FACTORS INFLUENCING SURGICAL CARE DELIVERY IN SIERRA LEONE

Changes in surgical productivity between 2012 and 2017 and an exploration of challenges and opportunities from the perspective of surgical providers

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FACTORS INFLUENCING SURGICAL CARE DELIVERY IN SIERRA LEONE:
Changes in surgical productivity between 2012 and 2017 and an exploration challenges and opportunities from the perspective of surgical providers

A thesis submitted in partial fulfilment of the requirement for the degree of

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by

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Declaration:

Where other people's work has been used (from either a printed source, internet or any other source), this has been carefully acknowledged and referenced in accordance with departmental requirements.

The thesis 'Surgical care in Sierra Leone: surgical productivity over time and an exploration of influencing factors' is my own work.

Signature: 

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II: Abbreviations

CHO	Community Health Officer
CPD	Continuous Professional Development
CS	Caesarean section
DHS	Demographic Health Survey
EVD	Ebola Virus Disease
FHCI	Free Health Care Initiative
GDP	Gross Domestic Product
HIS	Health Information System
IPC	Infection prevention and control
LCoGS	Lancet Commission on Global Surgery
LMIC	Low- and middle-income countries
MoHS	Ministry of Health and Sanitation
NCD	Non-communicable disease
NEMS	National Emergency Medical Service
NGO	Non-governmental organization
NHSSP	National Health Sector Strategic Plan 2017-2021
NMSA	National Medical Supplies Agency
NSOAP	National Surgical, Obstetric and Anaesthesia Plan
OT	Operating Theatre
PHU	Peripheral Health Unit
PI	Primary investigator
SACHO	Surgical Assistant Clinical Health Officer
SARA	Service Availability and Readiness Assessment
SLeSHI	Sierra Leone Social Health Insurance Scheme
STP	Surgical Training Programme
UNFPA	United Nations Population Fund
USD	US dollar
WHO	World Health Organization

III: Glossary

Surgical facilities Hospitals and clinics performing one or more of the comprehensive surgical procedures, as listed by the World Health Organization (WHO) in the Service Availability and Readiness Assessment (SARA), page 170 (1).

Surgical procedure Any procedure involving incision, excision, manipulation or suturing of tissue, usually performed in an operation room and requiring anaesthesia, listed in the facility operation recording system (2).

Surgical provider Any professional health worker performing any type of surgical procedures (as defined above), irrespective of level of training or supervision (2,3). In this study health workers providing only anaesthesia care are not included in the definition.

Surgical specialist Physician who completed a postgraduate specialist training in surgery (including paediatric surgery, urology, orthopaedic surgery), anaesthesia, obstetrics/gynaecology, or ophthalmology and who is currently registered and operating as surgical provider (3).

Surgical workforce A network of **t**rained and certificated health workers that operate together to deliver surgical care. This includes surgical providers, but also related professionals, such as anaesthetic providers, nurses, operating theatre managers and staff, etc. (3)

Specialist workforce All surgical specialists (see definition above) who are currently registered and operating as surgical provider.

Associate clinician A health worker who is not a physician, but is trained specifically to diagnose and manage certain medical and surgical conditions (3). Some might work as surgical provider. Also referred to as non-physician clinician, or community health officer (CHO) in Sierra Leone. CHO's follow a three-year training with a strong emphasis on community and public health. In Sierra Leone, a Surgical Assistant Community Health Officer (SACHO) is a specialised CHO or associate clinician trained to perform surgical procedures. An additional three years of full-time training is followed to qualify as SACHO. Some of the associate clinicians in Sierra Leone followed their training abroad.

Surgical productivity Number of surgical procedures performed per surgical provider per week (4)

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VII: Abstract

Introduction: Since 2012, when the unmet surgical need in Sierra Leone was 92% (5), the volume of surgeries per 100,000 population remained similar despite an increase in surgical workforce. Surgical productivity has decreased. This study aimed to explore influencings factors according to surgical providers to understand this decrease and identify opportunities for improvement.

Methodology: This explanatory sequential mixed methods study analysed surgical activity data from 287 surgical providers in 84% of public and private non-profit surgical facilities to determine median surgical productivity among different surgical cadres and settings. In-depth interviews about factors influencing surgical productivity were conducted with 21 surgical providers from 11 facilities and thematically analysed.

Results: Median surgical productivity was 1.2 surgical procedures per week with large differences between surgical cadres. Productivity decreased among all cadres except associate clinicians. Since a large group of surgical providers is performing few procedures, enhancing productivity provides an important opportunity to reduce unmet surgical need. Surgical providers experienced factors across the whole health system to influence surgical productivity.

Discussion: Strengthening of the health system as a whole is required to facilitate an increase in surgical productivity and meet surgical needs in Sierra Leone. Political commitment at country-level is required to expedite progress. The barrier of high out-of-pocket expenditure is important to address. Improving supplies and expanding training opportunities for new and established surgical providers can increase capacity. For sustainability and retention of surgical providers recognition and fair remuneration are needed. Quality of surgical care needs to be regarded while expanding capacity.

Key words: Global surgery, health systems, human resources, Sierra Leone, task-sharing

Word count summary: 249

Word count thesis: 13,146

VIII: Introduction

In 2017 I finished my training as a medical doctor in global health and tropical medicine. After an inspiring last residency in a hospital in India, I was ready to start working in a rural hospital in Ethiopia. In both places I faced the challenges that exist in low-resource settings, and I realized more and more my limitations as an individual doctor and the importance and power of strengthening local systems. Luckily I was also able to see the results of commitment and successful management and programmes. This motivated me to apply for the Master in International Health when returning to the Netherlands.

Around this time, I was fortunate to come into contact with CapaCare, an organization working on surgical task-sharing in Sierra Leone in collaboration with the Ministry of Health and Sanitation. As I have seen great results of task-sharing in obstetrics in Ethiopia, and observed how people thrive if given the right training, trust and confidence, their objectives of education and building local capacity were very much in line with mine. I am grateful for the opportunity they gave me to be involved in training obstetrics to associate clinicians and medical doctors in Sierra Leone.

My first impressions of Sierra Leone during this training were those of a heart-warming country with very motivated people. From the experiences they shared it was evident that there is still a high unmet need for surgical and obstetric care, and that health providers were dealing with the challenges of an ill-equipped health system on a daily basis. This motivated me to return for the research for this thesis to explore these challenges and the opportunities to improve surgical and obstetric care from the perspective of surgical providers. Not only does this thesis mark the end of the master International Health for me, it also has given me the opportunity to explore the field of qualitative research. But most importantly, with this thesis I want to give voice to the surgical providers of Sierra Leone in the hope of contributing a small part in strengthening the system.

I am thankful to everyone who welcomed me with open arms in health facilities, who shared their stories and challenges, to the CapaCare team, both international and local, for the guidance and support, and the research assistants for their help.
A special word of memory and thanks to Wouter, who, as programme coordinator of CapaCare during the research, was of tremendous help by introducing me to Sierra Leone and to the right people. Thank you for your sharp mind and discussions, for sharing great times in Masanga and during field trips and for your friendship and enthusiasm. You will keep inspiring us through the work you did and the people you touched.

1 Background

1.1 Country setting

Sierra Leone is a low-income country in West-Africa. The country is divided in four regions and one area, that are further subdivided into 16 districts and 190 chiefdoms (6). According to the most recent population and housing census in 2015 the population was 7.1 million people, of whom 59% lived in rural areas (7). Annual population growth is 2.1% (8).

Political and economic situation

Sierra Leone gained independence from Great Britain in 1961. A civil war affected the country from 1991 to 2002, leaving tens of thousands people killed and infrastructure and economy destroyed. In 2014-2016 Ebola Virus Disease (EVD) disturbed all vital structures of the country, including the health system. Together with a decline in iron ore price this resulted in negative growth of gross domestic product (GDP) in 2016. Since 2017 economic growth was restored with increased exports (8,9). In 2018 the annual growth rate of GDP was 2.4% and annual inflation 13.4% (8). In 2019 Sierra Leone was positioned 181 of 189 countries on the Human Development Index (10). More than half of the population lives under the poverty-line of $1.90 a day, with large and increasing inequality (figure 1 and 2)(9,11).

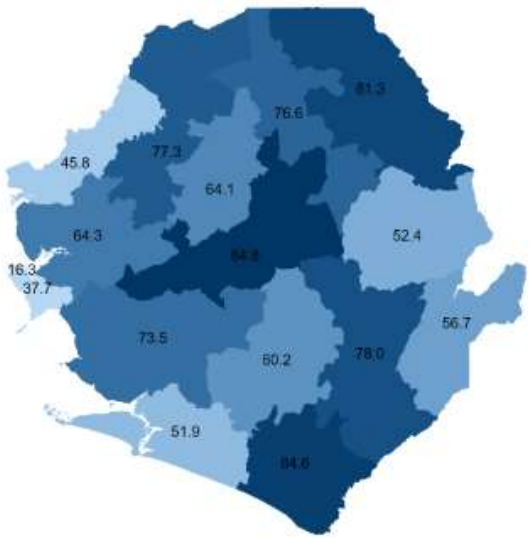

Figure 1 Total poverty rate in 2018 by district (11)

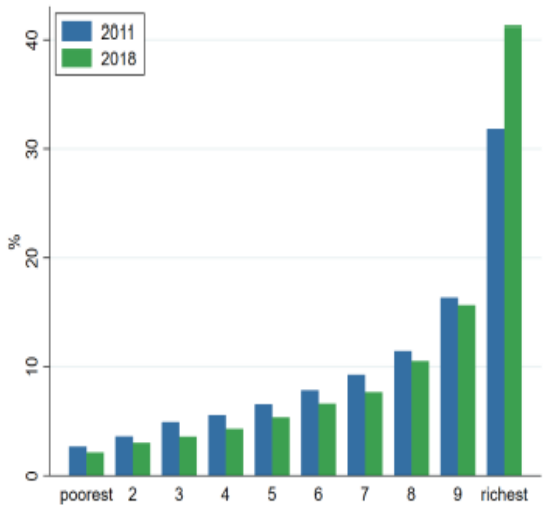

Figure 2 Share of household consumption (in % on y-axis) by decile of the population in 2011 and 2018 (11)

1.2 Health system

The health system consists of 'all organizations, people and actions whose primary intent is to promote, restore or maintain health' according to the World Health Organization (WHO), and has several components (building blocks): service delivery, governance and leadership, financing, access to medical products and technologies, health workforce and health information system (figure 3)(12). In 2017 Sierra Leone's health system scored among the worst globally (13). It is confronted with many challenges, like poor infrastructure, small health workforce with poor conditions of service, and poor governance of health delivery systems (9).

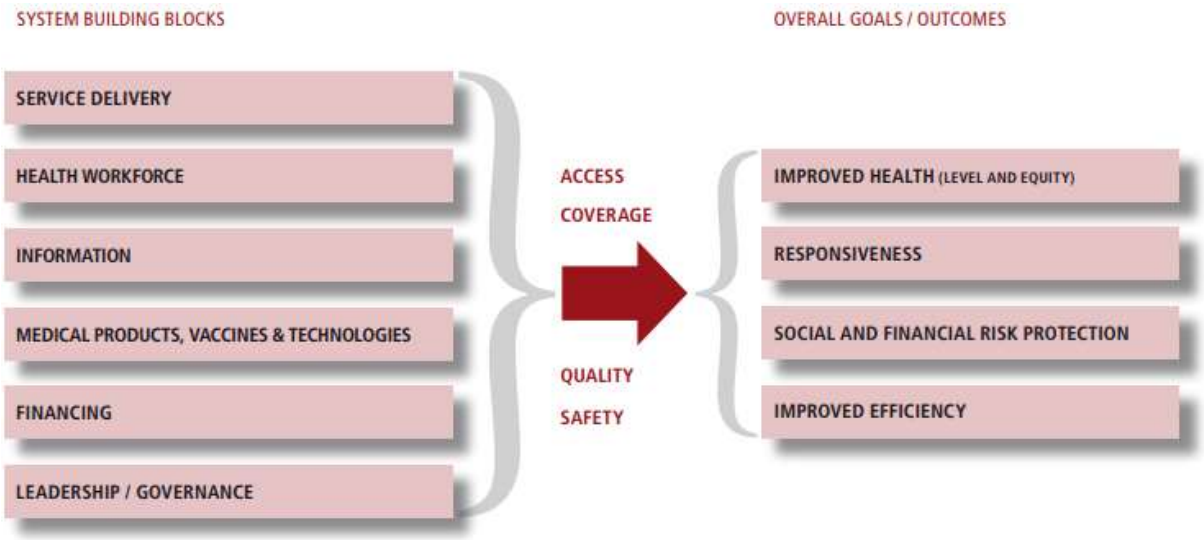

Figure 3 WHO Health System Framework (12)

Health services

Sierra Leone has a three tier health system (figure 4). The primary care level consists of peripheral health units (PHU's). Secondary care is delivered in district hospitals and regional hospitals (14). District hospitals function as first level referral centres. Their services include surgery, general anaesthesia, and comprehensive emergency obstetric care, including caesarean sections (CS) and blood transfusion services. Patients that cannot be managed at district hospitals may be referred to one of the three regional hospitals or referral (tertiary) hospitals (14). In 2017 there were 54 hospitals, of which approximately half were public facilities (15).

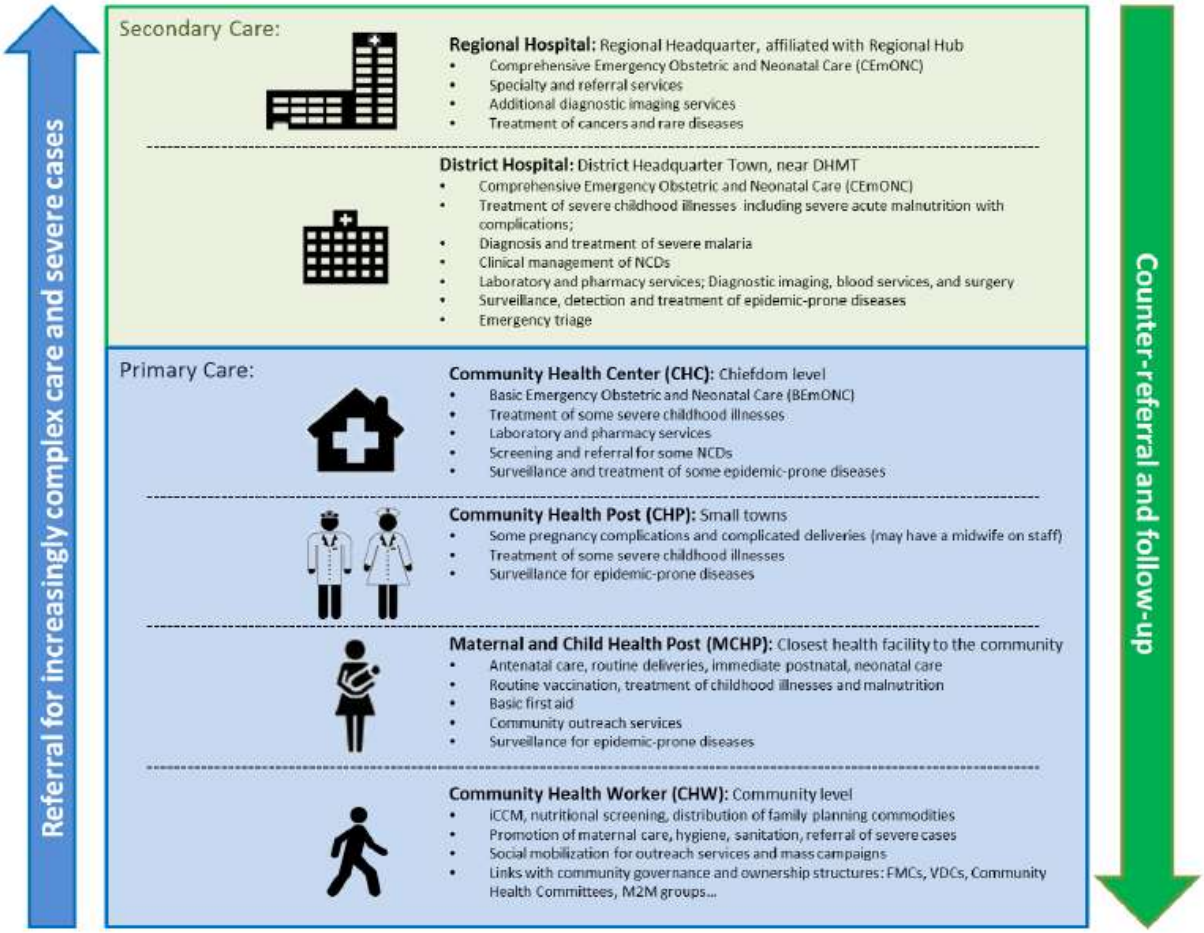

*Figure 4 Overview of the health services the health system in Sierra Leone with primary and secondary levels of care. *Tertiary facilities are not included in this figure, since currently they do not meet international levels of tertiary care. They are planned to be upgraded through the University Teaching Hospitals Complex.* (14)

Governance and financing for health

The main healthcare provider in Sierra Leone is the Ministry of Health and Sanitation (MoHS). Collaboration with implementing partners, donors and the private sector adds to the full implementation of services (14). Domestic spending on health in Sierra Leone was 2% of GDP in 2017. Eight percent of national budget was allocated to health, below the 2001 Abuja Declaration minimum of 15% (16,17). Fifty percent of total health expenditures were out-of-pocket expenditures (17).

Until now, national health policies have not prioritised surgical care. Recent health priorities included implementation of the Free Health Care Initiative (FHCI) in 2010, aiming to deliver free healthcare to vulnerable groups and improve access to maternal and child health (18). The national health sector strategic plan 2017-2021 (NHSSP) discusses the need to increase access to safe and affordable surgical care by further developing surgical, obstetric and anaesthesia care. Key challenges identified in the NHSSP are displayed in panel 1 (16). A national surgical, obstetric and anaesthesia plan (NSOAP) to

address deficiencies in the surgical healthcare system in Sierra Leone was initiated in 2016, however to date such plan has not materialized (16).

Access to medical products and technologies

In 2017 a Service Availability and Readiness Assessment (SARA) explored the health system infrastructure and available resources. This demonstrated considerable gaps in resources and workforce (15).

Human resources

Estimated physician density in Sierra Leone was 0.05 per 1,000 population in 2017, with 323 physicians (including specialists) and 389 community health officers (CHO's)(15). To meet staffing requirements established in the Basic Package of Essential Health Services, an additional 312 medical officers and 144 medical specialists are needed (19). There is one medical officer programme, delivering approximately 40 graduates per year (20). Over the last years postgraduate training in surgery, paediatrics and internal medicine have been (partially) accredited in-country to increase the specialist workforce in Sierra Leone (21). The health workforce has been severely affected by the EVD outbreak. Almost 300 doctors and nurses died, one of the teaching hospitals lost 25% of its surgeons (16,22) Moreover, many medical officers (26%) and specialists (37%) serve in administrative roles or are studying (19). Almost half of health workers (48%) are part of the unsalaried government health workforce, providing services without being on the payroll (19). Approximately 70% of health workers is concentrated in urban areas, especially the Western Area (19).

NHSSP KEY CHALLENGES FOR SURGERY, OBSTETRICS AND ANAESTHESIA

- Sierra Leone has a massive unmet need for safe surgery and anaesthesia, including obstetric surgery.
- There is inadequate infrastructure and supplies to meet this need.
- There is a critical shortage of trained, motivated workforce and existing staff are unevenly distributed.
- There is insufficient collection and use of data on surgical care, including both routine data and research efforts.
- The high cost of care is a major barrier to accessing surgical care. Many communities are unaware how to prevent surgical disease and when and where to seek care

Panel 1 Situation analysis and key challenges NHSSP 2017-2021 (16)

Health information system and health indicators

The health information system (HIS) in Sierra Leone is under responsibility of the directorate of planning, policy and information of the MoHS (16). In 2019 life expectancy at birth in Sierra Leone was 54 years (23). Despite recent improvements, neonatal and maternal mortality are amongst the highest

worldwide with 31 per 1,000 live births and 1,360 per 100,000 live births respectively (23,24). According to the Demographic and Health Survey (DHS) 2019 83% of women delivered in a health facility and 87% with skilled providers (23). In 2016 the CS rate was 2.9% of all live births, ranging from 0.4% to 5.2% between districts, with an in-facility CS rate of 23% (25). Surgical indicators were not included in the most recent DHS and HIS (16). However, in 2012 the unmet need for surgical care was estimated to be 92.1% (5).

2 Study overview

2.1 Problem statement and justification

Globally 5 billion people lack access to safe and affordable surgical care (3). Access is poorest in low- and middle-income countries (LMIC). Only 6% of global surgical procedures are being performed amongst the poorest one third of the global population (2,3). Regions with the highest burden of disease have the smallest health workforce (26). In 2014 the Lancet Commission on Global Surgery (LCoGS) was instituted and aimed to increase efforts to improve quality and access to safe surgical, obstetric and anaesthesia care globally. In 2015 emergency and essential surgical care were recognized as an essential component of the healthcare system to achieve universal health coverage by the World Health Assembly (3,27). These efforts are in line with the Sustainable Development Goals that call for a "broader, systems-based approach to development" (28).

International targets for access to safe surgery include a minimum of 80% coverage of essential surgical and anaesthesia services per country by 2030, and at least 5,000 surgical procedures and 20 surgical, anaesthetic, and obstetric specialist physicians per 100,000 population (3). In 2012 Sierra Leone reached less than 10% of these volumes (table 1) (3–5). Anaesthesia is mostly provided by nurse anaesthetists (29). An assessment of hospitals in Sierra Leone in 2017 reported 54 hospitals (87%) offering comprehensive surgical services, with availability of specific surgical procedures ranging from 4% to 57% (figure 5)(15).

	Sierra Leone (2012)	International targets* (2030)
Coverage of essential surgical and anaesthesia services	7.9%	≥ 80%
Volume of surgical procedures per 100,000 population	400	5,000
Number of surgical, anaesthetic, and obstetric specialist physicians per 100,000 population	0.97**	20

Table 1 Current level of surgical care in Sierra Leone compared to global surgery targets
** Lancet commission on global surgery* (3), **Excluding anaesthetic specialists

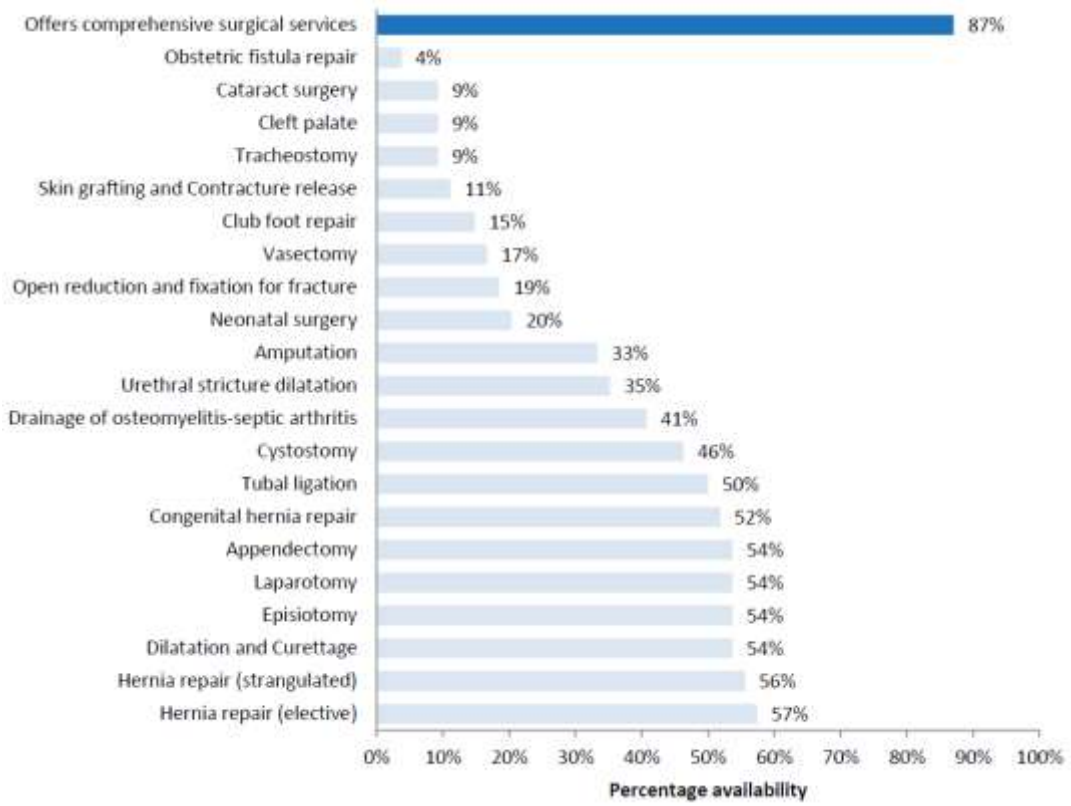

Figure 4 Availability of comprehensive surgery and certain surgical procedures in 54 hospitals in Sierra Leone as assessed by the SARA in 2017 (15)

A surgical workforce and productivity analysis in 2012 identified several ways to address the high unmet need for surgery, including increasing the number of surgical providers, task-sharing and increasing productivity of the surgical workforce (4). A surgical training programme (STP) was developed for CHO's and medical officers in order to increase the surgical workforce by task-sharing (panel 2)(30). This has proven its safety and efficacy in increasing the surgical volume in Sierra Leone (31,32). Despite an increase in surgical providers, surgical provider density, and total surgical volume,

The surgical task-sharing programme in Sierra Leone

The surgical training programme (STP) in Sierra Leone started in 2011 as partnership between CapaCare (NGO), the Ministry of Health and Sanitation, and UNFPA (United Nations Population Fund). The STP consists of two years training in selected hospitals and short courses in surgical and obstetric skills, followed by one year of housemanship in two tertiary facilities in Freetown. Community health officers with a minimum of two years' work experience and junior medical officers are eligible for the programme. CHO's completed a three year medical diploma training to do clinical work in community health centres or hospitals.

At the end of 2018 31 students had graduated from the programme, and an additional 34 were in basic training or housemanship. After graduating SACHOs (associate clinicians)are absorbed by the public system.

Panel 2 The surgical task-sharing programme in Sierra Leone (30)

the rate of operative procedures per 100,000 population remained unchanged at around 400 per 100,000 population between 2012 and 2017 (4,33). The observed increase in volume of surgeries between 2012 and 2017 can largely be explained by a doubling of CS. A shift from general to obstetric surgery was first observed during the EVD outbreak, when the public sector absorbed most CS the private sector stopped to perform, while total median surgical activity fell to 41% of the level of 2012 (34).

Assessment of surgical workforce in 2017 identified 339 full-time positions of surgical providers (33). Surgical provider density increased from 2.7 to 4.5 per 100,000 population between 2012 and 2017, and for specialists from 0.97 to 1.40 per 100,000 (4,33). The largest increase was seen among associate clinicians (from 0.23 to 0.80 per 100,000), also known as surgical assistant clinical health officers (SACHO). Between 2012 and 2017 an increased percentage of surgical procedures was performed by associate clinicians, while for specialists this remained similar, and for physicians and nurses a decrease was observed (table 2)(4,33). Furthermore, the surgical productivity, defined as weekly surgical procedures per full-time surgical provider, reveals a substantial decrease from an average of 2.8 in 2012 to 1.8 in 2017 in 40 facilities where surgical volume and providers were known for both years (4).

	Volume surgical procedures		
	2012	**2017**	
	24,152	**30,423**	
Cadre	**% of total procedures**		**Productivity (2017)**
Specialists	47.2	45.4	2.4
Physicians	39.4	30.4	1.1
Nurses	6.6	2.8	0.5
Associate clinicians	6.8	21.4	1.9
All	100	100	1.8

Table 2 Total volume of surgical procedures in 2012 and 2017, percentage of surgical procedures by cadre in 2012 and 2017 and 2017 mean productivity (4,33)

The decrease in surgical productivity is both unexpected and worrying. Firstly, the unmet surgical need in Sierra Leone is very high. Secondly, the need for surgery in Sierra Leone is expected to increase further over the next decades due to population growth and an expected increase in prevalence of non-communicable diseases (NCD's), which is expected to escalate the need for preventive, curative, and palliative (surgical) care (3,35,36). Lastly, facilities and surgical providers performing higher volumes of surgical procedures report better outcomes and lower complication rates (3,37,38). Maternal survival is known to improve with higher densities of providers per 100,000 population, especially when provider density is below 40 per 100,000 (3). Whereas various strategies to increase quantity and quality of the health workforce in Sierra Leone are outlined in the Human Resources for

Health Strategy 2017-2021, increasing productivity of existing surgical providers would provide a fast and low-cost solution (20).

Previous research identified several barriers to surgical care in Sierra Leone, particular on the demand-side. Barriers include fear of surgery, complications and death, perceived low quality of care, financial barriers, logistic concerns regarding transportation and referral, and awareness about conditions needing surgical care (39–42). Meanwhile, little is known about barriers for surgery on the supply-side from the viewpoint of facility managers and healthcare providers.

Current surgical productivity figures from 2012 and 2017 are based on mean surgical volumes within a group (total volume of surgeries performed by a cadre divided by the number of estimated full-time positions of the cadre), which for this reason might grossly under- or overestimate actual surgical productivity. To acquire more insight in surgical productivity, this study will analyse data of individual surgical providers to attain median surgical productivity. In addition, the research aims to gain insight in the factors that influence surgical productivity from a health workers' perspective. This includes exploring perceptions of the relative shift from general surgery to obstetrics, and how this influences overall surgical capacity. Validating changes in surgical productivity and clarification of underlying factors for these changes may guide future interventions by policy-makers to improve surgical care in Sierra Leone.

2.2 Objective and research questions

2.2.1 Overall objective

The overall objective of this research is to explore factors influencing surgical productivity in public and private-non-profit facilities from the perspective of surgical providers and hospital managers in Sierra Leone.

2.2.2 Research questions

The research will address the following research questions from the perspective of hospital managers and surgical providers in Sierra Leone:

1. How did the surgical productivity change since 2012?
2. Which factors influence surgical productivity?
3. Which opportunities exist to increase surgical volume and surgical productivity?
4. How can the shift from general surgery to obstetrics be explained, and how does this influence overall surgical capacity?

2.3 Methodology

2.3.1 Study design

This study applied an explanatory sequential mixed methods design, in which the quantitative part preceded the qualitative part and results of the quantitative part guided the qualitative research questions. Incorporating quantitative and qualitative research methods allowed for a more complete understanding of the research problem (43). The first research question was examined quantitatively. For the remaining research questions a qualitative approach was chosen, because of the explorative nature of these questions. Qualitative research designs are appropriate to answer questions explaining the "why" and "how" and allow for wide, explorative data collection. The phenomenon explored was the decline in surgical productivity observed between 2012 and 2017 and the increase in obstetric surgery compared to general surgery. Key terms for this research have been defined in the glossary.

2.3.2 Quantitative methods

Data from a nationwide, descriptive, retrospective study entitled "Surgical activity and surgical workforce in Sierra Leone in 2017" were reviewed and compared to data from 2012. In 2018 surgical activity data were collected from all hospitals and clinics performing comprehensive surgery in 2017 in Sierra Leone. The research used a modified the LCoGS Hospital Assessment Tool (44) to collect information from facility managers regarding the facility, workforce availability, and financing. Fifty out of sixty facilities shared their data. Surgical activity data of individual surgical providers were obtained from surgical, obstetric and anaesthesia logbooks for February, June, and October 2017 to acquire a representative sample for annual surgical activities. Microsoft Excel was used for data processing and analysis. Descriptive statistics were used to calculate median surgical productivity, the variation per facility, and per surgical cadre. Differences in surgical productivity between urban and rural areas, public and private-non-profit facilities and national and foreign surgical providers were determined. Since data was not normally distributed, median surgical productivity was used to give a more accurate estimation. Results were then compared with surgical productivity data from 2012.

2.3.3 Qualitative methods

Methods and sampling procedures

Individual, semi-structured, in-depth interviews were conducted with hospital managers and surgical providers. Semi-structured interviews using an interview guide (annex I) were performed to stimulate an open and deep exploration of factors influencing surgical activity, aiming to obtain a wide variety of information from the providers' perspective. The interview guide was based on the LCoGS Surgical Assessment Tool for qualitative interviews (45), adjusted to cover the research questions after discussion among the research team. The interview guide was piloted with a Sierra Leonean surgical provider to ensure understanding, relevance, and adjust to cultural norms and phraseology.

Participants were confronted with findings of the quantitative part of the study and asked to reflect on these in relation to their own experiences in surgical care provision. Three interviewers were selected, the primary investigator (PI), who is a foreign medical doctor, and two Sierra Leonean research assistants. During visits to the selected health facilities additional informal, conversational interviews were held other health workers (e.g. anaesthetists, midwives, operating theatre (OT) staff, nurses and other surgical providers). Observations during the health facility visits with use of an observation guide and format for field notes (annex II) improved understanding and interpretation of data from the interviews. The use of multiple sources of information improved comprehensiveness, allowing for triangulation and encouraging more reflexive analysis of the data, adding to the research validity (46).

Participants and setting

Facilities were purposefully selected. Eligible facilities included public and private-non-profit facilities performing comprehensive surgery that shared surgical activity data from 2017. Facilities identified to have either high or low surgical volumes per provider, and facilities with a vast change in surgical productivity between 2012 and 2017 were selected per region, as extremes were considered more likely to offer valuable insights in the factors influencing surgical productivity. Facilities were selected to represent both urban and rural facilities throughout the country. Study participants for the in-depth interviews were selected based on availability and willingness to participate. Both hospital managers and surgical providers were included in order to obtain a broader understanding of the research topic. Since specialists, physicians and associate clinicians perform the majority of surgical procedures, their perspectives were considered particularly interesting. No incentives were provided to study participants.

Data collection

Data collection took place in Sierra Leone between August and October 2019. Interviews were performed in English by the PI or one of the research assistants. Research assistants were trained by the PI before they started qualitative data collection. Research assistants were accompanied by the PI during the interviews until they were confident to conduct them independently. Facilities were randomly assigned to one of the interviewers, taking into account that research assistants did not collect data in facilities where they had been working as surgical provider. Interviews took place at the participants' preferred time and location. During and right after the visits to the selected facilities, field notes were taken to encompass data obtained from informal conversations and observations made in the facilities.

Data processing, analysis and framework

Interviews were recorded with permission of participants and transcribed verbatim. The PI transcribed the interviews using f4transkript software (version 7, dr. dressing & pehl GmbH – audiotranskription.de, Marburg Germany) within two weeks after the interview (47). Transcripts were shared among the research group after removal of personal identifiers. An emergent design was used, where the process of data collection and analysis occurred simultaneously. Regular discussions amongst the research team to discuss findings, codes and themes allowed for adjustments in the interview guide based on findings during the research (43). Transcripts were transferred into NVivo, a qualitative data manager software (QSR International Pty Ltd. Version 12, 2018, USA), to store transcripts and manage the manual coding of data. The phases of data processing and analysis described by Creswell were used and are explained in panel 3 (43). A thematic network analysis with an inductive approach was applied in order to recognize meaningful patterns (48). After familiarisation with the data, initial coding of all interviews was done by the PI. A selection of interviews was coded by other members of the research team as well. Codes and themes were then compared and discussed among the team. A thematic network analysis led to the development of a conceptual framework.

Phases of data processing and analysis

1. Familiarisation with data
2. Generating initial codes
3. Developing themes from codes
4. Reviewing themes
5. Defining and naming themes
6. Producing the final report

Panel 3 The phases used for processing and analysing qualitative data (43)

2.3.4 Framework

To keep an open mind towards themes emerging from the data a conceptual framework was developed instead of using an established framework that might guide themes. In the discussion the conceptual framework is compared to a framework from the literature, chosen after development of the conceptual framework, in order to reflect on the findings.

2.3.5 Strengths, limitations and reflexivity statement

This thesis articulates the views of surgical providers and hospital managers in Sierra Leone. As frontline workers their experiences are valuable in understanding the reality of surgical care provision. Verifying views from stakeholders and decision-makers at national levels was not included in the scope of the research. A wide variety of participants, working in different settings, allowed rich information gathering, increasing transferability of results. However, some results might be context-specific to Sierra Leone.

In qualitative studies, predispositions of the researchers might influence the research. The PI was a non-Sierra Leonean medical doctor, who prior to the research had provided emergency obstetric

training in Sierra Leone. Spending three months in Sierra Leone during the research allowed adaptation to cultural norms and facilitated interpretation of results. International experience as a medical doctor involved in surgical procedures, both in high- and low-resource settings facilitated adaptation and comprehension. However, nationality, cultural differences and own experiences might have influenced information collection and interpretation. Yet, it might prove easier for participants to discuss challenges with an outsider. The variety in interviewers was anticipated to balance interviewer effects, facilitating rich data collection and establishing cultural integrity. The Sierra Leonean research assistants, from different regions and facilities, participated in the STP and were therefore familiar with culture, setting, policies and regulations. Frequent discussions with the research team, who all had worked in Sierra Leone for prolonged time, strengthened the research. Although the fact that researchers were related to CapaCare elicited trust among participants, it should be taken into consideration that this might have influenced answers concerning the STP and role of associate clinicians. To balance this possible confounding, facilities without connection to the STP were purposefully included as well.

Quantitative results were discussed with participants, and interviews were supported by observations in the facilities during the visit. Supplementary focus group discussions could have provided additional information and validation of the findings of interviews. The inductive approach ensured that results were not influenced by already developed structures. Preliminary results and conceptual framework were shared during a global surgery symposium in Freetown, attended by a large number of surgical providers in Sierra Leone, for respondent validation, increasing trustworthiness. Final results and manuscripts are reviewed by participants and non-participating Sierra Leonean surgical providers to allow them to give feedback.

2.3.6 Ethical considerations

Ethical approval was granted by the Research Ethics Committee at the Royal Tropical Institute in The Netherlands, the Masanga Medical Research Unit Scientific Review Committee, and the Sierra Leone Ethics and Scientific Review Committee prior to data collection, including approval to use the previously collected 2017 surgical activity data. The study was non-intrusive. Participation was voluntary and written consent was obtained before inclusion in the study (annex III). Participants had the right to withdraw consent at any time without consequences. During transcription, analysis and reporting of the study identity of participants was anonymised. To keep confidentiality the health facilities and individuals remain undisclosed, with personal details only accessible to the PI. All electronic data has been encrypted and stored on password-protected devices only accessible to the researchers. Recordings were destroyed after verification of the transcription.

3 Results

This chapter aims to explain the change in surgical productivity in Sierra Leone between 2012 and 2017 and to explore factors that influence the surgical productivity. Paragraph 3.1 addresses the first research question by presenting the surgical productivity. Paragraphs 3.2.1 to 3.2.6 give a more in-depth understanding of the surgical productivity findings, and paragraph 3.2.7 discusses the last research question explaining the shift from general surgery to obstetrics.

3.1 Quantitative results: surgical productivity

Sixty facilities performed comprehensive surgery in Sierra Leone in 2017. All public and private-non-profit facilities were included. Private-for-profit facilities were excluded, because these accounted for only 3.6% of surgical procedures in 2017. Operating theatre logbooks with surgical activity data were available for 36 facilities (figure 6). In these facilities 5,485 procedures were performed during the study period, representing 74.0% of surgical procedures in these months and 18.0% of 30,423 total estimated surgical procedures performed in Sierra Leone in 2017. For excluded procedures either the identity (117 procedures, 2.1%) or the cadre of the surgical provider (102 procedures, 1.9%) was unknown to the researchers. The remaining 5,265 procedures were further analysed.

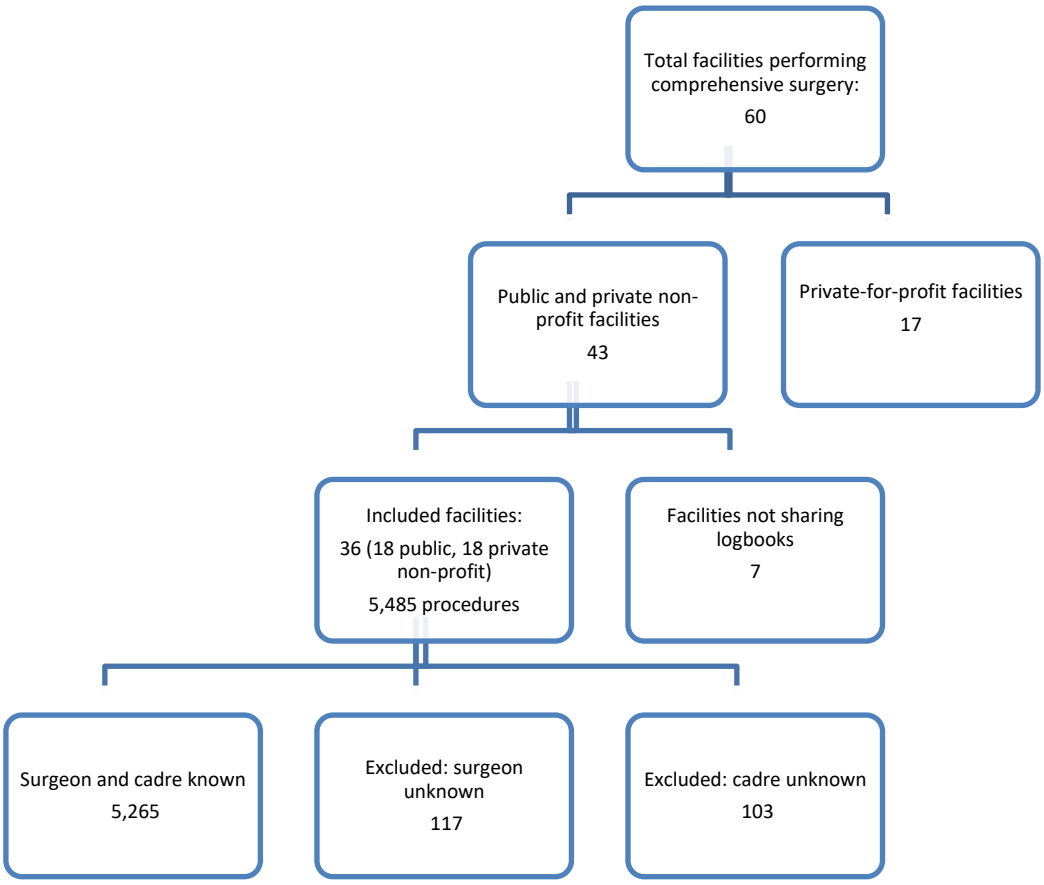

Figure 6 Overview of inclusion process of surgical procedures

Cadre	Public (n = 18)		Private non-profit (n = 17)		Total (n = 35)	
	#	Productivity (IQR)	#	Productivity (IQR)	#*	Productivity (IQR)
Specialist	44	0.9 (0.5-2.3)	42	2.5 (0.6-4.7)	82	1.8 (0.5-4.0)
Physician	101	0.7 (0.2-1.7)	32	1.1 (0.2-3.1)	131	0.7 (0.2-1.9)
Nurse	6	0.7 (0.3-2.2)	8	1.4 (0.9-3.1)	14	1.3 (0.3-2.4)
Associate clinician	13	1.7 (1.2-3.5)	10	2.2 (0.6-3.0)	21	2.3 (1.3-3.1)
STP student**	21	1.5 (0.9-2.9)	28	1.2 (0.5-1.9)	39	1.7 (0.9-2.7)
All	185	0.9 (0.4-2.3)	120	1.4 (0.5-3.1)	287	1.2 (0.5-2.7)

*Table 3 Number (#) of surgical providers and median weekly surgical productivity (P) per facility (n), by sector and cadre in 2017. *Numbers do not add up, because surgical providers worked in different facilities during the study period. **STP = student surgical training programme.*

Median surgical productivity in 2017 was 1.2 surgical procedures per provider per week amongst all 287 surgical providers (table 3). This was higher in private-non-profit than in public facilities (1.4 and 0.9 procedures per week respectively). Specialists in private-non-profit facilities were most productive with 2.5 procedures per week, followed by associate clinicians. All cadres apart from STP students had a higher surgical productivity in the private-non-profit sector than in the public sector. Surgical productivity was lowest among physicians and nurses in the public sector.

Mean surgical productivity per week was used to compare results between 2012 and 2017 (table 4). A clear decrease in mean surgical productivity is illustrated for all cadres apart for the associate clinicians, whose productivity increased, both in the public sector and the private-non-profit sector.

		Mean productivity		Change in mean productivity 2012 to 2017
		2012	2017	
Public	Specialist	3.0	2.1	-0.9 (-30%)
	Physician	2.1	1.4	-0.7 (-33%)
	Nurse	3.9	1.3*	-2.6 (-67%)
	Associate clinician	1.4	2.5	+1.1 (+79%)
	STP student	-	2.4	N/A
	All	2.3	1.8	-0.5 (-22%)
Private non-profit	Specialist	8.9	4.6	-4.3 (-48%)
	Physician	2.1	1.6	-0.5 (-24%)
	Nurse	5.4	3.5 *	-1.9 (-35%)
	Associate clinician	2.2	2.4	+0.2 (+9%)
	STP student		1.5	N/A
	All	2.3	2.8	+0.5 (+25%)
Total		**2.8**	**2.2**	**-0.6 (-21%)**

Table 4 Changes in mean weekly surgical productivity per sector and cadre between 2012 and 2017.
**When ophthalmologic surgical procedures are excluded the mean productivity was 0.4 in public and 0.2 in private non-profit facilities.*

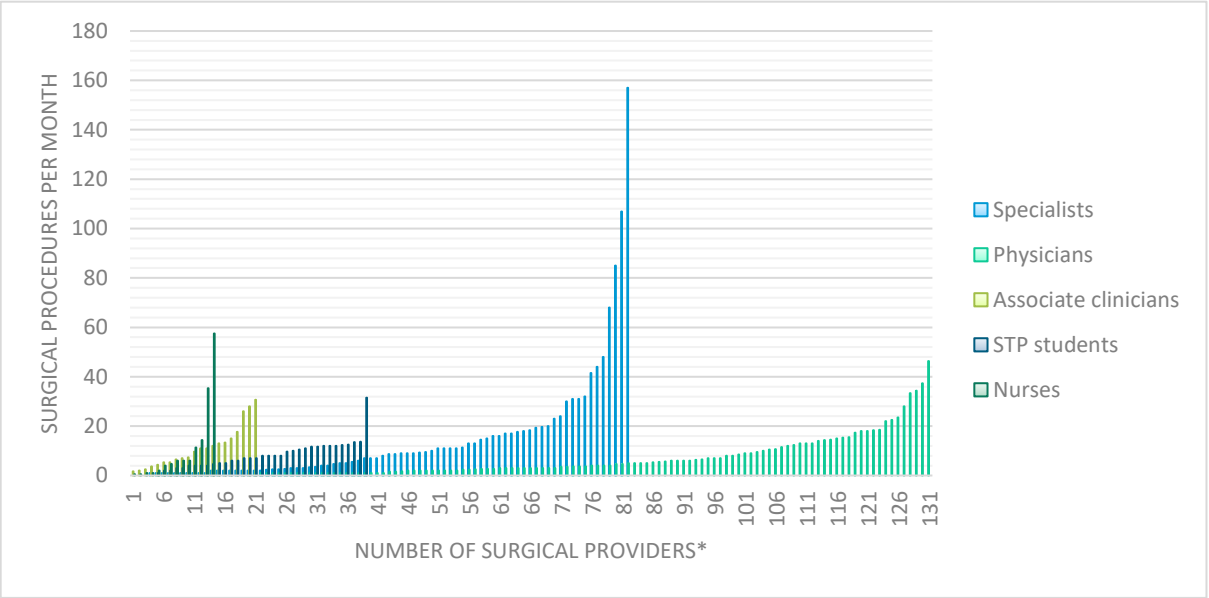

Figure 7 Number of surgical procedures per month per surgical provider by cadre
**Each number and bar on the x-axis represents an individual surgical provide.*

The difference between the median and mean overall surgical productivity in 2017 of 1.2 and 2.2 respectively indicates that a large group of surgical providers may be performing few surgeries (figure 7). Even though surgical productivity was still highest for the specialists in the private-non-profit sector, compared to 2012 their productivity almost halved. Surgical productivity of specialists in the public sector was less than half of that of specialists in private-non-profit sector. For other cadres this difference was smaller. The majority of specialists and physicians worked in urban facilities, associate clinicians and STP students on the contrary more often worked in rural facilities. In general, surgical productivity was higher in rural areas than in urban areas (table 5). No difference was observed between surgical productivity of national surgical providers and foreign surgical providers in general (table 6). However, foreign specialists (65% of all specialists in Sierra Leone) had a remarkably higher productivity than their Sierra Leonean colleagues.

Cadre	Urban (n = 188)		Rural (n = 113)	
	#	Productivity	#	Productivity
Specialist	56	1.2	27	2.6
Physician	97	0.7	35	1.2
Nurse	10	1.3	4	1.2
Associate clinician	9	1.7	14	2.0
STP student	16	2.6	33	1.4
All*	188	0.9	113	1.4

*Table 5 Number (#) of surgical providers and median weekly surgical productivity in 2017 by cadre in urban and rural settings. * Numbers do not add up, because surgical providers worked in different settings during the study period*

Cadre	Sierra Leone (n = 197)		Foreign (n = 90)	
	#	Productivity	#	Productivity
Specialist	29	1.3	53	2.2
Physician	97	0.7	34	0.9
Nurse	13	1.1	1	1.4
Associate clinician	19	2.6	2	0.8
STP student	39	1.7	N/A	-
All	197	1.2	90	1.2

Table 6 Number (#) of surgical providers and median weekly surgical productivity in 2017 by cadre for Sierra Leonean and foreign surgical providers.

3.2 Qualitative results

Twenty-one participants from 12 health facilities were included. Characteristics are displayed in annex IV. Public and private-non-profit facilities in both urban and rural settings were represented in the sample. All but one hospital manager also worked as surgical providers. Participants for interviews were included until saturation was reached. The average interview duration was 40 minutes.

Confronted with the observed decrease in surgical productivity, approximately half of the participants did not recognize this change, assuming volume of surgical procedures they performed had increased. Almost all acknowledged an increase in obstetric surgery over the past five years. Participants' explanations for these changes and the factors they experience to influence surgical volumes were structured into themes. The themes are presented as conceptual framework in figure 8. As displayed in the framework, factors were present at different overarching levels of the health system: national, health facility, and community level. Each theme will be discussed in a separate paragraph.

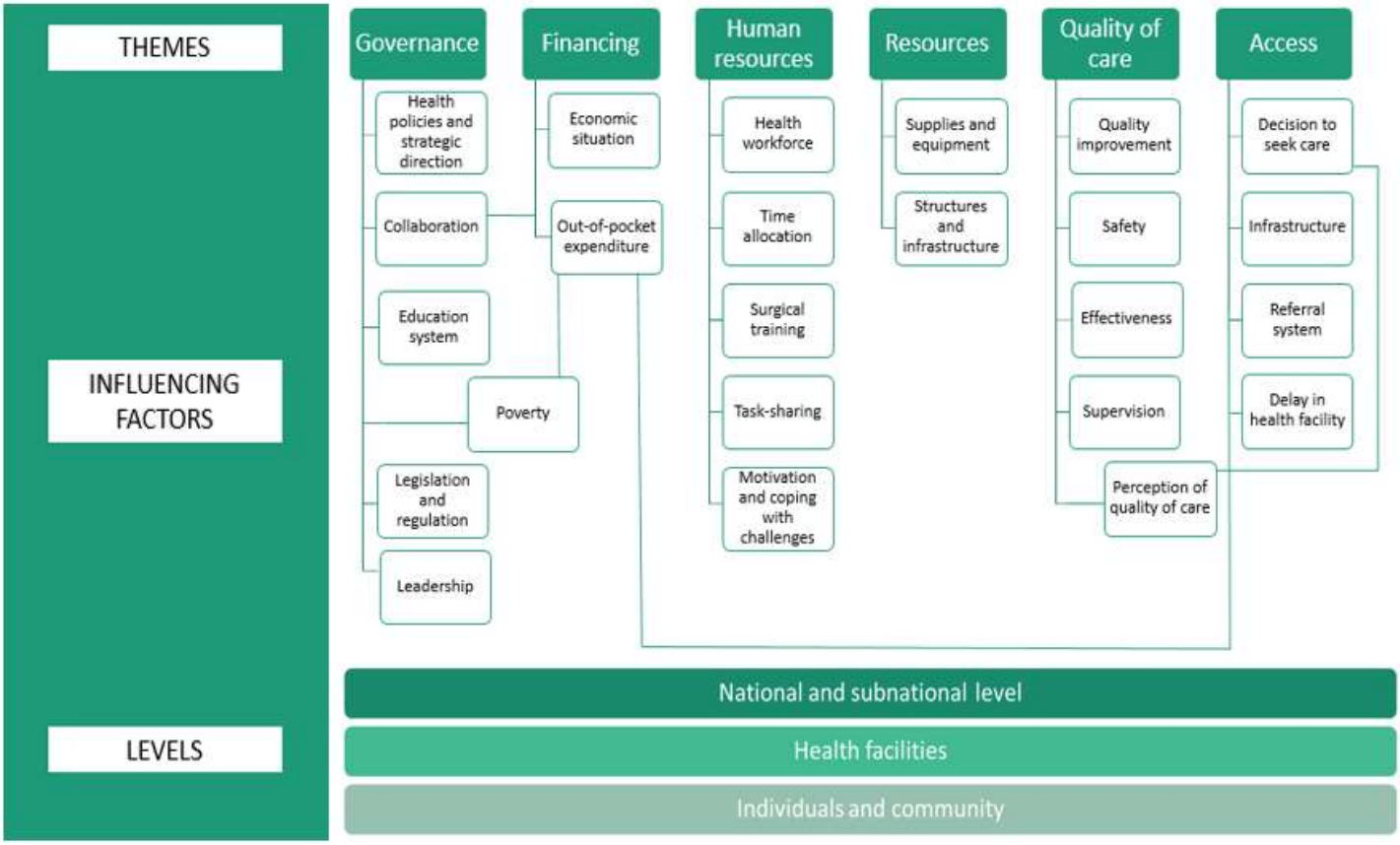

Figure 8 Conceptual framework with factors influencing surgical productivity based on thematic analysis of participants' responses. Strong connections between factors are connected with lines.

3.2.1 Governance and leadership

Health policies and strategic direction

Most participants were of the opinion that political decision-making strongly influences surgical care and productivity at facility level. This became evident from prioritization of maternal healthcare, e.g.

by introducing the FHCI and establishment of the National Emergency Medical Service (NEMS) ambulance system, leading to increased accessibility of obstetric care. Increased attention for anaesthesia and surgical care would provide opportunities to increase surgical volumes. Especially participants working in public facilities rely on the government to improve financing, supply of resources and workforce.

"*Political will should be there. Once this political will is there, the resource will be available". (ID17, physician, private-non-profit)*

Collaborations

Collaborations between the government or health facilities with partners, e.g. donors or non-governmental organizations (NGO's), were considered important to increase surgical productivity. Partners are described to offer financial assistance, deliver human capital, offer training, improve the hospital infrastructure (buildings, water supply, and electricity supply) and provide resources such as drugs. This supports the finding of higher surgical productivity in private-non-profit facilities than in public facilities. The value of these collaborations is illustrated by the following quote.

"It is tremendous, it is tremendous. Before this time, when we are not having partners, this hospital was in dark. (…) Then after that [Ebola emergency response], now they are really strengthening the health system in [district]…by providing most of these things, also with the government. So the hospital has really improved for now. They provide drugs, they provide skills, they provide manpower." (ID12, physician, public).

Whereas some participants express concerns about depending on donors and partners as a country and advocate for self-reliance, most see collaborations as an important way to improve surgical care.

Influence of the education system and poverty on surgical care

Not only policies directed at healthcare are important to improve surgical care. Participants advocate for measures to reduce poverty and improve education. They observe money as an important barrier for surgery, and expect that relieving poverty will increase accessibility. Education both could increase awareness of surgical conditions in the community, and play an important role in increasing skilled health workforce. This will be further discussed in paragraph 3.2.3.

"The biggest problem is the Government in this country, you know. They have to remove the barrier of the payment. I think the free healthcare should be…extended to eh wide…amount of population. Because people here, they don't have money." (ID13, specialist, private-non-profit)

Legislation and regulation

Participants describe incentives not to record surgical activities, which might lead to under-registration of surgical procedures in facilities. When surgical procedures are not registered, payment can go directly to surgical providers instead of the health facility.

"So most times, I don't think they have been logged in. Because there, if it has been logged in, something has to go to the hospital. So if it's not logged in, you give the hospital nothing." (…) "It [the payment] goes back elsewhere, it goes back to YOU that has done the surgery". (ID18, physician, public)

More often, participants describe that the informal healthcare sector is a large problem in Sierra Leone. Patients with surgical problems often consult traditional healers or informal, unlicensed clinics. This informal sector is described to exist both within regular health facilities by healthcare providers and outside official facilities, where services are offered by unqualified providers. Despite the sensitivity of this topic, almost half of the participants acknowledge the problem that this poses on both quality and volume of surgical care. Qualified staff is working voluntary for several years in public facilities, before being absorbed to the government payroll. Some participants argued this urges staff to generate income in informal ways.

"We have a lot of mushroom clinics, you understand (…) we receive a lot of moribund cases from these clinics. They are not covered by doctors, neither SACHO's, neither CHO's. Some of them just have experience saying 'Ok, I have worked in the hospital as a porter, now I know how to give injections', the people will start calling you a doctor, you (pose) like a doctor, you open a clinic. They have TRUST in you, because community people tend to have trust in their community fellows." (*ID10, physician, public*)

Furthermore, these informal practices can increase out-of-pocket payments for patients.

"A patient that we operated (..) went to a clinic, one of those PHU's, where he said they charged him 1.5 million [Leone] for hernia surgery [double the price of public facilities]." (ID18, physician, public)

Participants report that enforcement of regulations to address unlawful activities could help improve accountability. Currently, government auditing teams visit health facilities to check registration of activities. Moreover, several participants describe increased legal consequences for malpractice or corruption by healthcare providers.

"Because you cannot ask a pregnant woman, say 'You need to pay for this'. Otherwise you hear your name on the radio the next day, that you are asking for money." (ID6, specialist, public)

Leadership at facility-level

Strong leadership at facility level and involving employees in decision-making are described as factors that improve the work efficiency and atmosphere, and to assist in increasing surgical productivity.

"Leadership starts from the top. (…) You have to be motivated and you have to be willing to work. So of course when the top management works around the clock, the junior staff [will] also say 'Ok, if they are working, who are we not to work?'" (ID18, physician, public)

Observations and interviews revealed that many management positions are occupied by physicians without previous management experience and limited clinical experience. According to one participant hospitals could benefit from removing doctors from management positions and allow them to do clinical work, while nurses and other staff would get a larger role in hospital management.

3.2.2 Financing

Financing influences surgical care in several ways according to participants. An obstacle for surgery mentioned by all participants is the financial barrier. Results presented here reflect participants' ideas, and are not confirmed by financial data at national and facility level.

Economic situation

Fluctuations in the economic situation of Sierra Leone over recent years have had impact on healthcare. Inflation affected the budget of the health sector, health facilities and individuals, while simultaneously costs of living increased. Fluctuating (international) donor support influences the total budget for healthcare.

"(…) and the money, because of international growth, it has gone up. (….) So if you have your ten thousand dollars, that used to buy a hundred products, that same ten thousand dollars you are going to get less than fifty products, you see." (ID2, specialist, public)

Out-of-pocket expenditures

Health facilities experience a lack of surgical equipment, drugs and other supplies (see paragraph 3.2.4), associated with financial restrictions, both at facility level and at national level. Some departments are not income-generating, and prices for treatment in public facilities are determined by the government. Especially for cases under the FHCI a lack of supplies poses financial pressure on facilities. Some facilities are forced to pass on these costs to patients. Although payment for surgeries has not changed significantly according to participants, out-of-pocket expenditures have increased due to indirect and informal costs.

"The poverty, out-of-pocket expenditure has escalated. And people cannot afford, so some people they go home, because of lack of resources to pay the bills."(ID16, specialist, public)

Lack of income generation from surgeries is suggested to negatively influence prioritization of surgical care at facility-level. Information from financial managers could provide a relevant perspective for these experiences concerning financial decision-making at facility level and supply-chains.

"For my finance all he observes is [that] money is coming from the outpatient [department], money is coming from the maternity, but money coming from the theatre is very small." (ID17, physician, private-non-profit)

Poverty and free healthcare

"Well, people are very poor, you know. So it's not because the fees [for surgery] are quite expensive, but because even things for them to eat is a problem." (ID10, physician, public)

The high unmet surgical need and low surgical productivity can be explained by the high poverty rate in Sierra Leone. All participants illustrate how financial barriers affect access to surgery, leading to delayed presentation of patients, often after complications arise. On the other hand it is observed that free surgery facilitates access as illustrated by the rise in obstetric surgery after implementation of the FHCI for pregnant women and increase in surgical procedures when offered for free or for a reduced price. Several participants suggested that incorporation of (emergency) surgical care in the FHCI would increase access to surgical care. Participants from facilities where emergency surgery was free experience less financial barriers and often worked in facilities with high surgical productivity. However, since for many facilities prices of emergency surgery were not quantified this association could not be confirmed quantitatively.

"So even the very poor, that cannot afford, we can do the surgeries on cost-recovery, or maybe free of charge, once we notice that they are really like in deplorable (…) and they need emergency surgeries. That is not the case in other hospitals." (ID20, physician, private-non-profit)

One participant explained how implementation of a health insurance system could be an opportunity to reduce the financial barrier for patients. However, he also expressed doubts whether this would be feasible in a low-income country like Sierra Leone.

"We, the medical and dental association, have been discussing this issue to begin a national health insurance system (...) where the people pay, collecting money, going to the health sector (…) This will help to reduce this thing [out-of-pocket expenditure]." (ID2, specialist, public)

3.2.3 Human resources

Health workforce and time allocation

Despite an increase in health workers, according to most participants the current surgical workforce is still insufficient and unequally distributed. This leads to very high workloads. Other obligations, such as administrative tasks, meetings, and non-surgical care limit the time that can be allocated to surgery and reduce surgical productivity. Hospitals often have few physicians, functioning both as medical superintendent and as clinician. Although many physicians work in the private-for-profit sector next to government jobs, this is claimed to be outside office hours and not affecting their regular job.

"Like for the medical superintendent he seldomly comes to theatre, although he is doing surgery very well. (…) He is overwhelmed with his administrative work, and most of the times he has to attend meetings, doing other activities." (ID11, SACHO, public)

Insufficient numbers of health workers other than surgical providers further constrain surgical productivity. Many participants describe a lack of anaesthetists, anaesthetic nurses, scrub nurses and skilled nurses in inpatient departments restricting surgical volumes.

"We have five operating theatre suites, but because of lack of anaesthetists and nurses, nursing staff, we cannot use all at the same time." (ID16, specialist, public)

Surgical training

Participants emphasize the vital importance of increasing surgical workforce. Current educational capacity in Sierra Leone is limited, with only one medical school and few options for further education or specialization. Opportunities to increase health workforce include enhancing educational capacity, reducing financial barriers for studying, providing scholarships for further education, increasing university capacity, retention of the existing health workforce and attracting health workers from other countries.

"Because even if you come with the best equipment and then you (miss) the LEVEL of education, no training, no future training, no subsequent training, then you have done nothing." (ID12, physician, public)

For years, lacking opportunities for specialization resulted in physicians moving abroad for further education, leaving the Sierra Leonean health system, either temporarily or definitive. Establishing quality education within Sierra Leone provides the opportunity for health workers to contribute to the health system during their training, and at the same time increase health worker retention. However, this demands sufficient capacity to deliver quality training. Currently the majority of specialization still

occurs abroad and many hospitals lack specialists. Some participants stress the importance of long-term workforce planning to increase human capital according to requirements.

"So what we have realized is that the best place to train is locally. Because while you are training as a specialist, we'd be able to provide services to Sierra Leonean people. (…) [This requires] to upgrade our institutions, to get highly qualified people, highly skilled trainers, to train our doctors locally. That's the best way to do it." (ID1, hospital manager, public)

Physicians form the largest share of surgical providers. However, surgical training for physicians is limited. As a result some participants describe a lack of confidence in surgery. Capacity-building through increased training opportunities and improved supervision can increase confidence and thus surgical productivity. Several participants describe that short trainings to improve anaesthetic, surgical, obstetric, and post-operative management skills are of great value.

"They organized training, two weeks, although yes, you cannot learn surgery for (..) two weeks, you cannot learn surgery, but the BASIS things, the basic skills. They taught you how to hold instruments, they taught you how to loosen and then how to [pair], and then how to dissect, all those things, and then which suture are you to use." (ID12, physician, public)

Task-sharing

Introduction of the STP is described to be of great value for the surgical care in Sierra Leone. According to participants access to surgical care in rural areas has increased. The availability of SACHO's in district hospitals has increased the trust that communities have in surgery by having surgical providers available and having satisfactory results.

"Because the past years, there was no surgeon here, NOTHING we can do. (…) But since my training, I am working in this hospital, things have improved a lot and people really appreciate it." (ID21, SACHO, private-non-profit)

The surgical task-sharing programme and SACHO's have been embraced by most other surgical providers. Physicians and SACHO's both describe that task-sharing provides mutual benefits in terms of learning and sharing the work load. Moreover, physicians experience it creates time for them to spend on other obligations. Therefore most participants recognized the observed shift of surgeries from physicians to SACHO's.

"So we noted [when]we had a SACHO that he was a lot in the theatre, because his other duties were not as variate as for the medical officers. So he could easily spend more time in the theatre. So when

he was around, we also did almost three surgical days [instead of two]." (ID14, physician, private-non-profit)

The responsibility and supervision of SACHO's can be challenging for some physicians who lack additional surgical training. For some, this has opened their eyes to their limitations, and urged them to have additional surgical training, further strengthening the system.

"We see community health officers, I mean, doing surgeries very, very well, that even you the medical doctor, you can actually SEE the difference between you and the CHO, despite you are a doctor. But when you see that (…), I think that is one of the reasons that gave me the instinct that, even though I am a medical doctor, actually I needed to go and improve myself." (ID4, physician, public)

Participants working in one of the facilities without SACHO's critically reflected on task-sharing, describing challenges with qualifications and responsibilities.

"Well, it has been helpful at one (..) side [hesitantly], it has been eh, it has been a disaster on the other side. I think that is what we just said, these people are going above their mandates." (ID18, physician, public)

Motivation and coping with challenges

Motivation of health workers and surgical providers is often mentioned to influence surgical productivity. Motivating factors participants described are for example feeling useful and needed, saving lives, being respected, interest and love for surgery, maintaining knowledge and skills, financial motivation such as salary, conditions of service and scholarships and involvement in decision-making and being part of a team.

"That's what we have signed for from the start of your career, you want to become a medical doctor.

Government conditions of service

Conditions of service for government workers are determined by the 'Scheme of Service 2015', that describes career options and pay grades for health workers.

In 2019 physicians in Sierra Leone went on strike to increase salaries and improve working conditions.

For SACHO's during the time of research there had been no change in the level of scheme of service despite their additional training after CHO level. Furthermore, it can take several years for government workers to be put on the payroll. During data collection, meetings between the MoHS and SACHO's over further agreements concerning accreditation and recognition were ongoing. This situation might have influenced answers of participants concerning motivation, with many participants expressing frustration and discouragement about the current situation.

Panel 4 Conditions of service for government workers in Sierra Leone (20)

So yes, as long as we can make a change, it doesn't matter whether the number goes up." (ID19, physician, public)

Demotivating factors include high work load, lack of recognition by the government, challenging living conditions, experiencing a lack of rewards for their work, both in salary as condition of service (see panel 4). Nevertheless, most participants that describe these feelings then counterbalance them with the motivational factors.

"ALL my time is for surgeries. Even to see my family is a problem." (…) "Because my dream was to save people's life. And I am doing my level-best to do this. But sometimes when you are frustrated, you feel demotivated and you feel that [what] you are doing is just enslaving yourself. People are not doing it, but they are getting more than you." (ID15, SACHO, private-non-profit)

Whereas all participants describe multiple challenges in their surgical work, most of them will go a long way to be able to perform surgery when there is a need. In emergency situations surgical providers will go the extra mile to perform surgery, for example by buying medication or supplies with their own money, donating blood for the patient, adjusting the treatment in order to make surgery possible, and continuing work despite long hours.

"At times I buy sutures, because I don't want to operate a patient and later lose that patient (…) I have to buy them out of my own money." (ID11, SACHO, public)

3.2.4 Resources

Supplies and equipment

All participants experience a lack of supplies. Mostly mentioned were the lack of drugs, consumables (catheters, IV fluids, etc.), blood, and surgical equipment, both in quantity as quality. To some extent this can reflect the organization of the health system, since most supplies, especially for the public facilities, are provided by the government. Participants think this could be advanced by implementing a pull mechanism for drugs and supplies.

"But at least now it is beginning to change into the bottom-top, where WE will request for what we think we need, and that is happening." (ID6, specialist, public)

Lack of equipment limits the volume of surgery that can be performed. Several hospitals only have some surgical sets, and first need to sterilize the equipment before continuing surgery. Some surgeries cannot be performed at all because of lack of required surgical equipment, whereas the knowledge and skills are available.

"And then there is also, sometimes it's a problem of not having enough sterile sets for example, so then we have to wait for the sterilization process." (ID14, physician, private-non-profit)

Structures and infrastructure

Other aspects that limit surgical capacity for some facilities are the capacity of the OT, number of beds, scheduling of surgeries, or availability of post-operative care in the wards. A stable supply of electricity and water is not available in many facilities. In most facilities the OT is used two to three days a week for elective cases, and only for emergencies the remaining time. However, especially in larger hospitals surgical providers have to divide time in the OT due to limited number of OT beds and staff. Most facilities describe short waiting periods of days for elective surgeries, but some have waiting lists of several weeks for planned surgeries.

"Right now (…) it's FULL. You go, there are no beds available in the wards. So (..) that is limiting." (ID16, specialist, public)

3.2.5 Quality of care

Good quality of care can increase surgical productivity, e.g. through positive perception of care in the community. Improvements presented here reflect the perception of hospital management and surgical providers, who recognize this as an important aspect for surgical productivity.

"Once the coordination is there, you have good result, patients will have confidence and more patients will come in." (ID17, physician, private-non-profit)

Improvement in quality, safety and effectiveness

Quality and safety of surgical care have improved over the past five to ten years according to participants. Especially hygienic measures were promoted and implemented as a result of increased focus on infection prevention and control (IPC) during and after EVD. Participants experience a reduction of post-operative mortality and infection.

The importance of surgical and obstetric skills training for strengthening surgical quality is underlined by many participants. Moreover, involvement as trainers forces health workers to develop a critical attitude and incorporate evidence-based practice and deliver high quality care. Other quality improvements described are for example improved triage of incoming patients, increasing the uptake of emergency surgical patients, facilitating early treatment and improving surgical outcomes.

"[For] surgeries the timing (..) by buying the time, you decrease the rate of complications, so the quality is better of course. When you do one acute abdomen 48 hours later, the outcome is not the same as doing it as soon as possible." (ID13, specialist, private-non-profit)

Implementation of international and national guidelines helps to increase evidence-based practice in Sierra Leone. Improved diagnostic tools also assist in diagnosing patients in need of surgical interventions.

Supervision

Supervision could serve as meaningful indicator for safety of surgery. As discussed in paragraph 3.2.3, challenges exist with supervision. Regarding supervision there is a lot of variation between facilities. Some facilities count on students as 'full' surgical provider, while others provide on-the-job supervision by specialists, physicians or SACHO's. For SACHO's, supervision by a medical doctor is often from a distance, or only when necessary. For physicians just after graduation supervision is the most challenging. Most are posted in district hospitals with few surgical providers. Some described the challenges they are facing, especially concerning surgery.

"When you as a junior doctor are doing something (…) you don't have anybody to correct you." (ID10, physician, public)

In some situations safety is compromised in order to be able to perform emergency surgery. Surgical providers seem to recognize suboptimal care, but sense that sometimes they have no other option, and that some factors are outside their control.

"That is what I am saying, late referral and presence of [blood] donor, presence of drugs and timely cut, that affects the safety of surgery." (ID5, SACHO, public)

3.2.6 Access

Lack of access to surgery was perceived as one of the main barriers in Sierra Leone. The three delay model is often used in global health to assess accessibility (panel 5)(49). Results from the interviews are presented here using these levels of delay. Although the experience of health workers give valuable insights, part of the delay takes place before reaching a health facility.

The three delay model

This model, as described by Thaddeus and Maine, outlines the different levels where delay in healthcare occurs.

- First level: delay the decision to seek care
- Second level: delay to reach the health facility
- Third level: delay in provision of adequate care (in the health facility

Panel 5 Three delay model by Thaddeus and Maine (49)

Delay in decision to seek care

Most participants indicate that patients present late, therefore first and second level of delay seem substantial in Sierra Leone. Many participants describe that surgical productivity is restricted by the number of patients presenting with surgical problems. Barriers they describe for seeking care are numerous and include financial reasons, cultural habits, awareness of surgical problems and possible treatment, and perception of care in health facilities. In Sierra Leonean culture local clinics and traditional healers regularly form the first level of care. Often decision-making culturally needs to be approved by relatives.

"And maybe I can add for the barrier the (..) the culture. Sometimes you know, the people they fear the surgery. The time they come to accept the surgery, they have to consult all the family, maybe they have to go first to the traditional (healers) and come back. The culture, it can be one of the barriers, even one of the biggest barriers." (ID13, specialist, private-non-profit)

Conceptions about surgical conditions and quality of surgical care influence the decision-making. Surgical conditions will need to interfere with everyday life in order to be perceived as a problem. Fear of surgery used to be wide-spread with high complication rates for surgery, but is decreasing according to participants. Lack of knowledge about surgical conditions and treatment possibilities in nearby health facilities influences the number of people presenting to hospitals. Community sensitization can be an opportunity to raise awareness and increase patients presenting at the health facility.

"I have been here since (..) [recently], and one thing I have noticed also is that a lot of people are not aware of my presence and the skills that I have." (ID20, physician, private-non-profit)

As already described in paragraph 3.2.2 the financial barriers in Sierra Leone are tremendous. Financial factors impede early presentation in a health facility. The observation by participants that large numbers of people present at the health facility when surgery is free implies that people are aware of surgical conditions, have trust in health facilities, but postpone surgery because of financial barriers.

"If today you send out a WhatsApp message: '[Hospital X], they are going to start free hernia surgeries for 500 people, tomorrow we start the registration', by the time you come here to start your registration, you see thousands of people, you understand." (ID10, physician, public)

Delay in reaching healthcare

Surgical conditions often require treatment in secondary level facilities. Poor roads and infrastructure decrease access to surgical care. The distance and accessibility of hospitals could explain why people seek care in local clinics first.

Delay in receiving adequate healthcare

Referral

According to participants the referral system has much advanced with the establishment of the NEMS ambulance system in all districts. Most facilities experience a substantial increase in obstetric patients referred from PHU's, and consequently increased volume of obstetric surgeries. However, lack of knowledge of staff in PHU's can still cause delay in referral.

"If the staff heading a PHU is not knowledgeable, he will be referring or she will be mismanaging cases and refer them late-time." (ID5, SACHO, public)

Participants stressed that referrals from district hospitals to regional or tertiary hospitals decreased due to expansion of the surgical workforce with increased capacity and surgical skills at district level. Although the total number of facilities offering comprehensive surgery remained the same over the past five years, according to participants access to emergency surgery and common surgical procedures in district hospitals improved.

"But nowadays, the moment you have the issue, there is somebody to fix it. So there is much, much improvement as compared to before." (ID3, STP student, public)

Referral hospitals that offer more specialized surgical procedures still experience high caseloads from referrals from PHUs and district hospitals.

Delay in health facility

In health facilities, the surgical condition needs to be recognized by the first-line health worker. Participants in facilities that prioritized triage system and protocols describe an improvement in identification of patients eligible for surgery. Decisions to perform surgery are taken by physicians or by SACHO's in consultation with physicians. In the included facilities time from decision making to surgery for emergencies was between 15 minutes to several hours. Delays were caused by limited capacity of the OT and sterilization, lack of staff or demotivated staff, delay in preparing the patient, lack of resources, time until payment for surgery, buying of surgical supplies, or blood donation. Whereas in most hospitals surgical providers are available at any time, the burden of surgeries is sometimes high with small numbers of surgical providers.

"Yesterday, Sunday, I was here. I have six cases waiting for surgeries, they are all emergencies and I am alone, can you imagine." (ID11, SACHO, public)

Improvement in waiting time is seen when surgery and supplies are free, as is the case in some facilities where NGO's support the care.

3.2.7 Shift to obstetric care

All participants recognize the observed increase in obstetric surgeries over recent years. As main explanation for this change they describe the increased accessibility resulting from the financial barriers for obstetric care by the FHCI. Both the government and NGO's have put a lot of effort in improving maternal health. Initiatives to raise awareness and encourage deliveries in facilities were instituted together with establishment of a referral system and obstetric training for health workers.

"Because for obstetrics what I have noticed is that the introduction of the free healthcare and a lot of education, a lot of programmes in the communities, people don't have deliveries in the communities any more. They are encouraged to go to the centres. And we even have the referral system that has been strengthened, we have the ambulance system, so all those patients that have been even dying in the community that are not recorded, they are brought into the facility and we manage them, we operate them." (ID7, SACHO, public)

The increased attention for maternal deaths has induced fear in surgical providers for acting too late. This could influence decision-making and lead to higher rates of surgical interventions.

"But NOW, and you know this policy now, if you have one maternal death, it's an alarm to your facility." (ID11, SACHO, public)

Improved diagnostic possibilities and better surgical skills are explanations for the increase in obstetric surgery. Furthermore, some participants presume a change in the pregnant population, with higher prevalence of obesity, adolescents and older women, and larger foetuses. Few fear that decisions for CS are taken too soon, because healthcare providers feel more confident performing surgeries than with vaginal deliveries.

"So you see the shift, more people know how to operate, but then sometimes they don't know when to operate maybe." (ID8, physician, public)

"So it is not all about the SURGERY, but the other added [obstetric] skills have contributed a lot in improving the quality of care in obstetrics." (ID9, SACHO, public)

The high volume of obstetric surgeries puts a strain on surgical providers and OT's, possibly resulting in a decrease in general surgery. Some surgical providers are described to only perform obstetric surgery. Elective general surgeries are often postponed, because emergency (obstetric) surgery is prioritized.

"Because the demand is so high in it, you will see somebody who is a general surgeon, will end up being doing ONLY caesarean sections." (ID17, physician, private-non-profit)

In some larger hospitals therefore different health workers are on call for general surgery and for obstetrics. On the other hand, experience with obstetric surgery increased confidence and provided an opportunity to perform other surgeries as well for some participants.

4 Discussion

In the discussion changes in surgical productivity and influencing factors are discussed by combining quantitative and qualitative results. These can identify opportunities to decrease unmet surgical need. The conceptual framework is compared with the framework of Rowe et al (50), describing determinants of health worker performance (paragraph 4.2). An analysis of existing literature will further add to the discussion.

The use of surgical productivity as indicator in this study complicates comparison with literature, where surgical volumes, defined as the annual number of procedures in an operating theatre per 100,000 population, is most commonly used (51). Median surgical volume in low-income countries was 328 per 100,000 (52). In Sierra Leone this was 406 per 100,000 population, with variations from 35 to 1,112 per 100,000 between districts (33). During the EVD outbreak the volume of surgeries decreased substantially (34). Long-term effects on surgical volumes are unknown and might still have influenced results from 2017.

4.1 Changes in surgical productivity

Study findings confirm a decrease in median surgical productivity among individual surgical providers, revealing even lower values than previously described per cadre. Results show that large differences exist between and amongst different cadres. A large group of surgical providers is performing few surgical operations. Understanding the differences in surgical productivity and the challenges of surgical providers in different settings can provide relevant information and help target interventions to increase and improve surgical care.

Whereas in 2012 surgical productivity was higher for physicians than for associate clinicians, in 2017 this was vice versa. The same is observed in other sub-Saharan countries where presence of associate clinicians allowed physicians to focus on other obligations, while the associate clinician performs surgical procedures (53–55). Similar mechanisms can explain the difference in surgical productivity between Sierra Leonean and foreign specialists. Foreign specialist might be on short-term surgical missions, without involvement in administrative and other obligations, sometimes bringing equipment, anaesthetists, and offer cost-reduced procedures, thereby removing barriers that local providers face.

Even though volume of surgery per population is higher in urban than in rural areas in Sierra Leone (986 and 208 per 100,000 respectively in 2017), individual surgical productivity is lower (33). Concentration of health workers and private-for-profit facilities in urban areas can contribute to more distribution of the workload, when compared to rural areas. Differences between urban and rural

areas are reflected by the challenges described. In rural areas participants described high workload, limited supervision and difficult living circumstances, while in urban settings health facilities are more often overcrowded and exceeding surgical capacity. Both settings suffer from limited supplies, equipment, infrastructure and workforce, especially in public facilities. Private-non-profit facilities and public facilities collaborating with NGO's profit from increased supplies, and are commonly able to offer surgery for a reduced price, enhancing surgical productivity.

Surgical volume and productivity do not provide information whether necessary and quality surgery is performed or not. Therefore, increasing surgical productivity should not impede the quality of services delivered.

4.2 Factors influencing surgical care in relation to the conceptual framework

"There is light at the end of this tunnel."

The different factors described by participants to influence surgical productivity are presented in the conceptual framework (figure 8). When comparing this framework with the determinants of health worker performance in low-resource settings as described in a framework by Rowe et al (panel 6), both acknowledge the complexity of health worker performance, which is not only based on health worker factors such as skills, knowledge and motivation, but is influenced by factors in the environment (50). My findings and themes are predominantly in agreement with the determinants described by Rowe. Whereas in the conceptual framework the national, health facility and community level function as overarching levels for all themes, Rowe's framework further differentiates these determinants. This division allows for a structured and deep exploration of all factors and might help in targeting interventions. Some determinants, such as the commercial environment (explained as promotion of drugs by pharmaceutical companies), were not raised by participants in this study. Others are merged together (e.g. patient or client factors, community environment and sociocultural environment; economic and political environment). Reflection on the conceptual framework is important in order not to miss areas for intervention.

Determinants of health worker performance

- Health worker factors
- Patient or client factors
- Attributes of the work
- Health facility environment
- Professional environment
- Educational environment
- Administrative environment
- Employment environment
- Commercial environment
- Community environment
- Sociocultural environment
- Economic environment
- Political environment

Panel 6 Determinants influencing health worker performance in low-resource settings according to Rowe et al (50)

The conceptual framework clearly illustrates that surgical productivity in Sierra Leone is influenced by the health system as a whole. Themes resemble the health system building blocks of the WHO, although e.g. access and quality are considered outputs in the WHO framework. However, for the surgical providers these also influence the input for surgical productivity (12). Since the HIS does not influence surgical productivity, it does not represent a separate factor in the conceptual framework. The identified data gap for surgical activity suggests that weaknesses exist in the HIS in Sierra Leone. Incentives exist not to report all surgical procedures. Further research into the influence of the private sector, including informal practice for surgical procedures, and of underreporting is needed to determine the scale and the effects of this data gap. Actual access to surgery might be higher than suggested by my data. This could explain why participants did not recognize the decrease in surgical productivity from subjective experience. The perception of surgical providers can also differ from registered surgical procedures, because calculations for surgical productivity were based on procedures performed as 'first surgeon' only, not including procedures recorded as assistant in the logbooks. Furthermore, the sample of associate clinicians in the qualitative study, whose productivity increased, was relatively large in comparison to the other cadres.

The factors I found to influence surgical productivity are similar to those described in multiple other LMIC. These include poverty, workforce shortages, scarcities of supplies, and patients presenting late with surgical problems. Often policies do not reflect the necessities on the ground well, but surgical providers make the situation work despite challenges and deficits (56–59). The same was observed here, where participants were resilient and hopeful, stating "There is light at the end of the tunnel".

4.3 Opportunities to increase surgical productivity

> *"If we work together, we can work magic."*

This paragraph discusses opportunities for interventions to increase surgical productivity. Table 7 displays an overview of areas interventions across the different themes identified by the participants.

Governance and leadership & financing

Over the past decades the health agenda in Sierra Leone, influenced by domestic and international actors, focused on infectious diseases and maternal health. Although collaborations with donors and NGO's can be beneficial for financing, service provision and advocacy, both at national and facility level, alignment with national priorities is essential, since donors influence political decision-making and implementation of programmes (60,61). The small surgical workforce, smaller international partnerships and NGO's in surgery and political changes have impeded advocacy for and

implementation of national health policies concerning surgical care (62). Policies as the FHCI, have been effective in improving access to obstetric and surgical care for pregnant women and children in Sierra Leone (18,63,64). Challenges identified by surgical providers in this study are largely similar to the key challenges for surgery, obstetrics and anaesthesia in the NHSSP. Development of a NSOAP and surgical health policies could promote engagement to achieve identified objectives (16,65).

Participants stressed improved regulation of the public-private mix is required. The private sector includes a heterogeneous mix of facilities and providers. Increased stewardship and accountability for health facilities and providers by the government, including accreditation and licensing, can help regulate the private sector and strengthen the health system for surgical care (66,67). Informal surgery is often associated with higher costs for patients, contributing to the barriers for the already financially strained population, increasing risk of catastrophic health expenditure and inequity (66). However, regulation of private and informal clinics is only effective when credible alternatives to receive treatment exist, meaning that enhancing surgical capacity across the health system is essential (68). If good quality, affordable care is available, the demand for unqualified, low quality providers decreases (66).

Theme	**Areas for intervention**
Governance and leadership	Political attention for surgical care
	Legislation and regulation or enforcement to reduce impact of informal health facilities and unlicensed health workers in surgical care delivery
	Collaborations with partners and NGO's
Financing	Cost reduction for surgical care, e.g. incorporation of (emergency or essential) surgical care in FHCI
	Health insurance scheme
Human resources	Continuous professional development of surgical providers (e.g. postgraduate surgical specialization and other surgical training)
	Volume of surgical workforce (including surgical providers, anaesthesia providers and qualified nurses)
	Working conditions, e.g. scheme of service, recognition, living conditions
Resources	Hospital infrastructure, e.g. operating theatres, beds, water and electricity supply
	Management of resources and supply systems
Quality of care	Triage system for early recognition of emergency conditions to reduce in-hospital delay
	Guidelines and evidence-based medicine
	Supervision for medical graduates and students
Access to care	Affordability of surgical care
	Community awareness of and sensitization for surgical conditions

Table 7 Areas providing opportunities to increase surgical productivity in Sierra Leone according to surgical providers and hospital managers

Essential surgeries have proven to be cost-effective in LMICs (69,70). Incremental losses averted by increasing the volume of surgery in Sierra Leone were estimated to be between 360 million and 2.9 billion USD (71). Financing strategies to increase health coverage and reduce out-of-pocket expenditure include expanding the FHCI to cover emergency or essential surgical procedures, or introducing a health insurance scheme. In similar settings, for example in Ghana and Rwanda, health insurance effectively increased the use of health services for obstetric and surgical causes, while reducing the risk of catastrophic health expenditure (72,73). In 2018 the Sierra Leone Social Health Insurance Scheme (SLeSHI) was launched, but until now this is not operational (panel 7)(60,74,75).

Health insurance in Sierra Leone

The Sierra Leone Social Health Insurance (SLeSHI) scheme was launched by the former president in 2018 (74). It is established in order to provide universal health coverage in Sierra Leone and to reduce dependency on donors for financing of health care.

During the development of the NHSSP the benefit package covered by SLeSHI had not been decided yet, but was proposed to include primary health services. Contributions are planned to include both formal and informal sector employees, as well as other contributions, e.g. from the MoHS budget and goods and services taxes (16). A study from 2018 showed large support and willingness to pay for health insurance amongst informal sector workers (75).

Panel 7 Explanation of the proposed health insurance (SLeSHI) in Sierra Leone

Human resources

Opportunities to reinforce the surgical workforce can be categorized into measures to increase the volume of surgical workforce (including anaesthesia and OT staff), to strengthen the current workforce with continuous professional development (CPD), or to increase health worker retention. Explanations for the health worker shortage in Sierra Leone include few medical graduates, lack of training opportunities, poor working conditions and challenges with staff retention, resembling challenges described in other LMIC (76,77).

Currently, capacity of institutions in Sierra Leone to deliver medical and postgraduate training is limited. With the current volume of medical graduates, physicians alone will not be able to meet the surgical need for the next decades (20). While enhancing capacity of medical training, additional interventions to increase the volume of the surgical workforce therefore need to target the different surgical cadres, as well as anaesthesia providers and qualified nurses. In establishing a postgraduate surgical specialization it is essential to adapt to local needs, to utilize local institution and collaborate thoughtfully with foreign institutions and specialists (78). Improving quality of training is essential, since previously physicians described not to apply for specialization in Sierra Leone, because of

expected low quality of the programme (79). An additional opportunity is expansion of task-sharing through the STP. Although task-sharing has proven its worth in providing safe surgical care in Sierra Leone and associate clinicians currently perform over 25% of surgical procedures, so far the STP has not led to an increase in total surgical volume per population and has to some extent shifted surgical procedures from physicians to SACHO's, instead of resolving the gap in workforce (32).

A sustainable task-sharing programme requires adequate training and supervision, recognition, fair remuneration, and suitable regulatory frameworks (77,80). From my results, associate clinicians are accepted and valued by other surgical providers and the community. Experiences from task-sharing programmes in e.g. Zambia and Mozambique illustrate that official recognition and accreditation of associate clinicians provides credibility towards physicians and improved conditions of service increase work motivation (3,55,80,81). As associate clinicians in this study frequently expressed dissatisfaction with these aspects, improving recognition, regulations and conditions of service provide an opportunity to increase surgical productivity. As intended by the STP, associate clinicians are indeed more often working in rural areas where surgical providers are scarce. Living conditions, such as housing, opportunities for education for children, access to healthcare, and possibilities to generate income are important factors for retention of rural health workers (82).

Additionally, it is important to strengthen all surgical cadres with CPD activities (77). Even though recently graduated physicians in Sierra Leone have more commonly followed some surgical training, in this research some physicians expressed lack of skills and confidence (79,83). It is therefore especially important to provide them with the necessary tools to increase their surgical productivity. With differences observed between cadres and between e.g. obstetric surgery and general surgery, identifying training needs to address gaps in knowledge and skills is essential. Different CPD activities have value in increasing surgical knowledge and skills and increase health worker performance. These include supervision with audit and feedback, teamwork and on-the-job training and support (50). Building capacity by on-the-job training and support might be especially fruitful for recently graduated, inexperienced physicians. Continuous education through surgical coaching tailored to individual needs could, also for established surgical providers, improve skills and advance surgical capacity (84).

Resources

This research illustrates that expansion of the surgical workforce alone is not sufficient to increase surgical output, as the surgical volume per population in Sierra Leone remained similar. A comparable situation was described in Zambia, explained by simultaneous reduction of essential supplies and equipment (85). A lack of basic infrastructure and surgical equipment in government facilities in Sierra Leone was already identified as a problem a decade ago and reaffirmed by the SARA in 2017 (15,78).

Improved supply chain management at national level can improve access to surgery, e.g. through decentralization, improving feedback mechanisms between different levels of the health system, public-private partnerships, or by improving organization of multiple parallel mechanisms (86–89). Sierra Leone recently established the National Medical Supplies Agency (NMSA) to improve procurement and distribution of drugs and supplies (90). Consideration of context-specific needs of individual facilities is essential, since from this study it was evident that limiting factors are different between facilities, varying from anaesthetic and OT staff, sterilization capacity, drugs supply or facility infrastructure, all of which are needed to increase surgical capacity (3). System inefficiencies, leading to delay and cancellation of surgical procedures, need to be addressed to increase capacity. Studies in Tanzania and Malawi found cancellation rates of surgery of up to 44%, to a large extent caused by infrastructural constraints as shortages of equipment and lack of space (91,92). A collaboration between Connaught Hospital in Freetown and Surgeons OverSeas illustrates that a needs assessment combined with focused support can greatly increase surgical volume (93).

Quality of care & access

The Institute of Medicine (USA) established six domains of quality of healthcare: safety, effectiveness, patient centeredness, timeliness, efficiency and equity (panel 8)(94). When discussing quality of surgical care participants mainly reflected on safety and effectiveness of surgical care by giving examples of improved IPC, triage, surgical skills, use of evidence-based medicine, and decreased referrals from district hospitals to higher levels. Increased access to surgical procedures in district hospitals and decreased referrals are associated with mortality benefits (95). However, since the described improvements are the perception of the participants, further research on quality of care through assessment of surgical indications, complications and referrals, could strengthen these claims. Whereas the other domains of quality of care were discussed to a lesser extent by participants, or evaluated under other themes of the conceptual framework, it is evident that there is still a lot to gain. In-hospital delays to perform emergency surgery took up to several hours. Although this research focused on supply-side barriers for surgery, the demand-side plays an important role in determining surgical volumes in many facilities. There are multiple barriers

Components of quality of care

- Safety: avoiding injuries to patients from the care
- Effectiveness: providing evidence-based services to everyone who can benefit, and avoiding overuse
- Patient-centeredness: respectful care, responsive to individual needs, values and preferences of the patient
- Timeliness: minimizing waiting times and delays
- Efficiency: avoiding waste of e.g. equipment, supplies, ideas and energy
- Equity: providing consistent care among (groups of) people

Panel 8 Domains of quality of care as defined by the Institute of Medicine (94)

for accessing surgical care, with inequity between geographic areas and socioeconomic groups. Access and quality are closely related, since perceived quality of care highly influences demand and acceptance of surgery (41,50). Whereas patient centeredness was not mentioned in the interviews, this could be essential to change perceptions in the community. Fear and concerns about quality of surgical care are described by participants as some of the barriers for patients to access surgical care. This corresponds with factors identified in community-based studies, in addition to already described financial barriers and poverty, and community awareness and education (39–41,96).

4.4 Shift to obstetric surgery

Globally, CS rates increase with more institutional deliveries, as also observed in Sierra Leone (23). Even though no specific recommendation for an optimal CS rate is given, the WHO describes a decrease in maternal and neonatal mortality when CS rates below 10% are increased (97). Despite progress, the overall CS rate in Sierra Leone remains low at 2.9% in 2016, indicating that access to obstetric care continues to be a challenge (25,98). With low CS rates it is expected that most procedures are medically indicated and that surgical productivity needs to be further increased. However, overuse of CS among certain groups in the population, such as wealthier quintiles, has also been observed in LMIC's (98). Further research of indications for CS and quality of obstetric care would therefore provide valuable information on how to interpret the observed increase in obstetric surgery.

Difference in attention between obstetric and general surgery has resulted in a change in type of surgeries performed. Influences of increased obstetric surgery on surgical capacity are both positive and negative. On one side, the high obstetric caseload provides opportunities to improve surgical skills and practice, on the other side it limits time and infrastructure available for general surgery. Lessons learned from establishing maternal health infrastructure, information systems, and policies provide opportunities to develop general surgery faster (99).

5 Conclusion and recommendations

This chapter provides an answer to the research questions and gives recommendations based on the findings.

5.1 Conclusion

Change in surgical productivity

Despite an increase in surgical providers and total surgical volume, surgical productivity decreased between 2012 and 2017 to a median of 1.2 procedures, meaning the high unmet need for surgery remains. Specialists in private-non-profit facilities were most productive, but their surgical productivity almost halved since 2012. Only amongst associate clinicians surgical productivity increased, whereas for all other cadres a decrease was observed. A large number of surgical providers is performing few surgical procedures, especially among physicians, who represent the largest cadre of the surgical workforce. A lot could be gained if surgical output of these providers increased.

Limitations of the HIS and underreporting of surgical activities result in a data gap and overestimation of the unmet surgical need. Improving regulatory measures and increasing accountability is essential to obtain accurate information that is needed for decision-making.

Factors influencing surgical productivity

Numerous factors, related to all components of the health system, influence surgical productivity. At a national level surgical care has not been prioritized, resulting in few policies targeted at improving the surgical system. Furthermore, financing arrangements at national level influence accessibility. Currently surgical care is heavily reliant on out-of-pocket expenditures of patients and financial barriers provide one of the most important obstacles to access surgical care. Present surgical health workforce is insufficient to increase access. Currently educational capacity in Sierra Leone is not equipped to meet requirements for additional surgical providers and other health workers. Current surgical providers, especially physicians, experience lack of training and supervision. Despite surgical providers being highly motivated, dissatisfaction with terms of employment and career advancement creates a risk they leave their profession for fields providing more opportunities. At facility level factors that influence surgical productivity are often context-specific. Most facilities experience lack of drugs and essential surgical equipment as well as unstable electricity and water supply. For patients and communities, apart from financial constraints, trust in the health services and awareness limit access.

Opportunities to increase surgical volume and productivity

The numerous factors that influence surgical productivity and the large difference in surgical productivity between cadres and settings indicate that multiple solutions are required. Expanding

essential surgeries has proven cost-effective in LMICs. Increased political attention with implementation of a NSOAP could help advance surgical care and urge implementation of policies necessary to meet surgical needs in Sierra Leone. Financing arrangements to explore in order to decrease financial barriers arising from high out-of-pocket expenditures include implementation of a health insurance scheme or expansion of the FHCI policy to improve accessibility for surgical procedures.

Increasing the surgical capacity is essential to meet the surgical needs. To increase the surgical workforce educational capacity of medical and postgraduate training needs to be expanded, with attention for the quality. As this only offers an increase of surgical workforce in the longer term, continued training of associate clinicians is required as well. Development of a needs-based CPD programme for surgical providers from different cadres, e.g. with short surgical courses, surgical coaching and adequate supervision with audit and feedback can support the existing surgical workforce to increase productivity. In particular, attention is required for guidance of STP students and just graduated physicians. For sustainability of the STP recognition of associate clinicians with a suitable regulatory framework and fair remuneration is paramount. Improving working and living conditions is important for health worker retention, especially in rural areas. Need-assessments in facilities can identify relevant gaps and inefficiencies causing delay in the workflow, related to supplies, infrastructure and planning and coordinated supply chain management can ensure adequate supplies. Since local leadership and accountability are required for this, strengthening of facility management might be needed.

As quality of care is closely related to access, further research into quality of surgical care and the role of the informal private sector in surgical procedures in Sierra Leone can provide valuable insights to support regulation of the public-private mix. For regulation to be successful, accessible and valid alternatives for surgery need to be in place, hence increased stewardship and capacity of the surgical sector is required. Furthermore, it remains important to realize that the volume of surgical procedures is not related to the quality of surgical care, and whether essential surgical procedures are being performed. However, if quality of surgical care is poor, efforts to increase surgical productivity are meaningless.

Shift towards obstetric surgery

The increase in obstetric surgery can be explained by significant attention and policies directed towards improving maternal health, with large effects from implementation of the FHCI and improved referral system. These efforts have resulted in increased CS rates, although still low. Although general surgery can benefit from these already developed structures, at the same time the shift towards obstetrics limits capacity of the already strained surgical workforce. Instead of focusing on specific

objectives such as maternal mortality and morbidity, a more balanced and comprehensive approach might be beneficial.

5.2 Recommendations

The lessons that can be learned from the findings about surgical productivity among different cadres and the challenges surgical providers face provide opportunities for interventions. Recommendations are aimed both at increasing surgical productivity and at improving quality since both are required to increase access to surgical care and reduce the unmet need. Recommendations are given for different entities involved.

To Ministry of Health and Sanitation, Sierra Leone:

- To accelerate development and implementation of health policies for surgical care, e.g. through development of a NSOAP with targets for surgical, obstetric and anaesthetic care;
- To update the scheme of service and implement a regulatory framework, with recognition, fair remuneration and career development options for surgical providers, especially associate clinicians, to increase health worker retention and motivation;
- To investigate interventions to reduce out-of-pocket expenditure and financial barriers to improve access to healthcare, such as implementation of a health insurance scheme, expanding the FHCI to include emergency surgical procedures, and investing in supply management of drugs and supplies to health facilities offering comprehensive surgeries to reduce indirect costs and increase surgical productivity;
- To strengthen accountability of the surgical health system, e.g. by increased regulation of accreditation of health facilities and licensing of surgical providers in order to upgrade management of the public-private mix and ensure delivery of quality surgical care;
- To invest in an improved health information system and strengthening of monitoring and evaluation institutions, including facility management, to improve accuracy of data and health information structures.

To institutions involved in surgical training (e.g. University Teaching Hospital Complex, College of Medicine and Allied Health Sciences, CapaCare, and MoHS):

- To identify gaps in knowledge and skills of surgical providers and to develop a comprehensive CPD programme to provide needs-based capacity-building per surgical cadre;

- To strengthen the educational capacity in order to increase the number and productivity of surgical providers in Sierra Leone in several ways, adapted to the local needs and with use of local institutions (if needed in collaboration with foreign institutions and specialists): high-quality post-graduate surgical training for physicians, expanding capacity of undergraduate medical education, and continue task-sharing through the STP.

For facility managers (strengthened by MoHS and District Health Management Teams):

- To carry out a surgical needs assessment to identify context-specific needs in human resources, infrastructure and supplies in the facility. This can support priority setting to increase surgical productivity, e.g. by identification of needs for technical support and supervision of surgical providers providing relevant information for development of a CPD programme, and by improving the supply management of facilities by ensuring an adequate overview of needs, timely requests and communication with suppliers.

Areas for further research:

- To gain insight in the contribution of the informal private sector on surgical care delivery in Sierra Leone;
- To assess the quality of surgery, and whether essential surgery is being performed, e.g. by assessing indications for surgery, complications, and referrals (both volume and reasons) in order to validate the perceived decrease in referrals from district level to regional and national level and identify areas for improvement in surgical care delivery.

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Annex

Annex I: Interview guides in-depth interviews facility managers and surgical providers

Interview guide surgical provider

RESEARCH: "SURGICAL CARE IN SIERRA LEONE – ANALYZING SURGICAL PRODUCTIVITY OVER TIME AND EXPLORING FACTORS INFLUENCING SURGICAL PRODUCTIVITY"

Prior to the interview, the researcher will inform the participant about the research and the procedure. The participant must have read and voluntarily signed the Certificate of Consent in order to participate in the study.

Opening comment of primary investigator:
First of all, thank you for participating in this interview. My name is Juul Bakker, and I am a Medical Doctor in Global Health and Tropical Medicine from The Netherlands. In collaboration with the NGO CapaCare, I am here to do research for my thesis of the Master International Health at the Royal Tropical Institute in Amsterdam.
The research that I am doing is about the surgical productivity in Sierra Leone. It will explore factors that influence the surgical activity in facilities. I would like to ask you questions about your experiences as a surgical provider in Sierra Leone. With your position here in the hospital, I believe you have valuable knowledge and experiences to provide information about this topic. Therefore, I consider it very important that you participate in this study.
I want to remind you that your participation is voluntary. If you have any question that you do not want to answer, please let me know and we will move to the next question. There is no right or wrong answer to the questions. During the interview I will record our conversation, and also make notes. This is to remember your comments, to be able to ask further questions during the interview, and to ensure credibility and accuracy of the data.

INTERVIEW GUIDE

Background and setting

1. Please describe in short your educational background and your current work situation
    - How much experience do you have in your current work place and previous work places? And in a position that requires surgery as part of your job?
    - Can you quantify the above: how many hours or days do you work in each facility? What type(s) of facility? Which percentage of time do you work in each facility (assuming full-time (100%) is 40 hour working per week, total can be above 100%)
    - Do you have colleagues in this facility who perform surgery? How many and which cadres?
2. Can you describe what an average week at work looks like for you?
    - How much time do you spend in the operation theatre (percentage)
    - What other obligations do you have in the hospital? How much time do you spend on these obligations?
    - How is this for colleagues (of the same or different cadres) in your experience?

Surgical productivity

3. How many surgeries do you perform yourself on average in a week?
    - What kind of surgeries? Minor or major surgery? Elective or emergency?
    - How is supervision organized (providing supervision, or receiving supervision)? How does this influence the amount of surgeries?
    - How satisfied are you with the amount of (surgical) work that you are doing?
4. What do you think about the amount of time that you spend on surgeries?
    - Do you think it is enough / a lot / a little?
    - Why do you thinks this is (not) enough? If not enough, or a little: how do you think this number could be increased?
    - Why do you think you spend this amount of time on surgeries?
5. In your experience, how is the recording of procedures in OT logbooks?

Change

6. What has changed in your job over the past five to ten years?
    - What has changed in surgical care in Sierra Leone in general?
    - What has changed in the facility?
7. Over the past years we have observed that even though the number of surgical care providers (people performing surgery) in Sierra Leone increases, the number of surgeries per person per week decreases. Do you recognize this change? And can you explain why this is happening?
8. Over the past years we have observed that in Sierra Leone general surgical procedures (such as hernia repair and laparotomy) decrease, whereas obstetric surgery increases.
    - Can you explain this change?
    - How does this change influence overall surgical capacity?

Barriers and opportunities for surgical productivity

9. Can you describe the process that happens when you decide you need to do a surgery?
    - Who takes the decision to do surgery? What happens next?
    - How much time does it take?
    - What are factors that make it possible to start a surgical procedure soon? And what are factors that delay surgery (or make it impossible to operate)?
10. In your experience which factors enable you to have a high volume of surgeries?
    - When are you able to do most surgeries? When are you most productive?
    - Which factors make your surgical tasks easier?
11. In your experience, what are barriers for the volume of operations you are doing?
    - What are challenges in your job/in surgery?
    - How are the (human) resources? How is anaesthesia performed?
    - What about time of the day?
    - What would help you to do more surgeries?
12. What do you know about barriers in other hospitals?
13. What do you think about the safety of surgeries?
    - How are the circumstances to do surgery?
    - How is the anaesthesia? (e.g. availability, safety)
    - Who is taking care of pre-operative screening and postoperative care?

Future

14. If this hospital was going to double the volume of surgery over the next 2 years, what would be needed to do so?
15. What do you think is most important to do or change to improve surgical care and surgical productivity in Sierra Leone?

Interview guide facility manager

RESEARCH: "SURGICAL CARE IN SIERRA LEONE – ANALYZING SURGICAL PRODUCTIVITY OVER TIME AND EXPLORING FACTORS INFLUENCING SURGICAL PRODUCTIVITY"

Prior to the interview, the researcher will inform the participant about the research and the procedure. The participant must have read and voluntarily signed the Certificate of Consent in order to participate in the study.

Opening comment of primary investigator:
First of all, thank you for participating in this interview. My name is Juul Bakker, and I am a Medical Doctor in Global Health and Tropical Medicine from The Netherlands. In collaboration with the NGO CapaCare, I am here to do research for my thesis of the Master International Health at the Royal Tropical Institute in Amsterdam.
The research that I am doing is about the surgical productivity in Sierra Leone. It will explore factors that influence the surgical activity in facilities. I would like to ask you questions about your experiences as a manager in a facility that is performing surgeries in Sierra Leone. With your position in this hospital, I believe you have valuable knowledge and experiences to provide information about this topic. Therefore, I consider it very important that you participate in this study.
I want to remind you that your participation is voluntary. If you have any question that you do not want to answer, please let me know and we will move to the next question. There is no right or wrong answer to the questions. During the interview I will record our conversation, and also make notes. This is to remember your comments, to be able to ask further questions during the interview, and to ensure credibility and accuracy of the data.

INTERVIEW GUIDE

Background and setting

1. Please describe in short your educational background and your current work situation
2. Can you describe the surgical activities in your facility?
    - Who are involved in performing surgeries?
    - Can you quantify how much time is spent on surgical care by the surgical provider(s)? How is their work divided? What other obligations do they have in the hospital?

Surgical productivity

3. How much time per week is spent on surgeries in this facility?
    - How is the division between minor and major surgery? General surgery and obstetrics? Elective and emergency?
    - How are the procedures recorded in the OT logbooks?
4. What do you think about the amount of time that is spent on surgeries?
    - Do you think it is enough / a lot / a little?
    - Why do you thinks this is (not) enough? If not enough, or a little: how do you think this number could be increased?

Change

5. What has changed in your job over the past five to ten years?
    - What has changed in surgical care in Sierra Leone in general?
    - What has changed in the facility?
6. Over the past years we have observed that even though the number of surgical care providers (people performing surgery) in Sierra Leone increases, the number of surgeries per person per week decreases. Do you recognize this change? And can you explain why this is happening?
7. Over the past years we have observed that in Sierra Leone general surgical procedures (such as hernia repair and laparotomy) decrease, whereas obstetric surgery increases.
    - Can you explain this change?
    - How does this change influence overall surgical capacity?

Barriers and opportunities for surgical productivity

8. Can you describe the process that happens when you decide you need to do a surgery?
    - Who takes the decision to do surgery? What happens next?
    - How much time does it take?
    - What are factors that make it possible to start a surgical procedure soon? And what are factors that delay surgery (or make it impossible to operate)?
9. In your experience, what are opportunities (facilitating factors) for the volume of surgery that are being performed in this facility?
    - When are you able to do most surgeries? What increases surgical productivity?
    - Which factors make your surgical tasks easier?
10. In your experience, what are barriers (limiting factors) for the volume of operations that is being performed in this facility?
    - What are challenges in surgical care?
    - How are the human resources? And equipment and other resources required for surgery?
    - How are the working hours of the surgical providers? How is their attitude and motivation?
    - How do financial factors play a role?
    - Others factors?
11. What do you know about barriers in other hospitals?
12. What do you think about the safety of surgery in this hospital?
    - How are the circumstances to do surgery? How is the anaesthesia? How is the pre-operative screening and post-operative care?

Future

13. If this hospital was going to double the volume of surgery over the next 2 years, what would be needed to do so?
14. What do you think is most important to do or change to improve surgical care and surgical productivity in Sierra Leone?

Annex II: Observation guide with format for field notes

RESEARCH: "SURGICAL CARE IN SIERRA LEONE – ANALYZING SURGICAL PRODUCTIVITY OVER TIME AND EXPLORING FACTORS INFLUENCING SURGICAL PRODUCTIVITY"

Facility number:
Date and time:

Area	Topic	Observations and reflections
General hospital	Number of beds, staff, etc. Surgical staff, facilities and equipment Patient flow from entering hospital (where do they enter, who is seeing them first, how do they proceed through hospital) of surgical patients	
Surgical ward	Number of beds Bed occupancy Number of staff Resources Delays in ward	
Operation theatre	Number of OT rooms Number of staff (anaesthesia, scrub nurses, surgical nurses) Who is operating? How many hours per day is OT running Availability of resources Patient flow in OT Delays in OT	
Administrative	Duty schedule, staff rotation schedule OT logbooks, anaesthesia logbooks, etc.	
Other observations and reflections		

Table: Observation grid

Annex III: Informed consent form

This informed consent form is for surgical care providers and hospital management in public and private-non-profit facilities in Sierra Leone that perform surgical procedures, who we invite to take part in the research project "Surgical care in Sierra Leone – an analysis of surgical productivity over time and an exploration of influencing factors".

General information about this study:

Primary investigator: Juul Bakker, medical doctor, student Master International Health

The Netherlands

Organization: CapaCare

Name of project: Surgical care in Sierra Leone – an analysis of surgical productivity over time and an exploration of influencing factors

This Informed Consent form has two parts:
I: Information Sheet with information about the study
II: Certificate of Consent (to sign if you choose to participate)
You will receive a copy of the full informed consent form.

I: Information Sheet

Background

You have been asked to participate in a research project that aims to identify factors that are influencing surgical productivity in hospitals in Sierra Leone. Before you decide if you want to take part in the research, I will explain the purpose of the research and what it entails to participate. Participation is entirely voluntary. If you have any questions about the research, your participation, or the procedure, please ask me. If you have questions later, you can contact me through the contact details provided in this Informed Consent form.

Purpose of research:

The purpose of this qualitative research is to identify factors that influence surgical productivity in Sierra Leone in public and private-non-profit (NGO) health facilities. An assessment in 2017 has shown that surgical productivity is decreasing. Identification of opportunities and barriers will provide valuable information that can be used to understand the current situation and to increase surgical productivity and to advise policy makers in Sierra Leone.

Type of research

This study is performed by CapaCare. The study will use semi-structured interviews and focus group discussions to gather information about the factors that are influencing surgical productivity. You are invited as one of the participants for the interviews. As a surgical provider you can contribute to our understanding of surgical care provision in Sierra Leone. The interview will be in English, and will take approximately 30-60 minutes.

Voluntary participation

Your participation in this research is entirely voluntary. If you agree to participate at this time, you may later on withdraw your consent without any consequences. If you later on (after the interview) wish to withdraw your consent or have questions concerning the study, you may contact Juul Bakker (see contact details). This will not lead to a penalty or loss of benefits that you are otherwise entitled to. The information that you provided will then not be used for the study.

After the interview we may contact you to also take part in one of the focus group discussions for this study. This is again voluntary. It is possible to decide to participate in the interview, but not in the focus group discussion. The nature and purpose of the focus group discussion will be explained to you in more detail if we approach you to participate.

Procedure

If you agree to participate in the interview, you will be interviewed by Juul Bakker (the primary investigator), and/or one of the research assistants (STP student or SACHO trained by CapaCare). The interview is scheduled at a time and place that is comfortable for you. This can either be in the health facility where you work, or outside of the facility. A cell-phone will be used to record the interview. If you don't want to answer any of the questions, you can tell the interviewer and we will move on to the next question. All information that you provided will be kept strictly confidential and only the researchers will have access to the recording and transcription of the recording. The recording will be destroyed after transcription. Recording of the interview will help us to collect the information that you tell us in the most reliable way. If you do not want the interview to be recorded, we can instead only take notes during the interview. However, it will not possible to write everything down, and we might miss some of the information that you provide. The transcription of the interview will be encrypted and kept in a confidential folder on a password-locked laptop. The data that are registered about you will only be used in accordance with the purpose of the study as described above. All the data will be processed without name or other directly recognisable type of information. Results of the study will be communicated to the participating facilities. Results might also be used for scientific publication and presentation at an (inter)national level to guide policy makers.

No incentive will be provided to take part in this research. However, we will provide a reimbursement of travel expenses when applicable, and refreshments during focus group discussions.

This study might include currently unforeseeable risks. The study might be terminated by the investigators without regard to the participant's consent. Reasons for this include lack of reliability or accessibility of the data, or other unforeseen events.

Contact information

If you have any questions about this study, please contact: Juul Bakker.

Email: Telephone: (contact details)

For further questions regarding approval of this study in Sierra Leone, in case you have any issues, or when you suffered a research-related injury, please contact the office of the Sierra Leone Ethics and Scientific Review Committee, Directorate of Health Systems Policy, Planning & Information. Youyi Building, Fifth Floor, New England or +232-78-366-493 or efoday@health.gov.sl

II: Certificate of Consent

Consent for participation in the study

I have read and understood foregoing information about the study about factors influencing surgical productivity in Sierra Leone. I have had the opportunity to ask questions about the study and any questions I had have been answered to my satisfaction.

I consent voluntarily to participate in the study.

Date: ----------

Name of participant: ----------

Signature of participant: ----------

I have accurately given information about the study to the potential participant. I confirm that the participant was given opportunity to ask questions about participation in the study, and that I answered any questions to the best of my ability. I confirm that participation is voluntary, and the participant has not been coerced to give consent.

A copy of this signed Informed Consent Form has been given to the participant.

Date: ----------

Name of researcher: ----------

Signature of researcher: ----------

Annex IV: Characteristics of participants and facilities qualitative part of study

Participant number	Facility number	Function	Cadre	Gender	Nationality	Region	Sector	Setting	Facility performance	Median monthly surgical productivity of facility in 2017	Interviewer	Duration of interview (minutes)
1	2	Hospital manager	N/A	M	Sierra Leone	WA	Public	Urban	Low	1.5	PI	22
2	1	Hospital manager	Specialist	M	Sierra Leone	WA	Public	Urban	Change: decrease	2.0	PI	43
3	1	Surgical provider	STP student	M	Sierra Leone	WA	Public	Urban	Change: decrease	2.0	PI	46
4	3	Hospital manager	Physician	M	Sierra Leone	NW	Public	Rural	Low	4.0	PI	34
5	3	Surgical provider	SACHO	M	Sierra Leone	NW	Public	Rural	Low	4.0	PI	26
6	4	Hospital manager	Specialist	M	Sierra Leone	EP	Public	Urban	Low	3.0	PI + RA1	38
7	4	Surgical provider	SACHO	M	Sierra Leone	EP	Public	Urban	Low	3.0	RA1 + PI	37
8	5	Hospital manager	Physician	M	Sierra Leone	SP	Public	Urban	High	12.5	PI	30
9	5	Surgical provider	SACHO	F	Sierra Leone	SP	Public	Urban	High	12.5	PI	40
10	6	Hospital manager	Physician	M	Sierra Leone	NP	Public	Urban	Change: decrease	9.0	PI + RA2	53
11	6	Surgical provider	SACHO	M	Sierra Leone	NP	Public	Urban	Change: decrease	9.0	RA2 + PI	40
12	7	Hospital manager	Physician	M	Sierra Leone	EP	Public	Urban	High	18.0	PI	36
13	7	Surgical provider	Specialist	M	Foreign	EP	Public	Urban	High	18.0	RA2	36
14	8	Surgical provider	Physician	F	Foreign	NP	NGO	Rural	High	13.0	PI	27
15	9	Surgical provider	SACHO	M	Sierra Leone	SP	NGO	Rural	Change: decrease	11.0	RA1 + PI	40
16	2	Surgical provider	Specialist	M	Sierra Leone	WA	Public	Urban	Low	1.5	PI	44
17	10	Hospital manager	Physician	M	Sierra Leone	WA	NGO	Urban	High	11.0	PI	80*
18	11	Hospital manager	Physician	M	Sierra Leone	NW	Public	Rural	High	14.4	PI	66**
19	11	Surgical provider	Physician	M	Sierra Leone	NW	Public	Rural	High	14.4	PI	66**
20	12	Hospital manager	Physician	M	Sierra Leone	EP	NGO	Rural	Change: decrease	13.3	RA1	25
21	12	Surgical provider	SACHO	M	Sierra Leone	EP	NGO	Rural	Change: decrease	13.3	RA1	30

**25 minutes of the interview not recorded*
*** Interviewed simultaneously (participant request)*
SACHO = Surgical Assistant Clinical Health Officer
Regions: EP = Eastern Province, NP = Northern Province, NW = North Western Province, SP = Southern Province, WA = Western Area
Interviewer: PI = primary investigator, RA1 = research assistant 1, RA2 = research assistant 2