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ORIGINAL SCIENTIFIC REPORT

The Specialist Surgeon Workforce in East, Central and Southern Africa: A Situation Analysis

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Abstract

Background In East, Central and Southern Africa accurate data on the current surgeon workforce have previously been limited. In order to ensure that the workforce required for sustainable delivery of surgical care is put in place, accurate data on the number, specialty and distribution of specialist-trained surgeons are crucial for all stakeholders in surgery and surgical training in the region.

Methods The surgical workforce in each of the ten member countries of the College of Surgeons of East, Central and Southern Africa (COSECSA) was determined by gathering and crosschecking data from multiple sources including COSECSA records, medical council registers, local surgical societies records, event attendance lists and interviews of Members and Fellows of COSECSA, and validating this by direct contact with the surgeons identified. This data was recorded and analysed in a cloud-based computerised database, developed as part of a collaboration programme with the Royal College of Surgeons in Ireland.

Results A total of 1690 practising surgeons have been identified yielding a regional ratio of 0.53 surgeons per 100,000 population. A majority of surgeons (64 %) practise in the main commercial city of their country of residence and just 9 % of surgeons are female. More than half (53 %) of surgeons in the region are general surgeons.

Conclusions While there is considerable geographic variation between countries, the regional surgical workforce represents less than 4 % of the equivalent number in developed countries indicating the magnitude of the human resource challenge to be addressed.

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Introduction

It is estimated that 93 % of people in Sub-Saharan Africa do not have access to safe, affordable surgical and anaesthesia care when needed [1]. The population of the Eastern Sub-Saharan Africa region, as defined by the global burden of disease studies [2], is estimated to require 6145 surgical operations per 100,000 population per year. Current estimates indicate only 20 % of these operations are being performed [1]. The economic and social case for ensuring access to appropriate surgical care in LMICS has been eloquently made by both the Lancet Commission on Global Surgery [1] and the Disease Control Priorities 3rd edition volume on essential surgery [3]. Furthermore the member states of the World Health Organization (WHO) adopted World Health Assembly resolution 68.15 committing themselves to "strengthening emergency and essential surgical care and anaesthesia as a component of universal health coverage" [4].

While access to surgical care is limited by many factors (including transportation, infrastructure, geography, culture and finance), a crucial factor is the inadequate number of expert providers [1]. While surgical procedures can be safely performed by cadres of healthcare workers other than specialist surgeons [5, 6], the clinical governance framework that provides training, support, appropriate supervision and access to expertise in complex cases relies on an "adequate" number of specialist surgeons.

Accurate data on the distribution and composition of the surgical workforce remain crucial for all stakeholders working to improve the provision of surgery and surgical training in the region [4]. Previous studies have predominantly focused on particular specialties [7], or single countries [8, 9]. Other studies have been based on self-reported figures from medical licensing authorities and ministries, such as the WHO dataset [10] used by The Lancet Commission on Global Surgery [1]. These datasets (including the medical licensure data) date quickly as it is a challenge to continue to track surgeons throughout their careers. In addition, most of these datasets have limited detail on the surgical workforce, such as surgeon distribution within each country, specialty and gender (Fig. 1).

To this end, the present study has been designed to determine the number, distribution and career trajectory of all qualified specialist surgeons working in the ten member countries of the College of Surgeons of East, Central and Southern Africa (COSECSA): Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe. While an analysis of other cadres involved in the provision of safe surgical care is also required, it was beyond the scope of this study. Hereafter, for brevity, this paper will refer to surgical specialists as "surgeons".

COSECSA was established in 1999 "to advance education, training, standards, research and practice in surgical care" [10] in the region. Since 2007, COSECSA has been working with the Royal College of Surgeons in Ireland through a comprehensive collaboration programme funded by Irish Aid, which aims to develop the capacity of COSECSA to lead surgical training in the region [11].

Materials and methods

Data collection

The COSECSA database from which these data are drawn was launched in 2012 and uses Capsule CRM software [12], a cloud-based customer relationship management system. Initially this database comprised all COSECSA fellows and members ($n = 876$, December 8th 2015), in addition to the residents enrolled in COSECSA training programmes in each of the ten COSECSA countries.

From late 2012, contact details of attendees at COSECSA courses and events were also entered into the database. The status and professional details of surgeons who were not fellows of COSECSA were verified by COSECSA fellows and added to the database; in this manner the majority of surgeons in the COSECSA region were included. The database contains 67 data fields for each individual, of which 10 were analysed for this study (Table 1). Fields referring to COSECSA training and examinations and other data internal to COSECSA were excluded.

In 2014, a formal validation exercise was undertaken to cross check, update and expand all existing records through a combination of consultation of primary sources and direct contact with surgeons, their peers and their employers. Primary sources included:

- University teaching hospitals graduate lists
- National medical council records
- National surgical society records
- COSECSA and COSECSA Partner event and training course participant records
- Direct requests for information to hospitals, hospital groups and NGOs.

Only data verified from a minimum of two sources were included.

Each entry was then individually verified in consultation with a regional network of COSECSA country representatives, by direct contact with the registered surgeon or other surgeons in their hospital and through use of published professional social media profiles.

Fig. 1 Map of the COSECSA region

The database now contains an individual profile of every surgeon living and working in the region. The data are updated on a regular basis and the data in the current publication were finalised on 8th December 2015.

Obstetrician/gynaecologists and ophthalmologists have been excluded due to the limitations of the data to which the authors had access. Surgeons who work in the region part time or on a rotating basis have also been excluded.

Results

Surgeon population ratio

There are 1690 surgeons currently working in the ten countries in the COSECSA region of whom 588 (35 %) are COSECSA Members or Fellows. When standardised against population [13] the overall ratio is 0.53 per 100,000

population. However, there is an approximately seven-fold difference between the country with the lowest ratio (Burundi, 0.18/100,000) and that with the highest (Kenya, 1.21/100,000). A breakdown of the number of surgeons in each country and the ratio per head of population is set out in Table 2.

Surgeon specialty

Among the 1690 surgeons, specialty is recorded for 1619 (96 %) and shown in Table 3. Of those who have declared a specialty, just over half (53 %) of surgeons in the region are general surgeons. This varies from a high of 68 % of surgeons in Burundi, to a low of 35 % in Mozambique. Orthopaedic surgery is the second largest specialty group (18 %) followed by ENT (8 %). Each of the other six specialties comprises less than 6 % of the total. However, there appears to be considerable variation in the specialty profile between countries.

Surgeon location

Location of employment data were available for 1598 (95 %) surgeons in the region and are shown in Table 4. Surgeons are concentrated in larger conurbations with 71 % of surgeons for whom data were available practising in cities with populations of more than 500,000.

A majority of surgeons (64 % of those for whom location data are recorded) are employed in the major commercial city of their country of residence and this is shown in Table 5. In all countries the major commercial city is also the political capital with the exception of Tanzania (where Dodoma is the capital but Dar Es Salaam is the centre of commerce) and Malawi (where Lilongwe is the capital, but Blantyre, a similarly sized city, is the "commercial capital" [14]). Some countries are almost entirely without surgeons outside the major city. Mozambique, for example, a country significantly larger than France, has only six surgeons practicing outside the capital Maputo.

Surgeon gender

There are 155 practicing women surgeons in the COSECSA region, comprising just 9 % of the surgical workforce (Table 6). Further analysis of the COSECSA database has revealed that, among the 158 graduates of the COSECSA programme since its inaugural exams in 2004, only 13 (8 %) are women.

Surgeon country of training

Details of the first specialist surgical training qualification obtained are available for 1302 of the 1690 surgeons (77 %, Table 7). While many surgeons have completed more than one postgraduate training programme (post training fellowships or dual residency programmes, for example), only details of their initial qualification is reliably recorded in this dataset. Among this cohort, 1145 (88 %) obtained their primary surgical qualification within the COSECSA region and 157 (12 %) outside the

Table 1 Data fields queried

Capsule data fields queried	
First name	Address
Middle name	Academic qualifications
Last name	Job title
Specialty	Organisation
Gender	Organisation address

Table 2 Population per surgeon

	Population	Surgeons	Ratio	Surgeons per 100,000
Burundi	10,395,931	19	547,154	0.18
Ethiopia	96,633,458	337	286,746	0.35
Kenya	45,010,056	543	82,891	1.21
Malawi	17,377,468	41	423,841	0.24
Mozambique	24,692,144	57	433,196	0.23
Rwanda	12,337,138	49	251,778	0.40
Tanzania	49,639,138	177	280,447	0.36
Uganda	35,918,915	259	138,683	0.72
Zambia	14,638,505	85	172,218	0.58
Zimbabwe	13,771,721	123	111,965	0.89
Total	320,414,474	1690		
Regional surgeon: population ratio			189,594	
Regional surgeons per 100,000 population			0.53	

Table 3 Surgeon specialty

	General		Ortho		Urology		Plastic		ENT		Neuro		Paed		Oral/Max		Cardio		Total Surgeons specialty known		Unknown		Total Surgeons
Burundi	13	*68%*	1	*5%*	0	*0%*	0	*0%*	4	*21%*	1	*5%*	0	*0%*	0	*0%*	0	*0%*	19	*100%*	0	*0%*	**19**
Ethiopia	225	*67%*	59	*18%*	12	*4%*	14	*4%*	0	*0%*	10	*3%*	7	*2%*	0	*0%*	9	*3%*	336	*100%*	1	*0%*	**337**
Kenya	280	*52%*	86	*16%*	24	*4%*	8	*1%*	66	*12%*	19	*4%*	16	*3%*	28	*5%*	9	*2%*	536	*99%*	7	*1%*	**543**
Malawi	20	*49%*	11	*27%*	1	*2%*	2	*5%*	1	*2%*	2	*5%*	3	*7%*	1	*2%*	0	*0%*	41	*100%*	0	*0%*	**41**
Mozambique	18	*35%*	13	*25%*	7	*13%*	2	*4%*	5	*10%*	3	*6%*	2	*4%*	1	*2%*	1	*2%*	52	*91%*	5	*9%*	**57**
Rwanda	28	*57%*	8	*16%*	3	*6%*	1	*2%*	5	*10%*	3	*6%*	1	*2%*	0	*0%*	0	*0%*	49	*100%*	0	*0%*	**49**
Tanzania	52	*36%*	45	*31%*	13	*9%*	3	*2%*	7	*5%*	9	*6%*	5	*3%*	0	*0%*	12	*8%*	146	*82%*	31	*18%*	**177**
Uganda	120	*50%*	40	*17%*	12	*5%*	11	*5%*	27	*11%*	11	*5%*	7	*3%*	6	*2%*	7	*3%*	241	*93%*	18	*7%*	**259**
Zambia	48	*59%*	15	*19%*	7	*9%*	1	*1%*	4	*5%*	4	*5%*	1	*1%*	0	*0%*	1	*1%*	81	*95%*	4	*5%*	**85**
Zimbabwe	46	*39%*	17	*14%*	13	*11%*	4	*3%*	8	*7%*	7	*6%*	3	*3%*	17	*14%*	3	*3%*	118	*96%*	5	*4%*	**123**
Total	**850**	***53%***	**295**	***18%***	**92**	***6%***	**46**	***3%***	**127**	***8%***	**69**	***4%***	**45**	***3%***	**53**	***3%***	**42**	***3%***	**1619**	***96%***	**71**	***4%***	**1690**

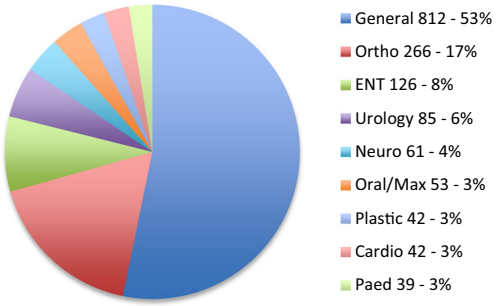

Table 4 Location: size of conurbation

	0–100,000		100,000–250,000		250,000–500,000		500,000+		Location recorded	Location not recorded	Total surgeons
Burundi	2	11 %	0	0 %	0	0 %	17	89 %	19	0	19
Ethiopia	49	15 %	48	15 %	38	12 %	187	58 %	322	15	337
Kenya	69	13 %	51	9 %	65	12 %	353	66 %	538	5	543
Malawi	3	7 %	2	5 %	0	0 %	36	88 %	41	0	41
Mozambique	0	0 %	1	2 %	3	5 %	52	93 %	56	1	57
Rwanda	13	27 %	0	0 %	0	0 %	35	73 %	48	1	49
Tanzania	5	3 %	27	16 %	1	1 %	140	81 %	173	4	177
Uganda	54	24 %	10	5 %	0	0 %	158	71 %	222	37	259
Zambia	6	7 %	4	5 %	9	11 %	65	77 %	84	1	85
Zimbabwe	1	1 %	0	0 %	1	1 %	93	98 %	95	28	123
Total	202	13 %	143	9 %	117	7 %	1136	71 %	1598	92	1690

region. The UK and Ireland accounted for the largest number of the latter group with almost one-third of this group qualifying as surgeons there, many of whom now seem to be nearing retirement. The vast majority of younger surgeons qualified within the COSECSA region. South Africa appears to be a popular destination for surgical specialisation for surgeons from the COSECSA region, though few obtained their initial qualification there.

Discussion

Data considerations and limitations

This paper only considers qualified specialist surgeons, which are not the only surgical providers. Furthermore, surgical providers provide such care as part of a team. The WHO Tool for situational analysis to assess emergency and

Table 5 Location: major commercial city or other conurbation

	In major commercial city		Outside major commercial city		Location recorded		Total surgeons
Burundi	17	89 %	2	11 %	19	0	19
Ethiopia	179	56 %	143	44 %	322	15	337
Kenya	319	59 %	219	41 %	538	5	543
Malawi	22	54 %	19	46 %	41	0	41
Mozambique	50	89 %	6	11 %	56	1	57
Rwanda	35	73 %	13	27 %	48	1	49
Tanzania	110	64 %	63	36 %	173	4	177
Uganda	158	71 %	64	29 %	222	37	259
Zambia	59	70 %	25	30 %	84	1	85
Zimbabwe	77	81 %	18	19 %	95	28	123
	1026	64 %	572	36 %	1598	92	1690

The major commercial city in each country is the capital city, except in case of Tanzania (where Dodoma is the capital and Dar es Salaam the major commercial city) and Malawi (where Lilongwe is the capital and Blantyre the major commercial city)

Table 6 Gender

	Male		Female		Total
Burundi	19	100 %	0	0 %	19
Ethiopia	322	96 %	15	4 %	337
Kenya	499	92 %	44	8 %	543
Malawi	36	88 %	5	12 %	41
Mozambique	48	84 %	9	16 %	57
Rwanda	44	90 %	5	10 %	49
Tanzania	156	88 %	21	12 %	177
Uganda	228	88 %	31	12 %	259
Zambia	69	81 %	16	19 %	85
Zimbabwe	114	93 %	9	7 %	123
Total	1535	91 %	155	9 %	1690

essential surgical care [15] collects information on the following cadres:

- Surgeons (qualified)
- Anaesthesiologist physician (qualified)
- Obstetrician/gynaecologist (qualified)
- General doctors providing surgery
- General doctors providing anaesthesia
- Nurse/Clinical/Assistant medical officers providing anaesthesia
- Clinical/Assistant medical officers providing surgery
- Paramedics/Midwives

All of those professions are directly involved in the provision of surgery. A situation analysis of the manpower of all professionals involved in surgical care in the COSECSA region would be of great value, but is beyond the scope of this paper. As well as determining similar data points to those analysed for specialist surgeons in this paper, it is recommended that any such analysis look at the roles and competencies of each of these other surgical care provider cadres in each country studied, as these roles and competencies can differ greatly between countries in the region.

As outlined, the database includes details of COSECSA members, fellows and trainees. The COSECSA training programme is of a minimum of 5 years duration and is split into two parts—core training (or surgery in general) lasting 2 years and specialty training (lasting 3 years). The membership examination (MCS ECSA) is taken at the end of year 2 (Postgraduate year (PGY) 2) and the fellowship examination (FCS ECSA) at the end of specialist training (PGY-5). In addition, surgeons who were already established in practice when the College was founded in 2003 became Foundation Fellows and surgeons trained elsewhere may become Fellows by election. Only those surgeons who have completed the COSECSA training programme (FCS ECSA) or an equivalent training programme in another jurisdiction were included in the present study as "specialist surgeons". As a regionally based surgical training college, COSECSA is uniquely well placed to obtain and maintain accurate specialist surgeon workforce data.

While surgical specialty data is recorded, training programmes in surgical specialties in Sub-Saharan Africa are a relatively recent development. As a consequence, the division between general surgery and surgical sub-specialities in the COSECSA region is fluid, particularly in rural areas where the general surgeon may frequently perform orthopaedic, urologic, neurosurgical or paediatric operations. It is also relatively more common for surgeons working in the COSECSA region to obtain sub-specialist training and qualifications outside the region, than it is for them to obtain their initial surgical qualification outside the

Table 7 Region where initial surgical qualification was obtained

Initial surgical qualification received in	Burundi		Ethiopia		Kenya		Malawi		Mozambique		Rwanda		Tanzania		Uganda		Zambia		Zimbabwe		Total	
COSECSA region	0	0 %	240	96 %	395	87 %	22	61 %	55	96 %	25	51 %	100	95 %	199	90 %	56	85 %	53	82 %	1145	88 %
Elsewhere in Africa	0	0 %	0	0 %	4	1 %	2	6 %	0	0 %	13	27 %	0	0 %	5	2 %	0	0 %	1	2 %	25	2 %
UK and Ireland	0	0 %	2	1 %	25	6 %	3	8 %	0	0 %	0	0 %	3	3 %	3	1 %	5	8 %	9	14 %	50	4 %
Elsewhere in Europe	0	0 %	1	0 %	4	1 %	1	3 %	0	0 %	6	12 %	1	1 %	10	5 %	4	6 %	2	3 %	29	2 %
USA and Canada	0	0 %	6	2 %	12	3 %	3	8 %	0	0 %	4	8 %	0	0 %	0	0 %	1	2 %	0	0 %	26	2 %
Rest of the World	0	0 %	1	0 %	12	3 %	5	14 %	2	4 %	1	2 %	1	1 %	5	2 %	0	0 %	0	0 %	27	2 %
Not recorded	19		87		91		5		0		0		72		37		19		58		388	
Total	19		337		543		41		57		49		177		259		85		123		1690	

region. This makes recording of later sub-specialisation relatively more difficult to record.

As many surgeons in the region work in both the public and the private sector, we have not attempted to make this differentiation. While data on surgeon work in the public and private spheres may be collected in future, for surgeons with both public and private practises, the balance of working time spent in each context may be difficult to determine. Without understanding this balance, data on public and private work may be of limited benefit in understanding surgical workforce capacity.

Date of birth of surgeons is not recorded due to non-availability; this data would allow for modelling of surgeon retirement and hence assist workforce planning. A more easily accessible data point is year of surgical qualification, which is increasingly recorded in this dataset, and may serve as a proxy for date of birth in future studies to predict surgeon retirement patterns.

Those surgeons with university academic posts, or with hospital or university administrative posts are regarded for the purpose of this paper as practising surgeons. The caseload undertaken is likely to vary considerably between such individuals, and it seems likely that a number of surgeons in this situation are not clinically active.

The surgical workforce is dynamic, meaning that any situation analysis such as this one will be rendered increasingly inaccurate as time passes, and even throughout the process of producing the research.

Conclusions

World Health Assembly resolution 68.15 calls on WHO member states to identify "human resource needs, and training and supply needs" [4] for surgery and anaesthesia. With a total of 1690 surgeons representing 0.53 surgeons per 100,000 population, it is clear that these needs are significant in the countries of the COSECSA region. While it must be recognised that the health systems are not otherwise comparable, the UK has 13.4 consultant surgeons per 100,000 population [16, 17]. Even within the region, there is an approximately seven-fold difference between the highest (Kenya) and lowest (Burundi) ratios. The Lancet Commission set a target of 20 surgeons, anaesthetists and obstetricians (combined) per 100,000 population [1]. If surgeons are taken to represent half of this target cohort, than this means a 10:100,000 surgeon: population ratio. This study shows a COSECSA region surgeon: population ratio of 0.53:100,000, thus highlighting the ambition of the Lancet Commission targets.

Non-clinician physicians who can undertake surgical procedures have been identified as a potential part of the solution to the human workforce crisis in LMICs [6, 18].

Further studies are underway including an extensive randomised controlled trial in Malawi and Zambia [19]. However, where surgical clinical officers can be trained and deployed, we believe that the development of a clinical officer grade that can safely perform surgery can only be successful with the parallel development of specialist surgeons to accept referrals, to support training and for on-going clinical governance.

The proportion of surgeons who are women in the region is low (9 %), but not greatly below international norms. Women comprise 9.95 % of consultant surgeons in the UK [20]. 8.2 % ($n = 13/158$) of COSECSA graduates since 2004 are female, while 14.5 % ($n = 43/297$) of COSECSA trainees as of December 2015 are female. Research in Zimbabwe shows 25 % of the medical student respondents who indicated an interest in postgraduate specialisation in surgery were female ($n = 32$) [21], and attitudes are likely to be similar throughout the COSECSA region. Thus a gradual increase of women as a proportion of the surgeon workforce in the region can be anticipated.

Whichever targets are set nationally for surgeon human resources in each COSECSA country, we believe it is clear that the number of surgeons in all countries in the region needs to be expanded significantly. We believe that the COSECSA model, which utilises appropriate surgical training environments, including provincial, mission and private hospitals as well as university teaching hospitals, provides a model through which surgical training can be rapidly expanded.

In addition to on-going validation and longitudinal analysis of the current dataset, we propose to expand the range of data to include the surgeons' date of birth, which will help predict the impact of likely retirement into surgical workforce forecasts.

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Compliance with ethical standards

Conflict of Interest This information was gathered as part of the RCSI/COSECSA collaboration programme, which is funded by Irish Aid. No additional funding was required. The authors declare no conflict of interest.

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