Southeast Asia.

3. *Who delivers by cesarean section?*

We assessed the profiles of women using nine factors available in the DHS questions as proxies for higher risk of maternal and newborn complications: woman aged ≥ 35 years; woman aged < 16 years; primiparity; grand multiparity (birth order ≥ 6); preceding birth interval < 12 months; multiple gestation; no receipt of antenatal care (ANC); preceding live birth in recall period resulted in neonatal death; and cesarean section(s) in recall period. In the 44 countries, the most common risk factors among women with births were primiparity (median across countries, 22%), grand multiparity (20%), and age ≥ 35 (18%). **Women with 3–6 risk factors, and especially grand multiparae and those with no antenatal care, were underrepresented in cesarean deliveries compared with all births.** Conversely, women with exactly one risk factor were overrepresented among cesarean sections compared with the underlying population of all births, and this phenomenon seemed to be driven partly by primiparity. **Trends among nulliparous women are particularly important in determining future overall cesarean rates, especially in settings of high fertility.**

B. Bangladesh Country Study

We examined trends over time and found that the population-level cesarean section rate in Bangladesh increased nearly 10-fold in the 18-year period examined (1996–2014), reaching 24.4% in 2014. There were wide differences in the rate by urban-rural residence and region of residence, but the widest disparity was by wealth: in 2014, 7.3% in the poorest quintile and 54.1% in the richest). **Between 1999 and 2014, the facility cesarean section rate doubled, from 32.5% of all births to 63.1% of births. The annual number of cesarean sections increased seven-fold, despite a decrease in the absolute number of births over this time period.** The share of all cesareans performed in the public sector declined from 53% to 21% over this 18-year time period, due to increasing utilization of nonpublic providers.

Most cesareans were performed during working hours on weekdays, though this phenomenon was less pronounced in nonpublic facilities. On average, women delivering by cesarean stayed at the facility for almost seven days after the birth and paid the equivalent of US\$261 for their cesarean. **Only 45% of cesareans were reported to have been decided on the day of delivery, while 30% were scheduled more than a week before the birth.** Among all cesareans, the **most commonly reported reason was “other complications during delivery” (33%),** which is uninformative and unexpected, considering that “failure to progress” accounted for only 17% of cesareans. Furthermore, the reported timing of the decision to perform a cesarean was not always consistent with the reported indication; only 44% of cesareans for cord prolapse were reported to have been decided on the day of the delivery. These findings highlight the **limitations of self-reported data on indications** and suggest that caution is needed when interpreting them.

C. Tanzania Country Study

Over the 25-year period covered by the DHS surveys, the **cesarean section rate in Tanzania more than tripled**, from 2.3% to 7.0%. **The annual number of cesarean sections performed in**

Tanzania increased five-fold, from around 28,500 in 1991–1996 to around 140,000 in 2011–2016. The differences in cesarean section rates according to residence (urban-rural) were smaller than those by wealth quintile, and the relative width of these gaps has remained constant over time. While there was no difference in 1996 in the cesarean section rate between public and nonpublic facilities, by **2016 nonpublic facilities had a cesarean section rate twice as high as that seen in public facilities (16.9% vs. 8.4%)**.

Analysis of the 2014–2015 SPA showed that **more than 90% of cesarean deliveries in Tanzania were performed at public hospitals or those operated by faith-based organizations (FBOs)**. The availability of basic infrastructure at facilities performing cesareans was poor, with fewer than half of such facilities having piped water and consistent electricity. **Only 40% of all cesareans in Tanzania were performed at facilities with any specialist doctor** (including obstetricians and surgeons), indicating that most cesareans are likely to be conducted by nonspecialists. The availability of three minimum readiness criteria (piped water and consistent electricity, availability of all general anesthesia equipment, and 24-hour coverage of cesarean provider and anesthetist) varied by geographic zone and facility type. Overall, **only 24% of all cesareans in Tanzania were conducted at facilities meeting all three of these minimum readiness criteria**.

Introduction and Objectives

Background

Cesarean sections can be lifesaving interventions, but they also entail risks to both mother and baby. Therefore, surgical deliveries are recommended only in the case of delivery complications where the health benefits of the intervention outweigh the risks. However, there is little consensus regarding the optimal use of cesareans, both at the population level and in defining which women are in need of cesareans. The “optimal” cesarean rate at the population level—if such a rate exists—is unknown, and a recent World Health Organization (WHO) statement on cesarean sections calls for “every effort [to] be made to provide cesarean sections to women in need, rather than striving to achieve a specific rate” (WHO, 2015). Nonetheless, wide variations in cesarean rates between facilities and in obstetricians’ opinions of which complications require a cesarean indicate that there is currently no consensus about which women are in need of a cesarean (Cavallaro, Cresswell, & Ronsmans, 2016). No standardized clinical algorithms exist for ascertaining the need for a cesarean, in part because this decision takes into account many different factors and their change over time.

In practice, many women in low- and middle-income countries (LMICs)—particularly poor and rural women—face substantial geographic and financial obstacles in accessing surgical services during delivery. This underuse of cesareans results in preventable maternal morbidity and mortality, including obstetric fistulas resulting from obstructed labor (Wall, 2012).

Conversely, cesarean rates in LMICs have been rising rapidly for the last few decades, with the highest national cesarean rates being observed in Latin America and the Middle East, far in excess of rates in high-income countries. National rates of over 50% have been recorded in Brazil, Egypt, and the Dominican Republic (Betrán et al., 2016), indicating widespread overuse of surgical deliveries without medical indications, particularly among wealthy, urban women (Alhabe & Belizán, 2017; Belizán et al., 1999). Unnecessary cesareans are also associated with risks for mothers and babies: The WHO Global Survey on Maternal and Perinatal Health found that the odds of severe maternal morbidity or mortality (including admission to intensive care, blood transfusion, and hysterectomy) were six times higher for antepartum cesareans without indications and 14 times higher for intrapartum cesareans without indications compared with spontaneous vaginal delivery (Souza et al. 2010).

Therefore, many LMICs face a concurrent double burden of both underuse and overuse of cesarean sections, similar to the “too little, too late” and “too much, too soon” dichotomy observed more widely in delivery care (Miller et al., 2016). Additionally, whether medically necessary or not, cesarean sections also bring increased risk if they are performed in settings where minimum standards of surgical safety and quality of care are not met. This may be difficult in many LMIC settings, due to shortages of essential resources, including skilled personnel. Recent evidence indicates that a substantial proportion of genito-urinary fistulas treated surgically were iatrogenic, caused by clinical errors during cesarean sections (Raassen, Ngongo, & Mahendeka, 2014; *Fistula Care Plus*, 2016).

In response to the lack of cesarean delivery providers in Sub-Saharan Africa, a number of countries have introduced task shifting policies whereby cadres other than physicians (nonphysician clinicians [NPCs], such as assistant medical officers or clinical officers) are trained to provide cesarean sections (Mullan & Frehywot, 2007). Studies in Mozambique, the Democratic Republic of the Congo, Malawi, Burkina Faso, and Tanzania (Wilson et al., 2011; Pereira et al., 2007; Chilopora et al., 2007; Ellard et al., 2016) showed that NPCs' quality of care was similar to that provided by doctors, making task shifting a potentially important strategy for expanding access to cesareans for women who need them, although the need for ongoing training and supervision was highlighted. Large increases in the proportion of deliveries occurring in health facilities have not been accompanied by the hoped-for substantial decrease in maternal mortality, which is likely due in part to the poor quality of delivery services in these countries. For example, in four Sub-Saharan African countries, most institutional births were at facilities incapable of providing five basic types of emergency obstetric care (Campbell et al., 2016).

Despite these broadly reported trends and concerns about the quality and safety of cesarean section care, the distribution of cesareans in LMICs—including who provides them, where they are provided, and what capacity facilities have to provide these services—is unknown. This report uses secondary data to contribute to the discussion on how to reduce unnecessary and unsafe cesarean sections while ensuring access to this lifesaving procedure for women who need it. The analysis described in this report was conducted as part of a July 2017 technical consultation on cesarean sections in low-resource settings, convened by the *Fistula Care Plus* Project and the Maternal Health Task Force.¹

Objectives

This report aims to provide an understanding of the landscape of cesarean sections in Sub-Saharan Africa and South and Southeast Asia, from both the women's and the providers' perspectives.

The first part of this report is a multicountry analysis describing the circumstances of cesarean sections. The objectives of this section are to:

1. Understand the scale and provision of cesarean sections
2. Describe the cadres of health professionals assisting women with cesarean section deliveries
3. Examine the distribution of factors that are proxies for risk among all women with births, compared with women with cesarean sections

The second part of this report consists of two in-depth country case studies, selected based on the availability of additional data on cesarean sections. The 2014 Bangladesh Demographic Health Survey (DHS) collected self-reported data on the circumstances surrounding cesarean delivery procedures, among women whose most recent birth in the survey recall period was by cesarean. The 2014–2015 Tanzania Service Provision Assessment (SPA) included a section assessing staffing and equipment specific to cesareans among facilities performing them. Somewhat uniquely among recently completed SPAs, the Tanzania survey collected information on the volume of cesarean sections performed at sampled facilities, which enabled us to produce nationally representative estimates of facility environments, taking into account the relative contribution of each facility type to the total number of cesareans performed.

¹ Information about the technical consultation can be found at <https://fistulacare.org/resources/program-reports/cesarean-section-technical-consultation/>.

The objectives of the second part of this report were to:

- In Bangladesh
 4. Describe the change in the cesarean section rate over time, at the national level and according to women's and facility characteristics
 5. Describe the circumstances around and reasons for cesareans

- In Tanzania
 6. Describe the change in the cesarean section rate over time, at the national level and according to women's and facility characteristics
 7. Describe the service readiness of facilities providing cesareans

Demographic and Health Surveys

Data Source

The DHS surveys are cross-sectional, nationally representative household surveys, usually covering 5,000–30,000 households. In the DHS, standard model questionnaires are used, but these can be adapted by each country; optional modules can also be added. Manuals and technical assistance ensure that the survey procedures followed in each country are similar, providing comparable data across countries. The surveys include questions on household and individual characteristics, fertility and family planning, maternal and child health, and details on antenatal and delivery care. The sampling design is a multilevel cluster survey, which often oversamples certain areas.

For the multicountry analysis, we included the most recent available DHS dataset for each country in Sub-Saharan Africa and South and Southeast Asia that conducted a DHS survey between 2000 and mid-2013. Table 1 (page 18) shows the 44 included countries, as well as the survey year and the question about mode of delivery.

For the Bangladesh case study, we analyzed surveys collected in 1999–2000, 2004, 2011, and 2014. For the Tanzania case study, we used five DHS surveys fielded in 1996, 1999, 2004–2005, 2010, and 2015.

The 2014 Bangladesh DHS further added more extensive questions for women whose most recent birth in the recall period was by cesarean. Appendix 1 (page XX) presents the questions included in the 2014 Bangladesh DHS, including the day and time of the delivery, how far ahead of the birth the decision to perform a cesarean was made, who first suggested the cesarean, and why.

Population

The analysis included women aged 15–49 with a live birth in the survey recall period. We examined the mode of delivery and maternal care for their most recent live birth during the recall period (five years in most recent surveys in all countries except in Vietnam and Bangladesh, where it was three years). In time trends analysis for Tanzania, all five surveys used had a recall period of five years, as did all surveys from Bangladesh apart from the most recent one. We analyzed circumstances surrounding the most recent live birth to provide comparable data across the countries, as the two most recent surveys did not collect information on the mode of delivery for all live births in the survey recall period (Sierra Leone and Bangladesh).²

² The population-level cesarean section estimates the percentage of live births delivered by cesarean section, based on a sample of most recent births were slightly higher than estimates calculated on the basis of all live births in the survey recall period (Appendix 2). This reflects secular trends in increasing cesarean section rates over time and the fact that the sample of most recent births likely overrepresents lower-fertility women, who are likely to be more urban, more educated, wealthier, and more likely to deliver at a health facility, and hence to have higher cesarean section rates. However, the 95% confidence intervals of the estimates based on most recent birth compared with all births in the recall period overlap in all countries, except in Indonesia (due to a high degree of precision as a result of the large survey sample size).

Table 1: Countries included in the analysis, by survey year and wording of question about mode of delivery

Country	Survey year	Question
Sub-Saharan Africa		
Benin	2011–2012	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Burkina Faso	2010	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Burundi	2010	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ? Igihe (naka) yavuka boba barinze kubabaga?
Cameroon	2011	Avez-vous accouché de (NOM) par césarienne?
Chad	2015	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Comoros	2012	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Congo-Brazzaville	2011–2012	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Côte d'Ivoire	2011–2012	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Dem. Rep. of Congo	2013–2014	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Ethiopia	2011	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Gabon	2012	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Gambia	2013	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Ghana	2014	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Guinea	2012	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Kenya	2014	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Lesotho	2014	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Liberia	2013	Was (NAME) delivered by Csection, that is, an operation to take the baby out?
Madagascar	2009	Avez-vous accouché de (NOM) par césarienne ?
Malawi	2010	Was (NAME) delivered by cesarean section?
Mali	2012–2013	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Mozambique	2011	O(A) (NOME) nasceu a cesariana, ou seja, foi operada para tirar o bebé?
Namibia	2013	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Niger	2012	Avez-vous accouché de (PRENOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Nigeria	2013	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Rwanda	2014–2015	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Sao Tome and Principe	2008–2009	O parto de (NOME) foi através da operação no ventre (cesariana)?
Sierra Leone	2013	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Swaziland	2006	Was (NAME) delivered by cesarean section?
Togo	2013–2014	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Uganda	2011	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Zambia	2013–2014	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Senegal	2015	Avez-vous accouché de (NOM) par césarienne, c'est-à-dire que l'on vous a ouvert le ventre pour faire sortir le bébé ?
Tanzania	2015–2016	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Zimbabwe	2015	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
South/Southeast Asia		
Bangladesh	2011	Was (NAME) delivered by cesarean section, that is, did they cut your belly open to take the baby out?
Bangladesh	2014	Was (NAME) delivered by cesarean section, that is, did they cut your belly open to take the baby out?
Cambodia	2010	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
India	2005–2006	Was (NAME) delivered by cesarean section?
Indonesia	2012	Was (NAME) delivered by cesarean, that is, they cut your belly open to take the baby out?
Maldives	2009	Was (NAME) delivered by cesarean section?
Nepal	2011	Was (NAME) delivered by cesarean, that is, did they cut your belly open to take the baby out?
Pakistan	2006–2007	Was (NAME) delivered by cesarean section?
Philippines	2008	Was (NAME) delivered by cesarean section?
Timor-Leste	2009–2010	Was (NAME) delivered by cesarean section?
Vietnam	2002	Was [Name] delivered by cesarian section?

- *2014 Bangladesh DHS: Cesarean section indications:* The main population used for analysis was all most recent births occurring by cesarean section. For a small number of calculations, we also used all most recent vaginal births for comparison.

Definitions

Figure 1 shows the set of three questions and response options used on DHS questionnaires querying the location of each woman’s most recent live birth, the person who provided assistance, and the mode of delivery.

Based on women’s responses to “Where did you give birth to (NAME)?”, we defined the location of delivery as home (the woman’s own home, or some other’s home) or health facility. Further, we categorized health facilities by level and by sector of ownership. Sector of facility was categorized as public (includes all governmental and parastatal [social security, military] facilities, based on the DHS response option heading “public sector”) versus nonpublic (includes all facilities outside of the public sector, including for-profit, nongovernmental organizations, faith-based organizations [FBOs], and facilities of other and unknown ownership/profit motive). Facility level was categorized as hospital versus all other facility types (including lower-level, responses with conflated facility levels [such as “private clinic/hospital”], and facilities of unknown level). The majority of countries did not separate hospitals from lower level facilities within the nonpublic sector; the category “hospital” therefore largely captures public-sector hospitals.

Figure 1: Example of questions on DHS women’s questionnaire (Malawi, 2010)

Malawi 2010		Where did you give birth to (NAME)?	
Who assisted with the delivery of (NAME)?	HEALTH PERSONNEL	DOCTOR/CLINICAL OFFICER A	HOME
Anyone else?	NURSE/MIDWIFE B	PATIENT ATTNDT C	YOUR HOME 11 (SKIP TO 444) ←
PROBE FOR THE TYPE(S) OF PERSON(S) AND RECORD ALL MENTIONED.	OTHER PERSON		OTHER HOME 12
IF RESPONDENT SAYS NO ONE ASSISTED, PROBE TO DETERMINE WHETHER ANY ADULTS WERE PRESENT AT THE DELIVERY.	TRADITIONAL BIRTH ATTENDANT D	IF UNABLE TO DETERMINE IF A HOSPITAL, HEALTH CENTER, OR CLINIC IS PUBLIC OR PRIVATE MEDICAL, WRITE THE NAME OF THE PLACE.	PUBLIC SECTOR
	RELATIVE/FRIEND E	(NAME OF PLACE)	GOVT. HOSPITAL 21
	OTHER X		GOVT. HEALTH CENTER 22
	NO ONE Y		GOVT. HEALTH POST/ OUTREACH 23
			OTHER PUBLIC 26
			CHAM/MISSION
			HOSPITAL 31
			HEALTH CENTER 32
			PRIVATE MED. SECTOR
			PVT. HOSPITAL/ CLINIC 41
			OTHER PRIVATE MEDICAL 46
			BLM 51
			OTHER 96 (SKIP TO 444) ←
Was (NAME) delivered by caesarean section?	YES 1		
	NO 2		
Was (NAME) delivered by caesarean, that is, did they cut your belly open to take the baby out?			

Women were asked “Who assisted with the delivery of (NAME)?”, and multiple responses to this question could be recorded. We defined three categories of delivery attendant based on the highest

level of medical professional women reported: doctor/NPC; other skilled birth attendant (SBA), such as a nurse or midwife; and non-SBA cadres, which include traditional birth attendants, auxiliary health cadres, and the woman's relatives. In most countries, response options conflate doctors and NPC cadres and cannot be disaggregated. As shown in Figure 1, the Malawi 2010 survey lists doctors along with clinical officers. As another example, the Tanzania 2015 survey listed doctors alongside assistant medical officers.

We categorized the mode of delivery as vaginal or cesarean. A question on mode of delivery was first introduced in the Phase 2 model DHS questionnaire, asking for each birth in the preceding five years: "Was [NAME] delivered by cesarean section?" Several modifications to the question have been made to minimize misreporting. The Phase 4 questionnaire introduced a skip pattern in 2001 so that this question would not be asked of women who reported delivering in their home or at an "other" location. The question was amended in the Phase 6 questionnaire in 2011 to "Was [NAME] delivered by cesarean, that is, did they cut your belly open to take the baby out?" There were some inconsistencies between delivery location, delivery attendant, and mode of delivery. We recoded cesarean section births for which the delivery location was home to be vaginal deliveries. We also recoded cesarean sections for which the highest attendant at delivery was reported to be "no one" (i.e., the woman delivered alone) to be a missing value for a delivery attendant.

In our analysis of characteristics that serve as proxies for higher risk of maternal and newborn complications, we assessed nine factors captured in DHS questionnaires, following Virgo et al. (2017).

1. Woman was aged <16 years at the time of the index birth.
2. Woman was aged ≥ 35 years at the time of the index birth.
3. Index birth was first birth.
4. Index birth was order six birth or above (grand multiparity).
5. Index birth was preceded by birth interval ≤ 12 months.
6. Index birth is with multiples (twins, triplets).
7. Index birth was not preceded by any antenatal care.
8. The child from the live birth before the index birth (if this occurred within the five-year recall period) died in the neonatal period (≤ 30 days).
9. Any of the live births in the recall period preceding the index birth occurred by cesarean section.

Some of these risk categories are mutually exclusive (for example, age <16 and age ≥ 35 ; preceding interval ≤ 12 months and first birth), but others are highly correlated (such as age ≥ 35 and grand multiparity). We present these risk factors individually and in categories: none and any (and within any: one, two, and three or more risk factors). The maximum number of risk factors any woman in the surveys had was six. It is important to note that not all of these risk factors are directly associated with an increased risk of cesarean section delivery specifically. However, they are the characteristics associated with obstetric risk available in the DHS questions, and they enable us to describe the distribution of risk factors among women delivering vaginally and by cesarean section.

- *2014 Bangladesh DHS: Cesarean section indications.* In the 2014 Bangladesh DHS, women were asked additional questions on the circumstances around cesarean sections and the reasons for them. We classified cesarean sections according to the day of the week on which they occurred and the time of day (12 am–9 am, 9 am–6 pm, and 6 pm–12 am). The timing of the decision to perform

the cesarean section was classified into four categories (day of delivery, day before delivery, 2–7 days before delivery, and more than seven days before delivery). Women were further asked “What were the main reasons for making the decision to have the operation?” and could report multiple answers to this question. For each cesarean and vaginal delivery, length of stay was defined as the time interval between the delivery and when the woman left the facility. Short length of stay was defined as less than 24 hours for a vaginal delivery and less than 72 hours for cesarean sections, as in a previous analysis by Campbell et al. (2016).

Analysis

The DHS analysis sample was based on individual women’s records with nonmissing values in all three key variables: location of delivery, delivery attendant, and mode of delivery. Overall, fewer than 1% of the analysis sample had missing values in one or more of these variables. All estimates were generated in Stata SE 14 (College Station, Texas) using the *svy* command adjusting for survey design (weights, clustering, and stratification).

For Objective 1, we estimated, for each country, the overall cesarean section rate (percentage of all most recent live births occurring by cesarean section) and separately by area of residence (urban, rural) and the range of rates across the regions within each country. We also estimated cesarean section rates within facilities and by facility level and sector. To complete the picture, we provide the percentage of births that occurred in urban areas, facilities, nonpublic facilities, and hospitals.

In Objective 2, we estimated, by facility level and by ownership type, the percentage of cesarean sections in each country for which the highest level of provider reported by the woman was a) a doctor/NPC, b) another cadre of SBA, and c) a non-SBA, so that A+B+C totaled 100% of cesarean sections. Further, we estimated the percentage of cesarean sections conducted by an SBA that were not conducted by a doctor or NPC ($B/[A+B]$). These indicators were not estimated in cases where the within-stratum number of deliveries was fewer than 50 or the within-stratum number of cesarean sections was fewer than 30.

In Objective 3, we calculated how the percentage of cesarean sections provided to women with the various risk factors (and categories of risk factors) compared with the risk factor distribution among all women with deliveries. To compare the composition of both populations, we present, by risk factor, the ratio of cesarean births to all births. We excluded three DHS surveys from this analysis—Vietnam, due to the shorter recall period of survey; Sierra Leone, due to an inability to capture risk factor 9 (mode of delivery was only asked for women’s most recent birth), and the 2014 Bangladesh survey, for the same reason (instead, we used the 2011 Bangladesh survey).

Analysis methods for trends over time in multiple surveys in Bangladesh and Tanzania were the same as for Objective 1. For each survey round, we estimated the overall cesarean section rate and the cesarean section rate by residence (urban, rural), region, and household wealth quintile; the facility cesarean section rate; and within facilities, the cesarean section rate by ownership (public, nonpublic) and level (hospital, lower/mixed/unknown). Further, we calculated the estimated annual number of live births for the five-year period preceding each survey. This was calculated as the average annual number of live births and based on the crude birthrate for each five-year period³ and the mid-year population for each of the five years included.⁴ Based on these absolute numbers of

³ From data files downloaded at <https://esa.un.org/unpd/wpp/Download/Standard/Population/>, June 20, 2017.

⁴ From data files downloaded at <https://esa.un.org/unpd/wpp/Download/Standard/Population/>, June 20, 2017.

births, we estimated, for each survey's recall period, the annual average number of cesarean section procedures overall and the number and percentage of cesareans, by facility ownership. Time trends were expressed as simple percentage change between surveys.

- *2014 Bangladesh DHS: Cesarean section indications.* This analysis included all cesarean sections, as well as all vaginal deliveries in facilities for several analyses. We calculated the percentage of all cesareans occurring in each day/time period, for all facilities and separately for public and nonpublic facilities. We also described the timing of the decision to perform a cesarean, the person who first suggested the cesarean, whether the woman was told the reasons if the doctor first suggested it, and the number of reasons for cesareans that a woman reported. The mean length of stay was calculated, as well as the percentage of women reporting a short length of stay and the mean delivery cost separately among facility vaginal and cesarean deliveries. Further, we described the self-reported reasons for cesareans, according to the timing of the decision to perform a cesarean as well as the time of delivery, so as to examine the consistency between indications and timing. Lastly, we compared the percentage of women who had previously delivered by cesarean among all women delivering by cesarean, across facility level and ownership.

There were no missing data for most clinical questions, with the exception that 15 of the 1,086 women (1.4%) delivering by cesarean reported no reason for the cesarean. There were fewer than 2% missing data for the cost of delivery and length of stay among facility vaginal and cesarean section deliveries. Women with missing data for these variables were excluded from the relevant analyses.

SPA Tanzania

Data Source

SPAs are nationally representative surveys of health facilities of different types and sectors. As with the DHS, the SPA uses model questionnaires, which can be adapted for each country. These surveys collect information on facility infrastructure, providers, and the availability of drugs and equipment. Facilities are sampled from a master list of formal-sector facilities, to provide estimates that are representative by facility type and sector, as well as region. For our second country case study, we used data from the 2014–2015 Tanzania SPA to examine characteristics of facilities reporting to provide cesarean sections.

The Tanzania SPA survey included a number of components, such as:

- A core questionnaire collecting information on basic infrastructure and staffing from the facility manager or in-charge
- Sections on services (including delivery care and cesarean sections) that are asked only at facilities reporting that they provide these services
- A list of providers present on the day of the survey, including their qualifications and types of care provided

The 2014–2015 Tanzania SPA sampled 1,200 health facilities among all hospitals, health centers, dispensaries, and clinics in the country managed by the government, private for-profit organizations, FBOs, and parastatal entities. Unlike most SPAs, the Tanzania SPA collected information on the number of cesareans performed at each facility, allowing us to describe the characteristics both of facilities providing cesareans and of facilities where most cesareans are performed.

Population

We used three main samples for analysis:

1. All facilities surveyed in the SPA
2. All facilities reporting that they provide cesarean sections
3. All facilities reporting that they provide cesarean sections and with complete data on delivery volume

Definitions

Facility type

We grouped parastatal and governmental facilities together, and we grouped all hospitals (district, regional, and national) into a single category. The classification of facility type used in the analysis categorized hospitals and health centers according to the three sectors (government, private for-profit, and faith-based), and dispensaries and clinics from all sectors together.

Surgical delivery providers

Among providers present on the day of the survey, we defined surgical delivery providers as health providers who reported providing both surgical and delivery care. Surgical providers were defined as all those reporting to provide surgical care.

Figure 2 presents a subset of the questions from the section on cesarean delivery in the Tanzania SPA. These questions were only asked for facilities that reported providing cesarean sections. Further questions in this section report on the availability and functional status of some surgical equipment for cesareans: equipment for general anesthesia (anesthesia machine, tubing and connectors, oropharyngeal airway [adult], Magill forceps [adult], endotracheal tube, intubating stylet, oxygen concentrator), for advanced neonatal resuscitation (oropharyngeal airway [pediatric], Magill

Figure 2: Subset of questions in section on cesarean delivery, 2014–2015 Tanzania SPA

ASK TO BE SHOWN THE LOCATION IN THE FACILITY WHERE CESAREAN DELIVERY ARE DONE. FIND THE PERSON MOST KNOWLEDGEABLE ABOUT PROVISION OF SUCH SERVICES IN THE FACILITY. INTRODUCE YOURSELF, EXPLAIN THE PURPOSE OF THE SURVEY AND ASK THE FOLLOWING QUESTIONS.			
2501	Does the facility have a health worker who can perform Cesarean delivery present at the facility or on call 24 hours a day (including weekends and on public holidays)?	YES..... 1 NO..... 2	→ 2504
2502	Is there a duty schedule or call list for 24-hr staff assignment?	YES..... 1 24-HOUR DUTY SCHEDULE NOT MAINTAINED... 2	→ 2504
2503	May I see the duty schedule or call list for 24-HR staff assignment?	SCHEDULE OBSERVED..... 1 SCHEDULE REPORTED, NOT SEEN..... 2	
2504	Does this facility have an anesthetist present in the facility or on call 24 hours a day (including weekends and on public holidays?)	YES..... 1 NO..... 2	→ 2507
2505	Is there a duty schedule or call list?	YES..... 1 24-HOUR DUTY SCHEDULE NOT MAINTAINED... 2	→ 2507
2506	May I see the duty schedule or call list?	SCHEDULE OBSERVED..... 1 SCHEDULE REPORTED, NOT SEEN..... 2	
2507	Has Cesarean section been performed in this facility during the past 3 months?	YES..... 1 NO..... 2	→ 2510
2507A	How many C-sections were performed at this facility during the past 3 completed months?	# OF C-SECTIONS <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> DON'T KNOW..... .9998	

Note: Additional questions in this section relate to the availability of equipment for anesthesia and advanced neonatal resuscitation, as outlined above.

forceps [pediatric], endotracheal tube size 3.0–5.0), and for spinal anesthesia (spinal needle). However, no data were collected on the availability of operating tables, operating lights, cesarean surgical kits, or basic neonatal resuscitation equipment (such as bag and mask) (Manley et al., 2017).

Delivery volume and cesarean rate

Cesarean volume was reported for the last three completed months in the questionnaire section on cesarean delivery. Vaginal delivery volume was reported for the previous month in the questionnaire section on delivery care (among facilities reporting to provide delivery services). The total monthly delivery volume was calculated as the sum of monthly vaginal deliveries and of the number of cesareans in the last three months divided by three (estimated monthly cesarean volume). The facility cesarean rate was subsequently calculated as the monthly cesarean volume, divided by the total monthly delivery volume.

Comprehensive emergency obstetric care capacity

Facilities were classified as comprehensive emergency obstetric care (CEmOC) facilities if they had performed all nine CEmOC functions in the last three months (administration of parenteral antibiotics, uterotonics, and anticonvulsants; manual removal of the placenta; removal of retained products; assisted vaginal delivery; basic neonatal resuscitation; obstetric surgery including cesareans; and blood transfusion) (WHO, 2009), as reported in the questionnaire section on delivery care.

Availability of all general anesthesia equipment

Among the cesarean section equipment for which availability is examined, a number of items needed for general anesthesia are assessed (anesthesia machine, endotracheal tube, tubing for endotracheal tube, oropharyngeal airway, Magill forceps, intubating stylet, and oxygen concentrator). Facilities were classified as having all general anesthesia equipment available if all of these pieces of equipment were available and functional on the day of the survey.

The spinal needle is the only piece of equipment for spinal anesthesia for which data were collected.

Minimum readiness criteria

Similar to a recent study of the scale and capability of childbirth care (Campbell et al., 2016), we examined facilities' readiness to provide cesarean deliveries. Three minimum readiness criteria were used:

1. *Basic infrastructure:* Facilities were considered to meet the basic infrastructure criterion if they had both piped water into the facility and consistent electricity (either connected to the national grid, with no more than two-hour interruptions, or sometimes connected to the national grid, with a functional back-up generator with fuel).
2. *General anesthesia equipment:* The second minimum readiness criterion is having all general anesthesia equipment available.
3. *24-hour cesarean provider and anesthetist:* This criterion was defined as having an observed rota (schedule) for the 24-hour presence or on-call availability of these providers.

Analysis

First, we calculated the percentage of all facilities that reported providing cesarean sections, according to facility type. We described the number of maternity beds, number of cesarean sections, and percentage of all cesareans conducted by facility level. Among facilities with complete delivery data, we also described the monthly total delivery volume and facility cesarean rate.

Second, we described the staffing characteristics of facilities reporting that they provide cesareans. We calculated the median number of general doctors, specialist doctors, clinical officers, and anesthetists employed full-time or seconded to the facility, as well as the percentage of facilities without each of these health cadres. We then calculated the percentage of facilities with a 24-hour rota for cesarean providers and anesthetists and the percentage of facilities with both. The presence of surgical providers and surgical delivery providers on the day of the survey was determined for each facility and was compared with the presence of a 24-hour rota for cesarean providers.

Third, we described the availability of basic and surgical infrastructure (piped water, consistent electricity, blood transfusion services, and a dedicated cesarean theater) among facilities reporting to provide cesareans, as well as the availability of functional equipment for general and spinal anesthesia. These analyses were conducted for all facilities reporting to perform cesareans and according to facility type, and we further calculated the percentage of all cesareans in Tanzania that are performed at facilities with each of the above characteristics.

Fourth, we calculated the percentage of facilities that met the first minimum readiness criterion, the first and second minimum criteria, and all three minimum criteria. These were calculated according to facility type among all facilities reporting to provide cesareans, among CEmOC facilities, and among facilities performing at least three cesareans per month. We also calculated the percentage of all cesareans performed at facilities meeting these readiness criteria.

Lastly, we examined geographic differences in cesarean sections and facilities providing cesareans. We calculated the percentage of all births and cesarean sections in each of the nine zones in Tanzania and the percentage of hospitals and health centers reporting to provide cesareans. We calculated the percentage of facilities meeting each minimum readiness criterion and all three readiness criteria, as well as the percentage of all cesarean deliveries performed in such facilities.

All analyses were performed using Stata SE 14 (College Station, Texas), and all took into account facility weights.

Missing Data

Of the 1,200 facilities sampled in the SPA, 12 did not participate in the survey due to the manager's refusal or because they were closed, and therefore they had missing responses for whether they performed cesareans. These were excluded from the denominator for Population 1 (all facilities, N=1,188). Among the 271 facilities reporting that they provide cesareans, seven (2.5%) had missing information on the volume of cesarean deliveries, and 42 (16%) had missing information on the volume of vaginal deliveries. Facilities with missing data for these variables were excluded from the relevant analyses. There were no missing data for basic or surgical infrastructure and equipment or for staffing.

Ethics

The DHS and SPA received government permission and followed ethical practices, including informed consent and assurance of confidentiality. The Research Ethics Committee of the London School of Hygiene & Tropical Medicine approved our secondary data analysis.

A. Multicountry DHS analysis

Key Messages

- National cesarean section rates ranged widely, from 1.5% in Chad to 33.8% in the Maldives.
- Cesarean section rates for urban populations were higher than for rural populations in all countries.
- In most of these 44 countries, cesarean section rates were higher in nonpublic facilities than in public facilities.
- Countries varied widely in the percentage of cesareans assisted by a nondoctor SBA, and this phenomenon was more common in Sub-Saharan African countries (and particularly at public-sector facilities) than in South and Southeast Asia.
- We assessed the profiles of women using nine factors as proxies for higher risk of maternal and newborn complications available in the DHS. Women with exactly one risk factor were overrepresented among those receiving cesarean sections, compared with the underlying population of all births. This seemed to be driven particularly by primiparity. Conversely, women with 3–6 risk factors, and especially grand multiparae and those who received no antenatal care, were underrepresented among those delivering by cesarean section, compared with all births.

AI. Where Do Cesarean Sections Occur?

We estimated cesarean section rates for each country, and within countries, by area of residence, facility ownership, and facility level. Table 2 (page 28) shows that national cesarean section rates ranged widely, from 1.5% in Chad to 33.8% in the Maldives. Cesarean section rates for urban populations were higher than for rural populations in all countries; the narrowest urban-rural ratio was in Swaziland (1.1) and the widest was in Ethiopia (19.2), as shown in Figure 3 (page 29).

The countries in this analysis represent different models of delivery care provision, based on the proportion of births in facilities and the sectors and levels of those facilities. The percentage of births occurring in facilities ranged from 12.1% in Ethiopia to 97.2% in the Maldives, with a median across the countries of 66.4%. In none of the Sub-Saharan African countries did nonpublic facilities provide more than half of facility deliveries (highest in Nigeria 37% and Swaziland 43%); some countries had negligible nonpublic provision (e.g., less than 1% in Sao Tome and Principe, 2% in Burkina Faso). On the other hand, in four of the 10 South and Southeast Asian countries (Bangladesh, India, Indonesia, and Pakistan), provision of cesarean section was predominantly (>50%) in nonpublic facilities. Figure 4 (page 30) shows a comparison in the cesarean section rates of public versus nonpublic facilities: In most of the 44 countries, cesarean rates were higher in nonpublic facilities than in public facilities (a median ratio of nonpublic to public of 1.5); Namibia had the largest gap between the sectors (3.6 times higher in nonpublic facilities). Bangladesh had the highest ratio in Asia (two times higher).

Table 2: Cesarean section rates and other delivery-related measures, by country

	Over all c-sec. rate	% of all births in urban	Cesarean section rate by				% of births in facilities	Facility c-sec. rate	% of facility deliveries in non-public facilities	Cesarean section rate by facility ownership		% of facility deliveries in hospitals	Cesarean section rate by facility level		Sample size of most recent births*
			Residence		Within country region					Public	Non-pub.		Hosp.	Lower	
Sub-Saharan Africa			Urban	Rural	Min	Max									
Benin	6.2	40.8	8.8	4.4	2.0	13.9	88.0	7.1	14.1	6.4	10.8	42.4	8.8	5.8	8,964
Burkina Faso	2.3	19.1	6.8	1.2	0.3	8.9	72.4	3.1	2.0	3.0	7.9	61.5	3.8	2.0	10,466
Burundi	4.8	8.7	13.8	3.9	3.3	14.5	67.4	7.1	14.8	7.4	5.4	30.4	17.7	2.5	5,046
Cameroon	4.7	45.4	8.3	1.8	0.8	12.9	65.6	7.2	35.9	6.7	8.1	45.5	9.2	5.6	7,615
Chad	1.5	19.9	4.3	0.8	0.0	7.3	23.6	6.3	6.2	6.3	5.8	39.0	9.5	4.3	11,100
Comoros	11.2	29.1	15.0	9.6	7.1	12.0	79.1	14.2	3.4	13.4	35.5	48.8	19.5	9.1	2,056
Congo-Brazzaville	6.6	64.0	8.6	3.0	0.9	9.9	92.5	7.2	12.9	7.7	3.3	64.7	9.8	2.3	5,726
Côte d'Ivoire	3.2	39.9	5.9	1.4	1.2	7.9	61.0	5.3	9.9	5.1	7.1	33.0	8.0	3.9	5,219
Dem. Rep. of Congo	5.8	31.7	8.2	4.8	2.2	14.6	81.7	7.1	19.9	7.6	5.1	21.2	19.7	3.8	11,030
Ethiopia	1.8	15.0	9.4	0.5	0.5	20.4	12.1	15.1	14.7	14.8	16.6	38.4	27.8	7.1	7,903
Gabon	11.1	85.9	11.8	6.8	3.4	15.0	93.9	11.9	26.4	8.9	20.0	62.6	9.5	15.7	3,659
Gambia	2.5	49.8	3.5	1.5	0.7	12.7	65.4	3.7	9.6	3.6	5.3	28.0	8.5	1.9	5,289
Ghana	13.6	46.2	19.4	8.6	3.6	22.5	75.6	18.0	12.0	17.7	20.1	60.6	22.9	10.4	4,141
Guinea	2.8	28.2	6.3	1.4	0.8	8.7	42.1	6.6	12.8	6.4	7.8	24.2	15.6	3.7	4,975
Kenya	9.7	38.5	15.2	6.2	2.7	20.2	67.2	14.4	27.2	12.5	19.4	63.1	19.1	6.2	14,405
Lesotho	10.3	29.1	13.3	9.1	3.5	13.6	79.1	13.0	24.7	11.5	17.8	71.9	14.8	8.6	2,572
Liberia	4.3	53.6	5.7	2.7	2.3	5.3	60.7	7.1	23.3	7.1	7.0	40.9	11.3	4.1	4,761
Madagascar	1.7	12.4	6.1	1.1	0.0	5.0	38.1	4.5	9.6	4.3	6.9	18.1	14.6	2.3	8,640
Malawi	5.1	15.4	9.1	4.4	5.1	5.4	78.6	6.5	24.5	6.7	5.9	39.6	13.3	2.1	13,642
Mali	3.2	20.7	7.8	2.0	1.3	8.3	59.5	5.4	7.4	5.5	3.3	16.8	14.2	3.6	6,773
Mozambique	4.7	29.3	10.0	2.5	1.4	13.7	62.1	7.6	4.3	7.4	11.8	35.2	12.2	5.1	7,476
Namibia	15.5	51.3	21.8	8.9	7.5	26.9	89.4	17.3	6.6	14.8	53.5	88.3	15.5	31.2	3,826
Niger	1.7	14.0	6.2	0.9	0.4	10.4	33.4	5.0	2.7	4.8	10.5	19.4	20.6	1.2	7,929
Nigeria	2.4	35.3	4.6	1.2	0.7	5.3	37.2	6.5	35.8	5.7	7.8	39.8	8.2	5.3	20,222
Rwanda	13.1	16.9	21.7	11.3	9.0	20.0	92.3	14.2	2.5	14.1	19.1	29.5	45.9	0.9	6,055
Sao Tome & Principe	5.6	49.6	7.0	4.1	2.1	6.1	81.3	6.8	0.8	6.9	.	88.0	7.5	2.0	1,369
Senegal	5.8	38.7	8.5	4.1	3.5	7.4	77.6	7.5	6.7	7.6	6.1	9.1	37.8	4.5	4,299
Sierra Leone	4.1	27.7	6.4	3.2	2.1	7.6	57.1	7.2	4.3	6.7	18.5	23.0	12.0	5.7	8,599
Swaziland	8.2	23.2	8.7	8.1	7.5	9.0	75.9	10.8	43.0	9.7	12.3	83.0	11.0	10.1	2,126
Tanzania	7.0	30.0	12.6	4.5	1.2	17.7	67.9	10.3	22.0	8.4	16.9	50.6	17.9	2.5	7,079
Togo	7.4	37.4	13.1	4.0	4.0	13.7	75.1	9.9	16.1	10.6	6.0	29.3	24.8	3.7	4,835
Uganda	6.1	16.2	14.3	4.6	1.6	17.9	61.1	10.0	25.1	10.0	10.2	29.3	18.3	6.6	4,965
Zambia	5.2	37.9	8.0	3.5	3.2	8.1	73.0	7.1	8.3	6.7	11.4	32.6	15.9	2.9	9,312
Zimbabwe	6.1	32.8	10.9	3.7	2.8	15.3	82.3	7.4	18.1	6.3	12.4	51.3	10.9	3.7	4,984
South/Southeast Asia															
Bangladesh (A—2011)	15.1	23.3	26.7	11.6	10.1	23.4	26.5	57.1	58.8	41.3	68.2	26.8	50.6	59.5	7,332
Bangladesh (B—2014)	24.4	26.1	40.3	18.8	12.1	34.5	38.6	63.1	66.2	38.9	75.5	16.3	52.7	65.1	4,596
Cambodia	3.2	16.3	8.6	2.2	1.0	9.8	57.3	5.7	18.7	4.8	9.1	31.1	11.5	3.0	6,462
India	9.8	26.8	18.7	6.5	2.6	31.0	41.6	23.5	54.4	16.1	29.7	43.8	16.2	29.1	39,636
Indonesia	12.8	49.7	17.1	8.4	4.1	27.0	64.7	19.7	72.7	25.6	17.5	17.8	37.5	15.9	14,664
Maldives	33.8	30.1	38.8	31.6	21.3	39.2	97.2	34.7	12.1	34.0	40.1	80.1	36.9	25.9	3,177
Nepal	5.2	10.1	16.6	4.0	1.6	6.5	40.2	13.0	29.4	9.4	21.6	54.9	11.8	14.4	4,148
Pakistan	8.5	30.3	14.2	6.1	1.6	10.6	37.2	23.0	69.0	22.0	23.4	28.6	22.8	23.0	5,643
Philippines	11.5	49.6	16.5	6.5	3.4	19.0	46.5	24.7	40.1	19.7	32.2	52.1	22.6	26.9	4,561
Timor-Leste	2.2	24.7	4.7	1.4	0.0	5.8	25.2	8.8	2.6	9.0	.	70.5	10.6	4.4	6,015
Vietnam	10.1	18.1	23.8	7.0	3.6	16.6	79.7	12.7	4.8	13.2	1.8	33.1	26.6	5.7	1,213
MIN	1.5	8.7	3.5	0.5	0.0	5.0	12.1	3.1	0.8	3.0	1.8	9.1	3.8	0.9	
MAX	33.8	85.9	40.3	31.6	21.3	39.2	97.2	63.1	72.7	41.3	75.5	88.3	52.7	65.1	
MEDIAN	5.8	29.3	9.4	4.1	2.2	12.9	65.6	7.6	14.7	7.7	11.4	39.0	15.5	5.1	

Figure 3: National (bars), urban (upper error bar), and rural (lower error bar) cesarean section rates, by country

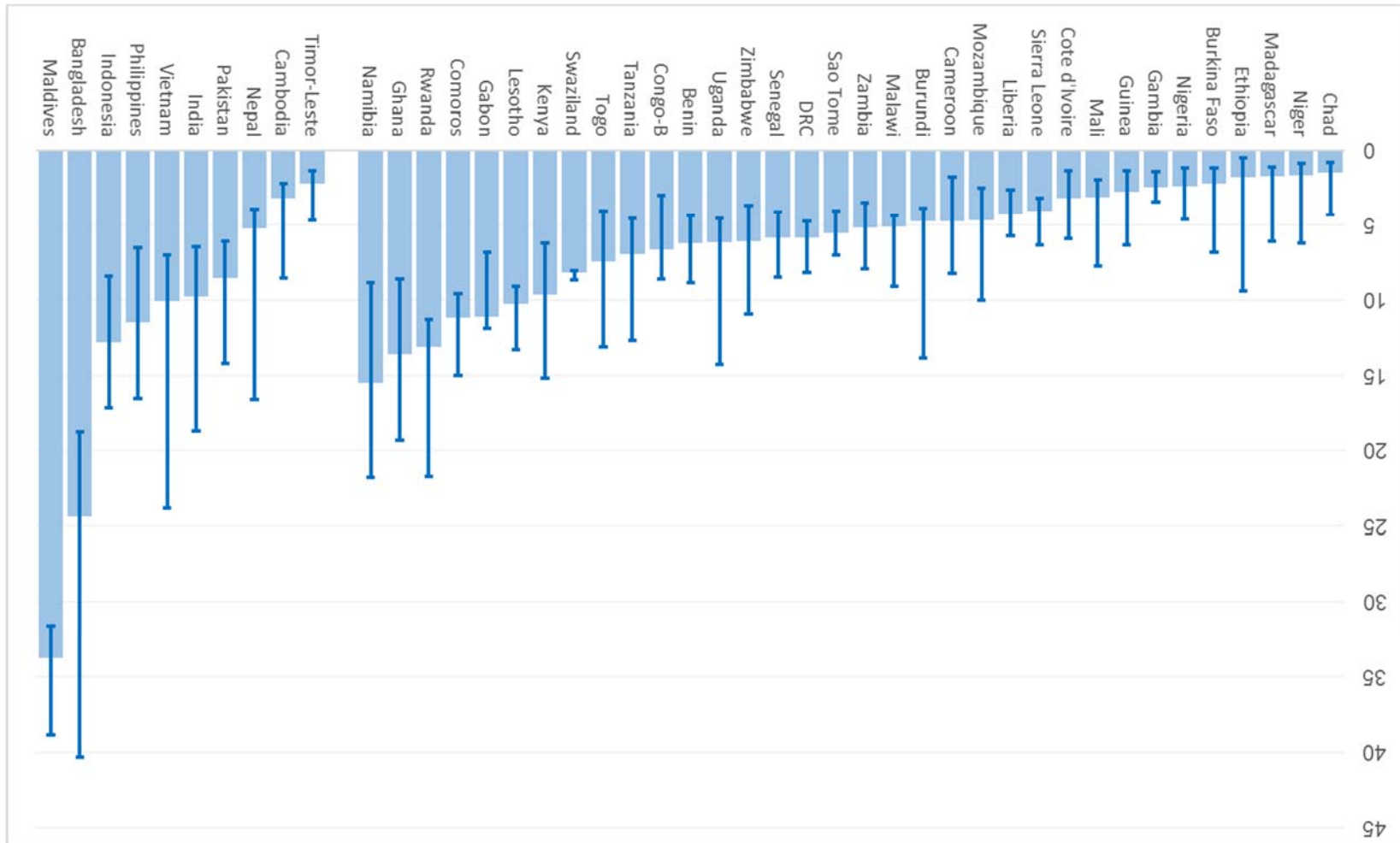
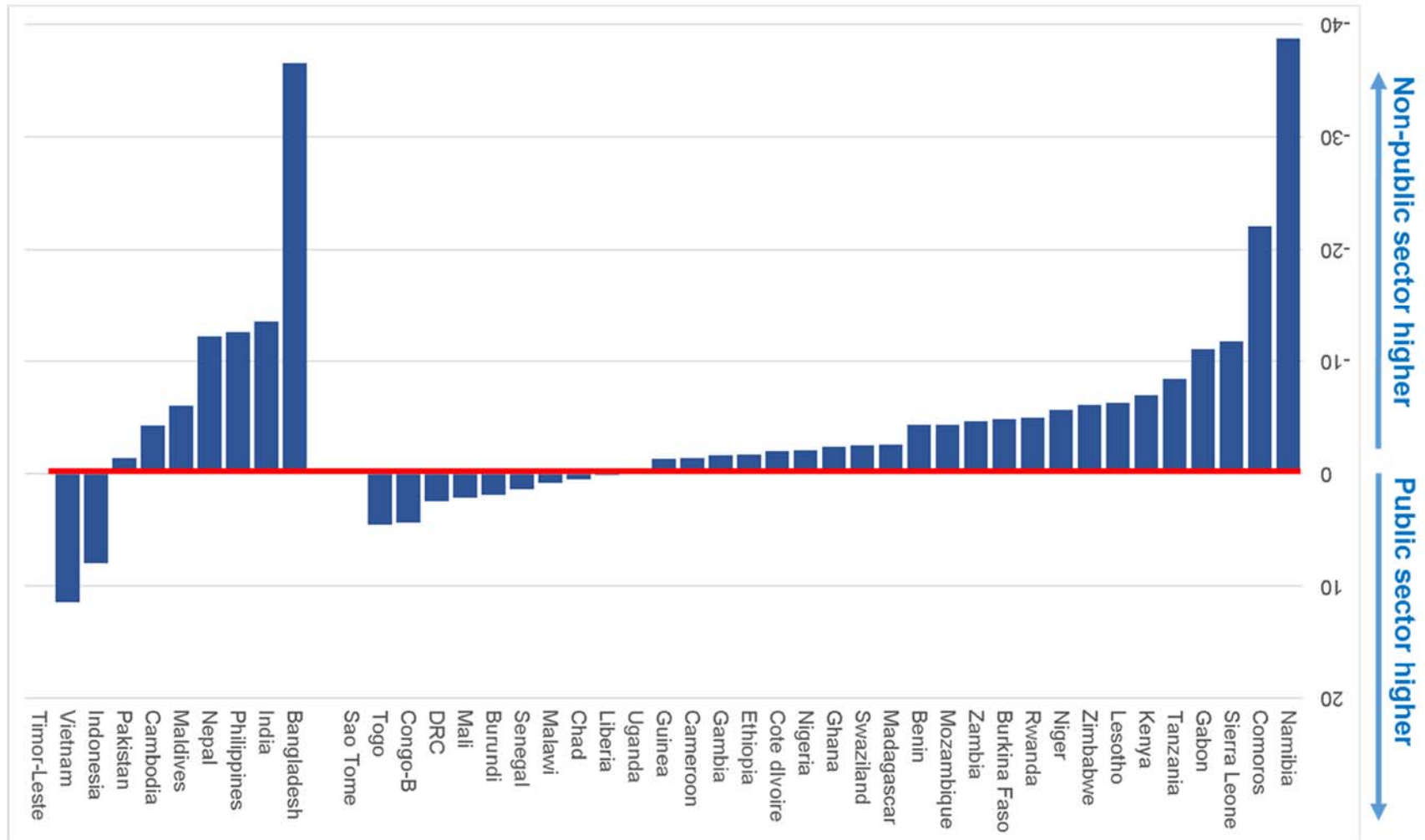


Figure 4: Absolute percentage-point difference between cesarean section rates at public versus nonpublic facilities, by country



A2. Who Performs Cesarean Sections?

We categorized the person with the highest level of medical training from women's potentially multiple responses about who assisted with their delivery into: doctor/NPC (which includes the cadres of medical or clinical officer, as response options were conflated), nondoctor SBA, and all non-SBAs (lower level medical professionals, traditional birth attendants, and relatives). As shown in Figure 5 (page 32), the percentage of women with a cesarean section who reported that the highest cadre assisting their delivery was not an SBA was minimal (median in 44 countries: 0.4%) and most likely represented recall error. However, relatively high levels were seen in Chad and Gambia (4%) and in Senegal (10%). Countries varied widely in the percentage of cesareans assisted by a non-doctor SBA. All countries in South and Southeast Asia had levels of 20% or below, except for Cambodia (37%) and Timor-Leste (49%). In Sub-Saharan Africa, Rwanda had the lowest level (7%), but 28 of the 34 countries there had levels above 20%, and six were higher than 50%. Burkina Faso and Mali had the highest levels, at 70%.

We had sufficient sample size to compare percentages of cesareans with a non-doctor SBA by facility ownership in 28 of the 44 countries (Table 3, page 33). In Sub-Saharan Africa, 18 of the 20 countries with data had a higher percentage of non-doctor SBA cesareans in public facilities than in nonpublic facilities; the widest difference was in Namibia, with 39% in public facilities but only 3% in nonpublic facilities. In South and Southeast Asia, four countries had higher percentages in public facilities (with India having the widest difference between public and nonpublic facilities, at 7% vs. 3%), and four had higher proportions in nonpublic facilities (with the widest difference in Indonesia, at 10% public vs. 23% nonpublic).

A3. Who Delivers by Cesarean Section?

The purpose of this analysis was to compare the risk profile of women who delivered by cesarean sections to all women that had live births, in order to understand whether women with higher risk were more likely to have delivered by cesarean. We assessed the profiles of women using the nine risk factors described above. The maximum possible number of risk factors for a single woman is seven; the maximum seen in the data was six. We compared risk profiles between all women with live births, those who delivered in facilities, and those who had a cesarean delivery.⁵

Across the 44 countries, the most common risk factors among all women with a live birth were: first-order birth (median across countries, 22%), grand multiparity (20%), and woman's age ≥ 35 . The median percentage of women with one or more risk factors was 56%, ranging from 46% (Malawi) to 79% (Ethiopia), as shown in Table 4 (page 34). Women delivering by cesarean section were equally or more likely to have had one or more risk factors compared to all women with births (medians across countries, 71% and 56%, respectively) (Table 5, page 35).

⁵ It is important to note that not all of these risk factors are directly associated with an increased risk of cesarean section delivery specifically. However, they are the characteristics associated with obstetric risk available in the DHS questions, and they enable us to describe the distribution of risk factors among women delivering vaginally and by cesarean section.

Figure 5: Percentage distribution of cesarean section deliveries, by category of highest level of health professional assisting with procedure, according to country

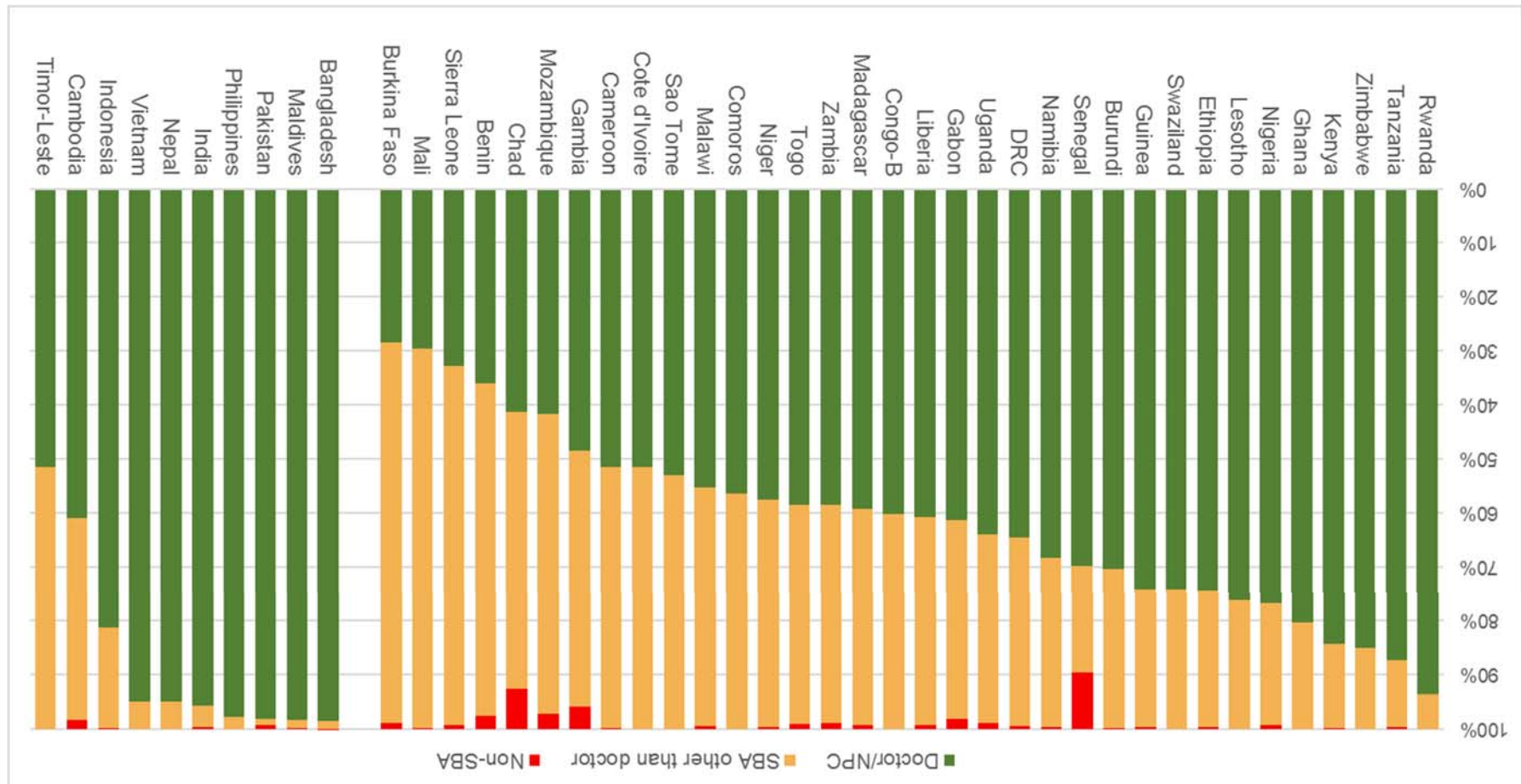


Table 4: Percentage of most recent live births with selected risk factors, and percentage distribution of most recent live births, by number of risk factors, all according to country

	By risk factor									By number of risk factors				
	Woman aged <16	Woman aged 35+	First-order birth	Order ≥6 birth	Short birth interval	Multiples	No ANC	Preceding neonatal death	Previous cesarean (in recall)	None	1	2	3-6	Any risk factor
Sub-Saharan Africa														
Benin	1.2	16.4	19.2	17.1	0.8	2.6	11.5	0.9	1.4	46.6	37.9	13.4	2.2	53.4
Burkina Faso	1.1	19.9	17.1	26.7	0.2	2.3	4.9	1.8	0.3	48.0	32.0	18.0	2.0	52.0
Burundi	0.4	24.9	18.7	25.5	1.3	1.4	1.1	2.1	1.3	46.1	32.6	20.0	1.3	53.9
Cameroon	2.8	15.1	22.2	21.9	1.7	2.3	14.5	1.9	0.9	40.6	39.2	16.9	3.3	59.4
Chad	3.3	16.6	14.3	35.5	2.1	1.7	35.5	2.4	0.6	28.8	39.3	23.7	8.2	71.2
Comoros	1.6	21.3	20.5	22.3	1.7	2.2	6.8	1.0	3.3	41.7	38.5	17.6	2.2	58.4
Congo-Brazza	3.5	16.5	25.0	12.8	1.0	2.2	6.7	1.0	1.2	47.6	37.1	13.3	2.0	52.4
Côte d'Ivoire	2.8	17.1	21.9	19.7	1.2	2.7	7.6	2.0	0.6	45.7	35.8	16.2	2.4	54.3
Dem. Rep. Congo	2.1	19.3	18.8	26.6	1.9	2.3	10.0	1.7	2.1	41.2	36.8	18.2	3.8	58.8
Ethiopia	1.2	18.2	17.8	28.2	1.4	1.2	57.1	1.9	0.3	20.6	43.6	24.0	11.8	79.4
Gabon	3.8	15.7	28.9	13.9	1.0	2.5	4.2	0.9	2.0	44.7	39.2	14.8	1.3	55.3
Gambia	1.6	18.6	21.0	22.6	0.7	1.9	0.7	1.4	0.3	48.1	35.8	15.2	0.9	51.9
Ghana	1.2	23.6	23.0	15.0	0.3	2.6	2.6	1.8	3.0	44.5	40.0	13.8	1.8	55.5
Guinea	4.5	18.0	21.1	22.9	0.4	2.4	12.9	1.8	0.5	42.7	34.5	18.8	4.0	57.3
Kenya	1.6	14.6	25.4	15.2	1.0	1.7	3.9	1.1	1.6	48.3	38.8	11.5	1.4	51.7
Lesotho	1.8	12.9	38.0	6.0	0.3	1.4	4.6	1.4	1.1	42.7	48.2	8.2	0.9	57.3
Liberia	3.3	17.6	24.4	19.3	0.6	2.1	2.4	1.1	0.6	46.8	36.5	15.5	1.3	53.2
Madagascar	4.0	19.0	21.5	22.3	0.9	1.1	9.1	1.3	0.3	43.8	35.3	18.7	2.3	56.2
Malawi	1.7	15.1	18.5	20.2	0.9	2.4	1.6	1.6	1.2	53.6	30.9	14.4	1.2	46.4
Mali	3.7	16.5	16.8	23.3	1.6	1.7	25.0	1.9	0.8	38.3	37.0	20.2	4.5	61.7
Mozambique	3.1	18.0	21.7	21.2	1.0	2.0	9.4	1.7	1.2	44.6	34.8	17.3	3.3	55.4
Namibia	1.8	17.5	33.4	9.1	0.4	1.4	3.1	0.8	2.2	42.6	46.0	10.6	0.8	57.4
Niger	1.9	19.3	12.7	36.7	1.2	2.0	14.5	1.7	0.5	39.3	35.6	20.8	4.3	60.7
Nigeria	2.1	20.2	18.1	26.8	0.9	1.9	34.4	2.1	0.6	30.7	39.9	21.4	8.0	69.3
Rwanda	0.5	19.9	27.4	14.6	0.9	1.6	0.8	0.9	3.0	45.2	41.0	13.0	0.8	54.8
Sao Tome and Principe	1.9	20.8	20.3	15.8	0.6	2.5	1.0	0.7	1.1	51.4	33.7	13.9	1.0	48.6
Senegal	1.7	21.0	20.6	21.3	0.7	2.2	3.3	1.0	0.6	47.7	34.1	16.5	1.7	52.4
Sierra Leone*	3.4	18.9	21.1	21.0	0.7	2.2	1.8	1.7	--	48.2	34.3	16.3	1.2	51.8
Swaziland	2.6	14.0	30.8	14.0	0.5	1.4	2.7	1.0	1.7	46.0	40.6	12.4	1.1	54.0
Tanzania	1.6	19.3	24.7	20.3	0.8	2.0	2.0	1.2	1.0	45.4	37.6	15.8	1.2	54.6
Togo	1.2	20.5	23.2	18.3	0.6	3.0	7.2	1.2	1.1	43.9	39.0	14.2	2.9	56.1
Uganda	1.2	18.5	15.6	31.9	1.6	1.9	4.2	1.6	2.1	44.2	35.4	18.1	2.3	55.8
Zambia	2.2	18.1	20.2	23.7	0.6	1.8	1.4	1.3	0.9	49.0	33.0	16.9	1.1	51.0
Zimbabwe	1.8	14.8	24.2	7.9	0.8	2.0	6.5	1.5	0.9	51.5	38.3	8.8	1.4	48.5
South/Southeast Asia														
Bangladesh 2011	5.9	5.6	33.7	4.9	1.0	0.9	35.5	1.6	1.4	32.5	48.6	15.0	4.0	67.5
Bangladesh 2014*	6.4	4.4	40.1	3.4	0.9	0.6	21.5	0.9	--	39.4	45.2	13.3	2.1	60.6
Cambodia	0.3	16.7	31.0	8.6	0.5	0.9	10.2	1.3	0.4	44.0	44.3	9.6	2.1	56.0
India	1.6	5.8	26.6	10.2	1.6	0.9	22.8	2.3	2.1	42.9	43.3	10.9	2.9	57.1
Indonesia	0.5	18.0	37.8	3.6	0.5	0.8	2.8	0.8	1.2	41.0	52.5	5.8	0.6	59.0
Maldives	0.1	13.7	39.9	7.6	0.2	0.7	0.3	0.3	3.9	40.7	52.3	6.7	0.3	59.3
Nepal	1.4	8.6	31.6	8.1	1.3	0.7	15.2	1.9	0.7	45.1	43.3	8.6	2.9	54.9
Pakistan	0.8	17.4	17.3	24.7	3.6	1.1	35.0	2.6	2.6	30.4	42.5	19.5	7.7	69.7
Philippines	0.9	20.3	28.2	12.7	2.5	0.7	3.8	0.8	1.4	43.2	43.7	11.8	1.3	56.8
Timor-Leste	0.3	30.0	14.2	31.6	1.1	1.0	12.5	1.4	0.5	39.5	33.8	21.7	5.0	60.5
Vietnam	0.4	9.0	41.1	2.1	0.6	0.7	12.8	0.7	0.5	42.1	49.8	6.5	1.7	58.0
MIN	0.1	4.4	12.7	2.1	0.2	0.6	0.3	0.3	0.3	20.6	30.9	5.8	0.3	46.4
MAX	6.4	30.0	41.1	36.7	3.6	3.0	57.1	2.6	3.9	53.6	52.5	24.0	11.8	79.4
MEDIAN	1.7	18.0	21.9	19.7	0.9	1.9	6.7	1.4	1.1	44.0	38.5	15.2	2.0	56.0

*The Sierra Leone and Bangladesh 2014 surveys only asked about cesarean sections for the most recent birth in the recall period and therefore did not capture one of the nine risk factors

Table 5: Percentage of cesarean sections with selected risk factors, and percentage distribution of cesarean sections, by number of risk factors, all according to country

	By risk factor									By number of risk factors				
	Woman age <16	Woman age 35+	First-order birth	Order ≥6 birth	Short birth interval	Multiples	No ANC	Preceding neonatal death	Previous cesarean (in recall)	None	1	2	3–6	Any risk factor
Sub-Saharan Africa														
Benin	1.8	18.9	28.8	11.1	0.6	4.5	3.3	1.6	9.5	36.6	49.1	12.3	2.0	63.4
Burkina Faso	0.0	19.4	27.9	18.7	0.0	8.3	0.8	1.5	7.6	35.8	45.4	17.6	1.2	64.2
Burundi	0.7	24.1	34.5	16.8	1.9	2.9	0.0	1.9	17.0	24.5	53.7	20.1	1.7	75.5
Cameroon	3.0	18.9	37.8	10.3	1.0	2.3	0.4	1.8	12.7	26.6	59.4	13.3	0.7	73.4
Chad	7.6	25.0	29.3	26.3	4.7	6.6	5.8	2.6	15.1	26.1	36.2	26.4	11.3	73.9
Comoros	0.0	21.0	41.9	6.7	2.2	1.3	3.4	1.4	18.5	19.7	65.4	13.5	1.4	80.3
Congo-Brazzaville	4.0	22.9	33.9	9.7	0.8	3.6	0.4	1.1	11.4	31.6	51.0	15.7	1.8	68.4
Côte d'Ivoire	1.6	23.7	37.6	8.4	3.5	5.8	0.3	2.7	6.9	31.7	47.6	19.7	1.0	68.3
Dem. Rep. of Congo	3.9	17.3	27.9	21.3	1.0	6.8	4.0	2.5	18.2	27.0	48.1	20.4	4.6	73.1
Ethiopia	0.8	14.9	54.5	5.7	0.1	1.6	6.5	2.3	4.4	21.2	68.8	8.3	1.8	78.9
Gabon	2.8	16.1	37.4	10.1	0.4	3.8	2.9	0.6	11.1	32.7	50.9	15.4	1.1	67.4
Gambia	1.3	24.7	36.2	20.5	1.4	7.4	0.0	2.4	6.4	26.5	49.1	22.1	2.3	73.5
Ghana	0.2	31.7	33.3	9.7	0.3	5.7	0.6	3.3	14.1	26.0	53.5	17.2	3.3	74.0
Guinea	1.7	23.3	36.8	24.2	0.0	5.9	4.2	0.5	8.2	26.3	48.0	20.3	5.4	73.7
Kenya	0.6	16.1	38.6	6.5	0.5	4.6	0.6	0.9	9.9	33.9	55.1	9.8	1.2	66.1
Lesotho	4.7	16.1	54.6	4.9	0.6	3.1	2.5	1.6	6.4	20.4	65.1	14.3	0.3	79.6
Liberia	2.1	19.5	29.6	14.8	0.0	8.2	2.4	2.5	6.4	34.9	46.0	18.2	0.9	65.1
Madagascar	1.5	19.3	49.7	6.2	0.0	3.3	0.0	0.0	6.4	24.3	64.9	10.8	0.0	75.7
Malawi	2.0	11.5	39.2	12.2	0.5	3.8	0.2	1.2	10.0	34.6	51.4	13.0	1.0	65.4
Mali	7.1	19.0	23.4	22.7	0.7	3.3	6.4	2.7	9.7	37.0	34.6	24.8	3.6	63.0
Mozambique	3.3	15.5	33.8	10.7	0.8	4.0	1.0	1.2	10.6	35.8	49.3	12.9	2.0	64.2
Namibia	1.2	16.7	44.2	2.7	0.3	1.8	2.8	0.2	11.9	29.5	60.6	8.9	1.0	70.5
Niger	0.5	23.7	30.1	28.4	0.8	11.8	3.4	3.5	9.2	25.9	42.7	25.7	5.8	74.1
Nigeria	0.9	24.2	34.0	10.8	0.2	6.8	5.8	2.5	12.7	27.0	52.1	17.1	3.8	73.0
Rwanda	0.0	16.5	39.9	7.4	1.0	4.8	0.5	0.8	19.0	26.1	59.6	13.2	1.2	73.9
Sao Tome and Principe	3.3	22.6	19.1	9.3	1.7	2.5	0.0	1.3	16.1	42.2	43.4	12.1	2.2	57.8
Senegal	2.5	21.1	34.3	9.3	1.7	6.5	0.2	0.3	6.0	35.1	50.3	12.4	2.3	64.9
Sierra Leone*	3.0	19.8	25.7	18.2	1.6	5.3	0.4	3.6	--	42.2	40.1	15.8	2.0	57.8
Swaziland	2.4	19.1	41.8	12.0	0.5	3.0	2.1	1.1	10.1	27.3	57.1	12.5	3.1	72.7
Tanzania	2.2	19.0	37.2	10.0	0.0	6.0	2.1	2.2	8.9	29.2	55.1	14.5	1.2	70.8
Togo	1.2	22.8	42.2	10.0	0.7	6.1	0.4	2.0	10.2	25.1	56.3	16.8	1.9	74.9
Uganda	1.4	15.4	29.7	17.2	2.1	4.1	1.3	1.2	18.4	33.4	46.7	15.7	4.2	66.7
Zambia	3.5	15.2	36.0	12.4	0.2	3.7	0.4	1.9	9.2	35.0	49.7	13.3	2.0	65.0
Zimbabwe	1.9	20.9	31.7	2.6	0.3	7.6	1.6	3.2	11.3	33.6	54.6	10.2	1.7	66.4
South/SE Asia														
Bangladesh 2011	3.5	4.1	50.6	0.6	0.7	2.1	9.4	2.4	7.7	31.8	56.7	10.1	1.4	68.2
Bangladesh 2014*	5.8	3.9	52.6	0.6	0.1	1.0	4.0	0.5	--	41.5	49.0	9.0	0.5	58.5
Cambodia	0.0	19.9	47.8	4.2	0.6	3.6	1.1	2.5	7.0	26.0	61.7	12.2	0.2	74.0
India	1.1	4.4	48.8	1.4	0.8	1.6	1.9	1.6	14.0	30.4	64.0	5.3	0.3	69.6
Indonesia	0.4	21.9	43.6	1.5	0.3	1.4	0.4	0.7	7.8	29.9	62.7	7.1	0.2	70.1
Maldives	0.1	12.6	48.2	5.4	0.2	1.0	0.3	0.4	10.0	29.4	63.5	6.7	0.4	70.6
Nepal	0.2	9.0	51.2	0.0	0.0	0.9	2.6	0.0	10.0	28.2	69.7	2.1	0.0	71.8
Pakistan	0.3	11.6	33.3	8.7	2.6	3.8	6.7	3.0	23.4	25.7	58.5	13.1	2.7	74.3
Philippines	0.5	25.2	39.2	2.3	2.4	2.2	0.7	1.8	10.4	28.5	58.4	12.9	0.2	71.5
Timor-Leste	1.2	28.9	33.3	20.1	1.5	4.1	0.6	2.9	13.6	23.5	52.0	20.1	4.4	76.5
Vietnam	0.0	21.4	56.5	0.0	0.0	1.3	9.3	3.2	3.4	21.8	64.5	10.4	3.3	78.2
MIN	0.0	3.9	19.1	0.0	0.0	0.9	0.0	0.0	3.4	19.7	34.6	2.1	0.0	57.8
MAX	7.6	31.7	56.5	28.4	4.7	11.8	9.4	3.6	23.4	42.2	69.7	26.4	11.3	80.3
MEDIAN	1.5	19.3	37.2	9.7	0.6	3.8	1.3	1.8	10.0	29.2	53.5	13.3	1.7	70.8

*The Sierra Leone and Bangladesh 2014 surveys only asked about cesarean sections for the most recent birth in the recall period and therefore did not capture one of the nine risk factors

Table 6 (page 37) shows the ratios of risk factor prevalence, comparing cesarean section deliveries with all births. A higher ratio of cesarean section versus all births means that women with a particular risk factor are more prevalent among births by cesarean section than in the underlying population of all births—or, in other words, their likelihood of having had a cesarean section was higher than average. The highest median ratios were seen for three risk factors: cesarean section in the recall period (9.2), multiples (2.2), and primiparity (1.5); of these, only primiparity is a relatively common risk factor. Conversely, the lowest median ratios (lower than 1.0, meaning they were underrepresented among cesarean section births) were seen among women with no antenatal care (0.2) and grand multiparae (0.5). These are likely to be the women who are marginalized in other ways, including rural residence and poverty. For example, in Cameroon, 73.4% of cesarean section births were to women with one or more risk factors, higher than the proportion of all live births with one or more risk factors (59.4%). However, women with three or more risk factors were underrepresented in the population of cesarean sections (<1% of cesarean sections, compared with 3.5% of all births).

Broadly, women with exactly one risk factor were overrepresented, and women with two or 3–6 risk factors were underrepresented among cesarean sections, compared with the underlying population of all births. This seems to be driven particularly by primiparity, a common risk factor. While primiparae are more likely to experience complications indicating a cesarean delivery (Hernández-Díaz, Toh, & Cnattingius, 2009; Myles & Santolaya, 2003), these results echo other findings that differences in cesarean rates among nullipara, term, cephalic, singleton deliveries account for much of the overall cesarean rate differences between health facilities in high-income countries. Trends among nulliparous women are particularly important, given that women with previous cesareans often require a cesarean at the next delivery, especially in contexts where trial of labor after cesarean is rare or unsafe, thereby setting women on a trajectory of repeat cesareans throughout their reproductive life.

Table 6: Ratios of risk factor prevalence comparing cesarean section births to all births

	By risk factor									By number of risk factors				
	Woman age <16	Woman age 35+	1st-order birth	Order ≥6 birth	Short birth interval	Multiples	No ANC	Preceding neonatal death	Previous cesarean (in recall)	None	1	2	3-6	Any risk factor
Sub-Saharan Africa														
Benin	1.5	1.2	1.5	0.6	0.8	1.7	0.3	1.7	6.7	0.8	1.3	0.9	0.9	1.2
Burkina Faso	0.0	1.0	1.6	0.7	0.0	3.6	0.2	0.8	23.8	0.7	1.4	1.0	0.6	1.2
Burundi	1.5	1.0	1.8	0.7	1.4	2.0	0.0	0.9	13.4	0.5	1.6	1.0	1.4	1.4
Cameroon	1.1	1.3	1.7	0.5	0.6	1.0	0.0	1.0	13.8	0.7	1.5	0.8	0.2	1.2
Chad	2.3	1.5	2.0	0.7	2.2	4.0	0.2	1.1	25.2	0.9	0.9	1.1	1.4	1.0
Comoros	0.0	1.0	2.0	0.3	1.3	0.6	0.5	1.4	5.6	0.5	1.7	0.8	0.6	1.4
Congo-Brazza	1.2	1.4	1.4	0.8	0.8	1.6	0.1	1.1	9.4	0.7	1.4	1.2	0.9	1.3
Côte d'Ivoire	0.6	1.4	1.7	0.4	2.9	2.1	0.0	1.4	12.1	0.7	1.3	1.2	0.4	1.3
Dem. Rep. of Congo	1.8	0.9	1.5	0.8	0.5	3.0	0.4	1.4	8.6	0.7	1.3	1.1	1.2	1.2
Ethiopia	0.6	0.8	3.1	0.2	0.1	1.4	0.1	1.2	14.2	1.0	1.6	0.3	0.1	1.0
Gabon	0.7	1.0	1.3	0.7	0.4	1.5	0.7	0.6	5.7	0.7	1.3	1.0	0.9	1.2
Gambia	0.8	1.3	1.7	0.9	1.9	4.0	0.0	1.7	21.2	0.6	1.4	1.5	2.8	1.4
Ghana	0.1	1.3	1.4	0.6	0.9	2.2	0.2	1.9	4.8	0.6	1.3	1.3	1.8	1.3
Guinea	0.4	1.3	1.7	1.1	0.0	2.4	0.3	0.3	17.1	0.6	1.4	1.1	1.3	1.3
Kenya	0.4	1.1	1.5	0.4	0.5	2.6	0.1	0.8	6.4	0.7	1.4	0.9	0.9	1.3
Lesotho	2.6	1.3	1.4	0.8	1.8	2.3	0.5	1.2	5.7	0.5	1.4	1.7	0.3	1.4
Liberia	0.6	1.1	1.2	0.8	0.0	3.9	1.0	2.3	11.7	0.7	1.3	1.2	0.7	1.2
Madagascar	0.4	1.0	2.3	0.3	0.0	3.1	0.0	0.0	19.4	0.6	1.8	0.6	0.0	1.3
Malawi	1.2	0.8	2.1	0.6	0.5	1.5	0.1	0.8	8.0	0.6	1.7	0.9	0.9	1.4
Mali	1.9	1.1	1.4	1.0	0.4	1.9	0.3	1.4	12.0	1.0	0.9	1.2	0.8	1.0
Mozambique	1.0	0.9	1.6	0.5	0.8	2.0	0.1	0.7	9.2	0.8	1.4	0.7	0.6	1.2
Namibia	0.6	1.0	1.3	0.3	0.7	1.3	0.9	0.2	5.4	0.7	1.3	0.8	1.3	1.2
Niger	0.3	1.2	2.4	0.8	0.7	5.9	0.2	2.0	19.6	0.7	1.2	1.2	1.3	1.2
Nigeria	0.4	1.2	1.9	0.4	0.2	3.5	0.2	1.2	21.5	0.9	1.3	0.8	0.5	1.1
Rwanda	0.0	0.8	1.5	0.5	1.1	3.0	0.6	0.9	6.2	0.6	1.5	1.0	1.6	1.3
Sao Tome and Principe	1.7	1.1	0.9	0.6	2.9	1.0	0.0	2.0	14.2	0.8	1.3	0.9	2.3	1.2
Senegal	1.5	1.0	1.7	0.4	2.3	3.0	0.0	0.3	10.6	0.7	1.5	0.7	1.3	1.2
Sierra Leone*	0.9	1.0	1.2	0.9	2.4	2.4	0.2	2.1	--	0.9	1.2	1.0	1.6	1.1
Swaziland	0.9	1.4	1.4	0.9	1.0	2.2	0.8	1.1	5.8	0.6	1.4	1.0	2.9	1.3
Tanzania	1.4	1.0	1.5	0.5	0.0	3.0	1.1	1.8	8.8	0.6	1.5	0.9	1.0	1.3
Togo	1.0	1.1	1.8	0.5	1.1	2.1	0.0	1.6	9.3	0.6	1.4	1.2	0.7	1.3
Uganda	1.2	0.8	1.9	0.5	1.4	2.2	0.3	0.8	8.9	0.8	1.3	0.9	1.8	1.2
Zambia	1.6	0.8	1.8	0.5	0.4	2.1	0.3	1.4	10.3	0.7	1.5	0.8	1.8	1.3
Zimbabwe	1.0	1.4	1.3	0.3	0.4	3.9	0.3	2.2	12.0	0.7	1.4	1.2	1.2	1.4
South/Southeast Asia														
Bangladesh 2011	0.6	0.7	1.5	0.1	0.7	2.3	0.3	1.5	5.5	1.0	1.2	0.7	0.4	1.0
Bangladesh 2014*	0.9	0.9	1.3	0.2	0.1	1.7	0.2	0.6	--	1.1	1.1	0.7	0.2	1.0
Cambodia	0.0	1.2	1.5	0.5	1.1	3.9	0.1	2.0	16.6	0.6	1.4	1.3	0.1	1.3
India	0.7	0.8	1.8	0.1	0.5	1.8	0.1	0.7	6.8	0.7	1.5	0.5	0.1	1.2
Indonesia	0.8	1.2	1.2	0.4	0.5	1.6	0.1	0.8	6.5	0.7	1.2	1.2	0.4	1.2
Maldives	1.4	0.9	1.2	0.7	0.8	1.4	1.1	1.4	2.6	0.7	1.2	1.0	1.3	1.2
Nepal	0.2	1.0	1.6	0.0	0.0	1.3	0.2	0.0	14.7	0.6	1.6	0.2	0.0	1.3
Pakistan	0.4	0.7	1.9	0.4	0.7	3.6	0.2	1.1	8.9	0.8	1.4	0.7	0.3	1.1
Philippines	0.6	1.2	1.4	0.2	1.0	3.0	0.2	2.3	7.5	0.7	1.3	1.1	0.1	1.3
Timor-Leste	4.3	1.0	2.3	0.6	1.4	4.0	0.0	2.1	27.1	0.6	1.5	0.9	0.9	1.3
Vietnam	0.0	2.4	1.4	0.0	0.0	2.0	0.7	4.5	7.5	0.5	1.3	1.6	2.0	1.3
MIN	0.0	0.7	0.9	0.0	0.0	0.6	0.0	0.0	2.6	0.5	0.9	0.2	0.0	1.0
MAX	4.3	2.4	3.1	1.1	2.9	5.9	1.1	4.5	27.1	1.1	1.8	1.7	2.9	1.4
MEDIAN	0.8	1.0	1.5	0.5	0.7	2.2	0.2	1.2	9.3	0.7	1.4	1.0	0.9	1.2

*The Sierra Leone and Bangladesh 2014 surveys only asked about cesarean sections for the most recent birth in the recall period and therefore did not capture one of the nine risk factors

B. Bangladesh case study

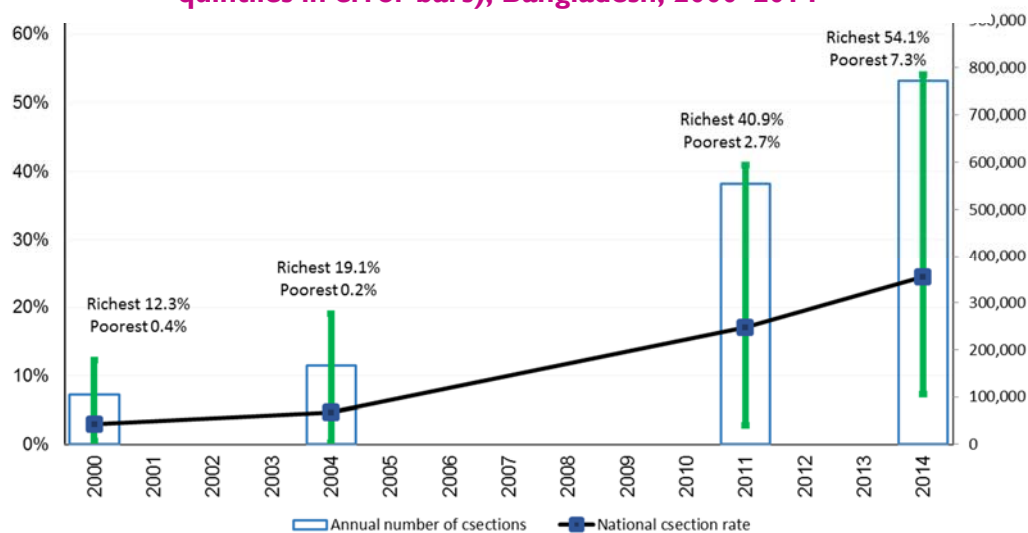
BI. Time Trends

Key Messages

- The national cesarean section rate in Bangladesh increased almost 10-fold, from 3% in 2000 to 24% in 2014. This translates into a seven-fold increase in the absolute number of cesareans, reaching almost 800,000 cesarean sections performed in 2014, despite a decline in the absolute numbers of births in this period.
- There are wide within-country disparities in the cesarean rate, particularly by wealth (in 2014, 7% in the poorest quintile, compared with 54% in the richest quintile).
- Over the same time period, both the percentage of facility deliveries and the cesarean rate in facilities increased substantially, and this rise was more pronounced in nonpublic facilities: Seventy-nine percent of all cesareans in Bangladesh now occur in nonpublic sector facilities.

We analyzed four rounds of DHS data (1999–2000, 2004, 2011, and 2014), examining the most recent live birth in the three-year recall period of each survey. We found that the overall cesarean section rate increased nearly 10-fold in the 18-year period examined, from 2.9% to 24.4%. There were wide geographic disparities in the rate (by urban-rural residence and region), but the widest disparity was by wealth (in 2014, 7.3% in the poorest quintile and 54.1% in the richest quintile) (Figure 6).

Figure 6: National cesarean section rates (poorest and richest wealth quintiles in error bars), Bangladesh, 2000–2014



The percentage of all births that occurred in health facilities more than quadrupled, from 9.0% to 38.9% during the time period under analysis (Table 7, page 39). The facility cesarean section rate nearly doubled during this time, from 32.5% to 63.1%. The annual numbers of cesarean sections performed in Bangladesh increased from around 100,000 in the recall period of the 1999–2000 survey to more than 770,000 in the latest survey (Table 8, page 40), despite a concurrent decrease in

the total number of births over the same period. The percentage of facility deliveries occurring in the public sector was halved, from 64.4% to 33.8% between the earliest and the most recent survey. The cesarean section rate in nonpublic facilities was 1.6 times higher than in public facilities in 1999–2000, and this ratio rose to nearly two times higher by 2014. During this time, the share of all cesareans performed in the public sector declined from 53% to 21%. The combined increase in the percentage of facility deliveries in the nonpublic sector, and in the cesarean rate in nonpublic facilities, suggests that the rising trend in cesarean deliveries is likely to continue, raising concerns for the morbidity and mortality consequences of additional unnecessary cesareans.

Table 7: Trends in cesarean sections and facility deliveries over time, Bangladesh

<i>n</i> (live births)	3,814	3,755	4,773	4,597
Survey year	1999/2000	2004	2011	2014
Overall cesarean section rate				
Estimate	2.9%	4.7%	17.1%	24.4%
Lower 95% CI	2.3%	4.0%	15.5%	22.3%
Upper 95% CI	3.6%	5.5%	18.7%	26.6%
Cesarean section rate by residence				
Overall cesarean section rate	2.9%	4.7%	17.1%	24.4%
Rural	1.7%	2.4%	13.6%	18.8%
Urban	9.2%	14.1%	28.7%	40.3%
Cesarean section rate by wealth				
Overall cesarean section rate	2.9%	4.7%	17.1%	24.4%
Poorest 20%	0.4%	0.2%	2.7%	7.3%
Richest 20%	12.3%	19.1%	40.9%	54.1%
Cesarean section rate by region				
Overall cesarean section rate	2.9%	4.7%	17.1%	24.4%
Barisal	0.9%	3.4%	12.9%	18.5%
Chittagong	1.8%	2.9%	14.0%	19.6%
Dhaka	4.2%	7.3%	20.1%	31.3%
Khulna	5.1%	5.5%	26.5%	34.5%
Rajshahi	2.0%	3.2%	17.3%	23.5%
Rangpur	n/a	n/a	11.6%	18.0%
Sylhet	2.6%	3.6%	12.4%	12.1%
% of births in health facilities				
Estimate	9.0%	11.7%	28.8%	38.6%
Lower 95% CI	7.8%	10.4%	26.6%	35.8%
Upper 95% CI	10.3%	13.3%	31.2%	41.5%
Facility cesarean section rate				
Estimate	32.5%	40.0%	59.1%	63.1%
Lower 95% CI	27.5%	35.2%	56.0%	60.2%
Upper 95% CI	37.9%	45.0%	62.2%	65.9%
% of facility births in public health facilities				
Estimate	64.4%	61.5%	40.7%	33.8%
Lower 95% CI	58.5%	55.6%	37.4%	30.3%
Upper 95% CI	69.9%	67.0%	44.2%	37.5%
Cesarean section rate by facility ownership				
Facility cesarean section rate	32.5%	40.0%	59.1%	63.1%
Public	26.8%	32.6%	43.1%	38.9%
Nonpublic	42.8%	51.7%	70.1%	75.5%
% of facility births in hospitals				
Estimate	46.1%	34.0%	26.6%	16.3%
Lower 95% CI	40.1%	29.0%	23.7%	14.0%
Upper 95% CI	52.1%	39.5%	29.8%	18.9%
Cesarean section rate by facility level				
Facility cesarean section rate	32.5%	40.0%	59.1%	63.1%
Lower (public, nonpublic)/mixed (nonpublic)/unknown	32.8%	38.7%	61.8%	65.1%
Hospital (public)	32.1%	42.3%	51.9%	52.7%

Table 8: Trends in absolute numbers of births and cesarean sections over time, Bangladesh

	1999/2000	2004	2011	2014
Annual average number of births during recall period	3,629,150	3,536,797	3,243,949	3,160,570
Annual number of cesarean sections	105,245	166,229	554,715	771,179
Annual number of cesarean sections in public facilities	56,373	82,964	163,885	160,405
Annual number of cesarean sections in nonpublic facilities	49,767	82,366	388,364	609,758
% of all cesarean sections conducted in public sector	53.1%	50.2%	29.7%	20.8%
% of all cesarean sections conducted in nonpublic sector	46.9%	49.8%	70.3%	79.2%

* Note the total of public plus nonpublic facility cesarean sections does not exactly equal the total number of cesarean sections due to rounding.

B2. Clinical information on cesarean sections

Key Messages

- Most cesareans were performed during working hours on weekdays, though this trend was less pronounced in nonpublic facilities.
- Almost half (45%) of cesareans were reported to be decided on on the day of delivery, while 30% were decided on more than a week before the birth.
- The most commonly reported reason by women for their cesarean was “other complications during delivery” (33%), and the reported timing of the decision to perform a cesarean was not always consistent with the reported indication.
- This analysis also highlighted issues of capturing indications for cesarean sections through population-based surveys; other data sources might be better suited for this purpose.

In both public and nonpublic facilities, the majority of cesareans were conducted between 9 am and 6 pm (Figures 7 and 8, page 41). However, in public facilities, a larger proportion of cesareans were concentrated in this time period on weekdays (Sunday to Thursday in Bangladesh). In contrast, the time patterns of cesareans in nonpublic facilities on weekends more closely resembled the weekday pattern, and there was less difference in the number of cesareans performed between 9 am and 6 pm and between 6 pm and 12 am. This may be because public providers practice in nonpublic facilities after their shifts end.

Forty-five percent of cesareans were reported to have been decided on on the day of delivery, while 30% were decided on more than one week before (Table 9, page 42). Doctors first suggested a surgical delivery in 70% of cesareans, with slightly higher proportions in public compared with nonpublic facilities, and 19% of all cesareans were suggested by doctors more than one week before delivery. Among cesareans suggested by doctors, 98% of women were told the reasons for the cesarean: Overall, 69% of women reported one reason, and 26% reported two; 1.4% of women did not report a reason.

On average, women stayed 161 hours (6.7 days) in the facility after undergoing a cesarean; this stay was longer in public facilities (200 hours) than in nonpublic facilities (151 hours). Around 3% of women stayed at the facility for less than 72 hours after their cesarean (i.e, had a short length of stay); this was more frequent in the nonpublic sector than in the public sector. In contrast, following

Figure 7: Day and time at which cesarean sections were performed in public facilities

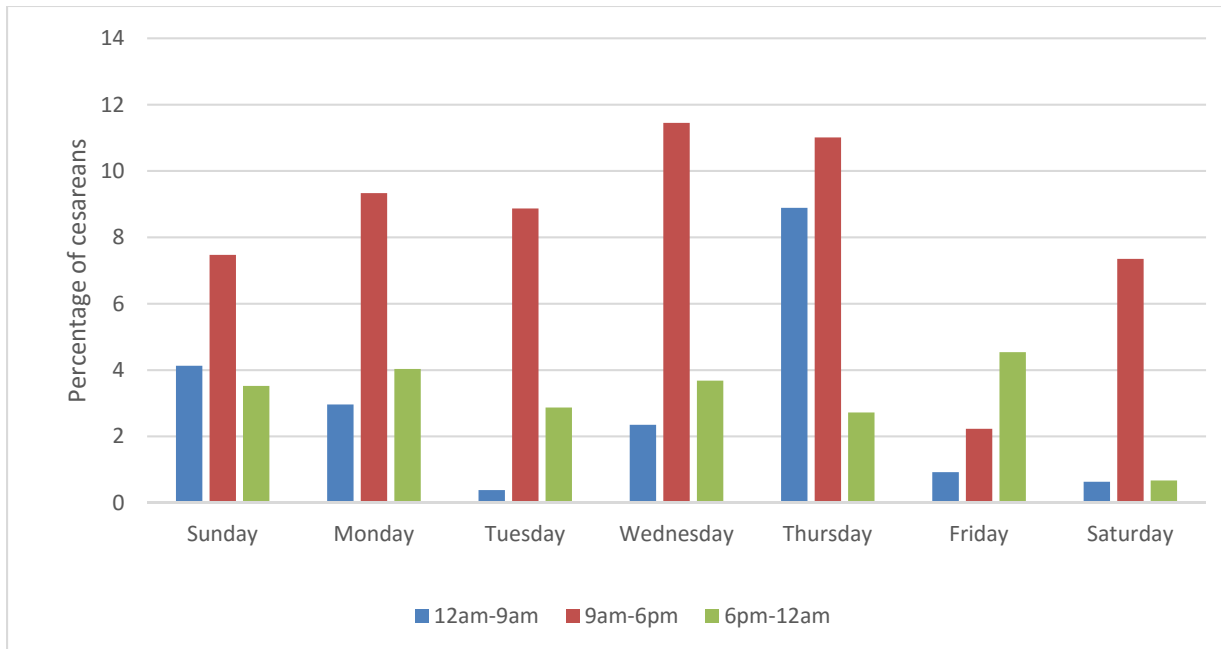


Figure 8: Day and time at which cesareans were performed in nonpublic facilities

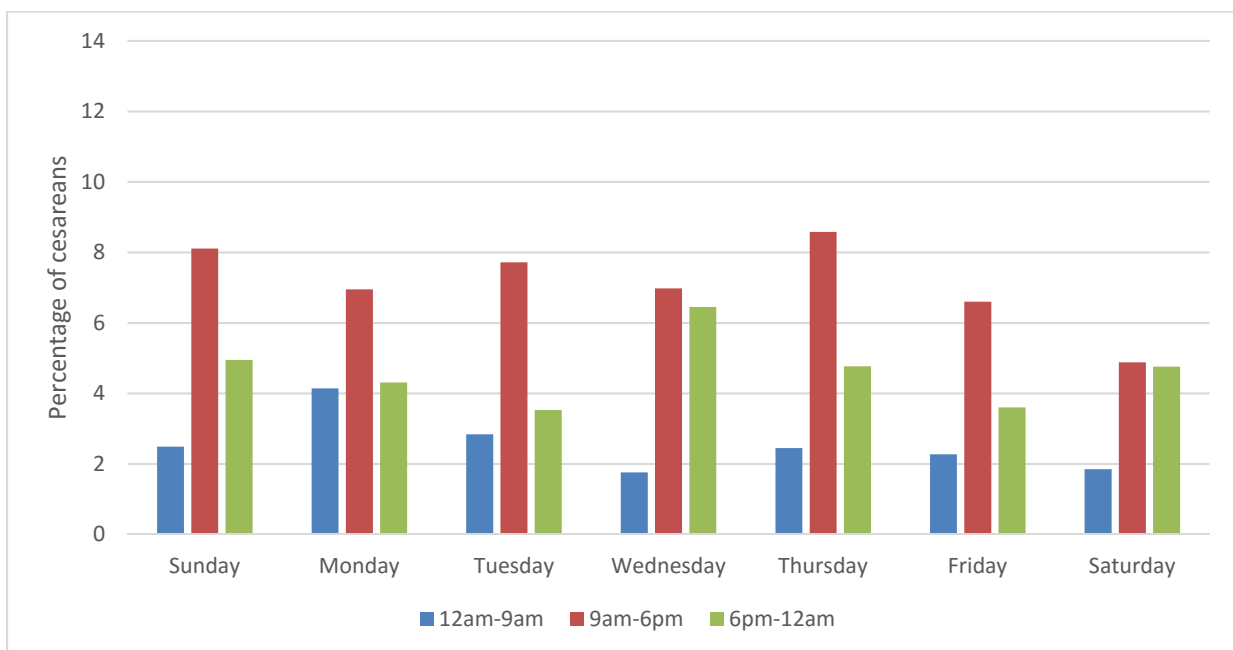


Table 9: Self-reported characteristics of cesarean sections, by facility level and facility ownership, Bangladesh, 2014

Characteristics	Overall	By facility level		By facility ownership	
		Hospital	Lower/ mixed/ unknown	Public	Nonpublic
Day of the week* cesarean was performed (%)					
Sunday	15.5	15.5	15.3	15.1	15.5
Monday	15.6	15.4	16.7	16.3	15.4
Tuesday	13.7	14.2	10.5	12.1	14.1
Wednesday	15.7	15.6	16.3	17.5	15.2
Thursday	17.2	15.6	27.2	22.6	15.8
Friday	11.5	12.4	5.3	7.7	12.5
Saturday	10.9	11.2	8.7	8.6	11.5
Time of day cesarean was performed (%)					
12 am–9 am	18.3	17.5	23.3	20.3	17.8
9 am–6 pm	51.5	51.3	52.5	57.7	49.8
6 pm–12 am	30.2	31.2	24.3	22.0	32.4
Timing of decision to perform a cesarean (%)					
Day of delivery	45.2	45.8	41.8	41.8	46.1
Day before	12.6	12.6	12.9	13.9	12.3
2–7 days before	12.0	10.1	23.6	18.7	10.2
Earlier than week before	30.2	31.5	21.8	25.5	31.4
Person first proposed to have the birth delivered by cesarean section (%)					
Respondent	7.1	7.7	3.3	5.6	7.5
Family member	21.5	21.6	21.1	18.2	22.4
Doctor	71.4	70.7	75.7	76.2	70.1
Woman was told the reasons for having the operation (%)					
No	1.6	1.5	2.3	1.8	1.6
Yes	98.4	98.5	97.7	98.2	98.4
Number of reported reasons for cesarean (%)					
0	1.4	1.4	1.7	1.4	1.4
1	69.0	70.0	62.8	64.2	70.2
2	25.5	24.0	34.8	31.7	23.9
3	3.8	4.3	0.6	2.7	4.0
4	0.3	0.4	0.0	0.0	0.4
Length of stay (hrs)					
Mean length of stay—cesarean	160.9	199.5	154.8	199.5	150.7
% short length of stay—cesarean	3.3	1.1	3.7	1.9	3.7
Mean length of stay—vaginal	39.6	47.5	37.5	37.7	42
% short length of stay—vaginal	42.6	29.1	46.2	44.1	40.7
Cost (taka)					
Mean delivery cost—cesarean	21196.5	15071.1	22170.6	14996.2	22817.4
Mean delivery cost—vaginal	4799.7	4501.9	4877.2	3951	5882.2

* Friday/Saturday is the weekend in Bangladesh.

Note: Short length of stay is defined as <72 hours for a cesarean and <24 hours for a vaginal delivery.

a vaginal delivery, women stayed on average 40 hours at the facility, with 43% leaving less than 24 hours after delivery (considered a short length of stay). Contrary to the case with cesarean sections, the proportion of women delivering vaginally who had a short length of stay was higher in public facilities than in nonpublic facilities. The relatively long length of stay after cesarean deliveries should be sufficient for postoperative care and immediate infection surveillance, although the length of stay alone does not provide information on whether women actually receive postcesarean care or on its quality.

The mean cost that women reported paying for the cesarean was 21,197 taka (US \$261) across all facilities. Reported mean costs were higher in nonpublic facilities (US \$278) than public ones (US \$183), as might be expected. The mean cost for vaginal delivery at a facility was much lower, at 4,800 taka (US \$59), but as with cesareans, this cost was higher in nonpublic facilities than in public facilities.

Of the 98.6% of women who reported at least one reasons for their cesarean, the two most commonly reported indications were “other complications during delivery” (32.7%) and “malpresentation” (32.5%) (Table 10). This highlights some of the limitations of these data: First, for more than one-third of all cesareans, we do not know the reason. Further, malpresentation refers to noncephalic fetal presentations, including breech, transverse, or oblique lie. A prevalence of 32.5% of cesarean deliveries with malpresentation is equivalent to a population-based malpresentation prevalence at delivery of around 8%, which is substantially higher than most estimates: Breech deliveries occur in 3–4% of deliveries at term (Hickok, Gordon, & Milberg, 1992),

Table 10: Self-reported reasons for cesareans, by timing of decision and timing of delivery

Reported reason for cesarean	N (%)	Doctor first mentioned (%)	Timing of decision				Weekday (%)	9am-6pm (%)
			Day of (%)	Day before (%)	Week before (%)	Earlier (%)		
Emergency/intrapartum complications								
Other complications during delivery	341 (32.7)	73.9	54.2	11.8	11.8	22.2	77.1	44.3
Failure to progress in labor	200 (17.3)	77.8	59.6	13.9	8.9	17.5	77.3	50.2
Less pressure on baby's brain	65 (6.3)	87.4	61.9	10.5	5.8	21.8	81.2	58.1
Pre-eclampsia	25 (2.4)	79.0	37.5	11.6	11.2	39.8	72.5	54.8
Cord prolapsed	24 (1.9)	87.0	44.2	18.8	4.0	32.9	77.9	55.9
Complications for which a cesarean may be planned ahead of time								
Malpresentation	358 (32.5)	81.7	42.0	17.2	11.6	29.1	78.2	54.0
Previous cesarean section	178 (15.4)	64.3	12.6	6.5	15.5	65.4	72.2	55.5
Convenience	99 (9.4)	48.6	45.3	1.9	12.8	40	87.5	56.3
Avoid labor pain	78 (7.0)	38.6	40.1	13.3	14.8	31.9	79.8	59.6
Other	38 (4.4)	71.0	44.8	6.4	37.5	11.3	83.3	21.4
Premature baby	24 (2.1)	78.1	41.6	6.7	2.8	48.9	90.9	62.1
Diabetes	9 (0.6)	81.7	6.4	0.0	22.7	70.9	96.1	48.8
Multiple births	5 (0.4)	53.1	16.9	19.7	0.0	63.4	63.3	63.4
All cesareans	1,071 (100)	71.3	45.2	12.6	12.0	30.2	77.5	51.6

Note: Multiple reasons for cesareans can be reported, and percentages add up to more than 100%.

and the other types of malpresentation are much rarer. Accordingly, it seems unlikely that all malpresentations reported by women who had a cesarean are true malpresentations. Moreover, some categories do not clearly correspond to a clinical indication, such as “too much pressure on baby’s brain,” which may or may not correspond to a clinical diagnosis of fetal distress, and some apparently nonclinical categories, such as “avoid labor pain,” may include women with prolonged labor. Lastly, the response options included in the DHS omit some important clinical indications for cesareans, such as hemorrhage and eclampsia/seizure. Caution is therefore needed in interpreting self-reported reasons for cesareans.

The timing of the decision to perform the cesarean was not always consistent with the reported reason. Overall, a larger percentage of cesareans reported to be performed for emergency or intrapartum complications were decided on the day of delivery, compared with those reportedly performed for complications where cesareans may be planned in advance. However, a substantial proportion of cesareans for emergency reasons were reported to have been decided far in advance of the cesarean: Only 44% of cesareans for cord prolapse were reported to have been decided on the day of delivery, and 33% were decided more than one week ahead of time. This does not appear to be consistent with clinical management. Similarly, around half of cesareans reported to be for “convenience” were decided on the day of delivery. Both the frequency of reported reasons and their comparison with the timing of the decision indicate that these findings should be interpreted with caution and may have limited validity, given their self-reported nature.

C. Tanzania Case Study

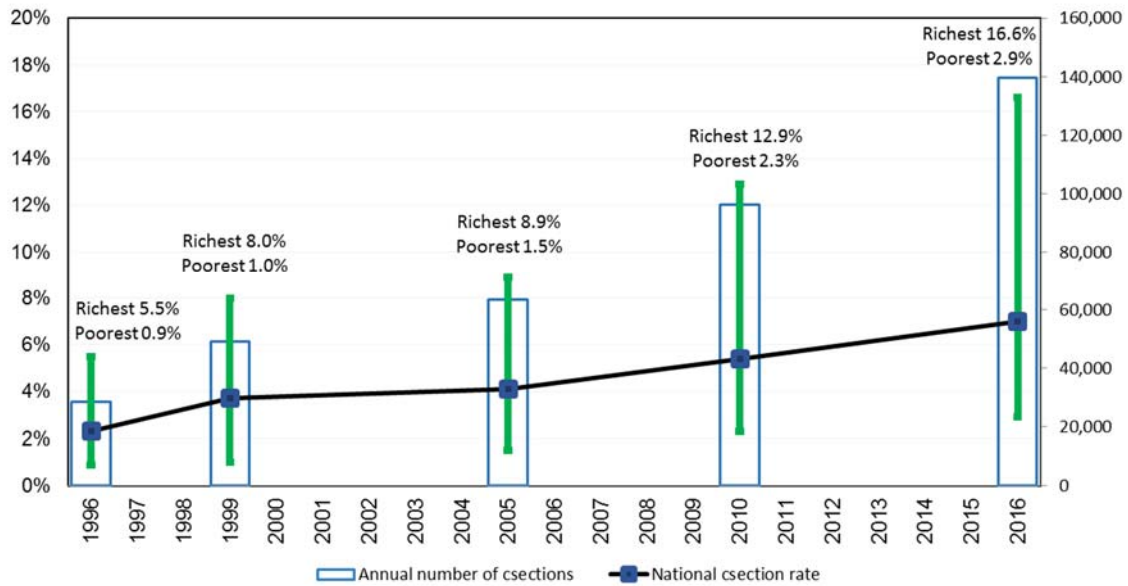
CI. Time Trends

Key Messages

- The national cesarean section rate in Tanzania increased from 2% in 1996 to 7% in 2016, alongside a five-fold increase in the absolute number of cesarean deliveries, reaching an estimated 140,000 cesareans in 2016.
- The percentage of facility births increased from 49% to 68% over this period, and the facility cesarean rate doubled, to 10%.
- The facility cesarean rate increased faster in nonpublic facilities than in public facilities and is now twice as high (17% vs. 8%); nonetheless, two-thirds of all cesareans in Tanzania occurred in public facilities in 2016, since the public sector accounts for a larger proportion of facility births.

We analyzed five rounds of DHS data (1996, 1999, 2005, 2010, and 2016), examining the most recent live birth in the five-year recall period before each survey. Over the 25-year period covered by the surveys, the overall cesarean section rate increased from 2.3% to 7.0%. The differences between cesarean section rates according to residence were smaller than by wealth quintile in 2016 (three times higher in urban areas than in rural areas, and six times higher in the richest quintile versus the poorest quintile), as shown in Figure 9 (page 45). The relative width of these gaps has remained constant.

Figure 9: National cesarean section rates and absolute annual numbers (poorest and richest wealth quintiles in error bars), Tanzania, 1996–2016



The percentage of births that occurred at health facilities increased from 48.8% in 1996 to 67.9% in 2016 (Table 11, page 46). The majority of facility births occurred in the public sector, but the share of facility deliveries occurring in the nonpublic sector tripled over this period (from 7% to 22%). The annual number of cesarean sections performed in Tanzania increased five-fold, from 28,500 in 1991–1996 to around 140,000 in 2011–2016 (Table 12, page 47), as a result of the increase in both the cesarean rate and the total number of births. The facility cesarean section rate doubled during this time period, from 4.7% to 10.3%. While there was no difference in the cesarean section rate between public and nonpublic facilities in 1996, in 2016 nonpublic facilities’ cesarean section rate was two times higher than that in public facilities (16.9% versus 8.4%). During this time, the percentage of all cesarean sections in Tanzania performed in public-sector facilities declined from 93% to 64%.

Table 11: Selected measures of cesarean section and facility delivery, by year, Tanzania

<i>n</i> (live births)	4,387	2,181	5,743	5,497	7,079
Survey year	1996	1999	2005	2010	2016
Overall cesarean section rate					
Estimate	2.3%	3.7%	4.1%	5.4%	7.0%
Lower 95% CI	1.9%	2.5%	3.4%	4.7%	6.1%
Upper 95% CI	2.8%	5.5%	4.8%	6.3%	7.9%
Cesarean section rate by residence					
Overall rate	2.3%	3.7%	4.1%	5.4%	7.0%
Rural	1.6%	2.6%	2.9%	4.0%	4.5%
Urban	4.9%	7.2%	8.1%	10.2%	12.6%
Cesarean section rate by wealth					
Overall rate	2.3%	3.7%	4.1%	5.4%	7.0%
Poorest 20%	0.9%	1.0%	1.5%	2.3%	2.9%
Richest 20%	5.5%	8.0%	8.9%	12.9%	16.6%
% of births in health facilities					
Estimate	48.8%	45.7%	50.1%	55.3%	67.9%
Lower 95% CI	45.0%	38.6%	47.2%	52.0%	65.1%
Upper 95% CI	52.7%	53.1%	53.1%	58.4%	70.6%
Facility cesarean section rate					
Estimate	4.7%	8.1%	8.1%	9.8%	10.3%
Lower 95% CI	3.9%	5.5%	6.8%	8.6%	9.1%
Upper 95% CI	5.7%	11.7%	9.5%	11.2%	11.6%
% of facility births in public health facilities					
Estimate	92.8%	83.7%	80.6%	79.9%	78.0%
Lower 95% CI	90.5%	74.2%	77.3%	76.4%	75.6%
Upper 95% CI	94.6%	90.2%	83.5%	83.0%	80.2%
Cesarean section rate by facility ownership					
Overall facility rate	4.7%	8.1%	8.1%	9.8%	10.3%
Public	4.7%	7.5%	6.5%	9.1%	8.4%
Nonpublic	4.7%	10.9%	14.5%	12.9%	16.9%
% of facility births in hospitals					
Estimate	63.9%	49.3%	54.4%	50.8%	50.6%
Lower 95% CI	59.9%	40.5%	50.3%	47.1%	47.9%
Upper 95% CI	67.7%	58.2%	58.3%	54.5%	53.4%
Cesarean section by facility level					
Overall facility rate	4.7%	8.1%	8.1%	9.8%	10.3%
Lower (public, nonpublic)/mixed (nonpublic)/unknown	1.2%	4.3%	1.3%	1.5%	2.5%
Hospital (public)	6.7%	12.0%	13.8%	17.9%	17.9%

*Hospitals are in both ownership types, except for the 1999 survey, where hospitals were only in the public sector. It was not possible to look at geographic zones over time, because the boundaries of zones have changed over time on DHS surveys.

Table 12: Selected measures of births and cesarean sections, by year, Tanzania

	1996	1999	2005	2010	2016
Annual average number of births during recall period	1,238,592	1,323,149	1,550,822	1,780,787	1,995,125
Annual number of cesarean sections	28,488	48,956	63,584	96,162	139,659
Annual number of cesarean sections in public facilities	26,363	37,959	40,705	71,602	88,759
Annual number of cesarean sections in nonpublic facilities	2,045	10,743	21,856	25,534	50,367
% of all cesarean sections conducted in public sector	92.8%	77.9%	65.1%	73.7%	63.8%
% of all cesarean sections conducted in nonpublic sector	7.2%	22.1%	34.9%	26.3%	36.2%

* Note the total of public plus nonpublic facility cesarean sections does not exactly equal the total number of cesarean sections due to rounding.

C2. SPA: Health Facilities' Cesarean Section Capability

Key Messages

- More than 90% of cesarean sections in Tanzania are conducted in public or faith-based hospitals.
- Fewer than half (40%) of all cesareans in Tanzania are performed in facilities with any specialist doctor (including obstetricians and surgeons), indicating that most cesareans are likely to be conducted by nonspecialists.
- Only 24% of cesareans in Tanzania are performed in facilities meeting all three minimum readiness criteria (piped water and consistent electricity, 24-hour availability of a cesarean section provider and anesthetist, and availability of all general anesthesia equipment).

Description of Sample

Of the 1,188 health facilities sampled in the 2014–2015 SPA with no missing information, 271 (4.5%) reported providing cesarean sections (Table 13, page 48). More than three-quarters of hospitals across all sectors reported providing cesareans, compared with fewer than one-third of health centers (ranging from 8% of public health centers to 28% of private health centers). The Tanzanian National Road Map Strategic Plan for RMNCH set a target of 100% CEmOC capacity for hospitals and 50% for health centers by 2015 (MOHSW, 2015). It is striking that one-quarter of public hospitals and 7% of FBO hospitals reported not providing cesarean sections; this figure is similar to findings from the 2012 Service Availability and Readiness Assessment (MOHSW, 2013) that 73% of hospitals had performed all CEmOC functions (including cesarean sections), although it would be important to ascertain whether the 77% of public hospitals reporting to provide cesareans may be an error, due to the way the survey was conducted. No dispensaries or clinics reported providing cesarean deliveries, which is consistent with the RMNCH Road Map (MOHSW, 2015).

Public and FBO hospitals had the highest number of maternity beds, as well as the largest median monthly volume of cesareans (35 and 23, respectively) (Table 14, page 48), while private hospitals and health centers from all sectors tended to have smaller wards and a lower volume of cesareans. More than two-thirds of health centers across all sectors performed fewer than 10 cesareans per month, on average. Among hospitals, the largest percentage of public and FBO hospitals performed 10–30 monthly cesareans, while for private hospitals the majority performed fewer than 10. Extreme cesarean volumes at both ends of the spectrum (both very high and very low) may represent a threat

Table 13: Number and percentage of all health facilities reporting that they provide cesarean sections, by facility type

Facility type	N	No. (%)
Public hospital	131	112 (76.6%)
Private hospital	35	31 (88.3%)
FBO hospital	90	84 (93.3%)
Public health center	281	25 (7.8%)
Private health center	33	11 (27.7%)
FBO health center	65	8 (13.0%)
Dispensary or clinic	553	0 (0.0%)
Total	1,188	271 (4.5%)

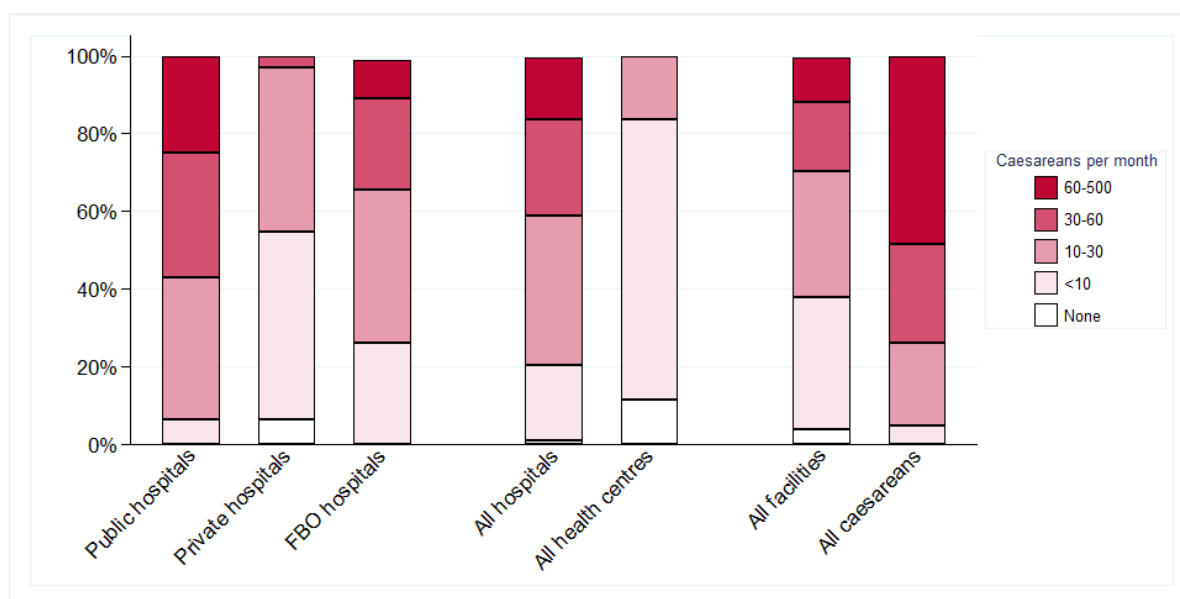
to the quality and safety of cesareans: Low-volume facilities may not perform sufficient numbers of cesareans for the surgical teams to work well together or see enough complicated cesareans to perform them safely. On the other hand, very high volumes may indicate high demands on the operating theater and teams, leading to time pressures and perhaps rushed procedures. However, the relationship between the volume of cesareans and their safety is affected by many other factors, such as the number of operating theaters, the number of providers, and whether surgical teams provide other types of trauma surgery together. Therefore, no direct conclusions about the quality of cesareans can be drawn from the monthly number of cesareans alone.

Table 14: Median monthly volume of cesarean sections, and percentage distribution of cesareans by monthly number per facility, all according to facility type

Facility type	Median no. of maternity beds	Median monthly no. of cesareans	No. of cesareans per month (based on last 3 months)				All cesareans (%)
			<10	10–30	30–60	60–500	
Public hospital	27	35	6.3	36.6	32.1	25.0	65.5
Private hospital	5	8	54.8	42.1	3.1	0.0	3.8
FBO hospital	24	23	26.5	39.8	23.9	9.7	25.8
Public health center	8	5	78.3	21.7	0.0	0.0	2.9
Private health center	4	1	100.0	0.0	0.0	0.0	0.6
FBO health center	13	9	69.4	30.6	0.0	0.0	1.5
Dispensary or clinic	na	na	na	na	na	na	0
Total	18	17	38.0	32.4	18.1	11.5	-

Two thirds (65.5%) of all cesareans are performed in public hospitals, and a further 26% in FBO hospitals; these two facility types therefore account for all but 8.5% of cesareans performed in Tanzania. Overall, based on the SPA data, we estimated that 68% of cesareans were performed in public facilities, which is in line with the 64% estimated based on women’s self-reports in the DHS analysis (section C1), in which FBO facilities were categorized within the nonpublic sector.

Figure 10: Percentage distribution of facilities, by monthly cesarean volume, Tanzania



Public and FBO hospitals tended to have higher volumes of cesarean sections compared with private hospitals, while overall health centers had lower volumes than hospitals across all sectors (Figure 10). While only 12% of all facilities providing cesareans performed more than 60 cesareans per month, these high-volume facilities accounted for around half of all cesarean sections in Tanzania. This concentration of cesareans in high-volume facilities suggest that such facilities should be targeted as a priority for any interventions related to the safety or quality of cesarean sections.

The median total delivery volume across all facility types was 139 total deliveries (vaginal and cesarean) per month (Table 15). Private facilities had the lowest median delivery volume (about four per month for private health centers and 34 for private hospitals), with all private health centers assisting less than one delivery per day on average. In contrast, public hospitals assisted a median of 257 deliveries per month, with 14% assisting more than 500 per month. Conversely, facility cesarean

Table 15: Monthly total delivery volume and cesarean rate, by facility type

Facility type	No. of facilities reporting that they provide cesareans, with complete delivery volume data	Median monthly total no. of deliveries	% distribution of facilities by monthly total delivery volume				Median facility cesarean rate (range)
			<30	30–150	150–500	≥500	
Public hospital	107	257	1.8	23.3	60.6	14.3	17.2 (0.2–100.0)
Private hospital	19	34	47.5	47.5	5.0	0.0	32.5 (6.1–64.7)
FBO hospital	75	138	9.5	43.8	43.8	2.8	18.8 (1.5–100.0)
Public health center	17	71	12.0	72.6	15.4	0.0	8.2 (0–54.3)
Private health center	4	4	100.0	0.0	0.0	0.0	25.0 (0–25.0)
FBO health center	7	40	0.0	100.0	0.0	0.0	14.0 (4.3–26.5)
Dispensary or clinic	na	na	na	na	na	na	na
Overall	229	139	12.3	40.2	40.6	6.9	17.8 (0.0–100.0)

rates were higher among private facilities (25% in health centers and 33% in hospitals, compared to around 18% among public and FBO hospitals). Facility cesarean rates were lower in FBO and public health centers (14% and 8%, respectively).

Staffing of facilities providing cesareans

Facilities reporting that they provide cesareans had a median number of two full-time general doctors and zero specialist doctors (including obstetricians and surgeons) (Table 16). Only private hospitals and health centers had a median of specialist doctors larger than zero. All facility types had a median of at least one clinical officer and anesthetist.

More than one-quarter (29%) of all facilities providing cesareans lacked a full-time general doctor on staff, including 10% of public hospitals and 24% of FBO hospitals, and more than half (56%) did not have any specialist doctor. One-fifth (21%) of all facilities reporting that they provide cesareans had neither a full-time general nor a specialist doctor. Around 15% of all facilities performing cesareans did not have a full-time anesthetist. Overall, 12% of cesareans are performed in facilities without a general doctor and 40% in facilities without a specialist doctor, while 13% of surgical deliveries occur in facilities without a full-time anesthetist.

Table 16: Median number of full-time staff employed or seconded at facilities providing cesareans, and percentage of facilities lacking particular staff, by staff type, all according to facility type

Facility type	No. of facilities reporting that they provide cesareans	Median no. of full-time staff				% without staff			
		General doctor	Specialist doctor (any specialty)	Clinical officer	Anesthetist	General doctor	Specialist doctor (any specialty)	Clinical officer	Anesthetist
Public hospital	112	4	0	8	2	9.8	59.7	2.7	21.4
Private hospital	31	3	3	2	2	15.6	15.3	23.2	9.7
FBO hospital	84	2	0	4	2	23.6	54.5	7.3	8.3
Public health center	25	0	0	2	2	75.6	95.9	5.0	7.1
Private health center	11	1	2	3	1	44.5	25.6	3.5	18.4
FBO health center	8	0	0	1	1	60.8	76.5	16.3	34.5
Overall (% of facilities)	271	2	0	4	2	28.6	56.3	7.1	15.3
Overall (% of cesareans)	-	-	-	-	-	11.9	40.2	6.1	12.5

Among facilities reporting that they provide cesareans, 26% did not have a rota for cesarean providers and anesthetists to be present or on call 24 hours per day (Table 17, page 51). This figure was lowest in facilities with the highest volumes of cesareans (public and FBO hospitals), while 46–60% of health centers across all sectors did not have both providers available 24 hours. Only 9% of cesareans occur in facilities without 24-hour rota for cesarean provider and anesthetist.

On the day of the survey, around one-quarter of facilities did not have a provider present for providing both surgical and delivery care (our proxy for surgical delivery provider), and 13% did not have any surgical provider present. These estimates for surgical delivery and surgery providers include all health provider cadres, including nurses and clinical officers. While it is possible that some nurses may in fact perform cesareans at some facilities, deliberate task-shifting interventions in Tanzania appear to have focused predominantly on training assistant medical officers to perform cesarean sections, while clinical officers and nurses seem to have been mainly trained in anesthesia

(Nyamtema et al., 2011; Bergström, 2015; Bergström, 2011). When the analysis is restricted to medical doctors and assistant medical officers as probable providers of cesareans, the percentages of all facilities without a higher-level surgical *delivery* provider increased from 27% to 36% and without a higher-level surgical provider from 13% to 21%. When the analysis is restricted to facilities that did have a 24-hour rota for cesarean providers, similar proportions of facilities did not have providers present on the day of the survey: Twenty-six percent did not have a provider of both surgical and delivery care, and in 17% no surgical provider was present, despite having a 24-hour rota. These providers may have been on call remotely, with implications for delays in accessing cesareans within facilities (the so-called “third delay” (Thaddeus & Maine, 1994)).

Table 17: Percentage of facilities with 24-hour provider rota and provider presence on the day of the survey, by facility type

Facility type	No. of facilities reporting that they provide cesareans	Staff not available 24 hours/day*			Staff present on the day of the survey‡		Comparison of 24-hour staff reported and present on day of survey		
		% without 24-hour cesarean provider†	% without 24-hour anes- thetist	% without 24-hour provider AND anes- thetist	% without surgical delivery provider§	% without surgical provider	No. of facilities with 24-hour cesarean provider	% with no cesarean provider present on day of survey	% with no surgical provider present on day of survey
Public hospital	112	5.3	12.4	14.2	30.2	14.2	106	28.1	13.1
Private hospital	31	16.1	25.8	25.8	25.5	12.7	26	26.7	11.5
FBO hospital	84	3.6	12.1	12.1	23.8	8.5	81	22.2	7.4
Public health centre	25	53.4	57.5	57.5	27.5	9.4	12	8.8	0
Private health centre	11	44.5	60.1	60.1	29.5	22.4	6	53.2	40.3
FBO health centre	8	16.3	45.9	45.9	23.5	13.9	7	28.1	16.6
Overall (% of facilities)	271	16.4	25.7	26.4	27.2	12.6	238	26.3	12.1
Overall (% of cesareans)	-	4.1	7.8	8.6	21.9	9.7	-	-	-

*Defined as surveyor having observed a 24 hour staff rota.

†Not defined in survey; this would depend on the definition of the respondent for the cesarean component of the questionnaire (who should be “the person most knowledgeable about [cesarean] services in the facility”).

‡Defined as staff being listed as present when surveyors went through each department in the facility.

§Defined as provider reporting to provide surgical and delivery care.

Infrastructure and equipment

The availability of basic infrastructure was relatively poor among facilities reporting to provide cesareans: Only 58% had piped water into the facility, and 77% had a consistent electricity supply (Table 18, page 52). These facilities performed 57% and 88% of all cesareans in Tanzania, respectively. Piped water into a facility is important for infection control, and especially so in the context of surgical interventions, where providers need to scrub in to prevent postsurgical sepsis; electricity is important to ensure appropriate lighting in the operating theater, administer the anesthesia, and monitor the client’s vital signs during general anesthesia.

In contrast, blood transfusion services were reported to be widely available at facilities performing cesareans, with 99% of cesareans performed in facilities capable of transfusing blood. Blood transfusions are important for hemorrhage management in the context of surgical delivery, given the potentially substantial blood loss prior or during the cesarean. Around 43% of facilities performing cesareans had a dedicated cesarean theater; this figure was lower among private hospitals (23%) and

Table 18: Availability of basic and surgical infrastructure among facilities reporting that they provide cesareans, according to facility type

Facility type	No of facilities reporting that they provide cesareans	Piped water*	24-hour electricity†	Blood transfusion services available	Dedicated cesarean theater	All CEmOC signal functions
Public hospital	112	66.0	88.4	98.2	45.7	55.3
Private hospital	31	61.7	93.6	87.0	22.7	25.8
FBO hospital	84	54.6	72.7	95.2	46.5	40.5
Public health center	25	47.1	42.0	72.9	45.1	23.5
Private health center	11	55.0	84.3	67.2	51.7	13.9
FBO health center	8	43.4	69.4	54.5	34.6	19.2
Overall (% of facilities)	271	57.8	77.3	87.7	43.4	38.5
Overall (% of cesareans)	-	57.0	88.1	98.6	57.6	61.8

*Defined as having piped water into the facility.

†Defined as being consistently connected to the national grid (no more than two-hour interruptions) or being sometimes connected to national grid, with a functional back-up generator with fuel.

FBO health centers (35%) than among other facility types. Having a dedicated cesarean theater is an indicator of the quality of services: First, it avoids “third delays” due to other teams occupying the theater and the additional travel time from the maternity ward to the main facility operating theater, which requires transport staff, monitoring en-route, portable oxygen, and portable fetal monitoring. Furthermore, they are more likely to be set up for cesarean sections and neonatal resuscitation specifically, minimising further delays and clinical errors due to missing equipment and inadequate supplies.

Overall, 39% of facilities performing cesareans had performed all nine CEmOC functions in the last three months, accounting for 62% of all cesareans. Most often, facilities were lacking one of the basic signal functions, but the majority had performed blood transfusions and at least one cesarean in the last three months.

The availability of functional equipment for general anesthesia was higher for oropharyngeal airway, tubings and connectors for endotracheal tube, and oxygen concentrator (84–89% of facilities) than for endotracheal tube, anesthesia giving set, intubating stylet, and Magills forceps (70–76% of facilities), as shown in Table 19 (page 53). It is striking that 11.5% of facilities providing cesareans—accounting for 13% of all cesareans performed in Tanzania—did not have a functional oxygen concentrator. Overall, fewer than half (44%) of facilities providing cesareans had all seven pieces of equipment functional and available in the operating theater, with 46% of all cesareans being performed in such facilities. Eighty-three percent of facilities had a needle for spinal anesthesia available in the theater. Although 96% of cesareans at a referral hospital in Dar es Salaam were conducted under spinal rather than general anesthesia (Eriksson et al., 2015), many lower-level facilities may routinely conduct cesareans under general anesthesia. Furthermore, all facilities need to be equipped for general anesthesia for every surgery done under regional (spinal or epidural) block anesthesia, in case of complications (such as cardiorespiratory arrest occurring as a result of “high spinal” complication).

Table 19: Percentage of facilities with functional equipment for general and spinal anesthesia, by facility type

Facility type	No. of facilities reporting that they provide cesareans	General anesthesia								Spinal anesthesia
		Anesthesia giving set	Endotracheal tube (adult)	Intubating stylet	Magill forceps (adult)	Oropharyngeal airway (adult)	Tubings + connectors for endotracheal tube	Oxygen concentrator	All general anesthesia equipment available	Spinal needle
Public hospital	112	67.2	73.3	60.8	63.4	83.2	80.4	91.8	34.1	77.8
Private hospital	31	93.6	93.4	80.6	80.6	93.4	93.4	77.0	61.0	93.4
FBO hospital	84	79.9	84.6	82.2	85.8	92.9	88.2	95.2	65.5	90.5
Public health center	25	66.9	67.6	60.9	61.1	82.4	79.5	84.6	25.1	74.3
Private health center	11	92.8	73.8	91.2	56.7	100.0	84.1	82.8	39.5	91.5
FBO health center	8	51.6	33.5	49.8	65.5	90.4	75.1	74.1	23.9	73.3
Overall (% of facilities)	271	74.7	75.5	70.7	70.3	88.6	83.7	88.5	44.0	83.3
Overall (% of cesareans)	—	79.3	79.1	67.0	70.3	86.3	85.2	87.2	45.6	85.5

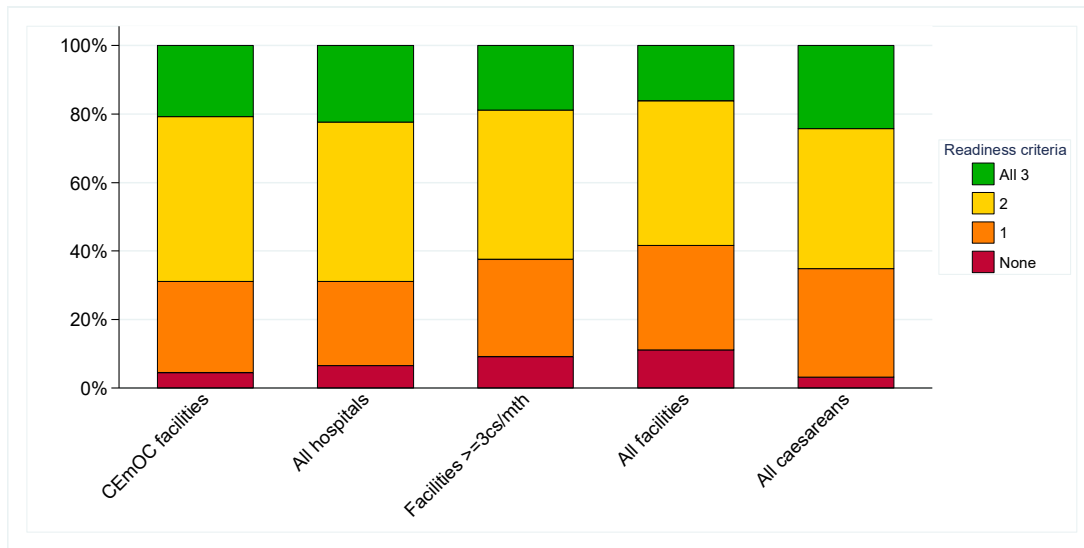
Minimum readiness criteria

We examined the proportion of facilities meeting all three minimum readiness criteria (piped water and consistent electricity, availability of all general anesthesia equipment, and 24-hour rota for cesarean provider and anesthetist) (Table 20 and Figure 11, page 54). Among all facilities reporting that they provide cesareans, only 16% of facilities met all three criteria. This proportion was higher among FBO hospitals (27%) than among public or private hospitals (20% in both categories). None of the health centers providing cesareans met all three criteria. Around 10% of all facilities providing cesareans did not meet any of the minimum readiness criteria. Our findings were similar when examining CEmOC facilities or facilities performing at least three cesareans per month only.

Table 20: Percentage of facilities meeting minimum readiness criteria (and 95% confidence intervals), by facility type

Facility type	[1] Both electricity and water	[2] I AND all general anesthesia equipment available	[3] 2 AND 24hr rota for cesarean provider and anesthetist present
Among all facilities reporting to provide cesareans (N=271)			
Public hospital	58.9 (49.5–67.6)	22.3 (15.6–30.9)	19.6 (13.2–28.0)
Private hospital	55.3 (37.9–71.6)	35.7 (21.0–53.7)	19.6 (9.1–37.4)
FBO hospital	36.8 (27.2–47.6)	28.5 (19.9–39.1)	27.3 (18.8–37.7)
All hospitals	50.3 (43.8–56.7)	26.5 (21.1–32.6)	22.4 (17.4–28.3)
All health centers	34.4 (21.2–50.5)	12.9 (5.4–27.8)	0 (-)
Overall (% of facilities)	45.9 (39.6–52.3)	22.8 (18.0–28.4)	16.2 (12.4–20.9)
Overall (% of cesareans)	49.2 (40.5–59.5)	25.9 (18.4–35.2)	24.3 (16.9–33.5)
Among CEmOC facilities (N=113)			
Public hospital	56.5 (44.0–68.2)	16.2 (8.9–27.6)	16.2 (8.9–27.6)
Private hospital	38.5 (13.0–72.4)	25.8 (6.5–63.3)	25.8 (6.5–63.3)
FBO hospital	46.9 (31.0–63.4)	38.1 (23.5–55.2)	38.1 (23.5–55.2)
All hospitals	51.9 (42.4–61.4)	24.1 (16.8–33.3)	24.1 (16.8–33.3)
All health centers	12.1 (1.6–52.9)	0 (-)	0 (-)
Overall (% of facilities)	46.4 (37.1–55.9)	20.7 (14.3–29.1)	20.7 (14.3–29.1)
Overall (% of cesareans)	49.1 (34.7–63.6)	23.0 (13.8–35.8)	23.0 (13.8–35.8)
Among facilities performing at least 3 cesareans per month (N=229)			
Public hospital	58.8 (49.2–67.7)	22.3 (15.4–31.2)	20.5 (13.9–29.2)
Private hospital	59.5 (38.5–77.5)	40.9 (22.8–61.9)	18.3 (7.0–40.0)
FBO hospital	37.1 (27.2–48.3)	28.2 (19.3–39.2)	26.8 (18.2–37.7)
All hospitals	50.8 (44.0–57.5)	26.6 (21.0–33.0)	22.6 (17.4–28.8)
All health centers	19.3 (7.1–42.7)	6.0 (0.8–32.2)	0 (-)
Overall (% of facilities)	45.5 (38.9–52.3)	23.2 (18.1–29.1)	18.8 (14.4–24.3)
Overall (% of cesareans)	49.2 (38.9–59.5)	25.9 (18.4–35.3)	24.4 (17.0–33.7)

Figure 11: Percentage distribution of facilities, by number of minimum readiness criteria met, according to type of facility



Overall, only 24% of all cesarean deliveries in Tanzania are carried out at facilities meeting the three minimum readiness criteria, while more than one-third are performed at facilities meeting at most one of these criteria.

Geographic distribution of cesareans and facility capacity in Tanzania

The geographic distribution of cesarean sections in Tanzania does not mirror the distribution of births (Figure 12). The Lake Zone in the North accounts for one-third of births, but only 17% of cesareans. Conversely, 14% of all births took place in the Western Zone (which includes Dar es Salaam), compared with 24% of all cesareans. This suggests that cesarean sections are not equitably distributed within Tanzania (assuming that the distribution of the need for cesareans does not vary substantially across zones).

Figure 12: Percentage distribution of all births (left) and of all cesarean deliveries (right) in Tanzania, by zone

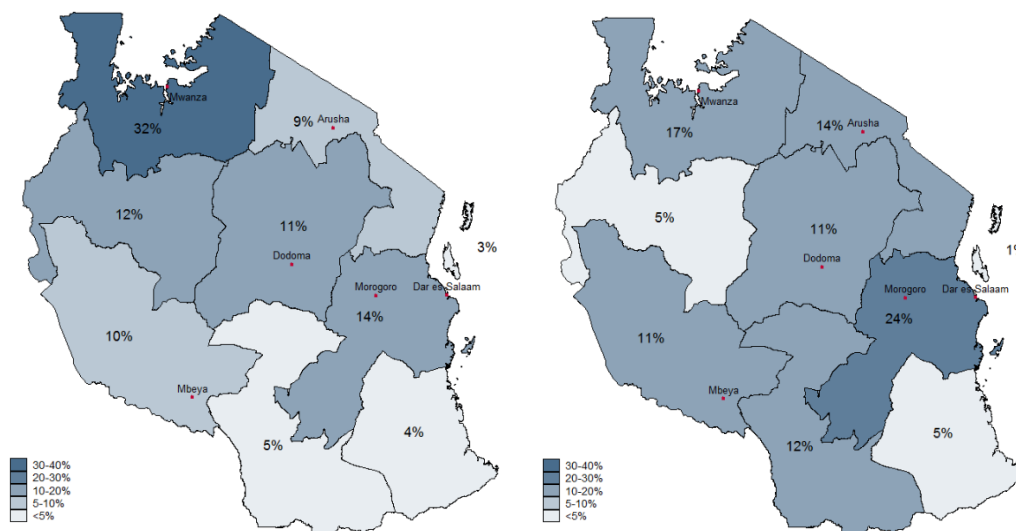
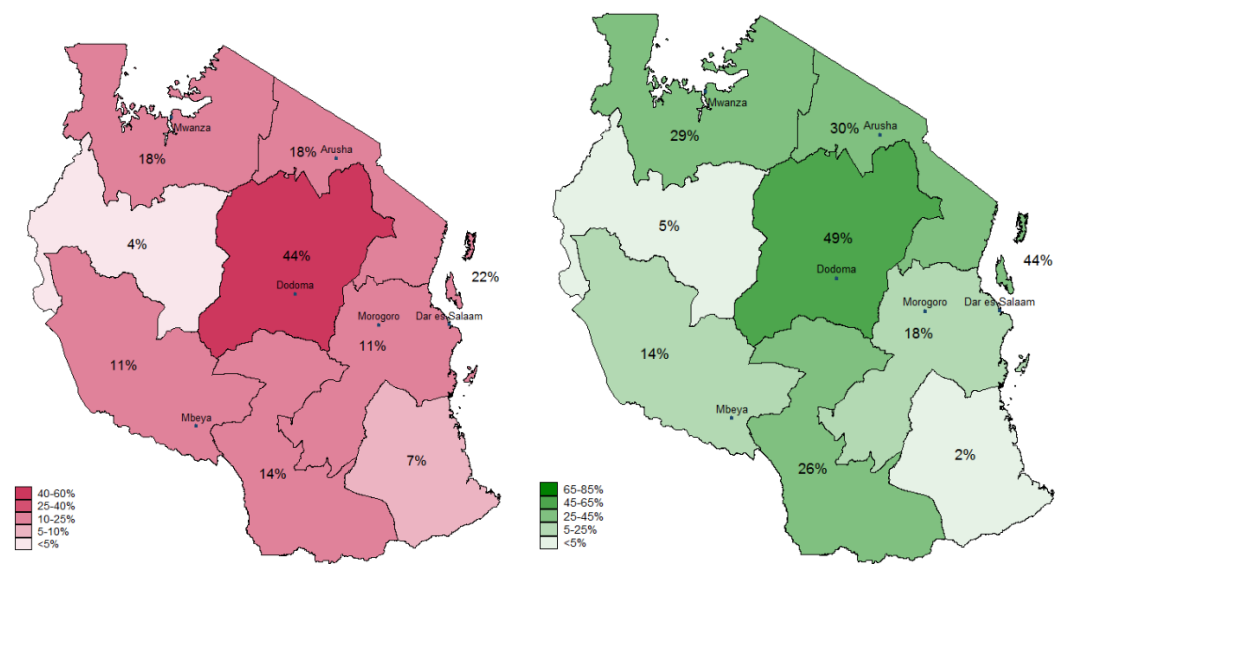


Table 21: Percentage of facilities meeting minimum readiness criteria and percentage of cesarean deliveries at such facilities, by criterion, by zone

Zone	% of health centers and hospitals reporting that they provide cesareans	Availability of running water and electricity		Availability of all equipment for general anesthesia		Availability of 24-hour anesthetist and cesarean provider		Availability of all 3 minimum criteria	
		% of facilities	% of cesareans	% of facilities	% of cesareans	% of facilities	% of cesareans	% of facilities	% of cesareans
Lake	32.4	40.0	45.8	42.6	61.6	75.2	93.1	18.2	28.7
Northern	24.9	67.3	55.5	53.2	58.5	65.2	90.5	17.8	30.3
Western	40.0	39.0	60.2	18.9	16.7	82.4	91.9	4.0	4.6
Central	27.2	66.5	66.3	55.2	54.8	77.5	92.0	44.2	49.1
Southwestern Highlands	30.0	31.9	32.4	45.4	50.2	75.9	90.4	10.6	13.5
Southern Highlands	28.2	27.8	49.8	41.7	38.0	83.4	96.5	13.9	26.1
Eastern	40.0	40.3	41.8	49.8	36.8	73.4	91.9	10.9	18.2
Southern	28.5	41.3	58.9	13.8	11.7	61.9	78.0	6.9	2.3
Zanzibar	17.2	77.8	79.3	44.4	56.2	55.6	65.7	22.2	44.4
All regions	30.5	45.9	49.2	44.0	45.6	73.6	91.4	16.2	24.3

Wide variations were observed in the percentage of facilities meeting all three minimum readiness criteria (Table 21 and Figure 13), with at most 18% of facilities in all zones except for the Central Zone (which includes Dodoma, the capital), where this proportion was 44%. Similarly, the percentage of all cesareans in each zone that occurred in facilities meeting all three readiness criteria varied substantially, from only 2% in the Southern Zone and 5% in the Western Zone, but still at most less than half (49%) of cesareans in the Central Zone.

Figure 13: Percentage of facilities performing cesareans that meet three minimum readiness criteria (pink) and percentage of all cesareans performed at such facilities (green), according to zone



Limitations

While this analysis benefited from the availability of dozens of DHS survey datasets and an SPA survey in Tanzania, it faced some important limitations. Many LMICs in Sub-Saharan Africa and South and Southeast Asia do not have a recent DHS survey and were excluded from this analysis. Furthermore, we did not assess the landscape of cesarean sections in LMICs outside of these two regions. Among the included countries, the most recent surveys were collected between 2006 and 2015, meaning that estimates for some countries might reflect the current situation less precisely. One of the most important limitations of the DHS data is that all of the information about live births is collected from women and is based on self-report. This means, first, that these data do not reflect the experiences of women who died between a birth and the survey and of women who had miscarriages and stillbirths. Second, women were asked to recall information for up to five years before the survey. Some of this information has been shown to have relatively poor validity (mostly lacking specificity), especially for questions that ask women to recall the circumstances surrounding intrapartum care and clinical aspects of care provision (Blanc et al., 2016; Tunçalp et al., 2013; Liu et al., 2013; Stanton et al., 2013). In terms of the multicountry analysis, issues of recall validity particularly affect women's ability to know and recall the skill level of their delivery attendant. Finally, DHS questionnaires and datasets often conflate conceptually different categories, such as medical doctors with nonphysician clinicians and, within the nonpublic sector, tertiary and lower-level facilities.

As with the other DHS questions on childbirth, the extended questions on circumstances surrounding cesareans in the Bangladesh DHS are self-reported, asking women to report information sometimes from several years back, raising questions about the validity of responses. Some self-reported information may be more valid than other data; for example, women may more accurately recall the time of day at which the cesarean delivery occurred than the day of the week itself. The reported reasons for cesareans include nonclinical reasons, have limitations, and are not always coherent with the timing of the decision; therefore, these should be interpreted with caution and cannot be assumed to be the “true” clinical indication for the cesarean. It is worth noting that previous DHS questionnaire versions included questions on delivery complications that were subsequently removed after they were shown to have poor validity (Maheu-Giroux et al., 2015).

Various sections of the Tanzania SPA questionnaire were administered to a range of people, and the responses reported by different providers may not be consistent. Surveyors were instructed to ask the questions on cesarean delivery to “the person most knowledgeable about such services in the facility,” without specifying who this person should be (for example, the head of obstetrics in a hospital, or the midwife in-charge in a health center), and the questionnaire does not record the position of the person who was actually interviewed in each facility. Furthermore, no instructions were given as to how the number of cesareans or vaginal deliveries conducted at the facility was to be ascertained (clinical records, verbal recall). Additionally, the section of the questionnaire on cesarean delivery was only asked at facilities for which the answer “yes” for cesarean delivery was given to the question “Does this facility offer any of the following client services? In other words, is there any location in this facility where clients can receive any of the following services.” However,

some respondents may have confused this question asking about the general availability of cesareans for one asking about their availability on the day of the survey. If no doctor or anesthetist was present at the time of survey, the respondent might have answered “no,” and thus facilities could have been misclassified as not providing cesareans at all, thereby underestimating the percentage of facilities offering this service. The lack of clarity of this question may explain why a substantial proportion of public hospitals (23%) and FBO hospitals (7%) reported not providing cesarean sections, although this estimate is in line with the 25% of hospitals which had not performed all CEmOC functions reported in the 2012 Service Availability and Readiness Assessment (MOHSW, 2013). Any underestimate of the number of hospitals providing cesareans may in turn have biased our estimate of service readiness. In the SPA, no data were collected on equipment available other than for anesthesia or advanced neonatal resuscitation. It would be important to also collect information on the availability of an operating table/light, gloves in the theater where cesareans are performed, and basic neonatal resuscitation equipment (bag and mask, dry towel, and bulb suction device), which are recommended as minimum equipment in low-resource settings (Newton & English, 2006).

Key Findings and Research Implications

This analysis of data from 44 LMICs shows a wide variation in cesarean section rates between and within countries. Of particular importance are the large within-country regional differences in cesarean section rates, which potentially identify regions with rates that are too low, indicating a lack of access to this lifesaving intervention. On the other hand, several countries had substantially higher cesarean section rates in nonpublic facilities compared with public facilities; further research into the reasons for this phenomenon is needed, as it might signal that unnecessary cesarean sections are being conducted. We were able to consider the cadre of provider who assisted women with their cesarean sections. While the data underpinning this analysis have several limitations, our findings show that substantial proportions of women, especially in Sub-Saharan African countries, report having had cesarean sections conducted by health professional cadres lower than doctors or nonphysician clinicians. Whether this reflects the country-specific realities of task shifting or not, it indicates a need to better capture and understand the implications of such practices on the quality of cesarean section care. The DHS does not systematically collect data on pregnancy and delivery complications in general or on cesarean section indications in particular. However, the cursory perspective of nine proxy risk factors highlighted potential overuse of cesarean sections, particularly driven by primiparity, which has negative implications across the reproductive life course and beyond (Guise et al., 2004; Tahseen & Griffiths, 2010; Wanyonyi & Ngichabe, 2014; Cook et al., 2013; Lindquist et al., 2017; McDonagh, Osterweil, & Guise, 2005).

In a detailed analysis of time trends over a period of 18 years from Bangladesh, we found rapid increases in the national cesarean rate, particularly among wealthy and urban women. This was driven by a rise in deliveries at nonpublic facility and an increase in the cesarean rate at nonpublic facilities, resulting in a seven-fold increase in the absolute number of cesareans performed annually. Self-reported data from the most recent DHS suggest that cesareans are more concentrated during regular working hours in public than in nonpublic facilities and that doctors suggest the cesarean in more than two-thirds of surgical deliveries. Almost one in five cesareans were suggested by a doctor more than a week before delivery. While these data should not be used to infer the indications or appropriateness of individual cesareans, they identify important directions of future research into clinical practice, incentives for cesarean sections, and the quality of intrapartum care overall.

Over the 25-year period up to 2015, the national cesarean rate in Tanzania also increased, albeit at a slower pace and to lower absolute levels than in Bangladesh. Currently, approximately 140,000 cesarean sections are conducted in Tanzania annually, and this number is likely to rise rapidly with population growth, an increase in the proportion of births occurring at health facilities, an increase in the share of the nonpublic sector, and provision of cesarean section to marginalized regions where rates of this surgery indicate unmet need for emergency obstetric care. This will require highly skilled health professionals and well-equipped facilities. In 2015, more than 90% of all cesareans were performed in public or FBO hospitals and around half in high-volume facilities (with more than 60 cesareans per month). However, the availability of basic infrastructure and equipment among facilities providing cesareans was poor, with only a quarter of cesareans nationally conducted

in facilities with piped water and consistent electricity, all equipment available for general anesthesia, and 24-hour coverage of a provider and anesthetist.

Policy and Program Implications

The findings of this secondary analysis raise important concerns regarding the distribution and oversight of material, human, and other resources for the safe provision of cesarean section care. For example:

- If increasing rates and absolute numbers of cesarean section procedures documented in many countries have not been accompanied by comparable increases in surgical infrastructure, equipment, supplies, and staffing, health systems will find it difficult to maintain the safety and quality of these procedures. The low proportion of cesareans in Tanzania performed at facilities meeting even minimum readiness criteria suggests that this concern is valid.
- The higher cesarean section rates in urban settings and in nonpublic facilities, a phenomenon seen in most countries included in this analysis, and the extent of variation in rates across settings indicate that decisions about operative delivery may be made based on criteria other than medical necessity. Nonpublic facilities, in particular, may also be outside the current scope and capability of much national health system regulation and monitoring.
- The underrepresentation of women with multiple obstetric risk factors and the overrepresentation of primiparous women among those delivering by cesarean section may reflect clinical decision making without appropriate or standardized guidance, as well as a failure to give women complete information about the risks and benefits of cesarean section delivery at the time they provide informed consent for the procedure. Additionally, the cost of unnecessary cesarean sections has enormous implications for both households and health systems, especially as cesarean deliveries among primiparae are likely to lead to repeat cesareans throughout women's reproductive life-course.
- The apparent variation in who performs cesarean sections by region, country, and facility setting may be a consequence of inequitable human resource gaps, policy-driven or "de facto" task shifting, or other pressures on health facilities and providers.

The findings of this analysis have important limitations, as described above, and must be considered in context with information from other national data sources. However, they demonstrate the need for improved monitoring of cesarean section in the public and nonpublic sectors, as well as a comprehensive health system response to help ensure the safety and quality of this widely performed procedure with important consequences for maternal and newborn health. The proposed elements of such a response are described in the report of the technical consultation convened by the *Fistula Care Plus* Project and the Maternal Health Task Force (2017). The elements most relevant to the findings of this report are:

1. The need to build bridges between the maternal health and safe surgery communities
2. The necessity to establish criteria and accreditation processes for facilities providing cesarean section
3. The importance of investing in expanding the surgical, anesthesia, and obstetric workforce
4. The development of evidence-based guidelines for labor management and decision making on cesarean delivery

Appendixes

Appendix 1. Questions related to cesarean section asked of women whose last birth was by cesarean, 2014 Bangladesh DHS

435	Was (NAME) delivered by caesarean section, that is, did they cut your belly open to take the baby out?	YES 1 NO 2 (SKIP TO 435i) ←
435A	What day of the week was the birth birth delivered by caesarean section?	SUNDAY 01 MONDAY 02 TUESDAY 03 WEDNESDAY 04 THURSDAY 05 FRIDAY 06 SATURDAY 07
435B	At what time of day was the caesarean section or operation done?	06:01 AM TO 09:00 AM 01 09:01 AM TO 12:00 NOON 02 12:01 PM TO 02:00 PM 03 02:01 PM TO 04:00 PM 04 04:01 PM TO 06:00 PM 05 06:01 PM TO 09:00 PM 06 09:01 PM TO 12:00 AM 07 12:01 AM TO 03:00 AM 08 03:01 AM TO 06:00 AM 09
435C	How many days before the delivery was the decision to have caesarean section made?	THE DAY OF DELIVERY 1 THE DAY BEFORE DELIVERY 2 2 - 7 DAYS BEFORE DELIVERY 3 8 - 30 DAYS BEFORE DELIVERY 4 30+ DAYS BEFORE DELIVERY 5

435D	Who proposed first to have the birth delivered by caesarean section, you, a family member or a doctor?	RESPONDENT 1 (SKIP TO 435F) ← FAMILY MEMBER 2 DOCTOR 3
435E	Were you or your family told the reasons for having the operation?	YES 1 NO 2 (SKIP TO 435G) ←
435F	What were the reasons for making the decision to have the operation? Any other reason? CIRCLE ALL MENTIONED.	CONVENIENCE A DO NOT WANT TO GO THROUGH LABOR PAIN B MAL PRESENTATION C PREMATURE BABY D CORD PROLAPSED E MULTIPLE BIRTHS F FAILURE TO PROGRESS IN LABOR G PRE-ECLAMPSIA H DIABETES I PREVIOUS C/S J LESS PRESSURE ON BABY'S BRAIN K OTHER COMPLICATIONS DURING DELIVERY L OTHER X

Appendix 2. Estimated percentage of cesarean sections among all live births in the survey recall period and among the most recent live births in the recall period

	All births in recall period*		Most recent birth in recall period		Sample size	
	Estimate	95% CI	Estimate	95% CI	All births	Most recent births
Sub-Saharan Africa						
Benin	5.4	4.88–6.02	6.2	5.56–6.87	13,192	8,993
Burkina Faso	1.9	1.63–2.28	2.3	1.92–2.66	15,375	10,487
Burundi	4.0	3.41–4.64	4.8	4.06–5.59	7,981	5,063
Cameroon	3.8	3.23–4.54	4.7	4.06–5.48	11,747	7,647
Chad	1.4	1.13–1.72	1.5	1.21–1.81	18,635	11,140
Comoros	9.7	8.00–11.61	11.2	9.34–13.28	3,235	2,064
Congo-Brazzaville	5.8	4.80–6.91	6.5	5.42–7.74	8,170	5,882
Côte d'Ivoire	2.8	2.20–3.43	3.2	2.58–3.95	7,492	5,244
Dem. Rep. of Congo	5.2	4.33–6.13	5.8	4.93–6.86	18,390	11,065
Ethiopia	1.5	1.14–1.91	1.8	1.38–2.41	11,872	7,908
Gabon	10.1	8.25–12.22	11.1	9.06–13.54	5,122	3,702
Gambia	2.0	1.57–2.56	2.4	1.94–3.06	7,906	5,305
Ghana	12.8	11.35–14.40	13.6	12.12–15.16	5,695	4,142
Guinea	2.4	1.96–3.02	2.8	2.27–3.46	7,067	4,995
Kenya	8.7	7.94–9.47	9.6	8.88–10.47	19,564	14,442
Lesotho	9.7	8.46–11.08	10.3	9.00–11.72	3,112	2,575
Liberia	3.9	3.19–4.70	4.3	3.54–5.17	6,502	4,769
Madagascar	1.5	1.15–1.85	1.7	1.36–2.18	12,686	8,662
Malawi	4.6	4.18–5.01	5.1	4.68–5.61	19,697	13,664
Mali	2.7	2.25–3.18	3.2	2.67–3.78	10,402	6,773
Mozambique	3.9	3.43–4.49	4.5	3.89–5.13	11,704	7,874
Namibia	14.6	13.26–15.95	15.5	14.11–17.01	4,804	3,842
Niger	1.4	1.15–1.70	1.7	1.36–2.01	13,347	8,002
Nigeria	2.1	1.79–2.36	2.4	2.09–2.73	31,826	20,467
Rwanda	13.0	11.93–14.07	13.1	12.07–14.14	8,004	6,060
Sao Tome and Principe	5.3	3.98–7.06	5.5	4.20–7.14	1,834	1,386
Senegal	4.6	3.88–5.54	5.8	4.86–6.97	6,334	4,348
Sierra Leone**	—	—	4.1	3.46–4.79	12,198	8,647
Swaziland	7.9	6.81–9.19	8.2	7.05–9.60	2,829	2,134
Tanzania	5.9	5.16–6.77	7.0	6.11–7.93	10,052	7,079
Togo	6.5	5.68–7.50	7.4	6.48–8.44	6,706	4,858
Uganda	5.3	4.57–6.09	6.1	5.30–7.08	8,077	4,968
Zambia	4.4	3.95–4.93	5.2	4.65–5.81	13,383	9,324
Zimbabwe	5.9	5.01–6.82	6.1	5.28–7.03	6,418	4,988
South/Southeast Asia						
Bangladesh (2011)	14.1	12.81–15.43	15.1	13.79–16.48	8,789	7,350
Cambodia	3.0	2.46–3.60	3.2	2.68–3.93	8,200	6,472
India	8.5	8.02–8.93	9.8	9.26–10.29	56,438	39,677
Indonesia	12.4	11.49–13.41	12.8	11.86–13.76	16,948	14,782
Maldives	32.4	30.18–34.78	33.7	31.39–36.09	3,736	3,190
Nepal	4.6	3.72–5.68	5.2	4.27–6.36	5,391	4,148
Pakistan	7.3	6.49–8.21	8.5	7.61–9.48	9,120	5,677
Philippines	9.6	8.53–10.71	11.5	10.36–12.73	6,359	4,590
Timor-Leste	1.7	1.39–2.13	2.2	1.78–2.73	9,828	6,015
Vietnam	9.8	7.56–12.53	10.1	7.94–12.72	2,210	1,871

* Recall period is five years for all countries except Vietnam (three years).

** Mode of delivery was only asked for most recent birth; unable to estimate for all births in recall period.

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