

A Situational Analysis of the Specialist Anaesthesia Workforce of East, Central and Southern Africa

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Abstract

Background: An accurate account of the distribution of qualified anaesthesiologists in East, Central and Southern Africa has been lacking with most of the current publications being estimates of headline figures. As university training programmes, and more recently the College of Anaesthesiologists of East, Central and Southern Africa (CANECSA), work to scale up the anaesthesiology workforce, it is crucial to understand the scope of the need by carrying out an extensive survey. This is key to informing policymakers and stakeholders for tackling the problem of human resources for anaesthesia.

Methods: The anaesthesiologist distribution in the eight CANECSA member countries was determined using a combination existing databases and collection of new data from sources such as CANECSA records, national medical council registers, national anaesthesiology society records, as well as data validation through direct and indirect contact with the anaesthesiologists. Data collation and analysis was performed using Microsoft Excel Spreadsheets and SPSS by assessing relevant frequencies and crosstabulations. Data was stored in a cloud-based database managed by CANECSA.

Results: 411 qualified anaesthesiologists were identified within the CANECSA member countries, a rate of 0.21 anaesthesiologists per 100,000 population compared to 333 (0.17 anaesthesiologists per 100,000 population) reported by the World Federation of Societies of Anaesthesiology (WFSA) in 2015/2016. Newly quantified details on the distribution of anaesthesiologists in the region include: the majority (89.5%) of anaesthesiologists perform clinical work and most (69.3%) are based in the main commercial cities of their countries of practice; only about one third (35.5%) are female; the majority are employed by government institutions (61.6%) and medical-training institutions (59.4%); and almost half (49.2%) of anaesthesiologists whose age was recorded ranged from 30 to 39 years.

Conclusion: The numbers of anaesthesiologists in CANECSA member countries are still far below all international recommendations constituting only about 5% of the minimum recommended figures for LMICs. Anaesthesiologist are highly concentrated in the major cities of the region, with few in provincial and rural areas. Nonetheless, all trends suggest huge opportunities for advancing training of more anaesthesiologists through collaborative efforts.

Background

In 2015 the Lancet Commission on Global Surgery (LCoGS) generated international interest in Surgery and Anaesthesia when it reported that nearly 5 billion people lacked access to safe, affordable and timely surgical and anaesthesia care (1). The Eastern Sub-Saharan population, as defined by the Global Burden of Disease Study, was estimated to meet only 20% of its required surgeries (1, 2). Moreover, there is a higher observed death rate post-surgery within Africa which has been partially attributed to inadequate anaesthesia care by the African Surgical Outcomes Study (ASOS) despite the region having a younger population with fewer comorbidities (3, 4).

The LCoGS recommended that the number of specialist Surgical, Anaesthetic, and Obstetric (SAO) specialist physicians working per 100,000 population be counted to understand the gaps facing safe surgical and anaesthesia care (1). It subsequently proposed 20 SAO specialists per 100,000 population by 2030 globally as the most cost-effective target for improving patient safety especially in Low-and Middle-Income Countries (LMICs) (1, 5). This measure is an indicator needed to measure progress towards Universal Health Coverage (6).

The World Federation of Societies of Anaesthesiologists (WFSA) argued that the number of specialist anaesthesia providers should match the combined number of specialist surgical providers, such as surgeons and obstetricians, to ensure effective leadership of anaesthesia services and delivery of emergency and essential patient care (7). This has not been the case in LMICs with more growth experienced in the number of surgeons compared to physician anaesthesia specialists, herein mainly referred to as anaesthesiologists (8).

In 2016, WFSA identified approximately 333 qualified anaesthesiologists in the eight College of Anaesthesiologists of East, Central and Southern Africa (CANECSA) member countries, representing 0.17 anaesthesiologists per 100,000 population (7). In context, WFSA recommends 5 anaesthesiologists per 100,000 population while Davies *et al.* suggest 4 anaesthesiologists per 100,000 population as a modest target required to achieve reasonable advances in anaesthesia in LMICs (7, 9).

High Income Countries (HICs) struggle with poor recruitment and high attrition in anaesthesia due to lack of supportive working and learning environments, poor perceived job satisfaction, lack of enthusiasm from seniors, and little or no early exposure to the field of anaesthesia resulting in poor knowledge of what the field involves (10). LMICs face additional challenges due to poor pay, inadequate infrastructure, migration and the lack of current data on the numbers, types and distribution of anaesthesia providers when tackling the problem of low workforce (7, 8, 11).

Consequently, more surgeons in Africa rely on other forms of anaesthesia practitioners especially Non-Physician Anaesthesia Providers (NPAPs) (3, 4, 7, 8). Nonetheless, it is imperative that the highest level of anaesthesia provision, namely anaesthesiologists, be kept to the highest quality of standard with an adequate and equitably distributed workforce to ensure the best training, supervision and performance of the other cadres (12, 13).

A growing number of National Surgical, Obstetric and Anaesthesia Plans (NSOAPs) have been produced by LMICs to address the health burden of conditions requiring surgery; these plans stress the need for continued global commitment through partnerships, the expansion of the health workforce and improved information management (14).

Aiming to advance education, standards, and research in safe anaesthesia and critical care, CANECSA sought to understand the extent of the need by determining not only headline figures, but also the distribution, profiles and career courses of the anaesthesiologists within member countries which are Eswatini, Kenya, Malawi, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe (15).

The aim of this study was to conduct a detailed situation analysis of qualified anaesthesiologists, within the East, Central and Southern Africa (ECSA) region and contribute to the development of a cloud-based database of anaesthesiologists managed by CANECSA.

Methods

Study Design

This situational analysis was conducted by performing a cross-sectional survey from May 2020 to September 2020. We sent relevant organisations and individuals an explanatory letter and the list of information required. Relevant tools for data validation were chosen based on their acceptability in different countries.

Data sources were divided into those that were publicly available and those available on request. Only data obtained from a minimum of two credible sources was included.

Table 1
Data sources used to identify anaesthesiologists

Publicly Available Data Sources	Data Sources Available on request
<ul style="list-style-type: none"> • Pre-existing records of CANECSA members, fellows, and council members. • National Medical Council Registers. Kenya, Zimbabwe, Rwanda, Tanzania had extensive publicly available registers compared to others. • Zambia College of Medicine and Surgery (ZACOMS). 	<ul style="list-style-type: none"> • Anaesthesia societies particularly Kenya Society of Anaesthesia (KSA), Rwanda Society of Anesthesiologists (RSA), and Association of Anesthesiologists of Uganda (AAU) records. • Direct requests for information to CANECSA members, hospitals, hospital groups and Non-Governmental Organisations (NGOs).

A formal validation exercise was undertaken to cross check, update and expand all existing records individually through a combination of consultation with the above primary sources and direct contact with anaesthesiologists, their peers, and their employers. Direct contact included telephone calls, email correspondence, an online survey, online video calls and published professional social media profiles. Additionally, national surgical society connections, the College of Surgeons of East, Central and Southern Africa (COSECSA) network of surgeons, and CANECSA partner events and training courses were consulted where available. The minimum dataset we collected is described in Table 2. Notably, the Anesthesiology Association of Uganda (AAU) had an unpublished validated anaesthesiologist database for Uganda in conjunction with the University of California, San Francisco.

Table 2
Minimum dataset collected on anaesthesiologists

Individuals	Organisations (Primary Employer)
<ul style="list-style-type: none"> • Name (First name, Middle name (where applicable), Surname). • Sex. • Age. • Clinical activity status. • Location (primary work address). • Country of origin (nationality/citizenship). • Academic qualifications including, where possible, year, institution, and country of qualification. • Sub-Specialisation (where applicable), including relevant fellowships and postgraduate diplomas. 	<ul style="list-style-type: none"> • Hospital name and location including town/city and country. • Medical training status of hospital of primary employment. • Type of hospital ownership– public or private. Private facilities included Private for Profit (PFP), Private not for Profit (PNFPs) and all others that are not categorised as public or government owned. • Other organisations such as Non-Governmental Organisations.

Population estimates of countries and cities/towns were obtained from the WHO database and World Population Review respectively (16, 17).

The first stage of data collection was limited to qualified anaesthesiologists (i.e. qualified specialist Physician Anaesthesia Providers or equivalent) who had completed postgraduate training in anaesthesiology/anaesthesia or equivalent (e.g. Master's in Medicine in Anaesthesiology and Critical Care (or equivalent) or Fellowship in Anaesthesia) and were permanently based in any of the eight CANECSA member countries. Other cadres of anaesthesia provider such as trainee anaesthesiologists, doctors providing anaesthesia without formal training, NPAPs including nurse anaesthetists, anaesthetic technicians and anaesthetic officers (or equivalent), and anaesthesiologists who work in the region part-time as visitors were excluded.

Using password-protected Microsoft Excel Spreadsheets and IBM SPSS software, deduplication, unification of terminology, identification of missing data and coding were performed. Data analysis was done using SPSS through assessment of various frequencies and crosstabulations relevant to the topics of interest. CANECSA retained all identifiable information.

Ethical approval was obtained from the College of Surgeons of East, Central, and Southern Africa (COSECSA), Queen's University Belfast (QUB) and the Royal College of Surgeons of Ireland (RCSI).

Results

Overall, the ECSA region seems to have had an increase in the numbers of anaesthesiologists since 2015/2016 from 333 to 411 (Table 3). 57.2% of the anaesthesiologists identified are CANECSA members. Kenya has 176 anaesthesiologists, the highest (42.8%) proportion in the region, while Malawi and Eswatini have the lowest at four anaesthesiologists (1%) each. Zimbabwe has the highest anaesthesiologist to population ratio in the region (0.43 per 100,000) which is over twenty times higher than Malawi (0.02 per 100,000) (Table 3 and Fig. 1). Rwanda is the only country that has more than doubled both ratios and total numbers of anaesthesiologists while Eswatini and Malawi both seem to have had decreases.

Table 3
Anaesthesiologists per population in comparison to the WFSA estimates of 2015–2016

Country	Population Estimate (WHO-2015) (17)	Current Numbers of Anaesthesiologists	Current Anaesthesiologists to Population Ratios (per 100,000)	WFSA 2015/16 Anaesthesiologists Estimate(7)	WFSA Population Ratio (per 100,000)
Eswatini	1287000	4	0.31	7	0.54
Kenya	46050000	176	0.38	152	0.33
Malawi	17215000	4	0.02	5	0.03
Rwanda	11610000	32	0.28	14	0.12
Tanzania	53470000	36	0.07	24	0.04
Uganda	39032000	66	0.17	47	0.12
Zambia	16212000	26	0.16	21	0.13
Zimbabwe	15603000	67	0.43	63	0.4
Total	200479000	411	0.21	333	0.17

There are 146 female anaesthesiologists in the CANECSA member countries constituting only about one third (35.5%) of all anaesthesiologists in the region. In Rwanda male anaesthesiologists are five times the number of their female counterparts (81.25% and 18.75% respectively). Only Malawi had an equal distribution of anaesthesiologists by sex.

Age is available for less than half (179) of the anaesthesiologists and ranges from 31–73 years (mean 42.7, median 40.7 years). Of these, almost four fifths (79.3%) are under 50 years of age and almost half (49.2%) are aged between 30 and 39 years.

The majority (89.5%) of anaesthesiologists within CANECSA were confirmed to be actively practising in clinical capacities. 32 (7.8%) remain unknown while 11 (2.7%) individuals were confirmed to be in entirely non-clinical roles such as administration, research or retirement.

The vast majority (96.6%) of individuals are originally from within CANECSA member countries and most (94.2%) work in their countries of origin or nationality. Eswatini has the greatest proportion (50%) of foreign anaesthesiologists, though, these were mainly from other CANECSA countries namely, Uganda and Tanzania (Fig. 2).

The anaesthesiologists confirmed to have received their first specialist anaesthesiology qualification from within the CANECSA region were 357 (86.86%) and of these, 96.6% practise in their country of training (Fig. 3). Two (0.5% of all) anaesthesiologists had trained in the Democratic Republic of Congo. A further 28 (6.8%) had trained from Asia (India, Pakistan – 2.4%), Europe (UK, the Netherlands, Belgium, Russia, Yugoslavia – 3.4%), America (Canada, USA – 0.8%) and Australia (0.2%). Most of the individuals trained from outside Africa qualified in the 1970s or earlier.

There were no anaesthesiology training programmes in Eswatini at the time of this study.

The majority (69.3%) of the 382 anaesthesiologists whose location by city/town was confirmed are based in the largest commercial cities of their countries of practice (Fig. 4). The largest commercial cities are also the capital cities of most countries except Tanzania and Malawi. Further analysis showed that 258 (67.5%) anaesthesiologists are based in cities of more than 1 million people, while only 12.6% are located in cities of less than 100,000 people. City/town populations vary across different countries within the region.

About three quarters (n = 312, 75.9%) of anaesthesiologists are general anaesthesiologists with no subspecialty listed (Table 4). Thirteen individuals were noted to have more than one subspecialty for example a combination of paediatric anaesthesia and critical care or cardiothoracic anaesthesia with critical care. Table 4: Subspecialties of Anaesthesiologists within CANECSA.

The majority (59.4%) of anaesthesiologists in the region are based in institutions that participate in medical training especially at the undergraduate level. Additionally, government/public institutions are reported as the primary facilities of employment by a majority (61.6%) of anaesthesiologists within the region while 20.9% are predominantly in the private sector and the rest remain unknown.

Discussion

This situation analysis finds 411 qualified anaesthesiologists (0.21 anaesthesiologists per 100,000 population) in CANECSA member countries. Comparison with previous estimates of 333 (0.17 per 100,000 population) in 2015/2016 (7) suggests that these numbers are slowly rising, but the figures still fall far below all available international recommendations for Low-and-Middle-Income-Countries (LMICs) (1, 7, 9). The lower of these recommendations, which is 4 anaesthesiologists per 100,000, is about twenty times the anaesthesiologist density of the CANECSA region (9). This would require at least an additional 7600 anaesthesiologists to achieve, even without any population increase.

In the last 5 years, Rwanda is the only country that has more than doubled its number of anaesthesiologists (from 14 to 32). This may be linked to initiatives taken by Rwanda to address issues facing healthcare delivery in the country, such as the Human Resources for Health (HRH) Program which was launched in 2012 and was hailed by Paul Farmer as “the boldest effort I’ve seen to make good on a central promise of global health” (18, 19). The HRH initiative targeted challenges in healthcare delivery in Rwanda, the greatest of which was seen as the critical shortage in skilled health workers (19). Other CANECSA countries could learn from Rwanda’s experiences in order to address their own challenges in human resources for health and in the field of anaesthesia.

In comparison, in the 2015 COSECSA survey, 1277 surgeons (0.68 surgeons per 100,000 population) were identified within seven of the countries that are members of both COSECSA and CANECSA (20). This ratio of about 2–3 surgeons per anaesthesiologist seems to be the norm worldwide (21, 22). In LMICs and especially Africa, NPAPs are utilised by many countries to fill the gap left by low numbers of anaesthesiologists (7). WFSA reported that there were 2461 NPAPs working in the ECSA region in 2015/2016 (7). However, the poor surgical outcomes reported within Africa call for better training and supervision of these cadres of anaesthesia providers (3, 7, 23). Key to this is the training of more anaesthesiologists and redefining the roles of NPAPs as the future anaesthesia workforce composition changes within the region.

Women are underrepresented in specialist anaesthesia in the ECSA region with 35.5% female anaesthesiologists within the CANECSA countries. This is, however, a higher proportion of women compared to surgeons. In the seven countries that belong to both CANECSA and COSECSA, there were just 10.3% female surgeons in 2015/2016 compared to 35.6% female anaesthesiologists in this survey (20). The low proportion of women amongst these specialties compared to men could be a result of low female medical student intake at the undergraduate level as a result of a historically long-standing gender gap in education, particularly in Africa (24). Even so, factors leading more women to specialise in anaesthesiology compared to surgery could prove beneficial to both sectors in future recruitment drives.

The predominantly young anaesthesiologist population in the ECSA region demonstrates potential for growth and sustainability in the field of anaesthesia as evidenced by the known age mean of 42.7 years (median 40.7 years) with about three quarters of anaesthesiologists being below 50 years. Each has the potential to be retained within the region and participate in the training of other individuals. However, challenges in obtaining information on age make it difficult to generalise these findings with attempts to reach individuals also yielding little additional information.

While the majority of anaesthesiologists (89.5%) were found to be active in some clinical capacity, it was not possible to identify what proportion of their work was clinical. Many of the non-clinical roles of anaesthesiologists are equally important if effective delivery of anaesthesiology services is to be achieved including administration and research. Good governance is one of the key pillars of good healthcare delivery and this is required in many African institutions; having anaesthesiologists involved in governance ensures prioritisation of the sector (25, 26).

We found that the majority (94.2%) of anaesthesiologists are from within the region and most work in their countries of origin or nationality. This may indicate a reliance on a local workforce instead of visiting specialists.

The majority (86.7%) of anaesthesiologists working in the ECSA region were trained from within the region. Those who received their initial anaesthesiology training from outside the region qualified mostly in the 1970s or earlier, reflecting advances in the field of anaesthesia. Sub-specialist training on the other hand is still predominantly being obtained from abroad.

The concentration of anaesthesiologists in major commercial and most densely populated cities is similar to the distribution of surgeons in the region (20). This is a chronic problem in developing countries across various fields of medicine which often leaves the rural communities at a disadvantage (27). While location of anaesthesiologists by conurbation reported in this study is crucial to understanding the workforce, it does not fully represent the catchment area of their hospitals of employment as some serve communities far beyond the cities/towns in which they are located.

Although 24.1% of anaesthesiologists reported a sub-specialty, many individuals (both sub-specialised and not) often perform roles in other disciplines, partly due to the inadequate numbers calling for more general anaesthesiologists first. As anaesthesiology is constantly developing and is under-represented in surgical care, it is important to note that the boundaries of sub-specialties are not always clearly defined and all individuals with or without a listed sub-specialty often also perform roles across many sub-specialties.

Tackling these problems requires new ideas, for instance training programmes that send anaesthesiologists to locations of greatest need, educating stakeholders on the field of anaesthesia and improving working conditions. Borrowing from the COSECSA model which utilises appropriate surgical training environments, including provincial, mission and private hospitals as well as university teaching hospitals, organisations such as CANECSA can prove useful to the expansion of the anaesthesia workforce as well as reaching the most vulnerable communities (15, 20).

Limitations

The study only considers fully qualified anaesthesiologists who are not the only anaesthesia providers in the region. There is a great bulk of the work undertaken by other cadres especially NPAPs. Further studies need to be undertaken to detail the distribution, roles, and the level of skill of other anaesthesia providers.

We cannot comment on the full extent of migration of anaesthesiologists as there are many individuals trained from within ECSA that are now based outside of the region and were not captured in this data collection process. Analysis of the full extent of migration was beyond the scope of the study.

Attempts were made to differentiate between anaesthesiologists by the ownership of their hospitals of primary employment, however, we recognise that many individuals often hold multiple jobs in the different sectors.

The WHO population estimates may not be the most recent for some countries but they offer a uniform source of information on population (16). Therefore, this may not be the most accurate representation of anaesthesiologist density since population change has not been considered.

Due to coronavirus disease (COVID-19) many countries either delayed graduations or had not updated their registers to reflect recently qualified anaesthesiologists. As such, the situational analysis of anaesthesiologists within the ECSA community requires ongoing updates for accuracy. The existence of a database such as the one from this study should simplify follow-up. Countries are encouraged to regularly update their own registers to make future research easier by having good quality accessible data in accordance with WHO resolutions to strengthen emergency surgical and anaesthesia care (28).

The numbers for Tanzania should be interpreted with caution due to difficulties in validating the information by direct/indirect contact. However, the information presented was obtained primarily from at least two credible sources mainly the Medical Council of Tanganyika and CANECSA records.

Conclusions

This is the first detailed situational analysis of the specialist anaesthesia workforce in CANECSA member countries. It confirms the expected low numbers of anaesthesiologists within the ECSA region. Additionally, variations in location, gender, age, training and primary employers of anaesthesiologists across the region have been highlighted through this survey, not least of which are difficulties facing delivery of specialist anaesthesia services to rural populations and recruitment of more doctors especially women into the field. Training is particularly challenging with some countries such as Eswatini lacking specialist anaesthesia training institutions as of the time of this study.

All are key factors to determining the quality of anaesthesia care provided to patients in the ECSA community as well as the future development and sustainability of the sector. While these factors need to be collectively addressed, questions arise as to how to proceed in policy and practice.

Urgent action is required by governments and other organisations working in the region through partnerships and creative solutions that effectively utilise the available human resource of anaesthesiologists to not only deliver quality anaesthesia care, but also to ensure accelerated growth with appropriate distribution of services for equitable delivery and sustainability of anaesthesia care.

Abbreviations

ASOS African Surgical Outcomes Survey

CANECSA College of Anaesthesiologists of East Central and Southern Africa

COSECSA College of Surgeons of East, Central and Southern Africa

ECSA East Central and Southern Africa

LCoGS Lancet Commission on Global Surgery

LMICs Low and Middle Income Countries

PAP Physician Anaesthesiology Provider

NPAP Non-Physician Anaesthesia Providers

WFSA World Federation of Societies of Anaesthesiologists

Declarations

Ethical approval and consent to participate

Ethics approval and affirmation was sought and granted by COSECSA, Royal College of Surgeon of Ireland (RCSI), and Queen's University Belfast (QUB) Research Ethics Committees (REC) and/or Internal Review Boards (IRB). (Faculty REC Reference Number MHLS 20_70).

Informed Consent from the individuals was implied in the survey but was not required for information which was publicly available. Assurance of confidentiality as per non-disclosure agreement was communicated to the appropriate individuals.

Availability of data and materials

The anonymised datasets used and analysed during the current study can be made available from the corresponding author on reasonable request.

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Competing Interests

The authors declare they have no competing interests.

Authors contributions

EOF, DM and MU had the original idea of surveying conducting the situation analysis of anaesthesiologists in the CANECSA member countries.

JA, EOF, DOD and SM designed the data collection processes and analysed the data.

JA led the data collection, analysis of the results and wrote the first draft of the paper.

All authors were involved in the design of the study, writing and approval of the manuscript.

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Table

Due to technical limitations, table 4 is only available as a download in the Supplemental Files section.

Figures

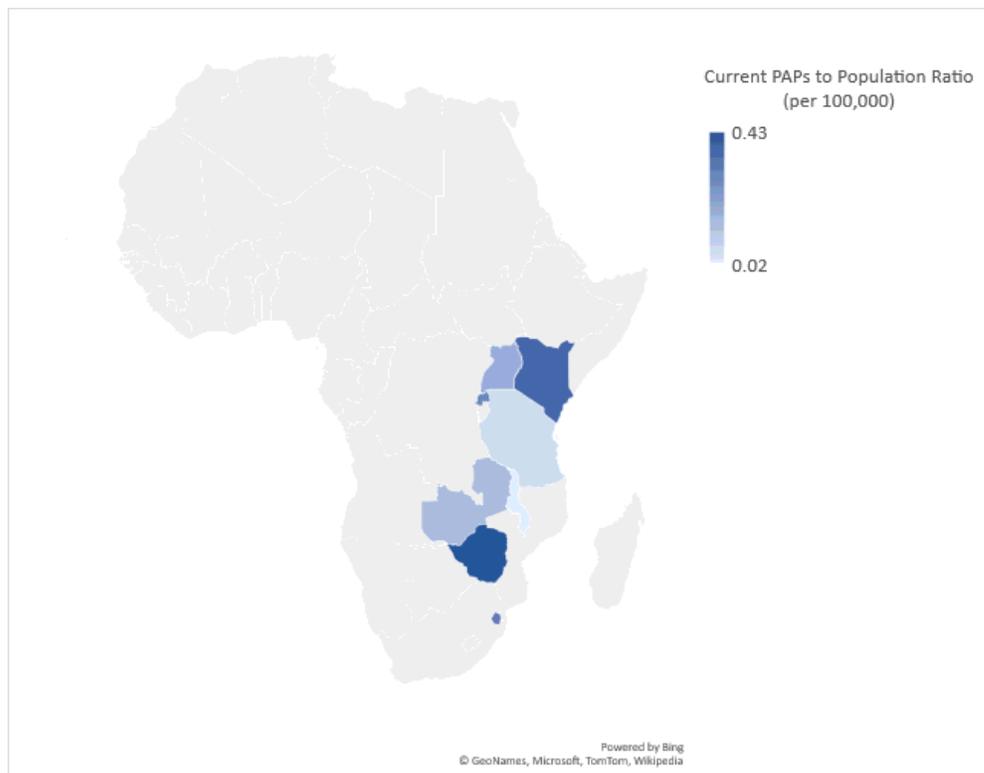


Figure 1

2020 Anaesthesiologist density in CANECSA member countries. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

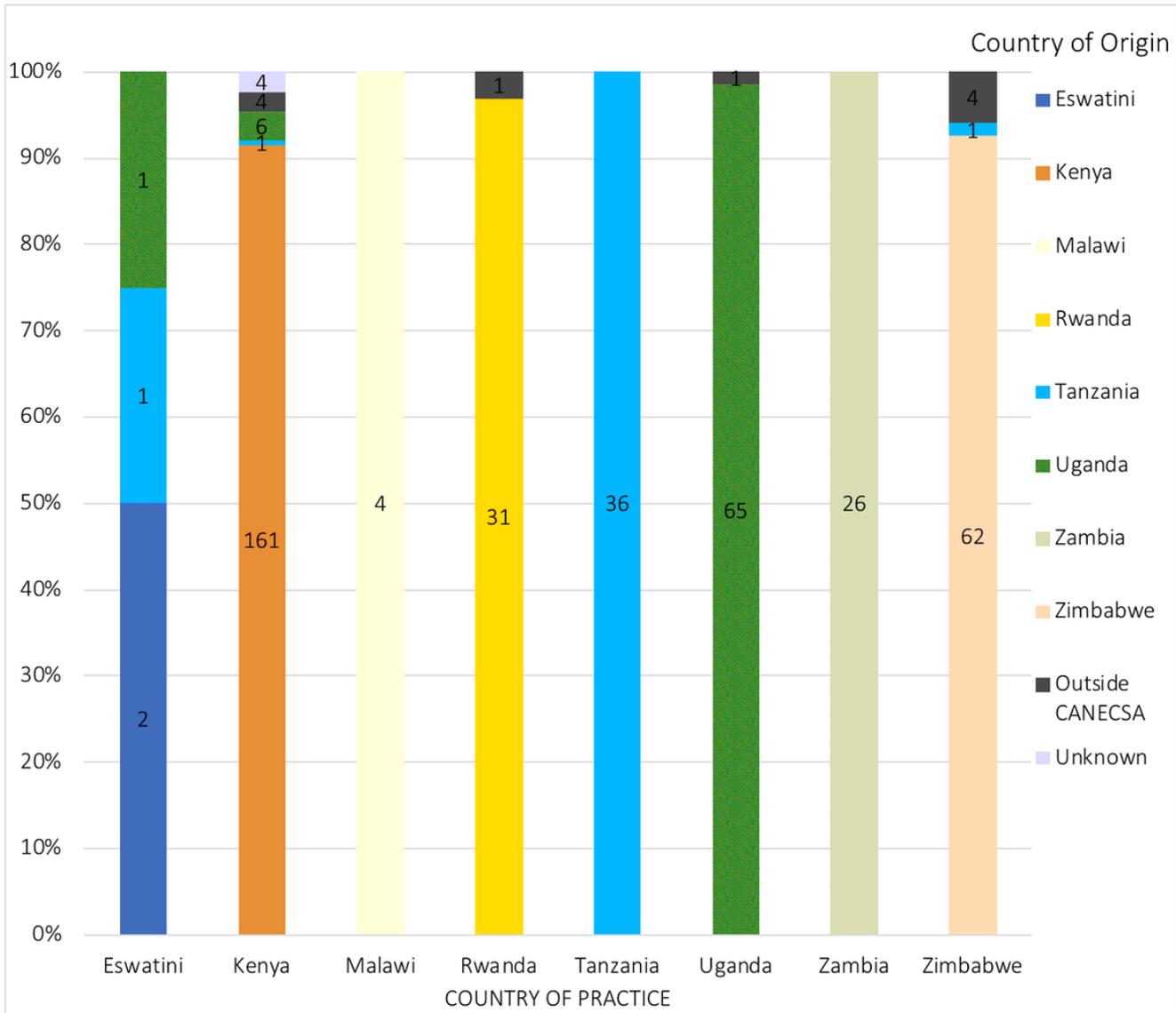


Figure 2

Anaesthesiologists' country of origin in comparison to their country of practice.

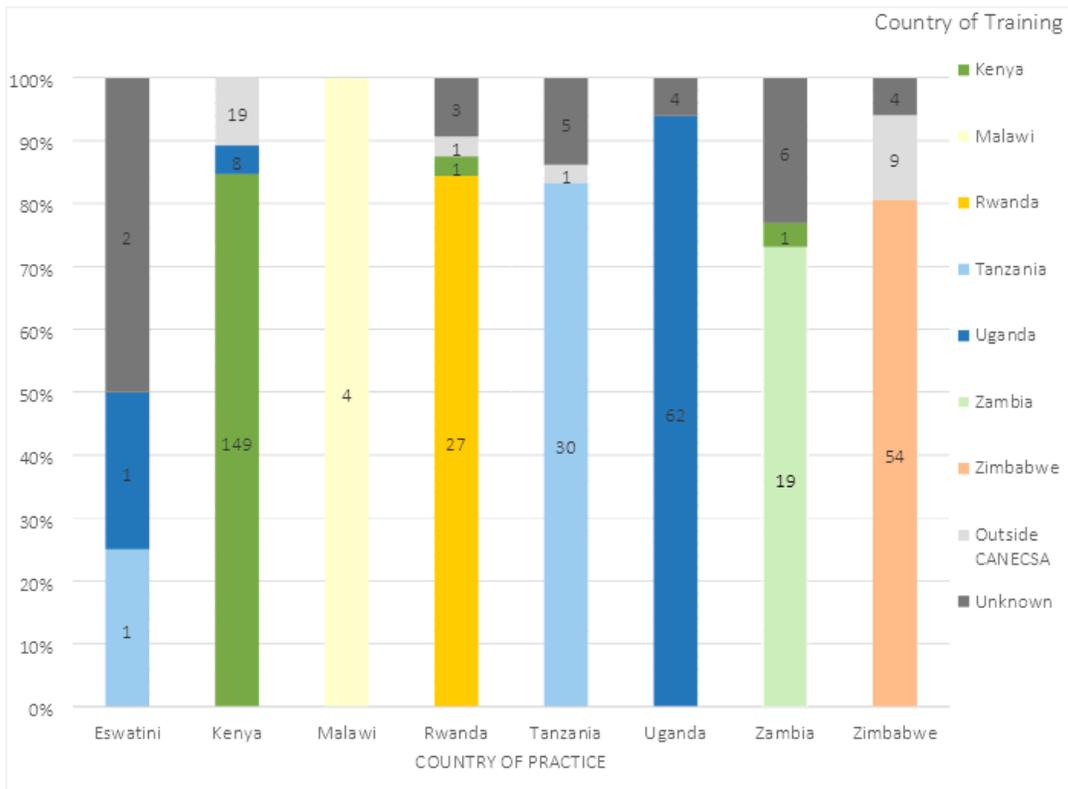


Figure 3

Country of secondary anaesthesiology qualification in comparison to country of practice

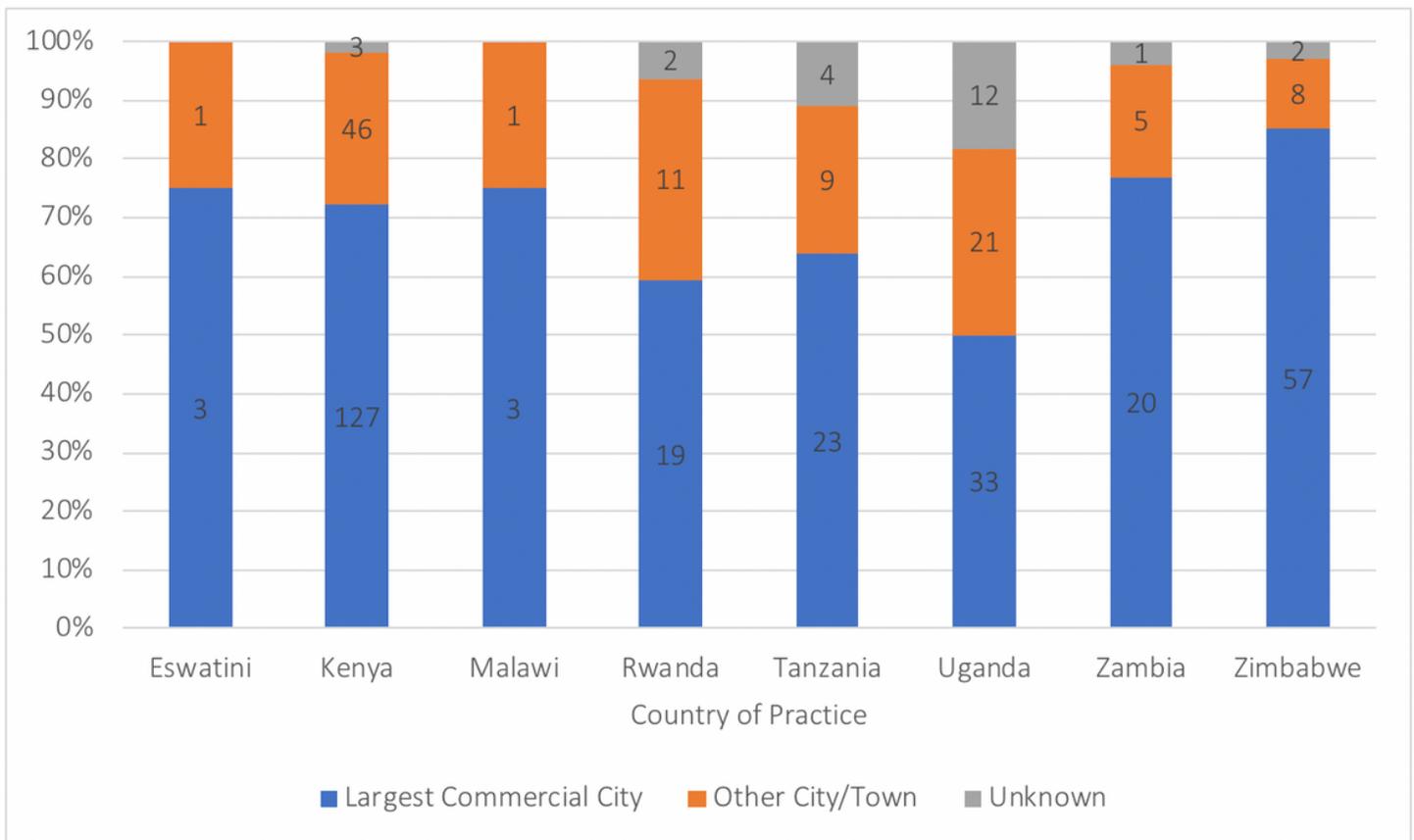


Figure 4

Anaesthesiologists' city of practice.

Supplementary Files

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- [table4.png](#)