

Quantifying Surgical Capacity in Sierra Leone

A Guide for Improving Surgical Care

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Hypothesis: Lack of access to surgical care is a public health crisis in developing countries. There are few data that describe a nation's ability to provide surgical care. This study combines information quantifying the infrastructure, human resources, interventions (ie, procedures), emergency equipment and supplies for resuscitation, and surgical procedures offered at many government hospitals in Sierra Leone.

Setting: Site visits were performed in 2008 at 10 of the 17 government civilian hospitals in Sierra Leone.

Main Outcome Measures: The World Health Organization's Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was used to assess surgical capacity.

Results: There was a paucity of electricity, running water, oxygen, and fuel at the government hospitals in Sierra Leone. There were only 10 Sierra Leonean surgeons practicing in the surveyed government hospitals.

Many procedures performed at most of the hospitals were cesarean sections, hernia repairs, and appendectomies. There were few supplies at any of the hospitals, forcing patients to provide their own. There was a disparity between conditions at the government hospitals and those at the private and mission hospitals.

Conclusion: There are severe shortages in all aspects of infrastructure, personnel, and supplies required for delivering surgical care in Sierra Leone. While it will be difficult to improve the infrastructure of government hospitals, training additional personnel to deliver safe surgical care is possible. The situational analysis tool is a valuable mechanism to quantify a nation's surgical capacity. It provides the background data that have been lacking in the discussion of surgery as a public health problem and will assist in gauging the effectiveness of interventions to improve surgical infrastructure and care.

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TRADITIONALLY, TREATING surgical diseases in developing countries has not been a priority in the public health sector. Large global programs have been successfully established for evaluating and treating diseases such as human immunodeficiency virus infection and malaria, but similar efforts for surgical diseases have been limited. Awareness of surgery as a branch of public health, however, is beginning to gain momentum. It is estimated that 11% of the world's disability-adjusted life years are caused by injuries, malignant neoplasms, and obstetric complications.¹ Treating surgical diseases in developing countries has recently been shown to be cost-effective compared with immunizations.^{2,3} Because it is economically efficient to treat surgical diseases and these diseases compose a significant portion of the overall burden of disease, the World Health Organization (WHO) established a Global Initiative for Emergency and Essential Surgical Care (GIEESC).⁴

It is impossible to precisely gauge the true state of surgical need in most devel-

oping countries. Reports from single institutions or districts are available, but it is rare that an entire country's capacity is described. Sierra Leone, however, is a sufficiently small country that surgical capacity can be effectively studied. Although infrastructure is slowly improving after its civil war that spanned 1991

See Invited Critique at end of article

through 2002, Sierra Leone ranks near the bottom of most lists that organizations such as the Central Intelligence Agency create to rank a population's health, such as life expectancy and infant mortality. The infant mortality rate, for example, is 156 per 1000 live births, the second highest in the world, and life expectancy is 40 years.⁵ There are 3 types of hospitals in Sierra Leone—government, mission, and private. The government hospitals were decimated during the civil war, but they form the backbone of surgical care for most of the country's population.

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Table 1. Basic Infrastructure

Hospital	Oxygen	Running Water	Electricity	No. of Beds	No. of Total Admissions per Year	Surgical Admissions per Year (% of Total Admissions)
Bo	Interrupted	No	Interrupted	450	1000	397 (39.7)
Connaught	Interrupted	Yes	Interrupted	267	1887	459 (24.3)
Kingharman	No	Interrupted	Interrupted	20	NA	400
Lumley	Interrupted	Yes	Interrupted	35	400	250 (62.5)
Magburaka	Interrupted	No	No	146	NA	340
Makeni	No	No	No	50	1000	250 (25.0)
Moyamba	No	No	No	30	210	35 (16.7)
PCMH	Interrupted	Interrupted	Interrupted	120	NA	273
Port Loko	Interrupted	No	No	200	654	NA
Rokupa	No	No	Interrupted	35	NA	350

Abbreviations: NA, not applicable, PCMH, Princess Christian Maternity Hospital.

This report examined the infrastructure, human resources, interventions (ie, procedures), and emergency equipment and supplies for resuscitation offered at most government hospitals in Sierra Leone. It is the first time the WHO's GIEESC Tool for Situational Analysis to Assess Emergency and Essential Surgical Care, adapted from the WHO Integrated Management for Emergency and Essential Surgical Care (IMEESC) toolkit, has been used to gain a snapshot of the surgical capacity of an entire country.⁶ The results of this study are striking in that they quantify the crisis in surgical care in Sierra Leone. Sierra Leone consistently ranks at the bottom of the United Nations' Health Development Index, so these data will serve as the foundation for building surgical capacity and evaluating the impact of interventions.

METHODS

The surgical needs assessment instrument, Tool for Situational Analysis to Assess Emergency and Essential Surgical Care, was developed by the GIEESC in 2007. The needs assessment in Sierra Leone was performed in all of the government hospitals in Freetown, the capital of Sierra Leone, and in other government hospitals throughout the country. In total, 10 of the 17 government civilian hospitals where surgery is performed were surveyed. Kono Government Hospital, Kailahun Government Hospital, Pujehun Government Hospital, Kenema Government Hospital, Bonthe Government Hospital, Kabala Government Hospital, and Kambia Government Hospital were not included in the survey owing to logistical difficulties in traveling throughout the country. In addition, these 7 hospitals only have a medical officer who is trained in basic surgical skills and 1 gynecologist/obstetrician. The private hospital in Freetown was surveyed by one of us (T.P.K.) in February 2008. The mission Emergency Hospital was surveyed by one of us (R.A.G.) in July 2008.

The assessment was made using a questionnaire that evaluated a hospital's infrastructure and personnel, surgical interventions that were performed, and availability of supplies. The form was filled out by two of us (T.P.K. and T.B.K.) in collaboration with local surgical personnel. Visits lasted between 1 and 5 hours and were conducted in February 2008. District populations were taken from WHO estimates for 2007 (obtained directly from the Sierra Leone Ministry of Health). The surgical procedures that were performed at each facility were captured from the surgical log books from October 1, 2007, to February 20, 2008. The harvest season is during the dry season, from December to February. Surgeons at Connaught Hospital re-

port a change in the types of cases during this period, with an increase in road traffic accidents due to passable roads and increased work requirements. There is, however, a decrease in elective surgical cases until the harvest has been completed. For the purposes of this article, 38 of the 256 data points were selected for comparison.

RESULTS

INFRASTRUCTURE

The infrastructure of all public facilities in Sierra Leone was devastated by the civil war that spanned from 1991 to 2002, and as a result, government hospitals have severe shortcomings (**Table 1**). There were a total of 1353 hospital beds in the 10 surveyed hospitals, averaging 135 beds per institution and 306 surgical patients per year per institution. All of the hospitals surveyed reported serving more than 200 000 people. Dependable water supplies and electricity are rare throughout most of Sierra Leone. Since January 2008, the 5 hospitals in Freetown have received electrical power at an increasingly steady rate. They use generators when electricity is unavailable. The 5 other hospitals surveyed depended on generator power, but owing to the scarcity and cost of fuel, patients' families were sometimes required to provide the necessary fuel to power generators during surgical procedures. Even when electricity was available, lighting was a problem, given there were approximately 6 individual lightbulbs that worked in all of the dome lights throughout Sierra Leone. Most operating rooms subsisted with a portable light or sunlight.

Bo Hospital and Connaught Hospital were the only 2 institutions that had more than 1 functional operating room (both had 2). Connaught Hospital has 6 operating rooms that were built when the hospital was reopened in 2006, but at the time of the survey only 1 was fully functional, and a second operating room has limited supplies. Basic supplies such as oxygen and anesthesia machines were severely limited. Sixty percent of hospitals had an interrupted supply of oxygen, and 40% had no oxygen. The only mode of oxygen delivery was oxygen concentrators. Twenty percent of the hospitals had a functioning anesthesia machine. Generally, anesthesia was pro-

Table 2. Human Resources^a

Hospital	Surgeon	Anesthesiologist	Obstetrician/ Gynecologist	General Surgeon	General Anesthesiologist	Nurse Anesthetist	Surgical Technician
Bo	1	0	1	1	0	1	2
Connaught	7	1	0	0	2	4	3
Kingharman	4 ^b	1 ^b	1 ^b	1	0	1	0
Lumley	1	0	1	0	0	1	0
Magburaka	1	0	0	0	0	1	0
Makeni	0	0	0	1	0	1	1
Moyamba	0	0	0	1.5 ^c	0	1	0
PCMH	0	0	4	0	1	5	7
Port Loko	0	0	0	1	0	2	1
Rokupa	0	0	0	1	0	1	0
Total	14	2	7	4.5	3	18	14

Abbreviation: PCMH, Princess Christian Maternity Hospital.

^aAt each facility surveyed, the personnel who participated in surgical care were documented. Surgeon, anesthesiologist, and obstetrician/gynecologist categories indicate fully trained consultants. The general surgeon and general anesthesiologist refer to medical officers who are responsible for surgery or anesthesia. Surgical technicians are clinical health officers whose responsibilities include caring for surgical patients both inside and outside of the operating room.

^bPersonnel are from China.

^cUse of 0.5 indicates a part-time employee.

vided via spinal injection or sedation with ketamine hydrochloride with the anesthetist monitoring the patient via a stethoscope attached to the patient's chest.

HUMAN RESOURCES

There are 59 full-time medical health professionals employed by the 10 public hospitals surveyed who are responsible for caring for patients, including physicians, nurses, technicians, and several volunteer employees (**Table 2**). There were a total of 10 fully trained Sierra Leonean surgeons in the government hospitals to serve a population of 5.3 million people. Until 2008, there had not been an opportunity for postgraduate training in surgery in Sierra Leone. Most Sierra Leonean surgeons have a professional history that includes completing medical school and their 2-year medical officer training in Sierra Leone and then traveling to countries such as Nigeria, Egypt, Russia, and China for formal surgical training. The mean (SD) age of the fully trained surgeons surveyed was 57 (7) years. Most of the surgeons are formally retired but have agreed to work on contract for the government. When other medical officers who perform surgeries are included, the mean (SD) age decreases to 52 (11) years.

INTERVENTIONS

The ability to perform important surgical procedures was surveyed at each hospital. Categories were divided into trauma, general surgery, obstetrics/gynecology, and subspecialties. Of the 10 hospitals evaluated, none offered all of the surveyed procedures identified as trauma procedures (**Table 3**). While personnel at each hospital had training in basic resuscitation, there was a severe lack of supplies, including intravenous fluids, to accommodate effective resuscitation. Although amputations were performed at all except 2 hospitals, advanced orthopedic care was available only at Connaught and Bo Hospitals. Referral patterns are dependent on personnel, supplies, training, and geography. While the distances between hospi-

tals in Sierra Leone is small (eg, 224 km from Connaught Hospital to Bo Hospital), the poor condition of the roads makes even short trips difficult for the average patient. The average travel distance to a government hospital is often less than 80 km, but this distance can be a multi-day journey, and in the rainy season many areas are impassable.

From October 1, 2007, to February 20, 2008, there were 724 procedures performed at the surveyed hospitals. Of these procedures, 593 (81.9%) were appendectomies, cesarean sections, or inguinal hernia repairs. Hydrocele resection, dilation and curettage, hysterectomy, and umbilical hernia repair were performed at many of the hospitals but in a small number. At Bo Hospital, there were 16 laparotomies for acute abdomens and 3 trauma laparotomies performed. At Connaught Hospital, laparotomies, prostatectomies, mastectomies, breast lumpectomies, urethroplasties, colon resections, and orchiectomies had been performed. Only Bo and Connaught Hospitals had the capability for performing most general surgery procedures (39% of all cases were performed at these 2 hospitals) and advanced pediatric surgical care (**Table 4**). All institutions were capable of performing appendectomies and inguinal hernia repairs. The 6 most often referred procedures were cleft lip and palate (10 of 10 referred), obstetric fistula, joint dislocation, intussusception, and imperforate anus (9 of 10), and clubfoot (8 of 10).

EQUIPMENT

Of the 10 hospitals surveyed, all of them failed to meet the 7 requirements for essential equipment or supplies (**Table 5**). These items were chosen for the survey as representatives of important facets of providing basic surgical care. Currently, patients are required to purchase the necessary supplies at local pharmacies and to provide them to the surgeon. This system fails to allow for emergency access to supplies once pharmacies are closed, so surgery at night is often performed with few supplies.

Table 3. Trauma Referral Patterns^a

Hospital	Foreign Body Removal	Cric/Trach	Chest Tube	Closed Fracture	Open Fracture
Bo	No	Yes	No	No	No
Connaught	No	No	No	No	No
Kingharman	No	No	Yes	No	Yes
Lumley	Yes	Yes	Yes	No	Yes
Magburaka	No	No	No	No	Yes
Makeni	No	Yes	Yes	No	Yes
Moyamba	Yes	No	No	Yes	Yes
PCMH	Yes	Yes	Yes	Yes	Yes
Port Loko	Yes	Yes	Yes	No	Yes
Rokupa	No	Yes	Yes	Yes	Yes

Abbreviations: Cric, cricothyroidotomy; PCMH, Princess Christian Maternity Hospital; Trach, tracheostomy.

^aReferral patterns were determined by interviewing surgical providers and inquiring about what procedures were performed at their hospital and what procedures required referral to another institution. Some hospitals could not perform foreign body removal (n=4), Cric/Trach (n=6), chest tube insertion (n=6), closed fracture treatment (n=3), or open fracture treatment (n=8). Yes represents referral is required.

Table 4. General Surgery Referral Patterns^a

Hospital	Intestinal Obstruction and Perforation	Laparotomy	Hernia Repair	Hemorrhoid Treatment	Skin Grafting
Bo	No	No	No	No	No
Connaught	No	No	No	No	No
Kingharman	No	No	No	No	No
Lumley	Yes	Yes	No	No	No
Magburaka	No	No	No	Yes	No
Makeni	No	No	No	Yes	No
Moyamba	Yes	Yes	No	No	No
PCMH	Yes	No	Yes	Yes	Yes
Port Loko	No	No	No	Yes	Yes
Rokupa	Yes	Yes	No	Yes	Yes

Abbreviation: PCMH, Princess Christian Maternity Hospital.

^aReferral patterns were determined by interviewing surgical providers and inquiring about what procedures were performed at their hospital and what procedures required referral to another institution. Some hospitals could not treat intestinal obstruction and perforation (n=4) or hemorrhoids (n=5) or perform a laparotomy (n=3), hernia repair (n=1), or skin graft (n=3). Yes represents referral is required.

Table 5. Availability of Essential Supplies^a

Hospital	Resuscitator Bag	Examination Gloves	Sterile Gloves	Sterilizer	Nasogastric Tubes	Intravenous Fluid Infusion Set	Eye Protection
Bo	NA	No	No	Yes	No	No	No
Connaught	Yes	Yes	No	Yes	Yes	Yes	No
Kingharman	Yes	Yes	Yes	Yes	No	Yes	Yes
Lumley	Yes	Yes	Yes	No	Yes	Yes	Yes
Magburaka	No	Yes	Yes	Yes	Yes	Yes	No
Makeni	Yes	Yes	Yes	Yes	Yes	Yes	No
Moyamba	Yes	Yes	No	Yes	Yes	No	No
PCMH	Yes	Yes	Yes	Yes	No	Yes	Yes
Port Loko	Yes	Yes	Yes	Yes	Yes	Yes	No
Rokupa	Yes	Yes	Yes	Yes	Yes	Yes	No

Abbreviation: PCMH, Princess Christian Maternity Hospital.

^aA list of essential supplies that represents multiple facets of surgical care was created and personnel were interviewed at each hospital to determine the availability of these supplies. In addition, supply rooms were observed to confirm the data. Of the 10 hospitals, some did not have resuscitator bags (n=2), examination gloves (n=1), sterile gloves (n=3), sterilizers (n=1), nasogastric tubes (n=3), intravenous fluid infusion set (n=2), or eye protection (n=7). Yes indicates supplies were available.

NONGOVERNMENT HOSPITALS

Choitram Hospital is the private hospital in Freetown. It has 20 surgical beds and 200 surgical admissions per year. It has running water, oxygen, a functioning generator, and an anesthesia machine. There are 5 surgeons

and 1 obstetrician on staff. All surveyed procedures were performed at Choitram Hospital. All supplies listed in the needs assessment were available on the premises of the hospital. It is unknown how many procedures are performed there. The largest mission hospital is the Emergency Hospital established by the Italian nongovern-

ment organization Emergency. It is the largest hospital in the country, with 97 surgical beds; 1023 major surgical cases per year, of which 53% are pediatric; 2 major operating rooms; 2 expatriate surgeons; 1 Sierra Leonean surgeon; 3 part-time surgeons; and 3 medical officers. All procedures listed in the needs assessment except for obstetric/gynecologic services are performed at Emergency Hospital. They have all of the equipment included in the needs assessment.

COMMENT

There are several studies that have described surgical services in districts in developing countries. Many of these studies have described case variety or training initiatives. Of the few recently published studies on the general availability of surgical services, 1 reported on adult surgical emergencies in Anambra State, Nigeria.⁷ Of the surgical emergencies, 75% were composed of appendectomies, motor vehicle crashes, gunshot injuries, acute urinary retention, and intestinal obstruction. Another study described the outcomes of surgical missions to rural southern Sudan, where local medical practitioners were trained in basic surgical skills.⁸ Forty-two percent of the procedures they performed were hernia repairs, and 77% of their cases were elective. The authors concluded after 6 years that the need for surgical care was still unmet and 10% to 20% of deaths of young adults were iatrogenic and directly attributable to inadequate surgical knowledge. A study from Uganda has shown there are 75 specialist-trained surgeons in the country to serve a population of approximately 30 million people.⁹

While these studies considered the workforce or the types of procedure performed in individual institutions, we studied an entire country and addressed the existing infrastructure and availability of supplies, to put the surgical capacity of the country into perspective. Given that surgery has recently been acknowledged as a critical component of public health in developing countries, systematic, quantitative descriptions of surgical capacity at the country level are required.¹⁰ In creating a snapshot of an entire country's surgical infrastructure and workforce, our needs assessment identified several striking shortcomings of available services. Every aspect of providing surgical care in Sierra Leone is severely limited. We found that the infrastructure is insufficient, with basic amenities such as running water absent throughout the country. Oxygen is supplied only by oxygen concentrators, and all except a few were broken. It is impossible to assess exactly the impact of such difficult conditions on the morbidity and mortality of surgical care in Sierra Leone, but the overall picture is one of no supplies, few surgeons, and most hospitals that are limited in the procedures that can be performed.

As Sierra Leone begins to rebuild in a peaceful political climate, there is an opportunity to improve hospital infrastructure and supplies. Currently, individual hospitals have no ability to store and administer supplies. Local responsibility for maintaining emergency supplies will allow hospitals to improve their trauma and emergency care and bolster confidence in the govern-

ment hospitals. Basic hospital supplies are available through several nongovernment organizations, and these can be used to assist in building more functional government hospitals. In addition, basic infrastructure, such as lighting in the operating room, is an example of a small investment that can have an enormous effect. The lightbulbs required in Sierra Leone, for example, were found to cost less than US \$0.50 at a factory in China. Coordinated needs assessments are vital to assist ministries of health in documenting and prioritizing their infrastructure and supply deficits.

Lack of human resources is a problem with surgical care in Sierra Leone. Low salaries, poor conditions, limited opportunities for professional development, professional isolation, and lack of infrastructure and supplies all factor into the surgical workforce shortage. One difficulty in retaining trained personnel is that nongovernment organizations pay much more (often up to 50% higher) than the government can afford, leading to an internal brain drain that draws valuable health care workers away from the government hospitals and labor-intensive fields such as surgery.¹¹ There are fewer than 10 fully trained Sierra Leonean surgeons, and only 1 is younger than 50. There is no next generation of surgeons in the country. Although Connaught Hospital was recently awarded certification by the West African College of Surgeons to establish a surgical residency, it will be years before another generation of surgeons is fully trained. Some lessons can be learned from Papua New Guinea, where they established a sustainable surgical training program 35 years ago.^{12,13} They found the elements to success were adjusting training goals to local needs, training with a local institution, and careful consideration of foreign experiences. Similarly, the newly established residency program in Sierra Leone could consider selective long-term collaboration with foreign surgeons to assist in providing training as the Sierra Leonean surgical community sees appropriate.

In Sierra Leone, most surgical procedures performed outside of Connaught and Bo Hospitals were hernia repairs, appendectomies, and cesarean sections. Another solution to the workforce shortage is to train paramedical personnel in 2-year programs to perform safe, basic surgical procedures, as they have done in Mozambique, Tanzania, and Malawi. In Mozambique, paramedical personnel called *tecnicos de cirurgia* train for 3 years to get a bachelor's degree, and after 2 additional years of supervised training, they are licensed to practice.¹⁴ In a study of 2000 cesarean deliveries performed in Mozambique, there was no difference in outcome between those performed by paramedical personnel and those performed by fully trained surgeons.¹⁵ There are paramedical personnel who are trained in Sierra Leone as clinical health officers, so the infrastructure exists to allow some of these personnel to shift tasks and become paramedical surgical providers. The World Health Assembly, in 2006, established the Task Force for Scaling Up Education and Training for Health Workers. It reported the average cost of educating physicians in Africa was 5 times greater than the cost of educating community health workers, such as clinical officers, making the avenue of training non-physicians even more attractive.

There are several limitations to this study. First, the study relied on the interviewees at many hospitals to provide information about the ability to perform surgical procedures. To verify these data, physical inspection was done to examine supplies and surgical log books. The government hospitals that were not studied were the smallest district hospitals that are difficult to reach geographically and that do not have a surgeon assigned to them. The Ministry of Health and surgeons at Connaught Hospital thought that historically these hospitals had such a small volume that their absence in the study would not affect the results of the study. There are several mission hospitals and 1 private hospital in Sierra Leone that treat patients.

The massive disparity in care provided by the government hospitals and the private and mission hospitals was evident by results of this needs assessment. The private hospital is not a reasonable option for the large majority of patients in Sierra Leone. Relying on mission hospitals is problematic as well because they are not affiliated with the public health system, and if they were to leave the country, the government hospitals would need to handle all surgical care. The mission hospitals in Sierra Leone provide an immensely valuable service to the many patients they treat. They cannot, however, provide a national network of hospitals available to all citizens of Sierra Leone. It is for this reason that the disparity evident between the mission hospital with a foreign sponsor and foreign surgeons and all of the government hospitals is so important to document to assist the government in improving its own health care system.

The documentation of the insufficiency of surgical capacity in Sierra Leone is unlikely to be an isolated example of the conditions in developing countries. Even though there were striking findings illuminated by this assessment, the demonstration of the situation in Sierra Leone probably represents only a fraction of the patients who have a need for surgical care. A next step in characterizing surgical need would be to perform an inquiry into the incidence of surgical diseases at the village level using a cluster sampling technique. When combined with the baseline information on capacity described in this study, interventions such as increased training and salary support, improved infrastructure, and additional supplies can be evaluated objectively to determine their success or failure.

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REFERENCES

1. Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet*. 1997;349(9063):1436-1442.
2. Gosselin RA, Thind A, Bellardinelli A. Cost/DALY averted in a small hospital in Sierra Leone: what is the relative contribution of different services? *World J Surg*. 2006;30(4):505-511.
3. Debas H. Surgery. In: Jamison D, ed. *Disease Control Priorities in Developing Countries*. 2nd ed. Washington, DC: World Bank; 2005:1245-1259.
4. Spiegel DA, Gosselin RA. Surgical services in low-income and middle-income countries. *Lancet*. 2007;370(9592):1013-1015.
5. Central Intelligence Agency. The World Factbook. <http://www.cia.gov/library/publications/the-world-factbook/rankorder/2091rank.html>. Accessed June 10, 2008.
6. World Health Organization. Integrated Management for Emergency and Essential Surgical Care (IMEESC) tool kit. <http://www.who.int/surgery/publications/imeesc/en/index.html>. Accessed November 12, 2008.
7. Chianakwana GU, Ihegihu CC, Okafor PI, Anyanwu SN, Mbonu OO. Adult surgical emergencies in a developing country: the experience of Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria. *World J Surg*. 2005; 29(6):804-808.
8. Meo G, Andreone D, De Bonis U, et al. Rural surgery in southern Sudan. *World J Surg*. 2006;30(4):495-504.
9. Ozgediz D, Galukande M, Mabweijano J, et al. The neglect of the global surgical workforce: experience and evidence from Uganda. *World J Surg*. 2008;32(6): 1208-1215.
10. Farmer PE, Kim JY. Surgery and global health: a view from beyond the OR. *World J Surg*. 2008;32(4):533-536.
11. McCoy D, Bennett S, Witter S, et al. Salaries and incomes of health workers in sub-Saharan Africa. *Lancet*. 2008;371(9613):675-681.
12. Kevau I, Watters DA. Specialist surgical training in Papua New Guinea: the outcomes after 10 years. *ANZ J Surg*. 2006;76(10):937-941.
13. Gruen RL. Template for surgical training in resource-poor countries. *ANZ J Surg*. 2006;76(10):871-872.
14. Final Report. Paper presented at: Conference on Increasing Access to Surgical Services in Resource-Constrained Settings in Sub-Saharan Africa; June 4-8, 2007; Bellagio Conference Center, Bellagio, Italy.
15. Pereira C, Bugalho A, Bergstrom S, Vaz F, Cotiro M. A comparative study of caesarean deliveries by assistant medical officers and obstetricians in Mozambique. *Br J Obstet Gynaecol*. 1996;103(6):508-512.