Essential Surgical Capacity in Somalia

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Essential Surgical Capacity in Somalia

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ABSTRACT

Objective: To assess life-saving and disability-preventing surgical including emergency, trauma, obstetrics, anaesthesia services of health facilities Somalia to assist in planning strategies for strengthening surgical care systems.
Design: Cross-sectional survey
Setting: Health facilities in all 3 administrative zones of Somalia: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland: and south/central Somalia (SCS).
Participants: 14 health facilities
Measures: The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to deliver (including obstetrics and trauma) and anaesthesia services by investigating four categories of data: infrastructure; human resources; interventions available; and equipment.
Results: The 14 facilities surveyed in Somalia represented 10 of 18 districts throughout the country. The facilities served an average patient population of 331,250 people, and 12 of 14 identified as hospitals. While major surgical procedures were provided at many facilities (Caesarean Section, Laparotomy, Appendectomy, etc.), only 22% had fully available oxygen access, 50% fully available electricity, and less than 30% had any management guidelines for emergency and surgical care. Further, only 36% were able to provide general anaesthesia inhalation due lack of skills, supplies, and equipment. Basic supplies for airway management and prevention of infection and HIV transmission were severely lacking in most facilities.
Conclusions: According to the results of the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care survey, there exist significant gaps in the capacity of emergency and essential surgical services in Somalia including inadequacies in essential equipment and infrastructure. The information provided by this tool can serve as a basis for evidenced-based decisions on country-level policy regarding the allocation of resources and provision of emergency and essential surgical services.

ARTICLE SUMMARY

Article Focus

- On-site visits to primary health centres in a developing nation
- Evaluate capacity to deliver emergency and essential surgical care

Strengths and limitations of this study

- Provides insight into the surgical capacity of Somalia
- Identifies significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies
- Does not capture data from every first-referral health facilities of the country

INTRODUCTION

Conditions that can be treated with surgery account for an estimated 11% of the world's disability-adjusted life years.[1] Despite recent data estimating the global volume of

surgery at 234 million surgical procedures annually and significant disparities between procedures performed in high- and low- income countries, global public health initiatives have traditionally neglected the necessity for the provision of surgical services.[2] Poor access to surgical services, particularly at rural facilities, results in excess morbidity and mortality from a broad range of treatable surgical conditions including injuries, complications of pregnancy, sequelae of infectious diseases, acute abdominal conditions and congenital anomalies. Improving the access to surgical services in low-income countries requires addressing gaps in infrastructure, trained/skilled personnel, appropriate equipment and medications.

BACKGROUND

Somalia's 21 years of war, armed conflict and insecurity have had a devastating effect on the health sector. The current situation is at its worst level since the beginning of the civil war in 1991, with unprecedented levels of child malnutrition, internal displacement, as well as conflict and insecurity rife in some parts of the country.[3] Continuing conflict has left 90% of health infrastructure looted, damaged or destroyed.[4] The low health workforce ratios before the war have depreciated through high levels of healthcare worker emigration, leaving an estimated 3 physicians per 100000 population (total 253 physicians), 11 nurses per 100 000 population (861 nurses) and 2 midwives per 100 000 population (116 midwives) serving the whole country.[5]

Rates of death and disability from treatable surgical conditions continue to be unacceptably high. Somalia's maternal mortality rate is estimated to be 1044 per 100 000 live births, one of the highest in the region.[6] This corresponds to a lifetime risk of one maternal death for every 10 women. The leading causes of maternal death (antepartum and postpartum haemorrhage, obstructed labour and eclampsia) can all be addressed with appropriate emergency obstetric care, which often require surgical and/or anaesthesia interventions. Trauma-related mortality, through road traffic accidents, armed fighting and landmine explosions is also common. In 2010 and 2011, WHO reported more than 7500 war-wounded civilians who were admitted to three main hospitals in Mogadishu, one in five being children and one in three women (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/)

The health sector faces overwhelming challenges in a country where two decades of lawlessness have resulted in the collapse of central government and 3 almost autonomously-ruled zones: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS). Somalia's public health system is tiered, comprising regional referral hospitals, district hospitals, maternal and child health centres and health posts. However, hospitals and health facilities are limited in number, inadequately distributed, operate using vastly different standards, and often cannot provide a minimum package of primary health care (PHC) services. As funders and public health experts adopt the expansion of primary healthcare services, the inclusion of surgical services at the first-referral level is critical. The purpose of this

survey was to collect knowledge gained from comprehensive quantitative assessments of surgical capacity in Somalia in order to assist in planning strategies for universal access to life-saving and disability-preventing surgical services (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/).

OBJECTIVE

To assess the current capacity for essential anesthesia and surgical services in Somalia with the purpose of providing a benchmark for critical areas needing improvement.

METHODS

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to perform basic surgical (including obstetrics and trauma) and anaesthesia interventions by investigating four categories of data: infrastructure, human resources, interventions provided and equipment availability. The tool queries the availability of 8 types of care providers, 35 surgical interventions and 67 items of equipment.

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was distributed by the Ministry of Health and WHO Somalia to the 20 first-referral-level-health facilities around the country and was completed at 14 health facilities representing 10 of the 18 regions of Somalia and all 3 administrative zones. The survey was extended to regional medical officers and facility administrators. The data were obtained during site visits from the Somalia Ministry of Health (MoH), the WHO country office and members of the Global Initiative for Emergency and Essential Surgical Care (GIEESC) between 2011 and 2012, many of whom were in attendance of the WHO Meeting on Strengthening Surgical and Obstetrics Care in Somalia in April 2012 (http://www.who.int/surgery/globalinitiative/gieesc_country_reports/en/index.html). Participation in the survey and reporting to the WHO was voluntary. Data on various indices were entered into and analyzed from WHO Global DataCol Database for Emergency and Essential Surgical Care.

Facilities were asked the size of the 'population served', intending to quantify the population living in the catchment area. This value represents the number of residents who might use the facility as their first-referral health facility, not the number of patients seen.

RESULTS

i	Health facility characteristics
ii	Infrastructure
iii	Human resources
iv	Interventions
v	Equipment

Data were gathered from 14 of 20 health facilities in 10 regions (out of 18) across Somalia, as featured figure 1 and table 1.

Type of Facility (Self-identified)	**Name of Facility**	**Region**
General Hospital	Garowe Hospital	Nugaal
	Gardo General Hospital	Bari
	Hergeisa Group Hospital	Woqooyi Galbeed
Provincial Hospital	Borama General Hospital	Awdal
	Burao Regional Hospital	Togdeer
	Berberra Referral Hospital	Woqooyi Galbeed
	Erigavo Regional Hospital	Sanaag
	Sool Regional Hospital	Sool
Health Center	Doolow Health Center	Gedo
Private/NGO/Mission Hospital	Galkayo Medical Center	Mudug
	Galkayo Specialist Hospital	Mudug
	Medina Hospital	Banadir
	Maani Hospital	Banadir
	Manhal Specialty Hospital	Woqooyi Galbeed

Table 1. Participating health facilities. N=14

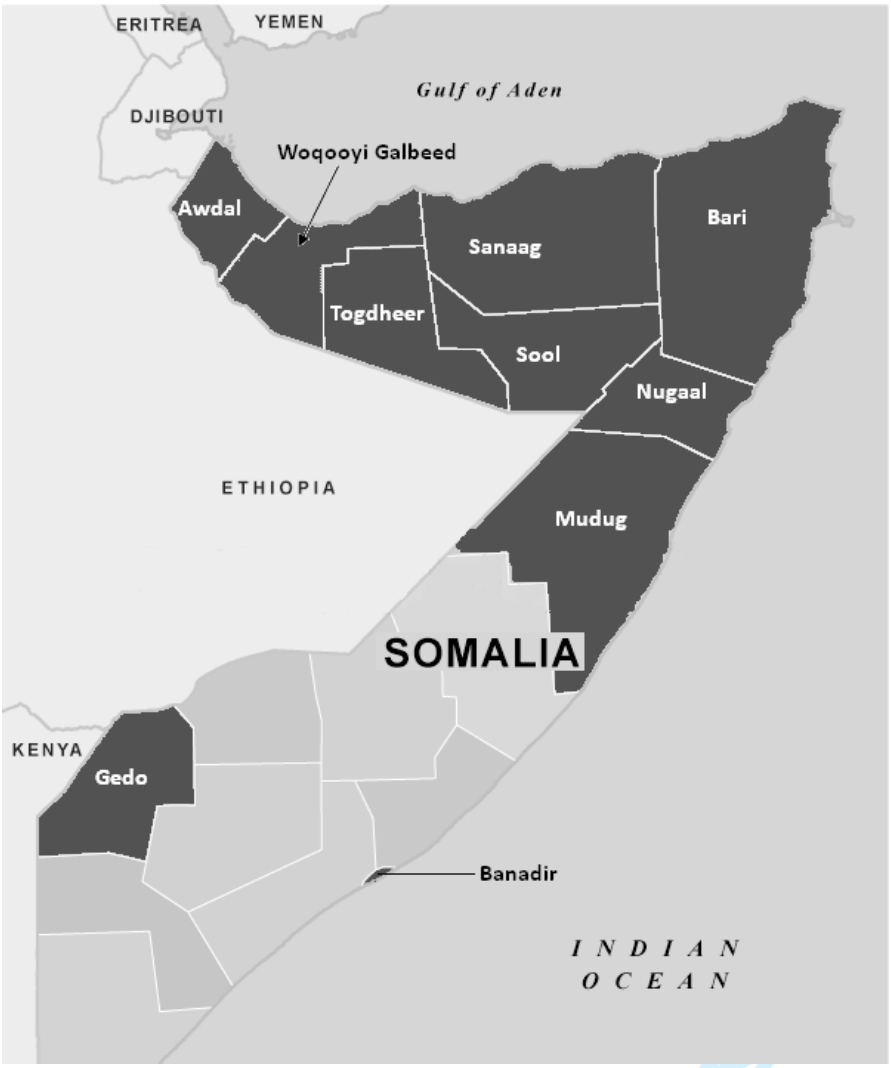

Figure 1. Participating regions of Somalia.

i. Health facility characteristics

Of the 14 facilities that responded to the survey 5 were provincial hospitals, 5 were private/mission/NGO hospitals, 3 were general hospitals and 1 was a health center. Each facility reported having at least 1 operating theatre, with a maximum of between 11 and 20 operating theatres. The populations served by each facility ranged from 100,000 to 1,000,000 people, with the average of the reporting facilities being 331,250 people.

ii. Infrastructure

The emergency and surgical infrastructure of the 14 reporting facilities were largely inadequate, with only 22% of health facilities having oxygen cylinder supplies consistently available. 28% of facilities never or only sometimes had access to running water available and only 50% had a consistently available electricity source. Only 50% of

the facilities had fully available access to both running water and electricity. Access to a functional anaesthesia machine was only present in 2 (15%) of the 14 facilities, one of those facilities being a local health center. Only 3 facilities had access to a functioning pulse oximeter.

50% of facilities had areas designated always for emergency care and only 38% of facilities had the same for postoperative care.

A minority of facilities had formal management guidelines for emergency care (3/14 = 21%), surgery (5/14 = 36%), anaesthesia (4/14 = 29%), or pain relief (1/14 = 7%).

Table 2 depicts the key infrastructural elements available in the health facilities accessed.

	Always	Sometimes	Not Available
Oxygen cylinder	22	7	71
Running water	72	14	14
Electricity source	50	36	14
Operational power generator	50	36	14
Functioning anaesthesia machine	15	15	70
Medical records	71	21	7
Area designated for emergency care	50	14	36
Area designated for postoperative care	38	8	54
Management Guidelines for Emergency Care	21	7	72
Management Guidelines for Surgery	36	0	64
Management Guidelines for Anaesthesia	29	7	64
Management Guidelines for Pain relief	7	21	72
Blood bank	36	21	43
Haemoglobin & urine testing	86	14	0
X-ray machine	57	29	14

Table 2. Availability of infrastructure and health resources in Somalia, 2012
% of facilities where element is always, sometimes, or never available. N=14

iii. Human Resources

More data is needed to comment on the Health Human Resources in Somalia. The 14 facilities reported a total of 137 healthcare providers. Only 15 (10.9%) individuals were identified as full time trained surgical specialists, located only at 9 out of 14 of the facilities. 14 (10.9%) were identified as obstetricians, and only 4 (2.9%) individuals were identified as qualified anesthesiologists and were located in only 3 of the 14 facilities, with 27 (19.7%) unlicensed medical staff (Nurses, medical assistants, etc.) providing anesthetic services.

iv. Interventions

Of the 35 basic interventions listed in the tool, only suturing and abscess incision and drainage are offered at all 14 facilities. Additionally, acute burn management, wound debridement, hydrocele treatment, and male circumcision are widely provided by the surveyed facilities being offered at 86%, 85%, 86%, 86%, of all facilities respectively. Caesarean section is offered at 93% of all facilities (n=14).

Provision of anaesthesia services was severely lacking, however, with only 36% of facilities able to perform general anaesthesia inhalational procedures. Of the 8 facilities that reported back why they could not provide this service, 1 attributed it to lack of skill, 4 to lack of supplies/drugs, and 2 to a lack of equipment. 1 facility attributed it both to lack of skill and lack of equipment.

The ability of each health facility to provide basic surgical and anaesthesia procedures was assessed (table 3).

General surgery & trauma	**Available**
Resuscitation (airway, haemorrhage, peripheral percutaneous intravenous access, peripheral venous cut down)	79
Cricothyroidotomy/ Tracheostomy	71
Chest tube insertion	64
Removal of foreign body (throat/ear/eye/nose)	79
Acute burn management	86
Incision & drainage of abscess	100
Suturing (for wounds, episiotomy, cervical & vaginal lacerations)	100
Wound debridement	85
Caesarean section	93
Dilatation & curettage (gynaecology/obstetrics)	92
Obstetric fistula repair	50
Appendectomy	79
Hernia repair (strangulated, elective)	71
Hydrocele	86
Cystostomy	64
Urethral stricture dilatation	79
Laparotomy (uterine rupture, ectopic pregnancy,, acute abdomen, intestinal obstruction, perforation, injuries)	86
Male circumcision	86
Congenital hernia repair	69
Neonatal surgery (abdominal wall defect, colostomy imperforate anus, intussusceptions)	39
Cleft lip repair	71

Clubfoot repair	64	
Contracture release/ skin grafting	71	
Fracture treatment	Closed	Open
	71	57
Joint dislocation treatment	64	
Drainage of osteomyelitis/septic arthritis	64	
Amputation	79	
Biopsy (lymph node, mass, other)	57	
Tubal ligation/vasectomy	64	
Cataract surgery	29	
Anaesthesia		
Regional anaesthesia blocks	43	
Spinal anaesthesia	93	
Ketamine intravenous anaesthesia	93	
General anaesthesia inhalational	36	

Table 3. Availability of surgical (including obstetrics and trauma) and anaesthesia interventions. % of facilities which offer the procedure. N=14

v. Emergency equipment and supplies for resuscitation

Basic equipment access was also lacking. No facility had access to all pieces of basic and essential surgical equipment listed on the tool. Only 1 hospital (7%) always had adult resuscitator bag valves and masks always available, and only 2 out 14 facilities (14%) reported the same for pediatric bag valves and masks. 64% of facilities had access to oxygen only sometimes or never, and less than 30% had oropharyngeal airways available always for both adults and children. 39% of institutions were without an examination table.

Basic tools such as suction catheters, IV cannulas, and Foley catheters were only consistently available in less than 30% of all facilities.

57 % of facilities did not have sterile gloves consistently available, and 64% reported the same for examination gloves. Only 64% of the reporting institutions had a sterilizer available all the time. 71% could not make face masks available, and 86% were without consistent availability of eye protection. Availability of soap and wash basins was reported in less than two thirds of the 14 facilities.

The availability of emergency equipment and supplies was assessed in each of the health facilities (depicted in table 4).

Capital Outlays	**Always**	**Sometimes**	**Never**
Resuscitator bag valve & mask			
Adult	7	50	43
Paediatric	14	36	50
Oxygen	36	28	36

Stethoscope	75	25	0
Batteries for flash light	57	14	29
Suction pump	79	21	0
Blood pressure monitoring equipment	71	21	7
Thermometer	71	21	7
Scalpel Handle with blade	64	29	7
Retractor	54	46	0
Scissors straight 12cm	57	36	7
Scissors blunt 14cm	54	46	0
Oropharyngeal airway			
Adult	29	42	29
Paediatric	28	36	36
Forceps Kocher no teeth	38	54	8
Forceps, artery	57	43	0
Kidney dishes stainless steel	46	46	7
Capped bottle, alcohol based solutions	33	42	25
Gloves (sterile)	43	50	7
Gloves (examination)	36	57	7
Needle holder	64	36	0
Sterilizer	64	36	0
Nail brush, scrubbing surgeon's	54	38	8
Vaginal speculum	64	14	22
Bucket, plastic	33	33	33
Drum for sterile compresses, bandages, dressings	61	31	8
Examination table	61	31	8
Renewable			
Suction catheter sizes 16 FG	15	39	46
Tongue depressor wooden disposable	23	54	23
Nasogastric tubes 10 to 16 FG	14	72	14
Light source (lamp & flash light)	29	64	7
Intravenous fluid infusion set	21	65	14
IV cannulas	29	57	14
Scalp vein infusion set	23	54	23
Syringes 2ml	29	64	7
Syringes 10 ml	29	71	0
Disposable needles	36	57	7
Sharps disposal container	36	57	7
Tourniquet	31	62	7
Sterile gauze dressing	23	52	15
Bandages sterile	23	54	23
Adhesive tape	23	69	8
Needles, cutting & round bodied (for suturing)	29	57	14
Suture synthetic absorbable	31	46	23

Splints for arm, leg	14	57	29
Towel cloth	15	62	23
Absorbent cotton wool	15	77	8
Urinary catheter Foleys disposable #12, 14,18 with bag	23	54	23
Sheeting, plastic for examination table	29	50	21
Waste disposal container	29	57	14
Face masks	29	57	14
Eye protection	14	36	50
Apron, plastic reusable	22	64	14
Soap	36	64	0
Wash basin	31	62	7
Supplementary equipment			
Magills forceps			
Adult	21	14	64
Paediatric	7	16	77
Endotracheal tubes	8	15	77
IV infusor bags	8	15	77
Chest tubes insertion equipment	8	23	69
Laryngoscope			
Adult	23	23	54
Paediatric	8	23	69
Cricothyroidotomy set	8	8	84

Table 4. Availability of Emergency Equipment and Supplies for Resuscitation.
% of facilities where element is always, sometimes, or never available. N=14

DISCUSSION

Surgically treatable diseases are among the top 15 causes of disability,[7] and conservative estimates show that 11% of the world's Disability-Adjusted life years (DALYs) stem from surgically treated conditions.[1] In 2004, South East Asia and Africa accounted for 54% of the global burden,[8] and since then the burden of surgical disease is thought to be increasing.[7]

More than 2 billion people globally are without access to surgical care.[9] Of the 243 million surgical procedures performed globally each year, the 34.8% of the world's population living in low-income countries only have access to 8.1 million (only 3.5%) of such procedures.[2] As a result, rates of maternal mortality are high, minor surgical pathologies become lethal, and treatable trauma progresses to death.
Despite the great unmet need and inclusion in policy-level dialogue on primary health care, the delivery of emergency surgical care has long been sidelined in global financing and policy debates, largely due to perceived complexity and cost. Further, despite the large and growing need for expanding access to surgical care, human resources, metrics and science focused on global surgery, and sustained financing mechanisms for surgical infrastructure lag behind other public health priorities (Smith-Rohrberg Maru, D, McGee,

HM, Brady, JS et al. Global Surgical Care in 2030: Metrics and Strategies for Expansion in Access and Quality. 2013. www.worldwewant2015.org/file/298623/download/323967)

Enormous shortfalls in infrastructure, supplies, and procedures undertaken are common at district-level health facilities in LMICs.[10] Every $1 spent strengthening local surgical capacity generates $10 through improved health and increased productivity.[11] In 2008, the Copenhagen Consensus Center's research identified strengthening surgical capacity, particularly at the district hospital level, as a highly cost-efficient solution to global diseases. Notably, strengthening local surgical capacity is an approach that would both provide a high degree of financial protection to populations and address the most DALYs in a cost effective manner.[1] In fact, the benefit-cost-ratio for the expansion of surgical capacity at district hospitals was found to be 10:1.[12] Further, due to the implementation of "vertical" programmes in public health (i.e. child health, maternal health, cancer, and trauma), in which most programmes contain some surgical component, strengthening surgical services may improve health system overall.[13]

This study provides an overview of the capacity for surgical care representing health facilities from in all 3 administrative zones, including 10 regions of 18 in Somalia, and demonstrates the significant gaps in infrastructure, life-saving and disability-preventive surgical interventions and essential equipment. Of the 14 reporting health facilities, 12 identified as full hospitals, serving an average patient population of over 300,000 people, further indicating the need for surgical care system strengthening.
Of the 35 basic surgical and anaesthesia interventions, most hospitals were unable to provide all of the basic surgical services. Major essential procedures such as Caesarean section, appendectomy, elective hernia repair, laparotomy, and hydrocele were offered at a majority of hospitals, but these conflicted directly with the continuous availability of basic and necessary supplies and infrastructures. Only 3 facilities had any consistent access to oxygen cylinders, and even less reported access to tubing, valves, and masks.

Necessary procedures including resuscitation and airway management were offered at a majority (79%) of facilities. Those reporting the inability to provide resuscitation procedures, however, all reported the provision of major surgical procedures that would require provision and knowledge of those same procedures. The facilities in questions could not be contacted for confirmation.

Still, many facilities lacked access to key equipment and supplies such as provisional oxygen equipment, oropharyngeal airways, and IV cannulas. Only 2 facilities reported access to a functional anaesthesia machines, and few facilities noted the ability to provide general anaesthesia inhalation. Both oxygen and anaesthesia are essential medicines, (WHO Model List of Essential Medicines. World Health Organizations. 2013. http://www.who.int/medicines/publications/essentialmedicines/18th_EML_Final_web_8Jul13.pdf) and the existing deficit limits the availability safe and effective life-saving surgeries in Somalia or can result in significant complication or unnecessary patient suffering when these medicines are not provided.[14]

A surprising low amount of facilities reported having access to equipment necessary for the prevention of HIV transmission and other infection control. Less than half of the

facilities reported access to sterile gloves, waste disposal containers, face masks, eye masks, aprons, and even soap and only slight more than half of the facilities had access to a sterilizer, all key components in the reduction of HIV transmission (WHO Prevention of Transmission of HIV. 2007. http://www.who.int/surgery/publications/HIVprevention.pdf)

A majority of the facilities lacked any formal guidelines for the management of emergency care, surgery, pain relief, or anaesthesia, providing a significant barrier to the strengthening of emergency and surgical care services and severely limiting their ability to respond to large scale disaster and crisis situations.

The provision of safe and effective surgical care is dependent on the presence of all components inherent in a functional health system. Systematic investments and changes that address and strengthen the availability of appropriately trained human resources, capital outlays, and necessary infrastructure are necessary to decrease mortality from surgically treatable conditions. Further, strengthening of surgical systems will not only reduce the disease burden of surgically related issues but can also increase progress toward achieving the 2015 Millennium Development Goals (MDGs). Strengthening surgical care delivery can help achieve MDGs 1 (eradication of poverty),[9] 4 (child health), 5 (maternal health), and 6 (HIV/AIDS prevention).[12] Systematic changes such and investments in oxygen and related equipment and appropriately trained surgical workforce will also serve to benefit patients suffering from a range of conditions including sepsis, pneumonia, HIV-related conditions and other infectious diseases.

To meet the needs of LMICs, the WHO Emergency and Essential Surgical Care (EESC) program with its partners worldwide developed the *Integrated Management for Emergency and Essential Surgical Care* (IMEESC) toolkit (WHO IMEESC Toolkit: http://www.who.int/surgery/en). It guides policies, research for evidence-based planning (WHO EESC Situation Analysis Tool to assess emergency, trauma, obstetrics, anesthesia and surgical services, WHO EESC Global Database), trainings, best practice protocols at point-of- care, monitoring and evaluation of the progress of surgical care systems. The IMEESC toolkit provides guidance for policymakers, managers, and providers at various levels of care, instructional videos, training modules on Emergency & Trauma Care for frontline health workers, disaster- management resources, and monitoring and evaluation.

There are a several limitations to this survey. First, it provides only a brief overview of the capacity for surgical care and cannot be used for detailed programme planning. Second, it does not capture data from every first-referral health facility of the country; however, a majority of first-referral health facilities identified by the MoH and WHO Somalia have responded, allowing us to provide a glimpse into the state of basic surgical capacity in the country. Third, some of the data was taken after the WHO IMEESC

toolkit was implemented in the country, and results should be qualified by the possibility of interpretation constraints of the survey.

However, this study provides insight into the surgical capacity of Somalia, using the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care. The survey identified significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies. Addressing these gaps and the strengthening of surgical services within existing related national programmes are needed to strengthen health systems as a whole, particularly at the district and sub-district level.[15] Further research is needed to determine the burden of surgical disease in Somalia and to determine the cost-benefit of specific interventions to improve surgical services.

Disclaimer: The authors include staff members of WHO. They are responsible for the views expressed in this publication and do not necessarily represent the decisions or stated policy of WHO.

Contributors: NE analyzed and interpreted the data, drafted the article, revised it and finally approved the submitted version. AS analyzed and interpreted the data, drafted the article, revised it and finally approved the submitted version. MC contributed to conception and design, acquisition and interpretation of data, helped draft the article, made critical revisions and finally approved the submitted version. OS contributed to acquisition of data, made critical revisions and finally approved the submitted version. ME contributed to acquisition of data, made critical revisions and finally approved the submitted version. GP contributed to acquisition of data, made critical revisions and finally approved the submitted version. AI contributed to acquisition of data, made critical revisions and finally approved the submitted version.

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REFERENCES

1. Debas HT, Gosselin R, McCord C, et al. Surgery. In: Jamison D, ed. Disease Control Priorities in Developing Countries. 2nd edn. New York: Oxford University Press, 2006:1245-59.
2. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet 2008;**372**:139-44.
3. World Health Organisation. Regional Office for the Eastern Mediterranean, Cairo. Country Cooperation Strategy for WHO and Somalia 2010-2014. 2010.
4. UNICEF. The private sector and health: a survey of Somaliland private pharmacies. 2008.
5. UNDP. Population projections. 2007.
6. UNDP. Millennium Development Goals Report for Somalia. 2007
7. Farmer P, Kim J. "Surgery and global health: a view from beyond the OR." World J Surg 2008; 32(4):533-536.
8. Johnson, WD. Surgery as a Global Health Issue. Surg Neurol Int. First: 03 April 2013. doi:10.4103/2152-7806.110030
9. Funk, LM, Weiser, TG, Berry, WR, et al. "Global Operating Theatre Distribution and Pulse Oximetry Supply: an Estimation from Reported Data." Lancet. 2010;**376**(9746): 1055-1061.
10. Kushner Al, Cherian MN, Shokohmand, AS, et al. Addressing the Millennium Development Goals from a surgical perspective: essential surgery and anesthesia in 8 low- and middle-income countries. Arch Surg 2010;**145**(2): 154-159.
11. United Nations. A New Global Partnership: Eradicate Poverty And Transform Economies Through Sustainable Development: The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. United Nations Publication 2013.
12. Jamison, D, Jha, P, Bloom, D. Diseases – disease control. In: Lomborg, B. Global Crises, Global Solutions: 2nd ed. New York: Cambridge University Press. 2009:129-163.
13. Ozgediz, D. Jamison, D, McQueen, K. The burden of surgical conditions and access to surgical care in low- and middle-income countries. Bull World Health Organ 2008;**86**(8):646-647
14. Cherian, MN, Merry, AF, Wilson, IH. The World Health Organization and Anaesthesia. Anaesthesia, 2007;**62**:65-66
15. Hedges JP, Mock CN, Cherian MN. The Political Economy of emergency and essential surgery in global health. World J Surg 2010;**34**:2003–2006. [PubMed: 20454792]

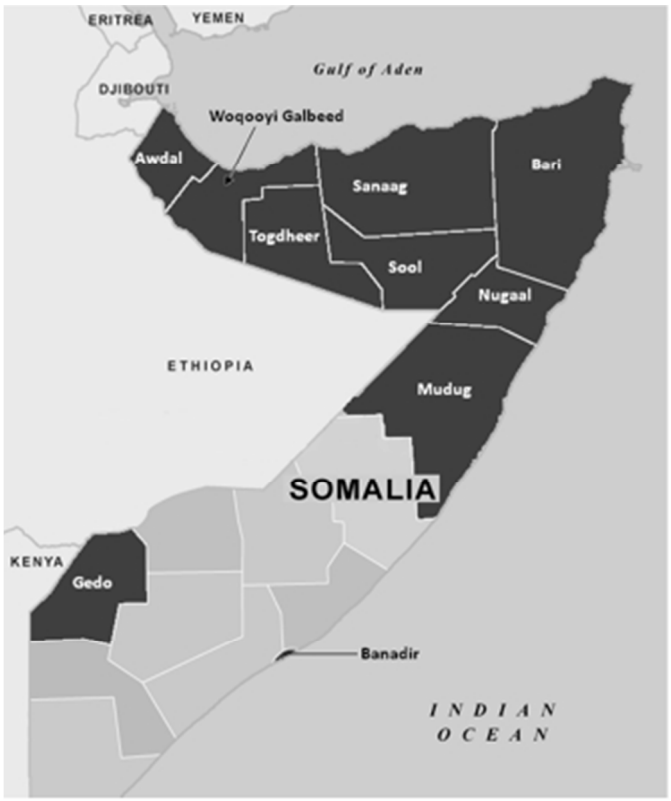

Figure 1: Participating regions of Somalia
117x140mm (72 x 72 DPI)

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A Survey of Essential Surgical Capacity in Somalia

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ABSTRACT

Objective: The objective of this study was to assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.

Design: Cross-sectional survey

Setting: Health facilities in all 3 administrative zones of Somalia: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland: and south/central Somalia (SCS).

Participants: 14 health facilities

Measures: The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to deliver surgical and anaesthesia services by investigating four categories of data: infrastructure; human resources; interventions available; and equipment.

Results: The 14 facilities surveyed in Somalia represent 10 of 18 districts throughout the country. The facilities serve an average patient population of 331,250 people, and 12 of 14 identifiy as hospitals. While major surgical procedures were provided at many facilities (Caesarean Section, Laparotomy, Appendectomy, etc.), only 22% had fully available oxygen access, 50% fully available electricity, and less than 30% had any management guidelines for emergency and surgical care. Further, only 36% were able to provide general anaesthesia inhalation due to lack of skills, supplies, and equipment. Basic supplies for airway management and the prevention of infection transmission were severely lacking in most facilities.

Conclusions: According to the results of the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care survey, there exist significant gaps in the capacity of emergency and essential surgical services in Somalia including inadequacies in essential equipment, services, and infrastructure. The information provided by this tool can serve as a basis for evidenced-based decisions on country-level policy regarding the allocation of resources and provision of emergency and essential surgical services.

ARTICLE SUMMARY

Article Focus

- On-site visits to primary health centres in a developing nation
- Evaluate capacity to deliver emergency and essential surgical care

Strengths and limitations of this study

- Provides insight into the surgical capacity of Somalia
- Identifies significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies
- Does not capture data from every first-referral health facilities of the country
- Measures are subjective and in some cases estimates

INTRODUCTION

Conditions that can be treated with surgery account for an estimated 11% of the world's disability-adjusted life years.[1] Despite recent data estimating the global volume of surgery at 234 million surgical procedures annually and significant disparities between procedures performed in high- and low- income countries, global public health initiatives have traditionally neglected the necessity for the provision of surgical services.[2] Poor access to surgical services, particularly at rural facilities, results in excess morbidity and mortality from a broad range of treatable surgical conditions including injuries, complications of pregnancy, sequelae of infectious diseases, acute abdominal conditions and congenital anomalies. Improving the access to surgical services in low-income countries requires addressing gaps in infrastructure, trained/skilled personnel, appropriate equipment and medications.

BACKGROUND

Somalia's 21 years of war, armed conflict and insecurity have had a devastating effect on the health sector. The current situation is at its worst level since the beginning of the civil war in 1991, with unprecedented levels of child malnutrition, internal displacement, as well as conflict and insecurity rife in some parts of the country.[3] Continuing conflict has left 90% of health infrastructure looted, damaged or destroyed.[4] The low health workforce ratios before the war have depreciated through high levels of healthcare worker emigration, leaving an estimated 3 physicians per 100000 population (total 253 physicians), 11 nurses per 100 000 population (861 nurses) and 2 midwives per 100 000 population (116 midwives) serving the whole country.[5]

Rates of death and disability from treatable surgical conditions continue to be unacceptably high. Somalia's maternal mortality rate is estimated to be 1044 per 100 000 live births, one of the highest in the region.[6] This corresponds to a lifetime risk of one maternal death for every 10 women. The leading causes of maternal death (antepartum and postpartum haemorrhage, obstructed labour and ecla
mpsia) can all be addressed with appropriate emergency obstetric care, which often require surgical and/or anaesthesia interventions. Trauma-related mortality, through road traffic accidents, armed fighting and landmine explosions is also common. In 2010 and 2011, WHO reported more than 7500 war-wounded civilians who were admitted to three main hospitals in Mogadishu, one in five being children and one in three women (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/)

The health sector faces overwhelming challenges in a country where two decades of lawlessness have resulted in the collapse of central government and 3 almost autonomously-ruled zones: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS). Somalia's public health system is tiered, comprising regional referral hospitals, district hospitals, maternal

and child health centres and health posts. However, hospitals and health facilities are limited in number, inadequately distributed, operate using vastly different standards, and often cannot provide a minimum package of primary health care (PHC) services. As funders and public health experts adopt the expansion of primary healthcare services, the inclusion of surgical services at the first-referral level is critical. The purpose of this survey was to collect knowledge gained from comprehensive quantitative assessments of surgical capacity in Somalia in order to assist in planning strategies for universal access to life-saving and disability-preventing surgical services (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/).

Similar studies using the WHO Situational Analysis tool have been conducted in Tanzania,[7] Solomon Islands,[8] Gambia,[9] Liberia,[10] Ghana,[11] Afghanistan,[12] Sri Lanka,[13] Sierra Leone,[14] and Mongolia.[15]

OBJECTIVE

To assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.

To assess the current capacity for essential anesthesia and surgical services in Somalia with the purpose of providing a benchmark for critical areas needing improvement.

METHODS

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to perform basic surgical (including obstetrics and trauma) and anaesthesia interventions by investigating four categories of data: infrastructure, human resources, interventions provided and equipment availability. The tool queries the availability of 8 types of care providers, 35 surgical interventions and 67 items of equipment.[7]

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was distributed by the Ministry of Health and WHO Somalia to 20 first-referral-level-health facilities around the country and was completed at 14 health facilities representing 10 of the 18 regions of Somalia and all 3 administrative zones. The survey was extended to regional medical officers and facility administrators. Participation in the survey and reporting to the WHO was voluntary The physical surveys were then obtained during either by post directly to the WHO Somalia office (Nairobi, Kenya) or by site visits from the Somalia Ministry of Health (MoH), the WHO country office and members of the Global Initiative for Emergency and Essential Surgical Care (GIEESC) between September 2011 and April 2012, many of whom were in attendance of the WHO Meeting on Strengthening Surgical and Obstetrics Care in Somalia in April 2012 (http://www.who.int/surgery/globalinitiative/gieesc_country_reports/en/index.html). At this meeting reporting protocol and initial survey data were discussed..

The answer of available was defined as "fully available for all patients all of the time," while sometimes was defined as "available with frequent shortages or difficulties".(WHO EESC Situational Analysis Tool. 2012. http://www.who.int/surgery/publications/WHO_EESC_SituationAnalysisTool.pdf)

Despite efforts to standardize the reporting and the collection of much of the data by site-visits performed by agents affiliated to the authors, it must be noted that an inherent reporting bias may be present in the data, given that survey data was compiled by different agents at each site. Further, in a limited number of cases, facilities did not respond to individual questions. Blank answers were considered as neither a positive or negative answer, but simply deemed as unreported.

Data were entered into and analyzed from WHO Global DataCol Database for Emergency and Essential Surgical Care.

Facilities were asked the size of the 'population served', intending to quantify the population living in the catchment area. This value represents the number of residents who might use the facility as their first-referral health facility, not the number of patients seen.

RESULTS

i Health facility characteristics
ii Infrastructure
iii Human resources
iv Interventions
v Equipment

Data were gathered from 14 health facilities in 10 regions (out of 18) across Somalia, as featured figure 1 and table 1.

Type of Facility (Self-identified)	**Name of Facility**	**Region**	**Number of Beds**	**Operating Theaters**
General Hospital	Garowe Hospital	Nugaal	51-80	11-20
	Gardo General Hospital	Bari	21-50	1
	Hergeisa Group Hospital	Woqooyi Galbeed	301-400	5-10
Provincial Hospital	Borama General Hospital	Awdal	201-300	1
	Burao Regional Hospital	Togdeer	201-300	1
	Berbera Referral	Woqooyi	101-200	2

	Hospital	Galbeed		
	Erigavo Regional Hospital	Sanaag	81-100	1
	Sool Regional Hospital	Sool	81-100	1
Health Center	Doolow Health Center	Gedo	5-10	1
Private/NGO/Mission Hospital	Galkayo Medical Center	Mudug	51-80	3-4
	Galkayo Specialist Hospital	Mudug	3-4	1
	Medina Hospital	Banadir	201-300	5-10
	Maani Hospital	Banadir	21-50	1
	Manhal Specialty Hospital	Woqooyi Galbeed	51-80	5-10

Table 1. Responding health facilities. N=14

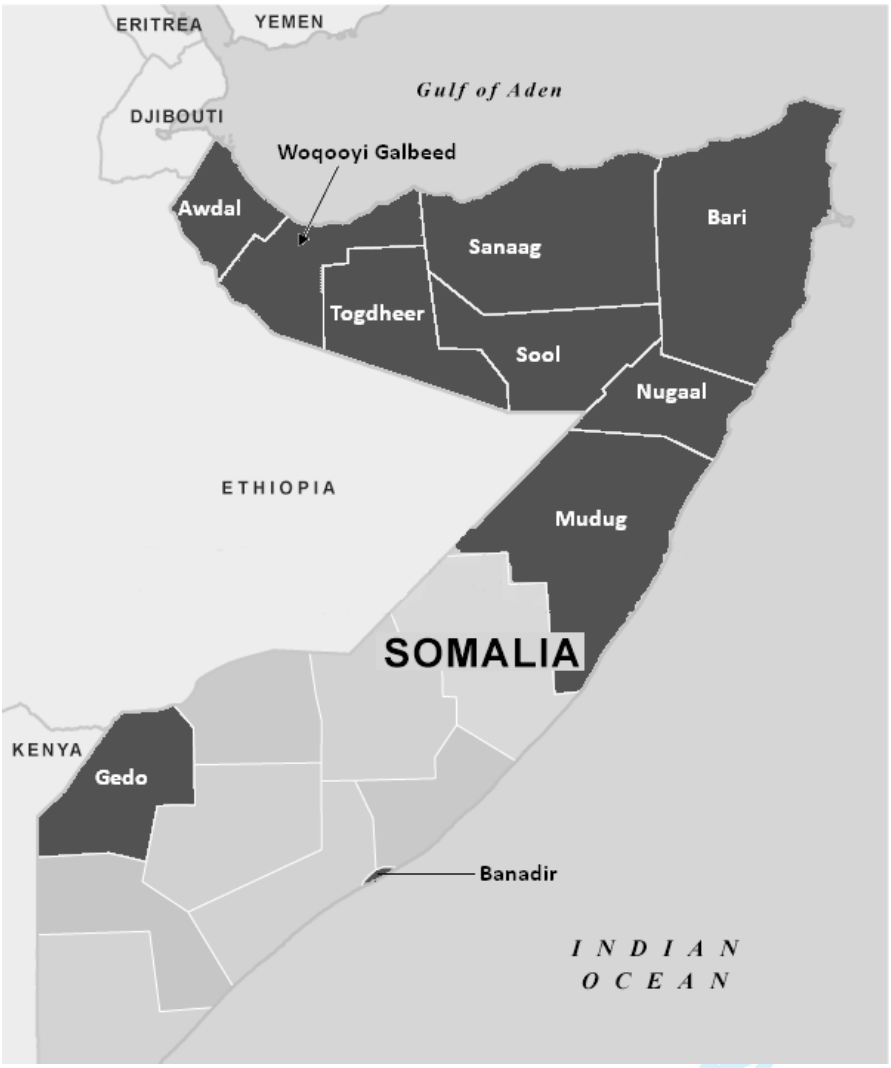

Figure 1. Participating regions of Somalia.

i. Health facility characteristics

Of the 14 facilities that responded to the survey 5 were provincial hospitals, 5 were private/mission/NGO hospitals, 3 were general hospitals and 1 was a health center. Each facility reported having at least 1 operating theatre, with a maximum of between 11 and 20 operating theatres. The populations served by each facility ranged from 100,000 to 1,000,000 people, with the average of the reporting facilities being 331,250 people.

ii. Infrastructure

The emergency and surgical infrastructure of the 14 reporting facilities were largely inadequate, with only 22% of health facilities having oxygen cylinder supplies consistently available. 28% of facilities never or only sometimes had access to running water available and only 50% had a consistently available electricity source. Only 50% of the facilities had fully available access to both running water and electricity. Access to a

functional anaesthesia machine was only present in 2 (15%) facilities, one of those facilities being a local health center. Only 3 facilities reported access to a functioning pulse-oximeter.

50% of facilities had areas designated always for emergency care and only 38% of facilities had the same for postoperative care.

A minority of facilities had formal management guidelines for emergency care (3/14 = 21%), surgery (5/14 = 36%), anaesthesia (4/14 = 29%), or pain relief (1/14 = 7%).

Table 2 depicts the key infrastructural elements available in the health facilities accessed.

	Always	Sometimes	Not Available
Oxygen cylinder	3	1	10
Running water	10	2	2
Electricity source	7	5	2
Operational power generator	2	2	9
Blood bank	5	3	6
Hemoglobin & urine testing	12	2	0
X-ray machine	8	4	2
Medical records	10	3	1
Pulse Oximeter	3	0	8
Area designated for emergency care	5	1	7
Area designated for postoperative care	5	1	7
Management Guidelines for Emergency Care	3	1	10
Management Guidelines for Surgery	5	0	9
Management Guidelines for Anaesthesia	4	1	9
Management Guidelines for Pain relief	1	3	10
Functioning anaesthesia machine	7	5	2

Table 2. Availability of infrastructure and health resources in Somalia, 2012
Number of facilities where element is always, sometimes, or never available. Bolded items designate those which are specific to quality surgical care delivery. N=14

iii. Human Resources

More data is needed to comment on the Health Human Resources in Somalia. In this section, blank answers to staffing questions impeded our ability to comment on the state

of the work force completely. We did however summarize the results to survey questions of which all or a majority of facilities supplied data.

The 14 facilities together reported a total of 137 healthcare providers. Only 15 (10.9%) individuals were identified as full time trained surgical specialists, located only at 9 out of 14 of the facilities. 14 (10.9%) were identified as obstetricians, and only 4 (2.9%) individuals were identified as qualified anesthesiologists and were located in only 3 of the 14 facilities, with 27 (19.7%) unlicensed medical staff (Nurses, medical assistants, etc.) providing anesthetic services.

iv. Interventions

Of the 35 interventions, only abscess incision and drainage is offered at all 14 facilities. Acute burn management, wound debridement, hydrocele treatment, and male circumcision are widely provided by the surveyed facilities being offered at 86%, 85%, 86%, 86%, of all facilities respectively. Caesarean section is offered at 93% of all facilities (n=14).

Provision of anaesthesia services was severely lacking, however, with only 36% of facilities able to perform general anaesthesia inhalational procedures. Of the 8 facilities that reported back why they could not provide this service, 1(Doolow Health Center) attributed it to lack of skill and 4(Borama General Hospital, Doolow Health Center, Erigavo Regional Hospital, Burao Regional Hospital) to lack of supplies/drugs. 1 (Gardo General Hospital) facility attributed it both to lack of skill and lack of equipment.

The ability of each health facility to provide basic surgical and anaesthesia procedures was assessed (tables 3 and 4).

General surgery & trauma	**Available**
Resuscitation (airway, haemorrhage, peripheral percutaneous intravenous access, peripheral venous cut down)	11
Cricothyroidotomy/ Tracheostomy	10
Chest tube insertion	9
Removal of foreign body (throat/ear/eye/nose)	11
Acute burn management	12
Incision & drainage of abscess	14
Suturing (for wounds, episiotomy, cervical & vaginal lacerations)	13
Wound debridement	11
Caesarean section	13
Dilatation & curettage (gynaecology/obstetrics)	12
Obstetric fistula repair	7
Appendectomy	11
Hernia repair (strangulated, elective)	10

Hydrocele	12	
Cystostomy	9	
Urethral stricture dilatation	11	
Laparotomy (uterine rupture, ectopic pregnancy,, acute abdomen, intestinal obstruction, perforation, injuries)	12	
Male circumcision	12	
Congenital hernia repair	9	
Neonatal surgery (abdominal wall defect, colostomy imperforate anus, intussusceptions)	5	
Cleft lip repair	10	
Clubfoot repair	9	
Contracture release/ skin grafting	10	
Fracture treatment	Closed	Open
	10	8
Joint dislocation treatment	9	
Drainage of osteomyelitis/septic arthritis	9	
Amputation	11	
Biopsy (lymph node, mass, other)	8	
Tubal ligation/vasectomy	9	
Cataract surgery	4	

Table 3. Availability of surgical (including obstetrics and trauma) interventions. Number of facilities at which the procedure is available. N=14

Anaesthesia	
Regional anaesthesia blocks	6
Spinal anaesthesia	13
Ketamine intravenous anaesthesia	13
General anaesthesia inhalational	5

Table 4. Availability of anaesthesia interventions Number of facilities at which the procedure is available. N=14

v. Emergency equipment and supplies for resuscitation

Basic equipment access was also lacking. No facility had access to all pieces of basic and essential surgical equipment listed on the tool. Only 1 hospital (7%) always had adult resuscitator bag valves and masks available, and only 2 out 14 facilities (14%) reported the same for pediatric bag valves and masks. 64% of facilities had access to oxygen only sometimes or never, and less than 30% had oropharyngeal airways available always for both adults and children. 39% of institutions were without an examination table.

Basic tools such as suction catheters, IV cannulas, and Foley catheters were only consistently available in less than 30% of all facilities.

57 % of facilities did not have sterile gloves consistently available, and 64% reported the same for examination gloves. Only 64% of the reporting institutions had a sterilizer available all the time. 71% could not make face masks available, and 86% were without consistent availability of eye protection. Availability of soap and wash basins was reported in less than two thirds of the 14 facilities.

The availability of emergency equipment and supplies for resuscitation was assessed in each of the health facilities (depicted in tables 5,6, and7).

Capital Outlays	**Always**	**Sometimes**	**Never**
Resuscitator bag valve & mask Adult	1	7	6
Paediatric	2	5	7
Oxygen	5	4	5
Stethoscope	9	3	0
Batteries for flash light	8	2	4
Suction pump	11	3	0
Blood pressure monitoring equipment	10	3	1
Thermometer	10	3	1
Scalpel Handle with blade	9	4	1
Retractor	7	6	0
Scissors straight 12cm	8	5	1
Scissors blunt 14cm	7	6	0
Oropharyngeal airway Adult	4	6	4
Paediatric	4	5	5
Forceps Kocher no teeth	5	7	1
Forceps, artery	8	6	0
Kidney dishes stainless steel	6	6	1
Capped bottle, alcohol based solutions	2	5	3
Gloves (sterile)	6	7	1
Gloves (examination)	5	8	1
Needle holder	9	5	0
Sterilizer	9	5	0
Nail brush, scrubbing surgeon's	7	5	1
Vaginal speculum	9	2	3
Bucket, plastic	4	4	4
Drum for sterile compresses, bandages, dressings	8	4	1
Examination table	8	4	1

Table 5. Availability of Capital Outlays for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

Renewable			
Suction catheter sizes 16 FG	2	5	6
Tongue depressor wooden disposable	3	7	3
Nasogastric tubes 10 to 16 FG	2	10	2
Light source (lamp & flash light)	4	9	1
Intravenous fluid infusion set	3	9	2
IV cannulas	4	8	2
Scalp vein infusion set	3	7	3
Syringes 2ml	4	9	1
Syringes 10 ml	4	10	0
Disposable needles	5	8	1
Sharps disposal container	5	8	1
Tourniquet	4	8	1
Sterile gauze dressing	3	8	2
Bandages sterile	3	7	3
Adhesive tape	3	9	1
Needles, cutting & round bodied (for suturing)	4	8	2
Suture synthetic absorbable	4	6	3
Splints for arm, leg	2	8	4
Towel cloth	2	8	3
Absorbent cotton wool	2	10	1
Urinary catheter Foleys disposable #12, 14,18 with bag	3	7	3
Sheeting, plastic for examination table	4	7	3
Waste disposal container	4	8	2
Face masks	4	8	2
Eye protection	2	5	7
Apron, plastic reusable	3	9	2
Soap	5	9	0
Wash basin	4	8	1

Table 6. Availability of Renewable Supplies for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

Supplementary equipment			
Magills forceps Adult	3	2	9
Paediatric	1	2	10
Endotracheal tubes	1	2	10
IV infusor bags	1	2	10
Chest tubes insertion equipment	1	3	9
Laryngoscope Adult	3	3	7
Paediatric	1	3	9

Cricothyroidotomy set	1	1	11

Table 7. Availability of Supplementary Equipment for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

LIMITATIONS

There are a several limitations to this survey. First, it provides only a brief overview of the capacity for surgical care and cannot be used for detailed programme planning. Second, it does not capture data from every first-referral health facility of the country; however, a majority of the first-referral health facilities identified by the MoH and WHO Somalia have responded, allowing us to provide a glimpse into the state of basic surgical capacity in the country. Third, some of the data was taken after the WHO IMEESC toolkit was implemented in the country, and results should be qualified by the possibility of interpretation constraints of the survey.

DISCUSSION

Surgically treatable diseases are among the top 15 causes of disability,[16] and conservative estimates show that 11% of the world's Disability-Adjusted life years (DALYs) stem from surgically treated conditions.[1] In 2004, South East Asia and Africa accounted for 54% of the global burden,[17] and since then the burden of surgical disease is thought to be increasing.[16]

More than 2 billion people globally are without access to surgical care.[18] Of the 243 million surgical procedures performed globally each year, the 34.8% of the world's population living in low-income countries only have access to 8.1 million (only 3.5%) of such procedures.[2] As a result, rates of maternal mortality are high, minor surgical pathologies become lethal, and treatable trauma progresses to death.

Despite the great, unmet need and inclusion in policy-level dialogue on primary health care, the delivery of emergency surgical care has long been sidelined in global financing and policy debates, largely due to perceived complexity and cost. Further, despite the large and growing need for expanding access to surgical care, human resources, metrics and science focused on global surgery, and sustained financing mechanisms for surgical infrastructure lag behind other public health priorities (Smith-Rohrberg Maru, D, McGee, HM, Brady, JS et al. Global Surgical Care in 2030: Metrics and Strategies for Expansion in Access and Quality. 2013. www.worldwewant2015.org/file/298623/download/323967)

Enormous shortfalls in infrastructure, supplies, and procedures undertaken are common at district-level health facilities in LMICs.[19] Every $1 spent strengthening local surgical capacity generates $10 through improved health and increased productivity.[20] In 2008, the Copenhagen Consensus Center's research identified strengthening surgical capacity, particularly at the district hospital level, as a highly cost-efficient solution to global diseases. Notably, strengthening local surgical capacity is an approach that would both provide a high degree of financial protection to populations and address the most DALYs in a cost effective manner.[1] In fact, the benefit-cost-ratio for the expansion of surgical

capacity at district hospitals was found to be 10:1.[21] Further, due to the implementation of "vertical" programmes in public health (i.e. child health, maternal health, cancer, and trauma), in which most programmes contain some surgical component, strengthening surgical services may improve health system overall.[22]

This study provides an overview of the capacity for surgical care representing health facilities from in all 3 administrative zones, including 10 regions of 18 in Somalia, and demonstrates the significant gaps in infrastructure, life-saving and disability-preventive surgical interventions and essential equipment. Of the 14 reporting health facilities, 12 identified as full hospitals, serving an average patient population of over 300,000 people, further indicating the need for surgical care system strengthening.

Of the 35 basic surgical and anaesthesia interventions, most hospitals were unable to provide all of the basic surgical services. Major essential procedures such as Caesarean section, appendectomy, elective hernia repair, laparotomy, and hydrocele were offered at a majority of hospitals, but these conflicted directly with the continuous availability of basic and necessary supplies and infrastructures. Only 3 facilities had any consistent access to oxygen cylinders, and even less reported access to tubing, valves, and masks.

Necessary procedures including resuscitation and airway management were offered at a majority (79%) of facilities. Those reporting the inability to provide resuscitation procedures, however, all reported the provision of major surgical procedures that would require provision and knowledge of those same procedures. The facilities in questions could not be contacted for confirmation.

Still, many facilities lacked access to key equipment and supplies such as provisional oxygen equipment, oropharyngeal airways, and IV cannulas. Only 2 facilities reported access to a functional anaesthesia machines, and few facilities noted the ability to provide general anaesthesia inhalation. Both oxygen and anaesthesia are essential medicines, (WHO Model List of Essential Medicines. World Health Organizations. 2013. http://www.who.int/medicines/publications/essentialmedicines/18th_EML_Final_web_8Jul13.pdf) and the existing deficit limits the availability safe and effective life-saving surgeries in Somalia or can result in significant complication or unnecessary patient suffering when these medicines are not provided.[23]

A surprising low amount of facilities reported having access to equipment necessary for the prevention of HIV transmission and other infection control. Less than half of the facilities reported access to sterile gloves, waste disposal containers, face masks, eye masks, aprons, and even soap and only slight more than half of the facilities had access to a sterilizer, all key components in the reduction of HIV transmission (WHO Prevention of Transmission of HIV. 2007. http://www.who.int/surgery/publications/HIVprevention.pdf)

A majority of the facilities lacked any formal guidelines for the management of emergency care, surgery, pain relief, or anaesthesia, providing a significant barrier to the strengthening of emergency and surgical care services and severely limiting their ability to respond to large scale disaster and crisis situations.

The severe gaps in infrastructure and capital entail obstacles for the delivery of basic primary care in these facilities as well. Absence of key infrastructural elements such as water, electricity, and oxygen, as well as the lack of consistent renewable sterilization tools and supplies involved in infection prevention (bandages, alcohol, gloves, aprons, soap, etc.) is common among the facilities depicted. Establishing management guidelines for surgical infrastructure and targeted development in improving access to these lacking areas would not only increase the quality of surgical services but also that of basic primary care services offered by these facilities.

Strengthening of surgical systems will not only reduce the disease burden of surgically related issues but can also increase progress toward achieving the 2015 Millennium Development Goals (MDGs). Strengthening surgical care delivery can help achieve MDGs 1 (eradication of poverty),[18] 4 (child health), 5 (maternal health), and 6 (HIV/AIDS prevention).[21] Investments in oxygen and related equipment and basic infrastructural needs, such as electricity and running water, will also serve to benefit patients suffering from a range of conditions.

To meet the needs of LMICs, the WHO Emergency and Essential Surgical Care (EESC) program with its partners worldwide developed the *Integrated Management for Emergency and Essential Surgical Care* (IMEESC) toolkit (WHO IMEESC Toolkit: http://www.who.int/surgery/en). It guides policies, research for evidence-based planning (WHO EESC Situation Analysis Tool to assess emergency, trauma, obstetrics, anesthesia and surgical services, WHO EESC Global Database), trainings, best practice protocols at point-of- care, monitoring and evaluation of the progress of surgical care systems. The IMEESC toolkit provides guidance for policymakers, managers, and providers at various levels of care, instructional videos, training modules on Emergency & Trauma Care for frontline health workers, disaster- management resources, and monitoring and evaluation.

This study provides insight into the surgical capacity of Somalia, using the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care. Addressing the gaps identified by this study and the strengthening of surgical services are needed to strengthen health systems holistically in Somalia.[24] Further research is needed to determine the burden of surgical disease in Somalia and to determine the cost-benefit of specific interventions to improve surgical services.

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REFERENCES

1. Debas HT, Gosselin R, McCord C, et al. Surgery. In: Jamison D, ed. Disease Control Priorities in Developing Countries. 2nd edn. New York: Oxford University Press, 2006:1245-59.
2. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet 2008;**372**:139-44.
3. World Health Organisation. Regional Office for the Eastern Mediterranean, Cairo. Country Cooperation Strategy for WHO and Somalia 2010-2014. 2010.
4. UNICEF. The private sector and health: a survey of Somaliland private pharmacies. 2008.
5. UNDP. Population projections. 2007.
6. UNDP. Millennium Development Goals Report for Somalia. 2007
7. Penoyar T, Cohen H, Kibatala P, et al. Emergency and surgery services of primary hospitals in United Republic of Tanzania. BMJ Open 2012; **2**(1): e000369
8. Natuzzi ES, Kushner A, Jagilly R, et al. Surgical Care in the Solomon Islands: a road map for universal surgical care delivery. World J Surg 2011; **35**(6):1183-93.
9. Idriss A, Shivute N, Bickler S, et al. Emergency, anaesthetic and essential surgical capacity in the Gambia. Bull World Health Organ. Epub 2011 May.
10. Sherman L, Clement P, Cherian M, et al. Implementing Liberia's Poverty Reduction Strategy: An Assessment of Emergency and Essential Surgical Care. Arch Surg 2011;**146**: 35 - 39.
11. Choo S, Perry H, Hesse AA, et al. Assessment of capacity for surgery, obstretrics and anaesthesia in 17 hospitals in Ghana using a WHO assessment tool. Trop Med Int Health 2010 September.
12. Contini S, Taqdeer A, Cherian M, et al. Emergency and Essential Surgical Services in Afghanistan: Still a Missing Challenge. World J Surg 2010 January.
13. Taira BR, Cherian MN, Yakandawala H, et al. Survey of Emergency and Surgical Capacity in the Conflict-Affected Regions of Sri Lanka. World J Surg 2009 October.

14. Kingham TP, Kamara TB, Cherian MN, et al. Quantifying Surgical Capacity in Sierra Leone: A Guide for Improving Surgical Care. Arch Surg 2009;**144**(2):122□127.

15. Cherian MN, Noel L, Buyanjargal Y, et al. Essential emergency and surgical procedures in resource-limited facilities: a WHO workshop in Mongolia. World Hosp Health Serv 2004;**40**(4):24□29.

16. Farmer P, Kim J. "Surgery and global health: a view from beyond the OR." World J Surg 2008; **32**(4):533-536.

17. Johnson, WD. Surgery as a Global Health Issue. Surg Neurol Int. First: 03 April 2013. doi:10.4103/2152-7806.110030

18. Funk, LM, Weiser, TG, Berry, WR, et al. "Global Operating Theatre Distribution and Pulse Oximetry Supply: an Estimation from Reported Data." Lancet. 2010;**376**(9746): 1055-1061.

19. Kushner Al, Cherian MN, Shokohmand, AS, et al. Addressing the Millennium Development Goals from a surgical perspective: essential surgery and anesthesia in 8 low- and middle-income countries. Arch Surg 2010;**145**(2): 154-159.

20. United Nations. A New Global Partnership: Eradicate Poverty And Transform Economies Through Sustainable Development: The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. United Nations Publication 2013.

21. Jamison, D, Jha, P, Bloom, D. Diseases – disease control. In: Lomborg, B. Global Crises, Global Solutions: 2nd ed. New York: Cambridge University Press. 2009:129-163.

22. Ozgediz, D. Jamison, D, McQueen, K. The burden of surgical conditions and access to surgical care in low- and middle-income countries. Bull World Health Organ 2008;**86**(8):646-647

23. Cherian, MN, Merry, AF, Wilson, IH. The World Health Organization and Anaesthesia. Anaesthesia, 2007;**62**:65-66

24. Hedges JP, Mock CN, Cherian MN. The Political Economy of emergency and essential surgery in global health. World J Surg 2010;**34**:2003–2006. [PubMed: 20454792]

A Survey of Essential Surgical Capacity in Somalia

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Keywords: Surgery, Somalia, Emergency, Anaesthesia, Trauma

Word count: 2,679

ABSTRACT

Objective: The objective of this study was ~~T~~to assess life-saving and disability-preventing surgical ~~including emergency, trauma, obstetrics, anaesthesia~~ services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.
Design: Cross-sectional survey
Setting: Health facilities in all 3 administrative zones of Somalia: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland: and south/central Somalia (SCS).
Participants: 14 health facilities
Measures: The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to deliver surgical ~~(including obstetrics and trauma)~~ and anaesthesia services by investigating four categories of data: infrastructure; human resources; interventions available; and equipment.
Results: The 14 facilities surveyed in Somalia represent~~ed~~ 10 of 18 districts throughout the country. The facilities serve~~d~~ an average patient population of 331,250 people, and 12 of 14 identifi~~yed~~ as hospitals. While major surgical procedures were provided at many facilities (Caesarean Section, Laparotomy, Appendectomy, etc.), only 22% had fully available oxygen access, 50% fully available electricity, and less than 30% had any management guidelines for emergency and surgical care. Further, only 36% were able to provide general anaesthesia inhalation due to lack of skills, supplies, and equipment. Basic supplies for airway management and the prevention of infection ~~and HIV~~ transmission were severely lacking in most facilities.
Conclusions: According to the results of the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care survey, there exist significant gaps in the capacity of emergency and essential surgical services in Somalia including inadequacies in essential equipment, services, and infrastructure. The information provided by this tool can serve as a basis for evidenced-based decisions on country-level policy regarding the allocation of resources and provision of emergency and essential surgical services.

ARTICLE SUMMARY

Article Focus

- On-site visits to primary health centres in a developing nation
- Evaluate capacity to deliver emergency and essential surgical care

Strengths and limitations of this study

- Provides insight into the surgical capacity of Somalia
- Identifies significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies
- Does not capture data from every first-referral health facilities of the country
- Measures are subjective and in some cases estimates

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INTRODUCTION

Conditions that can be treated with surgery account for an estimated 11% of the world's disability-adjusted life years.[1] Despite recent data estimating the global volume of surgery at 234 million surgical procedures annually and significant disparities between procedures performed in high- and low- income countries, global public health initiatives have traditionally neglected the necessity for the provision of surgical services.[2] Poor access to surgical services, particularly at rural facilities, results in excess morbidity and mortality from a broad range of treatable surgical conditions including injuries, complications of pregnancy, sequelae of infectious diseases, acute abdominal conditions and congenital anomalies. Improving the access to surgical services in low-income countries requires addressing gaps in infrastructure, trained/skilled personnel, appropriate equipment and medications.

BACKGROUND

Somalia's 21 years of war, armed conflict and insecurity have had a devastating effect on the health sector. The current situation is at its worst level since the beginning of the civil war in 1991, with unprecedented levels of child malnutrition, internal displacement, as well as conflict and insecurity rife in some parts of the country.[3] Continuing conflict has left 90% of health infrastructure looted, damaged or destroyed.[4] The low health workforce ratios before the war have depreciated through high levels of healthcare worker emigration, leaving an estimated 3 physicians per 100000 population (total 253 physicians), 11 nurses per 100 000 population (861 nurses) and 2 midwives per 100 000 population (116 midwives) serving the whole country.[5]

Rates of death and disability from treatable surgical conditions continue to be unacceptably high. Somalia's maternal mortality rate is estimated to be 1044 per 100 000 live births, one of the highest in the region.[6] This corresponds to a lifetime risk of one maternal death for every 10 women. The leading causes of maternal death (antepartum and postpartum haemorrhage, obstructed labour and ecla
mpsia) can all be addressed with appropriate emergency obstetric care, which often require surgical and/or anaesthesia interventions. Trauma-related mortality, through road traffic accidents, armed fighting and landmine explosions is also common. In 2010 and 2011, WHO reported more than 7500 war-wounded civilians who were admitted to three main hospitals in Mogadishu, one in five being children and one in three women (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/)

The health sector faces overwhelming challenges in a country where two decades of lawlessness have resulted in the collapse of central government and 3 almost autonomously-ruled zones: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS). Somalia's public

health system is tiered, comprising regional referral hospitals, district hospitals, maternal and child health centres and health posts. However, hospitals and health facilities are limited in number, inadequately distributed, operate using vastly different standards, and often cannot provide a minimum package of primary health care (PHC) services. As funders and public health experts adopt the expansion of primary healthcare services, the inclusion of surgical services at the first-referral level is critical. The purpose of this survey was to collect knowledge gained from comprehensive quantitative assessments of surgical capacity in Somalia in order to assist in planning strategies for universal access to life-saving and disability-preventing surgical services (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/).

Similar studies using the WHO Situational Analysis tool have been conducted in Tanzania,[7] Solomon Islands,[8] Gambia,[9] Liberia,[10] Ghana,[11] Afghanistan,[12] Sri Lanka,[13] Sierra Leone,[14] and Mongolia.[15]

OBJECTIVE

To assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.

To assess the current capacity for essential anesthesia and surgical services in Somalia with the purpose of providing a benchmark for critical areas needing improvement.

METHODS

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to perform basic surgical (including obstetrics and trauma) and anaesthesia interventions by investigating four categories of data: infrastructure, human resources, interventions provided and equipment availability. The tool queries the availability of 8 types of care providers, 35 surgical interventions and 67 items of equipment.[7]

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was distributed by the Ministry of Health and WHO Somalia to 20 first-referral-level-health facilities around the country and was completed at 14 health facilities representing 10 of the 18 regions of Somalia and all 3 administrative zones. The survey was extended to regional medical officers and facility administrators. Participation in the survey and reporting to the WHO was voluntary The physical surveys were then ~~data were~~ obtained during either by post directly to the WHO Somalia office (Nairobi, Kenya) or by site visits from the Somalia Ministry of Health (MoH), the WHO country office and members of the Global Initiative for Emergency and Essential Surgical Care (GIEESC) between September 2011 and April 2012, many of whom were in attendance of the WHO Meeting on Strengthening Surgical and Obstetrics Care in Somalia in April 2012 (http://www.who.int/surgery/globalinitiative/gieesc_country_reports/en/index.html). At this meeting reporting protocol and initial survey data were discussed.~~Participation in the survey and reporting to the WHO was voluntary~~.

The answer of available was defined as "fully available for all patients all of the time," while sometimes was defined as "available with frequent shortages or difficulties".(WHO EESC Situational Analysis Tool. 2012. http://www.who.int/surgery/publications/WHO_EESC_SituationAnalysisTool.pdf)

Despite efforts to standardize the reporting and the collection of much of the data by site-visits performed by agents affiliated to the authors, it must be noted that an inherent reporting bias may be present in the data, given that survey data was compiled by different agents at each site. Further, in a limited number of cases, facilities did not respond to individual questions. Blank answers were considered as neither a positive or negative answer, but simply deemed as unreported.

Data ~~on various indices~~ were entered into and analyzed from WHO Global DataCol Database for Emergency and Essential Surgical Care.

Facilities were asked the size of the 'population served', intending to quantify the population living in the catchment area. This value represents the number of residents who might use the facility as their first-referral health facility, not the number of patients seen.

RESULTS

i Health facility characteristics
ii Infrastructure
iii Human resources
iv Interventions
v Equipment

Data were gathered from 14 ~~of 20~~ health facilities in 10 regions (out of 18) across Somalia, as featured figure 1 and table 1.

Type of Facility (Self-identified)	Name of Facility	Region	Number of Beds	Operating Theaters
General Hospital	Garowe Hospital	Nugaal	51-80	11-20
	Gardo General Hospital	Bari	21-50	1
	Hergeisa Group Hospital	Woqooyi Galbeed	301-400	5-10
	Borama General Hospital	Awdal	201-300	1
	Burao Regional	Togdeer	201-300	1

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Provincial Hospital	Hospital			
	Berber~~r~~a Referral Hospital	Woqooyi Galbeed	101-200	2
	Erigavo Regional Hospital	Sanaag	81-100	1
	Sool Regional Hospital	Sool	81-100	1
Health Center	Doolow Health Center	Gedo	5-10	1
Private/NGO/Mission Hospital	Galkayo Medical Center	Mudug	51-80	3-4
	Galkayo Specialist Hospital	Mudug	3-4	1
	Medina Hospital	Banadir	201-300	5-10
	Maani Hospital	Banadir	21-50	1
	Manhal Specialty Hospital	Woqooyi Galbeed	51-80	5-10

Table 1. ~~Participating~~ Responding health facilities. N=14

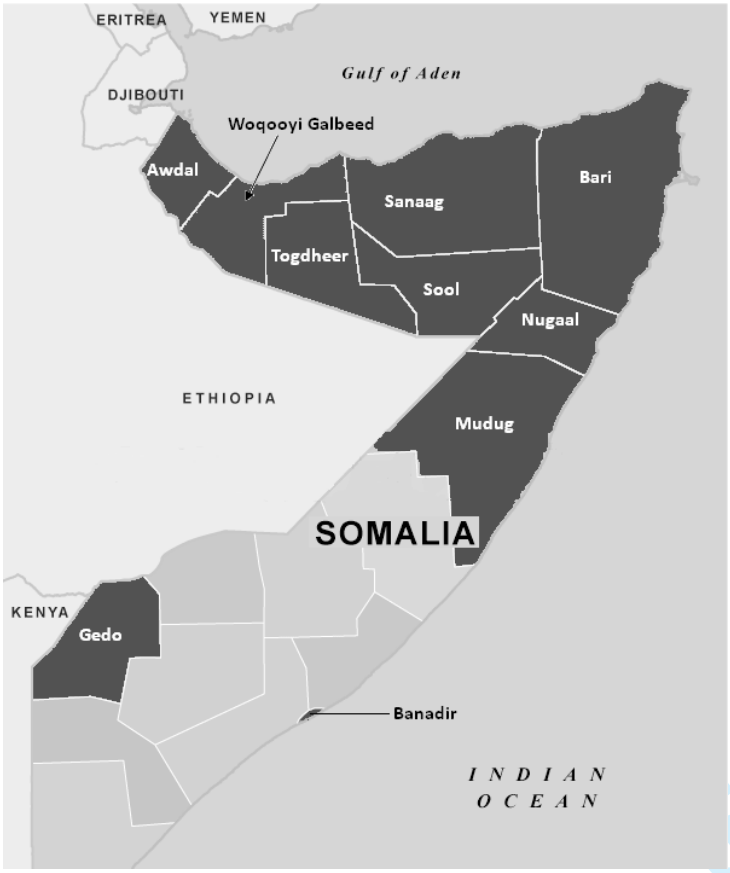

Figure 1. Participating regions of Somalia.

i. Health facility characteristics

Of the 14 facilities that responded to the survey 5 were provincial hospitals, 5 were private/mission/NGO hospitals, 3 were general hospitals and 1 was a health center. Each facility reported having at least 1 operating theatre, with a maximum of between 11 and 20 operating theatres. The populations served by each facility ranged from 100,000 to 1,000,000 people, with the average of the reporting facilities being 331,250 people.

ii. Infrastructure

The emergency and surgical infrastructure of the 14 reporting facilities were largely inadequate, with only 22% of health facilities having oxygen cylinder supplies consistently available. 28% of facilities never or only sometimes had access to running water available and only 50% had a consistently available electricity source. Only 50% of

the facilities had fully available access to both running water and electricity. Access to a functional anaesthesia machine was only present in 2 (15%) ~~of the 14~~ facilities, one of those facilities being a local health center. Only 3 facilities ~~had~~ reported access to a functioning pulse--oximeter.

50% of facilities had areas designated always for emergency care and only 38% of facilities had the same for postoperative care.

A minority of facilities had formal management guidelines for emergency care (3/14 = 21%), surgery (5/14 = 36%), anaesthesia (4/14 = 29%), or pain relief (1/14 = 7%).

Table 2 depicts the key infrastructural elements available in the health facilities accessed.

	Always	Sometimes	Not Available
Oxygen cylinder	3~~22~~	1~~7~~	~~71~~10
Running water	10~~72~~	2~~14~~	~~14~~2
Electricity source	~~50~~7	~~36~~5	~~14~~2
Operational power generator	~~50~~2	~~36~~2	~~14~~9
Blood bank	5	3	6
Hemoglobin & urine testing	12	2	0
X-ray machine	8	4	2
Medical records	10	3	1
Pulse Oximeter~~Functioning anaesthesia machine~~	3~~15~~	0~~15~~	8~~70~~
~~Medical records~~	~~71~~	~~21~~	~~7~~
Area designated for emergency care	~~50~~5	~~14~~1	~~36~~7
Area designated for postoperative care	~~38~~5	~~8~~1	~~54~~7
Management Guidelines for Emergency Care	~~21~~3	~~7~~1	~~72~~10
Management Guidelines for Surgery	~~36~~5	0	~~64~~9
~~Management Guidelines for Anaesthesia~~	~~29~~	~~7~~	~~64~~
~~Management Guidelines for Pain relief~~	~~7~~	~~21~~	~~72~~
~~Blood bank~~	~~36~~	~~21~~	~~43~~
Management Guidelines for Anaesthesia	4	1	9
~~Haemoglobin & urine testing~~	~~86~~	~~14~~	~~0~~
Management Guidelines for Pain relief	1	3	10
~~X-ray machine~~	~~57~~	~~29~~	~~14~~

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Functioning anaesthesia machine	7	5	2

Table 2. Availability of infrastructure and health resources in Somalia, 2012
Number% of facilities where element is always, sometimes, or never available. Bolded items designate those which are specific to quality surgical care delivery. N=14

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iii. Human Resources

More data is needed to comment on the Health Human Resources in Somalia. In this section, blank answers to staffing questions impeded our ability to comment on the state of the work force completely. We did however summarize the results to survey questions of which all or a majority of facilities supplied data.

~~More data is needed to comment on the Health Human Resources in Somalia.~~ The 14 facilities together reported a total of 137 healthcare providers. Only 15 (10.9%) individuals were identified as full time trained surgical specialists, located only at 9 out of 14 of the facilities. 14 (10.9%) were identified as obstetricians, and only 4 (2.9%) individuals were identified as qualified anesthesiologists and were located in only 3 of the 14 facilities, with 27 (19.7%) unlicensed medical staff (Nurses, medical assistants, etc.) providing anesthetic services.

iv. Interventions

Of the 35 ~~basic~~ interventions ~~listed in the tool~~, only abscess incision and drainage is offered at all 14 facilities. ~~Additionally, a~~Acute burn management, wound debridement, hydrocele treatment, and male circumcision are widely provided by the surveyed facilities being offered at 86%, 85%, 86%, 86%, of all facilities respectively. Caesarean section is offered at 93% of all facilities (n=14).

Provision of anaesthesia services was severely lacking, however, with only 36% of facilities able to perform general anaesthesia inhalational procedures. Of the 8 facilities that reported back why they could not provide this service, 1(Doolow Health Center) attributed it to lack of skill and~~,~~ 4(Borama General Hospital, Doolow Health Center, Erigavo Regional Hospital, Burao Regional Hospital) to lack of supplies/drugs, ~~, and 2 to a lack of equipment.~~ 1 (Gardo General Hospital) facility attributed it both to lack of skill and lack of equipment.

The ability of each health facility to provide basic surgical and anaesthesia procedures was assessed (tables 3 and 4).

General surgery & trauma	Available
Resuscitation (airway, haemorrhage, peripheral percutaneous intravenous access, peripheral venous cut down)	1179
Cricothyroidotomy/ Tracheostomy	1071
Chest tube insertion	964
Removal of foreign body (throat/ear/eye/nose)	1179

Acute burn management	12~~86~~
Incision & drainage of abscess	14~~100~~
Suturing (for wounds, episiotomy, cervical & vaginal lacerations)	13~~100~~
Wound debridement	11~~85~~
Caesarean section	13~~93~~
Dilatation & curettage (gynaecology/obstetrics)	12~~92~~
Obstetric fistula repair	7~~50~~
Appendectomy	~~79~~11
Hernia repair (strangulated, elective)	~~71~~10
Hydrocele	~~86~~12
Cystostomy	~~64~~9
Urethral stricture dilatation	~~79~~11
Laparotomy (uterine rupture, ectopic pregnancy,, acute abdomen, intestinal obstruction, perforation, injuries)	12~~86~~
Male circumcision	~~86~~12
Congenital hernia repair	~~69~~9
Neonatal surgery (abdominal wall defect, colostomy imperforate anus, intussusceptions)	~~39~~5
Cleft lip repair	~~71~~10
Clubfoot repair	~~64~~9
Contracture release/ skin grafting	~~71~~10
Fracture treatment	Closed: ~~71~~10 / Open: ~~57~~8
Joint dislocation treatment	~~64~~9
Drainage of osteomyelitis/septic arthritis	~~64~~9
Amputation	~~79~~11
Biopsy (lymph node, mass, other)	~~57~~8
Tubal ligation/vasectomy	~~64~~9
Cataract surgery	~~29~~4
~~**Anaesthesia**~~	
~~Regional anaesthesia blocks~~	~~43~~
~~Spinal anaesthesia~~	~~93~~
~~Ketamine intravenous anaesthesia~~	~~93~~
~~General anaesthesia inhalational~~	~~36~~

Table 3. Availability of surgical (including obstetrics and trauma) ~~and anaesthesia~~ interventions. ~~%~~ Number of facilities at which ~~offer~~ the procedure is available. N=14

Anaesthesia	
Regional anaesthesia blocks	6
Spinal anaesthesia	13
Ketamine intravenous anaesthesia	13
General anaesthesia inhalational	5

Table 4. Availability of anaesthesia interventions Number of facilities at which the procedure is available. N=14

v. Emergency equipment and supplies for resuscitation

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Basic equipment access was also lacking. No facility had access to all pieces of basic and essential surgical equipment listed on the tool. Only 1 hospital (7%) always had adult resuscitator bag valves and masks ~~always~~ available, and only 2 out 14 facilities (14%) reported the same for pediatric bag valves and masks. 64% of facilities had access to oxygen only sometimes or never, and less than 30% had oropharyngeal airways available always for both adults and children. 39% of institutions were without an examination table.

Basic tools such as suction catheters, IV cannulas, and Foley catheters were only consistently available in less than 30% of all facilities.

57 % of facilities did not have sterile gloves consistently available, and 64% reported the same for examination gloves. Only 64% of the reporting institutions had a sterilizer available all the time. 71% could not make face masks available, and 86% were without consistent availability of eye protection. Availability of soap and wash basins was reported in less than two thirds of the 14 facilities.

The availability of emergency equipment and supplies for resuscitation was assessed in each of the health facilities (depicted in tables 5~~4~~,6, and7).

Capital Outlays	Always	Sometimes	Never
Resuscitator bag valve & mask Adult	~~7~~1	~~50~~7	~~43~~6
Paediatric	2~~1~~4	5~~3~~6	~~57~~0
Oxygen	5~~3~~6	~~28~~4	~~36~~5
Stethoscope	~~75~~9	~~25~~3	0
Batteries for flash light	~~57~~8	~~14~~2	~~29~~4
Suction pump	11~~7~~9	~~21~~3	0
Blood pressure monitoring equipment	~~71~~10	~~21~~3	~~7~~1
Thermometer	~~71~~10	~~21~~3	~~7~~1
Scalpel Handle with blade	~~64~~9	~~29~~4	~~7~~1
Retractor	~~54~~7	~~46~~6	~~00~~
Scissors straight 12cm	~~57~~8	~~36~~5	~~7~~1
Scissors blunt 14cm	~~54~~7	~~46~~6	0
Oropharyngeal airway Adult	~~29~~4	~~42~~6	~~29~~4
Paediatric	~~28~~4	~~36~~5	~~36~~5
Forceps Kocher no teeth	~~38~~5	~~54~~7	~~8~~1
Forceps, artery	~~57~~8	~~43~~6	~~00~~

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Kidney dishes stainless steel	466	466	71
Capped bottle, alcohol based solutions	332	425	253
Gloves (sterile)	436	507	71
Gloves (examination)	365	578	71
Needle holder	649	365	0
Sterilizer	649	365	0
Nail brush, scrubbing surgeon's	547	385	81
Vaginal speculum	649	142	223
Bucket, plastic	334	334	334
Drum for sterile compresses, bandages, dressings	618	314	81
Examination table	618	314	81
Renewable			
Suction catheter sizes 16 FG	15	39	46
Tongue depressor wooden disposable	23	54	23
Nasogastric tubes 10 to 16 FG	14	72	14
Light source (lamp & flash light)	29	64	7
Intravenous fluid infusion set	21	65	14
IV cannulas	29	57	14
Scalp vein infusion set	23	54	23
Syringes 2ml	29	64	7
Syringes 10 ml	29	71	0
Disposable needles	36	57	7
Sharps disposal container	36	57	7
Tourniquet	31	62	7
Sterile gauze dressing	23	52	15
Bandages sterile	23	54	23
Adhesive tape	23	69	8
Needles, cutting & round bodied (for suturing)	29	57	14
Suture synthetic absorbable	31	46	23
Splints for arm, leg	14	57	29
Towel cloth	15	62	23
Absorbent cotton wool	15	77	8
Urinary catheter Foleys disposable #12, 14,18 with bag	23	54	23
Sheeting, plastic for examination table	29	50	21
Waste disposal container	29	57	14
Face masks	29	57	14
Eye protection	14	36	50
Apron, plastic reusable	22	64	14
Soap	36	64	0
Wash basin	31	62	7
Supplementary equipment			
Magills forceps			

~~Adult~~	~~21~~	~~14~~	~~64~~
~~Paediatric~~	~~7~~	~~16~~	~~77~~
~~Endotracheal tubes~~	~~8~~	~~15~~	~~77~~
~~IV infusor bags~~	~~8~~	~~15~~	~~77~~
~~Chest tubes insertion equipment~~	~~8~~	~~23~~	~~69~~
~~Laryngoscope~~ ~~Adult~~	~~23~~	~~23~~	~~54~~
~~Paediatric~~	~~8~~	~~23~~	~~69~~
~~Cricothyroidotomy set~~	~~8~~	~~8~~	~~84~~

Table 54. Availability of ~~Emergency Equipment and Supplies for~~Capital Outlays for Resuscitation~~.~~

~~%~~ Number of facilities where element is always, sometimes, or never available. N=14

Renewable			
Suction catheter sizes 16 FG	2	5	6
Tongue depressor wooden disposable	3	7	3
Nasogastric tubes 10 to 16 FG	2	10	2
Light source (lamp & flash light)	4	9	1
Intravenous fluid infusion set	3	9	2
IV cannulas	4	8	2
Scalp vein infusion set	3	7	3
Syringes 2ml	4	9	1
Syringes 10 ml	4	10	0
Disposable needles	5	8	1
Sharps disposal container	5	8	1
Tourniquet	4	8	1
Sterile gauze dressing	3	8	2
Bandages sterile	3	7	3
Adhesive tape	3	9	1
Needles, cutting & round bodied (for suturing)	4	8	2
Suture synthetic absorbable	4	6	3
Splints for arm, leg	2	8	4
Towel cloth	2	8	3
Absorbent cotton wool	2	10	1
Urinary catheter Foleys disposable #12, 14,18 with bag	3	7	3
Sheeting, plastic for examination table	4	7	3
Waste disposal container	4	8	2
Face masks	4	8	2
Eye protection	2	5	7
Apron, plastic reusable	3	9	2
Soap	5	9	0

Wash basin	4	8	1

Table 6. Availability of Renewable Supplies for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

Supplementary equipment			
Magills forceps Adult	3	2	9
Paediatric	1	2	10
Endotracheal tubes	1	2	10
IV infusor bags	1	2	10
Chest tubes insertion equipment	1	3	9
Laryngoscope Adult	3	3	7
Paediatric	1	3	9
Cricothyroidotomy set	1	1	11

Table 7. Availability of Supplementary Equipment for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

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LIMITATIONS

There are a several limitations to this survey. First, it provides only a brief overview of the capacity for surgical care and cannot be used for detailed programme planning. Second, it does not capture data from every first-referral health facility of the country; however, a majority of the first-referral health facilities identified by the MoH and WHO Somalia have responded, allowing us to provide a glimpse into the state of basic surgical capacity in the country. Third, some of the data was taken after the WHO IMEESC toolkit was implemented in the country, and results should be qualified by the possibility of interpretation constraints of the survey.

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DISCUSSION

Surgically treatable diseases are among the top 15 causes of disability,[167] and conservative estimates show that 11% of the world's Disability-Adjusted life years (DALYs) stem from surgically treated conditions.[1] In 2004, South East Asia and Africa accounted for 54% of the global burden,[178] and since then the burden of surgical disease is thought to be increasing.[167]

More than 2 billion people globally are without access to surgical care.[189] Of the 243 million surgical procedures performed globally each year, the 34.8% of the world's population living in low-income countries only have access to 8.1 million (only 3.5%) of such procedures.[2] As a result, rates of maternal mortality are high, minor surgical pathologies become lethal, and treatable trauma progresses to death.

Despite the great, unmet need and inclusion in policy-level dialogue on primary health care, the delivery of emergency surgical care has long been sidelined in global financing

and policy debates, largely due to perceived complexity and cost. Further, despite the large and growing need for expanding access to surgical care, human resources, metrics and science focused on global surgery, and sustained financing mechanisms for surgical infrastructure lag behind other public health priorities (Smith-Rohrberg Maru, D, McGee, HM, Brady, JS et al. Global Surgical Care in 2030: Metrics and Strategies for Expansion in Access and Quality. 2013. www.worldwewant2015.org/file/298623/download/323967)

Enormous shortfalls in infrastructure, supplies, and procedures undertaken are common at district-level health facilities in LMICs.[19~~10~~] Every $1 spent strengthening local surgical capacity generates $10 through improved health and increased productivity.[20~~11~~] In 2008, the Copenhagen Consensus Center's research identified strengthening surgical capacity, particularly at the district hospital level, as a highly cost-efficient solution to global diseases. Notably, strengthening local surgical capacity is an approach that would both provide a high degree of financial protection to populations and address the most DALYs in a cost effective manner.[1] In fact, the benefit-cost-ratio for the expansion of surgical capacity at district hospitals was found to be 10:1.[21~~12~~] Further, due to the implementation of "vertical" programmes in public health (i.e. child health, maternal health, cancer, and trauma), in which most programmes contain some surgical component, strengthening surgical services may improve health system overall.[22~~13~~]

This study provides an overview of the capacity for surgical care representing health facilities from in all 3 administrative zones, including 10 regions of 18 in Somalia, and demonstrates the significant gaps in infrastructure, life-saving and disability-preventive surgical interventions and essential equipment. Of the 14 reporting health facilities, 12 identified as full hospitals, serving an average patient population of over 300,000 people, further indicating the need for surgical care system strengthening.

Of the 35 basic surgical and anaesthesia interventions, most hospitals were unable to provide all of the basic surgical services. Major essential procedures such as Caesarean section, appendectomy, elective hernia repair, laparotomy, and hydrocele were offered at a majority of hospitals, but these conflicted directly with the continuous availability of basic and necessary supplies and infrastructures. Only 3 facilities had any consistent access to oxygen cylinders, and even less reported access to tubing, valves, and masks.

Necessary procedures including resuscitation and airway management were offered at a majority (79%) of facilities. Those reporting the inability to provide resuscitation procedures, however, all reported the provision of major surgical procedures that would require provision and knowledge of those same procedures. The facilities in questions could not be contacted for confirmation.

Still, many facilities lacked access to key equipment and supplies such as provisional oxygen equipment, oropharyngeal airways, and IV cannulas. Only 2 facilities reported access to a functional anaesthesia machines, and few facilities noted the ability to provide general anaesthesia inhalation. Both oxygen and anaesthesia are essential medicines, (WHO Model List of Essential Medicines. World Health Organizations. 2013. http://www.who.int/medicines/publications/essentialmedicines/18th_EML_Final_web_8J

ul13.pdf) and the existing deficit limits the availability safe and effective life-saving surgeries in Somalia or can result in significant complication or unnecessary patient suffering when these medicines are not provided.[2314]

A surprising low amount of facilities reported having access to equipment necessary for the prevention of HIV transmission and other infection control. Less than half of the facilities reported access to sterile gloves, waste disposal containers, face masks, eye masks, aprons, and even soap and only slight more than half of the facilities had access to a sterilizer, all key components in the reduction of HIV transmission (WHO Prevention of Transmission of HIV. 2007. http://www.who.int/surgery/publications/HIVprevention.pdf)

A majority of the facilities lacked any formal guidelines for the management of emergency care, surgery, pain relief, or anaesthesia, providing a significant barrier to the strengthening of emergency and surgical care services and severely limiting their ability to respond to large scale disaster and crisis situations.

The severe gaps in infrastructure and capital entail obstacles for the delivery of basic primary care in these facilities as well. Absence of key infrastructural elements such as water, electricity, and oxygen, as well as the lack of consistent renewable sterilization tools and supplies involved in infection prevention (bandages, alcohol, gloves, aprons, soap, etc.) is common among the facilities depicted. Establishing management guidelines for surgical infrastructure and targeted development in improving access to these lacking areas would not only increase the quality of surgical services but also that of basic primary care services offered by these facilities.

~~The provision of safe and effective surgical care is dependent on the presence of all components inherent in a functional health system. Systematic investments and changes that address and strengthen the availability of appropriately trained human resources, capital outlays, and necessary infrastructure are necessary to decrease mortality from surgically treatable conditions. Further, s~~Strengthening of surgical systems will not only reduce the disease burden of surgically related issues but can also increase progress toward achieving the 2015 Millennium Development Goals (MDGs). Strengthening surgical care delivery can help achieve MDGs 1 (eradication of poverty),[189] 4 (child health), 5 (maternal health), and 6 (HIV/AIDS prevention).[2112] ~~Systematic changes such and i~~Investments in oxygen and related equipment and ~~appropriately trained surgical workforce~~ basic infrastructural needs, such as electricity and running water, will also serve to benefit patients suffering from a range of conditions ~~including sepsis, pneumonia, HIV-related conditions and other infectious diseases~~.

To meet the needs of LMICs, the WHO Emergency and Essential Surgical Care (EESC) program with its partners worldwide developed the *Integrated Management for Emergency and Essential Surgical Care* (IMEESC) toolkit (WHO IMEESC Toolkit:

http://www.who.int/surgery/en). It guides policies, research for evidence-based planning (WHO EESC Situation Analysis Tool to assess emergency, trauma, obstetrics, anesthesia and surgical services, WHO EESC Global Database), trainings, best practice protocols at point-of- care, monitoring and evaluation of the progress of surgical care systems. The IMEESC toolkit provides guidance for policymakers, managers, and providers at various levels of care, instructional videos, training modules on Emergency & Trauma Care for frontline health workers, disaster- management resources, and monitoring and evaluation.

~~There are a several limitations to this survey. First, it provides only a brief overview of the capacity for surgical care and cannot be used for detailed programme planning. Second, it does not capture data from every first referral health facility of the country; however, a majority of first referral health facilities identified by the MoH and WHO Somalia have responded, allowing us to provide a glimpse into the state of basic surgical capacity in the country. Third, some of the data was taken after the WHO IMEESC toolkit was implemented in the country, and results should be qualified by the possibility of interpretation constraints of the survey.~~

T~~However, t~~his study provides insight into the surgical capacity of Somalia, using the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care. ~~The survey identified significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies.~~ Addressing the~~se~~ gaps identified by this study and the strengthening of surgical services ~~within existing related national programmes~~ are needed to strengthen health systems ~~as a whole~~holistically in Somalia~~, particularly at the district and sub-district level~~.[24~~15~~] Further research is needed to determine the burden of surgical disease in Somalia and to determine the cost-benefit of specific interventions to improve surgical services.

Disclaimer: The authors include staff members of WHO. They are responsible for the views expressed in this publication and do not necessarily represent the decisions or stated policy of WHO.

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REFERENCES

1. Debas HT, Gosselin R, McCord C, et al. Surgery. In: Jamison D, ed. Disease Control Priorities in Developing Countries. 2nd edn. New York: Oxford University Press, 2006:1245-59.
2. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet 2008;**372**:139-44.
3. World Health Organisation. Regional Office for the Eastern Mediterranean, Cairo. Country Cooperation Strategy for WHO and Somalia 2010-2014. 2010.
4. UNICEF. The private sector and health: a survey of Somaliland private pharmacies. 2008.
5. UNDP. Population projections. 2007.
6. UNDP. Millennium Development Goals Report for Somalia. 2007.
7. Penoyar T, Cohen H, Kibatala P, et al. Emergency and surgery services of primary hospitals in United Republic of Tanzania. BMJ Open 2012; **2**(1): e000369.
8. Natuzzi ES, Kushner A, Jagilly R, et al. Surgical Care in the Solomon Islands: a road map for universal surgical care delivery. World J Surg 2011; **35**(6):1183-93.
9. Idriss A, Shivute N, Bickler S, et al. Emergency, anaesthetic and essential surgical capacity in the Gambia. Bull World Health Organ. Epub 2011 May.
10. Sherman L, Clement P, Cherian M, et al. Implementing Liberia's Poverty Reduction Strategy: An Assessment of Emergency and Essential Surgical Care. Arch Surg 2011;**146**: 35 - 39.

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11. Choo S, Perry H, Hesse AA, et al. Assessment of capacity for surgery, obstretrics and anaesthesia in 17 hospitals in Ghana using a WHO assessment tool. Trop Med Int Health 2010 September.

12. Contini S, Taqdeer A, Cherian M, et al. Emergency and Essential Surgical Services in Afghanistan: Still a Missing Challenge. World J Surg 2010 January.

13. Taira BR, Cherian MN, Yakandawala H, et al. Survey of Emergency and Surgical Capacity in the Conflict-Affected Regions of Sri Lanka. World J Surg 2009 October.

14. Kingham TP, Kamara TB, Cherian MN, et al. Quantifying Surgical Capacity in Sierra Leone: A Guide for Improving Surgical Care. Arch Surg 2009;**144**(2):122□127.

15. Cherian MN, Noel L, Buyanjargal Y, et al. Essential emergency and surgical procedures in resource-limited facilities: a WHO workshop in Mongolia. World Hosp Health Serv 2004;**40**(4):24□29.

~~7.~~16. Farmer P, Kim J. "Surgery and global health: a view from beyond the OR." World J Surg 2008; **32**(4):533-536.

~~8.~~17. Johnson, WD. Surgery as a Global Health Issue. Surg Neurol Int. First: 03 April 2013. doi:10.4103/2152-7806.110030

~~9.~~18. Funk, LM, Weiser, TG, Berry, WR, et al. "Global Operating Theatre Distribution and Pulse Oximetry Supply: an Estimation from Reported Data." Lancet. 2010;**376**(9746): 1055-1061.

~~10.~~19. Kushner Al, Cherian MN, Shokohmand, AS, et al. Addressing the Millennium Development Goals from a surgical perspective: essential surgery and anesthesia in 8 low- and middle-income countries. Arch Surg 2010;**145**(2): 154-159.

~~11.~~20. United Nations. A New Global Partnership: Eradicate Poverty And Transform Economies Through Sustainable Development: The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. United Nations Publication 2013.

~~12.~~21. Jamison, D, Jha, P, Bloom, D. Diseases – disease control. In: Lomborg, B. Global Crises, Global Solutions: 2nd ed. New York: Cambridge University Press. 2009:129-163.

~~13.~~22. Ozgediz, D. Jamison, D, McQueen, K. The burden of surgical conditions and access to surgical care in low- and middle-income countries. Bull World Health Organ 2008;**86**(8):646-647

~~14.~~23. Cherian, MN, Merry, AF, Wilson, IH. The World Health Organization and Anaesthesia. Anaesthesia, 2007;**62**:65-66

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~~15.~~24. Hedges JP, Mock CN, Cherian MN. The Political Economy of emergency and essential surgery in global health. World J Surg 2010;**34**:2003–2006. [PubMed: 20454792]

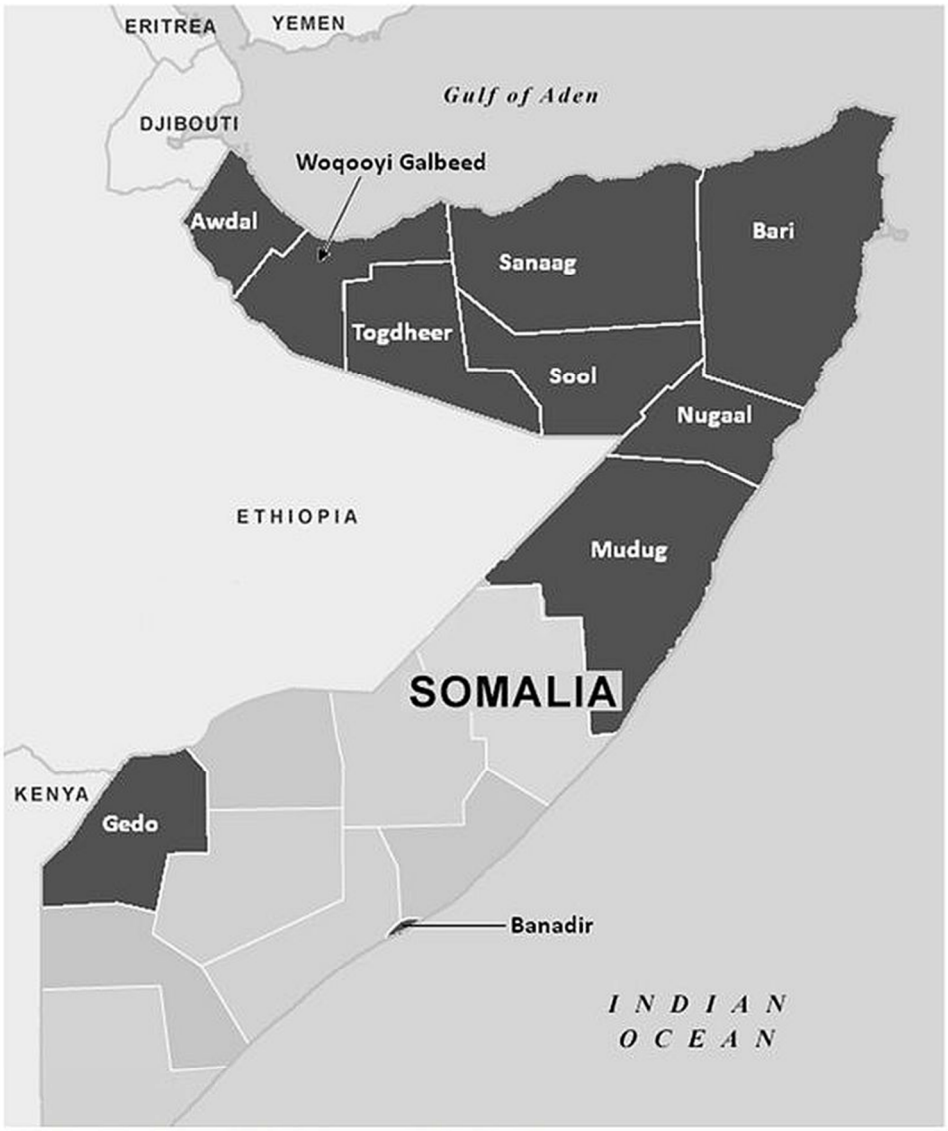

Figure 1. Participating regions of Somalia.

Figure 1: Participating regions of Somalia
75x90mm (300 x 300 DPI)

A Survey of Essential Surgical Capacity in Somalia

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A Survey of Essential Surgical Capacity in Somalia

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ABSTRACT

Objective: To assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.
Design: Cross-sectional survey.
Setting: Health facilities in all 3 administrative zones of Somalia; northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS).
Participants: 14 health facilities
Measures: The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to deliver surgical and anaesthesia services by investigating four categories of data: infrastructure; human resources; interventions available; and equipment.
Results: The 14 facilities surveyed in Somalia represent 10 of 18 districts throughout the country. The facilities serve an average patient population of 331,250 people, and 12 of 14 identify as hospitals. While major surgical procedures were provided at many facilities (caesarean Section, laparotomy, appendicectomy, etc.), only 22% had fully available oxygen access, 50% fully available electricity, and less than 30% had any management guidelines for emergency and surgical care. Furthermore, only 36% were able to provide general anaesthesia inhalation due to lack of skills, supplies, and equipment. Basic supplies for airway management and the prevention of infection transmission were severely lacking in most facilities.
Conclusions: According to the results of the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care survey, there exist significant gaps in the capacity of emergency and essential surgical services in Somalia including inadequacies in essential equipment, service provision, and infrastructure. The information provided by the WHO tool can serve as a basis for evidenced-based decisions on country-level policy regarding the allocation of resources and provision of emergency and essential surgical services.

ARTICLE SUMMARY

Article Focus

- On-site visits to primary health centres in a developing nation
- Evaluate capacity to deliver emergency and essential surgical care

Strengths and limitations of this study

- Provides insight into the surgical capacity of Somalia
- Identifies significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies
- Does not capture data from every first-referral health facility of the country
- In some cases, measures captured are estimates

INTRODUCTION

Conditions that can be treated with surgery account for 11% of the world's disability-adjusted life years.[1] Despite recent data estimating the global volume of surgery at 234 million surgical procedures annually and significant disparities between procedures performed in high- and low- income countries, global public health initiatives have traditionally neglected the necessity for the provision of surgical services.[2] Poor access to surgical services, particularly at rural facilities, results in excess morbidity and mortality from a broad range of treatable surgical conditions including injuries, complications of pregnancy, sequelae of infectious diseases, acute abdominal conditions and congenital abnormalities. Improving the access to surgical services in low-income countries requires addressing gaps in infrastructure, the training and skills of personnel, appropriate equipment and medications.

BACKGROUND

Somalia's 21 years of war, armed conflict and insecurity have had a devastating effect on the health sector. The current situation is at its worst level since the beginning of the civil war in 1991, with unprecedented levels of child malnutrition and internal displacement, as well as conflict and insecurity rife in some parts of the country.[3] Continuing conflict has left 90% of health infrastructure looted, damaged or destroyed.[4] The low health workforce ratios before the war have depreciated through high levels of healthcare worker emigration, leaving an estimated 3 physicians per 100000 population (total 253 physicians), 11 nurses per 100 000 population (861 nurses) and 2 midwives per 100 000 population (116 midwives) serving the whole country.[5]

Rates of death and disability from treatable surgical conditions continue to be unacceptably high. Somalia's maternal mortality rate is estimated to be 1044 per 100 000 live births, one of the highest in the region.[6] This corresponds to a lifetime risk of one maternal death for every 10 women. The leading causes of maternal death (antepartum and postpartum haemorrhage, obstructed labour and eclampsia) can all be addressed with appropriate emergency obstetric care, which often require surgical and anaesthetic interventions. Trauma, as a consequence of road traffic accidents, armed fighting and landmine explosions, is also common. In 2010 and 2011, WHO reported more than 7500 war-wounded civilians who were admitted to three main hospitals in Mogadishu, one in five being children and one in three women (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/)

The health sector faces overwhelming challenges in a country where two decades of lawlessness have resulted in the collapse of central government and 3 almost autonomously-ruled zones: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS). Somalia's public health system is tiered, comprising regional referral hospitals, district hospitals, maternal

and child health centres and health posts. However, hospitals and health facilities are limited in number, inadequately distributed, operate using vastly different standards, and often cannot provide a minimum package of primary health care (PHC) services. As funders and public health experts adopt the expansion of primary healthcare services, the inclusion of surgical services at the first-referral level is critical. The purpose of this survey was to collect knowledge gained from comprehensive quantitative assessments of surgical capacity in Somalia in order to assist in planning strategies for universal access to life-saving and disability-preventing surgical services (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/).

Similar studies using the WHO Situational Analysis tool have been conducted in Tanzania,[7] Solomon Islands,[8] Gambia,[9] Liberia,[10] Ghana,[11] Afghanistan,[12] Sri Lanka,[13] Sierra Leone,[14] and Mongolia.[15]

OBJECTIVE

The objective of this study was to assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.

To assess the current capacity for essential anesthesia and surgical services in Somalia with the purpose of providing a benchmark for critical areas needing improvement.

METHODS

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to perform basic surgical (including obstetrics and trauma) and anaesthesia interventions by investigating four categories of data: infrastructure, human resources, interventions provided and equipment availability. The tool queries the availability of 8 types of care providers, 35 surgical interventions and 67 items of equipment.[7] The answer of available was defined as "fully available for all patients all of the time," while sometimes was defined as "available with frequent shortages or difficulties".(WHO EESC Situational Analysis Tool. 2012. http://www.who.int/surgery/publications/WHO_EESC_SituationAnalysisTool.pdf).

Facilities were also asked the size of the 'population served', intending to quantify the population living in the catchment area. This value represents the number of residents who might use the facility as their first-referral health facility, not the number of patients seen.

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was distributed by the Ministry of Health and WHO Somalia to 20 first-referral-level-health facilities around the country and was completed at 14 health facilities representing 10 of the 18 regions of Somalia and all 3 administrative zones. The survey was extended to regional medical officers and facility administrators. Participation in the survey and reporting to the WHO was voluntary. The physical surveys were then obtained either by post directly to the WHO Somalia office (Nairobi, Kenya) or by site

visits from the Somalia Ministry of Health (MoH), the WHO country office and members of the Global Initiative for Emergency and Essential Surgical Care (GIEESC) between September 2011 and April 2012...

Despite efforts to standardize the reporting and the collection of much of the data by site-visits performed by agents affiliated to the authors, it must be noted that an inherent reporting bias may be present in the data, given that survey data was compiled by different agents at each site. Furthermore, in a limited number of cases, facilities did not respond to individual questions. Blank answers were considered as neither a positive or negative answer, but simply deemed as unreported.

The collected data were then entered into and analyzed from WHO Global DataCol Database for Emergency and Essential Surgical Care.

RESULTS

i Health facility characteristics
ii Infrastructure
iii Human resources
iv Interventions
v Equipment

Data were gathered from 14 health facilities in 10 regions (out of 18) across Somalia, as featured figure 1 and table 1. The 6 facilities that received the survey but did not return information are also listed below. Non-reporting can be attributed to a lack of consistent operation, inability to gather the data, and the pervasive political instability and high security risk throughout the country, making the transmission of this data difficult and costly.

Type of Facility (Self-identified)	**Name of Facility**	**Region**	**Number of Beds**	**Operating Theaters**
General Hospital	Garowe Hospital	Nugaal	51-80	11-20
	Gardo General Hospital	Bari	21-50	1
	Hergeisa Group Hospital	Woqooyi Galbeed	301-400	5-10
Provincial Hospital	Borama General Hospital	Awdal	201-300	1
	Burao Regional Hospital	Togdeer	201-300	1
	Berbera Referral Hospital	Woqooyi Galbeed	101-200	2
	Erigavo Regional Hospital	Sanaag	81-100	1
	Sool Regional Hospital	Sool	81-100	1
Health Centre	Doolow Health Centre	Gedo	5-10	1
	Galkayo Medical Centre	Mudug	51-80	3-4

Private/NGO/Mission Hospital	Galkayo Specialist Hospital	Mudug	3-4	1
	Medina Hospital	Banadir	201-300	5-10
	Maani Hospital	Banadir	21-50	1
	Manhal Specialty Hospital	Woqooyi Galbeed	51-80	5-10
Facilities Not Responding to Survey	Shikh Hospital	Woqooyi Galbeed	N/A	N/A
	Puntland Regional Hospital	Bossaso	N/A	N/A
	General Medical Service Hospital	Mudug	N/A	N/A
	Wajed Hospital	Bakool	N/A	N/A
	Dinsor Hospital	Bakool	N/A	N/A
	Sama Hospital	Bay	N/A	N/A

Table 1. Surveyed health facilities. N=14

i. Health facility characteristics

Of the 14 facilities that responded to the survey 5 were provincial hospitals, 5 were private/mission/NGO hospitals, 3 were general hospitals and 1 was a health centre. Each facility reported having at least 1 operating theatre, with a maximum of between 11 and 20 operating theatres. The populations served by each facility ranged from 100000 to 1000000 people, with the average population of the reporting facilities at 331,250 people.

ii. Infrastructure

The emergency and surgical infrastructure of the 14 reporting facilities were largely inadequate, with only 22% of health facilities having oxygen cylinder supplies consistently available. 28% of facilities never or only sometimes had access to running water available and only 50% had a consistently available electricity source. Only 50% of the facilities had fully available access to both running water and electricity. Access to a functional anaesthesia machine was only present in 2 (15%) facilities, one of those facilities being a local health centre. Only 3 facilities reported access to a functioning pulse-oximeter.

50% of facilities had permanent areas designated for emergency care and only 38% of facilities had the same for postoperative care.

A minority of facilities had formal management guidelines for emergency care (3/14 = 21%), surgery (5/14 = 36%), anaesthesia (4/14 = 29%), or pain relief (1/14 = 7%).

Table 2 depicts the key infrastructural elements available in the health facilities accessed.

	Always	Sometimes	Not Available
Oxygen cylinder	3	1	10
Running water	10	2	2
Electricity source	7	5	2
Operational power generator	2	2	9
Blood bank	5	3	6
Hemoglobin & urine testing	12	2	0
X-ray machine	8	4	2
Medical records	10	3	1
Pulse Oximeter	3	0	8
Area designated for emergency care	5	1	7
Area designated for postoperative care	5	1	7
Management Guidelines for Emergency Care	3	1	10
Management Guidelines for Surgery	5	0	9
Management Guidelines for Anaesthesia	4	1	9
Management Guidelines for Pain relief	1	3	10
Functioning anaesthesia machine	7	5	2

Table 2. Availability of infrastructure and health resources in Somalia, 2012
Number of facilities where element is always, sometimes, or never available. Bolded items designate those that are specific to quality surgical care delivery. N=14

iii. Human Resources

More data is needed to comment on human resources within healthcare in Somalia. In this section, blank answers to staffing questions impeded our ability to comment on the state of the workforce completely. We did however summarise the results to survey questions of which all or a majority of facilities supplied data.

The 14 facilities together reported a total of 137 healthcare providers. Only 15 (11%) individuals were identified as full time trained surgical specialists, located only at 9 out of 14 of the facilities. 14 (11%) were identified as obstetricians, and only 4 (3%) individuals were identified as qualified anesthetists and were located in only 3 of the 14 facilities, with 27 (20%) unlicensed medical staff (nurses, medical assistants, etc.) providing anesthetic services.

iv. Interventions

Of the 35 interventions queried, only abscess incision and drainage are offered at all 14 facilities. Acute burn management, wound debridement, hydrocoele treatment, and male circumcision are widely provided by the surveyed facilities being offered at 85-86% of all facilities. Caesarean section is offered at 93% of all facilities.

Provision of anaesthesia services was severely lacking, however, with only 36% of facilities able to perform general anaesthesia inhalational procedures. Of the 8 facilities that answered why they could not provide this service, 1 (Doolow Health Center) attributed it to lack of skill and 4 (Borama General Hospital, Doolow Health Center, Erigavo Regional Hospital, Burao Regional Hospital) to lack of supplies or drugs. 1 facility (Gardo General Hospital) attributed it both to lack of skill and lack of equipment.

The ability of each health facility to provide basic surgical and anaesthesia procedures was assessed (tables 3 and 4).

General surgery & trauma	**Available**
Resuscitation (airway, haemorrhage, peripheral percutaneous intravenous access, peripheral venous cut down)	11
Cricothyroidotomy/ Tracheostomy	10
Chest tube insertion	9
Removal of foreign body (throat/ear/eye/nose)	11
Acute burn management	12
Incision & drainage of abscess	14
Suturing (for wounds, episiotomy, cervical & vaginal lacerations)	13
Wound debridement	11
Caesarean section	13
Dilatation & curettage (gynaecology/obstetrics)	12
Obstetric fistula repair	7
Appendicectomy	11
Hernia repair (strangulated, elective)	10
Hydrocoele	12
Cystostomy	9
Urethral stricture dilatation	11
Laparotomy (uterine rupture, ectopic pregnancy, acute abdomen, intestinal obstruction, perforation, injuries)	12
Male circumcision	12
Congenital hernia repair	9
Neonatal surgery (abdominal wall defect, colostomy imperforate anus, intussusceptions)	5
Cleft lip repair	10
Clubfoot repair	9
Contracture release/ skin grafting	10

Fracture treatment	Closed	Open
	10	8
Joint dislocation treatment	9	
Drainage of osteomyelitis/septic arthritis	9	
Amputation	11	
Biopsy (lymph node, mass, other)	8	
Tubal ligation/vasectomy	9	
Cataract surgery	4	

Table 3. Availability of surgical (including obstetrics and trauma) interventions. Number of facilities at which the procedure is available. N=14

Anaesthesia	
Regional anaesthesia blocks	6
Spinal anaesthesia	13
Ketamine intravenous anaesthesia	13
General anaesthesia inhalational	5

Table 4. Availability of anaesthesia interventions Number of facilities at which the procedure is available. N=14

v. Emergency equipment and supplies for resuscitation

Basic equipment access was also lacking. No facility had access to all basic and essential surgical equipment listed by the tool. Only 1 hospital always had adult resuscitator bag valves and masks available, and only 2 out 14 facilities reported the same for paediatric bag valves and masks. 64% of facilities had access to oxygen only sometimes or never, and less than 30% had oropharyngeal airways always available for both adults and children. 39% of institutions were without an examination table.

Basic equipment such as suction catheters, IV cannulas, and Foley catheters were only consistently available in less than 30% of all facilities.

57 % of facilities did not have sterile gloves consistently available, and 64% reported the same for examination gloves. Only 64% of the reporting institutions had a sterilizer available all the time. 71% did not have face masks available, and 86% were without consistent availability of eye protection. Availability of soap and wash basins was reported in less than two thirds of the 14 facilities.

The availability of emergency equipment and supplies for resuscitation was assessed in each of the health facilities (depicted in tables 5, 6 and7).

Capital Outlays	**Always**	**Sometimes**	**Never**
Resuscitator bag valve & mask			

Adult	1	7	6
Paediatric	2	5	7
Oxygen	5	4	5
Stethoscope	9	3	0
Batteries for flash light	8	2	4
Suction pump	11	3	0
Blood pressure monitoring equipment	10	3	1
Thermometer	10	3	1
Scalpel Handle with blade	9	4	1
Retractor	7	6	0
Scissors straight 12cm	8	5	1
Scissors blunt 14cm	7	6	0
Oropharyngeal airway Adult	4	6	4
Paediatric	4	5	5
Forceps Kocher no teeth	5	7	1
Forceps, artery	8	6	0
Kidney dishes stainless steel	6	6	1
Capped bottle, alcohol based solutions	2	5	3
Gloves (sterile)	6	7	1
Gloves (examination)	5	8	1
Needle holder	9	5	0
Sterilizer	9	5	0
Nail brush, scrubbing surgeon's	7	5	1
Vaginal speculum	9	2	3
Bucket, plastic	4	4	4
Drum for sterile compresses, bandages, dressings	8	4	1
Examination table	8	4	1

Table 5. Availability of Capital Outlays for Resuscitation

Number of facilities where element is always, sometimes, or never available. N=14

Renewable			
Suction catheter sizes 16 FG	2	5	6
Tongue depressor wooden disposable	3	7	3
Nasogastric tubes 10 to 16 FG	2	10	2
Light source (lamp & flash light)	4	9	1
Intravenous fluid infusion set	3	9	2
IV cannulas	4	8	2
Scalp vein infusion set	3	7	3
Syringes 2ml	4	9	1
Syringes 10 ml	4	10	0
Disposable needles	5	8	1
Sharps disposal container	5	8	1

Tourniquet	4	8	1
Sterile gauze dressing	3	8	2
Bandages sterile	3	7	3
Adhesive tape	3	9	1
Needles, cutting & round bodied (for suturing)	4	8	2
Suture synthetic absorbable	4	6	3
Splints for arm, leg	2	8	4
Towel cloth	2	8	3
Absorbent cotton wool	2	10	1
Urinary catheter Foleys disposable #12, 14,18 with bag	3	7	3
Sheeting, plastic for examination table	4	7	3
Waste disposal container	4	8	2
Face masks	4	8	2
Eye protection	2	5	7
Apron, plastic reusable	3	9	2
Soap	5	9	0
Wash basin	4	8	1

Table 6. Availability of Renewable Supplies for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

Supplementary equipment			
Magills forceps Adult	3	2	9
Paediatric	1	2	10
Endotracheal tubes	1	2	10
IV infusor bags	1	2	10
Chest tubes insertion equipment	1	3	9
Laryngoscope Adult	3	3	7
Paediatric	1	3	9
Cricothyroidotomy set	1	1	11

Table 7. Availability of Supplementary Equipment for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

LIMITATIONS

There are a several limitations to this survey. It provides only a brief overview of the capacity for surgical care and cannot be used for detailed programme planning. Although not every first-referral health facility in Somalia was surveyed, the majority identified by the MoH and WHO Somalia did reply and this allows a credible insight into the surgical capacity of the country.

Some of the data was taken after the WHO IMEESC toolkit was implemented in the country, and results should be qualified by the possibility of interpretation constraints of the survey.

DISCUSSION

Surgically treatable diseases are among the top 15 causes of disability,[16] and conservative estimates show that 11% of the world's disability-adjusted life years (DALYs) stem from surgically treatable conditions.[1] In 2004, South East Asia and Africa accounted for 54% of the global burden,[17] and since then the burden of surgical disease is thought to be increasing.[16]

More than 2 billion people globally are without access to surgical care.[18] Of the 243 million surgical procedures performed globally each year, the 34.8% of the world's population living in low-income countries only have access to 8.1 million (only 3.5%) of such procedures.[2] As a result, rates of maternal mortality are high, minor surgical pathologies become lethal, and treatable trauma progresses to death.

Despite the great, unmet need and inclusion in policy-level dialogue on primary health care, the delivery of emergency surgical care has long been sidelined in global financing and policy debates, largely due to perceived complexity and cost. Despite the growing need for access to surgical care, human resources, metrics and science focused on global surgery, and sustained financing mechanisms for surgical infrastructure lag behind other public health priorities (Smith-Rohrberg Maru, D, McGee, HM, Brady, JS et al. Global Surgical Care in 2030: Metrics and Strategies for Expansion in Access and Quality. 2013. www.worldwewant2015.org/file/298623/download/323967)

Enormous shortfalls in infrastructure, supplies, and procedures undertaken are common at district-level health facilities in LMICs.[19] Every $1 spent strengthening local surgical capacity generates $10 through improved health and increased productivity.[20] In 2008, the Copenhagen Consensus Center's research identified strengthening surgical capacity, particularly at the district hospital level, as a highly cost-efficient solution to global diseases. Notably, strengthening local surgical capacity is an approach that would both provide a high degree of financial protection to populations and address the most DALYs in a cost effective manner.[1] In fact, the benefit-cost-ratio for the expansion of surgical capacity at district hospitals was found to be 10:1.[21] Furthermore, due to the implementation of "vertical" programmes in public health (i.e. child health, maternal health, cancer, and trauma), in which most programmes contain some surgical component, strengthening surgical services may improve health system overall.[22]

This study provides an overview of the capacity for surgical care representing health facilities from in all 3 administrative zones of Somalia, including 10 out of 18 regions, and demonstrates the significant gaps in infrastructure, life-saving and disability-preventing surgical interventions and essential equipment. Of the 14 reporting health facilities, 12 identified as full hospitals, serving an average patient population of over 300,000 people, further indicating the need for surgical care system strengthening.

Of the 35 basic surgical and anaesthesia interventions, most hospitals were unable to provide all of the basic surgical services. Major essential procedures such as caesarean section, appendicectomy, elective hernia and hydrocele repair, and laparotomy were offered at a majority of hospitals, but these conflicted directly with the continuous availability of basic and necessary supplies and infrastructures. Only 3 facilities had any consistent access to oxygen cylinders, and even less reported access to tubing, valves, and masks.

Necessary procedures including resuscitation and airway management were offered at a majority (79%) of facilities. Those reporting the inability to provide resuscitation procedures, however, all reported the provision of major surgical procedures that would require provision and knowledge of those same procedures. The facilities in questions could not be contacted for confirmation.

Still, many facilities lacked access to key equipment and supplies such as provisional oxygen equipment, oropharyngeal airways, and IV cannulas. Only 2 facilities reported access to a functional anaesthesia machines, and few facilities noted the ability to provide general anaesthesia inhalation. Both oxygen and anaesthesia are essential medicines, (WHO Model List of Essential Medicines. World Health Organizations. 2013. http://www.who.int/medicines/publications/essentialmedicines/18th_EML_Final_web_8Jul13.pdf) and the existing deficit limits the availability of safe and effective life-saving surgeries in Somalia or can result in significant complication or unnecessary patient suffering when these medicines are not provided.[23]

A surprisingly low amount of facilities reported having access to equipment necessary for the prevention of HIV transmission and other infection control. Less than half of the facilities reported access to sterile gloves, waste disposal containers, face masks, eye masks, aprons, and even soap and only slight more than half of the facilities had access to a sterilizer, all key components in the reduction of HIV transmission (WHO Prevention of Transmission of HIV. 2007. http://www.who.int/surgery/publications/HIVprevention.pdf)

A majority of the facilities lacked any formal guidelines for the management of emergency care, surgery, pain relief, or anaesthesia, providing a significant barrier to the strengthening of emergency and surgical care services and severely limiting their ability to respond to large scale disaster and crisis situations.

The severe gaps in infrastructure and capital entail obstacles for the delivery of basic primary care in these facilities as well. Absence of key infrastructural elements such as water, electricity, and oxygen, as well as the lack of consistent renewable sterilization tools and supplies involved in infection prevention (bandages, alcohol, gloves, aprons, soap, etc.) is common among the facilities depicted. Establishing management guidelines for surgical infrastructure and targeted development in improving access to these lacking areas would not only increase the quality of surgical services, but also that of basic primary care services offered by these facilities.

Strengthening of surgical systems will not only reduce the disease burden of surgically related issues but can also increase progress toward achieving the 2015 Millennium Development Goals (MDGs). Strengthening surgical care delivery can help achieve MDGs 1 (eradication of poverty),[18] 4 (child health), 5 (maternal health), and 6 (HIV/AIDS prevention).[21] Investments in oxygen and related equipment and basic infrastructural needs, such as electricity and running water, will also serve to benefit patients suffering from a range of conditions.

To meet the needs of LMICs, the WHO Emergency and Essential Surgical Care (EESC) program with its partners worldwide developed the *Integrated Management for Emergency and Essential Surgical Care* (IMEESC) toolkit (WHO IMEESC Toolkit: http://www.who.int/surgery/en). It guides policies, research for evidence-based planning (WHO EESC Situation Analysis Tool to assess emergency, trauma, obstetrics, anesthesia and surgical services, WHO EESC Global Database), training, best practice protocols at point-of- care, monitoring and evaluation of the progress of surgical care systems. The IMEESC toolkit provides guidance for policymakers, managers, and providers at various levels of care, instructional videos, training modules on emergency & trauma for frontline health workers, disaster- management resources, and monitoring and evaluation.

This study provides insight into the surgical capacity of Somalia, using the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care. Addressing the gaps identified by this study and the strengthening of surgical services are needed to strengthen health systems holistically in Somalia.[24] Further research is needed to determine the burden of surgical disease in Somalia and to determine the cost-benefit of specific interventions to improve surgical services.

Disclaimer: The authors include staff members of WHO. They are responsible for the views expressed in this publication and do not necessarily represent the decisions or stated policy of WHO.

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REFERENCES

1. Debas HT, Gosselin R, McCord C, et al. Surgery. In: Jamison D, ed. Disease Control Priorities in Developing Countries. 2nd edn. New York: Oxford University Press, 2006:1245-59.
2. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet 2008;**372**:139-44.
3. World Health Organisation. Regional Office for the Eastern Mediterranean, Cairo. Country Cooperation Strategy for WHO and Somalia 2010-2014. 2010.
4. UNICEF. The private sector and health: a survey of Somaliland private pharmacies. 2008.
5. UNDP. Population projections. 2007.
6. UNDP. Millennium Development Goals Report for Somalia. 2007
7. Penoyar T, Cohen H, Kibatala P, et al. Emergency and surgery services of primary hospitals in United Republic of Tanzania. BMJ Open 2012; **2**(1): e000369
8. Natuzzi ES, Kushner A, Jagilly R, et al. Surgical Care in the Solomon Islands: a road map for universal surgical care delivery. World J Surg 2011; **35**(6):1183-93.
9. Idriss A, Shivute N, Bickler S, et al. Emergency, anaesthetic and essential surgical capacity in the Gambia. Bull World Health Organ. Epub 2011 May.
10. Sherman L, Clement P, Cherian M, et al. Implementing Liberia's Poverty Reduction Strategy: An Assessment of Emergency and Essential Surgical Care. Arch Surg 2011;**146**: 35 - 39.

11. Choo S, Perry H, Hesse AA, et al. Assessment of capacity for surgery, obstretrics and anaesthesia in 17 hospitals in Ghana using a WHO assessment tool. Trop Med Int Health 2010 September.

12. Contini S, Taqdeer A, Cherian M, et al. Emergency and Essential Surgical Services in Afghanistan: Still a Missing Challenge. World J Surg 2010 January.

13. Taira BR, Cherian MN, Yakandawala H, et al. Survey of Emergency and Surgical Capacity in the Conflict-Affected Regions of Sri Lanka. World J Surg 2009 October.

14. Kingham TP, Kamara TB, Cherian MN, et al. Quantifying Surgical Capacity in Sierra Leone: A Guide for Improving Surgical Care. Arch Surg 2009;**144**(2):122□127.

15. Cherian MN, Noel L, Buyanjargal Y, et al. Essential emergency and surgical procedures in resource-limited facilities: a WHO workshop in Mongolia. World Hosp Health Serv 2004;**40**(4):24□29.

16. Farmer P, Kim J. "Surgery and global health: a view from beyond the OR." World J Surg 2008; **32**(4):533-536.

17. Johnson, WD. Surgery as a Global Health Issue. Surg Neurol Int. First: 03 April 2013. doi:10.4103/2152-7806.110030

18. Funk, LM, Weiser, TG, Berry, WR, et al. "Global Operating Theatre Distribution and Pulse Oximetry Supply: an Estimation from Reported Data." Lancet. 2010;**376**(9746): 1055-1061.

19. Kushner Al, Cherian MN, Shokohmand, AS, et al. Addressing the Millennium Development Goals from a surgical perspective: essential surgery and anesthesia in 8 low- and middle-income countries. Arch Surg 2010;**145**(2): 154-159.

20. United Nations. A New Global Partnership: Eradicate Poverty And Transform Economies Through Sustainable Development: The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. United Nations Publication 2013.

21. Jamison, D, Jha, P, Bloom, D. Diseases – disease control. In: Lomborg, B. Global Crises, Global Solutions: 2nd ed. New York: Cambridge University Press. 2009:129-163.

22. Ozgediz, D. Jamison, D, McQueen, K. The burden of surgical conditions and access to surgical care in low- and middle-income countries. Bull World Health Organ 2008;**86**(8):646-647

23. Cherian, MN, Merry, AF, Wilson, IH. The World Health Organization and Anaesthesia. Anaesthesia, 2007;**62**:65-66

24. Hedges JP, Mock CN, Cherian MN. The Political Economy of emergency and essential surgery in global health. World J Surg 2010;**34**:2003–2006. [PubMed: 20454792]

A Survey of Essential Surgical Capacity in Somalia

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Keywords: Surgery, Somalia, Emergency, Anaesthesia, Trauma

Word count: 2,679

ABSTRACT

Objective: ~~The objective of this study was to~~To assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.

Design: Cross-sectional survey.

Setting: Health facilities in all 3 administrative zones of Somalia; northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS).

Participants: 14 health facilities

Measures: The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to deliver surgical and anaesthesia services by investigating four categories of data: infrastructure; human resources; interventions available; and equipment.

Results: The 14 facilities surveyed in Somalia represent 10 of 18 districts throughout the country. The facilities serve an average patient population of 331,250 people, and 12 of 14 identif~~i~~y as hospitals. While major surgical procedures were provided at many facilities (c~~C~~aesarean Section, l~~L~~aparotomy, appendicectomy~~Appendectomy~~, etc.), only 22% had fully available oxygen access, 50% fully available electricity, and less than 30% had any management guidelines for emergency and surgical care. Further more, only 36% were able to provide general anaesthesia inhalation due to lack of skills, supplies, and equipment. Basic supplies for airway management and the prevention of infection transmission were severely lacking in most facilities.

Conclusions: According to the results of the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care survey, there exist significant gaps in the capacity of emergency and essential surgical services in Somalia including inadequacies in essential equipment, service~~s~~ provision, and infrastructure. The information provided by th~~is~~e WHO tool can serve as a basis for evidenced-based decisions on country-level policy regarding the allocation of resources and provision of emergency and essential surgical services.

ARTICLE SUMMARY

Article Focus

- On-site visits to primary health centres in a developing nation
- Evaluate capacity to deliver emergency and essential surgical care

Strengths and limitations of this study

- Provides insight into the surgical capacity of Somalia
- Identifies significant gaps and areas for improvement towards evidence-based planning to improve surgical infrastructure, skills training, and equipment and supplies
- Does not capture data from every first-referral health facilit~~y~~ies of the country

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- ~~Measures are subjective and i~~In some cases, measures captured are estimates

INTRODUCTION

Conditions that can be treated with surgery account for ~~an estimated~~ 11% of the world's disability-adjusted life years.[1] Despite recent data estimating the global volume of surgery at 234 million surgical procedures annually and significant disparities between procedures performed in high- and low- income countries, global public health initiatives have traditionally neglected the necessity for the provision of surgical services.[2] Poor access to surgical services, particularly at rural facilities, results in excess morbidity and mortality from a broad range of treatable surgical conditions including injuries, complications of pregnancy, sequelae of infectious diseases, acute abdominal conditions and congenital abnormalities~~nomalies~~. Improving the access to surgical services in low-income countries requires addressing gaps in infrastructure, the training and skills of ~~rained/skilled~~ personnel, appropriate equipment and medications.

BACKGROUND

Somalia's 21 years of war, armed conflict and insecurity have had a devastating effect on the health sector. The current situation is at its worst level since the beginning of the civil war in 1991, with unprecedented levels of child malnutrition and ~~,~~ internal displacement, as well as conflict and insecurity rife in some parts of the country.[3] Continuing conflict has left 90% of health infrastructure looted, damaged or destroyed.[4] The low health workforce ratios before the war have depreciated through high levels of healthcare worker emigration, leaving an estimated 3 physicians per 100000 population (total 253 physicians), 11 nurses per 100 000 population (861 nurses) and 2 midwives per 100 000 population (116 midwives) serving the whole country.[5]

Rates of death and disability from treatable surgical conditions continue to be unacceptably high. Somalia's maternal mortality rate is estimated to be 1044 per 100 000 live births, one of the highest in the region.[6] This corresponds to a lifetime risk of one maternal death for every 10 women. The leading causes of maternal death (antepartum and postpartum haemorrhage, obstructed labour and eclampsia) can all be addressed with appropriate emergency obstetric care, which often require surgical and~~/or~~ anaesthetic~~sia~~ interventions. Trauma ~~related mortality~~, as a consequence of ~~through~~ road traffic accidents, armed fighting and landmine explosions, is also common. In 2010 and 2011, WHO reported more than 7500 war-wounded civilians who were admitted to three main hospitals in Mogadishu, one in five being children and one in three women (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/)

The health sector faces overwhelming challenges in a country where two decades of lawlessness have resulted in the collapse of central government and 3 almost

autonomously-ruled zones: northwest Somalia (NWS), known as Somaliland; northeast Somalia (NES), known as Puntland; and south/central Somalia (SCS). Somalia's public health system is tiered, comprising regional referral hospitals, district hospitals, maternal and child health centres and health posts. However, hospitals and health facilities are limited in number, inadequately distributed, operate using vastly different standards, and often cannot provide a minimum package of primary health care (PHC) services. As funders and public health experts adopt the expansion of primary healthcare services, the inclusion of surgical services at the first-referral level is critical. The purpose of this survey was to collect knowledge gained from comprehensive quantitative assessments of surgical capacity in Somalia in order to assist in planning strategies for universal access to life-saving and disability-preventing surgical services (World Health Organization. Emergency and Essential Surgical Care. 2013. www.who.int/surgery/en/).

Similar studies using the WHO Situational Analysis tool have been conducted in Tanzania,[7] Solomon Islands,[8] Gambia,[9] Liberia,[10] Ghana,[11] Afghanistan,[12] Sri Lanka,[13] Sierra Leone,[14] and Mongolia.[15]

OBJECTIVE

The objective of this study was to assess life-saving and disability-preventing surgical services (including emergency, trauma, obstetrics, anaesthesia) of health facilities in Somalia and to assist in the planning of strategies for strengthening surgical care systems.

To assess the current capacity for essential anesthesia and surgical services in Somalia with the purpose of providing a benchmark for critical areas needing improvement.

METHODS

The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was employed to capture a health facility's capacity to perform basic surgical (including obstetrics and trauma) and anaesthesia interventions by investigating four categories of data: infrastructure, human resources, interventions provided and equipment availability. The tool queries the availability of 8 types of care providers, 35 surgical interventions and 67 items of equipment.[7] The answer of available was defined as "fully available for all patients all of the time," while sometimes was defined as "available with frequent shortages or difficulties".(WHO EESC Situational Analysis Tool. 2012. http://www.who.int/surgery/publications/WHO_EESC_SituationAnalysisTool.pdf).

Facilities were also asked the size of the 'population served', intending to quantify the population living in the catchment area. This value represents the number of residents who might use the facility as their first-referral health facility, not the number of patients seen.

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The WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care was distributed by the Ministry of Health and WHO Somalia to 20 first-referral-level-health facilities around the country and was completed at 14 health facilities representing 10 of the 18 regions of Somalia and all 3 administrative zones. The survey

was extended to regional medical officers and facility administrators. Participation in the survey and reporting to the WHO was voluntary. The physical surveys were then obtained either by post directly to the WHO Somalia office (Nairobi, Kenya) or by site visits from the Somalia Ministry of Health (MoH), the WHO country office and members of the Global Initiative for Emergency and Essential Surgical Care (GIEESC) between September 2011 and April 2012..

Despite efforts to standardize the reporting and the collection of much of the data by site-visits performed by agents affiliated to the authors, it must be noted that an inherent reporting bias may be present in the data, given that survey data was compiled by different agents at each site. Furthermore, in a limited number of cases, facilities did not respond to individual questions. Blank answers were considered as neither a positive or negative answer, but simply deemed as unreported.

~~D~~The collected data were then entered into and analyzed from WHO Global DataCol Database for Emergency and Essential Surgical Care.

RESULTS

i Health facility characteristics
ii Infrastructure
iii Human resources
iv Interventions
v Equipment

Data were gathered from 14 health facilities in 10 regions (out of 18) across Somalia, as featured figure 1 and table 1. The 6 facilities that received the survey but did not return information are also listed below. Non-reporting can be attributed to a lack of consistent operation, inability to gather the data, and the pervasive political instability and high security risk throughout the country, making the transmission of this data difficult and costly.

Type of Facility (Self-identified)	Name of Facility	Region	Number of Beds	Operating Theaters
General Hospital	Garowe Hospital	Nugaal	51-80	11-20
	Gardo General Hospital	Bari	21-50	1
	Hergeisa Group Hospital	Woqooyi Galbeed	301-400	5-10
Provincial Hospital	Borama General Hospital	Awdal	201-300	1
	Burao Regional Hospital	Togdeer	201-300	1
	Berbera Referral Hospital	Woqooyi Galbeed	101-200	2
	Erigavo Regional Hospital	Sanaag	81-100	1

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	Sool Regional Hospital	Sool	81-100	1
Health Centrcer	Doolow Health Centrcer	Gedo	5-10	1
Private/NGO/Mission Hospital	Galkayo Medical Centrcer	Mudug	51-80	3-4
	Galkayo Specialist Hospital	Mudug	3-4	1
	Medina Hospital	Banadir	201-300	5-10
	Maani Hospital	Banadir	21-50	1
	Manhal Specialty Hospital	Woqooyi Galbeed	51-80	5-10
Facilities Not Responding to Survey	Shikh Hospital	Woqooyi Galbeed	N/A	N/A
	Puntland Regional Hospital	Bossaso	N/A	N/A
	General Medical Service Hospital	Mudug	N/A	N/A
	Wajed Hospital	Bakool	N/A	N/A
	Dinsor Hospital	Bakool	N/A	N/A
	Sama Hospital	Bay	N/A	N/A

Table 1. Surveyed hResponding health facilities. N=14

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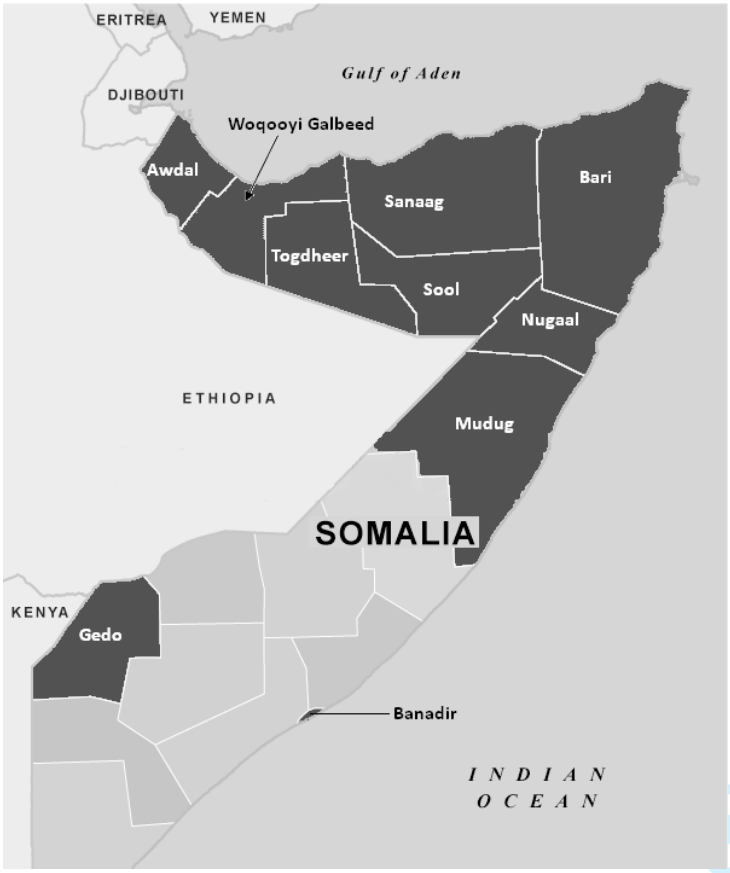

Figure 1. Participating regions of Somalia.

i. Health facility characteristics

Of the 14 facilities that responded to the survey 5 were provincial hospitals, 5 were private/mission/NGO hospitals, 3 were general hospitals and 1 was a health centere. Each facility reported having at least 1 operating theatre, with a maximum of between 11 and 20 operating theatres. The populations served by each facility ranged from 100,000 to 1,000,000 people, with the average population of the reporting facilities atbeing 331,250 people.

ii. Infrastructure

The emergency and surgical infrastructure of the 14 reporting facilities were largely inadequate, with only 22% of health facilities having oxygen cylinder supplies consistently available. 28% of facilities never or only sometimes had access to running water available and only 50% had a consistently available electricity source. Only 50% of

the facilities had fully available access to both running water and electricity. Access to a functional anaesthesia machine was only present in 2 (15%) facilities, one of those facilities being a local health centere. Only 3 facilities reported access to a functioning pulse-oximeter.

50% of facilities had permanent areas designated ~~always~~for emergency care and only 38% of facilities had the same for postoperative care.

A minority of facilities had formal management guidelines for emergency care (3/14 = 21%), surgery (5/14 = 36%), anaesthesia (4/14 = 29%), or pain relief (1/14 = 7%).

Table 2 depicts the key infrastructural elements available in the health facilities accessed.

	Always	Sometimes	Not Available
Oxygen cylinder	3	1	10
Running water	10	2	2
Electricity source	7	5	2
Operational power generator	2	2	9
Blood bank	5	3	6
Hemoglobin & urine testing	12	2	0
X-ray machine	8	4	2
Medical records	10	3	1
Pulse Oximeter	3	0	8
Area designated for emergency care	5	1	7
Area designated for postoperative care	5	1	7
Management Guidelines for Emergency Care	3	1	10
Management Guidelines for Surgery	5	0	9
Management Guidelines for Anaesthesia	4	1	9
Management Guidelines for Pain relief	1	3	10
Functioning anaesthesia machine	7	5	2

Table 2. Availability of infrastructure and health resources in Somalia, 2012
Number of facilities where element is always, sometimes, or never available. Bolded items designate those ~~which~~ that are specific to quality surgical care delivery. N=14

iii. Human Resources

More data is needed to comment on ~~the Health H~~human r~~R~~esources within healthcare in Somalia. In this section, blank answers to staffing questions impeded our ability to

comment on the state of the workforce completely. We did however summari~~z~~se the results to survey questions of which all or a majority of facilities supplied data.

The 14 facilities together reported a total of 137 healthcare providers. Only 15 (11~~0.9~~%) individuals were identified as full time trained surgical specialists, located only at 9 out of 14 of the facilities. 14 (11~~10.9~~%) were identified as obstetricians, and only 4 (3~~2.9~~%) individuals were identified as qualified ~~anesthesiologists~~ anesthetists and were located in only 3 of the 14 facilities, with 27 (20~~19.7~~%) unlicensed medical staff (~~N~~nurses, medical assistants, etc.) providing anesthetic services.

iv. Interventions

Of the 35 interventions queried, only abscess incision and ~~drainage~~ drainage are~~is~~ offered at all 14 facilities. Acute burn management, wound debridement, hydrocoele treatment, and male circumcision are widely provided by the surveyed facilities being offered at 85-86~~5~~% ~~86%, 85%, 86%, 86%,~~ of all facilities ~~respectively~~. Caesarean section is offered at 93% of all facilities ~~(n=14)~~.

Provision of anaesthesia services was severely lacking, however, with only 36% of facilities able to perform general anaesthesia inhalational procedures. Of the 8 facilities that ~~reported back~~answered why they could not provide this service, 1 (Doolow Health Center) attributed it to lack of skill and 4 (Borama General Hospital, Doolow Health Center, Erigavo Regional Hospital, Burao Regional Hospital) to lack of supplies or ~~/~~drugs. 1 facility (Gardo General Hospital) ~~facility~~ attributed it both to lack of skill and lack of equipment.

The ability of each health facility to provide basic surgical and anaesthesia procedures was assessed (tables 3 and 4).

General surgery & trauma	**Available**
Resuscitation (airway, haemorrhage, peripheral percutaneous intravenous access, peripheral venous cut down)	11
Cricothyroidotomy/ Tracheostomy	10
Chest tube insertion	9
Removal of foreign body (throat/ear/eye/nose)	11
Acute burn management	12
Incision & drainage of abscess	14
Suturing (for wounds, episiotomy, cervical & vaginal lacerations)	13
Wound debridement	11
Caesarean section	13
Dilatation & curettage (gynaecology/obstetrics)	12
Obstetric fistula repair	7
~~Appendectomy~~ Appendicectomy	11

Hernia repair (strangulated, elective)	10	
Hydrocoele	12	
Cystostomy	9	
Urethral stricture dilatation	11	
Laparotomy (uterine rupture, ectopic pregnancy, acute abdomen, intestinal obstruction, perforation, injuries)	12	
Male circumcision	12	
Congenital hernia repair	9	
Neonatal surgery (abdominal wall defect, colostomy imperforate anus, intussusceptions)	5	
Cleft lip repair	10	
Clubfoot repair	9	
Contracture release/ skin grafting	10	
Fracture treatment	Closed	Open
	10	8
Joint dislocation treatment	9	
Drainage of osteomyelitis/septic arthritis	9	
Amputation	11	
Biopsy (lymph node, mass, other)	8	
Tubal ligation/vasectomy	9	
Cataract surgery	4	

Table 3. Availability of surgical (including obstetrics and trauma) interventions. Number of facilities at which the procedure is available. N=14

Anaesthesia	
Regional anaesthesia blocks	6
Spinal anaesthesia	13
Ketamine intravenous anaesthesia	13
General anaesthesia inhalational	5

Table 4. Availability of anaesthesia interventions Number of facilities at which the procedure is available. N=14

v. Emergency equipment and supplies for resuscitation

Basic equipment access was also lacking. No facility had access to all ~~pieces of~~ basic and essential surgical equipment listed ~~on~~by the tool. Only 1 hospital ~~(7%)~~ always had adult resuscitator bag valves and masks available, and only 2 out 14 facilities ~~(14%)~~ reported the same for paediatric bag valves and masks. 64% of facilities had access to oxygen only sometimes or never, and less than 30% had oropharyngeal airways always available ~~always~~for both adults and children. 39% of institutions were without an examination table.

Basic equipment~~tools~~ such as suction catheters, IV cannulas, and Foley catheters were only consistently available in less than 30% of all facilities.

57 % of facilities did not have sterile gloves consistently available, and 64% reported the same for examination gloves. Only 64% of the reporting institutions had a sterilizer available all the time. 71% did not have~~could not make~~ face masks available, and 86% were without consistent availability of eye protection. Availability of soap and wash basins was reported in less than two thirds of the 14 facilities.

The availability of emergency equipment and supplies for resuscitation was assessed in each of the health facilities (depicted in tables 5, 6, and7).

Capital Outlays	**Always**	**Sometimes**	**Never**
Resuscitator bag valve & mask			
Adult	1	7	6
Paediatric	2	5	7
Oxygen	5	4	5
Stethoscope	9	3	0
Batteries for flash light	8	2	4
Suction pump	11	3	0
Blood pressure monitoring equipment	10	3	1
Thermometer	10	3	1
Scalpel Handle with blade	9	4	1
Retractor	7	6	0
Scissors straight 12cm	8	5	1
Scissors blunt 14cm	7	6	0
Oropharyngeal airway Adult	4	6	4
Paediatric	4	5	5
Forceps Kocher no teeth	5	7	1
Forceps, artery	8	6	0
Kidney dishes stainless steel	6	6	1
Capped bottle, alcohol based solutions	2	5	3
Gloves (sterile)	6	7	1
Gloves (examination)	5	8	1
Needle holder	9	5	0
Sterilizer	9	5	0
Nail brush, scrubbing surgeon's	7	5	1
Vaginal speculum	9	2	3
Bucket, plastic	4	4	4
Drum for sterile compresses, bandages, dressings	8	4	1
Examination table	8	4	1

Table 5. Availability of Capital Outlays for Resuscitation

Number of facilities where element is always, sometimes, or never available. N=14

Renewable			
Suction catheter sizes 16 FG	2	5	6
Tongue depressor wooden disposable	3	7	3
Nasogastric tubes 10 to 16 FG	2	10	2
Light source (lamp & flash light)	4	9	1
Intravenous fluid infusion set	3	9	2
IV cannulas	4	8	2
Scalp vein infusion set	3	7	3
Syringes 2ml	4	9	1
Syringes 10 ml	4	10	0
Disposable needles	5	8	1
Sharps disposal container	5	8	1
Tourniquet	4	8	1
Sterile gauze dressing	3	8	2
Bandages sterile	3	7	3
Adhesive tape	3	9	1
Needles, cutting & round bodied (for suturing)	4	8	2
Suture synthetic absorbable	4	6	3
Splints for arm, leg	2	8	4
Towel cloth	2	8	3
Absorbent cotton wool	2	10	1
Urinary catheter Foleys disposable #12, 14,18 with bag	3	7	3
Sheeting, plastic for examination table	4	7	3
Waste disposal container	4	8	2
Face masks	4	8	2
Eye protection	2	5	7
Apron, plastic reusable	3	9	2
Soap	5	9	0
Wash basin	4	8	1

Table 6. Availability of Renewable Supplies for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

Supplementary equipment			
Magills forceps Adult	3	2	9
Paediatric	1	2	10
Endotracheal tubes	1	2	10
IV infusor bags	1	2	10
Chest tubes insertion equipment	1	3	9

Laryngoscope Adult	3	3	7
Paediatric	1	3	9
Cricothyroidotomy set	1	1	11

Table 7. Availability of Supplementary Equipment for Resuscitation
Number of facilities where element is always, sometimes, or never available. N=14

LIMITATIONS

There are a several limitations to this survey. ~~Firstly, it~~ It provides only a brief overview of the capacity for surgical care and cannot be used for detailed programme planning. ~~Second~~Although not every first-referral health facility in Somalia was surveyed, the majority identified by the MoH and WHO Somalia did reply and this allows a credible insight into the surgical capacity of the country.

~~, it does not capture data from every first-referral health facility of the country; however, a majority of the first-referral health facilities identified by the MoH and WHO Somalia have responded, allowing us to provide a glimpse into the state of basic surgical capacity in the country.~~ ~~Third, s~~Some of the data was taken after the WHO IMEESC toolkit was implemented in the country, and results should be qualified by the possibility of interpretation constraints of the survey.

DISCUSSION

Surgically treatable diseases are among the top 15 causes of disability,[16] and conservative estimates show that 11% of the world's d~~D~~isability-a~~A~~djusted life years (DALYs) stem from surgically treatable~~ed~~ conditions.[1] In 2004, South East Asia and Africa accounted for 54% of the global burden,[17] and since then the burden of surgical disease is thought to be increasing.[16]

More than 2 billion people globally are without access to surgical care.[18] Of the 243 million surgical procedures performed globally each year, the 34.8% of the world's population living in low-income countries only have access to 8.1 million (only 3.5%) of such procedures.[2] As a result, rates of maternal mortality are high, minor surgical pathologies become lethal, and treatable trauma progresses to death.

Despite the great, unmet need and inclusion in policy-level dialogue on primary health care, the delivery of emergency surgical care has long been sidelined in global financing and policy debates, largely due to perceived complexity and cost. ~~Further, d~~Despite the ~~large and~~ growing need for ~~expanding~~ access to surgical care, human resources, metrics and science focused on global surgery, and sustained financing mechanisms for surgical infrastructure lag behind other public health priorities (Smith-Rohrberg Maru, D, McGee, HM, Brady, JS et al. Global Surgical Care in 2030: Metrics and Strategies for Expansion in Access and Quality. 2013. www.worldwewant2015.org/file/298623/download/323967)

Enormous shortfalls in infrastructure, supplies, and procedures undertaken are common at district-level health facilities in LMICs.[19] Every $1 spent strengthening local surgical capacity generates $10 through improved health and increased productivity.[20] In 2008, the Copenhagen Consensus Center's research identified strengthening surgical capacity, particularly at the district hospital level, as a highly cost-efficient solution to global diseases. Notably, strengthening local surgical capacity is an approach that would both provide a high degree of financial protection to populations and address the most DALYs in a cost effective manner.[1] In fact, the benefit-cost-ratio for the expansion of surgical capacity at district hospitals was found to be 10:1.[21] Furthermore, due to the implementation of "vertical" programmes in public health (i.e. child health, maternal health, cancer, and trauma), in which most programmes contain some surgical component, strengthening surgical services may improve health system overall.[22]

This study provides an overview of the capacity for surgical care representing health facilities from in all 3 administrative zones of Somalia, including 10 out of 18 regions ~~regions of 18 in Somalia~~, and demonstrates the significant gaps in infrastructure, life-saving and disability-preventing~~ive~~ surgical interventions and essential equipment. Of the 14 reporting health facilities, 12 identified as full hospitals, serving an average patient population of over 300,000 people, further indicating the need for surgical care system strengthening.

Of the 35 basic surgical and anaesthesia interventions, most hospitals were unable to provide all of the basic surgical services. Major essential procedures such as ~~C~~caesarean section, appendice~~e~~ctomy, elective hernia and hydrocele repair, and~~,~~ laparotomy were offered at a majority of hospitals, but these conflicted directly with the continuous availability of basic and necessary supplies and infrastructures. Only 3 facilities had any consistent access to oxygen cylinders, and even less reported access to tubing, valves, and masks.

Necessary procedures including resuscitation and airway management were offered at a majority (79%) of facilities. Those reporting the inability to provide resuscitation procedures, however, all reported the provision of major surgical procedures that would require provision and knowledge of those same procedures. The facilities in questions could not be contacted for confirmation.

Still, many facilities lacked access to key equipment and supplies such as provisional oxygen equipment, oropharyngeal airways, and IV cannulas. Only 2 facilities reported access to a functional anaesthesia machines, and few facilities noted the ability to provide general anaesthesia inhalation. Both oxygen and anaesthesia are essential medicines, (WHO Model List of Essential Medicines. World Health Organizations. 2013. http://www.who.int/medicines/publications/essentialmedicines/18th_EML_Final_web_8Jul13.pdf) and the existing deficit limits the availability of safe and effective life-saving surgeries in Somalia or can result in significant complication or unnecessary patient suffering when these medicines are not provided.[23]

A surprisingly low amount of facilities reported having access to equipment necessary for the prevention of HIV transmission and other infection control. Less than half of the

facilities reported access to sterile gloves, waste disposal containers, face masks, eye masks, aprons, and even soap and only slight more than half of the facilities had access to a sterilizer, all key components in the reduction of HIV transmission (WHO Prevention of Transmission of HIV. 2007. http://www.who.int/surgery/publications/HIVprevention.pdf)

A majority of the facilities lacked any formal guidelines for the management of emergency care, surgery, pain relief, or anaesthesia, providing a significant barrier to the strengthening of emergency and surgical care services and severely limiting their ability to respond to large scale disaster and crisis situations.

The severe gaps in infrastructure and capital entail obstacles for the delivery of basic primary care in these facilities as well. Absence of key infrastructural elements such as water, electricity, and oxygen, as well as the lack of consistent renewable sterilization tools and supplies involved in infection prevention (bandages, alcohol, gloves, aprons, soap, etc.) is common among the facilities depicted. Establishing management guidelines for surgical infrastructure and targeted development in improving access to these lacking areas would not only increase the quality of surgical services, but also that of basic primary care services offered by these facilities.

Strengthening of surgical systems will not only reduce the disease burden of surgically related issues but can also increase progress toward achieving the 2015 Millennium Development Goals (MDGs). Strengthening surgical care delivery can help achieve MDGs 1 (eradication of poverty),[18] 4 (child health), 5 (maternal health), and 6 (HIV/AIDS prevention).[21] Investments in oxygen and related equipment and basic infrastructural needs, such as electricity and running water, will also serve to benefit patients suffering from a range of conditions.

To meet the needs of LMICs, the WHO Emergency and Essential Surgical Care (EESC) program with its partners worldwide developed the *Integrated Management for Emergency and Essential Surgical Care* (IMEESC) toolkit (WHO IMEESC Toolkit: http://www.who.int/surgery/en). It guides policies, research for evidence-based planning (WHO EESC Situation Analysis Tool to assess emergency, trauma, obstetrics, anesthesia and surgical services, WHO EESC Global Database), trainings, best practice protocols at point-of- care, monitoring and evaluation of the progress of surgical care systems. The IMEESC toolkit provides guidance for policymakers, managers, and providers at various levels of care, instructional videos, training modules on ~~e~~Emergency & ~~T~~trauma ~~Care~~ for frontline health workers, disaster- management resources, and monitoring and evaluation.

This study provides insight into the surgical capacity of Somalia, using the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care. Addressing the gaps identified by this study and the strengthening of surgical services are needed to

strengthen health systems holistically in Somalia.[24] Further research is needed to determine the burden of surgical disease in Somalia and to determine the cost-benefit of specific interventions to improve surgical services.

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REFERENCES

1. Debas HT, Gosselin R, McCord C, et al. Surgery. In: Jamison D, ed. Disease Control Priorities in Developing Countries. 2nd edn. New York: Oxford University Press, 2006:1245-59.
2. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet 2008;**372**:139-44.
3. World Health Organisation. Regional Office for the Eastern Mediterranean, Cairo. Country Cooperation Strategy for WHO and Somalia 2010-2014. 2010.
4. UNICEF. The private sector and health: a survey of Somaliland private pharmacies. 2008.

5. UNDP. Population projections. 2007.

6. UNDP. Millennium Development Goals Report for Somalia. 2007

7. Penoyar T, Cohen H, Kibatala P, et al. Emergency and surgery services of primary hospitals in United Republic of Tanzania. BMJ Open 2012; **2**(1): e000369

8. Natuzzi ES, Kushner A, Jagilly R, et al. Surgical Care in the Solomon Islands: a road map for universal surgical care delivery. World J Surg 2011; **35**(6):1183-93.

9. Idriss A, Shivute N, Bickler S, et al. Emergency, anaesthetic and essential surgical capacity in the Gambia. Bull World Health Organ. Epub 2011 May.

10. Sherman L, Clement P, Cherian M, et al. Implementing Liberia's Poverty Reduction Strategy: An Assessment of Emergency and Essential Surgical Care. Arch Surg 2011;**146**: 35 - 39.

11. Choo S, Perry H, Hesse AA, et al. Assessment of capacity for surgery, obstretrics and anaesthesia in 17 hospitals in Ghana using a WHO assessment tool. Trop Med Int Health 2010 September.

12. Contini S, Taqdeer A, Cherian M, et al. Emergency and Essential Surgical Services in Afghanistan: Still a Missing Challenge. World J Surg 2010 January.

13. Taira BR, Cherian MN, Yakandawala H, et al. Survey of Emergency and Surgical Capacity in the Conflict-Affected Regions of Sri Lanka. World J Surg 2009 October.

14. Kingham TP, Kamara TB, Cherian MN, et al. Quantifying Surgical Capacity in Sierra Leone: A Guide for Improving Surgical Care. Arch Surg 2009;**144**(2):122□127.

15. Cherian MN, Noel L, Buyanjargal Y, et al. Essential emergency and surgical procedures in resource-limited facilities: a WHO workshop in Mongolia. World Hosp Health Serv 2004;**40**(4):24□29.

16. Farmer P, Kim J. "Surgery and global health: a view from beyond the OR." World J Surg 2008; **32**(4):533-536.

17. Johnson, WD. Surgery as a Global Health Issue. Surg Neurol Int. First: 03 April 2013. doi:10.4103/2152-7806.110030

18. Funk, LM, Weiser, TG, Berry, WR, et al. "Global Operating Theatre Distribution and Pulse Oximetry Supply: an Estimation from Reported Data." Lancet. 2010;**376**(9746): 1055-1061.

19. Kushner Al, Cherian MN, Shokohmand, AS, et al. Addressing the Millennium Development Goals from a surgical perspective: essential surgery and anesthesia in 8 low- and middle-income countries. Arch Surg 2010;**145**(2): 154-159.

20. United Nations. A New Global Partnership: Eradicate Poverty And Transform Economies Through Sustainable Development: The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. United Nations Publication 2013.

21. Jamison, D, Jha, P, Bloom, D. Diseases – disease control. In: Lomborg, B. Global Crises, Global Solutions: 2nd ed. New York: Cambridge University Press. 2009:129-163.

22. Ozgediz, D. Jamison, D, McQueen, K. The burden of surgical conditions and access to surgical care in low- and middle-income countries. Bull World Health Organ 2008;**86**(8):646-647

23. Cherian, MN, Merry, AF, Wilson, IH. The World Health Organization and Anaesthesia. Anaesthesia, 2007;**62**:65-66

24. Hedges JP, Mock CN, Cherian MN. The Political Economy of emergency and essential surgery in global health. World J Surg 2010;**34**:2003–2006. [PubMed: 20454792]

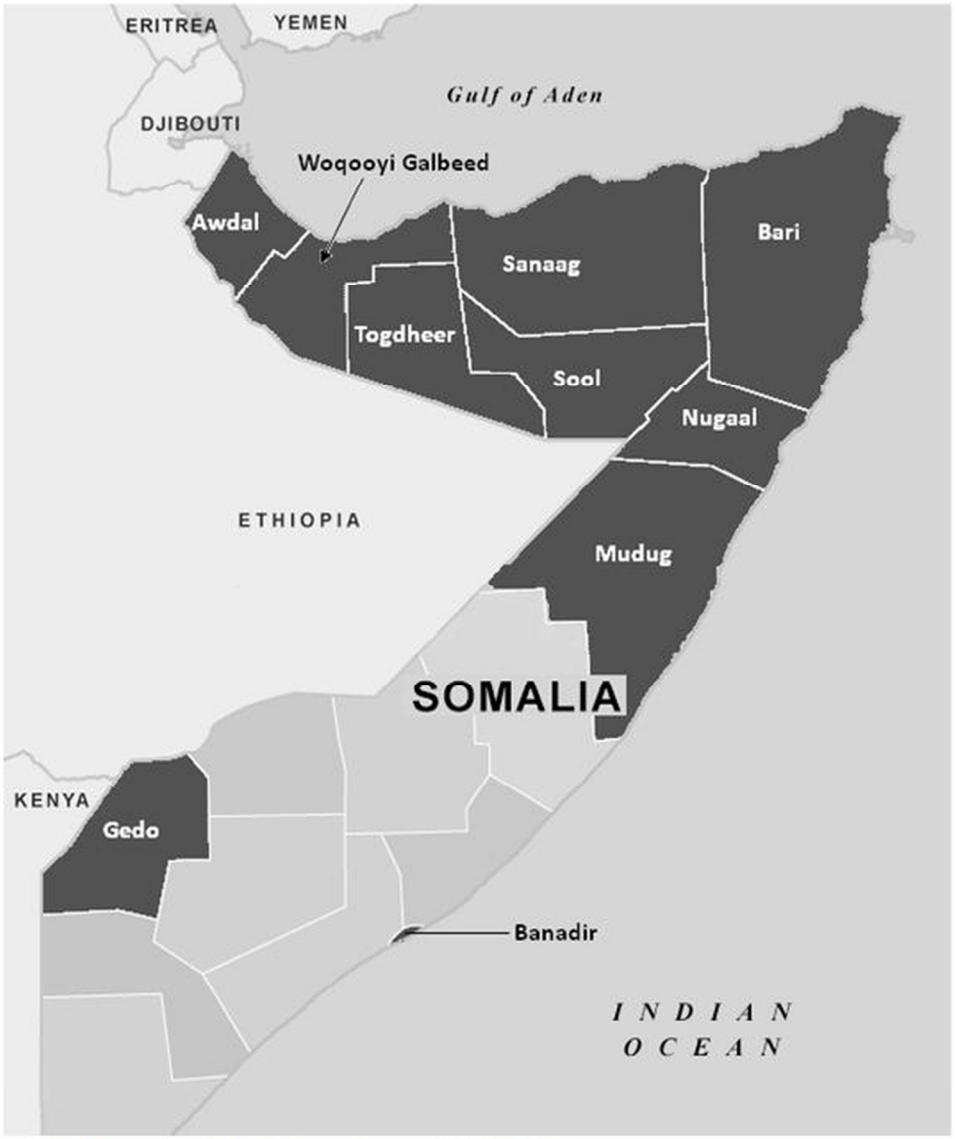

Figure 1. Participating regions of Somalia.

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