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Barriers and enabling factors for surgical task-sharing to physician assistants (PAs) in Liberia: a pre-implementation study.

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Abstract

Objectives This study explores potential barriers and enabling factors that may influence the acceptance of implementation of a surgical task-sharing initiative targeting physician assistants (PAs) in Liberia.

Design a qualitative, pre-implementation study using semi-structured interviews. Data was analyzed in NVivo 12 using deductive coding and the Consolidated Framework for Implementation Research (CFIR) as a guide.

Setting Liberia has few surgical providers and a poor surgical infrastructure resulting in a very low surgical volume. The research was conducted in the context of an already running surgical task-sharing program for midwives.

Participants In 2019 a total of 30 key stakeholders in the field of surgery and the PAs training program were interviewed.

Results The majority of the stakeholders supported the idea of training PAs in surgery. The high unemployment rate among PAs and the need for career advancement of this cadre were important enabling factors. Resistance against surgical task-sharing for mid-level clinicians is multifaceted. The Ministry of Health (MOH) did not share a common vision. Resistors within the MOH believed budgetary constraints within the MOH and the lack of surgical infrastructure is a more pressing problem compared to the surgically trained human resources. Another important group of resistors are medical doctors and their professional bodies. Many of their negative believes around surgical task-sharing reflect lessons to be drawn from the current surgical training program for midwives.

Conclusion: Prior to decide on implementation of a surgical training program for PAs a wider support is needed. If surgical task-sharing to PA's is to be considered, the intervention should focus on adapting the 'adaptable' periphery of the intervention to broaden the support of the MOH, medical officers (MOs) and their professional bodies. Failing to obtain such support, should make the implementors consider alternative strategies to strengthen surgical human resources in rural Liberia.

Keywords: surgical task-shifting, surgical task sharing, global surgery, CFIR, Liberia

Article summary

Strengths and limitations

- The study addresses a critical issue in Liberia, where there is a severe shortage of surgical providers and surgical infrastructure, resulting in a low surgical volume.
- It explores the potential for surgical task-sharing to PAs to expand surgical workforce, which is a highly relevant and important topic in global health.
- Utilization of the Consolidated Framework for Implementation Research (CFIR) adds a structured and theoretically informed approach to the study. It enhances the rigor of the research by providing a framework for organizing and analyzing the data.
- The study acknowledges that patients and the community are important stakeholders as well but were not included in the interviews. As surgical task sharing is already widely practiced in Liberia it is already known to be an accepted intervention by patients and the community.
- While the lead author is an experienced medical doctor with expertise in global health, having a single researcher conduct the interviews might have introduced potential bias or subjectivity in the data collection process.

Footnotes

Data availability

The research data used in this study is available upon reasonable request and has been anonymized to protect the privacy and confidentiality of the participants. Please contact the corresponding author for inquiries regarding data access.

Funding statement:

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflicts of interest:

The authors of the manuscript declare that they have no conflicts of interest related to the research study, ensuring that their work is conducted without any personal or financial interest that might compromise its objectivity or integrity.

Introduction

Nearly one-third of the burden of human disease worldwide is amenable to surgery (1). Surgery is a crosscutting intervention, at all ages, involved in every disease category. Currently, there is an increased global interest and effort on improving access to essential surgical care in low and middle-income countries (LMICs). It is estimated that 5 billion people lack access to safe and timely surgery (2). Shortage of human resources and geographical maldistribution are two main factors contributing to the lack of available surgical and obstetric emergency services (3)(4). Surgical task-sharing is a strategy to increase access to surgical services by delegating tasks from surgical specialists to non-specialist medical officers (MOs) and to associate clinicians like physician assistants (PAs) or midwives.

Important benefits of surgical task-sharing towards a cadre with fewer qualifications are the reduced training time, fewer employment costs and higher retention rates in rural areas. It is highly cost-effective and can increase accessibility to and availability of surgical care (5) without compromising the quality and safety of care (6)(7). The World Health Organization (WHO) supports the concept of surgical task-sharing in countries which face a human resource crises within the field of surgery (8)(9). Multiple studies from different African countries, comparing surgical outcomes of associate clinicians with MOs found no significant differences in emergency maternal care or in general surgery (5)(10) (11)(12).

A recent a countrywide observational survey found a surgical volume of 462 operations per 100 000 population per year in Liberia (13), which is far below the recommended 5000 surgeries per 100 000 population per year set by the Lancet Commission on Global Surgery (2). Prior to develop an intervention to strengthening surgical human resources in Liberia, we aimed to assess barriers and enabling factors that may influence the implementation of a surgical task-sharing program for PAs.

Methods

Study setting

Liberia is a country in West-Africa of 4.5 million inhabitants. A decade long civil war and the 2014-2016 Ebola epidemic resulted in a fragile healthcare system. The WHO estimates the need for at least 4.45 physicians, nurses and midwives per 1000 population. In 2015, when including the PAs, Liberia had 0.63 physicians, nurses and midwives per 1000 population (14% of recommended) (14). In 2017 there were 298 registered MOs in Liberia, of those, 12 were surgeons and 10 were gynecologists. The country lacks specialist anesthesiologists and anesthesia is given by anesthetic nurses *(source: Liberian Medical and Dental Council).* In Liberia, surgical tasks are performed by MOs without specialization, with the majority of them practicing surgery.

Furthermore, MOs are unequally distributed with 61% working in Montserrado county mostly in urban areas and caring for one-third of the population (15). During the rainy season, large areas in the interior are practically inaccessible affecting health seeking behavior and possibilities for referral.

Surgical task-sharing in Liberia:

Liberia initiated the PAs program in 1958 and has currently three PA trainings institutions. In 2019 there were 1036 registered PAs, of which 532 were actively practicing clinical medicine. Suggesting many PAs are not practicing or not being captured as practicing. Of the PA's practicing clinical medicine, 75% was working in the public and 25% in the private sector (source: PA association).

In 2009 Liberian Ministry of Health (MOH) staff participated in a conference on task-sharing to associate clinicians in Addis Ababa, Ethiopia. This resulted in the development of a document in which the MOH supported the concept of task-sharing, especially within the field of maternal and neonatal health (16). Maternal and Child health Advocacy International, an INGO from the UK, used this statement to justify the start of a surgical task-sharing program training midwives, called clinical obstetricians (COs) to perform obstetric surgeries in Liberia. In April 2019 the WHO published an external evaluation of the Liberian COs' program concluding positively about the performance on patient outcomes and cost-effectiveness (16). The report also highlighted the challenge that key stakeholders, most importantly the Liberian Medical and Dental Council (LMDC), opposed the training of COs, who were not given the opportunity to voice their concerns against the new training initiative.

Study design and data collection

This qualitative study consists of semi-structured key informant interviews (n=30) with key actors within the field of surgery and/or involved with the training of PAs in Liberia. The semi-structured

interviews were guided by themes distilled through a combination of literature identified and discussion among the research team. The general format of the semi-structured interview guide was pretested with the assistant researcher to gauge understanding within the Liberian setting. The interviews were performed in English by a Dutch medical doctor specialized in Global Health and Tropical Medicine and with experience with a surgical task-sharing program in Sierra Leone (17). The local assistant researcher joined to facilitate logistics and interpretation. Interviews were recorded and transcribed. Interviews lasted from 20 to 90 minutes depending on the input of the participants.

Patients and public involvement statement:

Patients or the public were not actively involved in the design, conduct, reporting, or dissemination plans of our research.

Sampling

Actors were identified through discussion within the research team and additionally through snowball sampling (asking all participants: "who are the most influential stakeholders in the field of surgery? And why?"). The qualitative sampling was purposive and is shown in figure 1. More stakeholders were identified but not interviewed as they were not expected to deliver new key insights, as shown in table 1.

Figure 1.

Table 1.

Data analysis

The qualitative data was analyzed using deductive coding and was coded using NVivo 12. The deductive codebook was developed prior to analyzing the qualitative data and was based on the themes as described within the semi-structured questionnaire and using the constructs of the consolidated framework for implementation research (CFIR)(18). The CFIR developed by Damschroder et al.(19) combines various implementation research frameworks together to assess an initiative, based within the context it operates. It assesses five domains; (1) the intervention characteristics; (2) the outer setting; (3) the inner setting; (4) characteristics of individuals, and finally; (5) the process of implementation. It can be used during different phases of implementation: pre-implementation, mid-implementation and post-implementation (20). For this study the CFIR was used to group findings in one of the five main domains using the CFIR-guide (18). The process of implementation was not described as this is a pre-implementation study.

Ethical considerations

The medical ethical research board of the university of Liberia, UL-PIRE-IRB, in Liberia granted ethical clearance for this study on 10-10-2019, protocol number: 19-10-180. Additional medical ethical clearance was requested and granted on 11-10-2019, number S-110, by The Royal Tropical Institute (KIT), The Netherlands, as Institutional Review Board. All participating stakeholders provided written consent prior to the interviews.

Results

Figure 2.

Intervention characteristics

***The core components**: the essential elements of the intervention and **the adaptable periphery**: elements that could be changed.*

Multiple participants considered surgery to be 'an art' and considered outcomes of surgeries to be the same for MOs and surgical specialists compared to PAs if trained in surgery. It was said that even some doctors were never officially trained in surgery. On the other hand, there were participants who expressed their reservations saying surgery not only to be a mechanical thing of cutting but is also about understanding for example the physiology, pre-operative management, resuscitation and the need for the surgical provider to be able to handle their own complications and that doctors and specialists are better trained for that.

It was also suggested that the program should start as a pilot program and the outcomes of the surgeries should be assessed in order to decide whether or not to continue with the program. It would also be important to know how exactly the curriculum would look like and who the trainers or supervisors would be and to consider their qualifications.

Most participants agreed that PAs trained in surgery should, in principal strengthen the public sector, at least for the first years after graduation. Reservations towards private for-profit clinics were expressed as many times proper supervision would not be available in those clinics.

Overall there was a preference to have surgically trained PAs work in rural underserved areas where there is a shortage of MOs and there would be more surgical cases available because of a higher unmet surgical need. It was also thought that PAs, as it was their original mission, would be more willing to accept rural assignments as compared to MOs.

Several participants proposed the duration of a surgical training program for PAs to be time bound, being a temporal solution. Durations between 3-30 years were proposed, until enough MOs would be trained.

The question was also raised that it would be depending on which procedure would be taught to PAs and depending on the evidence-based evaluation available from a similar program in Sierra Leone if PAs would be able to deliver similar health outcomes compared to MOs.
For the type of surgeries participants agreed that the training of PAs in surgery should focus on lifesaving or emergency procedures most frequently encountered. For more specialized procedures there was a division whether or not it would be appropriate to support training PAs into these areas. Considerations in relation with quality and difficulties with regard to referral were expressed.

Multiple stated ideas about program costs as an important adaptable element of the intervention are summarized in table 2.

Table 2.

Outer setting

The 'economic, political, and social context within which the implemented program will interact'. Associated constructs include 'peer pressure' and external policies and incentives.

The existing COs surgical training program for midwives was being criticized by various key stakeholders. Before the start of the COs' program in 2013 there was a stakeholders meeting in Bomi county, however which stakeholders were exactly involved in the meeting is unknown. At that time, some stakeholders said 'consensus' to start the surgical task-sharing program was reached.
The leadership of the Liberian Medical and Dental Council (LMDC), argued however that the decision to start the CO program was made on consensus by a few powerful stakeholders without the support of the MOs in general. This was one of the reasons why the LMDC refused to license the COs in the past. Therefore, the MOH in collaboration with Maternal and Child health Advocacy International decided to transfer the regulatory and licensing body of the COs towards the Nursing and Midwifery board. Further critique towards the COs' program varied from the opinion of the availability of a sufficient number of doctors to be able to do the obstetric surgeries, COs 'taking' the obstetric cases from intern doctors, COs being paid too much in relation to medical interns; and the lack of institutionalization (having a relation with a national university) of the COs' program and a BSc degree for CO graduates.
A former key stakeholder of the LMDC explained that prior to the start of the surgical task-sharing program for COs the concept of surgical task-sharing in Liberia was explored by the MOH. Several visits took place by the key stakeholders and law makers of Liberia to African countries already

implementing surgical task-sharing; Mozambique, Ethiopia and Zambia. But no act was passed into law.

Inner setting

The 'structural, political, and cultural context through which the intervention proceeds' and the relationship between these elements. This involves the implementation climate and the individuals involved.

Multiple suggestions were made by stakeholders and their organizations to collaborate with a surgical training program for PAs e.g. by the Liberian College of Physicians and Surgeons (LCPS) and PA trainings institutions. United Nations Population Fund (UNFPA) and WHO as potential donors of the program, showed both interest into the idea of training PAs in surgery. During the research a first level rural hospital was offered by its management to function as a training facility for the program. All PAs interviewed were enthusiastic about the idea of starting a surgical training program targeting their cadre as this would give them new career opportunities. By various stakeholders it was described that PAs were often not deployed, not paid or not paid on time. The unemployment rate of PAs was estimated to be between 30-40%, by the representative of a PA training institution and the representative of the LMDC. The high unemployment among PAs was one of the key reasons for stakeholders to support the idea of giving them additional skills in surgery as described below.

"I think, for me it is okay [..] in Liberia right now physician assistants do not have a career ladder, they are trained generally and after training they should really be assigned in rural health facilities where they can be there to support where medical doctors cannot reach. Right now, we even see after training it is also a challenge for government to employ them to go to those areas and we find out that because of this frustration many of them are turning into other professions."
(Representative of a PA training institution)

The weak economic status of the country influences the *availability of resources*. A UN representative commented that it would be key for the government to buy-in *(leadership engagement),* to make the program sustainable; and to absorb the program within the national budget. It was said that an economy that is weak would not deliver much revenue to government and would limit the capacity for government expenditure towards the program. A representative of the MOH commented on its current financial challenges.

"We have a limited budget. So, running a healthcare service is very difficult and I can give you a

typical example; last year our total budget for the ministry of health was 63 million dollars, out of these 63 million dollars we only got 46 million dollars. Out of that 46 million dollars 39 million dollar went towards salary payment of health care workers. Running a whole health system was on seven million dollar that is not sustainable [..]. How do you introduce more financial burden on the very weak financial system that the government has?" (Representative MOH).

Recently, donors who previously were contributing towards paying salaries of healthcare workers in a pooled fund pulled out leaving a gap in MOH' budget.

Characteristics of individuals

The individuals responsible for carrying out the intervention or otherwise related to the intervention, their agency, and their relationships to each other and the intervention. Including knowledge and believes about surgical task-sharing.

Medical doctors

From all participants interviewed for this study four were clearly against the concept of starting a surgical task-sharing program for PAs in Liberia. All four opposing participants were medical doctors. The main argument put forward was that human resources is not the most pressing challenge of the surgical health care system, but surgical infrastructure is. Output of the medical school has been increasing steadily and specialists' surgeons and gynecologists are being trained. On the other hand, government was criticized for not paying the doctors sufficiently or on time leaving the doctors unmotivated to take their (rural) assignments.

The main challenge stated by almost all participants was the resistance from the MOs to the start of a surgical task-sharing program for PAs. The fear that patients and thereby salary would be taken away by a newly trained cadre was argued. A representative of the WHO described the factors leading to doctors' resistance could be divided in two groups: one group of doctors being genuine willing to control the quality of the whole and the other group only willing to protect their own territory.

Ministry of Health

Multiple stakeholders within the MOH were interviewed. One important MOH representative was not in favor of training PAs in surgery. Again, poor surgical infrastructure was considered the main bottleneck of the surgical healthcare system, not shortage of human resources. Another challenge described were the weak financial resources of the government to absorb the program within the

government budget. It was mentioned that using a low doctor to population ratio as argument to train PAs in surgery would not be appropriate as many medical tasks are already shifted to nurses and PAs. Therefore, these cadres should be included in the doctor to population ratio.

Discussion

Key enabling factors

Surgical task-sharing is not a novel concept within the healthcare system of Liberia, as both MOs and clinical officers (COs) are already actively involved in performing surgeries. This pre-established practice has laid the groundwork for acceptance of the idea of training PAs in surgical procedures. Furthermore, the receptiveness of PAs to undergo surgical training is significant, as it offers them new career opportunities without significantly diverting them from their existing clinical duties, especially considering the substantial pool of unemployed PAs.

The interest towards collaboration expressed by multiple stakeholders in the development of a surgical training program for PAs are promising. Notably, partnerships with the postgraduate program for physicians, as proposed, (LCPS and John F. Kennedy tertiary hospital) can help alleviate resistance among MOs. Integrating the program into a PA training institution can contribute to its sustainability and institutionalization reinforcing its long-term impact.

The WHO has pointed out that the shortage of healthcare professionals is expected to worsen by 45% between 2013 and 2030 due to population growth in Sub-Saharan Africa (14). Considering Liberia's estimated population growth of approximately 3.3% year (21) and the low number of graduates from both the medical school and the postgraduate training programs, there is an urgent need to bolster the surgical workforce in the country. Based on international defined needs for surgeons, obstetricians and anesthesiologists, Liberia would need about 900-1800 surgical providers in total. Even when including all Liberian MOs as surgical providers only 9-18% of this target would be met.

Prioritizing the underprivileged and rural populations aligns with the sustainable development agenda of 'Leaving no one behind' and may lead to potential partnership with international organizations such as UNFPA and WHO (22). Such a focus on rural areas, the preference of most participants, could also increase support from doctors who may perceive less competition from the new cadre in urban areas where they are predominantly active.

Key challenges

The turnover of leadership within the MOH, Liberian Medical and Dental Association (LMDA) and LMDC during the process of starting the existing surgical task sharing program for COs has given rise to 'new' resistance towards the concept of training mid-level clinicians in surgery. This highlights the

importance of considering the opinions of new leaders and involving them in the program's development. As described by Saluja et al. (23) Liberia's top-down ministry engagement and the influential role of a few important individuals in decision-making processes underline the necessity of securing their support from the program's onset and maintaining their ongoing engagement. Continues policy dialogues and evidence-based evaluations are critical for the long-term sustainability of such programs.

Another key challenge lies in the resistance of medical doctors, which may be motivated by concerns of preserving professional territory. Some MOs and the MOH believe that the inadequacy of surgical infrastructure is a more immediate issue than the shortage of human resources for surgery. However, evidence (13) suggests that both human resources and infrastructure need to be strengthened, emphasizing the importance of a comprehensive approach to enhancing the surgical healthcare system.

Furthermore, medical doctor resistance to surgical task-sharing is not unique to Liberia and has been observed in other West African regions as it is not as widely practiced compared to other parts of Africa (24). Recommendations from experts advise involving various healthcare providers groups in the *design* of such interventions (6). Additionally, at the same time enhancing the surgical training of MOs can prevent the shift of surgical cases from (not surgically trained) MOs to surgically trained associate clinicians, as witnessed in other countries (11).

Political and Economic Considerations:

The prevailing political and economic situation in Liberia poses significant challenges. Recently major donors pulled out from a pooled fund to pay for healthcare worker salaries, inflation and strike actions have strained the country's political and economic stability. During the field work of the study there were signs that hospitals did not receive adequate supplies (25). In May 2019, donor funds were withdrawn by the government (26), which may have contributed to the reluctance of donors to support the Liberian government. The disproportionate allocation of government expenditure towards healthcare worker salaries and the subsequent non-payment of salaries have demotivated healthcare workers and made the government resistant to introducing a new cadre into the healthcare workforce. These economic and political factors underscore the complex environment in which efforts to enhance the surgical workforce must navigate.

By addressing these enabling factors and challenges, as well as maintaining a focus on rural populations, it is possible to lay the foundation for a successful surgical task-sharing initiative for PAs in Liberia.

Conclusion

The overall consensus is that surgical access has to be increased in Liberia. With PAs as the local champions advocating for a surgical training program, their high unemployment rate and desire for career advancement could justify a surgical task-sharing program targeting PAs. Additionally, various medical officers, The Nursing and Midwifery Board, the LCPS, UNFPA and WHO were also in favor of starting a surgical training program for PAs. Government support is fragile as there is no consensus within the MOH whether or not to support the training of PAs in surgery. Budgetary constraints and the opinion that the lack of surgical infrastructure is a more pressing problem compared to staff skilled in surgery were reasons for this division. Another challenge is the resistance from the MOs and their professional bodies. Factors for resistance are multiple and ranges from 'genuine' quality considerations to professional turf protection. Reservations from the MOs' professional bodies with regard to the already implemented COs' program also has to be considered. If a new surgical training program for PAs would be considered, it will be essential to align such initiative with the existing program for COs. Further preparation of the intervention should eventually focus on adapting the 'adaptable' periphery in a way which broadens and strengthens the support of the MOH, MOs and their professional bodies towards the training of PAs in surgery. Failing to obtain such support, should make the implementors consider alternative strategies to strengthen surgical human resources in rural Liberia.

Stakeholder	Description	Interviewed
Ministry of Health: key representatives	Main government regulatory and decision-making body concerning (public) health affairs.	Yes
Physician assistants (PAs)	PAs working in an urban, rural, private and public sector were interviewed.	Yes
PA training institutions Key representatives	All three PA (public and private) trainings institutions were interviewed.	Yes
PA association and PA board	Official regulatory bodies of the PAs.	Yes
Liberian Medical and Dental Association: key representative	Association of medical doctors with a close link to the LMDC and with a large influence within the medical sector.	Yes
Liberian Medical and Dental Council: key representative	Regulatory body of medical doctors with a large influence within the medical sector.	Yes
Medical Officers	General practitioners or non-specialized medical officers or doctors.	Yes
Surgeons and gynecologists	MOs specialized in surgery or gynecology. Senior authorities in the field of surgery and gynecology in the country.	Yes
AM Dogliotti medical college: key representative	The sole Liberian Medical college.	Yes
JFK hospital: key representative	Largest tertiary hospital and training center for medical post-graduate training.	Yes
Liberian college of physicians and surgeons: key representative	Institution involved in coordinating the medical post-graduate program.	Yes
World Health Organization: key representative	UN agency important for policy making, important donor to the medical sector.	Yes
United Nations Population Fund: key representative	UN agency important for policy making, important donor to the medical sector.	Yes
Nursing and midwifery board: key representative	Regulatory body of the nurses and midwives, including the COs.	Yes
Clinical obstetricians	Midwives trained in obstetric surgery	Yes
Trainer clinical obstetricians	Gynecologist training COs.	Yes
Hospital administrators	Non-medical lead within the hospital management.	Yes
National Public Health Institute: key representative	In collaboration with the Ministry of Health, NPHIL strengthens existing infection prevention and control efforts, public health capacity building, response to outbreaks, and monitoring of diseases with epidemic potential.	Yes
Ministry of Finance	Important for budget allocation towards the MOH.	No
Nurses	Another cadre that could be trained in surgery. Views assessed during the interview of the Nursing and Midwifery board.	No
Law makers (Senate and house of representatives)	Which could enact policy concerning surgical task-sharing into practice.	No
Community	Final recipients of medical services.	No
Other donor organizations. Like Partners in Health, MSF.		No
USAID: key representative	Important donor organization to the medical sector of Liberia.	No

Table 1. Stakeholders identified, description and interviewed (yes or no).

Tuition fee of surgical training program to be paid by participant or (partly) subsidized
Rehabilitation of training center
Incentive for students (housing and living costs)
Salaries of students and graduates
Salaries of trainers (local and expat)
Training material
Building new surgical infrastructure like health centers in which graduates can work
Ensure supply of surgical and anesthesia tools
Capacitating regulatory body

Table 2. Shows the proposed areas to be budgeted within a surgical training program for PAs, by various participants.

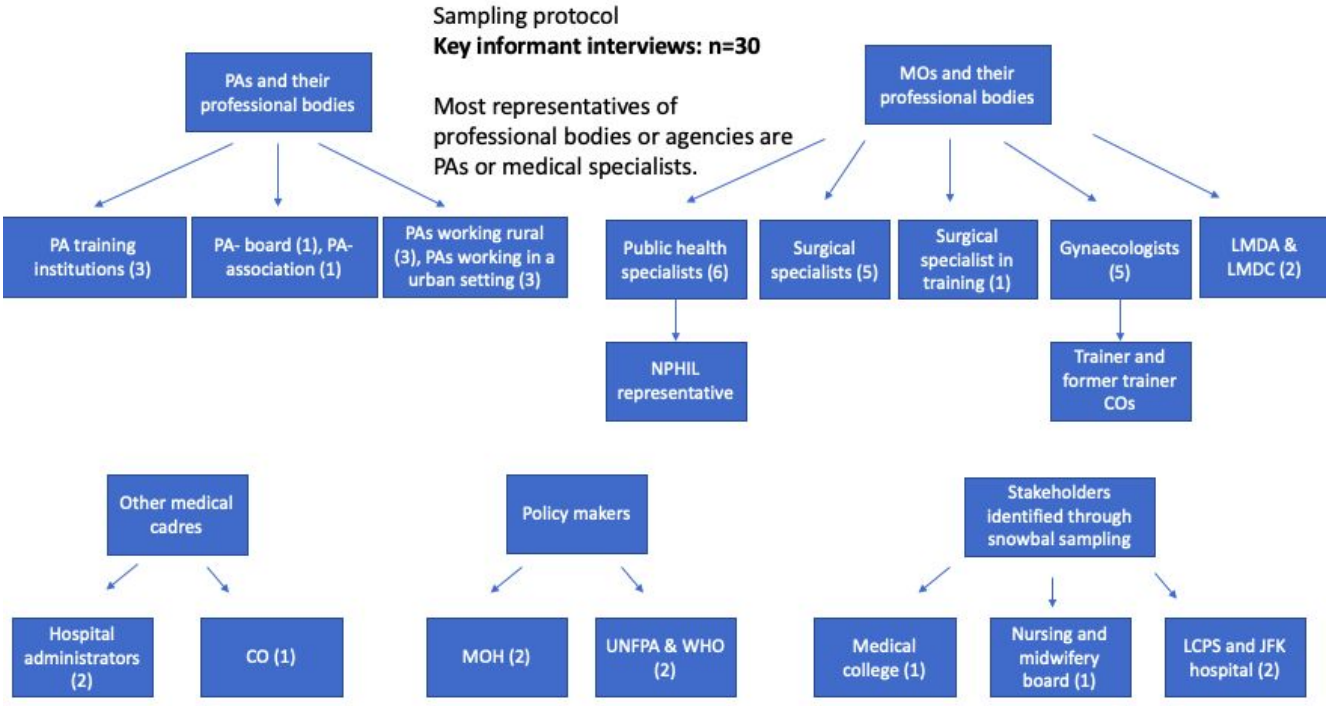


Figure 1. Purposive sampling protocol of the key stakeholders interviewed (n=30). Abbreviations: Physician assistants (PAs), Medical officers (MOs), Liberian Medical and Dental Council (LMDC), Liberian Medical and Dental Association (LMDA), National Public Health Institute of Liberia (NPHIL), Clinical obstetricians (COs), Ministry of Health (MOH), United Nations Family Planning Agency (UNFPA), World Health Organization (WHO), Liberian College of Physicians and Surgeons (LCPS), John F. Kennedy hospital (JFK hospital).

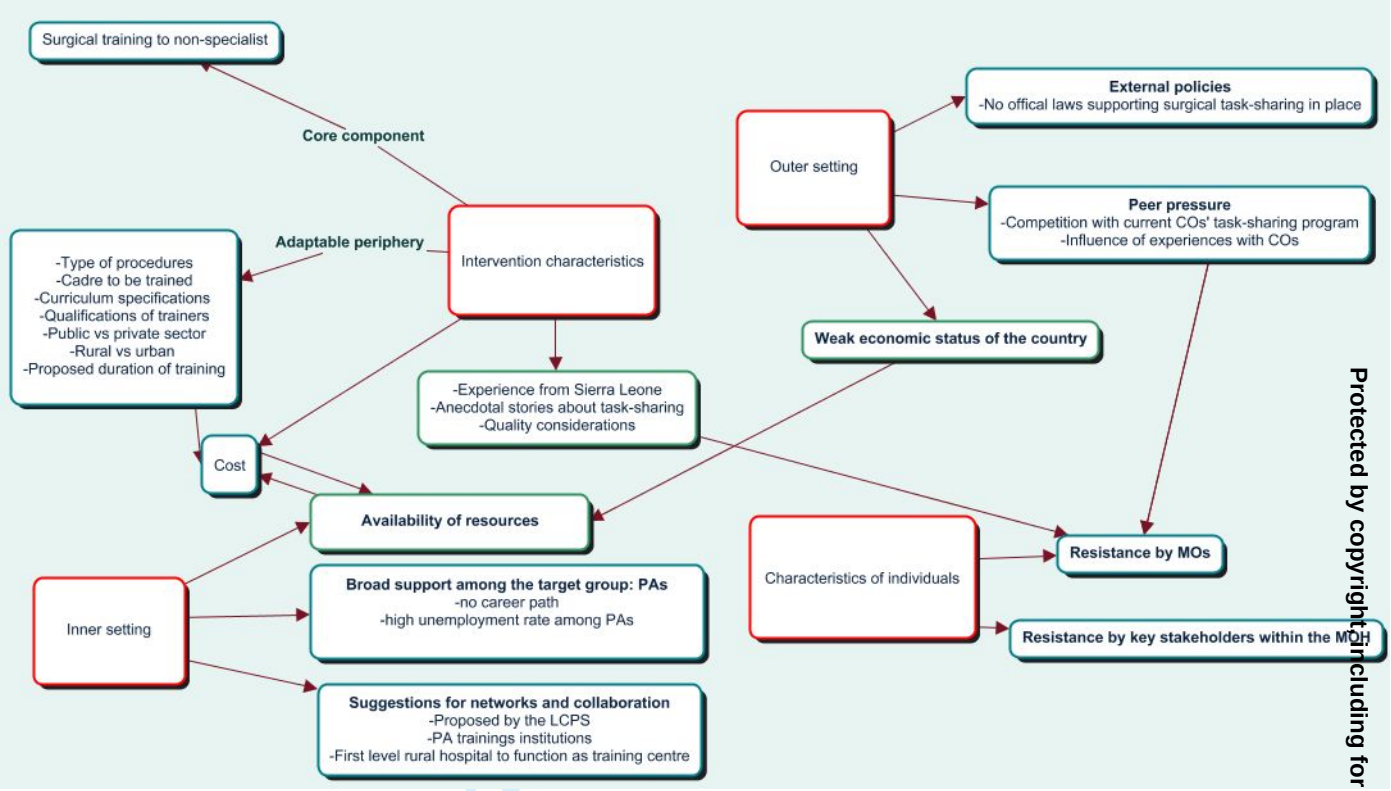


Figure 2. Overview and relation of results grouped within the four domains of the CFIR.

References:

1. Shrime MG, Bickler SW, Alkire BC, Mock C. Global burden of surgical disease: an estimation from the provider perspective. Vol. 3 Suppl 2, The Lancet. Global health. England; 2015. p. S8-9.
2. Meara JG, Greenberg SLM. The Lancet Commission on Global Surgery Global surgery 2030: Evidence and solutions for achieving health, welfare and economic development. Vol. 157, Surgery. United States; 2015. p. 834–5.
3. Knowlton LM, Chackungal S, Dahn B, Lebrun D, Nickerson J, McQueen K. Liberian surgical and anesthesia infrastructure: A survey of county hospitals. World J Surg. 2013;37(4):721–9.
4. Grimes CE, Bowman KG, Dodgion CM, Lavy CBD. Systematic review of barriers to surgical care in low-income and middle-income countries. World J Surg. 2011;35(5):941–50.
5. Wilson A, Lissauer D, Thangaratinam S, Khan KS, MacArthur C, Coomarasamy A. A comparison of clinical officers with medical doctors on outcomes of caesarean section in the developing world: Meta-analysis of controlled studies. Bmj. 2011;342(7807).
6. Ashengo T, Skeels A, Hurwitz EJH, Thuo E, Sanghvi H. Bridging the human resource gap in surgical and anesthesia care in low-resource countries: A review of the task sharing literature. Hum Resour Health. 2017;15(1):1–11.
7. Chao TE, Sharma K, Mandigo M, Hagander L, Resch SC, Weiser TG, et al. Cost-effectiveness of surgery and its policy implications for global health: A systematic review and analysis. Lancet Glob Heal. 2014;2(6):334–45.
8. World Health Organization. Task Shifting Global Recommendations and Guidelines HIV/AIDS. 2003;1–92. Available from: https://www.who.int/healthsystems/TTR-TaskShifting.pdf
9. WHO. Optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting. WHO Libr Cat Data [Internet]. 2012;1–98. Available from: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:health+worker+roles+to+improve+access+to+key+maternal+and+newborn+health+interventions+through+task+shifting#0%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Optimizing+health
10. van Duinen AJ, Kamara MM, Hagander L, Ashley T, Koroma AP, Leather A, et al. Caesarean section performed by medical doctors and associate clinicians in Sierra Leone. Br J Surg. 2019 Jan;106(2):e129–37.
11. Gajewski J, Cheelo M, Bijlmakers L, Kachimba J, Pittalis C, Brugha R. The contribution of non-physician clinicians to the provision of surgery in rural Zambia—a randomised controlled trial. Hum Resour Health. 2019;17(1):1–8.
12. Gajewski J, Borgstein E, Bijlmakers L, Mwapasa G, Aljohani Z, Pittalis C, et al. Evaluation of a surgical training programme for clinical officers in Malawi. Vol. 106, The British journal of

surgery. 2019. p. e156–65.

13. Adde HA, Duinen AJ, Oghogho MD, Dunbar NK, Tehmeh LG, Hampaye TC, et al. Impact of surgical infrastructure and personnel on volume and availability of essential surgical procedures in Liberia. BJS Open. 2020;4(6):1246–55.

14. WHO. Global strategy on human resources for health: Workforce 2030. Who [Internet]. 2016;64. Available from: http://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf%0Ahttp://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf?ua=1%5Cnhttp://www.who.int/hrh/resources/pub_globstrathrh-2030/en/

15. Ministry of Health L. Investment Plan for Building a Resilient Health System 2015 to 2021. 2015; Available from: http://pubdocs.worldbank.org/en/865131479921763514/Liberia-Investment-Plan-Final-May-15.pdf

16. Report EE. Support to Emergency Obstetric and Neonatal Care (EmONC) in Liberia through TASK SHARING Submitted to : The World Health Organization (WHO) - Liberia Ministry of Health - Liberia 17 th April 2019 Presented by : Dr Kwame Ampomah MD , MPH Lead consultan. 2019; Available from: https://docs.wixstatic.com/ugd/dd2ba4_ca41de0a172847acabeaddcca9625590.pdf

17. Bolkan HA, van Duinen A, Waalewijn B, Elhassein M, Kamara TB, Deen GF, et al. Safety, productivity and predicted contribution of a surgical task-sharing programme in Sierra Leone. Br J Surg. 2017;104(10):1315–26.

18. CFIR Research Team-Center for Clinical Management Research. Consolidated Framework for Implementation Research [Internet]. 2021. Available from: https://cfirguide.org/constructs/

19. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. Implement Sci. 2009;4(1):1–15.

20. Means AR, Kemp CG, Gwayi-Chore MC, Gimbel S, Soi C, Sherr K, et al. Evaluating and optimizing the consolidated framework for implementation research (CFIR) for use in low-And middle-income countries: A systematic review. Implement Sci. 2020;15(1):1–19.

21. The World Bank. Population growth (annual %) - Liberia [Internet]. 2019. Available from: https://data.worldbank.org/indicator/SP.URB.GROW?locations=LR

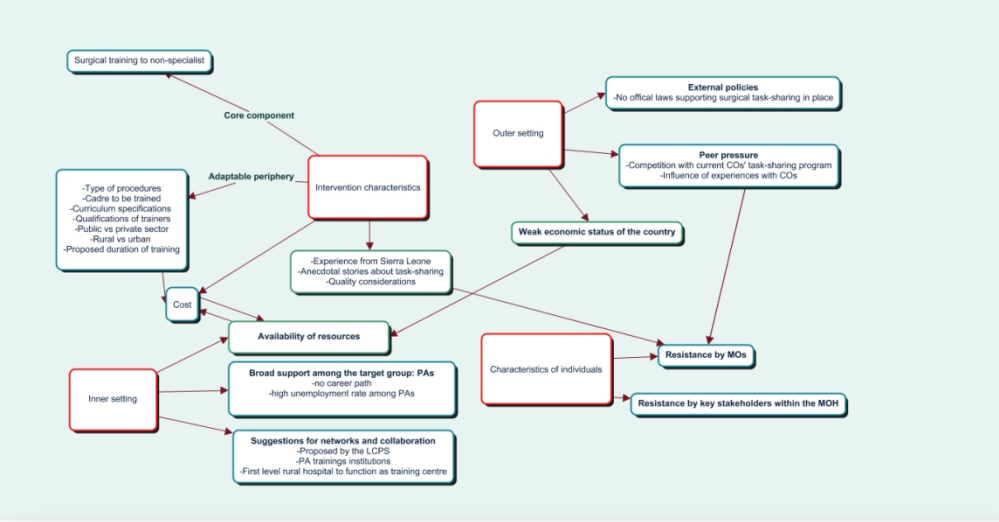
22. UNCDP. Leaving No One Behind - Summary Report. United Nations Econ Soc Counc [Internet]. 2018;13(13):1–4. Available from: http://www.un.org/en/development/desa

23. Saluja S, Silverstein A, Mukhopadhyay S, Lin Y, Raykar N, Keshavjee S, et al. Using the consolidated framework for implementation research to implement and evaluate national surgical planning. BMJ Glob Heal. 2017;2(2):1–8.

24. Nordstrand K, Sundby J. Surgical Task Shifting in Sub-Saharan Africa : A Narrative Synthesis of Current Evidence and Key Informant Perspectives [Internet]. Available from: https://www.med.uio.no/helsam/english/research/centres/global-health/signatory-themes/Surgery and anaesthesia/artikkel-task-shifting.pdf

25. Africa FP. Liberia: Redemption Hospital Gets Medical Boost. Available from: https://frontpageafricaonline.com/health/liberia-redemption-hospital-gets-medical-boost/

26. Dopoe R. “Dig Hole, Cover Hole” -Nagbe Defends Gov’t Misuse of Donor Project Funds. Dly Obs [Internet]. 2019;May. Available from: https://www.liberianobserver.com/news/dig-hole-cover-hole-nagbe-defends-govt-misuse-of-donor-project-funds/



CFIR interrelations.

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Barriers and enabling factors for surgical task-sharing to physician assistants (PAs) in Liberia: a pre-implementation study.

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

	Page/line no(s).
Title and abstract	
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Page 1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	Page 1
Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	Page 3
Purpose or research question - Purpose of the study and specific objectives or questions	Page 3
Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	Page 4 methods. Study design and page 5 data analysis.
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	Page 5 methods. Study design and data collection.
Context - Setting/site and salient contextual factors; rationale**	Page 4
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	Page 5 methods (and figure 1).
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Page 5 and 6 methods.

Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	Page 4 and 5 methods.
Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	Page 4 and 5 methods.
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Page 4 and 5 methods. Figure 1 and table 1.
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	Page 5
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	Page 5
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	N/A

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Page 6 Figure 2.
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Page 6-9

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	Page 10 and 11
Limitations - Trustworthiness and limitations of findings	Page 2

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	Page 2
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Page 2

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

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Exploring barriers and enabling factors for surgical task-sharing with Physician Assistants in Liberia: a qualitative pre-implementation study.

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Abstract

Objectives This study explores potential barriers and enabling factors that may influence the acceptance of implementation of a surgical task-sharing initiative targeting physician assistants (PAs) in Liberia.

Design a qualitative, pre-implementation study using semi-structured interviews. Data was analyzed in NVivo 12 using deductive coding and the Consolidated Framework for Implementation Research (CFIR) as a guide.

Setting Liberia has few surgical providers and a poor surgical infrastructure resulting in a very low surgical volume. The research was conducted in the context of an already running surgical task-sharing program for midwives.

Participants In 2019 a total of 30 key stakeholders in the field of surgery and the PAs training program were interviewed.

Results The majority of the stakeholders supported the idea of training PAs in surgery. The high unemployment rate among PAs and the need for career advancement of this cadre were important enabling factors. Resistance against surgical task-sharing for mid-level clinicians is multifaceted. The Ministry of Health (MOH) did not share a common vision. Opponents within the MOH believed budgetary constraints within the MOH and the lack of surgical infrastructure is a more pressing problem compared to the surgically trained human resources. Another important group of opponents are medical doctors and their professional bodies. Many of their negative beliefs around surgical task-sharing reflect lessons to be drawn from the current surgical training program for midwives.

Conclusion: Prior to deciding on implementation of a surgical training program for PAs wider support is needed. If surgical task-sharing to PA's is to be considered, the intervention should focus on adapting the 'adaptable' periphery of the intervention to broaden the support of the MOH, medical officers (MOs) and their professional bodies. Failing to obtain such support, should make the implementors consider alternative strategies to strengthen surgical human resources in rural Liberia.

Keywords: surgical task-shifting, surgical task sharing, global surgery, CFIR, Liberia

Article summary

Strengths and limitations

- Utilization of the Consolidated Framework for Implementation Research (CFIR) adds a structured and theoretically informed approach to the study.
- Surgical task sharing is already common in Liberia, involving non-specialist physicians, midwives, and anesthetic nurses. Consequently, in general it is recognized as an accepted intervention by patients and the community.
- A limitation is that important stakeholders such as patients and the community were not interviewed.
- Because of limited availability of medical specialists, it was difficult to compare the opinions of surgeons and gynecologists.
- While the lead author is an experienced medical doctor with expertise in global health and surgery, having a single researcher conduct the interviews might have introduced potential bias or subjectivity in the data collection process.

Introduction

Nearly one-third of the burden of human disease worldwide is amenable to surgery (1). Surgery is a crosscutting intervention, at all ages, involved in every disease category. Currently, there is an increased global interest and effort on improving access to essential surgical care in low and middle-income countries (LMICs). It is estimated that 5 billion people lack access to safe and timely surgery (2). Shortage of human resources and geographical maldistribution are two main factors contributing to the lack of available surgical and obstetric emergency services (3)(4). Surgical task-sharing is a strategy to increase access to surgical services by delegating tasks from surgical specialists to non-specialist medical officers (MOs) and to associate clinicians like physician assistants (PAs) or midwives.

Important benefits of surgical task-sharing towards a cadre with fewer qualifications are the reduced training time, fewer employment costs and higher retention rates in rural areas. It is highly cost-effective and can increase accessibility to and availability of surgical care (5) without compromising the quality and safety of care (6)(7). The World Health Organization (WHO) supports the concept of surgical task-sharing in countries which face a human resource crises within the field of surgery (8)(9). Multiple studies from different African countries, comparing surgical outcomes of associate clinicians with MOs found no significant differences in emergency maternal care or in general surgery (5)(10) (11)(12).

A recent a countrywide observational survey found a surgical volume of 462 operations per 100 000 population per year in Liberia (13), which is far below the recommended 5000 surgeries per 100 000 population per year set by the Lancet Commission on Global Surgery (2). Prior to develop an intervention to strengthening surgical human resources in Liberia, we aimed to assess barriers and enabling factors that may influence the implementation of a surgical task-sharing program for PAs. Capacare an organization involved in training associate clinicians in surgery in Sierra Leone (14) was interested to explore the opportunity of extending its activities to the context of neighboring Liberia. Therefore, outcomes of this study were used to guide their strategic direction.

Methods

Study setting

Liberia is a country in West-Africa of 4.5 million inhabitants. A decade long civil war and the 2014-2016 Ebola epidemic resulted in a fragile healthcare system. The WHO estimates the need for at least 4.45 physicians, nurses and midwives per 1000 population. In 2015, when including the PAs, Liberia had 0.63 physicians, nurses and midwives per 1000 population (14% of recommended) (15). Furthermore, MOs are unequally distributed with 61% working in Montserrado county mostly in urban areas and caring for one-third of the population (16). During the rainy season, large areas in the interior are practically inaccessible affecting health seeking behavior and possibilities for referral.

Physician assistants:

Since 1958 Liberia has implemented a program for PAs. PAs work mostly independently, especially, at (rural) health posts, clinics and health centers using the basic concepts of primary health care. In places where no trained midwife is available he or she could also provide basic obstetrical care. At the moment Liberia has 3 PA trainings institutions (Supplementary material 1). In 2019 there were 1036 registered PAs, of which 532 were actively practicing clinical medicine, suggesting many PAs are not practicing or not being captured as practicing (49%). Of the group practicing 75% were working in the public and 25% in the private sector. From the group working in public sector 80% is working in primary health care and the other 20% in the hospitals (source: PA association). The exact number of PAs involved in surgery or independently performing surgeries is unknown but expected to be low.

Surgical task sharing:

In the literature, the terms 'task-shifting' and 'task-sharing' are used interchangeably. In this manuscript we consciously choose the term 'task-sharing' as this underlines a broader systemic approach and the necessary support from medical officers to deliver safe and high-quality surgical care together with an eventually a newly trained cadre (17).

In 2018, Liberia had 286 registered surgical providers, including 67 medical specialists and 19 non-physicians. Including three anesthesiologist specialists. Areas with higher poverty had fewer specialists (0.7 per 100,000) compared to less impoverished areas (3.6 per 100,000). Non-specialist physicians (MOs) performed 58.3% of surgeries (18). A 6 months period during the training of MOs is dedicated to obtaining skills in emergency obstetrical surgeries and neonatal care.
Additionally, anesthesia is provided by anesthetic nurses trained at Phebe hospital.

In 2009 the Liberian Ministry of Health (MOH) staff participated in a conference on task-sharing to associate clinicians in Addis Ababa, Ethiopia. This resulted in the development of a document in which the MOH supported the concept of task-sharing, especially within the field of maternal and neonatal health (19). Maternal and Child health Advocacy International, an International Non-Governmental Organization (INGO) from the UK, used this statement to justify the start of a surgical task-sharing program training midwives, called clinical obstetricians (COs) to perform obstetric surgeries in Liberia (20). Within this training program the trainees started assisting senior doctors but progressed to independently manage obstetric surgeries. In April 2019, the WHO published an external evaluation of the Liberian COs' program concluding positively about the performance on patient outcomes and cost-effectiveness (19). The report also highlighted the challenge that key stakeholders, most importantly the Liberian Medical and Dental Council (LMDC), opposed the training of COs, who were not given the opportunity to voice their concerns against the new training initiative.

Sierra Leonean context

Sierra Leone and Liberia share similar healthcare challenges, including a high unmet need for surgery (21)(13) and weak healthcare systems. CapaCare, operating as both an international and national NGO, established in Sierra Leone in 2011 a surgical training program for associate clinicians in obstetric and general essential surgery. At the start, the training program was designed for Community Health Officers, a cadre comparable to PAs in Liberia, both working mainly in primary healthcare facilities. This program involves 12 months of basic training in a main training facility followed by clinical rotations in partner hospitals. After completing rotations and examinations, graduates undergo a one-year housemanship stage, split between tertiary hospitals in Freetown and district hospitals (14).

Study design and data collection

This qualitative study consists of semi-structured key informant interviews (n=30) with key actors within the field of surgery and/or involved with the training of PAs in Liberia. It explores the participants views on surgical task-sharing with special focus on the idea of implementing a 'hypothetical' surgical task-sharing training program for PAs in the future. The semi-structured interviews were guided by themes distilled through a combination of literature identified and discussion among the research team (Supplementary material 2). The general format of the semi-structured interview guide was pretested with the assistant researcher to gauge understanding within the Liberian setting. The interviews were performed in English by a Dutch medical doctor specialized in Global Health and Tropical Medicine and with experience with a surgical task-sharing

program in Sierra Leone (22). The local assistant researcher joined to facilitate logistics and interpretation. Interviews were recorded and transcribed. Interviews lasted from 20 to 90 minutes depending on the input of the participants.

Patients and public involvement statement:

Patients or the public were not actively involved in the design, conduct, reporting, or dissemination plans of our research.

Sampling

Actors were identified through discussion within the research team and additionally through snowball sampling (asking all participants: "who are the most influential stakeholders in the field of surgery? And why?"). The qualitative sampling was purposive and is shown in figure 1. More stakeholders were identified but not interviewed as they were not expected to deliver new key insights, as shown in table 1. The study acknowledges that patients and the community are important stakeholders as well but were not included in the interviews. Surgical task sharing is already common in Liberia, involving non-specialist physicians, midwives, and anesthetic nurses. Consequently, in general it is recognized as an accepted intervention by patients and the community.

Figure 1. Purposive sampling protocol of the key stakeholders interviewed (n=30). Abbreviations: Physician assistants (PAs), Medical officers (MOs), Liberian Medical and Dental Council (LMDC), Liberian Medical and Dental Association (LMDA), National Public Health Institute of Liberia (NPHIL), Clinical obstetricians (COs), Ministry of Health (MOH), United Nations Family Planning Agency (UNFPA), World Health Organization (WHO), Liberian College of Physicians and Surgeons (LCPS), John F. Kennedy hospital (JFK hospital).

Stakeholder	Description	Interviewed
Ministry of Health: key representatives	Main government regulatory and decision-making body concerning (public) health affairs.	Yes
Physician assistants (PAs)	PAs working in an urban, rural, private and public sector were interviewed.	Yes
PA training institutions Key representatives	All three PA (public and private) trainings institutions were interviewed.	Yes
PA association and PA board	Official regulatory bodies of the PAs.	Yes
Liberian Medical and Dental Association: key representative	Association of medical doctors with a close link to the LMDC and with a large influence within the medical sector.	Yes
Liberian Medical and Dental Council: key representative	Regulatory body of medical doctors with a large influence within the medical sector.	Yes
Medical Officers	General practitioners or non-specialized medical officers or doctors.	Yes
Surgeons and gynecologists	MOs specialized in surgery or gynecology. Senior authorities in the field of surgery and gynecology in the country.	Yes
AM Dogliotti medical college: key representative	The sole Liberian Medical college.	Yes
JFK hospital: key representative	Largest tertiary hospital and training center for medical post-graduate training.	Yes
Liberian college of physicians and surgeons: key representative	Institution involved in coordinating the medical post-graduate program.	Yes
World Health Organization: key representative	UN agency important for policy making, important donor to the medical sector.	Yes
United Nations Population Fund: key representative	UN agency important for policy making, important donor to the medical sector.	Yes
Nursing and midwifery board: key representative	Regulatory body of the nurses and midwives, including the COs.	Yes
Clinical obstetricians	Midwives trained in obstetric surgery	Yes
Trainer clinical obstetricians	Gynecologist training COs.	Yes
Hospital administrators	Non-medical lead within the hospital management.	Yes
National Public Health Institute: key representative	In collaboration with the Ministry of Health, NPHIL strengthens existing infection prevention and control efforts, public health capacity building, response to outbreaks, and monitoring of diseases with epidemic potential.	Yes
Ministry of Finance	Important for budget allocation towards the MOH.	No
Nurses	Another cadre that could be trained in surgery. Views assessed during the interview of the Nursing and Midwifery board.	No
Law makers (Senate and house of representatives)	Which could enact policy concerning surgical task-sharing into practice.	No
Community	Final recipients of medical services.	No
Other donor organizations. Like Partners in Health, MSF.		No
USAID: key representative	Important donor organization to the medical sector of Liberia.	No

Table 1. Stakeholders identified, description and interviewed (yes or no).

Data analysis

The qualitative data was analyzed using deductive coding and was coded using NVivo 12. The deductive codebook was developed prior to analyzing the qualitative data and was based on the themes as described within the semi-structured questionnaire and using the constructs of the consolidated framework for implementation research (CFIR)(23). The CFIR developed by Damschroder et al.(24) combines various implementation research frameworks together to assess an initiative, based within the context it operates. It assesses five domains; (1) the intervention characteristics; (2) the outer setting; (3) the inner setting; (4) characteristics of individuals, and finally; (5) the process of implementation. It can be used during different phases of implementation: pre-implementation, mid-implementation and post-implementation (25). For this study the CFIR was used to group findings in one of the five main domains using the CFIR-guide (23). The process of implementation was not described as this is a pre-implementation study.

Results

Intervention characteristics

***The core components**: the essential elements of the intervention and **the adaptable periphery**: elements that could be changed.*

Multiple participants considered surgery to be 'an art' and considered outcomes of surgeries to be the same for MOs and surgical specialists compared to PAs if trained in surgery. It was said that even some doctors were never officially trained in surgery. On the other hand, there were participants who expressed their reservations saying surgery not only to be a mechanical thing of cutting but is also about understanding for example the physiology, pre-operative management, resuscitation and the need for the surgical provider to be able to handle their own complications and that doctors and specialists are better trained for that.

It was also suggested that the program should start as a pilot program and the outcomes of the surgeries should be assessed in order to decide whether or not to continue with the program. It would also be important to know how exactly the curriculum would look like and who the trainers or supervisors would be and to consider their qualifications.

Most participants agreed that PAs trained in surgery should, in principal strengthen the public sector, at least for the first years after graduation. Reservations towards private for-profit clinics were expressed as many times proper supervision would not be available in those clinics.

Overall, there was a preference to have surgically trained Pas work in rural underserved areas where there is a shortage of MOs and there would be more surgical cases available because of a higher

unmet surgical need. It was also thought that PAs, as it was their original mission, would be more willing to accept rural assignments as compared to MOs.

Several participants proposed the duration of a surgical training program for PAs to be time bound, being a temporal solution. Durations between 3-30 years were proposed, until enough MOs would be trained.

The question was also raised that it would be depending on which procedure would be taught to PAs and depending on the evidence-based evaluation available from a similar program in Sierra Leone if PAs would be able to deliver similar health outcomes compared to MOs.

Participants generally agreed that surgical training for PAs should prioritize life-saving or emergency procedures commonly encountered. Obstetrical emergencies such as cesarean sections, placenta removal, and D&C were suggested, along with hernia surgery for general procedures. Regarding more specialized surgeries like laparotomies, hysterectomies, bowel resections, and anastomosis, opinions varied on whether PA training should encompass these areas. Proponents argued for inclusion, particularly in rural settings, to mitigate referral delays in the absence of a national ambulance system and poor rural road conditions.

Multiple stated ideas about program costs as an important adaptable element of the intervention are summarized in table 2.

Tuition fee of surgical training program to be paid by participant or (partly) subsidized
Rehabilitation of training center
Incentive for students (housing and living costs)
Salaries of students and graduates
Salaries of trainers (local and expat)
Training material
Building new surgical infrastructure like health centers in which graduates can work
Ensure supply of surgical and anesthesia tools
Capacitating regulatory body

Table 2. Shows the proposed areas to be budgeted within a surgical training program for PAs, by various participants.

Outer setting

The 'economic, political, and social context within which the implemented program will interact'. Associated constructs include 'peer pressure' and external policies and incentives.

Surgical task sharing initiative for midwifes (clinical obstetricians):

The existing COs surgical training program for midwives was being criticized by various key stakeholders. Before the start of the COs' program in 2013 there was a stakeholders meeting in Bomi county, however which stakeholders were exactly involved in the meeting is unknown. At that time, some stakeholders said 'consensus' to start the surgical task-sharing program was reached.

The leadership of the Liberian Medical and Dental Council (LMDC), argued however that the decision to start the CO program was made on consensus by a few powerful stakeholders without the support of the MOs in general. This was one of the reasons why the LMDC refused to license the COs in the past. Therefore, the MOH in collaboration with Maternal and Child health Advocacy International decided to transfer the regulatory and licensing body of the COs towards the Nursing and Midwifery board.

Further critique towards the COs' program varied from the opinion of the availability of a sufficient number of doctors to be able to do the obstetric surgeries, COs 'taking' the obstetric cases from intern doctors, COs being paid too much in relation to medical interns; and the lack of institutionalization (having a relation with a national university) of the COs' program and lacking a BSc degree for CO graduates.

It was suggested that the resistance against the COs' program was highly political. Possibly because of the current plan of extending the program of COs in the near future. The argument was made that the resistance was solely against the COs and not for example against the nurse anesthetists or the nurses that are trained to perform cataract surgery. There were only few statements made about PAs already performing surgeries in the country.

"They (MOs) trust a nurse to operate an eye, but you don't trust somebody to make a big abdominal incision and take out a baby. You know, I mean I would rather give you the knife to do a cesarean section quickly to give you the knife to work on my eye, you know, yeah but, so it is that kind of a paradox that we have." (Surgical specialist).

A former key stakeholder of the LMDC explained that prior to the start of the surgical task-sharing program for COs the concept of surgical task-sharing in Liberia was explored by the MOH. Several visits took place by the key stakeholders and law makers of Liberia to African countries already implementing surgical task-sharing; Mozambique, Ethiopia and Zambia. But no act was passed into law.

Inner setting

The 'structural, political, and cultural context through which the intervention proceeds' and the relationship between these elements. This involves the implementation climate and the individuals involved.

Multiple suggestions were made by stakeholders and their organizations to collaborate with a surgical training program for PAs e.g. by the Liberian College of Physicians and Surgeons (LCPS) and PA training institutions. United Nations Population Fund (UNFPA) and WHO as potential donors of the program, showed both interest into the idea of training PAs in surgery. During the research a first level rural hospital was offered by its management to function as a training facility for the program. All PAs interviewed were enthusiastic about the idea of starting a surgical training program targeting their cadre as this could give them new career opportunities. By various stakeholders it was described that PAs were often not deployed, not paid or not paid on time. The unemployment rate of PAs was estimated to be between 30-40%, by the representative of a PA training institution and the representative of the LMDC. The high unemployment among PAs was one of the key reasons for stakeholders to support the idea of giving them additional skills in surgery as described below.

"I think, for me it is okay [..] in Liberia right now physician assistants do not have a career ladder, they are trained generally and after training they should really be assigned in rural health facilities where they can be there to support where medical doctors cannot reach. Right now, we even see after training it is also a challenge for government to employ them to go to those areas and we find out that because of this frustration many of them are turning into other professions."
(Representative of a PA training institution)

The weak economic status of the country influences the *availability of resources*. A UN representative commented that it would be key for the government to buy-in *(leadership engagement),* to make the program sustainable; and to absorb the program within the national budget. It was said that an economy that is weak would not deliver much revenue to government and would limit the capacity for government expenditure towards the program. A representative of the MOH commented on its current financial challenges.

"We have a limited budget. So, running a healthcare service is very difficult and I can give you a typical example; last year our total budget for the ministry of health was 63 million dollars, out of

these 63 million dollars we only got 46 million dollars. Out of that 46 million dollars 39 million dollar went towards salary payment of health care workers. Running a whole health system was on seven million dollar that is not sustainable [..]. How do you introduce more financial burden on the very weak financial system that the government has?" (Representative MOH).

Recently, donors who previously were contributing towards paying salaries of healthcare workers in a pooled fund pulled out leaving a gap in MOH' budget.

Characteristics of individuals

The individuals responsible for carrying out the intervention or otherwise related to the intervention, their agency, and their relationships to each other and the intervention. Including knowledge and believes about surgical task-sharing.

Medical doctors

From all participants interviewed for this study four were clearly against the concept of starting a surgical task-sharing program for PAs in Liberia. All four opposing participants were medical doctors. The main argument put forward was that human resources is not the most pressing challenge of the surgical health care system, but surgical infrastructure is. Output of the medical school has been increasing steadily and specialists' surgeons and gynecologists are being trained. On the other hand, government was criticized for not paying the doctors sufficiently or on time leaving the doctors unmotivated to take their (rural) assignments.

The main challenge stated by almost all participants was the resistance from the Mos to the start of a surgical task-sharing program for Pas. The fear that patients and thereby salary would be taken away by a newly trained cadre was argued. A representative of the WHO described the factors leading to doctors' resistance could be divided in two groups: one group of doctors being genuine willing to control the quality of the whole and the other group only willing to protect their own territory.

Ministry of Health

Multiple stakeholders within the MOH were interviewed. One important MOH representative was not in favor of training PAs in surgery. Again, poor surgical infrastructure was considered the main bottleneck of the surgical healthcare system, not shortage of human resources. Another challenge described were the weak financial resources of the government to absorb the program within the government budget. It was mentioned that using a low doctor to population ratio as argument to

train Pas in surgery would not be appropriate as many medical tasks are already shifted to nurses and Pas. Therefore, these cadres should be included in the doctor to population ratio.

Discussion

In figure 2 the main results are grouped within the four domains of the CFIR. We are aware the domains could overlap and many more interrelations do exist.

Figure 2. Simplified overview and relations of results grouped within the four domains of the CFIR.

Key enabling factors

Task-sharing; not a novel approach

Surgical task-sharing is not a novel concept within the healthcare system of Liberia, as both MAs and COs are already actively involved in performing surgeries. This pre-established practice has laid the groundwork for acceptance of the idea of training Pas in surgical procedures.

Career opportunities

Furthermore, the receptiveness of PAs to undergo surgical training is significant, as it offers them new career opportunities without significantly diverting them from their existing clinical duties, especially considering the substantial pool of unemployed Pas.

Proposed partnerships

The interest towards collaboration expressed by multiple stakeholders in the development of a surgical training program for Pas are promising. Notably, partnerships with the postgraduate program for physicians, as proposed (LCPS and John F. Kennedy tertiary hospital) can help alleviate resistance among Mos. Integrating the program into a PA training institution can contribute to its sustainability and institutionalization reinforcing its long-term impact.

Increasing shortage of human resources for surgery

The WHO has pointed out that the shortage of healthcare professionals is expected to decrease by 45% between 2013 and 2030 due to population growth in Sub-Saharan Africa (15). Considering Liberia's estimated population growth of approximately 3.3% year (26) and the low number of graduates from both the medical school and the postgraduate training programs, there is an urgent need to bolster the surgical workforce in the country. Based on international defined needs for surgeons, obstetricians and anesthesiologists, Liberia would need about 900-1800 surgical providers in total. Even when including all Liberian MOs as surgical providers only 9-18% of this target would be

met.

Focus on the rural population

Prioritizing the underprivileged and rural populations aligns with the sustainable development agenda of 'Leaving no one behind' and may lead to potential partnership with international organizations such as UNFPA and WHO (27). Such a focus on rural areas, the preference of most participants, could also increase support from doctors who may perceive less competition from the new cadre in urban areas where they are predominantly active.

Key challenges

Negative experiences and leadership change

The turnover of leadership within the MOH, Liberian Medical and Dental Association (LMDA) and LMDC during the process of starting the existing surgical task-sharing program for COs has given rise to 'new' resistance towards the concept of training mid-level clinicians in surgery. This highlights the importance of considering the opinions of new leaders and involving them in the program's development. As described by Saluja et al. (28) Liberia's top-down ministry engagement and the influential role of a few important individuals in decision-making processes underline the necessity of securing their support from the program's onset and maintaining their ongoing engagement. Continuous policy dialogues and evidence-based evaluations are critical for the long-term sustainability of such programs. Support by a single key figure is not enough.

Resistance by medical doctors

The resistance towards the idea of training PAs in surgery is multifaceted. Ideas motivated by concerns of preserving professional territory were frequently posed.

Furthermore, medical doctor resistance to surgical task-sharing is not unique to Liberia and has been observed in other West African regions as it is not as widely practiced compared to other parts of Africa (29). Recommendations from experts advise involving various healthcare providers groups in the *design* of such interventions (6). Additionally, at the same time enhancing the surgical training of MOs can prevent the shift of surgical cases from (not surgically trained) MOs to surgically trained associate clinicians, as witnessed in other countries (11).

Surgical infrastructure

Some MOs and the MOH believe that the inadequacy of surgical infrastructure is a more immediate issue than the shortage of human resources for surgery. Surgical infrastructure encompasses the availability of resources like electricity, running water, hospitals, sterile tools and anesthesia

(including equipment). It can be assessed by a WHO Hospital Assessment Tool(2). However, evidence (13)(18) suggests that both human resources and infrastructure need to be strengthened in Liberia, emphasizing the importance of a comprehensive approach to enhancing the surgical healthcare system.

Political and Economic Considerations

The prevailing political and economic situation in Liberia poses significant challenges. Recently major donors pulled out from a pooled fund to pay for healthcare worker salaries, inflation and strike actions have strained the country's political and economic stability. During the field work of the study there were signs that hospitals did not receive adequate supplies (30). In May 2019, donor funds were withdrawn by the government (31), which may have contributed to the reluctance of donors to support the Liberian government. The disproportionate allocation of government expenditure towards healthcare worker salaries and the subsequent non-payment of salaries have demotivated healthcare workers and made the government resistant to introducing a new cadre into the healthcare workforce. These economic and political factors underscore the complex environment in which efforts to enhance the surgical workforce must navigate.

By addressing these enabling factors and challenges, as well as maintaining a focus on rural populations, it is possible to lay the foundation for a successful surgical task-sharing initiative for Pas in Liberia.

Study limitations

One of the main limitations in this study was the limited comparability between the opinions of specialists from different specialties. In Liberia, there is only a limited number of medical specialists available, which may hinder a comprehensive comparison of opinions. Two of the three gynecologists that were interviewed for this study are involved in the training of COs, which might have resulted in a more supportive attitude towards surgical task-sharing compared to other specialists.

Another limitation of this research is that patients and communities were not included in the interviews. Surgical task sharing is already common in Liberia, involving non-specialist physicians, midwives, and anesthetic nurses. Consequently, in general it is recognized as an accepted intervention by patients and the community. Acceptance by the community is mainly dependent on quality of the service provided and emphasizes the need for monitoring of the outcomes of any surgical task sharing initiative.

Finally, the primary author is non-Liberian medical doctor with expertise in global health. Having a single researcher conduct the interviews might have introduced potential bias or subjectivity in the data collection process.

Conclusion

Training of PAs in surgery is an opportunity to increase access to essential surgical services in Liberia. With PAs as the local champions advocating for a surgical training program, their high unemployment rate and desire for career advancement could justify a surgical task-sharing program targeting PAs. Additionally, various medical officers, The Nursing and Midwifery Board, the LCPS, UNFPA and WHO were also in favor of starting a surgical training program for PAs. Government support is fragile as there is no consensus within the MOH whether or not to support the training of PAs in surgery. Budgetary constraints and the opinion that the lack of surgical infrastructure is a more pressing problem compared to staff skilled in surgery were reasons for this division. Another challenge is the resistance from the MOs and their professional bodies. Factors for resistance are multiple and ranges from 'genuine' quality considerations to professional turf protection. Reservations from the MOs' professional bodies with regard to the already implemented COs' program also has to be considered. If a new surgical training program for PAs would be considered, it will be essential to align such initiative with the existing program for COs. Further preparation of the intervention should eventually focus on adapting the 'adaptable' periphery in a way which broadens and strengthens the support of the MOH, MOs and their professional bodies towards the training of PAs in surgery. Failing to obtain such support, should make the implementors consider alternative strategies to strengthen surgical human resources in rural Liberia.

Footnotes

Contributorship statement

MW, AD, HB, and AB designed the study. MW took the lead in drafting the proposal. MW and TH conducted data collection. All authors contributed to manuscript writing and provided critical reviews. All authors reviewed and approved the final manuscript. MW serves as the guarantor for the manuscript.

Competing interests:

AD and HB are unpaid board members of CapaCare, a non-governmental organization that has implemented a surgical task-sharing program in the neighboring country Sierra Leone in collaboration with the Ministry of Health and Sanitation.

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Data sharing statement

The research data used in this study is available upon reasonable request and has been anonymized to protect the privacy and confidentiality of the participants. Please contact the corresponding author for inquiries regarding data access.

Ethics approval

The medical ethical research board of the university of Liberia, UL-PIRE-IRB, in Liberia granted ethical clearance for this study on 10-10-2019, protocol number: 19-10-180. Additional medical ethical clearance was requested and granted on 11-10-2019, number S-110, by The Royal Tropical Institute (KIT), The Netherlands, as Institutional Review Board.

Informed consent

All participating stakeholders provided written consent prior to the interviews.

References:

1. Shrime MG, Bickler SW, Alkire BC, Mock C. Global burden of surgical disease: an estimation from the provider perspective. Vol. 3 Suppl 2, The Lancet. Global health. England; 2015. p. S8-9.
2. Meara JG, Greenberg SLM. The Lancet Commission on Global Surgery Global surgery 2030: Evidence and solutions for achieving health, welfare and economic development. Vol. 157, Surgery. United States; 2015. p. 834–5.
3. Knowlton LM, Chackungal S, Dahn B, Lebrun D, Nickerson J, McQueen K. Liberian surgical and anesthesia infrastructure: A survey of county hospitals. World J Surg. 2013;37(4):721–9.
4. Grimes CE, Bowman KG, Dodgion CM, Lavy CBD. Systematic review of barriers to surgical care in low-income and middle-income countries. World J Surg. 2011;35(5):941–50.
5. Wilson A, Lissauer D, Thangaratinam S, Khan KS, MacArthur C, Coomarasamy A. A comparison of clinical officers with medical doctors on outcomes of caesarean section in the developing world: Meta-analysis of controlled studies. Bmj. 2011;342(7807).
6. Ashengo T, Skeels A, Hurwitz EJH, Thuo E, Sanghvi H. Bridging the human resource gap in surgical and anesthesia care in low-resource countries: A review of the task sharing literature. Hum Resour Health. 2017;15(1):1–11.
7. Chao TE, Sharma K, Mandigo M, Hagander L, Resch SC, Weiser TG, et al. Cost-effectiveness of surgery and its policy implications for global health: A systematic review and analysis. Lancet Glob Heal. 2014;2(6):334–45.
8. World Health Organization. Task Shifting Global Recommendations and Guidelines HIV/AIDS. 2003;1–92. Available from: https://www.who.int/healthsystems/TTR-TaskShifting.pdf
9. WHO. Optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting. WHO Libr Cat Data [Internet]. 2012;1–98. Available from: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:health+worker+roles+to+improve+access+to+key+maternal+and+newborn+health+interventions+through+task+shifting#0%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Optimizing+health
10. van Duinen AJ, Kamara MM, Hagander L, Ashley T, Koroma AP, Leather A, et al. Caesarean section performed by medical doctors and associate clinicians in Sierra Leone. Br J Surg. 2019 Jan;106(2):e129–37.
11. Gajewski J, Cheelo M, Bijlmakers L, Kachimba J, Pittalis C, Brugha R. The contribution of non-physician clinicians to the provision of surgery in rural Zambia—a randomised controlled trial. Hum Resour Health. 2019;17(1):1–8.
12. Gajewski J, Borgstein E, Bijlmakers L, Mwapasa G, Aljohani Z, Pittalis C, et al. Evaluation of a surgical training programme for clinical officers in Malawi. Vol. 106, The British journal of

surgery. 2019. p. e156–65.

13. Adde HA, Duinen AJ, Oghogho MD, Dunbar NK, Tehmeh LG, Hampaye TC, et al. Impact of surgical infrastructure and personnel on volume and availability of essential surgical procedures in Liberia. BJS Open. 2020;4(6):1246–55.

14. Bolkan HA, van Duinen A, Waalewijn B, Elhassein M, Kamara TB, Deen GF, et al. Safety, productivity and predicted contribution of a surgical task-sharing programme in Sierra Leone. Br J Surg. 2017;104(10):1315–26.

15. WHO. Global strategy on human resources for health: Workforce 2030. Who [Internet]. 2016;64. Available from: http://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf%0Ahttp://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf?ua=1%5Cnhttp://www.who.int/hrh/resources/pub_globstrathrh-2030/en/

16. Ministry of Health L. Investment Plan for Building a Resilient Health System 2015 to 2021. 2015; Available from: http://pubdocs.worldbank.org/en/865131479921763514/Liberia-Investment-Plan-Final-May-15.pdf

17. Smith M. Is task sharing preferred to task shifting in the provision of safe surgical care? Surg (United States) [Internet]. 2018;164(3):559–60. Available from: https://doi.org/10.1016/j.surg.2018.05.005

18. Adde HA, van Duinen AJ, Sherman LM, Andrews BC, Salvesen, Dunbar NK, et al. A Nationwide Enumeration of the Surgical Workforce, its Production and Disparities in Operative Productivity in Liberia. World J Surg [Internet]. 2022;46(3):486–96. Available from: https://doi.org/10.1007/s00268-021-06379-8

19. Report EE. Support to Emergency Obstetric and Neonatal Care (EmONC) in Liberia through TASK SHARING Submitted to : The World Health Organization (WHO) - Liberia Ministry of Health - Liberia 17 th April 2019 Presented by : Dr Kwame Ampomah MD , MPH Lead consultan. 2019; Available from: https://docs.wixstatic.com/ugd/dd2ba4_ca41de0a172847acabeaddcca9625590.pdf

20. Dolo O, Clack A, Gibson H, Lewis N, Southall DP. Training of midwives in advanced obstetrics in Liberia. Bull World Health Organ. 2016;94(5):383–7.

21. Bolkan HA, Ystgaard B, Wibe A, Salvesen Ø, Von Schreeb J, Samai MM, et al. Met and unmet needs for surgery in Sierra Leone: A comprehensive, retrospective, countrywide survey from all health care facilities performing operations in 2012. Surg (United States). 2015;157(6):992–1001.

22. Bolkan HA, van Duinen A, Waalewijn B, Elhassein M, Kamara TB, Deen GF, et al. Safety, productivity and predicted contribution of a surgical task-sharing programme in Sierra Leone.

Br J Surg. 2017;104(10):1315–26.

23. CFIR Research Team-Center for Clinical Management Research. Consolidated Framework for Implementation Research [Internet]. 2021. Available from: https://cfirguide.org/constructs/

24. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. Implement Sci. 2009;4(1):1–15.

25. Means AR, Kemp CG, Gwayi-Chore MC, Gimbel S, Soi C, Sherr K, et al. Evaluating and optimizing the consolidated framework for implementation research (CFIR) for use in low-And middle-income countries: A systematic review. Implement Sci. 2020;15(1):1–19.

26. The World Bank. Population growth (annual %) - Liberia [Internet]. 2019. Available from: https://data.worldbank.org/indicator/SP.URB.GROW?locations=LR

27. UNCDP. Leaving No One Behind - Summary Report. United Nations Econ Soc Counc [Internet]. 2018;13(13):1–4. Available from: http://www.un.org/en/development/desa

28. Saluja S, Silverstein A, Mukhopadhyay S, Lin Y, Raykar N, Keshavjee S, et al. Using the consolidated framework for implementation research to implement and evaluate national surgical planning. BMJ Glob Heal. 2017;2(2):1–8.

29. Nordstrand K, Sundby J. Surgical Task Shifting in Sub-Saharan Africa : A Narrative Synthesis of Current Evidence and Key Informant Perspectives [Internet]. Available from: https://www.med.uio.no/helsam/english/research/centres/global-health/signatory-themes/Surgery and anaesthesia/artikkel-task-shifting.pdf

30. Africa FP. Liberia: Redemption Hospital Gets Medical Boost. Available from: https://frontpageafricaonline.com/health/liberia-redemption-hospital-gets-medical-boost/

31. Dopoe R. “Dig Hole, Cover Hole” -Nagbe Defends Gov’t Misuse of Donor Project Funds. Dly Obs [Internet]. 2019;May. Available from: https://www.liberianobserver.com/news/dig-hole-cover-hole-nagbe-defends-govt-misuse-of-donor-project-funds/

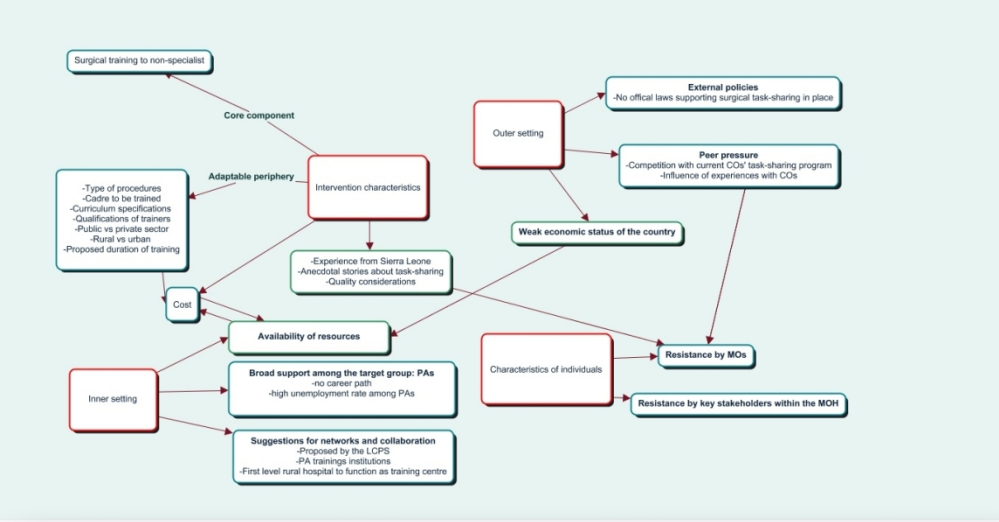

Figure 2. Simplified overview and relations of results grouped within the four domains of the CFIR.

478x251mm (72 x 72 DPI)

Type of training program	Entrance requirement	Duration of training	Recognition	Total duration	Output per year*
A.M. Dogliotti medical college.	BSc in natural or physical sciences (3-4 years)	5-years + a 2-years internship	Master degree	10-11 years	20-40 per year
JFK hospital/ LCPS post-graduate training program.	Medical officer	5 years	Specialist surgeon or gynecologist	15-16 years	2 surgeons and 2 gynecologists per year
The Tubman National Institute of Medical Arts (TNIMA). Public PA training institute.	Secondary school degree	3-years	Diploma degree	3-years	30 per year
Baptist College of Missionary Physician Assistants (BSMPA). Public PA training institute.	Secondary school	3-years	Diploma degree	3-years	10 per year
The Cuttington University School of PAs (CUSPA). Private PA training institute.	Secondary school	4-years	In transition from diploma to BSc degree	4-years	30 per year
Training program for clinical obstetricians (COs) in Liberia.	Midwives with at least a few years of experience	3-years	Diploma degree	Depending on experience prior to start of training (+- 8 years)	1-2 per year
Surgical training program for associate clinicians in Sierra Leone. Supported by CapaCare.	Associate clinician with at least 2-years of experience.	3-years	Diploma degree	8-years	5 per year

Supplementary material 1. Comparing specifications of relevant training programs in Liberia and Sierra Leone. *As an estimate reported by various interviewees over the year 2019.

Themes	Probes	Questions
Acceptability	Knowledge	• How difficult is it to have surgery, when needed in Liberia? • What are the factors that make it difficult to have surgery in Liberia? • What are the main challenges for the surgical health care system in Liberia? • What do you think could be solutions to the human resource gap within the field of surgery in Liberia? • Are you familiar with the concept of surgical task shifting? (if no: explain) if yes, see below. • What do you understand from the concept of surgical task shifting?
	Experience	• What is your experience with surgical task-shifting? • What do you think about surgical task shifting? And why? And what about training PAs in surgery?
	Attitude	• Would you support a surgical training program for PAs? If no, why not? If yes, see below. • How would you support a surgical training program for PAs?
	Quality	• Do you think a thoroughly trained PA in surgery could deliver similar health outcomes compared to a medical doctor, why yes or no? If need further clarification: under which circumstances?
	Competition	• How will the new surgical cadre create competition with other medical cadres? What could be solutions to this?
Feasibility	Challenges	• What could be challenges when starting a surgical training program for PAs?
	In relation to the educational system	• How do you think a curriculum for PAs trained in surgery should look like? • What could be challenges in the development of a training curriculum?

		• How should supervision and continuous training of the newly trained cadre be organized? • For medical doctors or specialists: how much responsibility would you give a well-functioning, surgically trained PA or surgically trained midwife?
	Recognition	• How should the new cadre be recognized? Why? (Bsc?)
	Regulation	• How should the new cadre be regulated? • Will there be need for new legislation?
	Remuneration	• What should be the salary of a surgical trained PA in relation to PAs not trained and medical doctors? Who will have to pay for this? (Donor or government?)
	Referral system	• What possibilities are there of referring complicated surgical cases?
	Benefits	• What could be benefits of training PAs in surgical task shifting?
Appropriateness	General versus obstetric surgery (types of procedures)	• Which surgical procedures would be accepted to be taught to PAs in surgical training, if any at all? Why these operations?
	Midwifes versus Pas	• Some midwifes are already trained in surgery, how do you think another program for PAs should be combined with this program?
	Rural versus urban	• How does the need for surgical task-shifting differs between rural and urban?
	Public versus private	• What is your view on the new surgical cadre be working in the public sector? • And what about the private sector? • What could be pros and cons?
	Complementary necessary workforce	• Is there enough anesthetic workforce to support the newly trained surgical cadre? If no, what could be solution to this?

	Gender distribution in training program	• What do you think about the need for women to be trained as surgical PAs?
Costs/sustainability	Funding	• What are the necessary financial resources to start and continue a surgical training program for PAs? • What could be challenges and opportunities for funding? • Which organizations might be interested in collaboration?
	Sustainability	• In what form would you prefer surgical task shifting to exist in the far future, when possibly more doctors are trained? • How to make a surgical task shifting program sustainable?
Power relations	Influential actors	• Who are the most influential actors in the field of surgical task shifting? And why? • Which players/ stakeholders could facilitate a program focusing on training PA within the field of surgery? • Which players/ stakeholders could oppose a program focusing on training PA within the field of surgery? • How do these stakeholders interact with each other? • What can be reasons not to support the surgical task shifting to PAs? • What can be reasons to support the surgical task shifting to PAs?
Adoption		• How did the tendency of government to support or not support surgical task shifting develop from the past to where we are now and what should we expect for the future? Why?
Fidelity	Lessons to be learned from MCAI	• Is the current MCAI program different than originally set up? And how is it different?

Supplementary material 2. Semi-structered interview guide.

BMJ Open

Exploring barriers and enabling factors for surgical task-sharing with Physician Assistants in Liberia: a qualitative pre-implementation study.

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Exploring barriers and enabling factors for surgical task-sharing with Physician Assistants in Liberia: a qualitative pre-implementation study.

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Abstract

Objectives This study explores potential barriers and enabling factors that may influence the acceptance of implementation of a surgical task-sharing initiative targeting physician assistants (PAs) in Liberia.

Design a qualitative, pre-implementation study using semi-structured interviews. Data was analyzed in NVivo 12 using deductive coding and the Consolidated Framework for Implementation Research (CFIR) as a guide.

Setting Liberia has few surgical providers and a poor surgical infrastructure resulting in a very low surgical volume. The research was conducted in the context of an already running surgical task-sharing program for midwives.

Participants In 2019 a total of 30 key stakeholders in the field of surgery and the PAs training program were interviewed.

Results The majority of the stakeholders supported the idea of training PAs in surgery. The high unemployment rate among PAs and the need for career advancement of this cadre were important enabling factors. Resistance against surgical task-sharing for mid-level clinicians is multifaceted. The Ministry of Health (MOH) did not share a common vision. Opponents within the MOH believed budgetary constraints within the MOH and the lack of surgical infrastructure is a more pressing problem compared to the surgically trained human resources. Another important group of opponents are medical officers (MOs) and their professional bodies. Many of their negative beliefs around surgical task-sharing reflect lessons to be drawn from the current surgical training program for midwives.

Conclusion: Prior to deciding on implementation of a surgical training program for PAs wider support is needed. If surgical task-sharing with PAs is to be considered, the intervention should focus on adapting the 'adaptable' periphery of the intervention to broaden the support of the MOH, MOs and their professional bodies. Failing to obtain such support, should make the implementors consider alternative strategies to strengthen surgical human resources in rural Liberia.

Keywords: surgical task-shifting, surgical task sharing, global surgery, CFIR, Liberia

Article summary

Strengths and limitations

- Utilization of the Consolidated Framework for Implementation Research (CFIR) adds a structured and theoretically informed approach to the study.
- Authors' extensive experience with a task-sharing program in neighboring Sierra Leone enhances the credibility and depth of the study.
- A limitation is that important stakeholders such as patients and the community were not interviewed.
- Because of limited availability of medical specialists, it was difficult to compare the opinions of surgeons and gynecologists.
- While the lead author is an experienced medical doctor with expertise in global health and surgery, having a single researcher conduct the interviews might have introduced potential bias or subjectivity in the data collection process.

Introduction

Nearly one-third of the burden of human disease worldwide is amenable to surgery (1). Surgery is a crosscutting intervention, at all ages, involved in every disease category. Currently, there is an increased global interest and effort on improving access to essential surgical care in low and middle-income countries (LMICs). It is estimated that 5 billion people lack access to safe and timely surgery (2). Shortage of human resources and geographical maldistribution are two main factors contributing to the lack of available surgical and obstetric emergency services (3)(4). Surgical task-sharing is a strategy to increase access to surgical services by delegating tasks from surgical specialists to non-specialist medical officers (MOs) and to associate clinicians like physician assistants (PAs) or midwives.

Important benefits of surgical task-sharing towards a cadre with fewer qualifications are the reduced training time, fewer employment costs and higher retention rates in rural areas. It is highly cost-effective and can increase accessibility to and availability of surgical care (5) without compromising the quality and safety of care (6)(7). The World Health Organization (WHO) supports the concept of surgical task-sharing in countries which face a human resource crises within the field of surgery (8)(9). Multiple studies from different African countries, comparing surgical outcomes of associate clinicians with MOs found no significant differences in emergency maternal care or in general surgery (5)(10) (11)(12).

A recent a countrywide observational survey found a surgical volume of 462 operations per 100 000 population per year in Liberia (13), which is far below the recommended 5000 surgeries per 100 000

population per year set by the Lancet Commission on Global Surgery (2). Prior to developing an intervention to strengthen surgical human resources in Liberia, we aimed to assess barriers and enabling factors that may influence the implementation of a surgical task-sharing program for PAs. Capacare an organization involved in training associate clinicians in surgery in Sierra Leone (14) was interested to explore the opportunity of extending its activities to the context of neighboring Liberia. Therefore, outcomes of this study were used to guide their strategic direction.

Methods

Study setting

Liberia is a country in West-Africa of 4.5 million inhabitants. A decade long civil war and the 2014-2016 Ebola epidemic resulted in a fragile healthcare system. The WHO estimates the need for at least 4.45 physicians, nurses and midwives per 1000 population. In 2015, when including the PAs, Liberia had 0.63 physicians, nurses and midwives per 1000 population (14% of recommended) (15). Furthermore, MOs are unequally distributed with 61% working in Montserrado county mostly in urban areas and caring for one-third of the population (16). During the rainy season, large areas in the interior are practically inaccessible affecting health seeking behavior and possibilities for referral.

Physician assistants:

Since 1958 Liberia has implemented a program for PAs. PAs work mostly independently, especially, at (rural) health posts, clinics and health centers using the basic concepts of primary health care. In places where no trained midwife is available he or she could also provide basic obstetrical care. At the moment Liberia has 3 PA training institutions (Supplementary material 1). In 2019 there were 1036 registered PAs, of which 532 were actively practicing clinical medicine, suggesting many PAs are not practicing or not being captured as practicing (49%). Of the group practicing 75% were working in the public and 25% in the private sector. From the group working in public sector 80% is working in primary health care and the other 20% in the hospitals (source: PA association). The exact number of PAs involved in surgery or independently performing surgeries is unknown but expected to be low.

Surgical task sharing:

In the literature, the terms 'task-shifting' and 'task-sharing' are used interchangeably. In this manuscript we consciously choose the term 'task-sharing' as this underlines a broader systemic approach and the necessary support from medical officers to deliver safe and high-quality surgical care together with an eventually newly trained cadre (17).

In 2018, Liberia had 286 registered surgical providers, including 67 medical specialists and 19 non-physicians. Areas with higher poverty had fewer specialists (0.7 per 100,000) compared to less impoverished areas (3.6 per 100,000). Non-specialist physicians (MOs) performed 58.3% of surgeries (18). A 6 months period during the training of MOs is dedicated to obtaining skills in emergency obstetrical surgeries and neonatal care.

Additionally, anesthesia is mostly provided by anesthetic nurses trained at Phebe hospital.

In 2009 the Liberian Ministry of Health (MOH) participated in a conference on task-sharing with associate clinicians in Addis Ababa, Ethiopia. This resulted in the development of a document in which the MOH supported the concept of task-sharing, especially within the field of maternal and neonatal health (19). Maternal and Child health Advocacy International, an International Non-Governmental Organization (INGO) from the UK, used this statement to justify the start of a surgical task-sharing program training midwives, called clinical obstetricians (COs) to perform obstetric surgeries in Liberia (20). Within this training program the trainees started assisting senior doctors but progressed to independently manage obstetric surgeries. In April 2019, the WHO published an external evaluation of the Liberian COs' program concluding positively about the performance on patient outcomes and cost-effectiveness (19). The report also highlighted the challenge that key stakeholders, most importantly the Liberian Medical and Dental Council (LMDC), opposed the training of COs, who were of the opinion of not given the opportunity to voice their concerns against the new training initiative.

Sierra Leonean context

Sierra Leone and Liberia share similar healthcare challenges, including a high unmet need for surgery (21)(13) and weak healthcare systems. CapaCare, operating as both an international and national NGO, started a surgical training program for associate clinicians in obstetric and general surgery in Sierra Leone in 2011. At the start, the training program was designed for Community Health Officers, a cadre comparable to PAs in Liberia, both working mainly in primary healthcare facilities. This program involves 12 months of basic training in a main training facility followed by clinical rotations in partner hospitals. After completing rotations and examinations, graduates undergo a one-year housemanship stage, split between tertiary hospitals in Freetown and district hospitals (14).

Study design and data collection

This qualitative study consists of semi-structured key informant interviews (n=30) with key actors within the field of surgery and/or involved with the training of PAs in Liberia. It explores the participants views on surgical task-sharing with special focus on the idea of implementing a 'hypothetical' surgical task-sharing training program for PAs in the future. The semi-structured interviews were guided by themes distilled through a combination of literature identified and discussion among the research team (Supplementary material 2). The general format of the semi-structured interview guide was pretested with the assistant researcher to gauge understanding within the Liberian setting. The interviews were performed in English by a Dutch medical doctor specialized in Global Health and Tropical Medicine and with experience with a surgical task-sharing program in Sierra Leone (22). The local assistant researcher joined to facilitate logistics and

interpretation. Interviews were recorded and transcribed. Interviews lasted from 20 to 90 minutes depending on the input of the participants. Interviews were performed in the last quarter of 2019.

Patients and public involvement statement:

Patients or the public were not actively involved in the design, conduct, reporting, or dissemination plans of our research.

Sampling

Actors were identified through discussion within the research team and additionally through snowball sampling (asking all participants: "who are the most influential stakeholders in the field of surgery? And why?"). The qualitative sampling was purposive and is shown in figure 1. More stakeholders were identified but not interviewed as they were not expected to deliver new key insights, as shown in table 1. The study acknowledges that patients and the community are important stakeholders as well but were not included in the interviews. Surgical task sharing is already common in Liberia, involving non-specialist physicians, midwives, and anesthetic nurses. Consequently, in general it is recognized as an accepted intervention by patients and the community.

Figure 1. Purposive sampling protocol of the key stakeholders interviewed (n=30). Abbreviations: Physician assistants (PAs), Medical officers (MOs), Liberian Medical and Dental Council (LMDC), Liberian Medical and Dental Association (LMDA), National Public Health Institute of Liberia (NPHIL), Clinical obstetricians (COs), Ministry of Health (MOH), United Nations Family Planning Agency (UNFPA), World Health Organization (WHO), Liberian College of Physicians and Surgeons (LCPS), John F. Kennedy hospital (JFK hospital).

Stakeholder	Description	Interviewed
Ministry of Health: key representatives	Main government regulatory and decision-making body concerning (public) health affairs.	Yes
Physician assistants (PAs)	PAs working in an urban, rural, private and public sector were interviewed.	Yes
PA training institutions Key representatives	All three PA (public and private) training institutions were interviewed.	Yes
PA association and PA board	Official regulatory bodies of the PAs.	Yes
Liberian Medical and Dental Association: key representative	Association of MOs or medical doctors with a close link to the LMDC and with a large influence within the medical sector.	Yes
Liberian Medical and Dental Council: key representative	Regulatory body of MOs with a large influence within the medical sector.	Yes
Medical Officers	General practitioners or non-specialized medical officers or doctors.	Yes
Surgeons and gynecologists	MOs specialized in surgery or gynecology. Senior authorities in the field of surgery and gynecology in the country.	Yes
AM Dogliotti medical college: key representative	The Liberian Medical college.	Yes
JFK hospital: key representative	Largest tertiary hospital and training center for medical post-graduate training.	Yes
Liberian college of physicians and surgeons: key representative	Institution involved in coordinating the medical post-graduate program.	Yes
World Health Organization: key representative	UN agency important for policy making, important donor to the medical sector.	Yes
United Nations Population Fund: key representative	UN agency important for policy making, important donor to the medical sector.	Yes
Nursing and midwifery board: key representative	Regulatory body of the nurses and midwives, including the COs.	Yes
Clinical obstetricians	Midwives trained in obstetric surgery	Yes
Trainer clinical obstetricians	Gynecologist training COs.	Yes
Hospital administrators	Non-medical lead within the hospital management.	Yes
National Public Health Institute: key representative	In collaboration with the Ministry of Health, NPHIL strengthens existing infection prevention and control efforts, public health capacity building, response to outbreaks, and monitoring of diseases with epidemic potential.	Yes
Ministry of Finance	Important for budget allocation towards the MOH.	No
Nurses	Another cadre that could be trained in surgery. Views assessed during the interview of the Nursing and Midwifery board.	No
Law makers (Senate and house of representatives)	Which could enact policy concerning surgical task-sharing into practice.	No
Community	Final recipients of medical services.	No
Other donor organizations. Like Partners in Health, MSF.		No
USAID: key representative	Important donor organization to the medical sector of Liberia.	No

Table 1. Stakeholders identified, description and interviewed (yes or no).

Data analysis

The qualitative data was analyzed using deductive coding and was coded using NVivo 12. The deductive codebook was developed prior to analyzing the qualitative data and was based on the themes as described within the semi-structured questionnaire and using the constructs of the consolidated framework for implementation research (CFIR)(23). The CFIR developed by Damschroder et al.(24) combines various implementation research frameworks together to assess an initiative, based within the context it operates. It assesses five domains; (1) the intervention characteristics; (2) the outer setting; (3) the inner setting; (4) characteristics of individuals, and finally; (5) the process of implementation. It can be used during different phases of implementation: pre-implementation, mid-implementation and post-implementation (25). For this study the CFIR was used to group findings in one of its main domains using the CFIR-guide (23). The process of implementation was not described as this is a pre-implementation study.

Results

Intervention characteristics

***The core components**: the essential elements of the intervention and **the adaptable periphery**: elements that could be changed.*

Multiple participants considered surgery to be 'an art' and considered outcomes of surgeries to be the same for MOs and surgical specialists compared to PAs if trained in surgery. It was said that even some doctors were never officially trained in surgery. On the other hand, there were participants who expressed their reservations saying surgery not only to be a mechanical thing of cutting but is also about understanding for example the physiology, pre-operative management, resuscitation and the need for the surgical provider to be able to handle their own complications and that doctors and specialists are better trained for that.

It was also suggested that the program should start as a pilot program and the outcomes of the surgeries should be assessed in order to decide whether or not to continue with the program. It would also be important to know how exactly the curriculum would look like and who the trainers or supervisors would be and to consider their qualifications.

Most participants agreed that PAs trained in surgery should, in principal strengthen the public sector, at least for the first years after graduation. Reservations towards working in private for-profit clinics were expressed as many times proper supervision would not be available in those clinics.

Overall, there was a preference to have surgically trained Pas work in rural underserved areas where there is a shortage of MOs. Additionally, there would be more surgical cases available because of a

higher unmet surgical need. It was also thought that PAs, as it was their original mission, would be more willing to accept rural assignments as compared to MOs.

Several participants proposed the duration of a surgical training program for PAs to be time bound, being a temporary solution. Durations between 3-30 years were proposed, until enough MOs would be trained.

The question was also raised that it would be depending on which procedure would be taught to PAs and depending on the evidence-based evaluation available from a similar program in Sierra Leone if PAs would be able to deliver similar health outcomes compared to MOs.

Participants generally agreed that surgical training for PAs should prioritize life-saving or emergency procedures commonly encountered. Obstetrical emergencies such as cesarean sections, placenta removal, and D&C were suggested, along with hernia surgery for general procedures. Regarding more specialized surgeries like laparotomies, hysterectomies, bowel resections, and anastomosis, opinions varied on whether PA training should encompass these areas. Proponents argued for inclusion, particularly in rural settings, to mitigate referral delays in the absence of a national ambulance system and poor rural road conditions.

Multiple participants stated ideas about program costs as an important adaptable element of the intervention are summarized in table 2.

Tuition fee of surgical training program to be paid by participant or (partly) subsidized
Rehabilitation of training center
Incentive for students (housing and living costs)
Salaries of students and graduates
Salaries of trainers (local and expat)
Training material
Building new surgical infrastructure like health centers in which graduates can work
Ensure supply of surgical and anesthesia tools
Capacitating regulatory body

Table 2. Shows the proposed areas to be budgeted within a surgical training program for PAs, by various participants.

Outer setting

The 'economic, political, and social context within which the implemented program will interact'. Associated constructs include 'peer pressure' and external policies and incentives.

Surgical task sharing initiative for midwifes (clinical obstetricians):

The existing COs surgical training program for midwives was being criticized by various key stakeholders. Before the start of the COs' program in 2013 there was a stakeholders meeting in Bomi county, however which stakeholders were exactly involved in the meeting is unknown. At that time, some stakeholders said 'consensus' to start the surgical task-sharing program was reached.

The leadership of the Liberian Medical and Dental Council (LMDC), argued however that the decision to start the CO program was made on consensus by a few powerful stakeholders without the support of the MOs in general. This was one of the reasons why the LMDC refused to license the COs in the past. Therefore, the MOH in collaboration with Maternal and Child health Advocacy International decided to transfer the regulatory and licensing body of the COs towards the Nursing and Midwifery board.

Further critique towards the COs' program varied from the opinion of the availability of a sufficient number of doctors to be able to do the obstetric surgeries, COs 'taking' the obstetric cases from intern doctors, COs being paid too much in relation to medical interns; and the lack of institutionalization (having a relation with a national university) of the COs' program and lacking a BSc degree for CO graduates.

It was suggested that the resistance against the COs' program was highly political. Possibly because of the current plan of extending the program of COs in the near future. The argument was made that the resistance was solely against the COs and not for example against the nurse anesthetists or the nurses that are trained to perform cataract surgery. There were only few statements made about PAs already performing surgeries in the country.

"They (MOs) trust a nurse to operate an eye, but you don't trust somebody to make a big abdominal incision and take out a baby. You know, I mean I would rather give you the knife to do a cesarean section quickly to give you the knife to work on my eye, you know, yeah but, so it is that kind of a paradox that we have." (Surgical specialist).

A former key stakeholder of the LMDC explained that prior to the start of the surgical task-sharing program for COs the concept of surgical task-sharing in Liberia was explored by the MOH. Several visits took place by the key stakeholders and law makers of Liberia to African countries already

implementing surgical task-sharing; Mozambique, Ethiopia and Zambia. But no act was passed into law.

Inner setting

The 'structural, political, and cultural context through which the intervention proceeds' and the relationship between these elements. This involves the implementation climate and the individuals involved.

Multiple suggestions were made by stakeholders and their organizations to collaborate with a surgical training program for PAs e.g. by the Liberian College of Physicians and Surgeons (LCPS) and PA training institutions. United Nations Population Fund (UNFPA) and WHO as potential donors of the program, showed both interest into the idea of training PAs in surgery. During the research a first level rural hospital was offered by its management to function as a training facility for the program. All PAs interviewed were enthusiastic about the idea of starting a surgical training program targeting their cadre as this could give them new career opportunities. By various stakeholders it was described that PAs were often not deployed, not paid or not paid on time. The unemployment rate of PAs was estimated to be between 30-40%, by the representative of a PA training institution and the representative of the LMDC. The high unemployment among PAs was one of the key reasons for stakeholders to support the idea of giving them additional skills in surgery as described below.

"I think, for me it is okay [..] in Liberia right now physician assistants do not have a career ladder, they are trained generally and after training they should really be assigned in rural health facilities where they can be there to support where medical doctors cannot reach. Right now, we even see after training it is also a challenge for government to employ them to go to those areas and we find out that because of this frustration many of them are turning into other professions."
(Representative of a PA training institution)

The weak economic status of the country influences the *availability of resources*. A UN representative commented that it would be key for the government to buy-in *(leadership engagement),* to make the program sustainable; and to absorb the program within the national budget. It was said that an economy that is weak would not deliver much revenue to government and would limit the capacity for government expenditure towards the program. A representative of the MOH commented on its current financial challenges.

"We have a limited budget. So, running a healthcare service is very difficult and I can give you a typical example; last year our total budget for the ministry of health was 63 million dollars, out of these 63 million dollars we only got 46 million dollars. Out of that 46 million dollars 39 million dollar went towards salary payment of health care workers. Running a whole health system was on seven million dollar that is not sustainable [..]. How do you introduce more financial burden on the very weak financial system that the government has?" (Representative MOH).

Recently, donors who previously were contributing towards paying salaries of healthcare workers in a pooled fund pulled out leaving a gap in the MOH its budget.

Characteristics of individuals

The individuals responsible for carrying out the intervention or otherwise related to the intervention, their agency, and their relationships to each other and the intervention. Including knowledge and believes about surgical task-sharing.

Medical doctors (MOs)

From all participants interviewed for this study four were clearly against the concept of starting a surgical task-sharing program for PAs in Liberia. All four opposing participants were MOs. The main argument put forward was that human resources is not the most pressing challenge of the surgical health care system, but surgical infrastructure is. Output of the medical school has been increasing steadily and specialists' surgeons and gynecologists are being trained. On the other hand, government was criticized for not paying the doctors sufficiently or on time leaving the doctors unmotivated to take their (rural) assignments.

The main challenge stated by almost all participants was the resistance from the MOs to the start of a surgical task-sharing program for PAs. The fear that patients and thereby salary would be taken away by a newly trained cadre was argued. A representative of the WHO described the factors leading to doctors' resistance could be divided in two groups: one group of doctors being genuine willing to control the quality of the whole and the other group only willing to protect their own territory.

Ministry of Health

Multiple stakeholders within the MOH were interviewed. One important MOH representative was not in favor of training PAs in surgery. Again, poor surgical infrastructure was considered the main

bottleneck of the surgical healthcare system, not shortage of human resources. Another challenge described were the weak financial resources of the government to absorb the program within the government budget. It was mentioned that using a low doctor to population ratio as argument to train PAs in surgery would not be appropriate as many medical tasks are already shifted to nurses and PAs. Therefore, these cadres should be included in the doctor to population ratio.

Discussion

In figure 2 the main results are grouped within the four domains of the CFIR. We are aware the domains could overlap and many more interrelations do exist.

Figure 2. Simplified overview and relations of results grouped within the four domains of the CFIR.

Key enabling factors

Task-sharing: not a novel approach

Surgical task-sharing is not a novel concept within the healthcare system of Liberia, as both MOs and COs are already actively involved in performing surgeries. This pre-established practice has laid the groundwork for acceptance of the idea of training PAs in surgical procedures.

Career opportunities

Furthermore, the receptiveness of PAs to undergo surgical training is significant, as it offers them new career opportunities without significantly diverting them from their existing clinical duties, especially considering the substantial pool of unemployed PAs.

Proposed partnerships

The interest towards collaboration expressed by multiple stakeholders in the development of a surgical training program for PAs are promising. Notably, partnerships with the postgraduate program for physicians, as proposed (LCPS and John F. Kennedy tertiary hospital) can help alleviate resistance among MOs. Integrating the program into a PA training institution can contribute to its sustainability and institutionalization reinforcing its long-term impact.

Increasing shortages of human resources for surgery

The WHO has pointed out that the shortages of healthcare professionals is expected to increase by 45% between 2013 and 2030 due to population growth in Sub-Saharan Africa (15). Considering Liberia's estimated population growth of approximately 3.3% year (26) and the low number of graduates from both the medical school and the postgraduate training programs, there is an urgent

need to bolster the surgical workforce in the country. Based on international defined needs for surgeons, obstetricians and anesthesiologists, Liberia would need about 900-1800 surgical providers in total. Even when including all Liberian MOs as surgical providers only 9-18% of this target would be met.

Focus on the rural population

Prioritizing the underprivileged and rural populations aligns with the sustainable development agenda of 'Leaving no one behind' and may lead to potential partnership with international organizations such as UNFPA and WHO (27). Such a focus on rural areas, the preference of most participants, could also increase support from doctors who may perceive less competition from the new cadre in urban areas where they are predominantly active.

Key challenges

Negative experiences and leadership change

The turnover of leadership within the MOH, Liberian Medical and Dental Association (LMDA) and LMDC during the process of starting the existing surgical task-sharing program for COs has given rise to 'new' resistance towards the concept of training mid-level clinicians in surgery. This highlights the importance of considering the opinions of new leaders and involving them in the program's development. As described by Saluja et al. (28) Liberia's top-down ministry engagement and the influential role of a few important individuals in decision-making processes underline the necessity of securing their support from the program's onset and maintaining their and associated organizations' ongoing engagement. Continuous policy dialogues and evidence-based evaluations are critical for the long-term sustainability of such programs. Support, only by a few key figures is not enough.

Resistance by medical doctors (MOs)

The resistance towards the idea of training PAs in surgery is multifaceted. Ideas motivated by concerns of preserving professional territory were frequently posed.

Furthermore, MOs resistance to surgical task-sharing is not unique to Liberia and has been observed in other West African regions as it is not as widely practiced compared to other parts of Africa (29). Recommendations from experts advise that various healthcare provider groups (for example representatives from the MOs) be involved in the *design* of such interventions (6). Additionally, at the same time enhancing the surgical training of MOs can prevent the shift of surgical cases from (not surgically trained) MOs to surgically trained associate clinicians, as witnessed in other countries (11).

Surgical infrastructure

Some MOs and the MOH believe that the inadequacy of surgical infrastructure is a more immediate issue than the shortage of human resources for surgery. Surgical infrastructure encompasses the availability of resources like electricity, running water, hospitals, sterile tools and anesthesia (including equipment). It can be assessed by a WHO Hospital Assessment Tool(2). However, evidence (13)(18) suggests that both human resources and infrastructure need to be strengthened in Liberia, emphasizing the importance of a comprehensive approach to enhancing the surgical healthcare system.

Political and Economic Considerations

The prevailing political and economic situation in Liberia poses significant challenges. During the time of the study major donors pulled out from a pooled fund to pay for healthcare worker salaries, inflation and strike actions have strained the country's political and economic stability. In May 2019, donor funds were withdrawn and possibly not used as intended by the government (30), which may have contributed to the reluctance of donors to support the Liberian government. Additionally, During the field work of the study there were signs that hospitals did not receive adequate supplies (31). The disproportionate allocation of government expenditure towards healthcare worker salaries and the subsequent non-payment of salaries have demotivated healthcare workers and made the government resistant to introducing a new cadre into the healthcare workforce. These economic and political factors underscore the complex environment in which efforts to enhance the surgical workforce must navigate.

Study limitations

One of the limitations of this study was the limited comparability between the opinions of medical specialists. In Liberia, there are only a limited number of medical specialists available, which may hinder a comprehensive comparison of opinions. Two of the three gynecologists that were interviewed for this study are involved in the training of COs, which might have resulted in a more supportive attitude towards surgical task-sharing compared to other specialists.

Another limitation of this research is that patients and communities were not included in the interviews. Surgical task sharing is already common in Liberia, involving non-specialist physicians (MOs), midwives (COs), and anesthetic nurses. Consequently, in general it is recognized as an accepted intervention by patients and the community. Acceptance by the community is mainly dependent on quality of the service provided and emphasizes the need for monitoring of the outcomes of any surgical task-sharing initiative.

Finally, the primary author is a non-Liberian medical doctor with expertise in global health. Having a single researcher conduct the interviews might have introduced potential bias or subjectivity in the data collection process.

Conclusion

Training of PAs in surgery is an opportunity to increase access to essential surgical services in Liberia. With PAs as the local champions advocating for a surgical training program, their high unemployment rate and desire for career advancement could justify a surgical task-sharing program targeting PAs. Additionally, various MOs, The Nursing and Midwifery Board, the LCPS, UNFPA and WHO were also in favor of starting a surgical training program for PAs. Government support is fragile as there is no consensus within the MOH whether or not to support the training of PAs in surgery. Budgetary constraints and the opinion that the lack of surgical infrastructure is a more pressing problem compared to staff skilled in surgery were reasons for this division. Another challenge is the resistance from the MOs and their professional bodies. Factors for resistance are multiple and ranges from 'genuine' quality considerations to professional turf protection. Reservations from the MOs' professional bodies with regard to the already implemented COs' program also has to be considered. If a new surgical training program for PAs would be considered, it will be essential to align such initiative with the existing program for COs. Further preparation of the intervention should eventually focus on adapting the 'adaptable' periphery in a way which broadens and strengthens the support of the MOH, MOs and their professional bodies towards the training of PAs in surgery. Failing to obtain such support, should make the implementors consider alternative strategies to strengthen surgical human resources in rural Liberia.

Footnotes

Contributorship statement

MW, AD, HB, and AB designed the study. MW took the lead in drafting the proposal. MW and TH conducted data collection. All authors contributed to manuscript writing and provided critical reviews. All authors reviewed and approved the final manuscript. MW serves as the guarantor for the manuscript.

Competing interests:

AD and HB are unpaid board members of CapaCare, a non-governmental organization that has implemented a surgical task-sharing program in the neighboring country Sierra Leone in collaboration with the Ministry of Health and Sanitation.

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Data sharing statement

The research data used in this study is available upon reasonable request and has been anonymized to protect the privacy and confidentiality of the participants. Please contact the corresponding author for inquiries regarding data access.

Ethics approval

The medical ethical research board of the university of Liberia, UL-PIRE-IRB, in Liberia granted ethical clearance for this study on 10-10-2019, protocol number: 19-10-180. Additional medical ethical clearance was requested and granted on 11-10-2019, number S-110, by The Royal Tropical Institute (KIT), The Netherlands, as Institutional Review Board.

Informed consent

All participating stakeholders provided written consent prior to the interviews.

References:

1. Shrime MG, Bickler SW, Alkire BC, Mock C. Global burden of surgical disease: an estimation from the provider perspective. Vol. 3 Suppl 2, The Lancet. Global health. England; 2015. p. S8-9.
2. Meara JG, Greenberg SLM. The Lancet Commission on Global Surgery Global surgery 2030: Evidence and solutions for achieving health, welfare and economic development. Vol. 157, Surgery. United States; 2015. p. 834–5.
3. Knowlton LM, Chackungal S, Dahn B, Lebrun D, Nickerson J, McQueen K. Liberian surgical and anesthesia infrastructure: A survey of county hospitals. World J Surg. 2013;37(4):721–9.
4. Grimes CE, Bowman KG, Dodgion CM, Lavy CBD. Systematic review of barriers to surgical care in low-income and middle-income countries. World J Surg. 2011;35(5):941–50.
5. Wilson A, Lissauer D, Thangaratinam S, Khan KS, MacArthur C, Coomarasamy A. A comparison of clinical officers with medical doctors on outcomes of caesarean section in the developing world: Meta-analysis of controlled studies. Bmj. 2011;342(7807).
6. Ashengo T, Skeels A, Hurwitz EJH, Thuo E, Sanghvi H. Bridging the human resource gap in surgical and anesthesia care in low-resource countries: A review of the task sharing literature. Hum Resour Health. 2017;15(1):1–11.
7. Chao TE, Sharma K, Mandigo M, Hagander L, Resch SC, Weiser TG, et al. Cost-effectiveness of surgery and its policy implications for global health: A systematic review and analysis. Lancet Glob Heal. 2014;2(6):334–45.
8. World Health Organization. Task Shifting Global Recommendations and Guidelines HIV/AIDS. 2003;1–92. Available from: https://www.who.int/healthsystems/TTR-TaskShifting.pdf
9. WHO. Optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting. WHO Libr Cat Data [Internet]. 2012;1–98. Available from: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:health+worker+roles+to+improve+access+to+key+maternal+and+newborn+health+interventions+through+task+shifting#0%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Optimizing+health
10. van Duinen AJ, Kamara MM, Hagander L, Ashley T, Koroma AP, Leather A, et al. Caesarean section performed by medical doctors and associate clinicians in Sierra Leone. Br J Surg. 2019 Jan;106(2):e129–37.
11. Gajewski J, Cheelo M, Bijlmakers L, Kachimba J, Pittalis C, Brugha R. The contribution of non-physician clinicians to the provision of surgery in rural Zambia—a randomised controlled trial. Hum Resour Health. 2019;17(1):1–8.
12. Gajewski J, Borgstein E, Bijlmakers L, Mwapasa G, Aljohani Z, Pittalis C, et al. Evaluation of a surgical training programme for clinical officers in Malawi. Vol. 106, The British journal of

surgery. 2019. p. e156–65.

13. Adde HA, Duinen AJ, Oghogho MD, Dunbar NK, Tehmeh LG, Hampaye TC, et al. Impact of surgical infrastructure and personnel on volume and availability of essential surgical procedures in Liberia. BJS Open. 2020;4(6):1246–55.

14. Bolkan HA, van Duinen A, Waalewijn B, Elhassein M, Kamara TB, Deen GF, et al. Safety, productivity and predicted contribution of a surgical task-sharing programme in Sierra Leone. Br J Surg. 2017;104(10):1315–26.

15. WHO. Global strategy on human resources for health: Workforce 2030. Who [Internet]. 2016;64. Available from: http://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf%0Ahttp://apps.who.int/iris/bitstream/10665/250368/1/9789241511131-eng.pdf?ua=1%5Cnhttp://www.who.int/hrh/resources/pub_globstrathrh-2030/en/

16. Ministry of Health L. Investment Plan for Building a Resilient Health System 2015 to 2021. 2015; Available from: http://pubdocs.worldbank.org/en/865131479921763514/Liberia-Investment-Plan-Final-May-15.pdf

17. Smith M. Is task sharing preferred to task shifting in the provision of safe surgical care? Surg (United States) [Internet]. 2018;164(3):559–60. Available from: https://doi.org/10.1016/j.surg.2018.05.005

18. Adde HA, van Duinen AJ, Sherman LM, Andrews BC, Salvesen, Dunbar NK, et al. A Nationwide Enumeration of the Surgical Workforce, its Production and Disparities in Operative Productivity in Liberia. World J Surg [Internet]. 2022;46(3):486–96. Available from: https://doi.org/10.1007/s00268-021-06379-8

19. Report EE. Support to Emergency Obstetric and Neonatal Care (EmONC) in Liberia through TASK SHARING Submitted to : The World Health Organization (WHO) - Liberia Ministry of Health - Liberia 17 th April 2019 Presented by : Dr Kwame Ampomah MD , MPH Lead consultan. 2019; Available from: https://docs.wixstatic.com/ugd/dd2ba4_ca41de0a172847acabeaddcca9625590.pdf

20. Dolo O, Clack A, Gibson H, Lewis N, Southall DP. Training of midwives in advanced obstetrics in Liberia. Bull World Health Organ. 2016;94(5):383–7.

21. Bolkan HA, Ystgaard B, Wibe A, Salvesen Ø, Von Schreeb J, Samai MM, et al. Met and unmet needs for surgery in Sierra Leone: A comprehensive, retrospective, countrywide survey from all health care facilities performing operations in 2012. Surg (United States). 2015;157(6):992–1001.

22. Bolkan HA, van Duinen A, Waalewijn B, Elhassein M, Kamara TB, Deen GF, et al. Safety, productivity and predicted contribution of a surgical task-sharing programme in Sierra Leone.

Br J Surg. 2017;104(10):1315–26.

23. CFIR Research Team-Center for Clinical Management Research. Consolidated Framework for Implementation Research [Internet]. 2021. Available from: https://cfirguide.org/constructs/
24. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. Implement Sci. 2009;4(1):1–15.
25. Means AR, Kemp CG, Gwayi-Chore MC, Gimbel S, Soi C, Sherr K, et al. Evaluating and optimizing the consolidated framework for implementation research (CFIR) for use in low-And middle-income countries: A systematic review. Implement Sci. 2020;15(1):1–19.
26. The World Bank. Population growth (annual %) - Liberia [Internet]. 2019. Available from: https://data.worldbank.org/indicator/SP.URB.GROW?locations=LR
27. UNCDP. Leaving No One Behind - Summary Report. United Nations Econ Soc Counc [Internet]. 2018;13(13):1–4. Available from: http://www.un.org/en/development/desa
28. Saluja S, Silverstein A, Mukhopadhyay S, Lin Y, Raykar N, Keshavjee S, et al. Using the consolidated framework for implementation research to implement and evaluate national surgical planning. BMJ Glob Heal. 2017;2(2):1–8.
29. Nordstrand K, Sundby J. Surgical Task Shifting in Sub-Saharan Africa : A Narrative Synthesis of Current Evidence and Key Informant Perspectives [Internet]. Available from: https://www.med.uio.no/helsam/english/research/centres/global-health/signatory-themes/Surgery and anaesthesia/artikkel-task-shifting.pdf
30. Dopoe R. “Dig Hole, Cover Hole” -Nagbe Defends Gov’t Misuse of Donor Project Funds. Dly Obs [Internet]. 2019;May. Available from: https://www.liberianobserver.com/news/dig-hole-cover-hole-nagbe-defends-govt-misuse-of-donor-project-funds/
31. Africa FP. Liberia: Redemption Hospital Gets Medical Boost. Available from: https://frontpageafricaonline.com/health/liberia-redemption-hospital-gets-medical-boost/

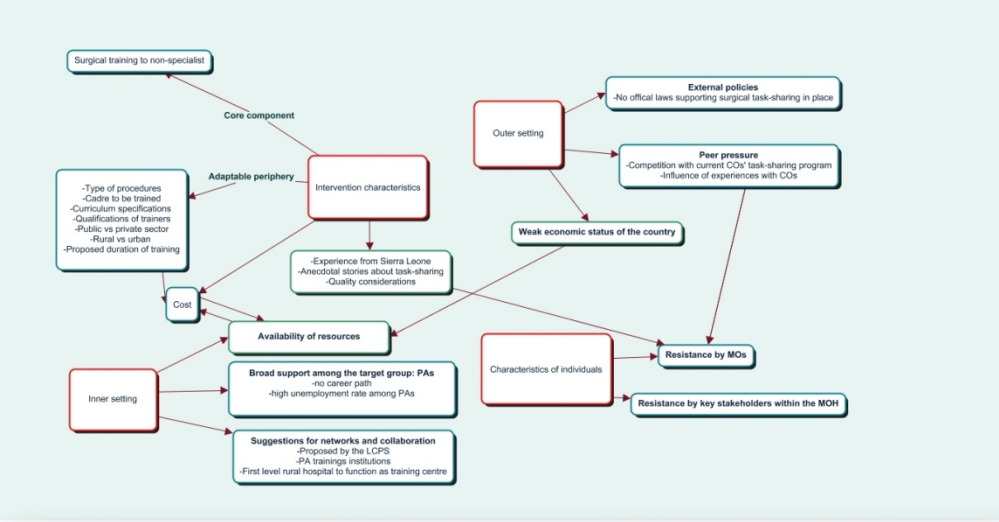

Figure 2. Simplified overview and relations of results grouped within the four domains of the CFIR.

478x251mm (72 x 72 DPI)

Type of training program	Entrance requirement	Duration of training	Recognition	Total duration	Output per year*
A.M. Dogliotti medical college.	BSc in natural or physical sciences (3-4 years)	5-years + a 2-years internship	Master degree	10-11 years	20-40 per year
JFK hospital/ LCPS post-graduate training program.	Medical officer	5 years	Specialist surgeon or gynecologist	15-16 years	2 surgeons and 2 gynecologists per year
The Tubman National Institute of Medical Arts (TNIMA). Public PA training institute.	Secondary school degree	3-years	Diploma degree	3-years	30 per year
Baptist College of Missionary Physician Assistants (BSMPA). Public PA training institute.	Secondary school	3-years	Diploma degree	3-years	10 per year
The Cuttington University School of PAs (CUSPA). Private PA training institute.	Secondary school	4-years	In transition from diploma to BSc degree	4-years	30 per year
Training program for clinical obstetricians (COs) in Liberia.	Midwives with at least a few years of experience	3-years	Diploma degree	Depending on experience prior to start of training (+- 8 years)	1-2 per year
Surgical training program for associate clinicians in Sierra Leone. Supported by CapaCare.	Associate clinician with at least 2-years of experience.	3-years	Diploma degree	8-years	5 per year

Supplementary material 1. Comparing specifications of relevant training programs in Liberia and Sierra Leone. *As an estimate reported by various interviewees over the year 2019.

Themes	Probes	Questions
Acceptability	Knowledge	• How difficult is it to have surgery, when needed in Liberia? • What are the factors that make it difficult to have surgery in Liberia? • What are the main challenges for the surgical health care system in Liberia? • What do you think could be solutions to the human resource gap within the field of surgery in Liberia? • Are you familiar with the concept of surgical task shifting? (if no: explain) if yes, see below. • What do you understand from the concept of surgical task shifting?
	Experience	• What is your experience with surgical task-shifting? • What do you think about surgical task shifting? And why? And what about training PAs in surgery?
	Attitude	• Would you support a surgical training program for PAs? If no, why not? If yes, see below. • How would you support a surgical training program for PAs?
	Quality	• Do you think a thoroughly trained PA in surgery could deliver similar health outcomes compared to a medical doctor, why yes or no? If need further clarification: under which circumstances?
	Competition	• How will the new surgical cadre create competition with other medical cadres? What could be solutions to this?
Feasibility	Challenges	• What could be challenges when starting a surgical training program for PAs?
	In relation to the educational system	• How do you think a curriculum for PAs trained in surgery should look like? • What could be challenges in the development of a training curriculum?

		• How should supervision and continuous training of the newly trained cadre be organized? • For medical doctors or specialists: how much responsibility would you give a well-functioning, surgically trained PA or surgically trained midwife?
	Recognition	• How should the new cadre be recognized? Why? (Bsc?)
	Regulation	• How should the new cadre be regulated? • Will there be need for new legislation?
	Remuneration	• What should be the salary of a surgical trained PA in relation to PAs not trained and medical doctors? Who will have to pay for this? (Donor or government?)
	Referral system	• What possibilities are there of referring complicated surgical cases?
	Benefits	• What could be benefits of training PAs in surgical task shifting?
Appropriateness	General versus obstetric surgery (types of procedures)	• Which surgical procedures would be accepted to be taught to PAs in surgical training, if any at all? Why these operations?
	Midwifes versus Pas	• Some midwifes are already trained in surgery, how do you think another program for PAs should be combined with this program?
	Rural versus urban	• How does the need for surgical task-shifting differs between rural and urban?
	Public versus private	• What is your view on the new surgical cadre be working in the public sector? • And what about the private sector? • What could be pros and cons?
	Complementary necessary workforce	• Is there enough anesthetic workforce to support the newly trained surgical cadre? If no, what could be solution to this?

	Gender distribution in training program	• What do you think about the need for women to be trained as surgical PAs?
Costs/sustainability	Funding	• What are the necessary financial resources to start and continue a surgical training program for PAs? • What could be challenges and opportunities for funding? • Which organizations might be interested in collaboration?
	Sustainability	• In what form would you prefer surgical task shifting to exist in the far future, when possibly more doctors are trained? • How to make a surgical task shifting program sustainable?
Power relations	Influential actors	• Who are the most influential actors in the field of surgical task shifting? And why? • Which players/ stakeholders could facilitate a program focusing on training PA within the field of surgery? • Which players/ stakeholders could oppose a program focusing on training PA within the field of surgery? • How do these stakeholders interact with each other? • What can be reasons not to support the surgical task shifting to PAs? • What can be reasons to support the surgical task shifting to PAs?
Adoption		• How did the tendency of government to support or not support surgical task shifting develop from the past to where we are now and what should we expect for the future? Why?
Fidelity	Lessons to be learned from MCAI	• Is the current MCAI program different than originally set up? And how is it different?

Supplementary material 2. Semi-structered interview guide.

Exploring barriers and enabling factors for surgical task-sharing with physician assistants (PAs) in Liberia: a qualitative pre-implementation study.

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

	Page/line no(s).
Title and abstract	
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Page 1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	Page 2
Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	Page 3
Purpose or research question - Purpose of the study and specific objectives or questions	Page 3 and 4
Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	Page 6 and 7
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	Page 6
Context - Setting/site and salient contextual factors; rationale**	Page 5 and 6
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	Page 7 methods (and figure 1).
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	See ethical clearance in footnotes.

Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	Page 6 and 7
Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	Page 6 and supplementary file 2.
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Page 7. Figure 1 and table 1.
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	Page 9 and footnotes (informed consent)
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	Page 9
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	N/A

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Page 14 and figure 2.
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Page 9, 10,11,12 and 13

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	Page 14,15 and 16
Limitations - Trustworthiness and limitations of findings	Page 16

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	Footnotes. Page 18
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Footnotes. Page 18

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:
O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388