



Global Medicine

Changes in surgical volume, workforce, and productivity in Sierra Leone between 2012 and 2017



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ABSTRACT

Background: The Lancet Commission on Global Surgery recommends a minimum of 20 surgical specialists and 5,000 annual operations per 100,000 population by 2030. In 2012, Sierra Leone was far from reaching these targets. This study aimed to assess the changes in surgical activity, surgical workforce, and surgical productivity between 2012 and 2017.

Methods: A nationwide, retrospective mapping of surgical activity and workforce in 2012 was repeated in 2017. All 60 facilities performing comprehensive surgery in Sierra Leone in 2017 were identified and data was obtained from surgical records and through structured interviews with facility directors. Annual estimates were calculated and compared with 2012.

Results: The surgical workforce increased from 164.5 to 312.8 full-time positions. The annual volume of surgeries was enhanced by 15.6% (95% CI: 7.8–23.4%) from 24,152 to 27,928 (26,048–29,808) operations. With simultaneous population growth, this led to a decrease in surgical volume from 400 to 372 procedures per 100,000 population and an unmet operative need of 92.7%. The mean productivity of surgical providers went from 2.8 to 1.7 surgeries per week per full-time position. An increasing number of caesarean deliveries were performed in public institutions, by associate clinicians.

Conclusion: The unmet need for surgery in Sierra Leone remains very high, despite an increase in the surgical workforce, subsidizing maternal healthcare, and initiation of a surgical task-sharing program. The decline in surgical productivity with simultaneous increases in the surgical workforce calls for further exploration of the barriers to access and delivery of surgical care in Sierra Leone.

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Introduction

The need to increase volume and quality of surgical, obstetric, and anesthetic care, especially in low-income countries (LICs), has been recognized as being essential to achieving universal health coverage.^{1–3} Six surgical and anesthetic core indicators were

developed by the Lancet Commission on Global Surgery (LCoGS) to monitor surgical healthcare systems, to compare surgical systems development between and within countries, and track progress of interventions.¹ Recommendations include targeting a minimum of 5,000 annual surgical procedures and at least 20 surgical, anesthetic, and obstetric specialist physicians per 100,000 population by 2030.¹

In 2012, the surgical volume and surgical workforce in Sierra Leone were, respectively, 400 surgical procedures and 0.97 specialist surgical and obstetric physicians per 100,000 population, less than 10% of the LCoGS recommendations.^{1,4,5} Average surgical productivity was 2.8 procedures per week, with considerable

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variations between health cadres and facility owner.⁵ Non-specialist surgical providers performed 52.8% of all surgeries in 2012.^{5,6}

Around 2012, national strategies were developed to improve surgical and obstetric care, aiming to increase the surgical workforce, improve quality of care, and decrease financial barriers.⁷ In 2010, a Free Health Care Initiative (FHCI) for pregnant and lactating mothers and children below 5 years of age was implemented to subsidize healthcare for vulnerable groups.⁸ In 2011, a surgical task-sharing initiative for physicians and associate clinicians was introduced to increase the surgical workforce.⁹ From 2014 to 2016, the health system in Sierra Leone, including the health workforce, was severely affected by the Ebola Viral Disease (EVD) outbreak.^{10,11} After the EVD epidemic, new regional partnerships facilitated an increase in the number of imported qualified health workers to strengthen the health system.^{8,12} A national surgical, obstetric, and anesthesia plan to address deficiencies in the surgical healthcare system in Sierra Leone was initiated in 2016; however, to date, such a plan has not materialised.¹³ The aim of this study was to assess changes in quantity and distribution of surgical volume, scope of practice, surgical workforce, and surgical productivity of all surgical providers in Sierra Leone between 2012 and 2017.

Methods

A nationwide, retrospective study of operative procedures and providers was performed in Sierra Leone in 2012 to obtain surgical activity data from all healthcare facilities performing surgical procedures.⁴ The same study was repeated in 2017 in order to assess changes over the 5 years. Both studies were conducted as a collaboration between the Sierra Leone Ministry of Health and Sanitation (MoHS), the Norwegian University of Science and Technology (NTNU), and the non-governmental organization

(NGO) CapaCare, which, together with the MoHS, has offered a nationwide surgical task-sharing program (STP) since 2011.⁹

Setting

Sierra Leone is an LIC in West-Africa with 7.1 million inhabitants (2015 census), of whom 59% live in rural areas.^{14,15} Life expectancy at birth is 54 years.¹⁴ Despite recent improvements, neonatal and maternal mortality are amongst the highest worldwide with 31 per 1,000 live births and 717 per 100,000 live births, respectively.^{16,17} The main healthcare provider is the MoHS, complemented by private clinics and hospitals.¹⁸ According to a Service Availability and Readiness Assessment (SARA), in 2017 there were 54 hospitals, of which approximately half were public facilities.¹⁹ Ten percent of the national budget was allocated to health, and 50% of total health expenditure was out-of-pocket expenditure.²⁰

Identification of surgical facilities

All healthcare facilities that performed surgical procedures were eligible for inclusion. Several complementary sources were consulted to identify all eligible healthcare facilities in 2012 and are previously described.⁴ We applied a similar approach in 2017, and in addition consulted the then recently performed Sierra Leonean SARA.¹⁹ In total, 164 institutions were identified to possibly perform surgical operations in 2012, and 262 in 2017 (Fig 1). All healthcare facilities were contacted and included if they were identified as a surgical facility.

Definitions

A surgical facility was defined as a hospital or a clinic that performed 1 or more of the 21 comprehensive surgical procedures as

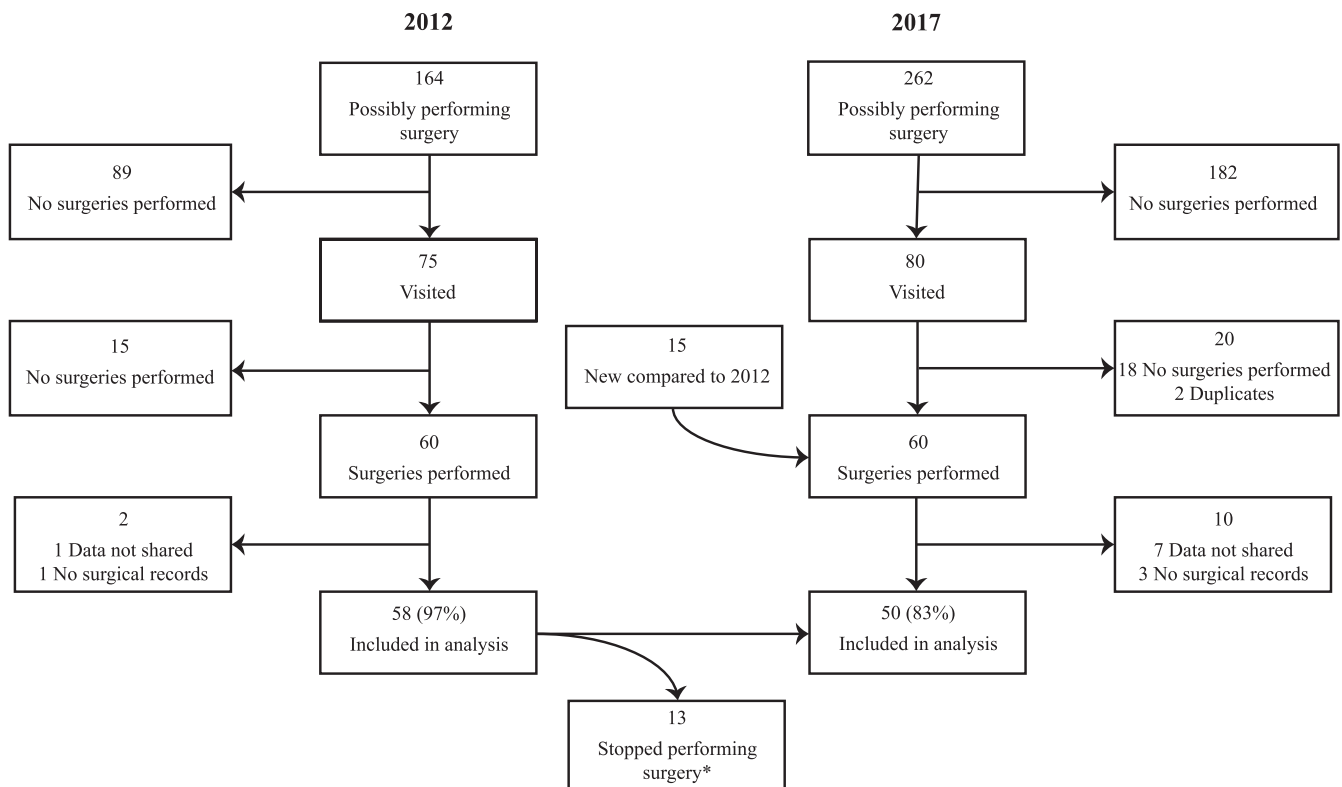


Fig. 1. Identification and inclusion process of facilities performing surgery in Sierra Leone in 2012 and 2017. *Three facilities closed down and 10 stopped performing surgery.

listed in the SARA health facility assessment tool.²¹ A surgical procedure was defined as “the incision, excision, or manipulation of tissue that needs regional or general anesthesia, or profound sedation to control pain.”¹ A surgical provider was defined as any healthcare worker who performed surgical procedures. A specialist was defined as a senior physician who had completed specialist training in surgery, orthopedics, gynecology/obstetrics, ophthalmology, or pediatric surgery.⁵ A physician was defined as a non-specialist holder of a medical degree, including house officers. Associate clinicians were defined as health workers who were not physicians or nurses but trained specifically to diagnose and manage certain medical and surgical conditions.¹ For comparison, surgical providers in part-time and/or temporary positions were considered proportionate of full-time positions (FTP). Productivity was defined as the number of surgical procedures performed per week per FTP.⁵ Surgical provider density was defined as number of surgical providers per 100,000 population.¹

Data collection

Medical students from the University of Sierra Leone and NTNU collected the data in 2012, while trainees and graduates from the STP collected the 2017 data supervised by medical students (B.L.M., A.G.) and co-authors (H.B., Dv.L., and I.B.). Data collection took place between January and June 2013 for 2012 and from February to June 2018 for 2017. All surgical facilities were visited, and the facility directors were interviewed regarding workforce availability using the LCoGS “Hospital Assessment Tool.”²² In addition, procedure-related surgical activity data were obtained from the different available sources where operative procedures were logged, including operating theater logbooks, anesthesia logbooks, and maternity logbooks. Photographs of the logbooks were taken for cross-checking between the sources and removal of duplicates. For all operative procedures, patient details (age, sex, and home address), operation date, emergency or elective procedure, surgical provider, and type of surgery were recorded. In 2017, surgical activity data were sampled for the months February, June, and October in 2017. The sampled months were purposely selected to capture both wet and dry season, including a maximum spread of 3 and 4 months apart, and avoiding the main festive season of December when planned surgical activity is low.

Data analysis

Surgical activity data were captured, processed, analyzed, and presented as descriptive statistics using Microsoft Excel and SPSS IBM 25 software. For 2017, annual surgical volumes were calculated from surgical activity data in the 3 months and presented with a 95% confidence interval (CI). Only facilities where data was available and shared were included for analysis. The surgical workforce data obtained with the LCoGS Hospital Assessment Tool was considered to adequately reflect the average annual volume of surgical providers in 2017.

Changes between 2012 and 2017 in operative volume, scope of surgery, surgical workforce, and surgical productivity were assessed at a national level together with comparisons between districts, facility type, and surgical cadres. The operative procedures were categorized into 5 groups (general surgery, obstetrics and gynecology, orthopedic surgery, ophthalmologic surgery, and “other”), further divided into 34 sub-groups of the most performed procedures.⁴

To calculate the surgical volume rate and the surgical workforce density, the 2012 and 2017 population projections from the 2004 and the 2015 census were used, respectively.¹⁵ The unmet need of surgery was calculated by subtracting the surgical volume rates

from the estimated need (5,100 per 100,000 population) for surgical procedures in Sierra Leone, as previously described.⁴

Ethical considerations

Ethical approval was granted by the Sierra Leone Ethics and Scientific Review Committee in 2013 and 2018. Written consent from the head of every included facility was obtained before data collection.

Results

Sixty facilities were identified that performed surgery, both in 2012 and in 2017 (Fig 1). Seventy-five percent of these were the same facilities in 2012 and 2017; 15 facilities, mostly private for-profit clinics and private nonprofit facilities, had changed. For 2012, surgical activity data was available for 58 facilities, and surgical workforce data was available for 56 facilities. In 2017, 52 facilities completed the LCoGS hospital assessment tool, including surgical workforce information, and 50 shared surgical activity logbooks.

Surgical volume

The annual number of operations increased between 2012 and 2017 from 24,152 to 27,928 procedures (95% CI 26,048–29,808), a 15.6% increase (Table 1). Public facilities increased the surgical volume by 34.0% (95% CI 20.1–47.9%), whereas the surgical volume in private non-profit and private for-profit institutions remained similar. In both years studied, the largest volume of surgical procedures (54.0% and 48.9%) were performed in private non-profit institutions. The increase in surgical volume between 2012 and 2017 is largely the result of the 3,865 additional surgical procedures performed by associate clinicians (239% increase, 95% CI 181–297%). There was a decrease in operations performed by nurses and physicians, however potentially biased as information on the surgical provider category was available for 92% of the registered surgeries in 2017, compared with 98% in 2012.

Despite an increase in absolute number of surgeries performed, the rate of surgical procedures performed per 100,000 population decreased from 400 to 372 over the 5 years examined. The estimated unmet need for surgery in Sierra Leone hardly changed (from 92.2% to 92.7%). The considerable disparities in population rates of surgeries performed between districts remain similar (Fig 2). Differences between districts ranged from 34 to 769 operations per 100,000 in 2017. Inequity in surgical rates between the highest and lowest performing districts decreased from almost 30-fold to 23-fold between 2012 and 2017. Surgical specialists mainly operated in the capital and regional capitals in both years, whereas most procedures in remote districts were performed by physicians, and since 2017 to a larger degree by the associate clinicians (Fig 2).

Scope of practice

Most surgical procedures were categorized as general surgery or obstetrics and gynecology. The increase in surgical volume between 2012 and 2017 can be explained, for a substantial part, by an increase in obstetric surgeries (Table 1), especially by a 62% (95% CI 22–103%) increase in caesarean deliveries from 4,868 to 7,696 (95% CI 5,796–9,569) (Supplementary Table S1). Whereas the volume of obstetric procedures increased, general surgery, ophthalmologic, and orthopedic procedures remained similar (Fig 3). Notably, more general and obstetric surgeries were performed by associate

Table 1

Total surgical volume in 2012 and 2017 by operative facility owner category, by surgical provider and by procedure category, and percentage change in surgical volume between 2012 and 2017

	Surgical volume		Percentage change 2012–2017
	2012*	2017 (95% CI)	(95% CI)
Total	24,152	27,928 (26,048–29,808)	15.6% (7.8; 23.4%)
By facility owner			
Public	9,565	12,820 (11,490–14,150)	34.0% (20.1; 47.9%)
Private nonprofit	13,050	13,652 (12,682–14,622)	4.6% (–2.8; 12.0%)
Private for-profit	1,537	1,456 (1,262–1,650)	–5.3% (–17.9; 7.4%)
By surgical provider category			
Specialist	11,172	11,612 (11,170–12,054)	3.9% (0.0; 7.9%)
Physician	9,328	7,796 (7,191–8,401)	–16.4% (–22.9; –9.9%)
Associate clinician	1,619	5,484 (4,547–6,421)	238.7% (180.9; 296.6%)
Nurse	1,574	716 (319–1,113)	–54.5% (–79.7; –29.3%)
Other/unknown	459	2,320 (1,460–3,180)	405.4% (218.0; 592.9%)
By procedure category			
General surgery	10,989	10,752 (9,803–11,701)	–2.2% (–10.8; 6.5%)
Obstetrics and gynecology	7,361	9,984 (7,920–12,048)	35.6% (7.6; 63.7%)
Orthopedic surgery	2,526	2,608 (2,484–2,732)	3.2% (–1.6; 8.1%)
Ophthalmology	2,304	3,752 (2,051–5,453)	62.8% (–11.0; 136.7%)
Other	28	32 (13–51)	14.3% (–52.7; 81.3%)
Unknown	944	800 (658–942)	–15.3% (–30.3; –0.2%)

CI, confidence interval.

* Bolkan et al, *Surgery*. 2015.⁴

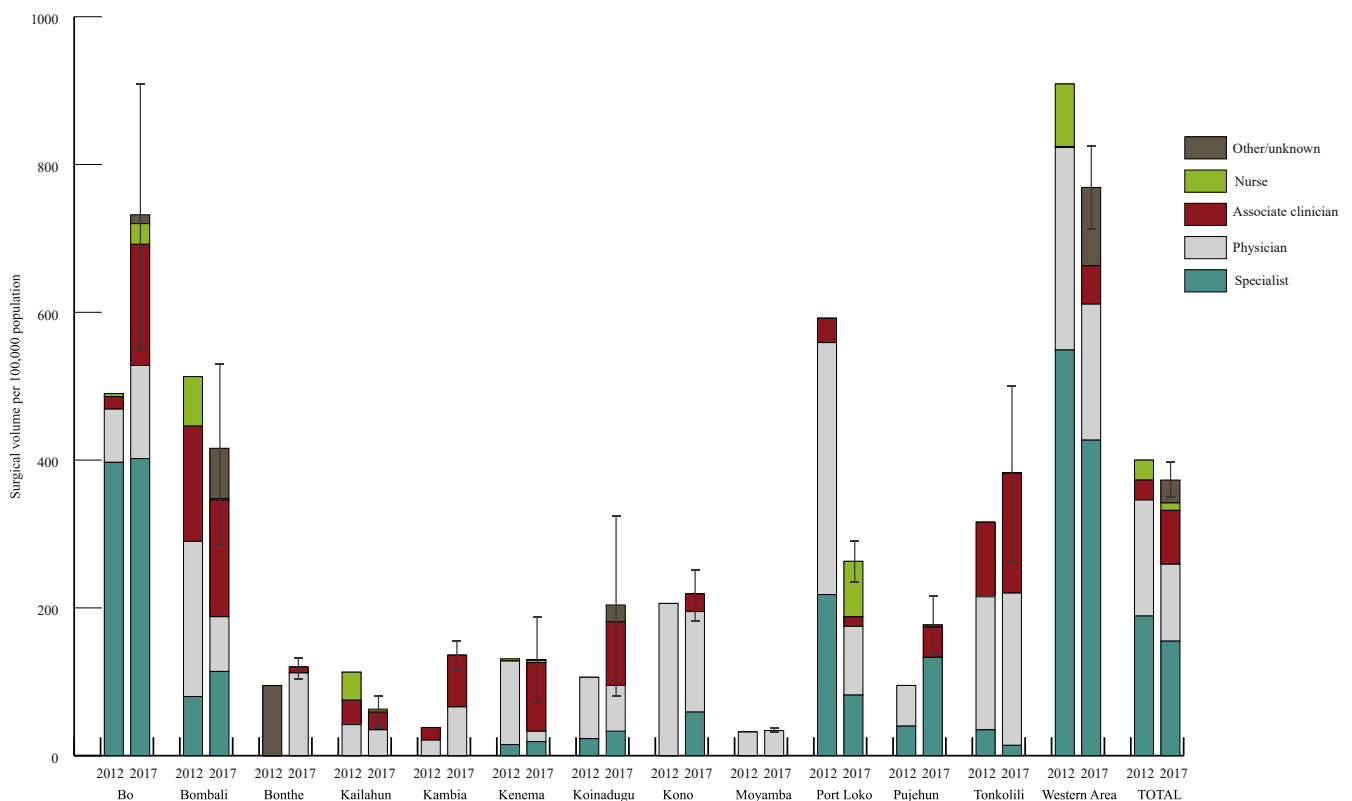


Fig. 2. Comparison of surgical volume per district per 100,000 population by surgical cadre between 2012 and 2017. *For 2017, a 95% confidence interval is displayed.

clinicians, whereas the proportion performed by specialists did not change substantially, and for physicians only a slight increase was observed for obstetric surgery.

Surgical workforce

Health professionals performing surgical operations almost doubled from 164.5 full-time positions in 2012 to 312.8 in 2017

(Table II). More than half of the additional surgical workforce was employed by governmental facilities. There was an increased number of surgical providers within all cadres, however, mostly among physicians and associate clinicians (54 and 52 FTP increase, respectively). The surgical specialist density increased from 0.97 to 1.18 FTP per 100,000 population. The total surgical provider density, which also includes physicians, associate clinicians, and nurses, increased from 2.7 to 4.2 FTP per 100,000 population.

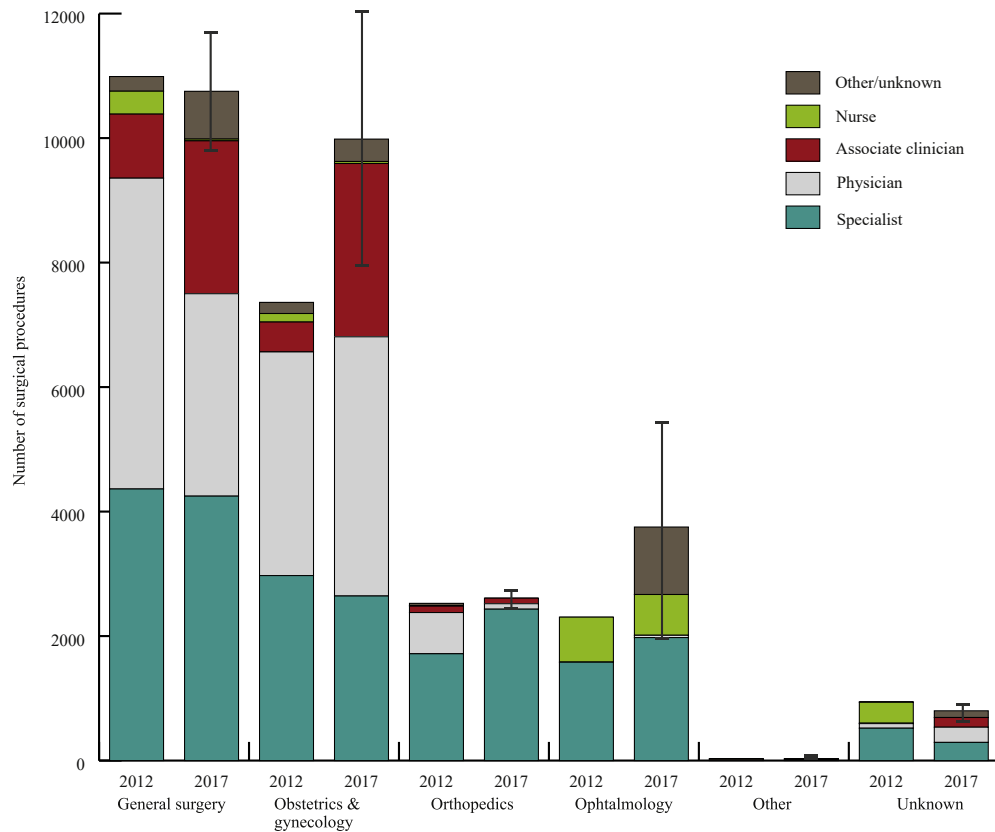


Fig. 3. Comparison of the volume of surgery between 2012 and 2017 by type of surgery and surgical provider cadre. *For 2017, a 95% confidence interval is displayed.

Table II

Overview of the surgical workforce and surgical productivity in 2012 and 2017 and percentage change between 2012 and 2017 by facility owner and surgical provider category

	2012 ^a		2017		% Change 2012–2017	
	Surgical providers [†]	Productivity [‡]	Surgical providers [†]	Productivity [‡] (95% CI)	Surgical providers	Productivity (95% CI)
Total	164.5 (100%)	2.8	312.8 (100%)	1.7 (1.6–1.8)	+90%	–39% (–43; –35%)
By facility owner						
Public	76.4 (46.4%)	2.4	154.0 (49.2%)	1.6 (1.4–1.8)	+102%	–34% (–40; –27%)
Private nonprofit	71.9 (43.7%)	3.5	92.8 (29.7%)	2.8 (2.6–3.0)	+29%	–19% (–25; –13%)
Private for-profit	16.2 (9.9%)	1.8	66.0 (21.1%)	0.4 (0.4–0.5)	+307%	–77% (–80; –74%)
By surgical provider cadre						
Specialist	58.5 (35.6%)	3.7	88.9 (28.4%)	2.5 (2.4–2.6)	+52%	–32% (–34; –29%)
Physician	86.0 (52.3%)	2.1	140.3 (44.9%)	1.1 (1.0–1.2)	+63%	–49% (–53; –45%)
Associate clinician	13.8 (8.4%)	2.3	66.1 (21.1%)	1.6 (1.3–1.9)	+379%	–29% (–41; –17%)
Nurse	6.2 (3.8%)	4.9	17.5 (5.6%)	0.8 (0.4–1.2)	+182%	–84% (–93; –75%)

CI, confidence interval.

^a Bolkan et al.⁵

[†] Surgical providers are presented as full-time positions.

[‡] Surgical productivity is presented in number of surgical procedures per full-time position per week.

The proportion of specialists and physician surgical providers decreased from, respectively, 35.6% to 28.4% and 52.3% to 44.9%, while the share of associate clinicians increased from 8.4% to 21.1%. Physicians made up almost half of the surgical workforce in 2017 and performed 28% of all surgical procedures.

Surgical productivity

Surgical productivity decreased substantially from an average of 2.8 surgical procedures per FTP per week in 2012 to 1.7 in 2017 (Table II). A decrease in productivity was observed for all cadres. In 2017, surgical providers in private non-profit facilities were most

productive with 2.8 procedures per week. By cadre, specialists were most productive with 2.5 surgical procedures per week, followed by associate clinicians with 1.6. The largest decrease in surgical productivity was observed for nurses (–84%) and surgical providers in the private for-profit sector (–77%).

Discussion

This study assessed the changes in surgical workforce and surgical activity in Sierra Leone between 2012 and 2017. Key findings include an almost doubling of health professionals performing surgeries in just 5 years, while the total number of surgical

procedures performed increased with an estimated 16%. Each cadre of surgical provider performed less operations in 2017 per FTP. A considerable increase in caesarean deliveries partly explains the total growth in surgical volume. Despite more surgeries being performed over this 5-year period, the population growth was even higher, leading to a decline in surgical procedures performed per 100,000 population.

Surgical workforce and annual surgical procedures

Strategies to increase the surgical workforce in Sierra Leone have previously been suggested and include training new surgical specialist providers, sharing surgical tasks with more healthcare workers, and using the entire workforce more efficiently.⁵ The increase in annual surgical procedures is likely related to the significant increase in surgical providers over the 5-year period assessed in this study. The additional surgical providers that entered the health system between 2012 and 2017 included 50 surgically trained associate clinicians and trainees, together with many of the 90+ health workers brought in after the EVD outbreak through a health system support project by the World Bank in collaboration with the Government of Sierra Leone.²³ Furthermore, strategies to strengthen medical and postgraduate training in Sierra Leone were established in 2016.¹²

The increase in surgical procedures performed by associate clinicians, especially in public institutions at district level, indicates that task-sharing is strengthening surgical care in harder to reach areas as intended from the task-sharing initiative implemented by the MoHS and the NGO CapaCare.⁹ Inequity in surgical volume between districts is still a concern, and districts with larger urban settlements tend to perform more surgeries. Rural retention of healthcare workers is challenging in Sierra Leone, and it is described that poor information about job entitlements, work related policies, and procedures, is a driver of rural health care workers job dissatisfaction and attrition.²⁴

Scope of surgery

A clear increase in obstetric and ophthalmologic surgery was observed between 2012 and 2017, contrary to general and orthopedic surgery. The increase in obstetric surgeries could reflect multiple interventions initiated to improve maternal healthcare over the past decade. One such initiative includes the FHCI, which subsidizes care for pregnant women, including when they need surgery, and reduces the financial barriers for this group.^{25–27} Another initiative would be a World Bank project that aims to improve the quality and utilization of essential maternal and child services.²³ The shift from general surgery to obstetrics was already observed during the EVD outbreak, when the public sector absorbed most caesarean deliveries the private sector stopped performing.²⁸ Effects of the EVD outbreak on surgical volumes likely influenced results from 2017. Other barriers that affect the provision of general and orthopedic surgery, such as fear and negative perceptions of surgery among patients has been previously identified in Sierra Leone.²⁵ Assuming that the FHCI has decreased barriers to obstetric care, it would be interesting to investigate whether this can be extended to include other (emergency) surgeries as well, such as the pediatric population that is also covered from the same health finance protection scheme. In addition, examining the impeding factors for surgery could further clarify whether different barriers exist for general and orthopedic surgery on one side and obstetric surgery on the other.

Decrease in surgical volume and surgical productivity

Despite the increase in surgical workforce and annual number of operations, current figures of 1.2 surgical specialists per 100,000 population are far behind the LCoGS targets for a surgical workforce by the year 2030.¹ The same applies to the surgical volume, which, owing to an annual population growth of 2.1%, decreased between 2012 and 2017.²⁹ Although the rate of surgical procedures performed in Sierra Leone is at the higher end compared to other LICs,³⁰ the unmet surgical need of 92.7% is alarmingly high. It will require immense efforts to upscale the surgical output that is essential to make progress toward universal health coverage. The declining rate of surgery combined with the predicted increase in the prevalence of non-communicable diseases and trauma in low- and middle-income countries is worrisome.^{1,31,32} This will increase the burden of surgical disease and further escalate the need for preventive, curative, and palliative surgical care.

The mean surgical productivity in Sierra Leone is very low, more than 5 times lower than reports on surgical volume by specialists in the United States.³³ Overall decrease in surgical productivity to 1.7 procedures per week per surgical provider is not only worrisome in the light of the high unmet need for surgery. It is recognized that surgeons' volume and quality relate, where both facilities and surgical providers performing higher volumes of surgical procedures report better outcomes and lower complication rates.^{34,35} Therefore, it should be a priority to increase the surgical productivity to foster quality of care.

It is important to understand why surgical productivity is decreasing and is surprisingly low in a country with such a high burden of surgical disease. A study in Zambia described a similar decline in productivity, where an increase in surgical workforce did not lead to increased surgical output due to the simultaneous reduction of essential supplies and equipment.³⁶ To better understand these barriers and the decrease in surgical productivity in Sierra Leone, more in-depth research, on both the supply and demand side, is needed to further inform areas of intervention for improvement of surgical services. A recent qualitative study from the Sierra Leone capital area of Freetown and its environs revealed that patients are very concerned about cost and view it as the biggest obstacle to seeking and receiving high-quality surgical care.³⁷ The decrease in productivity indicates that a parallel focus on cultural, financial, and structural barriers pertinent to surgery is needed to strengthen surgery in Sierra Leone.³⁸ Alongside establishing the required surgical workforce, other aspects of the health system such as regulation of associate clinician surgical providers, financial protection, and supply chains need to be targeted.

Strengths and limitations

The strengths of this study include the multi-sector and nationwide inclusion of health facilities and the repeated mapping over time, applying similar methodology. This allows the detection of major changes in the surgical ecosystem and the ability to evaluate the effects of initiatives. However, between the 2 years compared, the region experienced an EVD outbreak with a substantial effect on the wider health system that also challenged comparison of surgical activity between 2012 and 2017.

A limitation is that data from 3 selected months were used to estimate the annual surgical volume for 2017. To examine if this introduced a bias due to annual variations, we performed a sensitivity analysis comparing February, June, and October of 2017 with similar months in 2012 for (1) changes in total volume of surgery and changes in surgical activity for (2) governmental, (3) private nonprofit, and (4) private for-profit hospitals. All changes calculated in the sensitivity analysis were within the 95% CI of the annual

estimated change. The sensitivity analysis was, however, found within the lower band of the 95% CI, which indicates that the 3-month selection slightly overestimates changes in surgical volume. On the contrary, the higher proportion of missing data in 2017 compared with 2012 underestimates the surgical volume for 2017, and thus underestimates change in the volume of surgery that to some extent balances the potential 3-month selection bias.

Conversely, the surgical volume and productivity of surgical specialists could be overestimated, since for one of the larger, tertiary facilities, all procedures were classified as performed by specialists.

This research is based on data collected from surgical logbooks and there might be biases in how surgical providers record activity. Also, the self-reported information from facility directors for human resources might be biased and does not account for surgical providers working at more than one facility at a time. Although all data collectors were trained identically, they were many, and inhomogeneous in terms of academic background. Also, it should be noted that the specialist workforce indicator from the LCoGS also includes specialist anesthesiologists, who have not been accounted for in this study.

Although there are several studies indicating task-sharing to be a safe strategy to expand the surgical workforce within the Sierra Leonean context,^{9,39,40} further research from other settings and for a broader range of surgical procedures is welcomed. Equally important is implementation research on how to safely and cost-effectively train task-sharing surgical provider, maintain continuous professional development, and develop regulatory mechanisms for necessary quality assurance of the services offered.

In conclusion, although the surgical workforce and number of surgeries have increased over the past 5 years, Sierra Leone is still far from approaching international targets. Positive effects were observed from the FHCI and from task-sharing, as caesarean deliveries and surgeries performed by associate clinicians increased. However, owing to a fast-growing population in Sierra Leone, the population rate of surgical procedures performed decreased. We were also surprised to find decreasing surgical productivity, while the unmet need for surgery increased. As surgical volume is related to quality, this decrease in productivity is alarming and warrants a stronger focus on quality of the surgical care offered in the coming years. Since the substantial increase in surgical providers has not led to an equal increase in surgical volume, other limiting factors need attention for further surgical system strengthening. Research to identify these barriers to surgical care is needed to shape interventions for further development of surgical care delivery in Sierra Leone.

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Conflict of interest/Disclosure

HAB and AjvD are board members of CapaCare, a non-profit organization that provides surgical training to physicians and associate clinicians in Sierra Leone. DvL worked as program coordinator for CapaCare in Sierra Leone, and JMB was a volunteer trainer. There are no other conflicts of interest reported from the other authors.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [<https://doi.org/10.1016/j.surg.2021.02.043>].

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