

**ORIGINAL ARTICLE**

**SURGICAL SKILL PROVIDERS AND INFRASTRUCTURE NEEDS ASSESSMENT  
IN NORTH GONDAR, ETHIOPIA: A MIXED-METHOD STUDY**

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**ABSTRACT**

**Background:** *The shortage of skilled surgical providers in Sub-Saharan Africa is reaching a crisis level. The Canadian Network for International Surgery has been delivering structured surgical skills courses in Ethiopia for 15 years. However, an assessment of met needs, and ongoing barriers to surgical care has never been done. Ethiopia has set out plans to expand surgical capacity at the district hospital levels through upgrading and building hospitals, and task shifting through a surgical health officer program. This study aimed to assess the met need for surgical infrastructure, providers, and education in North Gondar Zone, Ethiopia. Sub-objectives are to assess the perceived values of a structured surgical training courses, and to identify ongoing barriers to emergency surgery.*

**Method:** *This mixed-method of study employed: semi-structured interviews to surgical providers, a review of operative records, an infrastructure needs assessment. The research also used questionnaires which was distributed to medical trainees to assess the met needs, and to identify barriers to care. A total of 190 trainees participated in the survey. In addition, 12 participants were involved in the interview from 4 hospitals. In addition, descriptive statistics were used to describe the study subjects and the surgical skill needs using tables and graphs.*

**Result:** *Emergency surgery was only performed in Gondar University Hospital with a met need for a cesarean section of only 15%. There was a severe shortage of both hospitals, and care providers in the zone. Lack of consumable emergency equipment was cited as the greatest barrier to delivering emergency care at the district level.*

**Conclusion:** *Shortage of providers, inadequate surgical infrastructure, and a severe lack of continuing skill improvement needs were observed.*

**Key words:** *Surgical skill, Infrastructure Need, North Gondar, Ethiopia*

**INTRODUCTION**

Following the signing of the declaration of Alma Ata in 1978, Primary Health Care has been at the forefront of addressing health disparities in low resource settings (1). In a call for help delivered to the World Congress of the International College of Sur-

geons in 1980, former WHO Director-General Mahler highlighted the essential role of ‘surgical first aid’ necessary for any population to have faith in their primary care systems(2). Unfortunately, this vision of comprehensive Primary Health Care has been essentially supplanted by targeted, vertically delivered, ‘high yield’ interventions which mostly focused on communicable diseases with essential surgery largely sidelined(3-6).

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Neglecting of primary surgical care is particularly concerning on giving that an estimated 11% of all Disability Associated Life Years (DALYs) globally can be attributed to treatable surgical conditions mainly injuries, malignancies, congenital abnormalities, and obstetrical complications (7). Injuries and obstetrical complications alone are estimated to account for 21 DALYs per 1000 people in Africa which is large number compared to only 9 percent 1000 people in the Americas and Europe (7). However, concrete data documenting on the burden of surgical disease in Sub-Saharan Africa, and the availability of surgical care is lacking. So, attempting to calculate the workforce gap based on an appropriate level of resources per capita in these low resource settings is virtually impossible (8). Modeling has indicated that the wealthiest third of the global population accounts for 74% of all surgical procedures performed, and the poorest third for only 3.5%(9). This leaves an estimated 2 billion people globally without access to basic surgical care(10).

The past decade has seen a resurgence of interest in both the need and the feasibility of essential surgery in low resource settings, and access to essential surgery is seen as a fundamental human right(6). Conventional, vertically delivered surgical missions have evolved into an earnest attempt to drive an evidence-based, sustainable pathway to ensure 'surgery for all'(5). The Canadian Network of International Surgery (CNIS) was founded in 1996 with these goals in mind. The creation of the Essential Surgical Skills (ESS) course by the CNIS represented a unique, sustainable and capacity-building model for disseminating surgical knowledge in low resource settings that seemed to be responding to Director-General Mahler's plea for universal surgical care at the primary care setting(2).

The ESS is a five-day intensive laboratory-based surgical skills course covering a range of surgical

skills from suturing lacerations to laparotomies. The course is now embedded in the curriculum of 12 African medical schools, and it has seen that over 7,500 trainees graduated the course (11) to address the critical shortage of surgical providers. A lack of skilled providers, however, is only one of the many barriers facing the delivery of essential surgical care in low and middle-income countries. The critical deficit of basic infrastructure (12), surgical equipment, pharmaceuticals (anesthetic drugs, antibiotics), and ancillary services such as laboratory services, radiology, blood bank(13) have all been implicated in preventing the delivery of essential surgery, but receive a fraction of the attention in the academic literature.

The realization that emergency and essential surgery is a core component of Comprehensive Primary Health Care is leading to real change. The creation of the Global Initiative for Emergency and Essential Surgical Care (GIEESC) in 2005 under the aegis of the World Health Organization (WHO) has led to working consortiums to improve access to surgery as a component of primary health care(14).

In Ethiopia, where there are over 100 million people (15), but there are only 140 surgeons(16),there is an urgent need to upscale surgical capacity. This was confirmed by a review of health services by the World Bank in 2009 that identified the delivery of surgical care as the weakest component of the Ethiopian primary health care system(17). However, the Ministry of Health has responded by adopting the Integrated Management of Emergency, and Essential Surgical Care (IMEESC) Toolkit developed by the WHO(14). This created a new health tier by empowering primary care hospitals with essential surgical capability which greatly increased the capacity for medical education, and the creation of a new mid-level provider, the Master Health Officer who would be trained in emergency surgical and obstetrical care (14,18). This initiative aimed to have 1600 Master

Health Officers staffing 800 district hospitals by 2015(19), and it is perhaps the most aggressive governmental commitment to increase surgical capacity in sub-Saharan Africa. Given that, by the most recent account, there are only 149 hospitals of any kind documented in the country(16) the objective is ambitious. The large increase in training of non-specialist surgical providers is an encouraging move towards increasing access to care. However, increasing educational volume without a corresponding increase in specialist instructors places even greater importance on the efficiency of training and structured courses such as the ESS. Short-term assessments of structured skills programs have shown them to be highly effective in knowledge translation and transfer, and building confidence amongst learners(20). However, till recent time, there has not been any assessment of the impact of these programs on overall surgical training, and whether or not they impact the delivery of surgical care.

The primary objective of this study was to determine the met need for surgical infrastructure, education, and providers in the North Gondar Zone of the Amhara Region, Ethiopia, where the Essential Surgical Skills (ESS) course has been taught by the CNIS to trainees in Gondar University since 1996(11).

The secondary objectives included: ascertaining the perceived value of the ESS course run by the CNIS, identifying barriers preventing the delivery of essential surgery, and providing the first snapshot of surgical activity in the region from which future activity can be measured and planned.

This study represents one of the only comprehensive catalogings of surgical care in Ethiopia. Previous health surveys have grossly assessed staffing and infrastructure necessary for surgery, but were largely focused on other aspects of the health care system

such as administrative functioning(17,21) or infectious diseases (22). In addition to identifying needs for resources, this study serves as a timely starting point from which the delivery of surgical care can be measured, and analyzed as future interventions are rolled out. This manuscript has been prepared in accordance with the STROBE statement on reporting observational studies(23).

## **METHOD**

**Study design:** The study employed a cross-sectional mixed methods design to catalog the current delivery of surgical care, available resources, infrastructure, barriers, and care providers in the North Gondar Zone, Ethiopia. Data acquisition instruments included: semi-structured interviews to surgical providers, a retrospective 30-day audit of procedure logs, a site visit using an abbreviated version of the WHO Needs Assessment and Evaluation Form for Resource-Limited Health Centres(24), and a self-administered questionnaire given to medical trainees. Ethical approval was taken from both the Human Research Ethics Committee of Curtin University, Australia, and the Gondar University Research Review Board.

**Setting:** The North Gondar Zone is home to 2.9 million people (25) in the northwest corner of the Amhara region, bordering Sudan. The population is 85% rural which is typical for the region (25). The Amhara Region has one specialized referral hospital at Gondar University which is a home to Ethiopia's oldest medical school(22). In addition, there are also two regional hospitals, six zonal hospitals and seven general hospitals in the region(22). Similarly, there are 4 hospitals in North Gondar Zone. In 2005, there were on average 2 general practitioners per hospital sometimes a surgeon or other specialist, and a median of 14 nurses per zonal hospital or larger (22).

**Participants:** Attempts were made to interview every surgeon or surgical provider in the zone as well as nurses and non-surgical health officers screened for their involvement in the delivery of surgical or anesthetic services. Positive responders were invited to participate in the interview. Medical trainees were given self-administered questionnaires. As the Gondar University Hospital is the only site expected to deliver surgical services in the zone, Bahir Dar Regional Referral Hospital was included in the sample as a useful comparator because it was geographically similar, and it has a medical school, but it has not yet offered the ESS course.

**Data sources/variables:** Hospital and health center data were aggregated from government census data and validated with interviews from health administrators to collect zonal information. Site visits were then performed using an instrument adapted from the WHO Needs Assessment and Evaluation Form for Resource-Limited Health Centres(24).

Interviews to care providers covered five topics: demographics, training, scope of current practice, confidence in performing essential, emergency surgical procedures, and barriers to delivering surgical care. The interview concluded with an open-ended question eliciting any further thoughts on surgical care delivery in their setting, and any suggestions they have to advance care delivery. All interviews were conducted in English which is the medium of education in Ethiopia. The questions were piloted with a small convenience sample of surgeons and general practitioners who were excluded from the study sample to ensure face and content validity. All interviews were conducted by the principal investigator, and he followed the same format.

Questionnaires which were prepared for medical students comprised brief and close-ended questions us-

ing a mix of multiple-choice and Likert scale questions. The questions were directed at exposure to surgical procedures, experience in structured courses, and perceived barriers to a surgical career. Questionnaires were piloted with experts in the field to ensure face and content validity, and they were pre-tested with a small group of volunteer surgical interns to ensure clarity.

**Study size:** Working on the available data from the 2005 health facility survey (22), the North Gondar Zone was estimated to contain two district hospitals each with a limited number of general practitioners, nurses, and health officers who may provide surgical services. The University of Gondar and Bahir Dar Regional Referral Hospitals were expected to have each several surgeons that were included in the sample. The target population for self-administered questionnaires consisted of senior medical students, and interns from Gondar and Bahir Dar medical schools representing from one to two hundred students. 190 trainees returned surveys at Gondar University representing an overall response rate of 79% from a sample of senior medical students and interns. Interns were the poorest responders with only 51.5% of those invited responding, and reflecting 44% of the total intern population. Only medical students in their first clinical year were available in Bahir Dar where 83.5% of the class was sampled with a 100% response rate.

**Statistical methods:** Qualitative data from interviews were transcribed, coded, and subjected to thematic analysis. On the other hand, SPSS was used for quantitative data analysis. Similarly, Simple descriptive statistics were performed on the questionnaire data. Hospital infrastructure and procedural data were tabulated. Questionnaire data were cross-tabulated with categorical associations tested with the chi-square test. Positive associations were quantified

by calculating odds ratios.

## RESULT

**Current Surgical Capacity:** From September to October 2011, there were two district hospitals, one private hospital and one specialized referral hospital in the North Gondar Zone. Each district hospital had been staffed with several general practitioners, nurses, and health officers, which is exceeding the 2005 survey data which was less than 1 GP per district hospital(22), and the Ethiopia target of two GPs per district hospital(16)(see table 1). Of the available surgical providers, a total of 4 general practitioners

(44% of district hospital total), 1 procedural nurse (50% of total), 1 procedural health officer (100%), 3 subspecialist surgeons (100% of total) and 1 general surgeon (25% of available) participated in the interviews. The only two surgeons working at Bahir Dar regional referral hospital have participated in the interviews. The average years in practice for surgeons was 10.1 whereas the GP population was much more junior with mean time in practice only 2.5 years. There were no specialist anaesthesiologists in the zone. The response rate for the interviews was 100%. Reasons for non-inclusion were largely due to time constraints and logistics of travel and scheduling with no systematic differences expected between sampled

**Table 1:** Selected staffing and infrastructure data from North Gondar Zone hospitals.

Class	Gondar	Debark	Metema	Bahir Dar*
	Specialized Referral	District	District	Regional Referral
GP's available for emergency care	6	4(2)	5(2)	20
Surgeons	8(12)	0(0)	0(0)	2(5)
Obstetrics/ Gynecology	2(13)	0	0	3(5)
Anesthetist (non-MD)	13(11)	0(3)	0(3)	7(7)
Anesthesiologist	0(4)	0(0)	0(0)	0(2)
OR Nurses	16	2	1	19
Health officers	4(0)	4(2)	5(2)	7(0)
Nurses	70	17	24	130
OR's	4	2	1	2
Power	Interrupted Weekly	Interrupted Weekly	Reliable	Interrupted Weekly
Water	Reliable	Reliable	Interrupted Weekly	Reliable
Oxygen	Cylinders / unreliable	Concentrator /reliable	Cylinders / unreliable	Cylinders / unreliable
Oxygen equipment	Always available	Not available	Not available	Often available
Autoclave	Yes	Yes	Yes	Yes

\* Bahir Dar hospital which is not in the zone included for comparison only Parenthesis () indicate Ethiopian targets(15)

There was one private hospital in the zone which has one major and one minor operating room (OR). Procedures performed there at the time of the survey were all elective, and all surgeons also worked at the University Hospital.

Surgical procedures at this private hospital were thus included when examining total zonal surgical volume, but the hospital did not deliver emergency surgery and thus was not included as part of the zonal capacity for emergency and essential surgery. Like-

wise, an International Fistula Training Centre in Gondar currently involved only in specialized fistula care as well as some cataract work by international groups was excluded from the analysis.

Gondar University Hospital was the only center in the Zone that provided emergency surgical services apart

from minor procedures. The top 15 surgical diagnoses from Gondar and Bahir Dar hospitals are tabulated in table 2. It was apparent on review of the records that there was a significant disparity between the logging practices of the two centers, but obstetric emergencies, orthopedic trauma and bowel obstructions and/or volvulus were common at both sites.

**Table 2:** Top 15 post-operative diagnoses

<b>Gondar Diagnosis count (%)</b>				<b>Bahir Dar Diagnosiscount (%)</b>			
General Surgery		OBGYN		General Surgery		OBGYN	
Foreign body	21 (6.4)					Obstructed labour	44(14.2)
Appendicitis	20 (6.1)			Appendicitis	27 (8.7)	Ectopic pregnancy	9 (2.9)
Fracture	19 (5.8)	Fetal distress	20(6.1)	Bowel obstruction	12 (3.9)	Fetal distress	8 (2.6)
Abscess	18 (5.5)	Obstructed labour	9 (2.8)	Volvulus	11 (3.6)	Fetal mal-presentation	7 (2.3)
Volvulus	17 (5.2)	Fetal mal-presentation	6(1.8)	BPH	9 (2.9)		
Neuro-trauma	12 (3.7)	Uterine rupture	6 (1.8)	Hernia	9 (2.9)		
Goiter	9 (2.8)	Ectopic pregnancy	5 (1.5)	Adhesions	8 (2.6)		
Superficial lesion	9 (2.8)			Cholelithiasis	8 (2.6)		
Bowel perforation	6 (1.8)			Goiter	7 (2.3)		
Bowel obstruction	5 (1.5)			Bowel perforation	6 (1.9)		
				Osteomyelitis	6 (1.9)		
				Cholecystitis	5 (1.6)		

Figure 2 provides a hospital-wise breakdown of the most common procedures performed. Major operations were dominated by cesarean sections, laparotomies and appendectomies. ‘Other’ refers to all procedures not totaling 3% or more of total procedures. Many indicators of surgical performance are hard to apply on a population level due to a lack of benchmarks in this population and due to variability in reporting in a retrospective review of this nature. Perhaps the most well-defined indicator of surgical need, the cesarean section rate is also the most readi-

ly identified upon retrospective review. Using the WHO recommendation of a minimum need for a cesarean section of 5% of live births (26) and using 2007 census data reporting 97,273 live births in the zone(27), the caesarean section rate is estimated at 0.74%, representing only 15% of met need for the region. Health care providers at the district hospital level ranked caesarean sections as the most important procedure they would like to see in their institutions, and cited a lack of trained providers as the major barrier to delivery of care.

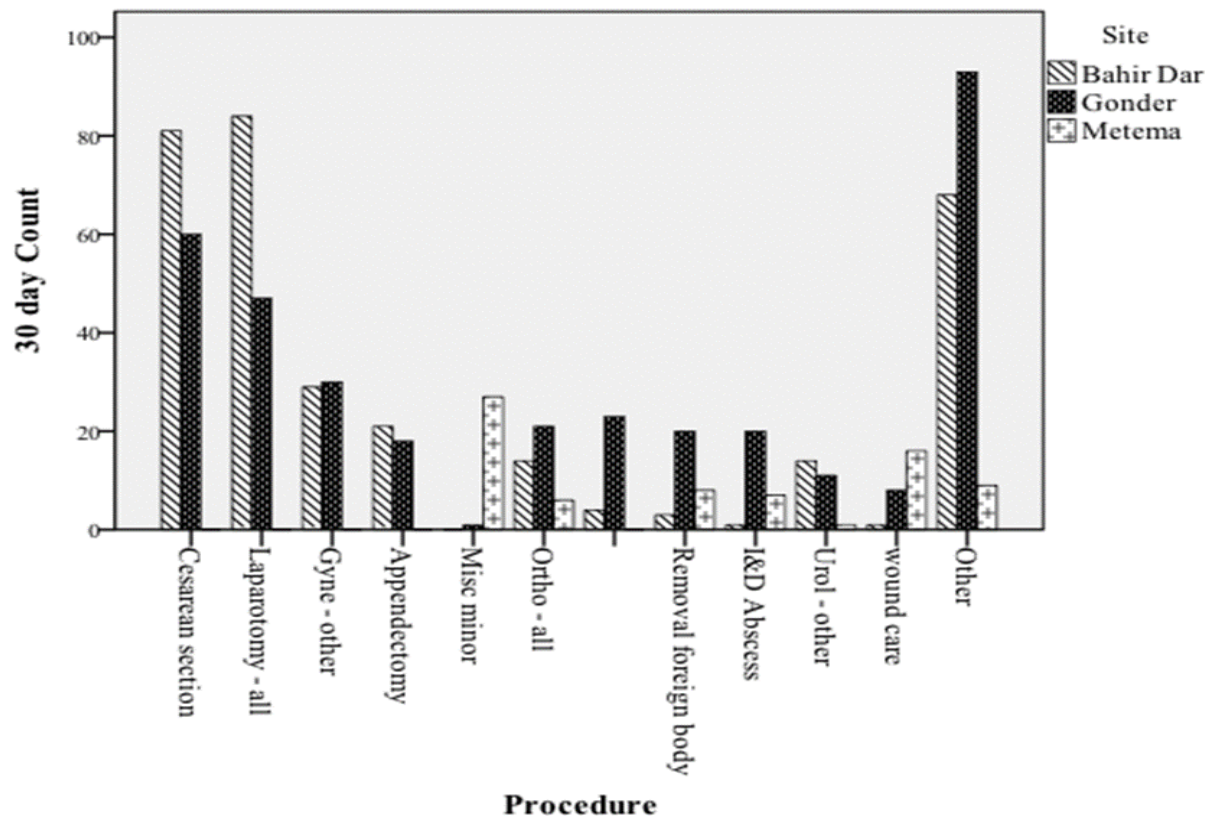


Figure 3: Surgical procedures over the past 30 days (Note: Debarq District Hospital did not maintain procedural records and thus not included in this figure)

**Surgical Infrastructure:** The health facility site which was visited demonstrated that there was interrupted supply of basic resources including running water, electricity and oxygen were ubiquitous (figure 1). All hospitals had both major and minor procedures/operating rooms. However, Gondar University Hospital had just 4 (of which 3 were functioning) rooms for 10 surgical specialists – cited in interviews as the major barrier to care by 75% of surgeons. Of note, the mean daily OR output from Gondar and Bahir Dar were equivalent (Gondar: 10.53 cases/day, std dev: 4.946; Bahir Dar: 10.07 cases/day, std dev. 4.291;  $t=0.390$  (58)  $p=0.698$ ), but Gondar is staffed by twice the number of surgical specialists (10 vs 5). 83% of providers across all hospitals cited a lack of basic supplies such as lighting, gauze, oxygen masks and tubing, anesthetic drugs and suture material as

the most important barrier preventing them from delivering good surgical care to their patients. 100% of district hospital respondents cited a lack of basic emergency equipment such as chest tubes and oxygen masks as the most important thing they needed.

**Surgical Education:** Of the providers interviewed, 75% had participated in the ESS as either an instructor or as a student. The breakdown is shown in figure 2. All respondents who had participated in the ESS found it to be a highly valuable training tool. All instructors noticed definite improvements in the performance of their interns and in their confidence and ability to perform procedures. All learners reported it as a key component of their surgical education. However, none reported that it had influenced their career choice, or made them perform more procedures.

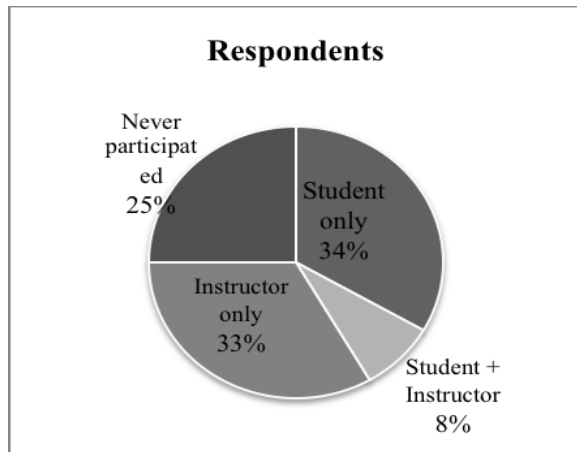


Figure 2: Respondents' participation in ESS

The medical student and intern survey data were strongly supportive of the ESS with 89.3 % of students who had taken the course reporting that it increased their confidence in performing surgical procedures, and 81.3% of them reporting that the ESS course had made them more likely to perform some surgical procedures in their career.

Regrettably, in contrast to the positive feedback about the ESS course, only 18.6% of interns somewhat or strongly agreed that their medical school surgical training was adequate, but this number fell to only 5.4% amongst those that had completed more than 50% of their intern surgical rotation. When looking at procedural volume, 85.2% of interns had sutured less than 5 lacerations in their education. Despite this, 64.1% of respondents felt their experience with surgery had been positive. This was not associated with the level of training ( $X^2=10.225$ ;  $p=0.805$ ), suggesting a persistent positive outlook throughout their education and suggesting that other factors such as surgical volume rather than overall surgical experience account for the perception of sub-optimal surgical training.

**Further Barriers to Surgery at the District Hospital:** At all hospitals which were outside Gondar

University, provided independently identified a lack of senior medical staff, and lack of professional support as a major barrier to the provision of surgical care. For the general practitioners, this manifested as both a perceived lack of support and education for themselves, but also as a grave concern for the success of the Integrated Emergency Surgery and Obstetrics Health Officer program. Somewhat surprisingly, support for the surgical health officer program was much higher amongst surgeons than other practitioners although all surgeons admitted to having initial reservations about the program. When asked, surgeons acknowledged the importance of ongoing support and follow-up for the surgical health officers, but they were not aware of any plan for this to take place.

## DISCUSSION

**Key Results:** This study has highlighted two key issues with the provision of surgical care in the North Gondar Zone of Ethiopia :one, the scarcity of trained surgical care providers, and two, the lack of surgical physical infrastructure and equipment.

These findings were also observed in many sub Saharan cuntries including Nigeria, Malawi and Tanzania. Among Physical infrastructures, eleticity interuptions which occur daily is observed across all institutions in the sudiea countries ( 28-30). At the same time, the study found that the ESS training course has become an integral component of surgical training at Gondar University and is highly valued by both students and instructors.

The massive workforce crisis in sub-Saharan Africa and especially Ethiopia is well documented, but with the extensive up-scaling of medical education return to service requirements, and creation of the surgical health officer, Ethiopia is making excellent progress



on this front. The Ethiopian government has committed to building and staffing several hundred district hospitals with capable of emergency surgery. However, the infrastructure gap in the North Gondar Zone remained formidable to achieve Ethiopia's target of having one district hospital per 100,000 people (16). There is a deficit of over 20 district hospitals in the Zone. On the other hand, the completion of a new specialized referral hospital which has, 10 operating theatres, and which is currently under construction at Gondar University will greatly boost the surgical output in the entire region.

This study has demonstrated that translating capability into results relies heavily on infrastructure, and a reliable supply of consumable equipment such as oxygen masks and tubing, chest tubes, sutures, and gauze which have to be available for providers to deliver care. Additionally, the importance of avoiding professional isolation which has been found to be a key barrier to skill development in this population, and could potentially be a critical factor in the success or failure of the Integrated Emergency Surgery and Obstetrics Health Officer program is highlighted in this study.

As the number of medical trainees rises in comparison to the available infrastructure and instructors, it can be expected that the per-student patient volume will be diminished. Of course, this is practical in Gondar University Hospital where the surgical service has ballooned from 12 interns and 30 medical students to 10 residents, 24 interns and 80 students (figure 3). To solve these educational challenges, the relevance of intensive lab-based surgical skills training should be given focus.

**Limitations:** This study has many limitations, but its main limitations was that anesthesia technicians and obstetricians were not included in the sample. In addition, the initial focus of the study on the general surgery population did not account for the overwhelm-



*Figure 3: Increasing class sizes threaten to decrease students' hands on experience.*

ing priority practitioners in the district hospitals placed on cesarean section capability. Similarly, the sample size was small, and the observational design did not lend itself to conclusive statements, but rather it was descriptive in nature. As a result, it didn't allow for the generation of hypotheses, proposals and recommendations. Furthermore, the study findings are specific for the North Gondar Zone. However, given the regionalization of health care in Ethiopia, and the typical nature of the North Gondar zone, these findings are largely generalizable to the rest of the Amhara region. The regional context will be important in interpreting the results of this study in other areas.

## CONCLUSION

The need for ongoing skill improvement, and the crucial need for surgical infrastructure building was surfaced in this study. Engagement with surgical providers outside major centers to combat professional isolation, and to improve poor retention as well as the need for supply management, and equipment maintenance must fall under the current Ministry of Health plans for up-scaling of surgical capacity. The study largely reflected the need to upgrade the health care provider with the continuous provision of surgical skill training.

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