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Caesarean section provision and readiness in Tanzania: analysis of cross-sectional surveys of women and health facilities over time

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ABSTRACT

Objectives To describe trends in caesarean sections and facilities performing caesareans over time in Tanzania and examine the readiness of such facilities in terms of infrastructure, equipment and staffing.

Design Nationally representative, repeated cross-sectional surveys of women and health facilities.

Setting Tanzania.

Participants Women of reproductive age and health facility staff.

Main outcome measures Population-based caesarean rate, absolute annual number of caesareans, percentage of facilities reporting to perform caesareans and three readiness indicators for safe caesarean care: availability of consistent electricity, 24 hour schedule for caesarean and anaesthesia providers, and availability of all general anaesthesia equipment.

Results The caesarean rate in Tanzania increased threefold from 2% in 1996 to 6% in 2015–16, while the total number of births increased by 60%. As a result, the absolute number of caesareans increased almost fivefold to 120 000 caesareans per year. The main mechanism sustaining the increase in caesareans was the doubling of median caesarean volume among public hospitals, from 17 caesareans per month in 2006 to 35 in 2014–15. The number of facilities performing caesareans increased only modestly over the same period. Less than half (43%) of caesareans in Tanzania in 2014–15 were performed in facilities meeting the three readiness indicators. Consistent electricity was widely available, and 24 hour schedules for caesarean and (less systematically) anaesthesia providers were observed in most facilities; however, the availability of all general anaesthesia equipment was the least commonly reported indicator, present in only 44% of all facilities (34% of public hospitals).

Conclusions Given the rising trend in numbers of caesareans, urgent improvements in the availability of general anaesthesia equipment and trained anaesthesia staff should be made to ensure the safety of caesareans. Initial efforts should focus on improving anaesthesia provision in public and faith-based organisation hospitals, which together perform more than 90% of all caesareans in Tanzania.

Strengths and limitations of this study

- This is the first known study to examine trends in the number of facilities performing caesareans over time in a sub-Saharan African country and to assess the readiness of these facilities to provide safe caesarean care using three indicators (availability of electricity, 24 hours providers and general anaesthesia equipment).
- Our study benefits from the availability of five consecutive Demographic and Health Surveys, nationally representative of Tanzanian women of reproductive age and of two Service Provision Assessments (SPA), nationally representative of Tanzanian health facilities, allowing us to examine trends over time.
- Unlike most SPA, the SPA in Tanzania collected information on the number of caesareans performed in each facility, enabling us to examine both the percentage of facilities meeting key readiness indicators as well as the percentage of all caesareans performed in such facilities.
- We were limited by the data collected in the SPA, which prevented us from examining availability of important equipment for surgery such as soap and running water, gloves or bag and mask for neonatal resuscitation.

INTRODUCTION

Uptake of skilled care during childbirth has increased in sub-Saharan Africa; however, maternal mortality in the region remains high at 546 per 100 000 live births, accounting for two-thirds of maternal deaths globally.[1] Persistently high maternal mortality raises concerns regarding the quality of delivery care provided in facilities in the region. Previous multicountry studies have shown that facilities in East Africa, for instance, often lack basic infrastructure and their readiness to provide care for complications or to refer patients is limited.[2–4]

Caesarean sections are an essential, potentially life-saving component of delivery care,

but they also entail risks.[5] Despite extensive debate around the appropriate level of caesarean rates[6] and increasing interest in the quality of delivery care,[7–9] little attention has been paid to the safety of caesareans. The global safe surgery movement has highlighted poor access to surgery and inadequate conditions in low-resource settings, and the Lancet Commission on Global Surgery called for integration of efforts between the surgical, obstetric and anaesthesia (SAO) communities.[10] Caesareans are the most commonly performed surgery accounting for one-third of all operations in Africa, with higher postoperative morbidity and mortality than in other regions.[11] In addition, many caesareans in sub-Saharan Africa are performed as emergency interventions and at more advanced stages of labour, carrying higher risks than planned caesareans[12 13]—likely due to limited risk screening during antenatal care and delays in reaching a facility performing caesareans.[14 15]

Tanzania is a good case study for assessing caesarean provision and readiness because, like most countries in sub-Saharan Africa, maternal mortality did not decline sufficiently to meet the Millennium Development Goal for maternal health,[1] and was estimated at 398 maternal deaths per 100 000 live births in 2015.[16] Maternal mortality from direct obstetric causes was strongly associated with distance to the nearest hospital in southern Tanzania, while caesarean deliveries decreased with distance.[17 18] Hospitals and selected health centres, but not dispensaries, can perform caesareans under national guidelines.[19] Within facilities, readiness for and availability of emergency obstetric care is low[3 20] (particularly in health centres[21]) and varies across regions.[22]

To our knowledge, no studies have examined the equipment and infrastructure of facilities providing caesarean care at the national level in Tanzania, although small-scale studies have found suboptimal anaesthesia care,[23] long decision-to-delivery intervals for emergency caesareans,[20 24] and inconsistent administration of prophylactic antibiotics.[25] There is some evidence that adverse outcomes among women following caesarean delivery are relatively common, with 11% incidence of surgical site infections in one hospital.[26] Moreover, a substantial proportion of maternal deaths and near-misses were found to have undergone a caesarean with delay or for inappropriate indications in a rural referral hospital.[27] The population of Tanzania has furthermore doubled in the last two decades,[28] requiring increases in infrastructure and personnel to maintain existing health service coverage levels. The Ministry of Health set a target for 100% of public hospitals and 50% of public health centres to be equipped for comprehensive emergency obstetric care, including caesareans, by 2015.[19] However, little is known about changes in the capacity to perform caesareans in facilities over time or their readiness to provide safe caesarean care.

The objective of this study is to describe trends in caesarean sections and facilities performing caesareans over time and to examine the current readiness of facilities performing caesareans in terms of staffing, equipment and infrastructure.

METHODS

Data sources

Two main data sources were analysed separately for this study. We used data from five Demographic and Health Surveys (DHS) conducted in Tanzania (1996, 1999, 2004–05, 2010 and 2015–16). The DHS are nationally representative surveys of women of reproductive age (15–49 years), which collect delivery information for live births within a 5-year recall period. Response rates were at least 96% in all surveys.

We used data from two Service Provision Assessments (SPA) conducted in Tanzania (2006 and 2014–15). The SPA in Tanzania are nationally representative surveys of health facilities of all sectors (government, parastatal, faith-based organisations (FBOs) and private for-profit) and levels (hospitals, health centres and dispensaries/clinics). The SPA collect information on basic infrastructure and staffing, and on delivery care and caesarean sections from facilities reporting to provide these services. In the 2006 SPA, 612 facilities were sampled, compared with 1200 in 2014–15; the response rate was 99% for both surveys.

Definitions and data quality checks

Parastatal and governmental facilities were grouped as 'public'; we considered the 'non-public' sector to include private for-profit and FBO facilities in the DHS and SPA. Further, in the 2014–15 SPA, we disaggregated the non-public sector into FBO and private for-profit; this information was not available in the 2006 SPA.

We performed checks on facilities recorded as hospitals in the 2014–15 SPA which reported not performing caesareans or performing fewer than 10 deliveries in the previous month. We compared facility level and sector to those recorded in the national Health Facility Registry[29] linked by GPS coordinates and recoded two public hospitals as dispensaries, and one public and one FBO hospital as private.

Each facility's total monthly delivery volume was calculated as the sum of vaginal deliveries in the previous month and of caesareans in the previous 3 months divided by three. Hospitals with fewer than 10 recorded vaginal deliveries in the previous month were considered to have implausibly low delivery volume, and 8 hospitals were excluded from the calculation of total delivery volume and caesarean rate as a result. If these volumes were, in fact, correct, reported results would overestimate the total delivery volume and underestimate the caesarean rate in hospitals. Similarly, caesarean rates below 1% in public hospitals were considered implausibly low, and one such hospital was excluded from the analyses on delivery volume.

We report piped running water (from pipe, bucket with tap or pour pitcher) on the delivery ward, since no data were collected on water at the surgical theatre. We did not use proxies from other locations for movable equipment (such as soap or neonatal resuscitation equipment).

Similar to a recent study,[2] we examined three indicators of readiness necessary for safe caesarean care: consistent electricity; 24 hours schedule for both caesarean and

anaesthesia providers; and availability of all general anaesthesia equipment. Facilities were considered to have consistent electricity if they were connected to the national grid with no interruptions in the previous week or had a back-up generator with fuel or solar power. All general anaesthesia equipment was classified as available if the seven items in the questionnaire (anaesthesia machine, endotracheal tube, tubing for endotracheal tube, oropharyngeal airway, Magill forceps, intubating stylet and oxygen concentrator) were available and functional on the day of the survey.

Facilities were considered to have 24 hour caesarean and anaesthesia providers if they had an observed schedule for 24 hour presence or on-call availability of both these providers, as defined by each facility (the specific cadre was not collected by the SPA).

Analysis

Trends in caesarean rates over time

For each DHS, we calculated the population-based caesarean rate among live births in the 5-year recall period, stratified according to urban/rural residence, and the caesarean rate among live births in facilities, stratified by sector. The estimated annual number of live births for each survey recall period was calculated as the crude birth rate for the 5-year period multiplied by the mid-year population for each of the 5 years, obtained from the United National Population Department.[30 31] We then calculated the annual average number of caesareans in Tanzania based on the caesarean rate and annual number of births in each recall period. Women with any missing data for mode of delivery, place of delivery or birth attendant were excluded from the analysis (less than 1% of sample). These analyses took into account DHS sampling weights, clusters and strata.

Trends in facilities performing caesareans over time

The remaining analyses used SPA facility data. To estimate the absolute number of facilities performing caesareans, we multiplied the percentage of facilities reporting to provide caesareans in the 2006 and 2014–15 SPA by the total number of hospitals and health centres (all sectors) in Tanzania, as reported in the SPA sampling frames.[32 33] These sampling frames do not report facility numbers by level and sector jointly, we therefore obtained the number of public hospitals and public health centres from the 2005–06 Tanzania Service Availability Mapping[34] for 2006. We used the Health Facility Registry[29] for mainland Tanzania at the time of analysis (2018) and the Zanzibar Health Sector Strategic Plan[35] (2013, with no increases in facility numbers noted in the 2017 mid-term review[36]) as proxy for the national number of public hospitals and health centres in 2014–15. We calculated the median monthly caesarean volume for each facility type using SPA data.

Readiness of facilities performing caesareans in 2014–15

The Tanzania SPA collected information on the number of caesareans performed in each facility in the past three completed months,[33] allowing us to describe facility readiness weighted according to facilities (representative of all facilities reporting to perform caesareans) and according to caesarean caseload (representative of all caesareans in Tanzania).[2 37]

We calculated the percentage of facilities in 2014–15 that reported being capable of performing caesareans, according to facility sector and level. Unlike the analysis over time, specialist public hospitals not providing delivery care were excluded from this analysis. We calculated median monthly caesarean and total delivery volumes, median caesarean rate and the proportion of all caesareans conducted by facility type.

There were no missing data for readiness indicators presented in the analysis sample, with the exception of 14 (5%) predominantly private facilities with missing data on running water on the delivery ward, which were excluded from this indicator. Among facilities reporting to provide caesareans, we calculated the percentage employing at least one medical doctor or assistant medical officer (AMO), employing an anaesthesia provider and with a 24 hour schedule for caesarean and anaesthesia providers. We described the availability of basic and surgical infrastructure and of functional equipment for general anaesthesia. We calculated the percentage of facilities that met the three selected readiness criteria as well as the percentage of all caesareans performed in facilities meeting these criteria. Last, we examined geographic differences in readiness.

All analyses of facility data took into account SPA sampling weights in calculating percentages as well as clusters and strata for 95% CIs. Reported sample sizes are unweighted. A sensitivity analysis of readiness indicators was performed using rescaled weights based on the proportion of facilities performing caesarean sections by facility level (calculation described in online supplementary table 1a).

Patient and public involvement

We did not seek patient or public involvement for this secondary data analysis.

Ethical approval

The DHS Program received government permission for the Tanzania DHS and SPA and used informed consent from participants.

RESULTS

Trends in caesareans over time

Our analysis sample included a total of 36 379 live births between 1991 and 2016. The population-based caesarean rate in Tanzania increased from 2% in 1996 to 6% in 2015–16 (table 1, figure 1). The caesarean rate remained higher among women living in urban than rural areas, the gap widening over time. Although the absolute number of births increased by 60% over this period, the absolute number of caesareans performed in Tanzania increased

Table 1 Change in caesarean rate and absolute number of caesareans over time in Tanzania

DHS recall period	1991–1996	1994–1999	2000–2005	2005–2010	2010 to 2015–2016	Ratio 2015-2016:1996
Number of births in recall period	6466	3197	8530	7954	10232	–
Population-based caesarean rate	2.1%	3.0%	3.2%	4.5%	5.9%	2.8
Urban	4.2%	6.9%	7.9%	9.7%	11.8%	2.8
Rural	1.6%	2.1%	2.1%	3.2%	3.7%	2.3
Births in health facilities	47.9%	43.6%	47.0%	51.4%	64.3%	1.3
Facility births in public facilities	92.9%	84.6%	80.2%	80.0%	78.7%	0.8
Facility caesarean rate	4.3%	6.8%	6.9%	8.8%	9.2%	2.1
Public facilities	4.4%	6.2%	5.7%	8.1%	7.7%	1.8
Non-public facilities	4.1%	10.1%	11.5%	11.5%	14.7%	3.6
Average annual number of births during recall period*	1 238 592	1 323 149	1 550 822	1 780 787	1 995 125	1.6
Average annual number of caesareans in recall period	26010	39694	49626	80135	117712	4.5
Caesarean sections conducted in public sector	93.2%	77.3%	66.8%	73.8%	65.9%	0.7

*Source: UNPD data.
DHS, Demographic and Health Surveys.

almost fivefold, from 26000 per year to almost 120000 per year.

The caesarean rate among all facility births doubled from 4% to 9% between 1996 and 2015–16, with faster increases in non-public than public facilities (3.6-fold and 1.8-fold, respectively). However, most (79%) facility deliveries occurred in the public sector in the most recent DHS and two-thirds of all caesareans were conducted in public facilities in 2015–16, decreasing from 93% in 1996.

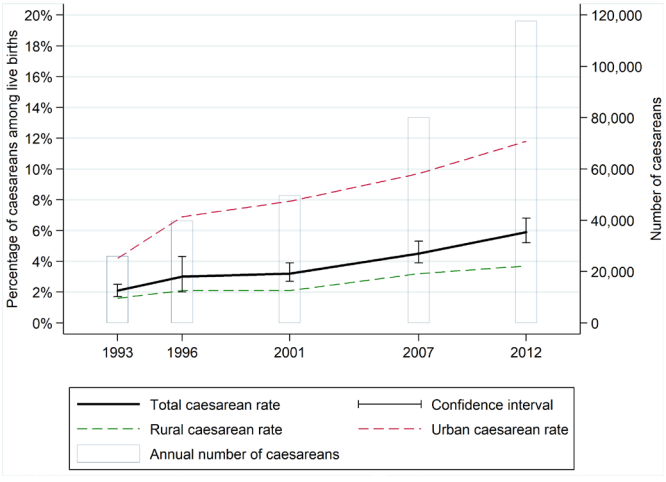

Figure 1 Caesarean section rate and annual number of caesarean sections over time in Tanzania for midpoint of each DHS survey's recall period. DHS, Demographic and Health Surveys.

Trends in facilities performing caesareans over time

Between 2006 and 2014–15, the total number of health facilities in Tanzania increased from 5663 to 7102. The total estimated number of facilities performing caesareans in Tanzania rose by 10% over the same period, from 278 in 2006 to 318 in 2014–15 (ratio: 1.1, table 2). Public health centres performing caesareans increased threefold, from 14 to 45, while the relative increase in public hospitals was smaller (ratio: 1.4). The median monthly volume in public hospitals doubled from 17 caesareans per month in 2006 to 35 in 2014–15 and increased from 1 to 5 monthly caesareans in public health centres.

Readiness of facilities performing caesareans in 2014–15

Caesarean volume

In 2014–15, 92% of all hospitals and 11% of all health centres reported providing caesareans (93% and 8%, respectively, for public facilities; table 3). None of the dispensaries sampled in the SPA reported performing caesareans, in line with national guidelines. Public and FBO hospitals had higher median caesarean volumes (35 and 23 caesareans per month, respectively) than health centres and private facilities. In contrast to absolute volume, the median caesarean rate was substantially higher in private (25%–30%) than public or FBO facilities (less than 20%), irrespective of facility level. Overall, two-thirds of all caesareans in Tanzania were performed in public hospitals and one quarter in FBO hospitals. Less than 5% were conducted in public health centres or private facilities.

Table 2 Change in number of facilities providing caesareans in Tanzania between 2006 and 2014–15

Facility type	2006				2014–15				Ratio 2014–15:2006	
	Total number of facilities in Tanzania (Data source*)	Percentage providing caesareans (95% CI) (SPA 2006)	Estimated number of facilities providing caesareans†	Median monthly caesarean deliveries (IQR) [SPA 2006]	Total number of facilities in Tanzania (Data source*)	Percentage providing caesareans (95% CI) (SPA 2014–15)	Estimated number of facilities providing caesareans†	Median monthly caesarean deliveries (IQR) (SPA 2014–15)	Number of facilities providing caesareans	Median monthly caesarean deliveries
Hospitals and health centres (all sectors)	751 (SPA 2006)	37% (29% to 47%)	278	12 (3–20)	1026 (SPA 2014–15)	31% (29% to 33%)	318	17 (5–36)	1.1	1.4
Hospitals (public sector only)	95 (SAM 2004–05)	87% (82% to 91%)	83	17 (9–29)	133 (HFR 2018; ZHSSP 2017)	88% (86% to 89%)	117	35 (22–61)	1.4	2.1
Health centres (public sector only)	341 [SAM 2004–05)	4% (1% to 25%)	14	1 (1–1)	567 (HFR 2018; ZHSSP 2017)	8% (6% to 10%)	45	5 (1–8)	3.2	5.0

Note: no dispensaries or clinics are reported in this table, since no facilities at these levels report performing caesareans.
*Facility numbers were obtained from the survey sampling frames, rather than the number of facilities surveyed in the SPA.
†Estimated by multiplying the total number of facilities by the percentage providing caesareans.
HFR, Health Facility Registry; SAM, Service Availability Mapping; SPA, Service Provision Assessment; ZHSSP, Zanzibar Health Sector Strategic Plan.

Public hospitals had a wide range of caesarean volumes (figure 2): 5% reported performing fewer than 10 caesareans per month, while one quarter reported more than 90 (>3 caesareans per day, on average). Patterns were similar but slightly lower in FBO hospitals. Among private hospitals, 97% performed fewer than 30 caesareans per month (<1 caesarean per day) and most health centres performed less than 10. Seven facilities reporting to perform caesareans had not performed any caesarean deliveries in the previous 3 months, including private hospitals and public and private health centres. High-volume facilities (more than 90 caesareans per month) represented only 10% of facilities performing caesareans, but performed around half of all caesareans in Tanzania.

Staffing

Almost all facilities (99%; 95% CI 98% to 99%) performing caesareans employed at least one provider licensed to perform caesareans (medical doctor or AMO, table 4). FBO hospitals and health centres were more likely to employ AMOs than medical doctors, while the opposite was true in private hospitals. Anaesthesia providers were less often available, employed in 85% of facilities providing caesareans (lowest among public hospitals, at 79%). Overall, three-quarters of facilities—accounting for 91% of all caesareans—had 24 hour schedules for both caesarean and anaesthesia providers; this figure was higher in hospitals than health centres (85%; 84%–85%, compared with 44%; 33%–56%). Generally, anaesthesia providers were less often available than caesarean providers.

Infrastructure and equipment

Consistent electricity was available almost universally among facilities providing caesareans (table 4); however, piped running water on delivery wards was lower, particularly among private hospitals and health centres of all sectors (58% for both). Almost all caesareans in Tanzania were conducted in facilities with access to an ambulance and with blood transfusion services, despite lower availability in health centres of all sectors. Overall, 43% of facilities had a surgical theatre dedicated to caesareans; this percentage was lowest among private hospitals. Less than half (44%; 41%–47%) of facilities performing caesareans had all equipment for general anaesthesia available, accounting for 46% (45%–47%) of caesareans nationally. Availability was higher in FBO and private hospitals than in public hospitals (34%) and health centres. Among the seven items assessed, availability was somewhat poorer for Magills forceps and intubating stylets (70%–71%) than for oxygen concentrators and oropharyngeal airways present in 88%–89% of facilities (online supplementary table 2). However, no single equipment item single-handedly explains the poor combined availability observed.

We examined three readiness criteria (consistent electricity, 24 hour staff availability and general anaesthesia equipment) in facilities performing caesareans. Overall, 99% of caesareans were performed in facilities

Table 3 Volume of caesarean sections according to facility type among facilities reporting to perform caesareans (SPA, 2014–15)

Facility type	Total facilities*	Facilities reporting to provide caesareans (%; 95% CI)	Median monthly total deliveries	Median monthly caesarean deliveries	Median percentage of caesareans deliveries (IQR)	Percentage of all caesareans performed by facility type (95% CI)
Hospitals (all sectors)	246	227 (92%; 92% to 93%)	189	25	18% (11%–24%)	95% (94% to 96%)
Public hospital	120	112 (93%; 93% to 94%)	260	35	17% (10%–23%)	65% (64% to 66%)
FBO hospital	89	84 (94%; 94% to 94%)	144	23	19% (12%–24%)	26% (25% to 26%)
Private hospital	37	31 (84%; 82% to 85%)	64	8	30% (21%–43%)	4% (4% to 4%)
Health centres (all sectors)	379	44 (11%; 9% to 14%)	55	2	10% (6%–25%)	5% (4% to 6%)
Public health centre	281	25 (8%; 6% to 10%)	71	5	8% (4%–10%)	3% (2% to 4%)
FBO health centre	65	8 (13%; 8% to 21%)	40	9	14% (11%–24%)	1% (1% to 3%)
Private health centre	33	11 (28%; 16% to 43%)	5	1	25% (0%–25%)	1% (0% to 1%)
Dispensary or clinic (all sectors)	555	0 (0%)	–	–	–	0
All facilities	1180	271 (5%; 4% to 5%)	150	17	17% (9%–25%)	100%
N facilities in analysis sample	1180	271	218	269	217	269

*Specialist public hospitals are excluded from total facilities.
FBO, faith-based organisation; SPA, Service Provision Assessment.

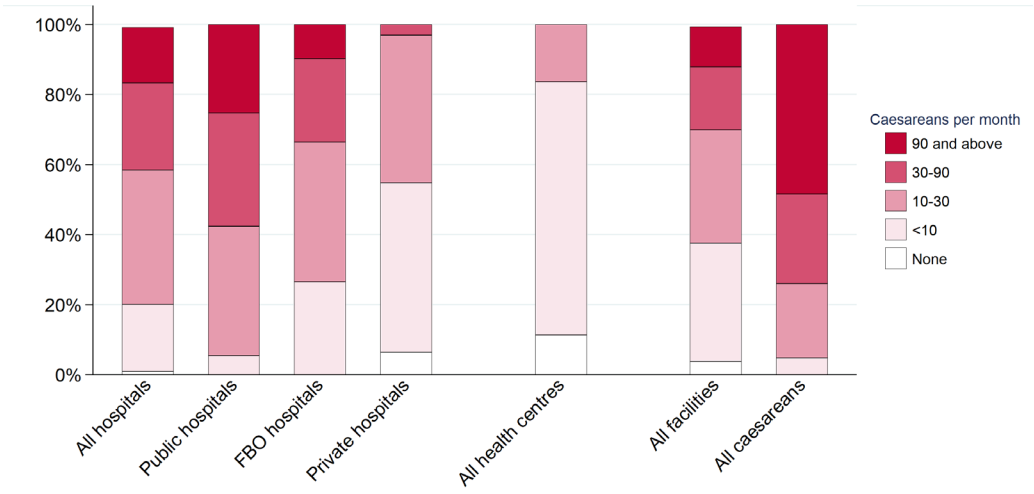

Figure 2 Distribution of caesarean section volume among facilities reporting to perform caesareans, according to facility type, and distribution of all caesareans according to facility caesarean volume. Note: All columns show percentages of facilities, except for the furthest right hand column which shows the percentage weighted by the number of caesareans in each facility and is therefore representative of all caesareans in all facilities in Tanzania. FBO, faith-based organisation.

with consistent electricity. Seventy-one per cent of facilities performing caesareans had consistent electricity and 24 hour schedules for caesarean and anaesthesia providers, accounting for 9 out of 10 of all caesareans in Tanzania. However, availability of all three readiness criteria reduced dramatically due to general anaesthesia equipment being poorly available across all facility types and sectors: only one-third (34%; 32%–36%) of all facilities met all three readiness criteria and less than half (43%; 42%–44%) of all caesareans were conducted in such facilities.

Geographic variation

Important regional variations in facility readiness to perform caesareans exist in Tanzania (figure 3). The smallest percentage of facilities meeting all three readiness criteria was found in the Southern (14%) and Western zones (19%), where only 12% and 17% of caesareans occurred in such facilities, respectively. In contrast, more than half of caesareans occurred in facilities meeting all three readiness criteria in Lake, Northern and Central zones. In most zones, general anaesthesia equipment was the least available, except in the Northern zone and Zanzibar where 24 hours schedules for caesarean and anaesthesia providers were less frequently available (online supplementary table 3).

Sensitivity analyses

Using rescaled weights resulted in slightly lower percentages of all facilities with caesarean and anaesthesia providers, but did not meaningfully change our findings (32% of facilities performing caesareans met all three readiness criteria, compared with 34% using SPA weights; online supplementary table 1b).

DISCUSSION

Key findings

Our findings show that the caesarean rate in Tanzania increased threefold from 2% in 1996 to 6% in 2015–16, while the absolute number of births increased by 60%. As a result, the absolute number of caesareans performed increased almost fivefold to 120 000 caesareans per year. Between 2006 and 2014–15, the total number of facilities providing caesareans increased marginally; the main mechanism sustaining the large increase in caesarean sections was a doubling in the monthly volume of caesareans performed in public hospitals. Overall, 90% of caesareans in Tanzania were performed in public or FBO hospitals in 2014–15. Less than half (43%) of all caesareans took place in facilities meeting all three readiness indicators. Consistent electricity, and to a lesser extent schedules for 24 hour provider availability, were widely available; however, general anaesthesia equipment was the least available indicator, present in only 44% of facilities.

Strengths and limitations

The main strength of our study stems from the analysis of five DHS and two SPA, providing complementary perspectives from women and facilities. Unlike most SPA, data on number of caesarean deliveries were collected in Tanzania. Similar to other analyses,[2 37] facility readiness improved when weighting by caesarean volumes rather than by facility types, because larger, better-equipped facilities perform a larger proportion of caesareans—highlighting the importance of collecting caesarean volume data.

Our study also has some limitations worth noting. The DHS do not collect mode of delivery for stillbirths, potentially overestimating the population-based caesarean rate. In addition, the 5-year recall period means that place of delivery may have been misclassified for some births, although it is reassuring that the estimate of two-thirds of caesareans performed in public sector facilities was consistent between DHS and SPA data. We were unable to examine trends in FBO facilities over time, which sometimes function as district or regional referral hospitals,

Table 4 Percentage of facilities with staffing, infrastructure and equipment indicators and 95% CIs, among facilities reporting to perform caesareans in Tanzania (SPA 2014–15)

	All hospitals	Public hospital	FBO hospital	Private hospital	All health centres	All facilities	Percentage of all caesareans performed in facilities meeting indicator
Number of facilities in analysis	**227**	112	84	31	**44**	**271**	**269***
Cadres employed (one or more)†							
Medical doctor	**89 (89 to 89)**	94 (94 to 94)	81 (81 to 81)	94 (94 to 94)	**54 (42 to 65)**	**79 (76 to 82)**	**92 (90 to 93)**
AMO	**90 (90 to 91)**	98 (97 to 99)	93 (93 to 93)	58 (55 to 60)	**78 (65 to 86)**	**87 (84 to 90)**	**94 (93 to 95)**
Medical doctor or AMO	**99 (99 to 99)**	99 (99 to 99)	99 (99 to 99)	100	**98 (94 to 99)**	**99 (98 to 99)**	**99 (99 to 99)**
Anaesthesia provider	**85 (84 to 86)**	79 (77 to 80)	92 (92 to 92)	90 (90 to 91)	**84 (73 to 91)**	**85 (82 to 87)**	**87 (87 to 88)**
Providers available 24 hours per day‡							
Caesarean provider§	**94 (93 to 94)**	95 (93 to 96)	96 (96 to 96)	84 (83 to 85)	**57 (45 to 68)**	**84 (80 to 87)**	**96 (94 to 97)**
Anaesthesia provider§	**86 (85 to 86)**	88 (86 to 89)	88 (88 to 88)	74 (73 to 75)	**44 (33 to 56)**	**74 (70 to 78)**	**92 (91 to 93)**
Both caesarean and anaesthesia providers	**85 (84 to 85)**	86 (85 to 87)	88 (88 to 88)	74 (73 to 75)	**44 (33 to 56)**	**74 (70 to 77)**	**91 (90 to 93)**
Basic infrastructure							
Running water from piped source (delivery ward)	**71 (70 to 71)**	78 (77 to 78)	65 (64 to 66)	58¶	**58 (46 to 69)**	**68 (65 to 70)**	**63 (62 to 64)**
Consistent electricity	**97 (97 to 97)**	97 (97 to 97)	98 (98 to 98)	97 (97 to 97)	**99 (97 to 99)**	**98 (97 to 98)**	**99 (99 to 99)**
Surgical infrastructure							
Ambulance stationed at facility or access to ambulance stationed elsewhere	**96 (96 to 96)**	100	92 (92 to 92)	91 (90 to 91)	**84 (71 to 91)**	**92 (89 to 95)**	**97 (97 to 98)**
Blood transfusion services available	**96 (95 to 96)**	98 (97 to 99)	95 (95 to 95)	87 (86 to 87)	**67 (55 to 77)**	**88 (84 to 91)**	**99 (98 to 99)**
Dedicated caesarean theatre	**43 (42 to 43)**	46 (45 to 47)	47 (46 to 47)	23 (22 to 24)	**45 (34 to 57)**	**43 (40 to 47)**	**58 (56 to 59)**
Anaesthesia equipment							
All general anaesthesia equipment available	**49 (49 to 50)**	34 (33 to 35)	66 (65 to 66)	61 (59 to 63)	**30 (20 to 42)**	**44 (41 to 47)**	**46 (45 to 47)**
Readiness criteria							
[1]: Consistent electricity	**97 (97 to 97)**	97 (97 to 97)	98 (98 to 98)	97 (97 to 97)	**99 (97 to 99)**	**98 (97 to 98)**	**99 (99 to 99)**

Continued

Table 4 Continued

	All hospitals	Public hospital	FBO hospital	Private hospital	All health centres	All facilities	Percentage of all caesareans performed in facilities meeting indicator
[2]: [1] plus 24 hour anaesthesia and caesarean providers	**82 (82 to 83)**	83 (82 to 84)	85 (85 to 86)	71 (70 to 72)	**43 (31 to 55)**	**71 (67 to 75)**	**90 (89 to 91)**
[3]: [2] plus all general anaesthesia equipment	**44 (43 to 44)**	30 (29 to 32)	62 (61 to 63)	42 (40 to 43)	**9 (5 to 16)**	**34 (32 to 36)**	**43 (42 to 44)**

Cell colours indicate facility readiness, with percentages closest to 100% represented in green and percentages closest to 0% represented in red.
Bold values indicate aggregate categories.
*Two facilities were excluded due to missing data on caesarean volume.
†As reported by facility manager.
‡As determined by observed rota (schedule) for 24 hour presence or on-call duty.
§Cadre not specified—anaesthesia providers exclude medical doctors.
¶Due to the small weighted sampled size of private hospitals with non-missing data (n=4), it was not possible to calculate the CI for this subgroup.
AMO, Assistant medical officer; FBO, faith-based organisation; SPA, Service Provision Assessment.

due to the 2006 SPA not distinguishing between FBO and private-for-profit facilities. Our analysis was also limited by the information collected in the SPA: for example, we were unable to examine running water in surgical theatres, specific cadre of caesarean and anaesthesia providers or availability of non-anaesthesia equipment such as bag and mask for neonatal resuscitation.[38]

Trends in facilities providing caesareans over time

Raising the caesarean rate above critically low levels is an important achievement for Tanzania, indicating improved access to caesareans for women. The increase in caesareans was primarily achieved via an increase in caesarean volume in public hospitals, more than by the increase in number of facilities performing surgery. It was also supported by a rise in caesareans conducted outside of the public sector, the vast majority in FBO hospitals with caesarean volumes only marginally lower than public hospitals. It is unlikely that the increase in surgical providers, infrastructure or supplies at extant facilities, kept pace with the almost fivefold increase in caesarean numbers: density of SAO physicians remained critically low in 2015.[39] As a result, the rise in caesarean numbers is likely placing a strain on already limited resources, with the consequence of some caesareans being conducted in settings unable to meet minimum standards for surgical safety.

Around 93% of public hospitals and 8% of public health centres providing delivery care reported performing caesareans in 2014–15, short of the targets for comprehensive emergency obstetric capacity of 100% for hospitals and 50% for health centres.[19] Public health centres performing caesareans increased from 14 in 2006 to 45 in 2014–15 as a result of Ministry of Health policies to expand access to surgical care[40]; however, they only perform 3% of all caesareans in Tanzania. Of the 7% of public hospitals not providing caesareans, some are likely to be recently upgraded health centres or parastatal military hospitals which function at dispensary level for the general population. When including specialist hospitals, 22% of all hospitals did not perform caesareans, in line with findings from the 2015 EmONC assessment.[41] Consistent with national guidelines, no dispensaries reported providing caesarean deliveries.[19]

Readiness for safe caesarean care

The important geographic variation in caesarean readiness mirrors documented differences in delivery care capability[3 41 42] and maternal mortality,[43] although all regions are critically under-resourced in workforce and essential health commodities.[22] Despite maternal health having high political priority since the 1990s in Tanzania, programmatic implementation across regions was found to be inconsistent.[28]

The poor availability of general anaesthesia equipment is a concern for the safety of caesareans: although some referral hospitals perform spinal anaesthesia routinely,[23] most facilities likely perform caesareans under general

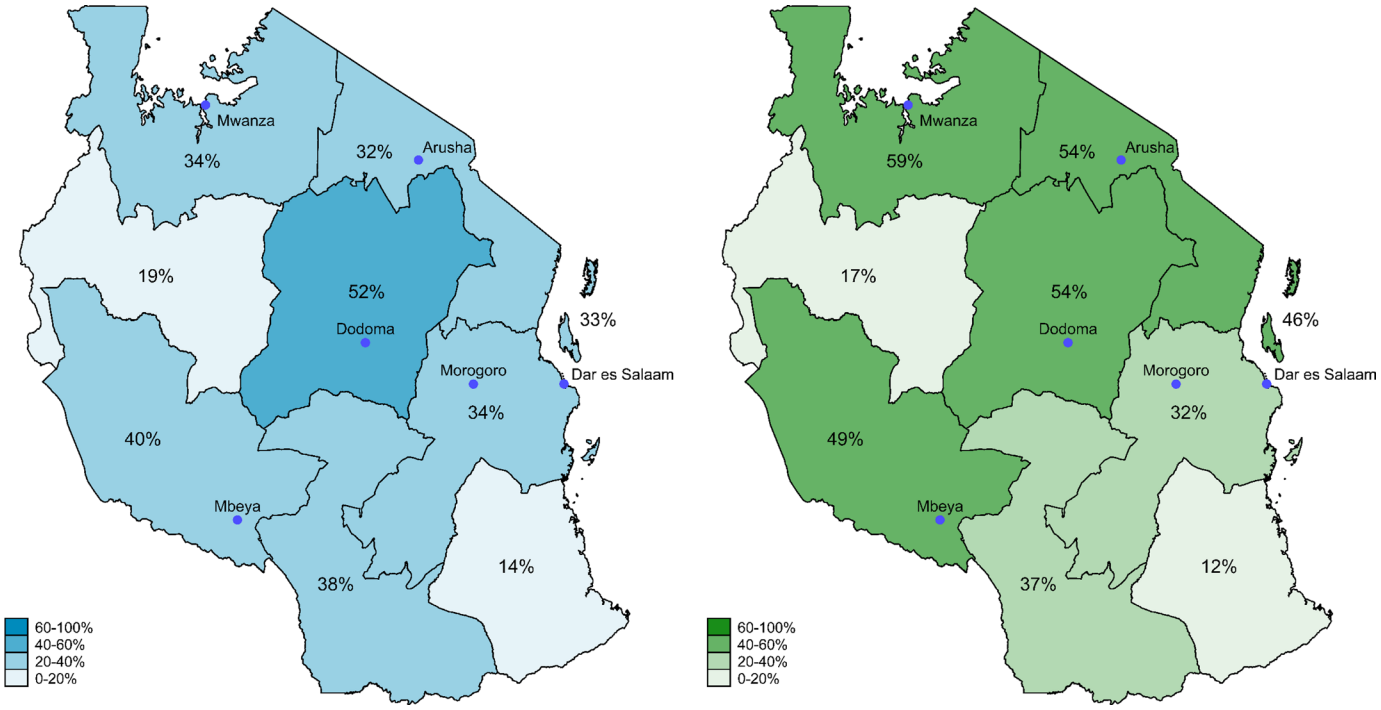

Figure 3 Percentage of facilities meeting three readiness criteria (left) and percentage of caesareans performed in such facilities (right), according to geographic zone.

anaesthesia. Spinal anaesthesia carries a low risk of rapid-onset cardiorespiratory arrest, typically a lethal complication known as 'high spinal', and spinal anaesthesia procedures should therefore be done in settings where equipment for general anaesthesia is immediately at hand.[44] Consistent electricity is crucial for surgical lighting and anaesthesia, and it is reassuring that it was comprehensively present in facilities performing caesareans.

Although most facilities had a schedule for 24 hour presence or on call of caesarean and anaesthesia providers—necessary to ensure access to caesareans at all times—this is not sufficient to ensure providers are available in practice. Therefore, our estimates for provider availability likely represent a best case scenario. In Tanzania, medical doctors and AMOs are licensed to perform caesareans, and training AMOs was part of the MoH's task-shifting policy to improve provision of caesareans in lower-level facilities since 1962.[45–49] A meta-analysis found no difference in maternal or perinatal mortality for caesareans performed by medical doctors and non-physician clinicians such as AMOs, although there was significant heterogeneity across studies and non-physicians had higher rates of wound infection.[50] Joint provider availability was mainly limited by the lower availability of anaesthesia providers. Although cadre was not reported in the SPA, most anaesthesia providers are likely to be clinical officers or nurses with anaesthesia training[47 51] (there were only six reported physician anaesthesiologists in Tanzania in 2015[39]).

Most caesareans took place in higher-level, high-volume facilities, but almost one-quarter occurred in facilities performing less than one caesarean per day, on average. Concerns have been raised about the implications of low caseload for quality of delivery care, although the minimum obstetric volume required to ensure patient safety and skill retention is unknown.[21 52] Similarly, there are likely to be safety implications of performing caesareans in low-volume facilities if processes for caesareans are less frequently performed, potentially resulting in breached safety protocols. The effect of low volume on safety may depend on other factors such as performance of other emergency surgeries; nonetheless, facilities with the lowest caesarean volumes had the lowest readiness levels (results not shown), indicating that the safety and quality of caesareans in these facilities is likely to be jeopardised. High caesarean volume relative to number of operating theatres and staff may also compromise safety, resulting in non-sterile theatres or fatigue-induced errors.

This study documented the availability of infrastructure, equipment and staffing necessary—but not sufficient—for the safe provision of caesareans. The gaps in equipment and staffing identified constrain the provision of safe caesarean care, with implications for adverse health outcomes. Previous studies have documented frequent surgical site infection,[26] and iatrogenic obstetric fistulas caused by clinical errors during caesareans in Tanzania and elsewhere.[53–55] One study found that 13% of maternal deaths in two hospitals in Dar es Salaam were due to causes specific to caesarean surgery (such as high spinal anaesthesia or sepsis following wound infection) or complications with an increased risk after caesarean, such as postpartum haemorrhage leading to shock.[56]

Safety concerns are particularly relevant in the context of rising caesarean rates. Not all women have ready access to caesareans, yet a non-negligible proportion of caesareans performed in Tanzanian hospitals have been found to be unnecessary or have inappropriate indications, as in other countries.[47 57 58] Caesarean rates in hospitals have risen even among low-risk obstetric groups.[59] These observations suggest women who do not need a caesarean are increasingly receiving unnecessary, potentially unsafe interventions.

Policy, programme and research recommendations

The concentration of over 90% of caesareans in public and FBO hospitals represents an opportunity for improving the safety and quality of caesarean care, and efforts in Tanzania should be targeted at these facilities first. Nonetheless, it is important not to ignore the small proportion of caesareans conducted in health centres, private facilities and low-volume facilities (including some hospitals), which tend to have lower capacity for safe caesareans as well as to strengthen referral links to surgical facilities. Health centres being upgraded to surgical facilities must receive the necessary training and equipment for safe surgery, and supervision and regular refresher trainings should be offered to AMOs performing caesareans in low-volume facilities. Considering limited staffing and material resources in Tanzania, selective identification of health centres for upgrading based on distance to nearest hospital may represent a better use of resources than the current target of 50% upgraded health centres by 2020.[19]

Our findings highlight a need to improve the availability of general anaesthesia equipment and trained providers nationwide to guarantee safe anaesthesia procedures. The global surgery movement has defined broad targets for the SAO workforce and surgical capacity in facilities that provide roadmaps for quality and safety improvement.[10 60] Specific targets within surgical obstetric care are also required. A recent technical consultation called for the development of minimal SAO criteria that all facilities performing caesareans should meet, as part of a comprehensive agenda for quality improvement.[61] Once defined, data systems need to be put in place to monitor these criteria, including on currently unavailable process and outcome indicators drawn from frameworks of quality caesarean care.[62]

We recommend that all SPA collect information on number of caesarean deliveries and surgical theatres as well as availability of gloves, bag and mask, and soap and running water in theatres. Similar studies should be conducted in other countries in the region and elsewhere. Additional microbiology studies are necessary to determine whether water in facilities meets safety levels for infection prevention during surgery. Last, reasons for low 24 hour availability of staff in the Northern zone and Zanzibar need to be understood and addressed.

CONCLUSION

The fivefold increase in the annual number of caesareans performed in Tanzania was mainly facilitated by the doubling of caesarean volume in public hospitals in the past decade. Electricity is widely available, but 24 hour availability of providers is problematic in some zones, and equipment for general anaesthesia appears to be lacking across facility types and zones: only one-third of facilities meet these three readiness criteria, compromising the safety of caesareans. Improvements in staffing and equipment should focus on public and FBO hospitals in the first instance to maximise gains in quality and safety.

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