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SUPPLEMENT ARTICLE

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Health facilities' capability to provide comprehensive postabortion care in Sub-Saharan Africa: Evidence from a cross-sectional survey across 210 high-volume facilities

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Abstract

Objective: To evaluate the capability of high-volume comprehensive emergency obstetric care (CEmOC) health facilities on the provision of comprehensive postabortion care (PAC) in Sub-Saharan Africa and to determine the frequency of women with severe abortion-related complications in high capability facilities.

Methods: A cross-sectional analysis conducted across 11 countries in Sub-Saharan Africa, using facility-level information from the World Health Organization (WHO) Multi-Country Survey on Abortion-related morbidity (MCS-A) between 2017 and 2018. PAC signal functions were adapted to assess facilities' capability to deliver comprehensive PAC through infrastructure, standard comprehensive capability, and extended comprehensive capability to provide PAC. The percentage of facilities with each signal function and distribution of facilities by number of signal functions were calculated for the three capability categories. Distribution of severe abortion complications by facility capability score was assessed.

Results: Of 210 high-volume CEmOC facilities included, 47.9% (n = 100) had capability to provide all facility infrastructure signal functions, 54.4% (n = 105) for standard comprehensive PAC, reducing to 17.7% (n = 34) for extended comprehensive PAC capability. Overall, there were gaps in extended capabilities including availability of a functioning ICU (available in 37.3% of facilities) and providers 24/7 (65.5% of facilities reported an obstetrician available 24/7 dropping to 41.3% for anesthesiologists). Facilities' PAC capability varied across regions. Overall, 34.6% (n = 614) of women with severe abortion-related complications were treated in facilities with the maximum capability score for extended comprehensive PAC.

Conclusion: Although high levels of capability to provide abortion-related care for most signal functions were evident, significant gaps that impact on the management of severe abortion-related complications remain, particularly related to extended facility capabilities including specialized human resources and ICU.

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capability, comprehensive emergency obstetric care, health facilities, postabortion care, quality of care, signal functions, Sub-Saharan Africa

1 | INTRODUCTION

Global commitment to provide high-quality postabortion care (PAC) was prioritized at the International Conference on Population and Development (ICPD) in 1994 and re-emphasized at the 25th anniversary meeting in Nairobi.[1,2] However, rates of morbidity and mortality due to unsafe abortion remain high across many settings in Sub-Saharan Africa,[3] where abortion practice is still largely legally restricted. Many abortion-related complications are still potentially life-threatening in these contexts,[4] and key challenges remain in ensuring access to quality care for these complications.[3] In these contexts, high-quality PAC is critical to reduce mortality and prevent complications resulting from unsafe and spontaneous abortions.[5]

Facility capability is key in the provision of quality PAC. Building on the model initially developed to assess emergency obstetric care availability, Healy et al.[6] proposed a framework of essential components ("signal functions") that could be used to measure the availability and implementation of key resources and procedures for the provision of safe abortion care in health facilities. The signal functions approach was then adapted by Campbell et al.[7] to define a set of composite indicators constructed from key preventive and curative services to assess health systems capability to provide basic PAC at primary level and comprehensive PAC at referral levels of care. Comprehensive PAC comprises essential components for abortion complications' management, including long-acting contraceptive methods, and surgical and blood transfusion capacities.[7]

The PAC signal function framework has been used in several studies in low- and middle-income countries.[8-11] However, most of these studies were secondary data analyses and could only include signal functions for which information was available, and were almost exclusively from surveys looking at facility capabilities for a wide range of health conditions and not necessarily focused on PAC.[8,9] As such, these studies did not include important signal functions needed to support quality of care (specific PAC guidelines, clinical audits) or for the management of very severe complications of unsafe abortion, such as the availability of an intensive care unit (ICU).

Our study is a multicountry analysis assessing high-volume comprehensive emergency obstetric care (CEmOC) facilities' capabilities to provide comprehensive PAC in Sub-Saharan Africa using data from the World Health Organization (WHO) Multi-Country Study on Abortion-related morbidity (MCS-A).[12] We draw on the health facility assessment tool that was designed specifically to collect information on abortion-related services from facilities that had a designated gynecology ward and reported surgical capability. We apply similar signal functions to those used in previous studies, as well as propose an expanded set of signal functions that could measure the availability of services or components necessary for quality of care or better management of severe cases at high volume CEmOC facilities. We also explore the extent to which the most severe abortion complications are managed in facilities with optimal PAC provision capabilities.

2 | MATERIALS AND METHODS

2.1 | Study design and data source

We conducted a secondary analysis using data from the MCS-A study in Africa, a large cross-sectional study with data collected prospectively in 210 facilities over a period of 3 months in 11 countries (Benin, Burkina Faso, Chad, Democratic Republic of Congo [DRC], Ghana, Kenya, Malawi, Mozambique, Niger, Nigeria, and Uganda) between February 2017 and February 2018. Participating countries and facilities' selection are described in the main study's protocol.[13] Briefly, three geographical provinces/states, including the capital city plus two provinces/states with probability proportional to the population size, were first sampled in each country. Ten facilities fulfilling the inclusion criteria were then selected from the census of private and public facilities within each selected area (with up to a total of 30 facilities per country). Facilities were included based on the following criteria: more than 1000 deliveries per year, a gynecology ward, and surgical capability. When there were fewer than 10 facilities fulfilling inclusion criteria within a geographical area, all eligible facilities in that area were selected.[13]

As part of the MCS-A survey, facility-level data were collected using an institutional assessment form that was completed by hospital coordinators (typically obstetrician/gynecologists or healthcare providers responsible for gynecology and obstetrics wards at identified facilities). This form was used to collect information on the location and type of facility, the capacity to provide emergency obstetric care, and a more detailed assessment of the facilities' ability to provide PAC within the previous 3 months (infrastructure, utilities, equipment, and human resources). Hospital coordinators reported, where necessary, equipment or services as available and/or functioning. Individual level information on women attending the facilities with abortion-related complications was also collected from medical records.[13]

2.2 | Defining the signal functions

We used a set of signal functions to assess facilities' capability to provide PAC across three categories: infrastructure, standard comprehensive capability, and extended capability to provide PAC. Table 1 describes in detail each signal function and the accompanying definition used in this study.

We defined an "infrastructure" category to emphasize the structural capacity of hospitals to provide quality care and included all components for which data were collected. While the elements of the infrastructure category are essential for quality care provision, they are not specific to the provision of comprehensive PAC. To measure the infrastructure category, seven signal functions were selected: availability of electricity, generator, refrigerator, telephone/radio call, email/internet, incinerator, ambulance, water supply, and sewerage system.

The Campbell et al. approach[7] was adapted to assess the standard comprehensive PAC category, which includes seven specific curative and preventive services and one staffing criteria on the availability of a provider on duty 24/7. Surgical capability was an inclusion criterion for facilities in the MCS-A study, therefore this capability was not included as a signal function in this study.

We then measured the extended comprehensive capability category by adding six components to the comprehensive category, to assess the capability of health facilities to manage all abortion complications, including severe cases, appropriately: availability of guidelines, clinical audits, an adult ICU, ultrasound services, biochemical/clinical laboratories, and at least one anesthesiologist on duty 24/7.[14] The choice of additional signal functions included in this analysis was based on recommendations from the WHO clinical management for abortion care guidelines.[14] The main author first developed these criteria, and they were then validated by a senior obstetrician and researchers involved in the study.

2.3 | Data analysis

The data were analyzed using Stata version 15 (StataCorp LLC). We initially examined the distribution of facilities concerning key

TABLE 1 Postabortion care signal functions

Categories[a]	Signal functions	Maximum score available per facility[e]
Facility general capability: Facility infrastructure	Electricity available and functioning Generator available and functioning Refrigerator available and functioning Telephone/radio call available and functioning Email/internet available and functioning Incinerator available and functioning Ambulance available and functioning Water supply available and functioning Sewerage system available and functioning	9
Capability to provide standard comprehensive postabortion care (adapted from Campbell et al.[7])[b]	Removal of retained products available Parenteral antibiotics available Uterotonics available (oxytocin or misoprostol) Intravenous fluids available Blood transfusion available 3+ contraceptives offered 1+ long-acting modern contraceptive(s) offered 1+ obstetrician on duty 24/7	8[f]
Extended capability to provide comprehensive postabortion care[d]	*Comprehensive indicators +* At least one guideline currently in use[c] Clinical audits currently in use Adult intensive care unit available and functioning Ultrasound services available and functioning Biochemical/clinical laboratories available and functioning 1+ anesthesiologist on duty 24/7	14[f]

[a]Facility infrastructure determines general hospital capability, while the two capability rows present two comprehensive postabortion care specific capabilities.

[b]Surgical capacity was already among the facility selection criteria.

[c]Safe Abortion Guidance/Clinical Handbook or WHO guidelines (e.g. for postpartum hemorrhage) or evidence-based, locally adapted guidelines.

[d]This category includes the components of comprehensive postabortion care.

[e]Presence of a given indicator for a facility adds a score of one to the total category score for that facility.

[f]Comprehensive postabortion care and extended comprehensive postabortion care capabilities include infrastructure capability signal functions; however, we made the choice to exclude general hospital capability signal functions in the analysis of facilities' specific postabortion care capabilities.

characteristics: facility type (hospital, health center/maternity) and facility location. These analyses were done for all facilities pooled together, and also stratified by region and country. Regions were defined as East (Kenya, Uganda, Malawi, Mozambique), Central (Chad, DRC), and West (Benin, Burkina Faso, Ghana, Niger, and Nigeria).

To describe the characteristics of the facilities, we used numbers for categorical variables (facility location and the types of abortion services offered such as surgical abortion method used for gestational age up to 12–14 weeks, medical abortion, and postabortion contraception). We also calculated the mean number of variables that informed the average hospital capacity (number of obstetric and gynecologic beds in use), the average number of abortion complications, and the average number of PAC services provided (surgical and medical uterine evacuations) in a typical month, with range also given.

The percentage of facilities with each signal function was calculated, overall and stratified by country. The signal functions were subsequently used to create composite measures for each of the three categories (infrastructure, standard comprehensive PAC, and extended comprehensive PAC), by calculating the total number of functions that each facility was reported to be able to conduct. We calculated the mean number of signal functions available across facilities for each category, and the distribution of facilities by the number of signal functions, overall, and by country.

To assess the percentage of severe abortion-related complications that were managed in facilities with the capability to provide comprehensive quality PAC, we calculated the percentage of the severe abortion-related complications that were managed at different levels of facility capability. Severe abortion-related complications included women who died or were considered either near miss or having potentially-life threatening complications, according to WHO criteria for near miss and on indicators present at assessment.[12] For this analysis, both comprehensive PAC capabilities (standard and extended) scores were grouped into four categories. The first category was included facilities where all components were met ("criteria met"). The remaining facilities were categorized as follows: "criteria unmet with 1–2 signal functions missing," "criteria unmet with 3–4 signal functions missing," or "criteria unmet with 5 or more signal functions missing." The percentage of severe abortion complications treated at each facility capability level was calculated overall and by country.

3 | RESULTS

Table 2 shows the distribution of the 210 facilities included and their characteristics. Most facilities were in urban areas ($n = 139$, 66.2%). Medical abortion services and first trimester PAC using surgical methods (manual vacuum aspiration, MVA or dilatation and curettage, D&C) were offered in 168 (80.8%) and 159 (76.4%) of the facilities, respectively. Overall, 190 (90.5%) facilities reported to offer contraception as part of PAC.

There was substantial variation in bed capacity and service utilization, both within and between countries (Table 2). The overall average number of gynecologic beds in use was 19.9, ranging from 0–217. Differences were noted between countries within the same region: in West Africa, the mean number of gynecologic beds available ranged from 14.1 (range, 4–58) in Nigeria to 58.8 (range, 23–217) in Benin. On average, approximately 37 women were reported to seek care for postabortion complications in a typical month in these facilities (range, 0–350).

Table 3 presents the percentage of facilities performing each of the PAC signal functions, overall and by country. With the exception of email/internet availability, which was available only in 64.3% ($n = 135$) of facilities, all infrastructure signal functions were reported as available in more than 80.0% ($n = 168$) of facilities overall. Within countries, availability of some infrastructure signal functions was notably lower than in the overall sample, such as telephone/radio (47.4%, $n = 9$) in Uganda; email/internet in Benin (50.0%, $n = 5$), Burkina Faso (52.4%, $n = 11$), Chad (33.3%, $n = 5$), and Uganda (42.1%, $n = 8$); incinerator in Nigeria (58.6%, $n = 17$) and Uganda (47.4%, $n = 9$); and ambulance (57.9%, $n = 11$) and sewerage system (63.2%, $n = 12$) in Uganda. The percentage of facilities able to provide each component of standard comprehensive PAC was relatively high across regions; almost all standard comprehensive components were performed at above 80% ($n = 168$), except for the availability of an obstetrician on duty 24/7 (65.5%, $n = 135$). Availability of providers was particularly low in Chad (46.7%, $n = 7$), the DRC (38.1%, $n = 8$), Malawi (26.1%, $n = 6$), Mozambique (31.6%, $n = 6$), and Uganda (68.4%, $n = 13$). For the extended comprehensive PAC category, adult ICU (37.3%, $n = 78$) and anesthesiology specialists (41.3%, $n = 85$) were the least available components. There were also regional differences in the availability of adult ICU. In West Africa it ranged from 38.1% ($n = 8$) in Burkina Faso to 90% ($n = 9$) in Benin, while in East Africa it ranged from 13.0% ($n = 3$) in Malawi to 26.3% ($n = 5$) in Uganda.

Figure 1 illustrates the distribution of the facilities' capability score for comprehensive PAC. For the infrastructure category score, facilities' capability ranged from zero to all nine functions (Figure 1a). Less than half of the facilities (47.9%, $n = 100$) could perform all nine signal functions, varying from 30.8% ($n = 12$) in Central Africa to 58% ($n = 48$) in East Africa. The majority of health facilities could fulfil at least seven infrastructure signal functions (88.0%, $n = 184$). The mean score for the infrastructure category was 7.9 ± 1.6) (Table 4).

Facilities' capability for the eight components of the standard comprehensive PAC category varied from three to the maximum number of functions (Figure 1b). More than half (54.4%, $n = 105$) of facilities could provide all standard comprehensive signal functions, ranging from 28.2% in Central to 81.2% in West Africa. In all, 88.6% ($n = 171$) of facilities overall could provide at least six functions. The mean score for this category was 7.4 ± 0.9, ranging from 6.4 ± 1.4 in Uganda to 8.0 ± 0.0 in Niger (Table 4).

The composite score for the 14 functions of the extended comprehensive PAC category ranged from a minimum of four to all 14 components across the facilities. Only 17.7% ($n = 34$) of facilities

TABLE 2 Description of facility characteristics

Characteristics	Overall	West Africa					Central Africa		East Africa			
		Benin	Burkina Faso	Ghana	Niger	Nigeria	Chad	DRC	Kenya	Mozambique	Malawi	Uganda
Number of facilities	210	10	21	19	10	29	15	24	21	19	23	19
Location, No. (%)												
Urban	139 (66.2)	9 (90.0)	20 (95.2)	12 (63.2)	10 (100.0)	20 (69.0)	13 (86.7)	17 (70.8)	9 (42.9)	10 (52.6)	8 (34.8)	11 (57.9)
Peri-urban	35 (16.7)	1 (10.0)	1 (4.8)	4 (21.1)	0 (0.0)	7 (24.1)	1 (6.7)	1 (4.2)	9 (42.8)	0 (0.0)	9 (39.2)	2 (10.5)
Rural	36 (17.2)	0 (0.0)	0 (0.0)	3 (15.8)	0 (0.0)	2 (6.9)	1(6.6)	6 (25.0)	3 (14.3)	9 (47.4)	6 (26.1)	6 (31.6)
Abortion services, No. (%)												
Surgical abortion method employed for gestational age up to 12–14 weeks (MVA or D&C)[a]	159 (76.4)	7 (70.0)	18 (85.7)	14 (73.7)	9 (90.0)	17 (60.7)	12 (80.0)	13 (56.5)	17 (81.0)	14 (73.7)	23 (100.0)	15 (79.0)
Medical abortion offered at the facility (including medical management of incomplete abortion)	168 (80.8)	10 (100.0)	19 (90.5)	14 (73.7)	8 (80.0)	27 (93.1)	14 (93.3)	12 (54.6)	18 (85.7)	11 (57.9)	19 (82.6)	16 (84.2)
Abortion for gestational age over 13–14 weeks offered	131 (63.0)	7 (70.0)	18 (85.7)	10 (52.6)	6 (60.0)	18 (62.1)	13 (86.7)	10 (45.5)	14 (66.7)	8 (42.1)	20 (87.0)	7 (36.8)
Postabortion contraception offered	190 (90.5)	9 (90.0)	19 (90.5)	18 (94.7)	10 (100.0)	28 (96.6)	14 (93.3)	18 (75.0)	19 (90.5)	19 (100.0)	22 (95.7)	14 (73.7)
Average of hospital capacity and services provided for PAC, mean (min–max)												
Hospital structure and capacity												
Average number of obstetrical beds in use	37.9 (1–400)	52.5 (16–217)	36.5 (10–90)	53.2 (10–400)	38.2 (10–173)	30.1 (4–107)	11.1 (2–35)	51.2 (3–132)	58.0 (15–120)	40.8 (10–126)	28.0 (6–92)	20.4 (1–62)
Average number of gynecologic beds in use	19.9 (0–217)	58.8 (23–217)	19.3 (0–90)	25.1 (5–150)	21.2 (12–35)	14.1 (4–58)	16.3 (1–50)	24.7 (5–156)	20.0 (5–62)	15.5 (0–84)	16.5 (1–76)	10.3 (0–30)

(Continues)

TABLE 2 (Continued)

Characteristics	Overall	West Africa					Central Africa		East Africa			
		Benin	Burkina Faso	Ghana	Niger	Nigeria	Chad	DRC	Kenya	Mozambique	Malawi	Uganda
Average number of gynecologic patients with an overnight stay in a typical month	95.5 (0–1000)	436.6 (6–999)	135.0 (0–1000)	74.7 (15–239)	57.3 (3–298)	22.8 (0–85)	113.5 (10–999)	28.2 (0–108)	117.4 (15–705)	84.6 (1–600)	86.3 (24–450)	90.4 (0–450)
Abortion complications in a typical month												
Average number of women who received abortion-related care or PAC	37.1 (0–350)	21.3 (14–36)	25.0 (5–68)	24.8 (3–100)	26.3 (5–87)	14.2 (0–43)	18.3 (6–33)	17.3 (2–163)	57.9(14–150)	74.0 (2–350)	69.5 (3–300)	53.3 (2–300)
Average number of gynecology admissions due to abortion complications	32.1 (0–602)	18.6 (15–23)	43.7 (0–602)	14.7 (0–55)	16.6 (2–50)	8.0 (0–25)	20.9 (6–66)	8.1 (0–37)	44.3(3–150)	59.8 (2–480)	68.5 (0–300)	40.3 (0–300)
Average number of surgical uterine evacuations (MVA or D&C)	30.9 (0–340)	16.7 (9–30)	18.7 (2–68)	27.1 (2–120)	22.6 (5–87)	17.1 (0–170)	15.4 (3–65)	10.9 (0–90)	48.0 (15–150)	57.1 (1–340)	58.3 (3–300)	42.1 (0–240)
Average number of medical abortions	10.3 (0–213)	12.4 (3–30)	11.7 (0–37)	8.0 (0–45)	17.1 (0–87)	4.8 (0–15)	14.7 (2–54)	4.7 (0–67)	13.3(0–58)	17.4 (0–213)	6.7 (0–40)	11.5 (0–30)

Note: Abbreviations: D&C, dilatation and curettage; MVA, manual vacuum aspiration; PAC, postabortion care.

[a]While the inclusion criteria for facilities were based on more than 1000 deliveries per year, a gynecology ward, and surgical capability, the institutional form still performed an assessment of the facilities' overall medical and surgical abortion capabilities. The information available in the database does not report the number of health facilities offering only surgical management of postabortion complications.

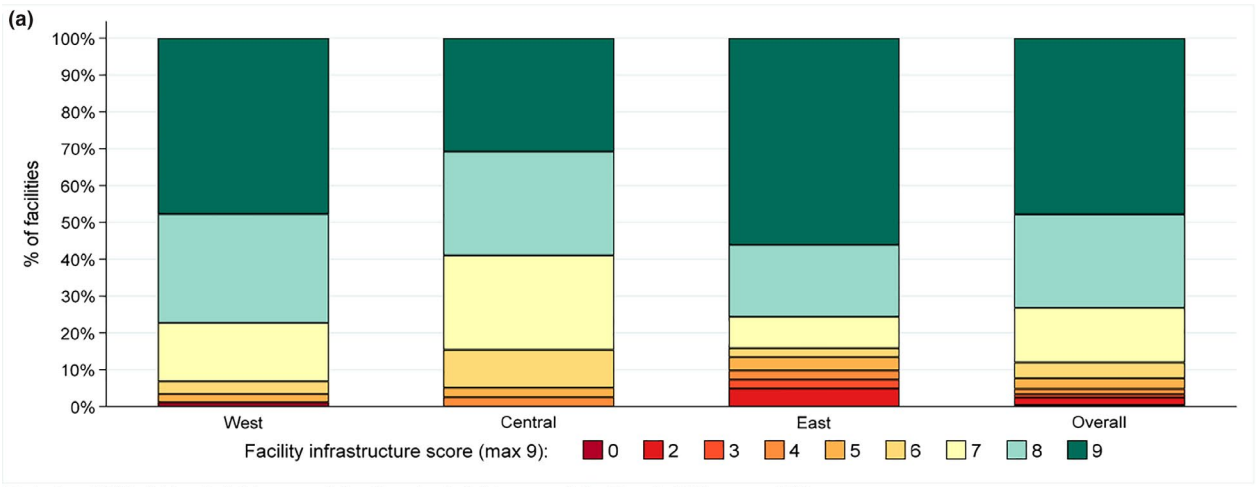
TABLE 3 Capability to provide each postabortion care signal function, overall and per country

	Number of facilities with information	Overall	Regions										
			West ($n = 89$)					Central ($n = 39$)		Eastern ($n = 82$)			
			Benin	Burkina Faso	Ghana	Niger	Nigeria	Chad	DRC	Kenya	Malawi	Mozambique	Uganda
	No.	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Facility infrastructure													
Electricity	209	197 (94.3)	10 (100.0)	20 (95.2)	19 (100.0)	10 (100.0)	26 (92.9)	14 (93.3)	20 (83.3)	21 (100.0)	23 (100.0)	19 (100.0)	15 (79.0)
Generator	210	199 (94.8)	10 (100.0)	19 (90.5)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	22 (91.7)	21 (100.0)	22 (95.7)	16 (84.2)	16 (84.2)
Refrigerator	210	193 (91.9)	10 (100.0)	20 (95.2)	19 (100.0)	10 (100.0)	29 (100.0)	11 (73.3)	19 (79.2)	21 (100.0)	23 (100.0)	18 (94.7)	13 (68.4)
Telephone/radio	210	182 (86.7)	10 (100.0)	18 (85.7)	19 (100.0)	8 (80.0)	24 (82.8)	13 (86.7)	21 (87.5)	21 (100.0)	22 (95.7)	17 (89.5)	9 (47.4)
Email/internet	210	135 (64.3)	5 (50.0)	11 (52.4)	17 (89.5)	8 (80.0)	18 (62.1)	5 (33.3)	15 (62.5)	20 (95.2)	17 (73.9)	11 (57.9)	8 (42.1)
Incinerator	210	176 (83.8)	8 (80.0)	19 (90.5)	19 (100.0)	7 (70.0)	17 (58.6)	15 (100.0)	22 (91.7)	19 (90.5)	23 (100.0)	18 (94.7)	9 (47.4)
Ambulance	210	183 (87.1)	10 (100.0)	19 (90.5)	15 (79.0)	10 (100.0)	27 (93.1)	14 (93.3)	18 (75.0)	20 (95.2)	22 (95.7)	17 (89.5)	11 (57.9)
Water supply	210	201 (95.7)	10 (100.0)	20 (95.2)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	22 (91.7)	21 (100.0)	23 (100.0)	18 (94.7)	14 (73.7)
Sewerage system	210	192 (91.4)	9 (90.0)	19 (90.5)	19 (100.0)	10 (100.0)	25 (86.2)	14 (93.3)	24 (100.0)	20 (95.2)	22 (95.7)	18 (94.7)	12 (63.2)
Capability to provide standard comprehensive PAC													
Removal of retained products	207	205 (99.0)	10 (100.0)	21 (100.0)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	24 (100.0)	21 (100.0)	21 (100.0)	18 (100.0)	17 (89.5)
Parenteral antibiotics	209	206 (98.6)	10 (100.0)	21 (100.0)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	24 (100.0)	21 (100.0)	23 (100.0)	18 (100.0)	16 (84.2)
Uterotonics	210	207 (98.6)	10 (100.0)	21 (100.0)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	24 (100.0)	21 (100.0)	23 (100.0)	18 (94.7)	17 (89.5)
Intravenous fluids	207	203 (98.1)	10 (100.0)	19 (95.0)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	23 (95.8)	21 (100.0)	23 (100.0)	18 (100.0)	17 (89.5)
Blood transfusion	209	201 (96.2)	10 (100.0)	21 (100.0)	19 (100.0)	10 (100.0)	28 (96.6)	15 (100.0)	23 (95.8)	21 (100.0)	23 (100.0)	18 (100.0)	13 (68.4)
3+ contraceptive methods offered	202	182 (90.1)	8 (80.0)	19 (90.5)	19 (100.0)	10 (100.0)	26 (92.9)	15 (100.0)	14 (73.7)	18 (85.7)	22 (95.7)	18 (94.7)	13 (76.5)
1+ long-acting contraceptive method offered	203	190 (93.6)	8 (80.0)	19 (90.5)	19 (100.0)	10 (100.0)	29 (100.0)	15 (100.0)	16 (80.0)	20 (95.2)	23 (100.0)	18 (94.7)	14 (82.4)

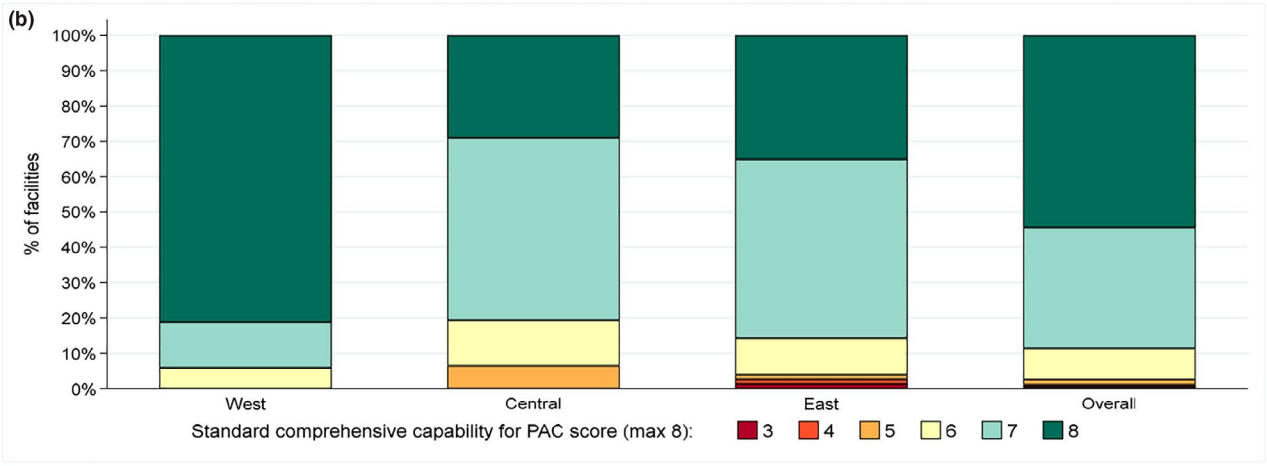
(Continues)

TABLE 3 (Continued)

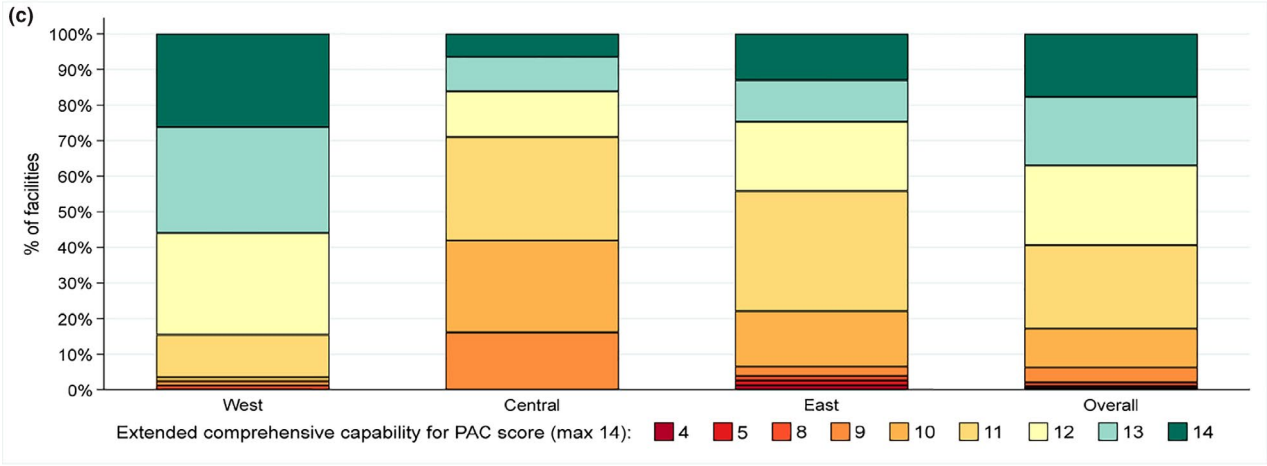
	Number of facilities with information	Overall	Regions										
			West ($n = 89$)					Central ($n = 39$)		Eastern ($n = 82$)			
			Benin	Burkina Faso	Ghana	Niger	Nigeria	Chad	DRC	Kenya	Malawi	Mozambique	Uganda
	No.	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
1+ obstetrician on duty 24/7	206	135 (65.5)	9 (90.0)	16 (80.0)	17 (89.5)	10 (100.0)	27 (93.1)	7 (46.7)	8 (38.1)	16 (76.2)	6 (26.1)	6 (31.6)	13 (68.4)
Extended capability to provide comprehensive PAC													
At least one guideline currently in use	210	195 (92.9)	10 (100.0)	19 (90.5)	19 (100.0)	10 (100.0)	28 (96.6)	11 (73.3)	21 (87.5)	20 (95.2)	23 (100.0)	19 (100.0)	15 (79.0)
Clinical audits currently in use	210	192 (91.4)	10 (100.0)	19 (90.5)	19 (100.0)	10 (100.0)	27 (93.1)	8 (53.3)	22 (91.7)	21 (100.0)	22 (95.7)	19 (100.0)	15 (79.0)
Adult intensive care unit functioning	209	78 (37.3)	9 (90.0)	8 (38.1)	8 (42.1)	7 (70.0)	13 (46.4)	4 (26.7)	12 (50.0)	5 (23.8)	3 (13.0)	4 (21.1)	5 (26.3)
Ultrasound services functioning	210	195 (92.9)	10 (100.0)	20 (95.2)	19 (100.0)	10 (100.0)	29 (100.0)	14 (93.3)	24 (100.0)	21 (100.0)	21 (91.3)	15 (79.0)	12 (63.2)
Biochemical/ clinical laboratories functioning	210	193 (91.9)	10 (100.0)	20 (95.2)	18 (94.7)	9 (90.0)	29 (100.0)	15 (100.0)	17 (70.8)	21 (100.0)	22 (95.7)	19 (100.0)	13 (68.4)
1+ anesthesiologist on duty 24/7	206	85 (41.3)	4 (40.0)	8 (40.0)	6 (31.6)	1 (10.0)	23 (79.3)	6 (40.0)	3 (14.3)	12 (57.1)	8 (34.8)	5 (26.3)	9 (47.4)



Total = 209 (West Africa n=88, Central Africa n=39, East Africa n=82).



Total = 193 (West Africa n=85, Central Africa n=31, East Africa n=77).



Total =192 (West Africa n=84, Central Africa n=31, East Africa n=77).

FIGURE 1 Facility capability to provide abortion-related care, overall and stratified by region for: (a) facility infrastructure; (b) standard comprehensive capability to provide postabortion care; and (c) extended capability to provide postabortion care

TABLE 4 Mean score for key categories, overall and per country

Region/country	Total number of observations	Mean score ± SD: Facility infrastructure (Max score = 9)[a]	Mean score ± SD: Standard capability to provide comprehensive postabortion care (Max score = 8)[b]	Mean score ± SD: Extended capability to provide comprehensive postabortion care (Max score = 14)[c]
Overall	210	7.9 ± 1.6	7.4 ± 0.9	11.8 ± 1.6
West Africa	89			
Benin	10	7.5 ± 0.8	7.5 ± 0.8	12.8 ± 1.2
Burkina Faso	19	7.5 ± 0.7	7.5 ± 0.7	12.0 ± 1.3
Ghana	19	7.9 ± 0.3	7.9 ± 0.3	12.6 ± 1.0
Niger	10	8.0 ± 0.0	8.0 ± 0.0	12.7 ± 0.7
Nigeria	27	7.8 ± 0.5	7.8 ± 0.5	12.9 ± 1.3
Central Africa	39			
Chad	15	7.5 ± 0.5	7.5 ± 0.5	11.3 ± 1.6
DRC	16	6.6 ± 0.9	6.6 ± 0.9	10.6 ± 1.2
Eastern Africa	82			
Kenya	21	7.6 ± 0.6	7.6 ± 0.6	12.3 ± 1.2
Malawi	21	7.2 ± 0.5	7.2 ± 0.5	11.5 ± 1.4
Mozambique	18	7.2 ± 0.5	7.2 ± 0.5	11.5 ± 1.5
Uganda	17	6.4 ± 1.4	6.4 ± 1.4	10.0 ± 2.4

[a]Excludes one facility from West Africa.

[b]Excludes 17 facilities: 4 from West Africa, 8 from Central Africa, and 5 from East Africa.

[c]Excludes 18 facilities: 5 from West Africa, 8 from Central Africa, and 5 from East Africa.

could meet all functions. Those in West Africa had the highest percentage of facilities that reported all functions (26.2%, *n* = 22), while Central Africa had the lowest (6.5%, *n* = 2). Overall, most facilities could provide from 10–14 signal functions (93.7%, *n* = 180) (Figure 1c). The mean score of this category was 11.8 ± 1.6, varying from 10.0 ± 2.4 in Uganda to 12.9 ± 1.3 in Nigeria (Table 4).

Table 5 presents the distribution of severe abortion-related complications by reported facility capability to provide standard or extended comprehensive PAC. Approximately two-thirds (65.8%) of women with very severe abortion-related complications (severe maternal outcome/potentially life-threatening condition) were managed in facilities with full capability for standard comprehensive PAC. This percentage dropped to about one-third (34.6%) for extended capability score overall, ranging from 70.1% (*n* = 129) in Benin to 0% (*n* = 0) in DRC, Niger, and Uganda. Some 3.6% (*n* = 64) of severe abortion-related complications were managed in facilities with the lowest extended comprehensive capability score.

4 | DISCUSSION

We used a set of signal functions to assess facilities' capability to provide PAC across three categories: infrastructure, standard comprehensive capability, and extended capability to provide PAC. Our results suggest a high level of capability for the provision of each PAC signal function in 210 health facilities across 11 Sub-Saharan African countries. Across the three categories, certain components were less consistently available across all facilities and countries: incinerator, healthcare specialists, email/internet, and adult intensive care. The percentage of facilities that could provide all components of PAC varied by category of capability, but also within and between regions. There were more facilities for which criteria for signal functions were all met for the standard comprehensive PAC category (54.4%), compared with the percentage of facilities that could perform all functions for both the infrastructure (47.9%) and the extended comprehensive PAC (17.7%) categories. Capabilities to provide standard comprehensive PAC (81.2%) and extended comprehensive PAC (26.2%) in West African countries were higher compared with other regions, while East Africa presented a better infrastructure capability score (56.0%). Our findings also showed that the percentage of women with the most severe complications that are treated in facilities with full capability to address severe abortion complications is low (34.6%).

The levels of capabilities found in our study vary with results from referral-level facilities from previous studies in Sub-Saharan Africa.[7-9,15] The standard PAC comprehensive capability we found in West African countries (81.2%) was much higher than was documented in referral-level facilities in Senegal in 2015 (37.0%).[8] There were also notable differences between our findings and those in the multicountry study of PAC capacity by Owolabi et al..[8] We found that 61.9% of facilities in Kenya had all signal functions to provide PAC compared with 44% in the study by Owolabi et al.[8]; conversely, in Malawi, we found lower

TABLE 5 Distribution of severity of complications per facility capability to provide extended comprehensive postabortion care, overall and per country

Score	Total number of facilities ($n = 192$)	Women with abortion-related complications ($n = 14\,500$) No. (%)	Women with SMO/PLTC ($n = 1773$) No. (%)	Women with SMO/PLTC treated at each level of facility capability										
				Benin ($n = 184$) No. (%)	Burkina Faso ($n = 169$) No. (%)	Ghana ($n = 236$) No. (%)	Niger ($n = 22$) No. (%)	Nigeria ($n = 155$) No. (%)	Chad ($n = 95$) No. (%)	DRC ($n = 90$) No. (%)	Kenya ($n = 373$) No. (%)	Malawi ($n = 223$) No. (%)	Mozambique ($n = 66$) No. (%)	Uganda ($n = 160$) No. (%)
Facility capability score for standard comprehensive PAC[a]														
Criteria met (all 8 signal functions)	105	9190 (63.2)	1781 (65.8)	145 (78.8)	148 (87.6)	229 (97.0)	22 (100.0)	158 (96.9)	50 (52.6)	24 (26.7)	197 (52.8)	101 (45.3)	38 (57.6)	60 (37.5)
Criteria unmet (1–2 signal functions missing)	83	5148 (35.4)	570 (32.0)	39 (21.2)	21 (12.4)	7 (3.0)	0 (0.0)	5 (3.1)	45 (47.4)	56 (62.2)	176 (47.1)	122 (54.7)	28 (42.4)	71 (44.4)
Criteria unmet (3–4 signal functions missing)	4	99 (0.7)	10 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	10 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Criteria unmet (5 or more signal functions missing)	1	94 (0.6)	29 (1.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	29 (18.1)
Facility capability score for extended comprehensive PAC[b]														
Criteria met (all 14 signal functions)	34	3914 (27.0)	614 (34.6)	129 (70.1)	75 (44.4)	92 (39.0)	0 (0.0)	98 (63.2)	6 (6.3)	0 (0.0)	133 (35.7)	61 (27.4)	20 (30.3)	0 (0.0)
Criteria unmet (1–2 signal functions missing)	80	6042 (41.7)	601 (33.9)	25 (13.6)	63 (37.3)	126 (53.4)	22 (100.0)	55 (35.5)	25 (26.3)	32 (35.6)	103 (27.6)	71 (31.8)	21 (31.8)	58 (36.2)
Criteria unmet (3–4 signal functions missing)	66	3870 (26.7)	494 (27.9)	30 (16.3)	30 (17.7)	18 (7.6)	0 (0.0)	0 (0.0)	49 (51.6)	46 (51.1)	137 (36.7)	89 (39.9)	25 (37.9)	70 (43.8)
Criteria unmet (5 or more signal functions missing)	12	674 (4.6)	64 (3.6)	0 (0.0)	1 (0.6)	0 (0.0)	0 (0.0)	2 (1.3)	15 (15.8)	12 (13.3)	0 (0.0)	2 (0.9)	0 (0.0)	32 (20.0)

Note: Abbreviations: PAC, postabortion care; SMO/PLTC, severe maternal outcome/potentially life-threatening condition.

[a]Standard comprehensive PAC score included the following indicators: removal of retained products available, parenteral antibiotics available, uterotonics (oxytocin or misoprostol) available, intravenous fluids available, blood transfusion available, 3+ contraceptives offered, 1+ long-acting modern contraceptive(s) offered, 1+ obstetrician on duty 24/7.

[b]Extended comprehensive PAC score included the following indicators: standard comprehensive indicators + at least one guideline currently in use, clinical audits currently in use, adult intensive care unit available and functioning, ultrasound services available and functioning, biochemical/clinical laboratories available and functioning, 1+ anesthesiologist on duty 24/7.

capability to provide PAC compared with Owolabi et al. (44% and 58%, respectively).[8] While the better results in West Africa and Kenya could be interpreted as progress due to quality PAC improvement interventions in that region,[16,17] the wide variation in levels is likely to be explained, at least in part, by the difference in the sampling method of facilities used to assess the capacity of the health system to provide PAC. Most previous studies used nationally representative samples and the present study selected for high-volume CEmOC facilities.

We found low levels of facilities reporting a functioning ICU (37.3%) and of skilled health professionals 24/7 (65.5% for obstetricians and 41.3% for anesthesiologists), which is particularly concerning for the treatment of the most severe maternal outcomes. The MCS-A facility survey tool specifically captured whether there was a functioning adult ICU. Therefore, we could not identify facilities that did not have an ICU but did have high dependency units or standalone rooms to manage women with severe abortion-related complications that require monitoring but not intubation. The availability of specialists for near-miss management has not been directly reported in the published literature to our knowledge, but studies did measure the availability of doctors or staff capable of undertaking cesareans. Owolabi et al.[8] reported different availability rates of medical doctors at referral-level facilities in Sub-Saharan Africa: 50% in Kenya in 2010, 75% in Senegal in 2015, 88% in Tanzania in 2014–2015, and 89% in Malawi in 2013–2014. It is difficult to make a comparison with our results because of task shifting recommendations for PAC,[18] which means that not every medical doctor who can perform a cesarean section is necessarily an obstetrician/gynecologist. Nevertheless, this high availability of specialized health providers in the referral facilities could reflect subnational imbalances in skilled health workers' availability between urban and rural areas.[18] In general, differences in performance of PAC signal functions across countries in the different studies could reflect the different contextual factors within each country's health system.

In this study, we proposed an extended measurement of capabilities of health facilities to provide comprehensive postabortion care, by including specific signal functions for the diagnosis, management, and prevention of severe abortion complications that are rarely assessed in PAC signal function studies. We found that clinical guidelines (92.9%), audit services (91.4%), and functioning laboratories (91.9%) were generally reported to be available. We included use of clinical guidelines as an extended capability as it had not been included in previous studies looking at PAC signal functions; however, given that guidelines should be available and followed in all facilities, this could be considered as an important signal function not just to be included for measuring extended capability, but for measuring all facilities' capability to provide PAC. Given that having a functioning ICU and ultrasound and the capability to undertake laboratory investigations are essential for managing the most severe abortion complications, we would encourage further studies to collect data on these components within referral-level facilities to track progress in ensuring the availability of these services.

There are still relatively large numbers of women with abortion-related complications in referral facilities in Sub-Saharan Africa with low capability that may be at risk of not receiving timely appropriate care,[14,19] and at an increased risk of severe morbidity and mortality. A missing PAC component that falls under this level of care, such as the availability of an ICU, may be the one most urgently needed at a given time to save a woman's life. Nevertheless, as ICUs require considerable infrastructure and human resources, ensuring their availability at larger facilities and a well-functioning referral system to this level of care from the lowest level of facilities is necessary. Other factors such as delays in seeking care and reaching the appropriate facilities are also reported in studies from DRC, Kenya, Nigeria, and Zimbabwe.[20-23]

Our study was unable to deduce health professionals' knowledge and practices necessary on the provision of quality care, or their compliance with evidence-based PAC recommendations. However, these are important factors to consider in the capability to provide quality PAC. For example, while we showed high levels of facilities reporting providing postabortion contraception, we did not determine whether women in these facilities were more likely to get contraceptive counselling and, among women wanting contraception, to receive a contraceptive method. A study in Kenya showed that adherence to the predefined PAC service standards was low, with less than half (41.8%) of all women admitted for first-trimester PAC treated with the appropriate technology.[15]

The present study had some limitations inherent in the methodology used. Hospital coordinators were asked to report on the availability and functioning of most signal functions, but this was not independently verified nor were there any checks that the commodities or equipment to provide the services were available. We also noted some limitations to specific questions that were asked, notably that both methods of uterine evacuation were grouped together, whereas it would have been better to ask about each separately. We could only investigate signal functions for PAC owing to the lack of relevant data collected on procedures for safe termination. Moreover, due to the type of facilities included in our sample, we are not able to generalize to private for-profit facilities, which were not included in the study sample. However, by using a large cross-sectional approach, this study provides updated estimates on the capacity of facilities in Sub-Saharan Africa to provide comprehensive postabortion care, while allowing for comparison across regions and countries to a certain extent, albeit somewhat limited by small numbers of countries in some of our regions (i.e. Central Africa). The data collection tool that included additional indicators in the assessment of facilities' capability to provide quality comprehensive PAC is one of the key strengths of this study. By using this tool in a standardized way, this approach could constitute one more step for more comprehensive and harmonized assessments of health facility service quality, based on global service standards.

In conclusion, this study provides important information on the availability of equipment, supplies, and services for quality PAC provision in and across 11 countries in different Sub-Saharan African regions. While overall capabilities were generally high for most signal functions, key functions important for the management of severe abortion-related complications were not always available, in particular with respect to specialized human resources and ICU, which needs to be urgently addressed. Some gaps were

found by adding specific components through the extended comprehensive PAC category. There is a clear need to improve the capability of facilities, and the referral system, given the high percentage of severe abortion complications that do not reach high capability facilities.

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CONFLICTS OF INTEREST

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AUTHORS' CONTRIBUTIONS

RC conceptualized the study and wrote the first draft. CC, HM, OT, and SK made substantial contributions to the study methodology, data analysis, and critically reviewed the first draft. HM, CC, ZQ, OT, FAB, AB, OTM, NI, PG, and SK reviewed and edited all versions of the manuscript.

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