An Assessment of Surgical and Anesthesia Staff at 10 Government Hospitals in Sierra Leone

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**IMPORTANCE** Strengthening workforce capacity to deliver essential surgical and anesthesia care has been identified as a strategy for addressing the unmet burden of morbidity and mortality in under-resourced countries. Sierra Leone is one of the poorest countries in the world and faces the challenge of stretching limited resources to provide appropriate health care for a population of 6 million.

**OBJECTIVES** To investigate the training of surgical and anesthesia staff in Sierra Leone and to build an evidence base for future health care policy and training programs tailored to local needs.

**DESIGN, SETTING, AND PARTICIPANTS** Health care professionals who conduct surgery or deliver anesthesia at 10 of the 23 government hospitals in Sierra Leone were surveyed regarding training and clinical practices. This study surveyed 36 of 70 surgical staff (51%) and 38 of 68 nurse specialists (56%) nationally.

**MAIN OUTCOMES AND MEASURES** Descriptive analysis of demographic details, training levels, and reported needs for future development.

**RESULTS** Thirty-six surgeons were surveyed in study hospitals, of whom the majority had limited surgical specialization training, whereas most anesthesia was provided by 47 nurse specialists. All consultants had postgraduate qualifications, but 4 of 6 medical superintendents (67%) and all medical officers lacked postgraduate surgical qualifications or formal surgical specialist training. The number of trained anesthesia staff increased after the introduction of the Nurse Anesthesia Training Program in 2008, funded by the United Nations Fund for Population Activities, increasing the number from 2 to 47 anesthesia staff based at the study hospitals. Although 32 of 37 nurse anesthetists (86%) reported having attended training workshops, 30 of 37 (>80%) described anesthesia resources as “poor,” reporting a critical need for anesthesia machines and continual oxygen supply. Of the 37, 25 specifically mentioned the need for a better-functioning anesthesia machine and 16 mentioned the need for oxygen.

**CONCLUSIONS AND RELEVANCE** To address unmet surgical need in the long term, accredited local surgical specialization programs are required; training of nonphysician surgical practitioners may offer a short-term solution. To develop safe anesthesia care, governments and donors should focus on providing health care professionals with essential equipment and resources.

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Provided care in resource-poor countries is increasingly recognized as a vital, yet under-researched, component of international health care. The poorest 33% of the world’s population receive only 3.5% of all global surgical procedures, indicating great inequalities in access to adequate anesthesia and surgical care. Surgery typically has been viewed as an expensive health measure, however, work by Gosselin and colleagues has challenged this premise. They suggest that surgical care can contribute to reducing the burden of disease as cost-effectively as immunization campaigns in low-income countries. Thus, improving surgical care warrants further research and global attention.

The World Health Organization’s Global Initiative for Emergency and Essential Surgical Care has identified descriptive data gathering in low-income countries to be a research priority. Sierra Leone was chosen as the study site because of its high burden of surgically treatable illness and the critical need to strengthen local surgical and anesthesia capacity. In addition, a partnership had been fostered with a concurrent study on the Universal Anaesthesia Machine and perioperative practice by the Johns Hopkins Austere Anesthesia Health Outcomes Group and the Ministry of Health in Sierra Leone (MOHS).

This West African nation of 6 million people recently emerged from a decade-long civil war and currently ranks 177th on the United Nations Development Index. With an average life expectancy of 49 years, all health statistics are poor, but those for surgery and anesthesia are particularly stark. Recent work by Groen et al highlighted that 25% of deaths in Sierra Leone could be averted with timely access to surgical care, and Kingham et al reported that government hospital resources currently do not meet the minimum surgical standards set forth by the World Health Organization’s Global Initiative for Emergency and Essential Surgical Care. To date, no study, to our knowledge, has investigated surgical provider training and skills. In a country with an estimated shortfall in surgical staff of 81% and only 2 consultant anesthetists (0.03 per 100,000 compared with 17 per 100,000 in the United Kingdom) and 10 consultant surgeons (0.16 per 100,000 compared with 20 per 100,000 in the United Kingdom), building workforce capacity represents a crucial aspect of perioperative care.

This questionnaire-based study aims to describe the academic training and clinical skill set of surgical and anesthesia staff who provide care in this low-resource setting, often in the absence of specialists. It also aims to describe the geographic distribution of these personnel and their views on barriers to effective care provision and training needs. It is anticipated that this review of current training levels will inform future national health policy and nongovernmental organization (NGO) initiatives that are tailored to the surgical and anesthesia needs of Sierra Leone.

### Methods

From March 8 through 22, 2013, the study team, consisting of a British and a Sierra Leonean medical student, visited 10 of the 23 civilian and military government hospitals in Sierra Leone (Figure). Maximal sampling enabled 10 hospitals to be included in this study, including the 2 largest referral hospitals in the country—Connaught and Princess Christian Maternity Hospitals in Freetown—and 2 hospitals randomly selected from each province. A questionnaire was adapted from Choo et al, with permission from the corresponding author. Questions were converted to British English to increase cultural relevance in Sierra Leone (see appendixes and 3 in Choo et al). The questionnaire underwent face validity testing by American and English clinical staff and was pilot-tested in Sierra Leone. Following approval from the University of Birmingham’s Internal Ethics Review Committee, the Sierra Leone Ethics and Scientific Review Committee, and the MOHS, we contacted study hospitals to ascertain the number of surgical and anesthesia staff and to confirm site visit dates.

The team visited 9 of the selected study hospitals. The tenth hospital could not be reached because of poor road conditions, and an alternate hospital was randomly selected (Table 1). Questionnaires were administered during interviews with all consenting surgical (36; all physicians) and anesthesia (28; 1 physician and 37 nurses) staff during site visits. Foreign surgical and anesthesia staff (n = 4) were excluded from the study because they had different training paths and short-term contracts in Sierra Leone. The questionnaire focused on academic and clinical training, clinical skill set, barriers to effective surgical or anesthesia care, and training needs.

### Terminology

A number of terms are used to describe medical and surgical professionals in this article. These terms include self-identified descriptions and formally recognized titles that are used to distinguish different levels of training and experience. Consultant is used to describe a senior physician who has completed specialist training and assumes ultimate responsibility for patient care. Medical superintendents represent administrative and clinical department heads. Medical officers are physicians who have completed 2 years of internship or training as house officers. Both terms have been included to reflect self-reported job titles. House officers are physicians who are currently completing their 2-year postgraduate internship.

### Statistical Analysis

Anonymous questionnaire response data were entered into a Microsoft Access (Microsoft Corporation) database and subjected to descriptive analysis. The aims of this study were descriptive in nature, and group sizes were too small for substantially inferential statistical analysis. Twenty percent of the study data was double entered, showing an error rate of 0.17%, which is less than the 1% error acceptability rate. Data were stratified by specialty. To compare training and skills between groups, we subdivided surgery into 4 levels of surgical expertise.
Results

The questionnaire response rate was 76% (74 of 97). In total, 36 of 70 surgical staff (51%) and 38 of 68 anesthesia staff (56%) currently working in all government hospitals nationally were reached. Table 1 shows the number of clinical personnel in the study hospitals and the rates of surgical procedures. The only 2 surgical and obstetric tertiary referral centers are in the capital, Freetown, and accounted for 62 of the 97 study personnel (64%). Satellite hospitals in Freetown accounted for 11 participants (11%), and the district hospitals accounted for 24 (25%) (Table 1).

Surgical Training

Ninety percent of consultant-level staff (n = 10; median age, 60.5 years; interquartile range [IQR], 55.0-62.8) were trained outside of Sierra Leone, predominantly in other West African countries and Europe. Since the establishment of the medical school in Sierra Leone in 1988, the number of internationally trained staff has declined; 67% of medical superintendents (n = 6; median age, 43.5 years; IQR, 33.8-48.0), 44% of medical officers (n = 9; median age, 35.0 years; IQR, 33.0-47.4), and only 18% of house officers (n = 11; median age, 28.0 years; IQR, 26.5-30.0) reported having had undergraduate training outside of Sierra Leone (Table 2).

All consultant staff had received postgraduate training in surgery, including obstetrics and gynecology (OB/GYN), orthopedics, trauma, urology, and general surgery. In contrast, 2 of 6 medical superintendents (33%) and none of the medical officers or house officers had received formal postgraduate surgical training. This subpopulation had completed 6-month OB/GYN and 6-month surgical rotations as house officers, followed by informal on-the-job training and infrequent surgical courses from NGOs and the MOHS. The courses included topics that ranged from hydrocele management and bowel resection to basic surgical skills.

Table 3 demonstrates self-reported levels of surgical specialty training by clinical rank. Of 10 consultants, 7 (70%) reported that they received pediatric surgery training of some
form, whereas none of the medical superintendents and 2 of the medical officers (22%) had received some pediatric training. These responses may be an indication that pediatric surgery, orthopedic surgery, and amputations. Among house officers and are subsequently posted to provincial hospitals to conduct unsupervised surgery.

Clinical Competency
All personnel were asked if they conducted certain procedures without supervision and if they were completely confident in performing the procedures (Table 4). All operations listed were acknowledged as conducted confidently by at least 1 member of the consultant group. Among medical superintendents and medical officers, no personnel conducted vascular surgery or thyroidectomy, and some physicians lacked confidence when conducting operations, particularly bowel resection, trauma surgery, orthopedic surgery, and amputations. Among house officers, the only operations conducted by more than 50% of the subgroup were cesarean sections, complications of miscarriage, appendectomy, and incision and drainage.

Geographic Distribution
The unequal geographic distribution of trained staff was marked. All consultants who were surveyed work in 1 of the 2 tertiary referral hospitals in Freetown. Elsewhere, surgery is provided by medical superintendents or medical officers based in provincial hospitals in which the surgical burden is high—up to 1072 operations annually. Despite surgical rates sometimes similar to those in tertiary referral centers, provincial hospitals lack both numbers of surgical staff and access to specialist consultants.

Table 1. Total Number of Surgical and Anesthesia Staff at Study Hospitals, Response Rate, and Total Number of Surgical Procedures

<table>
<thead>
<tr>
<th>Hospital by Province</th>
<th>Hospital Type</th>
<th>Surgical Staff, No.</th>
<th>Participating Surgical Staff (Response Rate), No. (%)</th>
<th>Anesthesia Staff, No.</th>
<th>Participating Anesthesia Staff (Response Rate), No. (%)</th>
<th>Annual Surgical Procedures, No. (2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Province</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Princess Christian</td>
<td>Tertiary referral</td>
<td>18</td>
<td>13 (72)</td>
<td>12</td>
<td>6 (50)</td>
<td>NA*</td>
</tr>
<tr>
<td>Connaught</td>
<td>Tertiary referral</td>
<td>19</td>
<td>12 (63)</td>
<td>13</td>
<td>11 (85)</td>
<td>NA*</td>
</tr>
<tr>
<td>Lumley</td>
<td>Satellite</td>
<td>2</td>
<td>2 (100)</td>
<td>2</td>
<td>2 (100)</td>
<td>227</td>
</tr>
<tr>
<td>Rolupa</td>
<td>Satellite</td>
<td>1</td>
<td>1 (100)</td>
<td>3</td>
<td>3 (100)</td>
<td>NA*</td>
</tr>
<tr>
<td>Kingharman Road</td>
<td>Satellite</td>
<td>1</td>
<td>1 (100)</td>
<td>2</td>
<td>2 (100)</td>
<td>1100</td>
</tr>
<tr>
<td>Northern Province</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Loko</td>
<td>District</td>
<td>2</td>
<td>1 (50)</td>
<td>2</td>
<td>2 (100)</td>
<td>1072</td>
</tr>
<tr>
<td>Makeni</td>
<td>District</td>
<td>1</td>
<td>1 (100)</td>
<td>5</td>
<td>4 (80)</td>
<td>455</td>
</tr>
<tr>
<td>Southern Province</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pujehun</td>
<td>District</td>
<td>1</td>
<td>1 (100)</td>
<td>2</td>
<td>2 (100)</td>
<td>183</td>
</tr>
<tr>
<td>Bo</td>
<td>District</td>
<td>2</td>
<td>2 (100)</td>
<td>2</td>
<td>2 (100)</td>
<td>300</td>
</tr>
<tr>
<td>Eastern Province</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenema Hospital</td>
<td>District</td>
<td>3</td>
<td>2 (67)</td>
<td>4</td>
<td>4 (100)</td>
<td>427</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>50</td>
<td>36 (72)</td>
<td>47</td>
<td>38 (81)</td>
<td>5530</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not available.

* Surgical staff included those conducting surgical obstetrics and junior staff on surgical or obstetric rotations.

* Data on total surgical procedures were unavailable on the day of the study visit and subsequent follow-up visits (data accurate as of March 22, 2013).

* Kono Hospital (Eastern Province) was excluded because of poor road conditions; another Western Province hospital was randomly selected in its place.

Table 2. Demographic Data and Training Levels of Surgical Staff*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Consultants (n = 10)</th>
<th>Medical Superintendents (n = 6)</th>
<th>Officers (n = 9)</th>
<th>House (n = 11)</th>
<th>Total (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (IQR)</td>
<td>60.5 (55.0-62.8)</td>
<td>43.5 (33.8-48.0)</td>
<td>35.0 (33.0-47.4)</td>
<td>28.0 (26.5-30.0)</td>
<td>35 (29-54.5)</td>
</tr>
<tr>
<td>Participating staff by type, No. (%)</td>
<td>0</td>
<td>3 (50)</td>
<td>4 (44)</td>
<td>0</td>
<td>7 (19)</td>
</tr>
<tr>
<td>Staff trained outside of Sierra Leone, No. (%)</td>
<td>9 (90)</td>
<td>4 (67)</td>
<td>4 (44)</td>
<td>2 (18)</td>
<td>19 (53)</td>
</tr>
<tr>
<td>Years of study, mean (SD)</td>
<td>6.5 (0.9)</td>
<td>6.8 (1.2)</td>
<td>6.7 (0.7)</td>
<td>7.5 (0.5)</td>
<td>6.8 (0.7)</td>
</tr>
<tr>
<td>Staff with postgraduate qualifications, No. (%)</td>
<td>10 (100)</td>
<td>2 (33)</td>
<td>0</td>
<td>0</td>
<td>12 (33)</td>
</tr>
</tbody>
</table>

Abbreviation: IQR, interquartile range.

* Clinical rank of staff was determined by the self-defined job title of participants.

* Medical superintendents were self-defined titles denoting that they were the head of the hospital in provincial locations.

* Medical officers have completed 2 years of internship or training as house officers and are subsequently posted to provincial hospitals to conduct unsupervised surgery.
All respondents indicated that most of their skills had been developed through on-the-job training provided by the government and NGOs. For instance, the MOHS has provided hydrocele management courses through its Non-Communicable Disease Program. Organizations such as the West African College of Surgeons also conduct surgical skills training courses in collaboration with the MOHS. In addition, a number of NGOs have provided training to health care professionals who work in the districts.

According to survey responses, 5 of 10 consultants (50%), 2 of 6 medical superintendents (33%), 9 of 9 medical officers (100%), and 5 of 11 house officers (46%) attended such training. However, 5 of 10 consultants (50%) and 4 of 11 house officers (36%) said that they had never attended such training, and 2 of 6 medical superintendents (33%) and 5 of 9 medical officers (56%) attended training only once every 1 to 3 years. Of 36 surgical staff, 32 (89%) reported a need for continued surgical education. Areas cited as most in need of training were the following: among consultants, endoscopy and laparoscopy (5 [50%]); among medical superintendents, general surgery (4 [67%]), gastroenterology (3 [50%]), and OB/GYN (2 [33%]); among medical officers, general surgery (4 [44%]) and OB/GYN (3 [33%]); and among house officers, OB/GYN (5 [46%]) and trauma and orthopedics (4 [36%]).

When asked about future avenues for skill development, all surgical staff responded that a partnership with a surgical department in a foreign hospital would be useful, citing improved access to equipment and training on new surgical tech-

### Table 4. Number of Personnel Conducting Surgical Procedures and Self-reported Confidence

<table>
<thead>
<tr>
<th>Surgical Procedure</th>
<th>Consultants (n = 10)</th>
<th>Medical Superintendents (n = 6)</th>
<th>Medical Officers (n = 9)</th>
<th>House Officers (n = 11)</th>
<th>Total (N = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesarean section</td>
<td>9 (89)</td>
<td>6 (100)</td>
<td>9 (100)</td>
<td>10 (80)</td>
<td>34 (90)</td>
</tr>
<tr>
<td>Vacuum delivery</td>
<td>4 (75)</td>
<td>5 (80)</td>
<td>6 (67)</td>
<td>1 (0)</td>
<td>16 (69)</td>
</tr>
<tr>
<td>Episiotomy</td>
<td>8 (100)</td>
<td>6 (100)</td>
<td>8 (100)</td>
<td>5 (60)</td>
<td>27 (93)</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>8 (100)</td>
<td>6 (100)</td>
<td>7 (100)</td>
<td>2 (0)</td>
<td>23 (91)</td>
</tr>
<tr>
<td>Complications from miscarriage and abortion</td>
<td>9 (100)</td>
<td>6 (100)</td>
<td>8 (88)</td>
<td>10 (0)</td>
<td>33 (97)</td>
</tr>
<tr>
<td>Major incision and drainage</td>
<td>8 (100)</td>
<td>6 (100)</td>
<td>9 (100)</td>
<td>6 (67)</td>
<td>29 (93)</td>
</tr>
<tr>
<td>Appendectomy</td>
<td>10 (100)</td>
<td>6 (100)</td>
<td>9 (100)</td>
<td>7 (43)</td>
<td>32 (88)</td>
</tr>
<tr>
<td>Inguinal hernia repair</td>
<td>10 (100)</td>
<td>5 (100)</td>
<td>9 (89)</td>
<td>4 (75)</td>
<td>28 (93)</td>
</tr>
<tr>
<td>Laparotomy</td>
<td>10 (100)</td>
<td>6 (83)</td>
<td>8 (62)</td>
<td>3 (0)</td>
<td>27 (74)</td>
</tr>
<tr>
<td>Bowel resection</td>
<td>8 (100)</td>
<td>4 (75)</td>
<td>5 (40)</td>
<td>1 (0)</td>
<td>18 (72)</td>
</tr>
<tr>
<td>Trauma</td>
<td>8 (100)</td>
<td>2 (0)</td>
<td>4 (25)</td>
<td>1 (100)</td>
<td>15 (67)</td>
</tr>
<tr>
<td>Amputation</td>
<td>8 (100)</td>
<td>3 (67)</td>
<td>4 (50)</td>
<td>1 (100)</td>
<td>16 (81)</td>
</tr>
<tr>
<td>Orthopedics</td>
<td>8 (75)</td>
<td>3 (33)</td>
<td>2 (50)</td>
<td>0</td>
<td>13 (62)</td>
</tr>
<tr>
<td>Vascular</td>
<td>4 (50)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4 (50)</td>
</tr>
<tr>
<td>Thyroidectomy</td>
<td>8 (100)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 (100)</td>
</tr>
</tbody>
</table>

* Formal training was defined as learning with experienced supervision or dedicated training schemes. Informal training was defined as on-the-job periodic learning with limited supervision.

### Future Surgical Development

All respondents indicated that most of their skills had been developed through on-the-job training provided by the government and NGOs. For instance, the MOHS has provided hydrocele management courses through its Non-Communicable Disease Program. Organizations such as the West African College of Surgeons also conduct surgical skills training courses in collaboration with the MOHS. In addition, a number of NGOs have provided training to health care professionals who work in the districts.

According to survey responses, 5 of 10 consultants (50%), 2 of 6 medical superintendents (33%), 9 of 9 medical officers (100%), and 5 of 11 house officers (46%) attended such training. However, 5 of 10 consultants (50%) and 4 of 11 house officers (36%) said that they had never attended such training, and 2 of 6 medical superintendents (33%) and 5 of 9 medical officers (56%) attended training only once every 1 to 3 years. Of 36 surgical staff, 32 (89%) reported a need for continued surgical education. Areas cited as most in need of training were the following: among consultants, endoscopy and laparoscopy (5 [50%]); among medical superintendents, general surgery (4 [67%]), gastroenterology (3 [50%]), and OB/GYN (2 [33%]); among medical officers, general surgery (4 [44%]) and OB/GYN (3 [33%]); and among house officers, OB/GYN (5 [46%]) and trauma and orthopedics (4 [36%]).

When asked about future avenues for skill development, all surgical staff responded that a partnership with a surgical department in a foreign hospital would be useful, citing improved access to equipment and training on new surgical tech-
niques. The suggestion of online training was consistently rejected as unsuitable because of unreliable power and limited access to computers and Internet. Instead, equipment, visits from foreign teams to conduct training programs, and professional development programs were cited across all groups as being most important to improve the standard of surgical knowledge and provision.

Anesthesia Training
Anesthesia care in Sierra Leone has changed considerably in recent years. In 2008, the country had only 2 medical anesthetists. By the time of this study, 47 trained nurse anesthetists were available in the 10 study hospitals as a result of the Nurse Anesthesia Training Program funded by the United Nations Fund for Population Activities (UNFPA). One physician anesthetist and 37 nurse anesthetists responded to our questionnaire; because of the need for anonymity, we describe only responses from nurse anesthetists.

The median age of nurse anesthetists (n = 37) was 39.0 years (IQR, 36.0-45.0), and 17 of 37 (46%) were male. All nurse anesthetists had first obtained a 2½-year nursing diploma in Sierra Leone, and 17 of 37 (46%) had also completed a midwifery program. All participants then completed the UNFPA program, receiving formal accredited training in the field of anesthesia.

Clinical Skills
Hospital staff were asked to rank the most commonly used methods of anesthesia delivery. Responses included spinal bupivacaine for obstetric anesthesia (34 of 37 [92%]); general anesthesia and ketamine, with or without intubation, for minor cases (34 of 37 [92%]); and general anesthesia and ketamine intubation for major cases (37 of 37 [100%]).

Future Anesthesia Development
Nurse anesthetists had a high rate of continuing skill development. All respondents indicated that they had attended MOHS annual updates in anesthesia, and 32 of 37 (86%) had also attended training by foreign NGO specialists (eg, training on anesthesia delivery with the Universal Anaesthesia Machine). Respondents most frequently cited general and obstetric anesthesia as areas in which they required additional training. On average, 6 to 7 nurse anesthetists were assigned to each Freetown hospital, with approximately 3 nurse anesthetists posted at each provincial hospital. Demand for additional anesthesia staff in study hospitals was low (4 of 37 [11%]). Rather, 30 of 37 respondents (81%) suggested that a lack of physical anesthesia resources was the main reason for service provision barriers. A total of 25 respondents specifically mentioned the need for functioning anesthesia machines and 16 mentioned the critical need for adequate oxygen supply. Indeed, 36 of 37 respondents (97%) ranked anesthesia drugs, machines, and oxygen supply above training and increased staffing as being of vital importance to improving care.

Discussion
Comparing and contrasting the training of surgical and anesthesia staff at all clinical levels has highlighted areas in need of health care policy development. Data revealed a shortage in surgical staff at all levels. The current number of consultants (n = 10) does not meet the government’s predicted need for 30 specialist surgeons by 2015 to address the 81% deficiency in surgical staff. Furthermore, with most consultant-level staff close to retirement (median age, 60 years), the number is at risk of falling because data showed a lack of skilled intermediate surgical staff ready to take their place. Medical superintendents and medical officers are few (6 and 9, respectively) and have limited formal surgical training despite operating unsupervised in provincial hospitals. The geographic distribution of skilled staff is markedly unbalanced; all consultants in our survey work in Freetown. The lack of specialist staff in satellite hospitals in Freetown may be offset through patient referrals to either of the 2 tertiary care hospitals in that city. However, the provincial hospitals, which are between 150 and 400 km from Freetown via paved and dirt roads, are far more isolated. The costs and logistical issues make referral to a tertiary center out of reach for most of the population. As one surgeon stated, “Referral of surgical patients is not an option, so we just have to do the best we can for them.”

In addition to low numbers of surgical staff and geographic inequalities, the data highlighted a lack of formal surgical training for personnel. Although all consultant-level staff completed postgraduate surgical studies, few lower-ranking clinical staff had more than informal, on-the-job training. Indeed, many of the specialist consultants trained abroad because no medical school existed in the country before 1988. In general, consultant-level staff were able to pursue surgical specialization in established foreign programs. In contrast, few of the increasing numbers of younger, locally trained medical officers have any formal surgical training. A planned West African College of Surgeons surgical specialization program has not yet been established, leaving prospective surgeons to try to locate funding to specialize abroad. In the absence of formal programs, training is mainly informal or delivered in short-term NGO programs; 23 of 35 respondents (66%) said that they had attended training from organizations such as Mercy Ships or Médecins Sans Frontières. Such programs, while useful, are sporadic, focus on a small area of surgery, and are not a substitute for long-term structured learning.

In contrast to the continuing shortage of surgical staff, the UNFPA Nurse Anesthesia Training Program has transformed anesthesia staffing from only 2 trained staff in 2008 to 47 in the hospitals included in our study, but the number of nurse anesthetists is still less than half the minimum goal established by the UNFPA. A model for using nonphysician clinicians in low-resource settings, this 1½-year program has created a large cadre of specialist-trained nurses, enabling even provincial hospitals to be better staffed. However, data highlighted a continuing critical shortage of equipment and supplies. Although the anesthesia personnel maintain high levels of continued training, they lack the supplies to implement their skills and provide safe anesthesia care.

An integrated approach for surgery and anesthesia is needed to ensure the long-term development of trained, well-equipped staff. In the long term, surgery requires a local West African College of Surgeons–accredited training program that
will enable medical graduates to become highly skilled without the need to study abroad. Because such a program will require time to become established, short-term measures must be explored to fill the deficit in surgical staffing and training, particularly in provincial hospitals. All study respondents thought that a partnership with a foreign surgical department would be beneficial. Indeed, studies of previous partnerships between hospitals in developed and developing nations show promise and could, with local engagement and long-term collaboration, offer continuity and depth of surgical training programs.\textsuperscript{19} Although most of the staff dismissed the idea of Internet-based surgical learning, potential increases in computer and mobile telephone access in Sierra Leone may allow a cost-effective distance-learning system to become a viable option, as investigated in Malawi.\textsuperscript{20}

To mitigate the critical shortage of intermediate staff, surgery departments could learn from the experience of the UNFPA Nurse Anesthesia Training Program and similar initiatives in East Africa by training nursing staff to conduct surgical procedures.\textsuperscript{17} Data from similar initiatives are promising. In 1 study, clinical officers who had undergone a 2- to 3-year surgical training program had patient outcomes (surgical mortality and morbidity) similar to those of physicians.\textsuperscript{21} One such endeavor was recently begun by CapaCare, a Norwegian NGO that has developed a 2-year surgical training program for physicians and physician assistants in Sierra Leone. To improve the standard of anesthesia and surgical care, the UNFPA, MOHS, and other NGOs need to augment successful training schemes with efforts to ensure that all trained staff have the resources and equipment required to deliver safe perioperative care.\textsuperscript{22}

Limitations of this study include the inability to survey all government hospitals nationwide owing to personnel and resource constraints. As our analysis is descriptive rather than inferential, findings are solely applicable to the study participants. However, with more than 50% of the target population accessed, the findings are representative of both referral and provincial hospitals and have strength and relevance for health care policy and training in Sierra Leone. Accounts of training levels and differing interpretations of the definitions of formal and informal training could not be validated. The potential for unreliable self-reporting was mitigated by using anonymous questionnaires. We did not assess the quality of surgical care provided and relied on self-reported confidence in conducting procedures. Although a subjective measure, it was the only available assessment tool within the scope of this study. While government hospitals constitute the backbone of care provision, mission and charity hospitals play a large role. However, we were unable to include them in this study because of logistical limitations and the labile composition and differing training paths of their foreign staff.

Conclusions

The evidence from this study may contribute to health care policy direction and focus attention on increasing surgical and anesthesia resources for the population of Sierra Leone. We hope that our study will encourage both long- and short-term initiatives to increase the number of surgical personnel and improve training levels. Building on the success of the UNFPA Nurse Anesthesia Training Program, it is critical that attention now turn to adequately equipping hospitals with anesthesia machines, oxygen, and drugs that will enable surgical and anesthesia staff to provide safe perioperative care. Additional research is needed to investigate the feasibility of nonphysician surgical practitioners, surgical specialty training in Sierra Leone, and partnerships with foreign specialist hospitals.

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