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A Survey of Surgical Capacity in Rural Southern Nigeria: Opportunities for Change

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Abstract
Background Despite growing recognition of the massive surgical burden of disease, unmet need, and disparities in access to care in many African countries, little is known about their capacity to deliver surgical, obstetric, emergency, and anesthetic care, particularly in the rural areas where up to 50 % of the population lives. This study aimed to quantify the surgical capacity of select healthcare facilities in rural southern Nigeria in five key areas: Workforce, Infrastructure, Skill, Equipment, and Supplies.
Methods We assessed the surgical capacity of 41 private, rural hospitals in southern Nigeria using the Personnel, Infrastructure, Procedures, Equipment, and Supplies survey tool developed by Surgeons OverSeas. The survey was administered to surgical practitioners during their annual conference in November 2011.
Results Among the 41 hospitals surveyed, general practitioners (52.1 %) constituted most of the surgical workforce. Only one anesthesiologist was available in 16 secondary hospitals. Although most of the primary and secondary hospitals had running water (82.3 %), a designated emergency room (80.5 %), and medical records (95.9 %), only 50.3 % of all hospitals had electricity through the power grid. Also, only 37.5 % of all facilities had a blood bank and 43.8 % had an X-ray machine. Common surgical procedures were done by most of the facilities; however, cricothyroidotomy, clubfoot repair, and obstetric fistula repair were scarcely done. Less than half of the facilities provided general anesthesia, only 20 % have an anesthesia machine, and 44.5 % have a pulse oximeter.
Conclusion Severe shortages in key areas should motivate stakeholders to devote more effort and resources to strengthening surgical capacity in rural southern Nigeria.

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Introduction

The role of surgery in global health is increasingly being recognized [1]. At this stage, numerous efforts have focused on defining the problem of unmet need, surgical burden [2], and access to surgical care worldwide [3]. Conditions due to injury, congenital deformity, noncommunicable diseases, or related to pregnancy may result in death or confer unnecessary disability that could be prevented with the availability of basic surgical services [4].

To date, surveys from ten countries in sub-Saharan Africa (SSA) have been published documenting the severe deficiencies in surgical capacity: Ethiopia [5], Gambia [6, 7], Ghana [8, 9], Liberia [7, 10], Malawi [11], Sao Tome and Principe [7], Sierra Leone [7, 12], Rwanda [13, 14], Tanzania [7, 15], and Uganda [16]. No published data

currently exist on the surgical capacity of hospitals in the rural areas of southern Nigeria. The aim of this study was to quantify the surgical capacity of primary and secondary hospitals based on an assessment of Workforce, Infrastructure, Skill, Equipment, and Supplies. These data will document the baseline conditions and identify gaps in surgical capacity as a first step in improving surgical services.

Materials and methods

Country profile

Nigeria is a large West African country (area = 923,768 km^2) and is the most populous country in Africa (population = 170,123,740) [17]. Although Nigeria has reached middle-income status [18] and despite being ranked 31st in the world in terms of GDP [17], it is ranked only 156 of 187 countries on the United Nations Human Development Index [19].

Health indicators for Nigeria are among the worst in the world with average life expectancy: 52 years; infant mortality: 75 per 1,000 live births (global average: 43), and under-5 mortality: 157 deaths per 1,000 live births (global average: 57). The maternal mortality ratio is 870 deaths per 100,000 live births (global average: 260), and in 2008 there were 0.4 physicians per 1,000 population compared with the recommended 2.3 [17].

Politically, Nigeria is a Federal Republic split into six geopolitical zones (North Central, North Eastern, North Western, South Eastern, South South, and South Western) comprising 36 states and one Federal Capital Territory. These zones are further subdivided into 774 local government areas. The healthcare system is organized into three hierarchical structures and includes public and private facilities. Primary healthcare facilities (dispensaries), managed by the local government, are the patients' first point of contact and handle minor medical and surgical problems. Secondary health centers (general hospitals), run by the state government, have emergency care and diagnostic units and can manage more complex cases. According to the Medical and Dental Council of Nigeria, secondary health centers should have a minimum of 30 beds and at least three doctors who can provide medical, surgical, pediatric, and obstetric care [20]. Tertiary health facilities (university hospitals and federal medical centers) are managed mostly by the federal government, although some private teaching hospitals have recently been approved [20]. Private hospitals operate at different levels that may correspond to any of the three tiers of the public system.

Hospitals are located mainly in urban areas where, historically, a high concentration of Europeans and government officials resided. Mobile clinics and community dispensaries were initially established by missionaries in the rural areas. Rural medical centers were later built to address primary healthcare concerns and epidemics such as small pox, sleeping sickness, and malaria. This arrangement led to stark inequality in the provision of healthcare between urban and rural areas [20].

Nigeria has faced severe physician shortages. In 1995, it was estimated that 30,000 Nigerian doctors were practicing in the US, Europe, Australia, Saudi Arabia, and other African countries [21]. Physicians who remain in Nigeria are predominantly in the urban centers that are better equipped and have a higher-income base [22].

The association of rural surgical practitioners of Nigeria (ARSPON)

In 1979, the Nigerian National Postgraduate Medical College was established to train fellows to become specialists in surgery [23]. Fellows were intended to operate at primary and secondary healthcare facilities throughout Nigeria and as of 2007 there were 116. Of the fellows who chose to remain in Nigeria, all were based either in urban areas or in tertiary institutions; thus, the workforce in rural areas and urban slums were filled by medical officers with little formal training in providing surgical care. In 2008, the Association of Rural Surgical Practitioners of Nigeria (ARSPON) was founded by a group of rural surgical practitioners to address the workforce gap. ARSPON aimed to provide training opportunities for medical officers in a short period of time that would enable them to provide safe and affordable surgery to rural and urban slum populations. In 2011, ARSPON hosted its fourth annual conference [24].

Survey administration

The Personnel, Infrastructure, Procedures, Equipment, and Supplies (PIPES) survey developed by the nongovernmental organization Surgeons OverSeas (SOS) is a tool used to assess surgical capacity through the workforce, infrastructure, skill, equipment, and supplies of health facilities in low- and middle-income countries [24]. The PIPES tool was administered to the rural surgical practitioners who attended the fourth annual conference of ARSPON in November 2011.

Data analysis

From the data collected, descriptive statistics was used to determine frequencies. Missing data were excluded. The procedures section was further subdivided according to type of surgery or anesthesia and nature of the surgical procedure assessed (Table 1). The type of surgery included minor, major, orthopedic, trauma and resuscitation, obstetric,

Table 1 Procedures assessed using the PIPES tool

		Procedures	Primary	%	Secondary	%	Combined %
Minor surgery							
		Suturing	24	100	16	100	100
		Wound debridement	24	100	16	100	100
		Incision and drainage	24	100	16	100	100
Trauma and resuscitation		Resuscitation	21	100	15	93.8	96.9
		Cricothyroidotomy	4	25	1	7.1	16
		Tracheostomy	2	12.5	3	21.4	17
		Chest tube insertion	11	61.1	10	62.5	61.8
	Burns	Management	23	100	13	86.7	93.4
		Skin grafting	9	47.4	8	53.3	50.4
		Contracture release	7	41.2	5	38.5	39.9
Orthopedic trauma		Splinting	21	95.5	12	85.7	90.6
		Casting	15	75	13	86.7	80.9
		Traction (closed fracture)	11	61.1	9	64.3	62.7
		Open fracture	8	47.1	5	35.7	41.4
		Osteomyelitis management	15	75	7	50	62.5
		Amputation	10	50	9	64.3	57.2
Major basic surgery	Emergency (fatal if not addressed)	Appendectomy	23	95.8	14	87.5	91.7
		Hernia repair—strangulated	20	87	15	93.75	90.4
	May or may not be emergency	Bowel resection	16	80	10	76.9	78.5
		Laparotomy	23	95.8	14	93.3	94.6
		Cholecystectomy	3	16.7	1	7.1	11.9
		Laparoscopic surgery	0	0	3	21.4	10.7
	Nonemergency	Hernia repair—elective	23	95.8	16	100	97.9
Obstetric		Cesarean section	22	95.7	15	93.8	94.8
		Dilation and curettage	22	100	16	100	100
		Tubal ligation	20	91	12	75	83
		Hysterectomy	19	82.6	14	93.3	88
		Obstetric fistula repair	7	38.9	4	26.7	32.8
Pediatric surgery		Hydrocele	21	87.5	16	100	93.8
		Male circumcision	23	100	15	93.8	96.9
		Pediatric hernia repair	21	87.5	16	100	93.8
		Pediatric abdominal wall defect	6	30	9	60	45
		Imperforate anus	3	16.7	2	14.3	15.5
		Clubfoot repair	1	5.3	1	7.1	6.2
		Cleft lip repair	3	16.7	2	14.3	15.5
Cancer		Biopsy	20	100	13	86.7	93.4
Anesthesia		Regional anesthesia	17	77.3	11	84.6	81
		Spinal anesthesia	12	60	11	78.6	69.3
		Ketamine anesthesia	24	100	16	100	100
		General anesthesia	8	47.1	7	46.7	46.9
Total			586		411		

pediatric, and cancer. The major basic surgical procedures were further classified into emergency, emergent/nonemergent, and elective surgery.

Surveyed hospitals were stratified into self-reported primary and secondary levels. The one tertiary facility was excluded in the main analysis. The remaining hospitals that did not give their classification were assigned a level based on the Medical and Dental Council of Nigeria definition. Hospitals were classified as secondary if they had a minimum of 30 beds or had at least three doctors who could provide medical, surgical, pediatric, and obstetric care [20]. The distribution of scores was plotted to determine homogeneity and which hospitals to focus on. Means were calculated per component of the PIPES tool. All results were analyzed and graphed using STATA software ver. 11 (Stata Corp., College Station, TX, USA) and Microsoft Excel ver. 12.3.2 (Microsoft Corp., Redmond, WA, USA).

Results

A total of 41 surveys were received representing 41 individual institutions. These hospitals were all private, rural facilities representing 22.2 % of the states of Nigeria. Stratified according to geopolitical zones, 34.1 % were located in the South East, 4.9 % North Central, and 61 % in the South West. Primary hospitals were 58.5 %, while 39 % were secondary hospitals. Total number of beds was 818, with average bed size of 13 for primary and 31 for secondary hospitals. There were a total number of 65 operating rooms (Table 2).

Personnel

There were a total of 117 personnel in the 41 institutions. Of that, 52.1 % were general practitioners performing surgery, 22.2 % were board-certified specialist surgeons, 15.4 % were nurse anesthetists, and 5.1 % were anesthesiologists. Only one anesthesiologist was available in the 16 secondary hospitals (Fig. 1).

Infrastructure

Most of the primary and secondary hospitals surveyed had running water (82.3 %). While electricity from the power grid was available to only 50.3 % of all hospitals (63.6 % of primary and 37.5 % of secondary), most (91.2 %) had a functioning backup generator. Designated areas for care, such as an emergency department (80.5 %) and postoperative area (79 %), and a system for maintaining medical records (95.9 %) were mostly present. Although ancillary services such as a laboratory were available in 88.3 % of the facilities, only 37.5 % of all facilities had a blood bank. Radiology services such as ultrasound were available in 80 % of the facilities, while only 43.8 % had an X-ray machine (Fig. 2).

Table 2 Summary of facilities and personnel surveyed

Level	Primary	Secondary	Tertiary	Total (%)
Total no. of facilities	24	16	1	41
No. of beds	318	500		818
Average no. of beds	13	31		
No. of operating rooms	36	23	6	65
Personnel				
General surgeon	12	10	4	26 (22.2)
Anesthesiologist (MD)	4	1	1	6 (5.1)
Medical doctors (doing surgery)	33	24	10	67 (52.1)
Nurse anesthetists	8	6	4	18 (15.4)
Total	57	40	19	117

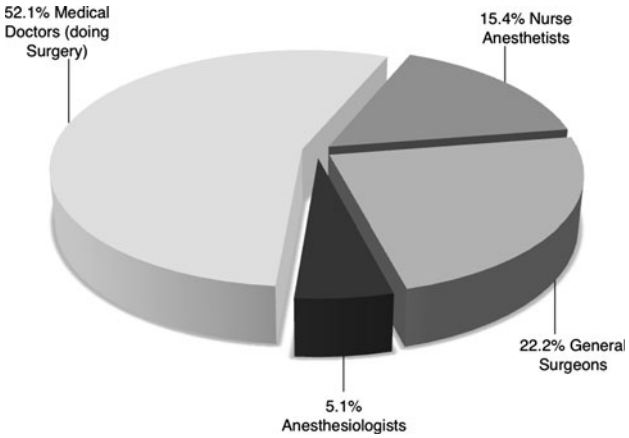

Fig. 1 Personnel distribution of facilities surveyed

Procedures

Minor surgery

All facilities surveyed were able to perform minor surgical procedures such as suturing, wound debridement, and incision and drainage.

Trauma resuscitation

Although 96.9 % of all facilities were able to perform basic resuscitation, only 16–17 % of all facilities could perform a cricothyroidotomy or tracheostomy, respectively. Slightly more than half of all facilities (61.8 %) reported the capacity to insert a chest tube. Most (93.4 %) of facilities could manage burns; however, only half of the facilities performed skin grafting, and less than half (39.9 %) performed post-burn contracture releases.

Orthopedic trauma

The majority of facilities could perform simple orthopedic procedures such as splinting (90.6 %), casting (80.9 %), traction (63 %), and management of osteomyelitis. However, only 41.4 % of the facilities could treat open fractures. Slightly more than half (57.2 %) of the facilities reported performing amputations.

Major surgery

A majority of the facilities performed emergency surgery; however, only 11.9 % could undertake a cholecystectomy and 10.7 % a laparoscopic procedure.

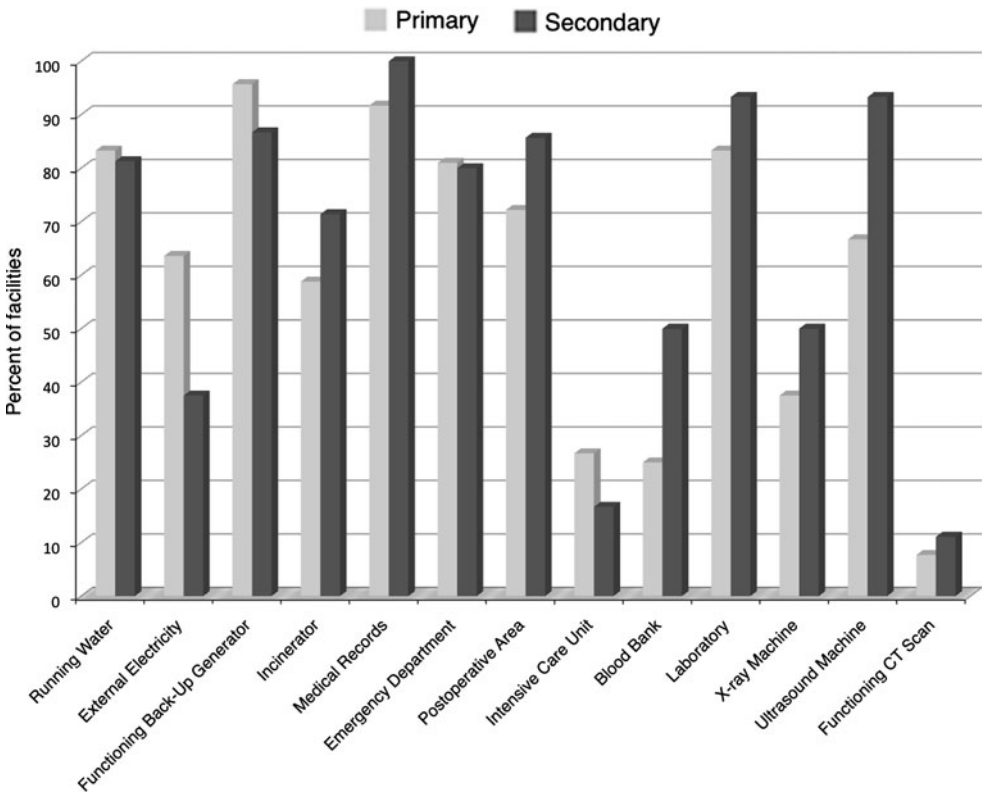

Fig. 2 Infrastructure assessment

Obstetric surgery

Most facilities provided essential obstetric procedures such as cesarean section (94.8 %), dilation and curettage (100 %), tubal ligation (83 %), and hysterectomy (88 %). Only 32.8 % of the facilities could perform an obstetric fistula repair.

Pediatric surgery

A high percentage of facilities could perform common pediatric surgical procedures such as hydrocele (93.8 %), male circumcision (96.9 %), and hernia repair (93.8 %). Less than half of facilities could undertake a repair of an abdominal wall defect (45 %). Only 15.5 % of the facilities performed cleft lip or imperforate anus repair and 6.2 % could perform a clubfoot repair.

Anesthesia

All facilities could provide ketamine anesthesia, 81 % could give regional anesthesia, and 69.3 % spinal anesthesia. Only 46.9 % provide general anesthesia.

Table 1 provides a summary of all procedures assessed.

Equipment

Although most of the facilities had equipment such as oxygen compressors, instrument sets, and sterilizers, only 19.9 % of facilities had a functioning anesthesia machine and only 44.5 % had a pulse oximeter (Fig. 3).

Supplies

Most of the facilities surveyed had adequate supplies. Only 38.1 % of the facilities, however, had eye protection. Less than half of the facilities have chest tubes and only 9.8 % of the facilities had tracheostomy tubes.

The frequency distribution of the scores on the Procedures, Infrastructure, Equipment, and Supplies components are shown in Fig. 4. The mean score for Procedures is 25/40 (SD 6.2), Infrastructure 7.4/13 (SD 2.6), Equipment 13.5/22 (SD 4), and Supplies 20.9/25 (SD 2.4).

Discussion

This survey aimed to provide a snapshot of the surgical capacity of rural hospitals in Nigeria. Using the PIPES survey tool, data on the current surgical capacity of 41 rural hospitals were obtained. These data highlighted significant deficiencies and can be used to help plan interventions by the Nigerian Ministry of Health and members of ARSPON.

Since 2008, ARSPON has been involved in the training of medical doctors to provide surgical care throughout rural Nigeria. It is due to their efforts that more than half of the surgical workforce identified in this study was made up of

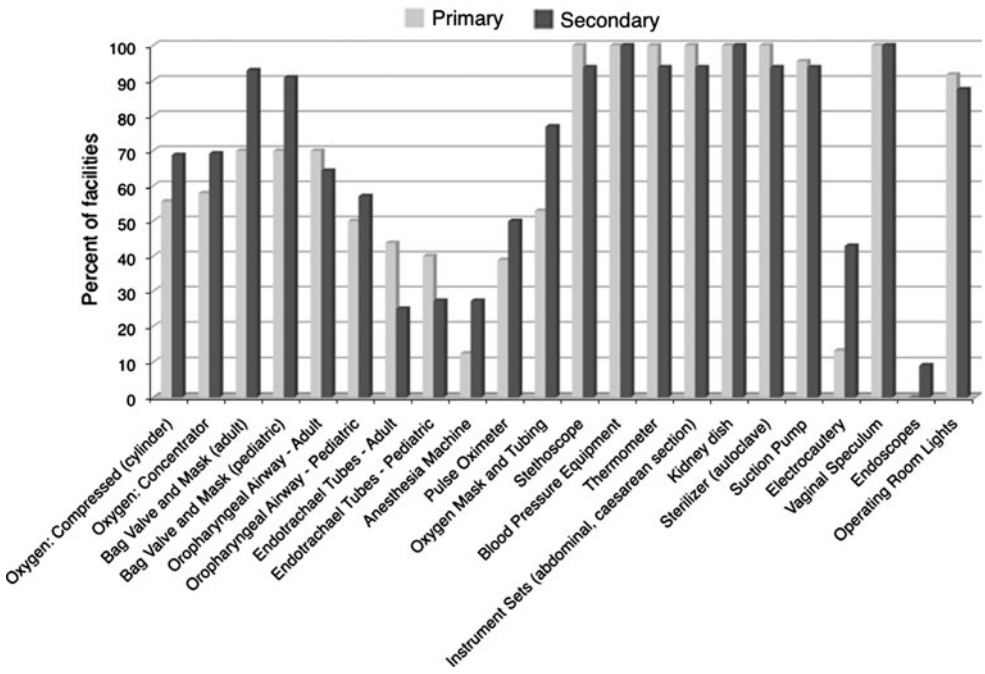

Fig. 3 Equipment assessment

nonsurgeons. Overall, the survey results indicate that most facilities can undertake many major and minor surgical, orthopedic, obstetric, and anesthetic procedures. Figure 4 shows that the facilities are fairly homogeneous and remarkably evenly distributed across the components of surgical capacity assessed.

Areas in need of improvement include the ability to provide more advanced procedures such as surgical airway (e.g., cricothyroidotomy and tracheostomy) and repair of imperforate anus. Other complex procedures such as post-burn contracture release, treatment of open fractures, and repair of obstetric fistula, clubfoot, and cleft lip were scarcely done. Efforts to train providers to undertake these procedures safely should be prioritized because their impact on the community is large.

The incidence of post-burn contractures has been estimated at 8.6–20 % in northern Nigeria, 11–13.5 % in western Nigeria, and up to 55 % among epileptic patients in eastern Nigeria [25]. Untreated contractures lead to severe disfigurement, disability, and loss of productivity. African children lose six times more productive years from disabling burns and contracture formation than from war [26]. Injuries are also a major cause of death and disability worldwide, often affecting the most productive members of society [27]. In a study of open fractures in Nigeria, the mean patient age was 33.3 years, with males at a 2.4 times greater risk than females. Complications of untreated open fractures often include chronic osteomyelitis and permanent disability [28]. Worldwide, an estimated two million women live with a vesicovaginal or vesicorectal fistula, a complication of prolonged pregnancy. In Nigeria, estimates range from 100,000 to one million. With proper surgical care, over 90 % of women can be cured with a single operation and can resume an active and fulfilling life. A common barrier to treatment cited by the World Health Organization is the lack of knowledge, skills, and facilities for fistula repair [29]. Clubfoot is the most common congenital musculoskeletal disorder in Nigeria [30]. A randomized, double-blind study in Nigeria found that the Ponseti method, a nonsurgical treatment for clubfoot, had fewer treatment complications, lower recurrence rates, more satisfactory outcomes, and lower cost compared with non-Ponseti management (manipulation with extensive soft tissue/bony surgery) [31]. The incidence of cleft lip, cleft palate, or both is 0.37 per 1,000 live births in Nigeria, 32 % of which are both cleft lip and cleft palate. This condition causes not only physical and psychological disability but also decreased productivity and earning potential due to speech defects. Alkire et al. [32] found through economic modeling that the potential benefit of repairing all cleft lip and palate defects in SSA ranged from $252 million to $441 million.

The data collected by this study is important in helping clinicians, government officials, and donors plan and implement specific programs backed by evidence. There is a need to continue training physicians to perform surgery, improve infrastructure, and provide sufficient equipment and supplies. We suggest focusing on additional training on the surgical and anesthetic procedures that were scarcely done such as post-burn contracture release, treatment of open fractures, and repair of obstetric fistula, clubfoot, and cleft lip. Members of ARSPON can host training programs for hospitals that lack capacity to perform these procedures.

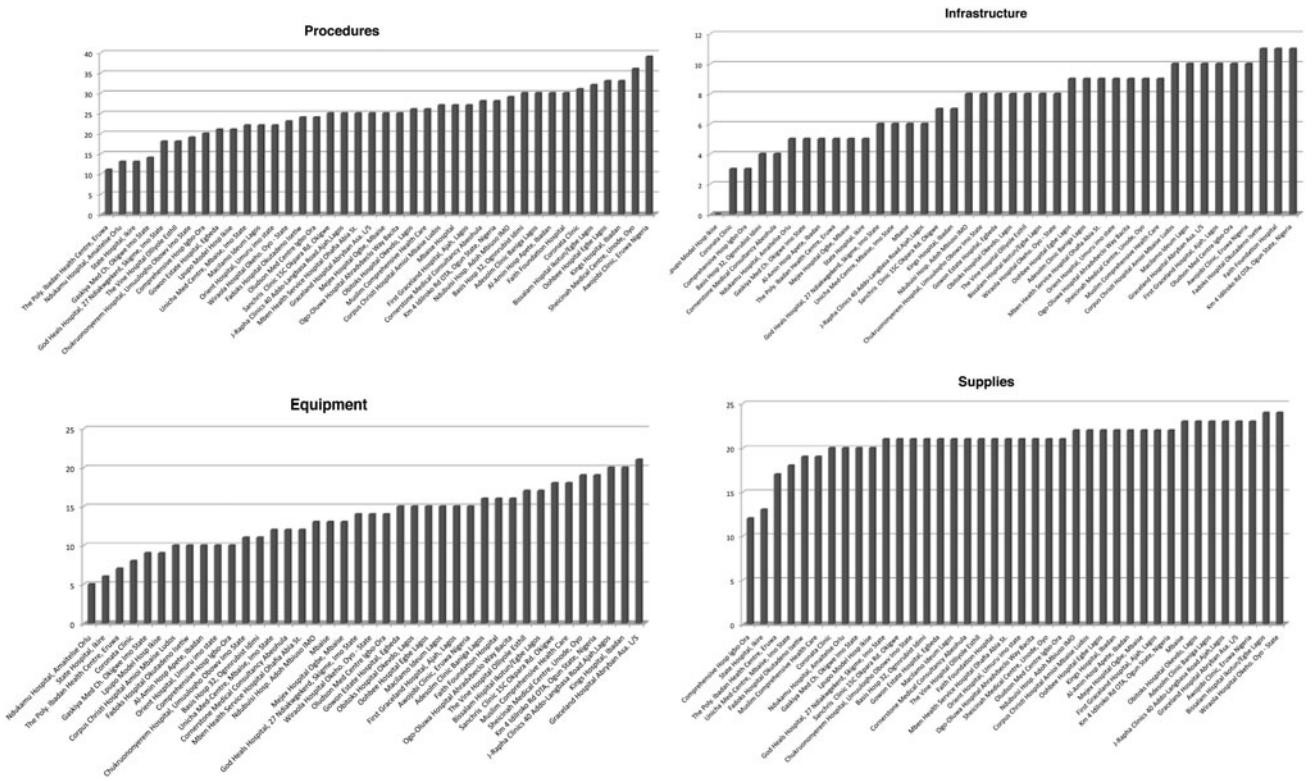

Fig. 4 Procedural, infrastructural, equipment, and supplies capacity of surveyed hospitals. Perfect scores = 40, 13, 22, 25, respectively

Moreover, protocols such as basic resuscitation should be available and periodically exercised. In infrastructure, a focus on setting up blood banks and increasing X-ray machines should be the priority. The goal for equipment is to have 100 % pulse oximeter coverage on all hospitals. For supplies, plastic goggles should always be on hand and included in the protocol when operating on HIV patients, especially in areas with high incidence.

This study has several limitations. While easy to administer, the PIPES tool provides only a brief overview of the surgical capacity of rural hospitals in Nigeria. To better understand the surgical needs of the population, a more detailed analysis of factors affecting access to care, provision of services, and the epidemiology of surgical disease is needed. Additionally, the survey was a convenience sample of rural surgical practitioners attending the ARSPON annual conference and there is the potential for selection bias. With this limitation, the study is still useful in that the results highlight a diverse range of hospitals in many different locations. Lastly, the sample size is small compared with the total number of hospitals in Nigeria. In the future, it is hoped that additional surveys will be undertaken to assess a wider range of health facilities and provide a broader overview of the surgical capacity of Nigeria.

This survey represents the first documented assessment of the surgical capacity of rural hospitals in Nigeria. The PIPES tool was effective in highlighting the severe shortages in personnel, infrastructure, procedures performed, equipment, and supplies. The results of this study will be helpful to clinicians, medical directors, Ministry of Health personnel, and donors in planning interventions and in monitoring and evaluating programs that help to improve access to care for the people of Nigeria.

Conflict of interest None.

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