

# Met and unmet needs for surgery in Sierra Leone: A comprehensive, retrospective, countrywide survey from all health care facilities performing operations in 2012

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**Background.** Understanding a country's baseline operative actors and capacity is critical to improving the quality of services and outcomes. The aim of this study was to describe all operative providers and national operative production, to evaluate district and nationwide population rates for operations, and to estimate unmet operative need in Sierra Leone.

**Methods.** A nationwide, exhaustive, retrospective, facility-based study of operative actors and surgical procedures was performed in Sierra Leone. Between January and May 2013, 4 teams of 12 medical students collected data on the characteristics of the institutions and of the operations performed in 2012. Data were retrieved from the log books of operations, anesthesia, and delivery.

**Results.** A total of 24,152 operative procedures were identified, equal to a national rate of 400 operative procedures per 100,000 inhabitants (district range 32–909/100,000, interquartile range 95–502/100,000). Hernia repair was the most common operative procedure at 86.1 per 100,000 inhabitants (22.4% of the total national volume) followed by cesarean delivery at 80.6 per 100,000 (21.0% of the total). Private, nonprofit facilities performed 54.0% of the operations, compared with 39.6% by governmental and 6.4% by private for-profit facilities. More than 90% of the estimated operative need in Sierra Leone was unmet in 2012.

**Conclusion.** The unmet operative need in Sierra Leone is very high. The 30-fold difference in operative output between districts also is very high. As the main training institution, operative services within the governmental sector need to be strengthened. An understanding of the existing operative platform is a good start for expanding operative services. (*Surgery* 2015;157:992-1001.)

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THE GREATEST UNMET NEED FOR OPERATIVE CARE is found where the burden of operative disease per capita is greatest.<sup>1-4</sup> Leaders in global health advocate that operative care must be an essential component of the recently adopted policy of universal health coverage.<sup>5</sup> The great need for operative care, in combination with global inequity, has called on governments, policy makers, and donor agencies, as part of strengthening health systems, to adopt operative health care delivery as a priority in low-income countries (LICs).<sup>6</sup>

To meet this priority, a massive expansion of operative care within LICs is needed. To plan for and identify priority interventions, there is need for more comprehensive data on the current operative actors and production from countries with the greatest surgical needs.<sup>7</sup> With a few exceptions, such data are scarce, and we still need more insights into the complexity and function of surgical health care systems in LICs.<sup>4,8-11</sup> A better understanding of all operative actors within a country, as well as how they complement each other, is needed to improve the delivery of operative health care.<sup>8</sup>

The distribution of operative actors and operative production varies greatly between regions and countries.<sup>4</sup> Identifying these variations makes it possible to target interventions toward populations that are most in need of operative services. Estimating the unmet need for surgery in a LIC serves to visualize the scale of the challenge in underdeveloped operative health care systems, and it might contribute to the development of aspirational targets for surgical services.<sup>12</sup> The primary aim of this study was to describe all operative providers, eg, governmental, private for-profit, and private nonprofit actors, and also the number of operations performed at the district and national level in Sierra Leone in 2012. The second aim was to estimate the unmet need of surgery in Sierra Leone in 2012.

## **MATERIALS AND METHODS**

Because there was no available mapping of operative providers outside the governmental sector in Sierra Leone before this study, this retrospective study intended to collect data from all facilities performing operations in the country during 2012.<sup>13</sup> The study was a collaboration between the Sierra Leonean Ministry of Health and Sanitation, the Nongovernmental Organization CapaCare, and the Norwegian University of Science and Technology.

Sierra Leone is a West-African, low-income country, with 14 districts and 6 million inhabitants, of whom 60% live in rural areas.<sup>14</sup> Life expectancy is 49 years, and infant and maternal mortality remain high at 89 per 1,000 live births and 857 per 100,000 live births, respectively.<sup>15</sup> Total expenditure on health care per capita in 2012 was 96 US dollars.<sup>16</sup> The health care system consists of 1,054 peripheral health units and 51 hospitals, 20 of which are governmental.<sup>17</sup>

Facilities performing surgery were identified by triangulation at 3 levels. First, at the capital level, where the director of hospitals and laboratory

services and the director of research and non-communicable diseases of the Ministry of Health and Sanitation, the chief surgeon at the highest governmental surgical referral hospital, and the Nongovernmental Organization-liaison officer individually listed facilities that possibly performed operations. Second, District Medical Officers in the 4 largest districts (Western Area Urban, Bo, Bombali, and Kenema) were consulted to identify additional operative providers within their districts. Third, these facilities were supplemented by the list of registered health care facilities in Sierra Leone, which was obtained on January 5, 2013, from the national regulatory body, the Sierra Leone Medical and Dental Council. This process identified 164 institutions that possibly could perform operations.

Facilities performing operations were defined as those that performed one or more of the 21 surgical procedures listed as comprehensive in the health facility assessment tool "Service Availability and Readiness Assessment," developed by the World Health Organization.<sup>18</sup> An operative procedure was defined as any procedure requiring anesthesia, performed within an operation theater, and listed in any of the records for the operation theater.<sup>4</sup>

A total of 12 fourth- and fifth-year medical students from the College of Medicine and Health Sciences in Freetown and the Norwegian University of Science and Technology collected the data. Data collectors received a 1-day training, during which definitions and a written guide to data entry were presented. Simulation interviews with a hospital director and recording of operation log books were rehearsed before the facilities were visited. Data of operative activity data were entered into an Excel Spreadsheet (Microsoft Corp, Redmond, WA), and photos of the logbooks were taken as backup and for crosschecking procedures.

Data were collected from all available sources in which operative procedures were logged. The institutions used log books from the operating theater, anesthesia, and delivery. Some facilities used common log books for operations, anesthesia, and/or delivery procedures, whereas others had separate log books for each service. When separate log books existed, operating theater and delivery log books recorded different procedures, whereas anesthesia log books recorded the same procedure as delivery and operating theater log books, a form of double bookkeeping. When visiting a facility, all sources were examined, and duplicates were removed.

Facilities owned by the government or the armed forces were categorized as governmental,

whereas all others were listed as private. The private sector was further divided into for-profit, if profit generating was one of the aims; all others were nonprofit facilities. Facilities providing 24-hour emergency in-patient care were defined as hospitals; all others were listed as clinics. Hospitals offering highly differentiated clinical services were defined as referral hospitals, and all others were categorized as district hospitals.<sup>1</sup> After being presented with the definitions, the facility directors themselves decided the owner category and administrative level of their institution. For all operative procedures, age category, sex, home address, type of procedure, emergency vs elective procedure, and date of operation were recorded. Thirty-four predefined groups of the most commonly performed procedures were created. This included 4 categories labeled "other" in general surgery, obstetrics and gynecology, orthopedic surgery, and ophthalmic surgery.

Data were aggregated by administrative districts for analyses. The Western Area Urban and Western Area Rural districts were merged into one, because most records did not differentiate between them. The 2012 projections from the most recent census were used to estimate population-based rates for operations.<sup>14</sup>

#### NEED FOR SURGERY IN SIERRA LEONE

The annual unmet need was defined as the need subtracted from the met need in a given year. Because there is no established method of defining the need for operation in a population, the present analyses were based on two population surveys that were designed to measure surgical conditions that may necessitate a consultation or surgical intervention. Random samples of the population were asked about their perceived need for surgery in 2 similarly performed surveys from Rwanda in 2011<sup>19</sup> and Sierra Leone in 2012.<sup>3</sup> To estimate the annual need for surgery, only surgical conditions that had developed over a 12-month period were counted. In the Sierra Leonean survey, 13.5% (493/3,645) of the responders had developed an operative condition over the 12 months, while 14.8% (95% CI, 13.3–16.5) of the Rwandan responders developed surgical conditions, equivalent to an annual incidence of 14,800 (13,300–16,500)/100,000.

In the Rwandan survey, 34.3% of the operative conditions stated a disability, ie, the interviewee reported "significant shame" or "inability to work" and needed help with daily activities or transportation. Because not all self-reported operative conditions require operative care within an operating theater, the fraction of those with a disabling

operative condition might better reflect those in need of an operative procedure. The annual need for surgery in Sierra Leone was estimated by use of the reported operative conditions with disabilities from Rwanda, which equals 34.3% of 14,800 (13,300–16,500)/100,000, giving an annual need of 5,100 (4,562–5,660)/100,000. For the 6 million people of Sierra Leone, the estimated need for surgery would be 307,000 (275,000–342,000).

The Statistical Package for the Social Science (SPSS), version 21 (SPSS, Armonk, NY), was used for descriptive statistics. Operative production, the met need, is presented per 100,000 inhabitants. Operative met need by district is presented by medians and interquartile range. The Sierra Leone Ethics and Scientific Review Committee and the Regional Committees for Medical and Health Research Ethics in central Norway (Ethical clearance number: 2012/2,187) granted ethical clearance for the study.

#### RESULTS

**Operative actors.** From the list of 164 institutions potentially providing operation, 89 were excluded because they did not perform operations in 2012, according to the local expert group or a telephone interview with the management of the facility. Four teams of data collectors visited the remaining 75 entities between January 14 and February 15 and May 10 and 20, 2013, (Fig 1). Of these, another 15 locations did not perform operations. Thus, 60 facilities performed operations in Sierra Leone, and 58 (97%) of these shared their annual records for 2012.

At 6 locations accounting for 21% (5,099/24,152) of the procedures, 3 separate sources were used to record surgical procedures. This approach gave the possibility to crosscheck anesthesia logbooks against operating theater and delivery logbooks. The consistency between the sources was fairly good; operating theater and delivery log books alone captured 90.1% of the procedures, whereas anesthesia log books captured 96.2%.

Private, nonprofit institutions performed 54.0% of the national operative volume, whereas the governmental sector performed 39.6% and the private for-profit institutions performed 6.4% of the operations (Table I). Most of the clinics (76.5%, 13/17) were private for-profit, whereas the hospitals were equally distributed between the governmental sector and the private nonprofit sector.

**Met need for surgery.** A total of 24,152 surgical procedures were recorded in Sierra Leone in 2012,

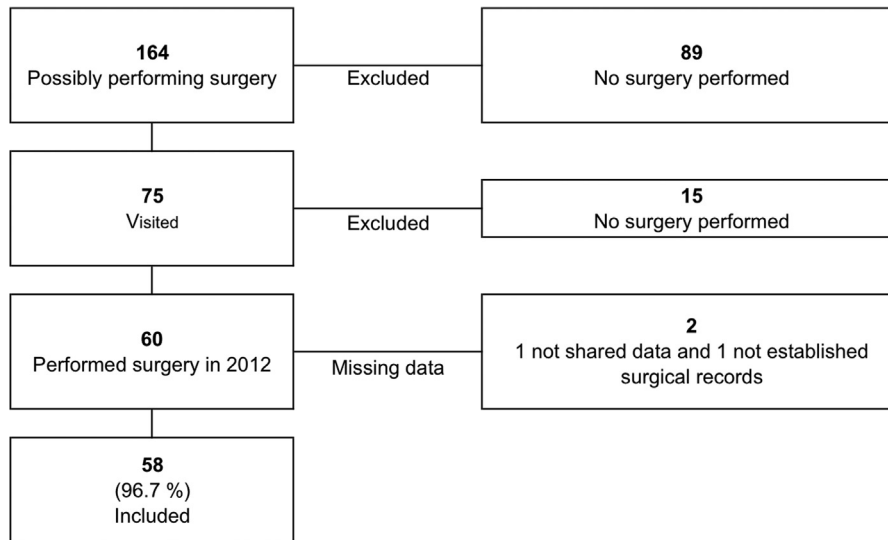


Fig 1. Identification of facilities performing surgery in Sierra Leone in 2012.

Table I. Operative facilities and procedures by owner category and organizational level

Facilities	Number	%	Procedures	%
Private nonprofit	22	37.9	13,050	54.0
Clinic	3		2,508	19.2
District hospital	16		7,418	56.8
Referral hospital	3		3,124	23.9
Private for-profit	17	29.3	1,537	6.4
Clinic	13		1,418	92.3
District hospital	4		119	7.7
Referral hospital	0		0	0.0
Governmental	19	32.8	9,565	39.6
Clinic	1		89	0.9
District hospital	14		4,574	47.8
Referral hospital	4		4,902	51.2

equal to 400 procedures per 100,000 inhabitants and a district median of 131 per 100,000 [interquartile range 95–502/100,000]. The volume of surgery varied considerably between districts, ranging from 32 to 909 procedures per 100,000. The western Area, including the capital Freetown, performed 30 times more procedures per 100,000 compared with the lowest served district (Fig 2, Table II).

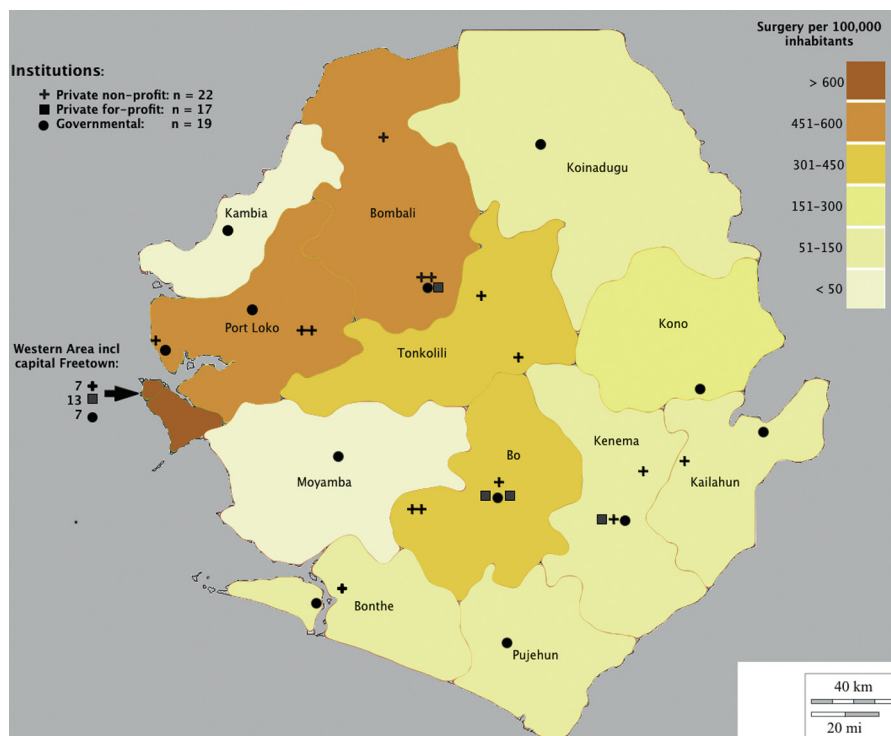
Slightly more operations were performed on women (56.1%, 12,206/21,745). Information on emergency (65%) vs elective (35%) indications for surgery was available for less than 30% of the procedures. A few procedures were performed on foreigners (1.7%, 105/6,243). The majority (82%, 5,129/6,243) of those patients with a known home

address underwent operation in the same district in which they resided.

The type of procedure was available in 96.1% (23,203/24,152) of the entries. Those procedures in which the type was unknown were attributable to illegible handwriting, the name of the procedure was unknown to the data collector, or no name of procedure was entered in the records. There were 11,002 (47.4%) procedures in general surgery; 7,361 (31.7%) procedures in obstetrics and gynecology; 2,526 (10.9%) in orthopedic surgery; and 2,314 (10%) in ophthalmic surgery (Table III). Hernia repair was the most common operative procedure (22.4%), performed at a rate of 86.1 per 100,000 inhabitants, followed by cesarean deliveries (21%), at 80.6 per 100,000 inhabitants.

More than half (56.3%, 5,290/9,383) of the operative procedures in the governmental sector were either cesarean deliveries or hernia repairs (Fig 3). Nearly every (96.2%, 872/906) operative fracture treatment and the vast majority of all orthopedic operations (86.3%, 2,224/2,576) were performed in the private nonprofit sector.

The age of the patient was available in 73.4% (17,708/24,152) of the procedures. Surgery in children younger than 1 year of age was rare (1.2%, 205/17,708), whereas 12.3% (2,176/17,708) of operations were performed on children between 1 and 15 years. Adults between 16 and 33 years represented 41.3% (7,306/17,708) of the operative patients, whereas 45.3% (8,022/17,708) of the patients were 34 years of age or older.



**Fig 2.** Location of 58 facilities providing surgery in Sierra Leone in 2012, and rate of surgery/100,000 by district.

**Unmet need.** The unmet need, calculated as the met need (24,152 performed procedures) subtracted from total need (307,000 [275,000–342,000] surgical procedures), was 283,000 (251,000–318,000), which equals to 4,700 (4,200–5,300) per 100,000 inhabitants. Thus, the unmet surgical need was 92.1% in Sierra Leone in 2012, and the district variation in the unmet need ranged from 82.1–99.4% (Table III).

## DISCUSSION

A total of 400 operative procedures per 100,000 is very low, and at the lower end of previously published data on global operative volumes that range from 148 to 23,369 per 100,000 persons per year.<sup>4</sup> The rate of 400 per 100,000 is within the same range as of other studies from LICs, and equals 10% of the estimated average global rate for operations.<sup>4,8</sup> The 30-fold difference in operative production between the greatest and least served districts, ie, between predominantly urban and rural districts, highlights the degree to which rural populations are underserved. The scale of this domestic inequity in operative production is of the same proportion as the global inequity between the poorest and the richest parts of the world.<sup>4</sup>

The scale of domestic differences in surgical production is not well described, but greater operative volumes in referral hospitals, among

urban populations and individuals with favorable economic status, are found in low and middle income countries.<sup>20</sup> Barriers to operative care in similar settings include lack of human resources, often the result of limited surgical training opportunities, poor operative health care infrastructure, long distances, the resultant costs related to operative care, and fear of undergoing surgery.<sup>21-23</sup>

Another intriguing finding was the division of operative activity between governmental and private actors. The fact that only 40% of all operations and almost no orthopedic operations were performed in public hospitals suggests that training opportunities are limited for the upcoming operative work force within governmental institutions. This lack is a particular concern, because the burden of trauma-related morbidities is increasing.<sup>24</sup> Targeted training programs for operative trauma care are needed at all levels of the health care system.

Because 54.0% of the total volume of operations in Sierra Leone was performed in the private nonprofit sector, this sector must be included in studies aspiring to establish population-based rates for surgical activity. To date, there is limited knowledge regarding the volume of operations performed by the private sector in low- and middle-income countries.<sup>25,26</sup> Furthermore, the



**Table II.** The estimated operative need, and met and unmet surgical needs by district

	District											Total		
	Bo	Bombali	Bonthe	Kailahun	Kambia	Kenema	Koinadugu	Kono	Moyamba	Port Loko	Pujehun		Tomkolili	Western area*
Population (1,000)	624	469	160	443	325	622	319	306	263	530	321	413	1,244	6,039
Need of surgery†	31,700	23,800	8,100	22,500	16,500	31,600	16,200	15,500	13,300	26,900	16,300	21,000	63,100	307,000
Met need of surgery	3,057	2,405	152	497	124	815	340	631	83	3,134	304	1,305	11,305	24,152
Private nonprofit	69.6%	65.0%	82.9%	40.0%	—	16.8%	—	—	—	65.2%	—	100%	49.1%	54.0%
Private for-profit	15.9%	8.7%	—	—	—	4.5%	—	—	—	—	—	—	7.1%	6.4%
Governmental	14.6%	26.2%	17.1%	60.0%	100%	78.7%	100%	100%	100%	34.8%	100%	—	43.8%	39.6%
Surgery/100,000	490	513	95	112	38	131	107	206	32	591	95	316	909	400
Unmet need of surgery	28,600	21,400	8,000	22,000	16,400	30,800	15,900	14,900	13,300	23,800	16,000	19,700	51,800	282,000
% Unmet need	90.3	89.9	98.1	97.8	99.2	97.4	97.9	95.9	99.4	88.4	98.1	93.8	82.1	92.1

\*Two districts, Western Area Rural and Western Area Urban, were combined as Western Area.

†Need estimate: 5,100 surgery/100,000.

potential of this sector in training and operative capacity building should not be underestimated.

More sophisticated methods of estimating the unmet need for surgery based on Disability-Adjusted Life Year calculations are suggested,<sup>27</sup> but a major obstacle when calculating the unmet need for surgery is to estimate the need, because there is no validated method. The lack of data on operative need in LICs is profound, but recently population studies from Rwanda, Sierra Leone, and Nepal<sup>2,3,28</sup> have described the need for surgery, and, thus, together with the present nationwide data on performed operations, the unmet need may be estimated.

The population studies used in this calculation have important limitations in estimating the need for surgical procedures within an operating theater. First, a self-reported need for operation is most likely different from a surgical need judged by a operative practitioner. Second, even some disabling operative conditions will not benefit from surgery, or the surgical condition can be treated outside an operating theater. Despite such limitations for estimating surgical need, however, there are no other good approaches, and the estimated annual need for surgery of 5,100/100,000, as used in this paper, seems reasonable and within the range of the average annual global surgical production rate of 4,000/100,000.<sup>4</sup> An operative need in Sierra Leone that is greater than the average global surgical production is also reasonable, because sub-Saharan Africa has the greatest burden of surgical diseases per capita.<sup>1</sup> For this reason, using the present model to estimate the need and the unmet need for surgery in Sierra Leone seems accurate. Our estimated unmet need for surgery of more than 90% is very high and demonstrates an urgent call to scale up surgical services in this country.

## STRENGTHS AND LIMITATIONS

This study has limitations. It was retrospective, facility-based, and data were retrieved from registers. The distinction between clinic and hospital was a self-reported ability to provide 24-hour emergency service. We found that some very small private for-profit facilities categorize themselves as district hospitals, probably because they fell within the hospital definition because they offered 24-hour emergency in-patient services, although to a strictly selected subset of patients. The distinction between district hospital and referral hospital was equally difficult, as the definitions were not very clear.

**Table III.** Thirty-four predefined groups of the most commonly performed operative procedures, internal ranking, and percentage of the total volume of the procedures, and rates per 100,000 inhabitants

	<i>General</i>	<i>Obstetrics and Gynecology</i>	<i>Orthopedic</i>	<i>Ophthalmic</i>	<i>Percentage</i>	<i>Surgery/ 100,000</i>
Hernia Repair	5,202				22.4	86.1
Cesarean Delivery		4,868			21.0	80.6
General Surgery Other	2,417				10.4	40.0
Cataract Surgery				2,304	9.9	38.1
Appendectomy	1,630				7.0	27.0
Orthopedic Surgery Other			1,190		5.1	19.7
Laparotomy	1,036				4.6	17.2
Operative Fracture Treatment			906		3.9	15.0
Obstetrics and Gynecology Other		768			3.3	12.7
Dilation and Curettage		611			2.6	10.1
Hysterectomy		489			2.1	8.1
Incision and Drainage Abscess	384				1.7	6.4
Obstetric Fistula Repair		264			1.1	4.4
Amputation, Lower Limb			204		0.9	3.4
Salpingectomy Ectopic Pregnancy		174			0.7	2.9
General Cancer Surgery	174				0.7	2.9
Conservative Fracture Treatment			157		0.7	2.6
Manual Placenta Removal		122			0.5	2.0
Urethral Stricture Dilation	75				0.3	1.2
Amputation Upper Limb			60		0.2	1.0
Chest Tube	39				0.2	0.7
Cervical or Vaginal Laceration		27			0.1	0.4
Neonatal Surgery	18				0.1	0.3
Cystotomy	16				0.1	0.3
Tubal Ligation		14			0.1	0.2
Repair of Ruptured Uterus		12			0.1	0.2
Gynecology Cancer Surgery		11			0.0	0.2
Ophthalmic Surgery Other				10	0.0	0.2
Orthopedic Cancer Surgery			9		0.0	0.1
Tracheostomy	8				0.0	0.1
Cleft Lip Repair	2				0.0	0.0
Vasectomy	1				0.0	0.0
Episiotomy		1			0.0	0.0
Missing (949)					(3.9)	(15.8)
Total	11,002	7,361	2,526	2,314	100	400

The type of procedure was missing in 949 of the 24,152 entries (3.9%).

As opposed to a retrospective study, a prospective registration could be an option; however, it would have been considerably more resource-demanding and fewer locations could have been surveyed. A household study examining surgical procedures would include recall bias. Because data were collected from 96.7% of all surgical providers, it may be argued that population rates can be inferred.

Many sources for retrieving data on surgical procedures were considered. The surgeon's personal daily log, the operation theater log book, is considered by some to be the gold standard, and this was also the easiest data to obtain.<sup>29</sup> Personal variations in recording habits will always occur.

On the contrary, inconsistencies in recording routines seems less likely in this study, because it used 3 potential sources to capture the operative procedure data.

The district rates are based on the notion that patients have their operation performed in the same district as they reside. A recent study from Mozambique revealed that patients undergoing operation travel greater distances than nonsurgical patients to receive care at a rural hospital.<sup>30</sup> Within this material, the patients' corresponding home addresses were available in only 26% (6,243/24,152) of the recorded procedures. Of these, 82% had their operation performed in the same district in which they were living. In a small country like Sierra Leone,

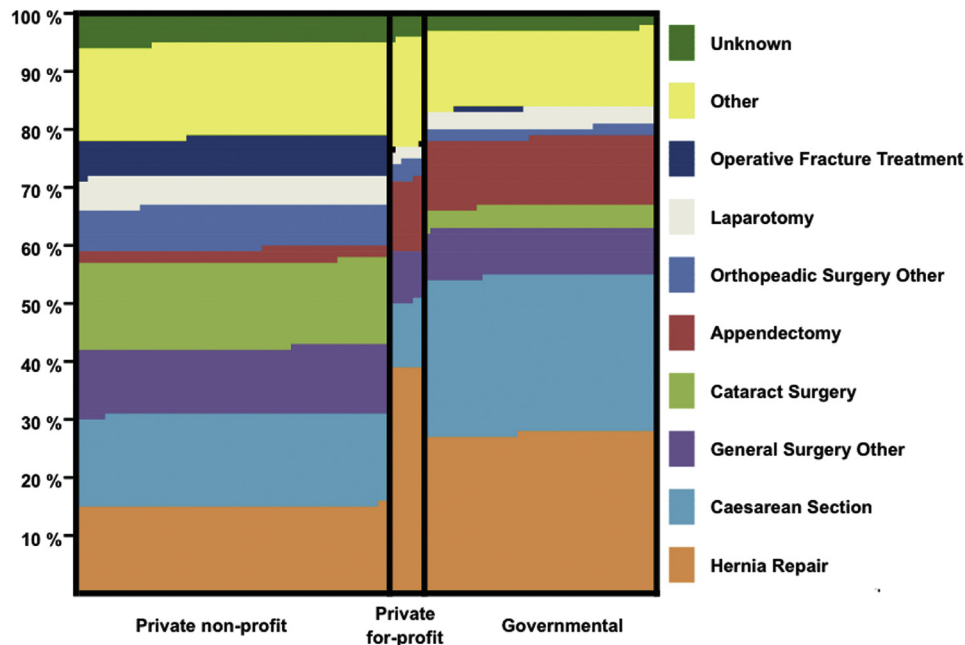


Fig 3. The rate of the most common procedures and their variation by owner category.

cross-district travel for operative health care is likely. This factor may decrease the differences between districts, and has to be taken into consideration when comparing rates of surgery at the district level. Cross-district travel will not affect national figures.

The challenge of calculating population rates from facility studies often is the difficulty in obtaining reliable catchment populations. The strength of this study is a trustworthy catchment population, as it equals the total population of Sierra Leone. Because foreigners represented only 1.7% of the patients with a known home address, immigration for operative care should be negligible. The emigration of Sierra Leonean operative patients crossing national borders was discussed with facility directors and surgical providers of hospitals located closest to the borders of neighboring countries. In the border regions, this was reported as unlikely at a larger scale; however, its extent is unknown.

**Key implications.** The main implication of this study is the finding of a very high unmet need for surgery in Sierra Leone. Since these data were collected, the Ebola epidemic has ravaged West Africa, with a considerable negative effect on hospital functioning, and it most likely further increased the unmet need. The finding that in-country variations in surgical output between the capital and the lowest served districts was as large as the differences between high- and low-income countries is important, because it demonstrates

that a focus on operative care at the district hospital level still is important.<sup>31</sup> How can the findings in this study best support an expansion of surgical services in LICs? In the Sierra Leonean context, the following can be suggested based on this study:

1. Inclusion of the private for-profit and nonprofit sector when measuring the met need for surgery is important.
2. Strengthening district hospitals will balance out the large differences in operative output between the districts.
3. The monopolization of certain surgical services, such as orthopedic surgery, solely to the private sector should be avoided. Trauma care needs to be made available also in the governmental sector.
4. Because the private nonprofit sector is such a large contributor to the national surgical production, this sector needs to be included in surgical capacity building.
5. Because more than 55% of all operative procedures at governmental hospitals are either hernia repairs or cesarean sections, task-shifting of even a very narrow scope of the surgical practice would allow qualified surgeons, who are scarce, to use their knowledge and skills far more rationally, rather than performing basic surgical procedures in high numbers.

If operative care is to become an essential component of universal health coverage, there is a long way to go in Sierra Leone and, most likely, in



many other LICs. The fact that more than 90% of the operative need is unmet and that there is a very limited ability to provide trauma care, as well as a governmental sector that perform only a handful of operative procedures in large numbers, are major challenges that need to be addressed, if or when an expansion of surgical services is planned. A better understanding of the existing surgical platform is a good start to build upon.

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