REVIEW ARTICLE

Barriers and Enablers to Task Shifting for Caesarean Sections in sub-Saharan Africa: A Scoping Review

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Abstract

Task shifting of Caesarean-sections to non-physician clinicians (NPCs) has raised concerns over NPCs' competences and rationale of using them in facilities where medical doctors (MDs) are scarce to provide mentorship. We conducted a scoping review to provide an update on NPCs' contribution to C-sections including barriers and enablers to task shifting. Using the PRISMA Flow Diagram, we identified 15 eligible articles from Google Scholar, PubMed and Africa Index Medicus using specific search terms and a pre-established inclusion criterion. All 15 studies characterised NPCs: their names, training, challenges and enablers to task shifting. NPCs performed 50%-94% C-sections. Outcomes of such C-sections were comparable to those performed by MDs. Enablers included supportive policies, pre-existing human resources for health shortage, well-resourced health facilities and supervision of NPCs. Weak health systems were major barriers. While NPCs make a significant contribution to accessing C-sections services, there is need to address challenges to fully realize benefits. *(Afr J Reprod Health 2019; 23[3]: 149-160).*

Keywords: Task shifting; task sharing; caesarean section, associate clinicians; comprehensive emergency obstetric care; clinical officers; non-physician clinicians

Résumé

Le transfert de tâches des césariennes à des cliniciens non médecins (CNP) a suscité des inquiétudes quant aux compétences de ces derniers et aux raisons de les utiliser dans des établissements où les médecins ne sont pas en mesure de fournir un mentorat. Nous avons procédé à un examen de la portée afin de fournir une mise à jour de la contribution des CNP aux césariennes, y compris les obstacles et les facteurs permettant le transfert de tâches. À l'aide du diagramme de flux PRISMA, nous avons identifié 15 articles éligibles de Google Scholar, PubMed et Africa Index Medicus en utilisant des termes de recherche spécifiques et un critère d'inclusion préétabli. Les 15 études ont toutes caractérisé les PNJ: leurs noms, leur formation, leurs défis et les moyens de transférer des tâches. Les PNJ ont réalisé des césariennes de 50% à 94%. Les résultats de telles césariennes étaient comparables à ceux obtenus par les médecins. Les catalyseurs incluaient des politiques de soutien, des ressources humaines préexistantes pour lutter contre la pénurie en matière de santé, des établissements de santé disposant de ressources suffisantes et la supervision des CNP. La faiblesse des systèmes de santé constituait un obstacle majeur. Bien que les CNP apportent une contribution importante à l'accès aux services des césariennes, il est nécessaire de relever les défis pour tirer pleinement parti des avantages. *(Afr J Reprod Health 2019; 23[3]: 149-160).*

Mots-clés: Transfert de tâches; partage de tâches; césarienne, cliniciens associés; soins obstétricaux d'urgence complets; officiers cliniques; cliniciens non Médecins

Introduction

Sub-Saharan Africa (SSA) has the highest maternal mortality ratio (MMR) of 546/100,000 and accounts for 66% of the global maternal mortality burden[1]. Shortage of medical doctors (MDs) and specialist obstetricians has been blamed for the high maternal mortality (MMR) ratios in the region[2-3]. Task shifting is increasingly being utilised by many countries in sub-Saharan Africa (SSA) as a stop-gap measure to alleviate shortage of professional health workforce[4-8]. Task shifting has been reported as having potential to increase both access and coverage to maternal and child health services by expanding roles of MDs and obstetricians through the utilisation of NPCs[9-12]. Although non-physician clinicians (NPCs), also known as associate clinicians, have for a long time performed obstetric surgery in SSA, the potential has not been fully exploited[8]. Some countries have viewed task shifting with scepticism and doubted capacity of NPCs to perform quality obstetric surgery[6, 13] while others referred to task shifting as controversial[14-15]. We conducted a scoping review to provide an update on (i) characteristics of NPCs and their contribution to the provision of C-sections services and (ii) barriers and enablers of task shifting for C-sections. A greater understanding of the nature of task shifting for C-sections is likely to help policy makers to make decisions for adopting or scaling up this strategy, thus contributing to universal coverage of maternal and newborn care.

Methods

We utilized the scoping review methodology as we found it most suitable[16-17] in identifying, analysing and summarising relevant research literature from PubMed/Medline, African Index Medicus (AIM), and Google Scholar. The inclusion criteria were: (i) studies on task shifting of C-sections from MDs to NPCs; (ii) studies published in English conducted in SSA from 2007 to May 2017. The following terms were used individually and in combination: task shifting, task sharing, caesarean sections, comprehensive emergency obstetric care, clinical officers, assistant medical officers, associate clinicians, non-physician clinicians, mid-level health workers and obstetric surgery using the Boolean operator[18] "AND." We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to guide the review process. Google scholar indicated 19,600 records in the data base, but only 1,000 records were accessed after browsing through 100 pages. Pub/Med yielded 412 articles and AIM yielded 8. Thus, total records accessed from the 3 data bases were 1420. Following removal of 165 duplicates, 1255 records remained. Initial screening was conducted based on title, language and geographical region where the study was carried out, making 1227 records ineligible, and 28 records remained. Based on the abstracts, further 10 records were excluded for not meeting the inclusion criteria. Full articles for the remaining 18 articles on task shifting and C-sections in SSA for the past 10 years were identified and assessed for eligibility Out of these, 3 were excluded; The remaining fifteen articles were included in the final scoping review (Figure 1).

Data abstraction

We designed a template that ensured abstraction of relevant data. To determine nature of studies, we extracted study objectives, design, sample size, outcome variables and statement of results summary. To determine nature of NPCs, we extracted cadre names and type of trainings. For the contribution to meeting C-section demand, we extracted the proportion of C-sections performed by NPCs. We also extracted data on challenges and enablers.

Results

Fifteen studies met our inclusion criteria. Five studies were conducted in Tanzania and three in Ethiopia. Mozambique and Burkina Faso had two each while Malawi, Uganda and Zambia had one study each. All studies (N=15) described enablers and challenges. Other studies focussed on percentage and quality of C-sections by NPCs (n=10), training of NPCs (n=6), cost-effectiveness of utilising NPCs (n=3), HRM outcomes (n=2), perceptions (n=1) and policy (n=1).

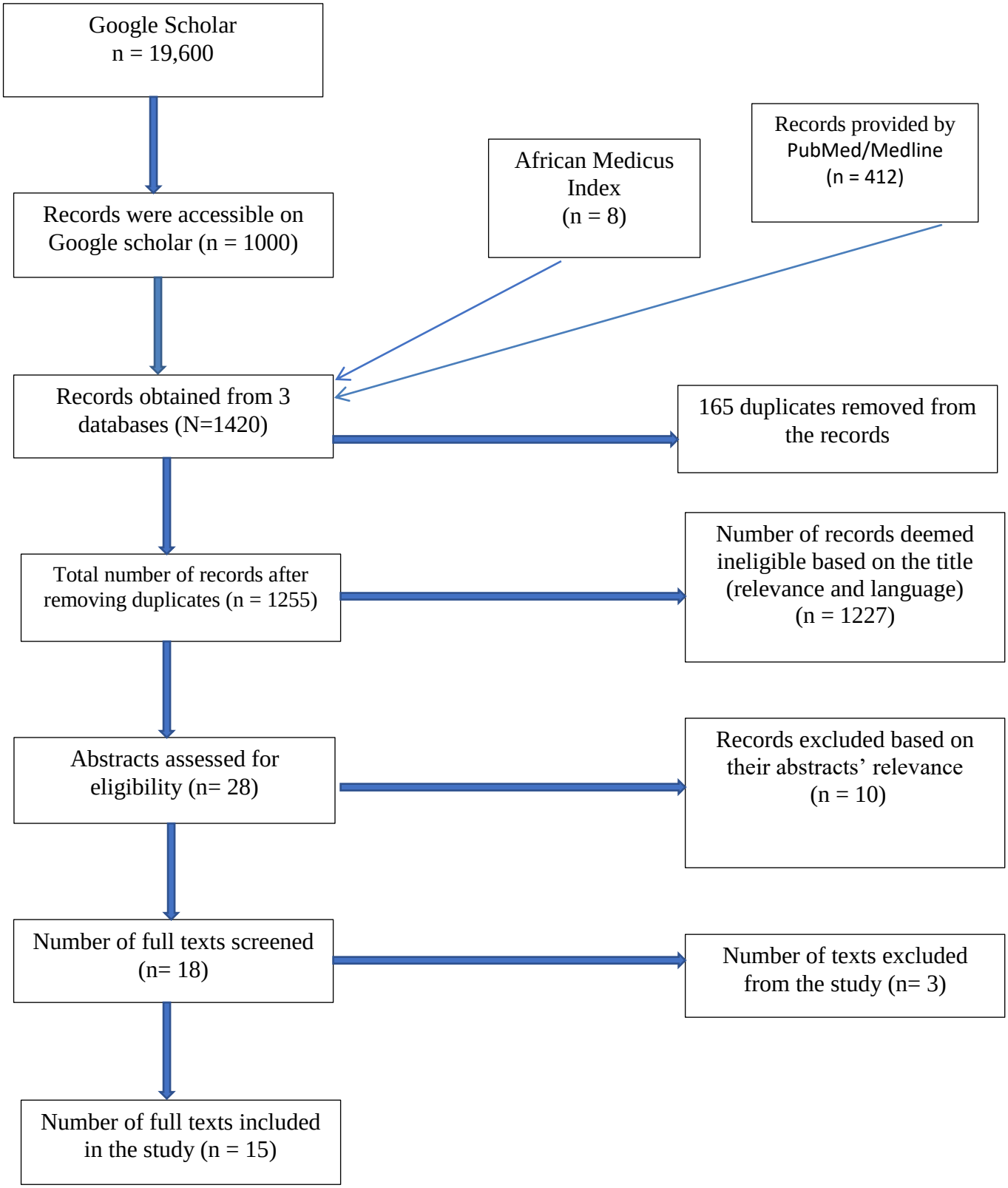


Figure 1: PRISMA diagram showing the process of the search of included studies

Nomenclature of C-sections providers

Health workers utilised for task shifting purposes have been collectively referred to as NPCs, associate clinicians, mid-level health workers, non-doctors and non-surgeons. However, there are specific country-based nomenclatures to describe C-section care-providers. In Tanzania, they were called AMOs[6, 11, 15]. In Malawi, they were called clinical officers while Ethiopia called them Emergency Surgical Officers (ESOs) [5, 13]. Burkina Faso, Mozambique and Zambia referred to them as attaché's de sante' en chirurgies, Técnicos de Cirurgia (TCs) and medical licentiate practitioners (MLPs) [19] respectively (Table 1).

Training models for NPCs that provide C-section services

Six studies described different training Models (Table 1). Burkina Faso, Ethiopia, Malawi, and Zambia offered university degrees. Tanzania and Mozambique were offering advanced diplomas.

The contribution of NPCs towards meeting the need for C-Section services

The proportion of C-sections performed by NPCs was equal to or greater than those performed by MDs. In Burkina Faso and Ethiopia, NPCs performed 50%[20] and 94%[13] C-sections respectively. In yet another study in Tanzania, all 2980 C-sections were conducted by AMOs in 10 health centers which did not have MDs[11].

Performance of NPCs and quality of care

10 studies found no significant differences between NPCs' and MDs' performance of C-sections[4-6, 13, 21]. This was based on four outcome measures of (i) risk indicators for which C-section was performed; (ii) Maternal or fetal death, (iii) post-operative major complications and length of hospital stay. However, in contrast to these positive outcomes, two studies in Burkina Faso found that NPCs performed 12 % of C-sections without medical justification[22] and a higher neonatal mortality was recorded in C-sections performed by NPCs[20].

Cost effectiveness of C-sections performed by NPCs

The cost of training, deploying and utilising técnico de cirurgia in Mozambique was found to be only 27% compared to that of physicians[23]. Another evaluation was conducted in Ethiopia using the extended cost-effectiveness analysis framework[24]. In addition to analysing costs, the study also analysed the impact of task shifting policy in making C-section accessible; universal public financing policy that makes services affordable; and how these policies might impoverish intended beneficiaries if opportunity costs like transport and accommodation were not taken care of. This is the only study that we found that evaluated the impact of policies. Results of the cost-effectiveness analysis framework indicated that without travel vouchers for beneficiaries, such policies may paradoxically induce poverty. However, a study in Burkina Faso found that training and deploying MDs to perform C-sections was more cost-effective given that neonatal outcomes were significantly better with MDs[20]. Notwithstanding this, the study concluded that investment in NPCs was a viable and rational option given the high attrition rate of MDs.

Enabling factors for task shifting

Two types of enablers were identified; factors influencing policy change and factors influencing scaling up and enhancing practice. All the 15 studies corroborated on factors that stimulated adoption of task shifting as high MMR, limited access to quality maternal health services coupled with human resource shortage. Evidence showed that Tanzania introduced AMO programme in 1963[21], Malawi in 1976[4], and Mozambique in 1994[23] with Ethiopia commencing the programme in 2006[13]. A study in Ethiopia cited research evidence and lessons learnt from Tanzania and Malawi as factors that finally led Ethiopia to adopt task shifting for C-sections[13]. Enablers for enhancing practice mentioned in a Malawi study included donor support in infrastructural development where hospitals and operating theatres were constructed and equipped adequately. A similar experience in Tanzania was

Table 1: Cadre names and training models of NPCs that provide C-section services in selected SSA countries

Author and year	Country	Name of NPCs that provide C-section services	Training model
Chilopora *et al*. (2007)	Malawi	Clinical officer	**From 1979**: 3 years training plus 1-year internship
		Clinical officer	**#From: 2013:** University Degree programme introduced
Gessessew *et al*. (2011)	Ethiopia	NPCs	**From 2006:** 3-year training in clinical medicine plus 6-9 months training in CEmOC
Gobeze *et al*. (2016)		Emergency surgical officers (ESOs); Non-doctor health professionals	**From 2009:** Post-basic- 3-year master's degree level training
Hounton *et al*. (2009)	Burkina Faso	Attache's de sante' en chirurgies	Trained Nurses with an additional 2-year training in surgery
Kruk *et al*. (2007)	Mozambique	Assistant medical officers, Tecnicos de Cirurgia)	2-year training and 1-year internship for nurses, or tecnico de medicina or medical assistant.
McCord *et al*. (2009) Nyamtema *et al*. (2016) Pereira *et al*. (2011)	Tanzania	Assistant medical officer	A 2-year post -basic competence-based training offered to clinical officers previously trained in clinical medicine for 3 years.
Gajewski *et al*. (2017)	Zambia	Medical licentiate practitioners	**From 2002: to 2012:** A 2-year post -basic competence-based training offered to clinical officers previously trained in clinical medicine for 3 years. **From 2013:** BSc. Clinical medicine; 4 years direct entry (post-secondary education

Key
#: Government of Malawi has since introduced a degree programme for COs that wish to advance their careers

described where a donor upgraded 10 rural health facilities, equipped them for C-sections, trained AMOs in CEmOC and supported structured monthly supervision and monitoring. Dramatic increases of up to 300% facility deliveries including C-sections were achieved[11].

Challenges of task shifting for C-sections

Numerous challenges were described in all 15 studies (Table 2). Concerns were raised about capacity for decision making and clinical skills of NPCs, sometimes leading to unnecessary C-sections and referrals[13, 22]. Human resources management challenges included unavailability of anaesthetists[11], conflicts between surgeons and NPCs[13], poor remuneration, lack of incentives, demotivation[20-23], unclear career ladder[20], unnecessary absenteeism and inadequate supervision[22,25]. Training challenges included inadequate numbers of trained cadres resulting in persistent HR deficits, limited exposure to cases for practising competences and lack of recognition of qualifications[8, 25]. Reported operational challenges included shortage of equipment and essential supplies (anaesthetic drugs, antibiotics, suction machines, blood)[3,6,11] , weak referral system, sub-optimal CEmOC service availability and poor health information management system as mostly data on case fatality rates were missing[3,21].

Discussion

Our review brought out the diversity in nomenclature and training programmes for NPCs that provide C-Sections in SSA. This diversity brings confusion to role expectations. For example, a clinical officer in Tanzania is not expected to perform C-sections until he/she undergoes a further 2-year competency-based training to become an AMO[26]. The clinical officer in Malawi has gone through an advanced training and internship and is mandated to perform major surgery[4]. With this confusion of differences in nomenclature and role expectations, the NPCs may have challenges in finding employment across countries[12]. Findings have demonstrated that in SSA, task shifting using NPCs contributes to saving lives through C-sections.

Table 2: Summary of studies included in the scoping review and key findings

No	Author (year)	Country	Study Objectives	Study Design	Outcome measures	Sample size	Percentage of CS by NPCs	Summary statement of findings	Challenges
1	Chilopora *et al*. (2007)	Malawi	To validate advantages/ disadvantages of delegating major obstetric surgery to non-doctors, quantify proportion and quality of work by NPCs	Prospective study	Proportion of C-sections by NPCs, Maternal & neonatal deaths, post -operative complications	2131 obstetric surgery records from all 38 hospitals	88%	Clinical officers perform most C-sections and outcomes comparable to that of doctors	Low quality of internship at district hospitals
2	Ellard *et al*. (2016)	Tanzania	To explore CEmONC impact on maternal and neonatal mortality and challenges at work places	Retrospective record review, prospective performance monitoring	Maternal/neonatal deaths, health systems indicators, service provision indicators	36 trainees	**	No significant difference key on obstetric outcomes	Shortage of supplies, equipment, infrastructure, poor health management systems, resistance from senior doctors
3	Galukande *et al*. (2013)	Uganda:	To assess health workers and managers views on surgical task shifting	Mixed methods	Views on task shifting, Surgical procedures most performed	37 key informants, 24 FGDs at 24 sites in 15 districts.	**	TS viewed positively by the majority but policy, rewards, supervision, acceptance, are pre-requisites	Perceived increase in mortality, demotivation, inadequate equipment, resistance, lack of supervision, and rewards
4	Gessessew *et al*. (2011)	Ethiopia:	To assess contribution of NPCs to CEmOC	Retrospective review of obstetric records	Proportion of C-sections by NPCs Maternal and neonatal outcomes.	11,059 obstetric surgeries over a period of 3 years	63.30%	Mean hospital stay and patient outcomes similar to C-sections by doctors	C-section rate remains lower than minimum recommended by the WHO
5	Gobeze *et al*. (2016)	Ethiopia:	To assess access CEmOC and surgical competences and decision-making skills of ESOs	Qualitative and quantitative Retrospective record review	Proportion of C-sections by NPCs, Post-operative hospital stay and haemoglobin levels	4075 patients, records from 8 hospitals over a period of 3 years	94% of surgeries by ESOs of which 62.6% were C-sections	ESOs increased access to emergency services, skill for decision-making excellent	Skill mix, essential supplies & equipment, conflicts between NPCs and surgeons

No	Author (year)	Country	Study Objectives	Study Design	Outcome measures	Sample size	Percentage of CS by NPCs	Summary statement of findings	Challenges
6	Hounton *et al*. (2009)	Burkina Faso	To evaluate effectiveness and cost effectiveness of alternative training strategies to increase access to emergency obstetric surgery	Retrospective cross-sectional facility-based survey of C-section deliveries	Mothers' and newborns' case fatality rates, Costs of performing C-sections Incremental cost effectiveness ratios	2305 records in 2 years in 12 hospitals.	50%	Non-specialist doctors are cost- effective but training substitutes is a viable option	Demotivation, lack of supervision, no clear-cut career, no salary review
7	Kouanda *et al*. (2013)	Burkina Faso	To assess the level and determinants of C-sections with no medically justified indicators for low risk women	Retrospective analysis of C-Section records for low risk women.	Factors associated with C-sections done with no medically justified reason	300 Low risk women in 10 referral hospitals	**	Clinical officers associated with a 12% risk of unnecessary C-sections	Lack of skills and inadequate supervision implicated for unnecessary C-sections
8	Kruk *et al*. (2007)	Mozambique	To compare training, deployment and surgical productivity of AMOs and specialist physicians	Cost Analysis Desk review of budgets and C-section performance reports	Surgical productivity- proportion of AMO contribution,	12,178 major obstetric surgery performed by 47 MDs and 53 TCs	57%	Training, deployment and productivity costs for TCs were all far less than MDs	Limited capacity to train more NPCs. Results cannot be applied to other countries with different country contexts.
9	McCord *et al*. (2009)	Tanzania	To determine quantity and quality of obstetric surgery performed by AMOs	prospective study of all complicated deliveries	Proportion of C-sections performed by NPCs, Maternal/ neonatal outcomes	1087 C-section records in 14 district hospitals	87%	Difference between AMO and MDs, performance not significant.	Inadequate blood supply. Unmet C-section need
10	Nyamtema *et al*. (2016)	Tanzania	To determine feasibility and impact of decentralizing CEmONC services in underserved areas using NPCs.	Operations research	Proportion of C-sections performed by NPCs	2, 890 records over a period of 4 years in 10 health centers	*100%	Upgrading, equipping health centres, training NPCs in CEmONC, increase access to CEmOC & reductions in referrals	inadequate supplies; drugs; staff; incentives. Absenteeism
11	Nyamtema *et al*. (2011)	Tanzania	Addressing skill mix needs through a 3-months training of course of AMOs in	To determine if the 3-months CEmOC course for facility	Improved access to CEmOC: number of C-sections,	**	107%	CEmOC coverage improved, referrals reduced	Limited exposure to cases for practising competences, Structured

No	Author (year)	Country	Study Objectives	Study Design	Outcome measures	Sample size	Percentage of CS by NPCs	Summary statement of findings	Challenges
			CEmOC at upgraded health centers	teams will result in improved accessible acceptable quality care	Anaesthetic procedures, normal deliveries and referrals				systematic supervision required
12	Pereira *et al*. (2011)	Tanzania	To calculate met need for CEmOC and to document contribution of AMOs and MDs	Retrospective survey or obstetric surgery	Proportion of C-sections performed by NPCs C-section met need Case fatality rates	4599 major obstetric surgeries from 16 hospitals	85%	Despite AMO performing most C-sections, unmet need remains high at 23%	Weak referral system, CEmOC service availability sub-optimal, Missing CFR data
13	Pereira *et al*. (2007)	Mozambique	To document surgery by TCs, To elucidate retention of TCs at district level.	Retrospective document reviews, qualitative work histories	Proportion of obstetric surgeries by TCs and MDs, Proportion of TCs and MDs retained for 7 years	59 MDs and 34 TCs in 34 district hospitals	92%	Retention better with AMOs.	inadequate number being trained and HR deficit being the major impediment in meeting MDGs
14	Shrime *et al*. (2016)	Ethiopia	To determine how Universal Public Financing (UPF), Task shifting and Support for opportunity cost policies expand access to surgery	Extended cost-Effectiveness analyses methodology,	No. of deaths and number of cases of poverty averted	**	**	UPF +task shifting + Support for opportunity cost had greatest impact on health	Uncoordinated policy implementation
15	Gajewski *et al*. (2017)	Zambia	Describe MLPs roles, contributions & challenges	Qualitative	roles, contributions & challenges	43 Health professionals	**	MLPs increase access to emergency & elective surgery	Lack of professional recognition, Conflict with MDs

Studies conducted in Ethiopia, Malawi, Mozambique and Tanzania, reported high proportions of 94%, 88%, 92%, 87% of C-sections performed by NPCs compared to MDs respectively[4,6,8,13]. NPCs alleviate HRH crisis; improve access to CEmOC, contribute to universal health coverage, reduce MMR, avert maternal disability; thus, contribute to the attainment of the third Sustainable Development Goal[27]. However, all the countries where studies were conducted were still unable to provide all the essential C-sections services and the HR crisis continues[9], implying sub-optimal utilisation of task shifting[6,25]. Inadequate institutional training capacity[11] and resistance by academic institutions to recognise NPCs[5] were reported as contributory to sub-optimal utilisation of task shifting. The challenges that we found, corroborated those of a systematic review by Lawn *et al*, that revealed an association between poor intrapartum outcomes and weak health systems[29].

Cost effectiveness studies have shown that investing in training, deployment and utilising NPCs for C-sections costs much less than the costs associated with use of MDs and obstetric specialists[23-24]. As such, investing in NPCs would be a rational policy decision for under resourced countries.

This review showed that maternal and fetal outcomes of C-sections performed by NPCs were comparable with those performed by MDs[5-6,8], a factor on which quality of C-sections by NPCs was based. UNFPA introduced a process indicator of CFR where MMR of 1% or below is acceptable performance. However, some researchers argue that this UNFPA indicator gives an impression that it is acceptable for a certain number of women to die at child birth[21]. We recommend studies on quality of C-sections performed by both MDs and NPCs to give credence to comparability. Only two studies reported negative NPCs' performance (high neonatal CFR)[20], and unnecessary C-sections[22]. However, these challenges can be addressed through refresher courses, mentoring, couching and supportive supervision of NPCs.

Although task shifting for C-section is a technical clinical issue, it is also an HR aspect. We found only two studies that specifically investigated retention of NPCs in Mozambique and Zambia. There is need to investigate other HR indicators such as adherence to staffing norms, vacancy rate, turnover rate, absenteeism, rural/urban distribution, supervision, staff satisfaction, percentage of total budget spent on staff salaries and their impact on health outcome indicators. These challenges are known to weaken performance of health systems in Africa[12].

With regards to task shifting policy, our review revealed two aspects namely; the paucity of policy impact evaluation studies and lack of commitment to implement policies in a coordinated manner. These observations are consistent with findings of a survey on tracking policies and practices of countries experiencing HRH crisis[30]. Researchers found that only 42% of countries increased investment in HR development over a period of 4 years. We also found that that NPCs work in challenging environments where there are shortages of supplies, equipment and infrastructure. Similar observations were made in a study that assessed the impact of poor funding for surgical task shifting in 132 district health facilities in 8 LMICs, including Tanzania, Liberia, Sierra Leone and Gambia.

The study revealed that all health facilities had some shortfalls in basic infrastructure, water, electricity, oxygen, and functioning anaesthetic machines although surgical procedures were being performed[31]. Resistance to task shifting for C-sections by some policy makers and senior academics and the controversy surrounding task shifting has been documented[12-13]. Other studies found that task shifting for C-sections is considered unethical as it subjects vulnerable women to substandard care[12, 10, 32]. Such negative perceptions may impede the implementation and scaling up of task shifting. There is therefore need for policy makers and program managers to address perceptions to maximise on the contribution of NPCs in meeting the C-section need.

Limitations

Our search strategy only focussed on 3 data bases hence we may have excluded some eligible studies indexed elsewhere and in grey literature.

Furthermore, our sample comprised of articles published in English, dating ten years back for practical reasons, implying that studies in other languages and those earlier than 2007, were excluded. In addition, studies that covered task shifting for surgery without specifying C-sections were excluded as it was difficult to know if C-sections were included. Given that our search may have not been exhaustive our conclusions and recommendations should be considered in that context. As typical for scoping reviews, the rigor of the research processes was not assessed[16], hence bias in the results of the reviewed papers cannot be discounted given that most studies used the retrospective records review design that may be affected by selection bias, recall bias, missing and incomplete documentation. This is an indication that more studies, preferably systematic reviews and meta analyses studies need to be conducted to enhance credibility of findings.

Conclusion

Evidence has demonstrated that task shifting for C-sections, implemented through trained NPCs continues to play a critical role in improving access to services in SSA where MDs are scarce. NPCs' performance is of good quality as it was found to be comparable with that of doctors despite differences in the rigour and duration of the training programmes for the two cadres. It is evident that HR crisis, coupled with high MMR and reports of quality performance by NPCs, stimulated adoption of task shifting for C-sections. Utilising NPCs was shown to be cost-effective and to have potential to alleviate HRH crisis especially where doctors are scarce. However, many operational and HRM challenges that impede implementation of task shifting for C-sections were noted and need to be addressed if full benefit of investing in NPCs is to be realised.

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Contribution of Authors

SM contributed to the development of the concept, conducting document search, screening of identified documents based on the predetermined inclusion criteria, abstracting data, synthesis of findings, drafting of the manuscript and revised it to its final form with inputs from the co-authors. MJC contributed to the refining of the concept, provided the overall direction for the development of the manuscript, reviewed the draft manuscript and provided comments, contributed to the revision and finalization of the manuscript. Both authors have read and approved the final version for submission and publication.

References

1. World Health Organisation. Trends in Maternal Mortality: 1990 to 2015 Estimates by the WHO, UNICEF, UNFPA, the World Bank and the United Nations Population Division. [WHO Website]. 2015. http://apps.who.int/iris/bitstream/10665/193994/1/WHO_RHR_15.23_eng.pdf?ua=1 Accessed July 05, 2017
2. Sharma G, Mathai M, Dickson KE, Weeks A, Hofmeyr GJ, Lavender T, Day LT, Mathews JE, Fawcus S, Simen-Kapeu A and de Bernis L. Quality care during labour and birth: a multi-country analysis of health system bottlenecks and potential solutions. BMC Pregnancy and Childbirth. 2015;15(Suppl 2): S2
3. Ellard DR, Shemdoe A, Mazuguni F, Mbaruku G, Davies D, Kihaile P, Pemba S, Bergström S, Nyamtema A, Mohamed H and O'Hare JP. Can training non-physician clinicians/associate clinicians (NPCs/ACs) in emergency obstetric, neonatal care and clinical leadership make a difference to practice and help towards reductions in maternal and neonatal mortality in rural Tanzania? The ETATMBA project. BMJ Open. 2016;6(2):e008999.
4. Chilopora G, Pereira C, Kamwendo F, Chimbiri A Malunga E and Bergström S. Postoperative outcome of caesarean sections and other major emergency obstetric surgery by clinical officers and medical officers in Malawi.Malawi Med J. 2016;28(3):94-98.

5. Gessessew A, Barnabas GA, Prata N and Weidert K. Task shifting and sharing in Tigray, Ethiopia, to achieve comprehensive emergency obstetric care. Int J Gynaecol Obstet. 2011;113(1):28-31.
6. McCord C, Mbaruku G, Pereira C, Nzabuhakwa C and Bergstrom S. The quality of emergency obstetrical surgery by assistant medical officers in Tanzanian district hospitals. Health Aff. 2009;28(5):876-85.
7. Mullan F and Frehywot S. Non-physician clinicians in 47 sub-Saharan African countries. Lancet. 2007; 370:2158—63.
8. Pereira C, Cumbi A, Malalane R, Vaz F and McCord C, Bacci A and Bergstrom S. Meeting the need for emergency obstetric care in Mozambique: work performance and histories of medical doctors and assistant medical officers trained for surgery BJOG. An Int. J. of Obstet & Gynaecol. 2007;114(12):1530-3.
9. World Health Organization. The world health report: Working together for health. [WHO Website]. 2006. http://www.who.int/whr/2006/whr06_en.pdf. Accessed December 15, 2014.
10. Galukande M, Kaggwa S, Sekimpi P, Kakaire O and Katamba A, Munabi I, Runumi FM, Mills E, Hagopian A, Blair G, Barnhart S and Luboga S. Use of surgical task shifting to scale up essential surgical services: a feasibility analysis at facility level in Uganda. BMC Health Services research. 2013;13(1):292.
11. Nyamtema AS, Mwakatundu N, Dominico S, Mohamed H and Pemba S, Rumanyika R, Kairuki C, Kassiga I, Shayo A, Issa O, Nzabuhakwa C, Lyimo C and van Roosmalen. Enhancing Maternal and Perinatal Health in Under-Served Remote Areas in Sub-Saharan Africa: A Tanzanian Model. PLoS One. 2016;11(3):e0151419.
12. Dovlo D. Using mid-level cadres as substitutes for internationally mobile health professionals in Africa. A desk review. Human resources for health. 2004;2(1):7.
13. Gobeze AA, Kebede Z, Berhan Y and Ghosh B. Clinical Performance of Emergency Surgical Officers in Southern Ethiopia. Ethiop J Health Sci. 2016;26(5):463-470.
14. Milland M and Bolkan H. Surgical task shifting in Sierra Leone: a controversial attempt to reduce maternal mortality. BJOG: An International Journal of Obstetrics & Gynaecology. 2015;122(2):155-.155.
15. Pereira C. Task-shifting of major surgery to midlevel providers of health care in Mozambique and Tanzania: A solution to the crisis in human resources to enhance maternal and neonatal survival. Institutionen för folkhälsovetenskap/Department of Public Health Sciences; 2010
16. Grant MJ and Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Information & Libraries Journal. 2009;26(2):91-108.
17. Colquhoun H. Current best practices for the conduct of Scoping Reviews: Impactful Biomedical Research: Achieving quality and transparency. 2016. http://www.equator-network.org/wp-content/uploads/2016/06/Gerstein-Library-scoping-reviews_May-12.pdf Accessed June 20, 2016
18. Database Search Tips: Boolean operators. [MIT Website] http://libguides.mit.edu/c.php?g=175963&p=1158594 Accessed November 12, 2016.
19. Gajewski J, Mweemba C, Cheelo M, McCauley T, Kachimba J, Borgstein E, Bijlmakers L and Brugha R. Non-physician clinicians in rural Africa: lessons from the Medical Licentiate programme in Zambia. *Hum Resour Health*. 2017;15(1):53. Published 2017 Aug 22. doi:10.1186/s12960-017-0233-0
20. Hounton SH, Newlands D, Meda N and De Brouwere V. A cost-effectiveness study of caesarean-section deliveries by clinical officers, general practitioners and obstetricians in Burkina Faso. Human Resources for Health. 2009;16;7(1):34
21. Pereira C, Mbaruku G, Nzabuhakwa C, Bergström S and McCord C. Emergency obstetric surgery by non-physician clinicians in Tanzania. Int J Gynaecol Obstet. 2011;114(2):180-3.
22. Kouanda S, Coulibaly A, Ouedraogo A, Millogo T, Meda BI and Dumont A. Audit of cesarean delivery in Burkina Faso. Int J Gynaecol Obstet. 2014;125(3):214-8.
23. Kruk ME, Pereira C, Vaz F, Bergström S and Galea S. Economic evaluation of surgically trained assistant medical officers in performing major obstetric surgery in Mozambique. BJOG: An International Journal of Obstetrics & Gynaecology. 2007;114(10):1253-60.
24. Shrime MG, Verguet S, Johansson KA, Desalegn D, Jamison DT and Kruk ME. Task-Sharing or Public Finance for Expanding Surgical Access in Rural Ethiopia: An Extended Cost-Effectiveness Analysis. In: Debas HT, Donkor P, Gawande A, Jamison DT, Kruk ME, Mock CN, eds. Essential Surgery: Disease Control Priorities, Third Edition (Volume 1). Washington (DC). The World Bank; 20. Chapter 19.
25. Nyamtema AS, Pemba SK, Mbaruku G, Rutasha FD and van Roosmalen J. Tanzanian lessons in using non-physician clinicians to scale up comprehensive emergency obstetric care in remote and rural areas. Human resources for health. 2011;9(1):28.
26. Pemba SK, Meckel M and Cobb N. The United Republic of Tanzania's Clinical Officers and Assistant Medical Officers. Transformative Education for Health Professionals; 2015
27. UNDP Sustainable development Goals: Goal 3, Good health and well-being http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-3-good-health-and-well-being.html Accessed July 12, 2017

28. De Brouwere V, Dieng T, Diadhiou M, Witter S and Denerville E. Task shifting for emergency obstetric surgery in district hospitals in Senegal. Reproductive Health Matters. 2009; 17(33):32-44.
29. Lawn JE, Kinney M, Lee AC, Chopra M, Donnay F, Paul VK, Bhutta ZA, Bateman M and Darmstadt GL. Reducing intrapartum-related deaths and disability: can the health system deliver? Int J Gynaecol Obstet. 2009;107 Suppl 1:S123-40, S140-2.
30. World Health Organization. Policies and Practices of Countries that Are Experiencing a Crisis in Human Resources for Health: Tracking Survey. 2010. World Health Organization, Geneva
31. Kushner AL, Cherian MN, Noel L, Spiegel DA, Groth S and Etienne C. Addressing the millennium development goals from a surgical perspective essential surgery and anesthesia in 8 low- and middle-income countries. Arch Surg. 2010;145:154–159
32. Aliu O, Corlew SD, Heisler ME, Pannucci CJ and Chung KC. Building surgical capacity in low-resource countries: a qualitative analysis of task shifting from surgeon volunteers' perspectives. *Annals of Plastic Surgery.* 2014;72:108-12.