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STUDY PROTOCOL

REVISED Addressing the need for an appropriate skilled delivery care workforce in Burundi to support Maternal and Newborn Health Service Delivery Redesign (MNH-Redesign): a sequential study protocol [version 2; peer review: 2 approved, 1 approved with reservations]

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Abstract

Background
Despite Burundi having formed a network of 112 health facilities that provide emergency obstetric and neonatal care (EmONC), the country continues to struggle with high rates of maternal and newborn deaths. There is a dearth of empirical evidence on the capacity and performance of EmONC health facilities and on the real needs to inform proper planning and policy. Our study aims to generate evidence on the capacity and performance of EmONC health facilities in Burundi and examine how the country might develop an appropriate skilled delivery care workforce to improve maternal and newborn survival.

Methods
We will use a sequential design where each study phase serially inputs into the subsequent phase. Three main study phases will be carried out: i) an initial policy document review to explore global norms and local policy intentions for EmONC staffing and ii) a cross-sectional survey of all EmONC health facilities to determine what percent of facilities are functional including geographic and population coverage gaps, identify staffing gaps assessed against norms, and identify other needs for health facility strengthening. Finally, we will conduct surveys in selected schools and ministries to examine training and

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staffing costs to inform staffing options that might best promote service delivery with adequate budget impacts to increase efficiency. Throughout the study, we will engage stakeholders to provide input into what are reasonable staffing norms as well as feasible staffing alternatives within Burundi's budget capacity. Analytical models will be used to develop staffing proposals over a realistic policy timeline.

Conclusion
Evidence-based health planning improves cost-effectiveness and reduces wastage within scarce and resource-constrained contexts. This study will be the first large-scale research in Burundi that builds on stakeholder support to generate evidence on the capacity of designated EmONC health facilities including human resources diagnosis and develop staffing skill-mix tradeoffs for policy discussion.

Keywords
EmONC, skilled birth personnel, health policy, Burundi

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Introduction

Burundi aspires to deliver an ambitious maternal and newborn health agenda[1,2] by reducing maternal mortality from 568 deaths per 100,000 live births in 2015 – which ranked among the top fifteen highest maternal mortality ratios in the world[3,4] – to below 140 deaths per 100,000 live births by 2030[5]. At the same time, the country aims to halve neonatal mortality from approximately 23 deaths in 2016[6] to below 12 deaths per 1,000 live births[5]. The major direct causes of maternal deaths include obstetric haemorrhage, eclampsia, and uterine rupture[7–9]. Global evidence corroborates with specific local evidence in Burundi. For instance, findings from a recent small-scale study conducted on 184 maternal deaths that occurred in rural hospitals revealed that obstetric haemorrhage was responsible for 72.2% of all-cause maternal deaths and eclampsia and uterine rupture represented 10.3 and 8.2% of maternal deaths; respectively[10]. To achieve its aspirations, Burundian policymakers will need to strategically allocate resources, redesigning maternal and neonatal health care provision to ensure that all mothers and babies receive adequate intrapartum and postpartum care including emergency obstetric and neonatal care (EmONC). Delivering such services is critically dependent on having sufficient, appropriately skilled human resources who are competent to offer adequate, timely, and life-saving maternal and newborn care[11–13]. Today, a network of 112 health facilities provide EmONC services in Burundi. Of them,

59 primary care facilities should dispense basic emergency services and 53 hospitals should provide comprehensive care[14]. In this country, delivery care is officially only provided by qualified nurses, midwives, medical doctors, or obstetricians depending on the availability of human resources and the need for higher or specialised competency. Except for obstetricians, all these professionals must complete pre-service or in-service EmONC training to qualify as "skilled delivery personnel". For clarity, we use "maternal and newborn health professionals or cadres" to refer to all qualified and licenced nurses, midwives, medical doctors, and obstetricians and "skilled delivery care personnel or cadres" to imply qualified obstetricians or nurses, midwives, and medical doctors who have completed the EmONC training.

Generally, Burundi has made significant progress in terms of maternal and child health. From 2012 to 2017 for instance, 84% deliveries occurred in a health facility with some areas achieving more than 90% of health facility based deliveries. Many deliveries (77%) were assisted by nurses while only 8% of deliveries were assisted by qualified medical doctors. Despite a persistent high rate of maternal and newborn complications (15% of childbirths)[15], it remains unclear whether nurse birth assistants are skilled birth attendants as per the standard definition[16]. Existing data from the health information system (HIS) in Burundi do suggest a declining trend in maternal and neonatal mortality partly as a result of EmONC interventions. More specific local research also underscores the critical role of EmONC services. A study conducted in a rural district hospital of Burundi demonstrated that 60% of 6,084 mothers needing emergency care underwent a major (42%) or minor (22%) lifesaving surgical procedure[17] that in many cases were likely to have averted a death; for example surgery for uterine rupture and extra-uterine pregnancies[17]. However, a key concern now is whether quality EmONC services are available and accessible to all women including those in rural settings. For effective service provision, sufficient numbers of skilled health workers who have received the necessary training and support to maintain their skillset to national and international standards are needed. National health policies and planning that guide resource allocation should therefore ensure appropriate staffing that takes account of local service demand, needs, and workload.

With attention to human resources for health (HRH), Burundi's aspirations to deliver on a universal health coverage agenda are undermined by severe shortage and maldistribution of health workers[18]. With attention to the quantity of trained health personnel for instance, the number of medical doctors per 10 000 population which rose from 0.28 in 2010 to 1.00 in 2017[19] implies that Burundi remains below the recommended World Health Organization threshold of 2.3. skilled health workers (physicians and nurses/ midwives) per 1000 population[20]. Moreover, for an estimated 11.5 million population, the country has less than 200 medical specialists across all disciplines of whom more than 95% are located in Bujumbura capital city which is home to only 2.7% of Burundi's population[19]. Under those circumstances, Burundians continue to face difficulties to access and use quality health care services[21–24]. This places Burundi among countries that continue to register higher

maternal and neonatal mortality ratios as the reduction of maternal and neonatal deaths requires equitable access to quality health care services which constitute a cornerstone of the survive, thrive, and transform agenda[1,25]. Noting that Burundi's population is mostly female and youthful[26], the country needs to decide on how many facilities should offer basic and comprehensive EmONC as well as their geographic distribution and population coverage to ensure equity in quality delivery care access.

Our research stems from the above background and seeks to address some of the above raised concerns. In Burundi, there is sparse empirical evidence on the capacity and performance of EmONC health facilities and the real needs to inform proper planning and policy. Particularly, partial evidence has highlighted that Burundi faces major barriers to quality EmONC service delivery. Some of the challenges that undermine the sustained provision of quality EmONC services include the inefficient resource allocation, shortages, and maldistribution of skilled birth personnel, increasing workloads, and the lack of essential supplies and medications, among others[27]. A weak training curriculum, a poor harmonisation and coordination of training, and the lack or inadequate in-service training have also been cited[27]. Therefore, our study aims to generate empirical evidence on the capacity and performance of EmONC health facilities in Burundi and further examine how the country might develop an appropriate skilled delivery care workforce to improve maternal and newborn survival.

Study aim and objectives
This study aims to explore how EmONC services are currently organised in Burundi, diagnose EmONC human resources issues by focusing on skilled delivery care personnel, and examine how the country might develop an appropriate skilled delivery care workforce to improve maternal and newborn survival. We focus on human resources as this constitutes a major stake in health care service provision. Also, it takes a long time to produce the right workforce if an expansion in service provision is needed, hence the need to explore the most efficient and effective mix of staffing. Specifically, the study will (i) examine the prevailing capacity of designated EmONC health facilities including the scope of emergency care currently being provided, (ii) describe the national total stock of maternal and newborn care workforce and estimate the government budget impact of training and employing different skilled delivery care cadres, and (iii) estimate and cost the workforce gap of skilled delivery care and develop skill-mix staffing alternatives to close the identified gap. Additionally, the study will advise on the need to empower all or some designated EmONC health facilities and whether the country might consider increasing the number and geographic and population coverage to ensure equity.

Methods
Study design
This study will use a sequential design with each of the phased research stages serially inputting into the subsequent phase. Three main study phases will be carried out: i) an initial policy document review to explore global norms and local policy intentions for BEmONC and CEmONC in Burundi with a

particular focus on stated or reasonable staffing norms for different levels of facility and ii) a cross-sectional survey of all BEmONC and CEmONC health facilities to map out and determine what percent of facilities are functional including geographic and population coverage gaps, to identify staffing gaps assessed against norms or expectations, and to identify other needs for health facility strengthening. Finally, we will examine potential staffing costs and explore alternative staffing options (service designs) that might best promote service delivery with adequate budget impacts to increase efficiency. Throughout the study, we will engage with a stakeholder group to provide input into what are reasonable staffing norms as well as feasible staffing alternatives within Burundi's budget capacity.

Study setting and participants
This study will be carried out in all designated EmONC health facilities in Burundi (n = 112) which comprise 59 primary health facilities providing basic emergency care and 53 hospitals dispensing comprehensive emergency care. We will engage stakeholders including policymakers, researchers, donors, and implementers and target health facility managers, heads of maternity and labour wards or units, skilled delivery care professionals, and students as detailed in Table 1.

Study description and methods
This study will be implemented in three phases as described in Figure 1.

Underlying challenges
The study rationale stems from the challenges underpinning efficient HRH planning in Burundi. Like in most other low-income countries (LICs), Burundi lacks empirical local evidence to guide policy discussion, which implies that the country planning relies on the adoption of global guidelines or recommendations and on historical patterns which are incrementally revised[28,29]. For instance, the results of a study that mapped available health research works highlighted that Burundi suffers a severe lack of empirical evidence. From 2002 until 2011, only 34 health publications, which were mostly authored by foreign researchers, came from Burundi[30]. In comparison, Rwanda contributed 205 health publications and Kenya a wealth of 3004 health publications[30]. Most importantly, while Kenya and Rwanda respectively registered 205 and 20 clinical trials during the same period, Burundi did not conduct any clinical trial[30]. Therefore, health workforce planning is poor and non-evidence-based, which undermines the country's aspiration to deliver on the universal health coverage agenda[18].

Delivery care staffing levels
Understanding current delivery care staffing levels in designated EmONC health facilities is critical as this will inform the workforce gap analysis to quantify real-time staffing needs. With reference to international standards for clinical staffing of delivery care in maternity units, the International Federation of Gynaecology and Obstetrics (FIGO) sets out minimum requirements for BEmONC and CEmONC birthing centres depending on the number of births. For instance, a BEmONC birthing centre with approximately 2000 deliveries should

Table 1. Description of study participants and sample size.

Phase	Activity description	Study participants	Sample size estimation
One	Policy document review to gather evidence on EmONC staffing standards for LMICs	—	—
	Stakeholder panel to reflect on global practice and recommendations and discuss acceptable EmONC staffing standards for Burundi	Policymakers, donors, researchers, and implementers	6–8 participants (Supplement 1). List of stakeholders for the MNH-Redesign project). The stakeholder group was formed by the MoH in consultation with partners namely WHO and JICA and professional bodies namely AGOB (Burundian Association of Gynaecology and Obstetrics) and ABUNE (Burundian Association of Neonatology).
	Health facility assessment to examine the capacity of designated EmONC health facilities including the scope of emergency care currently being provided and existing staffing levels	Health facility managers (or representatives) and managers (or heads) of maternity or delivery wards	There are 112 designated EmONC health facilities. The health facility survey will require inputs from the health facility manager who will respond to general questions concerning the facility (e.g., infrastructure and staffing) and the manager of maternity or delivery wards who will answer specific questions concerning maternal and newborn care (e.g., EmONC signal functions). Therefore, the health facility survey will be conducted on 224 participants.
	Individual delivery care provider assessment to evaluate the extent to which they are confident to provide emergency care for maternal and newborn complications	Delivery care providers present in maternity or labour wards during our visits	There are an estimated 831 delivery care providers across all 112 designated EmONC health facilities (Supplement 2). Estimation of total delivery care staff in designated EmONC health facilities). We estimate to survey 40% of the possible sample (n = 335 participants) corresponding to delivery care providers who will be on duty during our visits.
Two	Secondary data analysis of historical records of graduates to examine the total national stock of delivery care professionals	—	—
	Secondary data analysis of historical records of recruits to explore the extent to which the government absorbs delivery care graduates	—	—
	Interviews with students in private medical universities and nursing and midwifery schools to estimate the financial cost of training different delivery care cadres using a payee-perspective (student) approach	Medical students and nursing and midwifery students in private universities and schools	There are 2 private medical schools in Burundi and both will be included in the study. Nursing and midwifery schools will be stratified in public versus private and urban versus rural to account for cost variability which depends on the geographic location of the school (e.g., private schools in major cities may charge higher costs to account for higher expenses such as investment in buildings). A random or convenient sample of 10 schools will be used in this study. Since tuition fee does not vary per student, we will survey a maximum of 5 random students in each selected university or school to ensure consistency in costs data (n=65 students).
	Secondary cost data analysis to estimate the financial cost (and increase in cost) of training and employing different delivery care cadres in public schools using a provider-perspective (government) approach	—	—

Phase	Activity description	Study participants	Sample size estimation
Three	A scoping review to understand what workforce gap analysis methods have been used in LMICs	—	—
	Analysis and costing of the workforce gap between existing and proposed* skilled delivery care staffing requirements for EmONC health facilities in Burundi	—	—
	Development of staffing trade-offs of different skill-mix options (e.g., nurses vs midwives; midwives vs junior doctors, etc.) over a realistic policy timeline (e.g., 10–15 years)	—	—
	A stakeholder panel to stimulate discussion and policy reform	Policymakers, donors, researchers, and implementers	6–8 participants (Supplement 1)

*Current delivery staff levels will be ascertained against proposed normative staffing standards agreed upon during the stakeholder discussion held earlier in phase one: *Stakeholder panel to discuss what EmONC staffing standards should be acceptable for Burundi.*
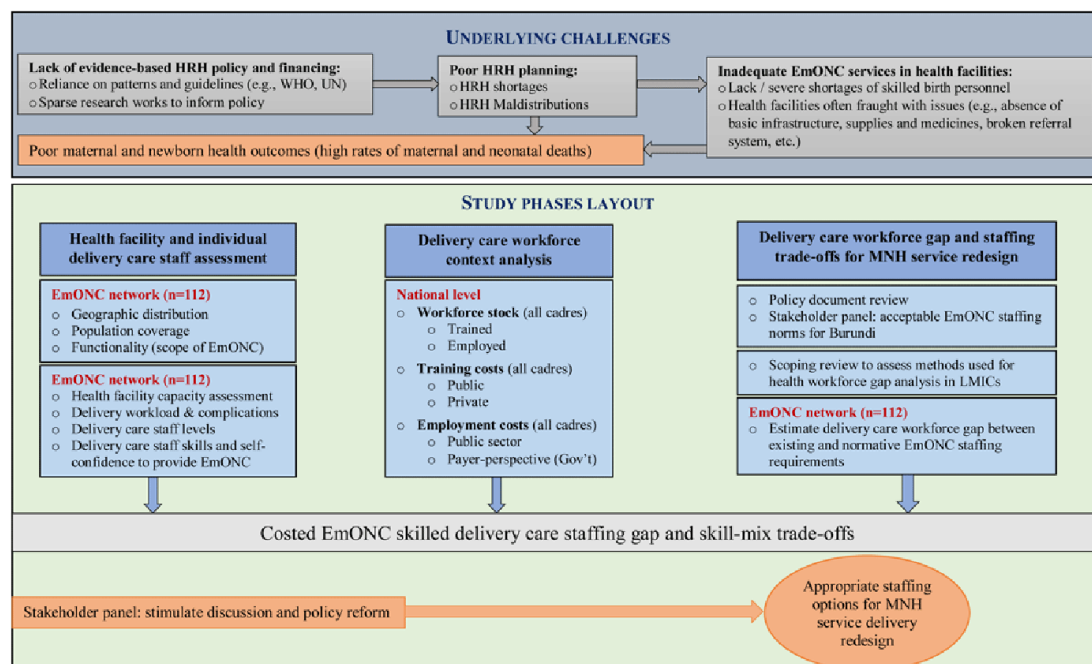
Figure 1. Overview of the MNH-Redesign study phases.

be equipped with at least three skilled birth attendants and a minimum of four labour beds and three individual delivery rooms. Ideally, such a health facility should be equipped with five skilled delivery attendants and seven individual labour and delivery rooms[31]. We will map EmONC health facilities and conduct a health facility assessment to understand the scope of EmONC services being provided. The health facility assessment will enable appraisal of which EmONC facilities are functioning and providing which services with which skilled delivery staff levels. Next, we will conduct an individual delivery care provider survey to assess their general knowledge in maternal and newborn health and their self-confidence to

provide emergency care for complications. Findings from the health facility and individual assessments will inform how well Burundi performs concerning EmONC services provision including skilled delivery personnel and further feed into the workforce gap analysis later in the study.

Delivery care workforce context

Understanding Burundi's capacity concerning the national stock of delivery care professionals constitutes another important input to inform policy change. In the first instance, we will assess the total stock of delivery care professionals by documenting historical numbers of graduates in both public

and private medical and nursing schools. Next, we will document the training costs per type of cadre and per type of institution, in the public and private sectors. Direct financial training costs will be explored using a provider-perspective approach i.e., the government for public schools, and a payee-perspective approach i.e., trainees in private schools. Last, the same approach will be used to determine the government cost of employing each delivery care cadre. Employment costs will be stratified by cadre and by type of geographic residence to encompass rural incentives. The workforce stock analysis will help to understand the government budget impact to train and employ different delivery care cadres. This outcome will feed into the staffing gap costing exercise in the next study phase.

Delivery care workforce gap and staffing tradeoffs

We will review policy documents to gather evidence on delivery care staffing standards or norms for EmONC health facilities, particularly in low-income settings. Results of the document review will be appraised against policy recommendations for EmONC staffing in Burundi. This stage will require the engagement of relevant stakeholders to discuss what should be "acceptable" staffing norms or standards for Burundi. Next, we will conduct a scoping review to build the body of evidence on the methods that have been used to estimate the gap of health workers, particularly in LMICs. Each method will be appraised to understand its strengths and weaknesses and how it can be applied to Burundi. The chapter will conclude with the analysis of the current staffing gap in all EmONC health facilities. Most studies used staff workload to estimate current and future staffing needs[32–34]. Other methods include the health care worker to population ratio, the service demand, the service-target, and the health and service needs approaches[35,36]. A gap analysis will be done and skill-mix staffing alternatives developed to close the identified gap[37,38]. Since we aim to generate evidence that can stimulate policy reform discussion, we will employ two different gap analysis methods that are likely to yield different results to give room to stakeholder trade-offs at times of decision making or policy discussion.

Study outcomes

Results from the latter section will be used to develop delivery care staffing tradeoffs using a skill-mix approach. Staffing alternatives will be costed drawing on the costs of employment of different delivery care cadres from phase two and presented during a local stakeholder panel to discuss what should be the most appropriate staffing options considering the financial needs and country capacity. In addition to the thesis, study findings will be used by the MoH and its partners to strengthen EmONC health facilities with the provision of needed EmONC human resources, equipment, supplies and essential medicines as well as infrastructures well relevant. Findings will form the basis to advocate for actions needed to improve maternal and newborn health survival in Burundi.

Data description and analysis plan

Data will be sourced using a set of methodological approaches (Supplement 3) including i) secondary data collection, ii) primary health facility assessments, iii) primary surveys with students and delivery care providers, iv) direct observation, v) stakeholder discussion, and vi) evidence synthesis using structured and non-structured literature and policy document review. Data description and analysis plan are described in Table 2.

Table 2. Data description and analysis plan.

Data type	Data description and analysis plan
Health facility data	We will collect geocoordinates and use the existing 2021 database on population coverage which is available at the Ministry of Health in Burundi. These data will be used to layout the geographic distribution of EmONC health facilities and evaluate disparities in population coverage. The geographic analysis will be done in ArcGIS software. The scope of emergency obstetric and neonatal care will be assessed using a health facility assessment (Supplement 4). The literature provides a range of tools used to collect health facility-level data to assess service availability, readiness, and provision[15,39–44]. Tools commonly assess general requirements for health facilities depending on the level of care, routine obstetric and newborn care, and basic and comprehensive EmONC, among others[45]. Our tool was adapted from the EmONC Needs Assessments toolkit (Averting Maternal Death and Disability)[39], the World Health Organization (WHO) service availability and readiness assessment (SARA)[43,46], and the Quality Evidence for Health System Transformation (QuEST) health facility assessment tool[47]. The EmONC Needs Assessment toolkit, which was designed by the Averting Maternal Death and Disability (AMDD) program at Columbia University Mailman School of Public Health and adopted by WHO, UNFPA, and UNICEF[39,45,48] enables to classify each health facility in either of the three categories: i) comprehensive EmONC, ii) basic EmONC, or iii) not an EmONC health facility[49,50]. Data collection will require trained data collectors and field visits in all 112 designated EmONC health facilities in Burundi. Specifically, we will collect data on the availability of basic infrastructure, the availability and functionality of EmONC equipment, supplies and medicines, and overall and delivery care staff plus weekly pattern staff availability. Further, we will record the number of deliveries, complications, deaths, etc. from maternity registries. Health facility data will be described to define functioning EmONC health facilities and explore the overall staffing capacity to provide emergency care. Workload patterns will be depicted using a run chart.

Data type	Data description and analysis plan
Individual data in health facilities	A sample of 335 delivery care providers in maternity wards will be surveyed using Supplement 5. We will collect background information and perceptions on working conditions, quality of care, and self-confidence. Further, we will assess general clinical, maternal, and newborn care knowledge. We will conduct descriptive statistics and continue with analytical models to understand the level of confidence and knowledge and determine individual and health facility level factors that affect confidence and knowledge to provide emergency care. Individual questionnaire was developed using the EmONC skills training module and the EmONC practical guidelines. Tools were validated by the technical and stakeholder committees comprising of staff from the MoH, WHO, JICA, ABUNE, AGOB, UNICEF, UNFPA, and the University of Burundi.
National stock of delivery care cadres	We will map public and private medical and nursing and midwifery schools in Burundi and obtain historical records of the number of delivery care graduates over the recent past and the number of delivery care cadres employed by the public sector over the same period. In Burundi, the Ministry of Health is the certificate awarding body for nurses and midwives while the Ministry of Education certifies medical doctors and medical specialists. Therefore, the total number of graduates per annum will be obtained from those two ministries. Summary statistics will be done to estimate the prevailing national total stock and determine the government capacity to absorb graduate delivery cadres.
Training cost data	Training cost estimation will be done separately in public and private schools. Public medical and nursing/midwifery schools receive a full government subsidy and students are paid a monthly subsistence stipend while private schools run a profit-making model and do not receive government financial support. **Training cost in private schools:** individual students (n = 60) in private schools will be surveyed on direct training financial cost (Supplement 6. Section 2.B) which comprises inclusive tuition fees and living costs. Average training cost stratified per type of training will be calculated. **Training cost in public schools:** the financial costs of training account for recurrent and infrastructure costs[51,52]. We will not collect infrastructure costs; assuming that the government does not need to build additional medical and nursing training infrastructures in the short-run (we anticipate that results from the schools mapping will support this assumption). Recurrent costs include: i) teaching staff salaries, ii) non-teaching (administrative) staff salaries, and iii) student subsidies. The overarching question to answer is: what is the provider's average financial cost of producing each type of delivery care cadre? Costs data at the University of Burundi will be obtained from the Department for Finance while costs data for public nursing and midwifery training will be obtained from the Ministry of Finance or Labour. We will collect the following types of data: i) gross teaching staff salaries (TSS) and non-teaching staff salaries (nTSS) per annum, ii) total number of students per year at school or faculty level, and iii) monthly student subsidies. We will collect time-series data to allow education costs growth estimation and time horizon projections (Supplement 6. Section 2.A). Concerning student subsidies, while nursing and midwifery trainees receive a standard package, medical students receive an increasing package depending on the level of training. From first to third-year medical training, students receive a government subsidy only while students in higher classes 4th–5th year and 6th year receive an additional package to compensate for clinical duties. In the same perspective, residents are paid a higher subsidy. Therefore, costs will be disaggregated by type and level of medical education. The Average Cost (AC) of producing each of the delivery care cadres will be estimated using the following formula*: $$AC_i = (TSS_{yi} + nTSS_{yi} + AS_i) \ast n_i \: ; \text{ where:}$$ AC_i = average cost of producing a delivery care cadre i TSS_{yi} = average annual teaching staff salary for a student i $nTSS_{yi}$ = average annual non-teaching staff salary for a student i AS_i = gross annual subsidy for student i n_i = number of years of training for student i. *The formula does not account for repeating students.

Data type	Data description and analysis plan
Employment cost data	We will focus on the public sector as the aim is to estimate the government budget needs for employing different delivery care cadres (Supplement b. Section 2.C). We will assume that: • The government does not need to build new or expand health facilities or maternity wards • In-service performance-based incentives paid to providers by health facilities are not captured into the employment direct investment by the government • Employment costs calculation is based on a newly recruited and non-experienced staff (a recent graduate or career entry-level employee) Annual total financial costs of employing different delivery care cadres will be assessed using a payer-perspective i.e., the government. Inclusive costs for newly recruited non-experienced staff will be calculated by the type of cadre using gross annual wages, annual wage increase rate, pre-service and in-service training costs (e.g., EmONC training), etc. as follows: $$EC_j = \sum_{i=1}^{n} X_{ji} \text{ ; where:}$$ EC_j = annual government total cost of employing a delivery care cadre j X_{ji} = annual individual cost i [wages, pre-service and in-service training] for each delivery cadre j

Discussion

Evidence-based health planning and resource allocation has been found to improve cost-effectiveness and reduce wastage within scarce and resource-constrained contexts[53–55]. Concerning the health workforce, many countries including LMICs have started to develop time horizon projections of health professionals to provide national policymakers with the evidence needed for HRH policy development[56–59]. As outlined earlier, Burundi lacks evidence on the real needs of skilled delivery care personnel to meet staffing standards and ensure that all labouring mothers including those in rural settings receive adequate and timely care including for emergency complications. Furthermore, the country suffers a dearth of knowledge on the existing national stock of health professionals and the capacity to produce and employ different delivery care cadres. This constitutes a barrier to appropriate planning, hence the reliance on the adoption of global guidelines or recommendations and historical patterns of health planning[28,29]. This study will be the first large-scale research in Burundi that will generate national-level evidence on the capacity of designated EmONC health facilities and the scope of care being provided. The study will diagnose human resources issues by estimating and costing the staffing gap of skilled delivery personnel and will further develop skill-mix staffing tradeoffs to close the identified gap. Moreover, the study will inform on the government investments needed for rolling out alternative skilled delivery staffing proposals. Findings from this study will be projected on a reasonable policy timeframe to enable a time horizon planning.

Potential strengths of this study are the early engagement of national stakeholders and the stakeholder panels which are planned to take place during the study implementation. Stakeholder engagement has become a cornerstone in health guidelines and policy development[60–62]. Amounting evidence supports that stakeholder buy-in bolsters policy acceptability and adoption into local practice[63,64]. We formed and engaged a local permanent stakeholder advisory committee early in the project design (Supplement 1). The committee is composed of policymakers from the Ministry of Health (MoH), donors represented by WHO and the Japan International Cooperation Agency (JICA), academicians and researchers from the University of Burundi, and national implementers represented by Association Burundaise pour le Bien-Etre Familial (ABUBEF). The first committee meeting was held during the study design to seek stakeholders' inputs. The committee will continue to convene on regular basis which is a strategic approach to maintain engagement and stimulate a smooth policy discussion. In addition to the permanent committee, we plan to conduct two stakeholder panels where a wider stakeholder audience will be invited. The first panel will aim to discuss EmONC staffing standards that are feasible in Burundi, sourcing from the review of EmONC policy documents from LMICs and global and regional guidelines. The second panel will be held at the end of the study to discuss staffing alternatives and policy options. Moreover, the use of mixed methods constitutes a potential strength as evidence from mixed methods studies help to better apprehend complex problems and produce evidence in support of policy reform[65]. In addition to its bolstering effect, early stakeholder engagement constitutes a strategy to mitigate potential implementation challenges such as access to secondary data and the conduct of primary health facility surveys.

Results from this study will be disseminated locally through stakeholder meetings and globally as publications in peer-reviewed journals and through presentations at relevant scientific meetings and conferences. Most importantly, findings from this study will be compiled in a thesis report to be submitted to the Nuffield Department of Medicine at Oxford University in fulfillment of the Doctor of Philosophy in Clinical Medicine by the primary and corresponding author.

Ethics clearance

This study has been approved by the Human Research Ethics Committee of the Faculty of Medicine, University of Burundi (approval ref. FM/CE/01/M/2022) and the Oxford Tropical Research Ethics Committee (OxTREC approval reference: 516-22) (Supplements 7). All participants will sign a written informed consent form (Supplement 8). We will not collect participants' identities. Plus, principles of confidentiality and anonymity will be guaranteed. Collected data will be kept on encrypted computers and backed up on WHO Burundi and MoH servers.

Study status

At time of manuscript submission (June 22nd, 2022), the country stakeholder committee has started planning for fieldwork in target health facilities, but recruitment of study participants has not started. However, data collection in schools, universities, ministries, and individual students is underway.

List of abbreviations

ABUBEF: Association Burundaise pour le Bien-Etre Familial

ABUNE: Burundian Association of Neonatology

AC: average cost

AGOB: Burundian Association of Gynaecology and Obstetrics

AMDD: averting maternal death and disability program at Columbia University Mailman School of Public Health

EmONC: emergency obstetric and neonatal care

FIGO: International Federation of Gynaecology and Obstetrics

GDP: Gross Domestic Product

HIS: Health Information System

HRH: human resource for health

JICA: Japan International Cooperation Agency

LICs: low-income countries

LMICs: low and middle-income countries

MoH: ministry of health

nTSS: non-teaching staff salaries

OBGYM: obstetrics and gynecology

OxTREC: Oxford Tropical Research Ethics Committee

QuEST: Quality Evidence for Health System Transformation

TSS: Teaching staff salaries

UNFPA: United Nations Population Fund

UNICEF: United Nations Children's Fund

WHO: World Health Organization

Data availability

Figshare. Supplements - Addressing the need for an appropriate skilled delivery care workforce in Burundi to support Maternal and Newborn Health Service Delivery Redesign (MNH-Redesign): a sequential study protocol. DOI: https://doi.org/10.6084/m9.figshare.20055257.v1[66]

This project contains the following underlying data:

- Supplement 1. List of local stakeholders for the MNH-Redesign project

- Supplement 2. Estimation of total delivery care staff in designated EmONC health facilities

- Supplement 3. Data sources

- Supplement 4. Health facility questionnaire

- Supplement 5. Individual delivery care provider questionnaire

- Supplement 6. Individual student and school questionnaire

- Supplement 7. Written informed consent form

- Supplement 8. Full study protocol

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Declarations

Acknowledgments

We acknowledge the members of the stakeholder advisory committee in Burundi (Data Availability: Supplement 1).

Authors' contributions

DH conceptualized the study, formed the local stakeholder advisory committee, sought ethics approvals and WHO funding, and wrote the first draft of the manuscript. ME, CN, and AL contributed substantially to the study conceptualization and reviewed the draft manuscript. All authors read and approved the final manuscript.

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Open Peer Review

Current Peer Review Status: ✓ ✓ ？

Version 2

Reviewer Report 30 September 2022

https://doi.org/10.21956/wellcomeopenres.20408.r52526

✓ **Katherine Semrau** (iD)

[1] Ariadne Labs, Brigham and Women's Hospital, Boston, MA, USA
[2] Harvard Medical School, Boston, MA, USA

Thank you for the review response and updated manuscript!

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal and newborn health; epidemiology; quality of care

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 27 September 2022

https://doi.org/10.21956/wellcomeopenres.20408.r52528

✓ **Ejemai Eboreime** (iD)

Department of Psychiatry, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada

The authors have addressed my concerns

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Implementation science, primary health care, mental health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

- -

Version 1

Reviewer Report 30 August 2022

https://doi.org/10.21956/wellcomeopenres.19875.r51935

? **Merlin Willcox** iD

Primary Care, Population Sciences and Medical Education, University of Southampton, Southampton, UK

Major comments:
This is an interesting study and protocol.
There are two important issues which need to be considered by the authors.

Firstly: the discussion states "the use of mixed methods constitutes a potential strength". However, the data description and analysis plan in Table 2 refers only to quantitative data and quantitative analyses. If qualitative data collection and analyses are planned, these should be added to Table 2 as a minimum. If not, the statement about mixed methods should be removed from the discussion.
Examples of opportunities for qualitative research are as follows:

- Phase 1: health facility assessment: it is not clear whether these will be written questionnaires, an online survey, or qualitative interviews, or a mix. Please clarify. I would suggest that a subsample could be selected for qualitative interviews to ask about their experience of strategies to increase recruitment. It would be good to include a few district health officers in this too. You may find that several strategies have already been tried.

- Phase 2: Interviews with medical, midwifery and nursing students – it isn't clear whether you will interview 5 in total in each school, or 5 of each category. I would recommend 5 of each category. Furthermore, will you only ask about tuition fees? Why not ask about accommodation and subsistence costs? And why not also conduct more in-depth interviews about their career intentions – whether they would want to work in the public sector (and what it would take for them to do so) or whether they are intending to work in the private sector or even abroad. It would be interesting to compare this with students in government training schools. Their career intentions may differ compared to those in private schools – eg if they are not saddled with a large debt, they may be able to afford to work in government health facilities for a lower salary. They may also be obliged to work in govt health facilities as a condition of their government scholarships?

Secondly, the focus appears to be heavily on "staffing norms" and "staffing" which implies numbers of health workers and posts – rather than other potential solutions. In the aims, the authors state: "Also, it takes a long time to develop the right workforce if an axpansion in service provision is needed". No reference is given for this statement, and it may not be true, for the following reasons:

1. In many African countries, there is a paradox of unemployed doctors / nurses etc, because the number trained is greater than the number of posts available. This has clearly been documented in several countries e.g. see https://gh.bmj.com/content/7/Suppl_1/e008420.[1]

   So the workforce could immediately be expanded in many countries by simply increasing recruitment and retention of existing health workers. The authors should acknowledge this and include methods to assess the number of unemployed health workers in Burundi. How many doctors / nurses / midwives are trained each year, and how many of these are able to find jobs in government health facilities? – I can see you should be able to address this in your assessment of "national stock of delivery care cadres". It would be important to use qualitative methods to understand reasons for any differences observed between staff available and posts filled. E.g. are there vacant posts which have been advertised with no applicants? (and is this because of poor pay / working conditions, or because of a shortage of people with the right qualifications?) Or are there insufficient posts in health facilities?

2. The distribution of the existing workforce is often suboptimal, both geographically and between types of health facility. E.g. in Mali and Uganda, there are far more vacancies in primary care than in secondary care facilities – see https://human-resources-health.biomedcentral.com/articles/10.1186/s12960-015-0073-8.[2]
   Redistributing the existing workforce could markedly improve service provision. I can see that the authors are planning to collect data on this in the "Health facility data" (Table 2). However, alongside existing staffing in health facilities, it would also be good to obtain a measure of "unmet need" for services in different areas. Eg how many mothers are delivering at home or in inappropriate facilities? This will not be captured by only measuring number of deliveries in each official facility.

3. Increasing pay / working conditions and also improving staff management (to reduce absenteeism) may be more effective, in certain conditions, than simply increasing numbers of staff. E.g. in many health centres I have visited in sub-Saharan Africa, there are very high rates of absenteeism, because pay is poor and people work as little as possible in their designated government health facility, in order to then go and earn more money in the private sector. Also, there are no sanctions for staff absenteeism as this is accepted to be the "norm". Increasing the number of poorly-paid posts may do little or nothing to improve this situation. For example a health centre with 5 midwives (compared to 3 midwives) may still only have 1 midwife on duty at any one time, because the midwives may organise themselves to have a 1 in 5 rota (instead of a 1 in 3 rota). The methods should include ways of addressing this issue – eg qualitative interviews of staff and managers about how to reduce absenteeism and the potential cost of paying staff enough so that they do not feel the need to moonlight in the private sector.

4. Training "unskilled" staff to fill the gaps. In practice, in many countries, staff considered to be "unskilled" are managing patients in many health facilities (eg nursing assistants, midwifery assistants, traditional birth attendants). see https://human-resources-

health.biomedcentral.com/articles/10.1186/s12960-015-0073-8[2]
The methods should assess the extent of this practice in Burundi, and whether training them with essential skills could immediately improve management, while waiting for more midwives etc to be trained. Please clarify whether your health facility data will include these cadres.

There are also several typos and minor errors which need to be corrected (see below).

Minor (specific) comments:

Abstract:
○ Change "Throughout the study, we will engage stakeholders to provide input into what is reasonable staffing norms as well as feasible staffing alternatives within Burundi's budget capacity" to "Throughout the study, we will engage stakeholders to provide input into what **are** reasonable staffing norms as well as feasible staffing alternatives within Burundi's budget capacity"

Intro:
○ Change "More specific local research also underscore the critical role of EmONC services." to "More specific local research also **underscores** the critical role of EmONC services."

○ "With attention to the quantity of trained health personnel, the number of medical doctors per 10 000 population remains below the thresholdold (from 0.28 in 2010 to 1.00 in 2017)19."

Correct spelling of "threshold".

I think the authors are referring to the WHO threshold of 2.3 health workers per 1000 population (or 23 per 10,000). If so, add a reference to this. If not, add a reference for the "threshold" to which you are referring. Are you sure that the figures you quote are per 10,000 and not per 1,000? Also the WHO "threshold" is for all health workers not only for doctors. If you are going to compare figures for Burundi to the WHO "threshold" you need to include ALL trained health workers including nurses and midwives, etc.

Aims:
○ Change "axpansion in service provision" to "**expansion** in service provision".

○ Change "geograpgic and population coverage" to "**geographic** and population coverage".

Study design:
○ Change "what is reasonable staffing norms" to "what **are** reasonable staffing norms"

Underlying challenges:
○ Change "From 2002 until 2011, only 34 health publications; which were mostly authored by foreign researchers; came from Burundi" change to "From 2002 until 2011, only 34 health publications**,** which were mostly authored by foreign researchers**,** came from Burundi"

Top of p7:

◦ Most studies used staff workload to estimates current and future staffing needs" change to "Most studies used staff workload to **estimate** current and future staffing needs"

Table 1:

◦ Change "There is an estimated 831 delivery care providers" to "There **are** an estimated 831 delivery care providers"

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Is the rationale for, and objectives of, the study clearly described?

Yes

Is the study design appropriate for the research question?

Partly

Are sufficient details of the methods provided to allow replication by others?

Partly

Are the datasets clearly presented in a useable and accessible format?

Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Primary health care, global health, maternal and child health, human resources for health.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 20 Sep 2022

Desire Habonimana, Faculty of Medicine, University of Burundi, Bujumbura, Burundi

Merlin Willcox

APPROVED WITH RESERVATIONS

Major comments:

This is an interesting study and protocol.
There are two important issues which need to be considered by the authors.

Firstly: the discussion states "the use of mixed methods constitutes a potential strength". However, the data description and analysis plan in Table 2 refers only to quantitative data and quantitative analyses. If qualitative data collection and analyses are planned, these should be added to Table 2 as a minimum. If not, the statement about mixed methods should be removed from the discussion.

Thanks so much for your feedback, a bold contribution. By mixed methods, we mean the mixture of strategies and approaches of sourcing information. For instance, we will use primary data (collected at health facility level and health care providers), secondary data (collected from health facilities, ministries, and schools), stakeholder discussions (which will take the form of Focused-group discussion), and structured literature search (scoping review). These methods allowed us to used the term "mixed methods" hoping that we are scientifically correct.

Examples of opportunities for qualitative research are as follows:
○ Phase 1: health facility assessment: it is not clear whether these will be written questionnaires, an online survey, or qualitative interviews, or a mix. Please clarify. I would suggest that a subsample could be selected for qualitative interviews to ask about their experience of strategies to increase recruitment. It would be good to include a few district health officers in this too. You may find that several strategies have already been tried. Surveys will be quantitative and administered using direct interviews with health managers. The questionnaire will be software-based (KoboCollect) and will comprise of questions that aim to assess the health facility capacity using tools adapted from existing tools including The SARA tool and AMDD (see table 2, health facility level). The study does not intent to interview health facility/ district health officers concerning strategies to increase human resources as policies to increase human resources are taken at higher decision-making levels. In other words, in Burundi, the central level of the Ministry of Health is the leading body to handle human resources strategies. Lower cadres (at peripheral levels) do not take part to decision making. That is why our aim is to organise stakeholder discussions rather than interviewing lower cadres.

○ Phase 2: Interviews with medical, midwifery and nursing students – it isn't clear whether you will interview 5 in total in each school, or 5 of each category. I would recommend 5 of each category. Furthermore, will you only ask about tuition fees? Why not ask about accommodation and subsistence costs? And why not also conduct more in-depth interviews about their career intentions – whether they would want to work in the public sector (and what it would take for them to do so) or whether they are intending to work in the private sector or even abroad. It would be interesting to compare this with students in government training schools. Their career intentions may differ compared to those in private schools – eg if they are not saddled with a large debt, they may be able to afford to work in government health facilities for a lower salary. They may also be obliged to work in govt health facilities as a condition of their government scholarships? Thanks for this invaluable contribution. We will interview 5 students in each school which exactly corresponds to more than 5

students in each category of students. In fact, we will interview 5 medical students in each of the two private Universities, 5 students in each of the remaining 10 schools (some schools train only midwives or nurses while others train both). In private schools, we will collect data on inclusive tuition fees as well as living costs (accommodation, meals, other bills). Our study will unfortunately assess career intentions as this slightly lies beyond our scope.

Secondly, the focus appears to be heavily on "staffing norms" and "staffing" which implies numbers of health workers and posts – rather than other potential solutions. In the aims, the authors state: "Also, it takes a long time to develop the right workforce if an axpansionexpansion in service provision is needed". No reference is given for this statement, and it may not be true, for the following reasons: We totally agree with you on this. In many low-income countries, the number of graduates largely outweighs the number of employed, mostly due to incapacity of the government / private sector to absorb graduates. By alluding to "it takes a long time to develop the right workforce if an expansion in service provision is needed", we mean that it takes long to train health care professionals. We have changed the word "develop" and made it more specific "produce".

1. In many African countries, there is a paradox of unemployed doctors / nurses etc, because the number trained is greater than the number of posts available. This has clearly been documented in several countries e.g. see https://gh.bmj.com/content/7/Suppl_1/e008420.[1]

   So the workforce could immediately be expanded in many countries by simply increasing recruitment and retention of existing health workers. The authors should acknowledge this and include methods to assess the number of unemployed health workers in Burundi. How many doctors / nurses / midwives are trained each year, and how many of these are able to find jobs in government health facilities? – I can see you should be able to address this in your assessment of "national stock of delivery care cadres". It would be important to use qualitative methods to understand reasons for any differences observed between staff available and posts filled. E.g. are there vacant posts which have been advertised with no applicants? (and is this because of poor pay / working conditions, or because of a shortage of people with the right qualifications?) Or are there insufficient posts in health facilities? Certainly, we will evaluate the national stock which is the difference between available and employed delivery care professionals. Evaluation of this stock will be done using historical records (over a period of 10 or so years depending on available data) of the number of delivery care professionals who graduated each year from all the universities and schools minus the number of these professionals who have been recruited in each corresponding year. We have acknowledged that we will not account for those entering private sector (NGOs, private health facilities, industry, brain drain, etc.) due to inability of finding an accurate method to do so. Plus, except those joining local private health facilities, the other professionals less profit delivery care as they either work in NGOs (without direct impact on delivery care), industries (e.g., insurance companies), or choose to leave the country.

2. The distribution of the existing workforce is often suboptimal, both geographically and between types of health facility. E.g. in Mali and Uganda, there are far more

vacancies in primary care than in secondary care facilities – see https://human-resources-health.biomedcentral.com/articles/10.1186/s12960-015-0073-8.[2] Redistributing the existing workforce could markedly improve service provision. I can see that the authors are planning to collect data on this in the "Health facility data" (Table 2). However, alongside existing staffing in health facilities, it would also be good to obtain a measure of "unmet need" for services in different areas. Eg how many mothers are delivering at home or in inappropriate facilities? This will not be captured by only measuring number of deliveries in each official facility. We will measure unmet needs by i) comparing available staff versus "minimum standards" (there are minimum standards for EmONC health facilities e.g., FIGO standards https://obgyn.onlinelibrary.wiley.com/doi/abs/10.1002/ijgo.12815 and Burundi has also a policy that establishes minimum standards for EmONC health facilities) and versus "workload" using the Workload Indicators of Staffing Need (WISN) which is seen as an accurate metrics to understand the "unmet staffing needs". Plus, we might find it needed / useful to use the existing "expected deliveries" to triangulate information and estimate the "unmet needs". However, existing data on estimated deliveries are disaggregated by health district and not health facility level, making it less informative in our stance.

3. Increasing pay / working conditions and also improving staff management (to reduce absenteeism) may be more effective, in certain conditions, than simply increasing numbers of staff. E.g. in many health centres I have visited in sub-Saharan Africa, there are very high rates of absenteeism, because pay is poor and people work as little as possible in their designated government health facility, in order to then go and earn more money in the private sector. Also, there are no sanctions for staff absenteeism as this is accepted to be the "norm". Increasing the number of poorly-paid posts may do little or nothing to improve this situation. For example a health centre with 5 midwives (compared to 3 midwives) may still only have 1 midwife on duty at any one time, because the midwives may organise themselves to have a 1 in 5 rota (instead of a 1 in 3 rota). The methods should include ways of addressing this issue – eg qualitative interviews of staff and managers about how to reduce absenteeism and the potential cost of paying staff enough so that they do not feel the need to moonlight in the private sector. We perfectly agree these observations and suggestions. In many contexts, absenteeism rate is high due to moonlighting. That is the reason why we have proposed to collect pattern data on weekly availability (weekdays days versus nights, weekends / holidays days versus nights) of each staff category that is available in each health facility. However, strategies to address shortages of staff (bother the numbers and availability on duty) will be discussed during stakeholder meetings. Our overall aim is to engage policy discussions (by stakeholders) to ensure appropriateness of the project outcomes going forward.

4. Training "unskilled" staff to fill the gaps. In practice, in many countries, staff considered to be "unskilled" are managing patients in many health facilities (eg nursing assistants, midwifery assistants, traditional birth attendants). see https://human-resources-health.biomedcentral.com/articles/10.1186/s12960-015-0073-8[2] The methods should assess the extent of this practice in Burundi, and whether

training them with essential skills could immediately improve management, while waiting for more midwives etc to be trained. Please clarify whether your health facility data will include these cadres. Exactly, this is absolutely true. Our study will collect information on training received (preboarding or in-service training) on each delivery care in all health facilities. This information will be supplemented by an indicator questionnaire of a selected sample of delivery care professionals to assess their knowledge of "complications management" as well as their self-confidence to manage maternal and / or neonatal complications. The individual questionnaire was designed using the locally adapted EmONC guidelines and training module which clearly set out key skills delivery care personnel should have.

There are also several typos and minor errors which need to be corrected (see below).

Minor (specific) comments:

Abstract:
- Change "Throughout the study, we will engage stakeholders to provide input into what is reasonable staffing norms as well as feasible staffing alternatives within Burundi's budget capacity" to "Throughout the study, we will engage stakeholders to provide input into what **are** reasonable staffing norms as well as feasible staffing alternatives within Burundi's budget capacity" Thank you. We have made the change.

Intro:
- Change "More specific local research also underscore the critical role of EmONC services." to "More specific local research also **underscores** the critical role of EmONC services." Thank you. We have made the change.

- "With attention to the quantity of trained health personnel, the number of medical doctors per 10 000 population remains below the thresholdold (from 0.28 in 2010 to 1.00 in 2017)19." Thank you. We have made the change.

  Correct spelling of "threshold".

  I think the authors are referring to the WHO threshold of 2.3 health workers per 1000 population (or 23 per 10,000). If so, add a reference to this. If not, add a reference for the "threshold" to which you are referring. Are you sure that the figures you quote are per 10,000 and not per 1,000? Also the WHO "threshold" is for all health workers not only for doctors. If you are going to compare figures for Burundi to the WHO "threshold" you need to include ALL trained health workers including nurses and midwives, etc. Thank you. We have made the change.

Aims:
- Change "axpansion in service provision" to "**expansion** in service provision". Thank you. We have made the change.

- Change "geograpgic and population coverage" to "**geographic** and population coverage". Thank you. We have made the change.

Study design:
- Change "what is reasonable staffing norms" to "what **are** reasonable staffing norms"
  Thank you. We have made the change.

Underlying challenges:
- Change "From 2002 until 2011, only 34 health publications; which were mostly authored by foreign researchers; came from Burundi" change to "From 2002 until 2011, only 34 health publications**,** which were mostly authored by foreign researchers **,** came from Burundi" Thank you. We have made the change.

Top of p7:
- Most studies used staff workload to estimates current and future staffing needs" change to "Most studies used staff workload to **estimate** current and future staffing needs" Thank you. We have made the change.

Competing Interests: None.

Reviewer Report 19 August 2022

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Katherine Semrau (iD)
[1] Ariadne Labs, Brigham and Women's Hospital, Boston, MA, USA
[2] Harvard Medical School, Boston, MA, USA

Thank you for the chance to review. The authors have presented an important justification and a set of research questions to address the needs and opportunities for skilled birth attendance provision in Burundi. The sequential study will use a three-phase approach with a (i) document/policy review; (ii) cross sectional study on health facilities and staffing; and (iii) costing study. There are a few areas where clarification would be useful to readers:

1. The justification for the study is well-presented and strong. It would be helpful if the authors clarified that the facilities and training schools included are a census (i.e. all) or a sample? If they are a sample, how are they being selected? For example, in Table 1, the authors share that there are 2 private medical schools and allude to several nursing/midwifery schools; how were they selected? Are there government/public schools as well?

2. In the Introduction, the authors presented the number of medical doctors per 1000 population that remains below the threshold, but the readers may not know what that recommended level/threshold is. Please consider adding the background.

3. In the Methods section, the authors highlight a stakeholder group and then add more detail in the Discussion. Please add the details in the Methods as it will make it clearer who is included in the stakeholder group and how they were selected.

4. The delivery care staffing levels information will be critical to the study and recommendations. The authors need to provide more details about how the surveys will be developed and topics areas to understand the skills that will be covered. Are there validated tools being used? Additional detail about tool development would be useful. Further, it is known that provider confidence and knowledge alone are necessary, but insufficient, to provide high quality care. Did the authors consider assessment of infrastructure and supply availability that may prevent high quality care provision?

5. Please make sure to run a spellcheck throughout the manuscript and also check for references to the dissertation/thesis. In addition to the thesis, I understand there are other uses for these data. It would be important to note who will receive and use this information in the Study outcomes section.

6. In Table 2, the authors note the assumption that the government does not need to build new or expand health facilities. Will the authors re-consider their assumptions after Phases I and II before embarking on Phase III?

Is the rationale for, and objectives of, the study clearly described?
Yes

Is the study design appropriate for the research question?
Yes

Are sufficient details of the methods provided to allow replication by others?
Partly

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal and newborn health; epidemiology; quality of care

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 20 Sep 2022

Desire Habonimana, Faculty of Medicine, University of Burundi, Bujumbura, Burundi

Katherine Semrau

APPROVED WITH RESERVATIONS

info_outline

Thank you for the chance to review. The authors have presented an important justification and a set of research questions to address the needs and opportunities for skilled birth attendance provision in Burundi. The sequential study will use a three-phase approach with a (i) document/policy review; (ii) cross sectional study on health facilities and staffing; and (iii) costing study. There are a few areas where clarification would be useful to readers:

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Thanks for this note. In Burundi, the EmONC network is made of 112 health facilities of which 59 BEmONC and 53 CEmONC. All these 112 facilities will be included in our study. Concerning ministries, data will be collected from three relevant ministries holding data on education of delivery care professionals (doctors, midwives, and nurses) including cost of training: ministry of health, ministry of education, and ministry of finance. There are one public University (University of Burundi) and two private universities (University of Ngozi and Hope Africa University) training medical doctors, and all will be included in the study to understand the cost of training as well as estimate the national stock (trained doctors over time). There are about 18 public and private schools training nurses and midwives. To appraise the cost of training, we will stratify these schools into public vs private and again into rural vs urban as costs vary according to these aspects. A subset of rural public, rural private, urban public and urban private schools will be selected (convenient or random if there are more than one school in each stratum) and used as a sample for the study. We anticipate surveying a sample of 10 schools in total.

1. In the Introduction, the authors presented the number of medical doctors per 1000 population that remains below the threshold, but the readers may not know what that recommended level/threshold is. Please consider adding the background.

There are mainly three different thresholds used to assess health care workforce availability. They are:

1. The minimum of 2.3. skilled health workers (physicians and nurses/ midwives) per 1000 population, which was considered generally necessary to attain high coverage (80%) of skilled birth attendance (The 2006 World health report)

2. The minimum workforce availability of 3.4 skilled health workers per 1000 population, termed as a "staff access deficit indicator", which value has subsequently been updated to 4.1 per 1000 (ILO definition)

3. The minimum of 5.9 skilled health professionals (midwives, nurses and physicians) per 1000 population which was identified as the workforce requirement for the Ending Preventable Maternal Deaths initiative (ENAP and EPMM).

We used the threshold of 2.3 skilled health workers per 1000 population.

1. In the Methods section, the authors highlight a stakeholder group and then add more detail in the Discussion. Please add the details in the Methods as it will make it clearer who is included in the stakeholder group and how they were selected.

Thanks for asking to update the methods section with additional information on the stakeholder group. We have added details in Table 1 and updated the list of abbreviations.

1. The delivery care staffing levels information will be critical to the study and recommendations. The authors need to provide more details about how the surveys will be developed and topics areas to understand the skills that will be covered. Are there validated tools being used? Additional detail about tool development would be useful. Further, it is known that provider confidence and knowledge alone are necessary, but insufficient, to provide high quality care. Did the authors consider assessment of infrastructure and supply availability that may prevent high quality care provision?

The health facility survey (supplement 4) details information that will be collected. We will collect a wide range of data including infrastructure, equipment, supplies and drugs, etc, etc. that define a health facility and further a maternity that delivers care for complications. Surveys development was informed by existing tools (Table 2. Health facility data description provides a note of tools that inspired development of health facility survey tools) and adapted to Burundi's context. We have updated the 'individual questionnaire' section to include details on its development and validation (Table 2. Individual data in health facilities description).

1. Please make sure to run a spellcheck throughout the manuscript and also check for references to the dissertation/thesis. In addition to the thesis, I understand there are other uses for these data. It would be important to note who will receive and use this information in the Study outcomes section.

Thanks for the suggestion to run spellcheck. We have checked spelling throughout the manuscript. Plus, we have updated the study outcome section to mention what else the study findings will be used for in addition to the thesis.

1. In Table 2, the authors note the assumption that the government does not need to build new or expand health facilities. Will the authors re-consider their assumptions after Phases I and II before embarking on Phase III?

Though this assumption was made, stakeholder discussion (based on survey findings) may suggest expansion of infrastructures where relevant. However, infrastructure expansion is something hard to achieve in the short run, hence our assumptions. Markedly, our study aims to propose immediate and easy-to-implement actions.

Competing Interests: No competing interests were disclosed.

Reviewer Report 12 August 2022

?   **Ejemai Eboreime** iD

Department of Psychiatry, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada

This is a very interesting study proposed.
My key comment is with respect to how the proposed methods are described. I think more detail and/or better organization of the detail would be helpful. For example, the authors describe that the study will be implemented in three sequential phases:

1. an initial policy document review to explore global norms and local policy intentions for BEmONC and CEmONC in Burundi with a particular focus on stated or reasonable staffing norms for different levels of the facility

2. a cross-sectional survey of all BEmONC and CEmONC health facilities to map out and determine what percent of facilities are functional including geographic and population coverage gaps, to identify staffing gaps assessed against norms or expectations, and to identify other needs for health facility strengthening.

3. examine potential staffing costs and explore alternative staffing options (service designs) that might best promote service delivery with adequate budget impacts to increase efficiency.

I think that it would be a very good idea to organize the description of the methodological detail along these subheadings. In the current form, the details are not sequential, making it a little challenging for readers to follow

Is the rationale for, and objectives of, the study clearly described?
Yes

Is the study design appropriate for the research question?
Partly

Are sufficient details of the methods provided to allow replication by others?
Partly

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Implementation science, primary health care, mental health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 20 Sep 2022

Desire Habonimana, Faculty of Medicine, University of Burundi, Bujumbura, Burundi

Ejemai Eboreime

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Thank you so much for this contribution which we gratefully accept. We would like to highlight that these phases do not follow the chronological order though information from each phase inputs into the other. This means that we can start with cross-sectional surveys and continue with the scoping review and vice-versa; for instance. Therefore, our methods section sought to highlight the following areas:

1.
   1. **Study design**
   2. **Study settings and participants**
   3. **Description of the study methods. This is where we describe the framework which comprises the three study phases: i) cross-sectional surveys conducted in health facilities and on delivery care personnel, ii) delivery care workforce context analysis, and iii) delivery care workforce gap analysis. These sections are succinct descriptions of each phase by laying out the methods to be used and the expected outputs. Overall, outputs from all phases will merge together to enable the costing of delivery care unmet needs which will feed into policy discussions.**
   4. **Study outcomes**
   5. **Data description and analysis plan**

We believe that point 3 (description of the study methods) can be seen as structured to respond to the layout as per the study phases. However, we are keen on your

feedback, and we accept any further comment with this regard. Thank you.

Competing Interests: No competing interests were disclosed.

Comments on this article

Version 1

Reader Comment 27 Jul 2022

Jean Claude NDAYISHIMIYE, SERVICE YEZU MWIZA, Bujumbura, Burundi

This research is very important in my home country(Burundi) in order to contribute to the reduction of maternal and neonatal mortality and thus achieve the SDGs.

Competing Interests: No competing interests were disclosed.