The Status of Emergency Obstetric and Newborn Care in Post-Conflict Eastern DRC: A Facility-Level Cross-Sectional Study.

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Abstract

Background Pregnancy-related mortality remains persistently higher in post-conflict areas. Part of the blame lies with continued disruption to vital care provision, especially emergency obstetric and newborn care (EmONC). In such settings, assessment of EmONC is essential for informed interventions needed to improve maternal and neonatal survival. In the North Kivu Province (NKP), the epicentre of armed conflict in eastern Democratic Republic of the Congo (DRC) between 2006-2013, the post-conflict status of EmONC is unknown. We assessed the availability, use, and quality of EmONC in 3 health zones (HZs) of the NKP.

Method A cross-sectional survey of all 42 public facilities designated to provide EmONC in 3 HZs (Goma, Karisimbi, and Rutshuru), purposively selected based on their relative proximity to previous conflicts and their respective locations encompassing the entire economic landscape of the province, was conducted in 2017. Interviews, reviews of maternity ward records, and observations were used to assess the accessibility, use, and quality of EmONC against WHO standards.

Results The 3 HZs fell short of WHO standards. Only three referral facilities (two faith-based facilities in Goma and the MSF-run referral hospital of Rutshuru) met the criteria for comprehensive EmONC, i.e., 1.5 EmONC facilities per 500,000 population. None of the health centres qualified as basic EmONC, nor could offer obstetric and neonatal care services 24 hours, 7 days a week (24/7). Assisted vaginal delivery was the least performed signal function, followed by parenteral administration of anticonvulsants, mostly due to policy restrictions and lack of demand. Moreover, none of the HZs could achieve a direct-obstetric case facility rate of at most 1% and, the met need for EmONC was as low as 6.5% and 5.4% in Goma and Rutshuru, respectively. However, the proportion of births by caesarean section in EmONC facilities met the minimum standard in both HZs. Overall, the intrapartum and very early neonatal death rate was 1.5%.

Conclusion This study provides grounds for the development of coordinated and evidence-based programming, involving local and external stakeholders, as part of the post-conflict effort to improve maternal and neonatal health in the NKP. Particular attention to basic EmONC is required, focusing on strengthening human resources, equipment, supply chains, and referral capacity, on the one hand, and on tackling residual insecurity that might hinder 24/7 staff availability, on the other.

Background

Emergency obstetric and newborn care (EmONC) is globally recognized as an essential health package for reducing preventable maternal and neonatal mortality, particularly in high-burden countries (1–5). Most of these countries are located in sub-Saharan Africa (SSA)(6,7), a region that has witnessed the majority of armed conflicts over the past 3 decades (8). Research shows that conflict disproportionately affects maternal and child health, both during and years after it has ended (9–15), and that many of the countries where most maternal and child deaths occur worldwide are experiencing or have emerged from conflict (16,17). Some have argued that reduced availability/less quality of EmONC services is 'the single most important factor implicated in maternal deaths in conflict and post-conflict settings'(12). Accordingly, it is of vital importance to improve access to quality EmONC in conflict-affected settings through data-driven programming.

The EmONC life-saving services, or signal functions, define 2 types of complementary health facilities based on their capacity to provide, within a 3-month period, the 7 basic signal functions or all 9 signal functions when pregnancy- and childbirth-related complications occur (see Table 1). These complications, including haemorrhage, hypertensive disorders, sepsis, obstructed labour, complications of abortion, and intrapartum related asphyxia, cause most maternal deaths, stillbirths, and early neonatal death (18–20). Their occurrence is often unpreventable (21), unforeseeable (1), and expected in about 15% of women during pregnancy, childbirth, and the immediate postpartum (22). The disruptive and lingering effects of conflict on health services provision—deficient health personnel, damaged health infrastructure, inadequate healthcare coordination, and weak supply chains—contribute to increased vulnerability to adverse outcomes related to these complications (15,23).

The Inter-Agency Working Group for Reproductive Health in Crises (IAWG) guidelines place a priority on ensuring the provision of the full EmONC package during post-conflict recovery, a strategy to prevent excess mortality in mothers and newborns (24). A clear understanding of the capacity of the existing health system to respond to the sexual and reproductive health (SRH) needs of affected populations is essential to planning and implementing SRH programmes effectively (25). For example, the IAWG advocates the use of a well-established Needs Assessment Toolkit (26) that allows for a system of EmONC process/performance evaluation against United Nations (UN) standards, which is instrumental in identifying gaps and guiding programmes.

The eastern Democratic Republic of the Congo (DRC) was disproportionately affected by protracted armed conflict in the country. This region suffered higher preventable mortality, including neonatal mortality, reflecting the impact of conflict on public health (27,28). In the North Kivu Province, where most of the state-based conflict events (i.e., pitting government troops against foreign-backed rebel groups) occurred between 2006–2013 in eastern DRC (29), maternal mortality was as high as 790 deaths per 100,000 live births for the first half of 2013 (30). Recent evidence indicates that proximity to and deadliness and duration of armed conflict in SSA are associated with indirect effects on the survival of mothers and their babies; these effects persist for years after the conflict has ceased (15,31).

While the North Kivu Province has entered the health-sector recovery phase, there is a lack of data on the post-conflict status of EmONC. This situation can be partly explained by poor government stewardship and 'the proliferation of fragmented humanitarian and recovery initiatives', as observed in other post-conflict settings in SSA (Southern Sudan and Sierra Leone) and eastern DRC (32–35). This often results in uncoordinated health interventions, with little attention to data-driven plans and policies that are customized to local contexts (36,37). Therefore, this study aimed to contribute to filling this gap by assessing the availability, use and quality of EmONC in 3 Health Zones (HZs) in the North Kivu Province of eastern DRC. Evidence generated from this study will contribute to informed programming and data-driven interventions, involving local and external stakeholders, as part of the post-conflict effort to improve maternal and neonatal health in the Province.

Table 1
Signal functions for basic and comprehensive EmONC health facilities

Basic EmONC	Comprehensive EmONC
#1. Administration of parenteral antibiotics	Performs #1 through #7, plus
#2. Administration of uterotonic drugs	#8. Surgery (Caesarean section)
#3. Administration of anticonvulsants	#9. Blood transfusion
#4. Manual removal of placenta (MRP)	
#5. Removal of retained products of conception (RRP)	
#6. Assisted vaginal delivery (AVD)	
#7. Neonatal resuscitation with bag and mask	

EmONC: emergency obstetric and newborn care

Source: Monitoring emergency obstetric care: a Handbook. WHO; 2009.

Methods

Study design and setting

This is a cross-sectional survey at health facility level conducted from March to May 2017 in the North Kivu province. From 2006–2013, this Province accounted for about two thirds of battle-related deaths across the country, reflecting the intensity of conflict events between government troops and major rebel groups backed by neighbouring countries, including *le Congrès National pour la Défense du Peuple* (CNDP) and *le Mouvement du 23 Mars* (M23) (38).

Three health zones (HZs), namely Goma, Karisimbi, and Rutshuru, were purposively selected based on their 'red flag' proximity—that is, within a 50 km range (15,31), to most of the deadliest conflict events from 2006–2013 (39,40). Moreover, their respective locations encompass the entire economic landscape of the North-Kivu Province, which presented the opportunity to explore the post-conflict status of maternal and neonatal health care in urban (Goma), peri-urban (Karisimbi) and rural (Rutshuru) areas in the province.

A HZ is an administrative entity that represents the operational unit for planning and implementing health services in the DRC. It operates as a tiered system consisting of a network of health facilities, supervised by the Central Bureau of the Health Zone (CBHZ), with increasing service capacity along a chain of referral (41). Health centres (HC) are first-line facilities dedicated to primary health care tasks (curative, preventive, promotional and support activities) that are delegated to a team of multi-purpose nurses. They refer cases that are beyond their means and competencies to a referral health centre (RHC) or the referral hospital (RH).

The HZs of Goma and Karisimbi integrate both state-owned and private not-for-profit (religious or other) referral facilities (RHs and RHCs) into the public health sector. Not-for-profit organizations have entered into a contractual agreement with the state specifying the rights and duties of both partners; however, they remain largely autonomous in terms of management.

Selection of health facilities and sample size

We selected all public health facilities providing maternal and neonatal health services across the 3 HZs, the list of which was provided by their respective CBHZs. The rationale for this was that institutional births represent 92% of deliveries in North Kivu province, of which 80% take place in public facilities (42). Therefore, a total of 42 public facilities (11 in Goma, 14 in Karisimbi, and 17 in Rutshuru) were included in the study. Table 2 shows these health facilities per HZ and per level. As per the DRC Ministry of Health (MOH) guidelines, all HCs and referral facilities (RHs and RHCs) are required to provide basic and comprehensive EmONC 24 hours a day and 7days a week, respectively.

Data collection

Data were obtained from medical records and registries for the year 2016, as well as from interviews with relevant in-charges and observation of available facilities and supplies, using the EmONC Needs Assessment (NA) toolkit. The toolkit is organised in modules of questionnaires developed and refined over time by the Averting Maternal Death and Disability (AMDD) programme at Columbia University Mailman School of Public Health. The WHO, UNFPA, and UNICEF have adopted these modules to capture key indicators of availability, use, and quality of EmONC services. These indicators are constructed to inform interventions aiming to reduce maternal and neonatal mortality by identifying gaps, monitoring implementation, and measuring progress (26). Moreover, these modules have been proven useful in conflict-affected settings (43).

Prior to the survey, we held meetings with the Chief Medical Officer (CMO) of each HZ, recruited four research assistants and adapted the French versions of the AMDD modules for local use. The CMOs granted authorizations to collect data at selected health facilities and provided relevant information on public health facilities (population covered, ownership/management, the distance between HCs and the closest referral facility).

The research assistants were all final year students at the Midwifery Section of the *l'Institut Supérieur des Technique Médicales* in Goma. They received 3-day training to secure a clear understanding of the objectives and methods of the survey, the content as well as the proper filling out of the modules. Didactic

sessions covered appropriate interviewer behaviour, relevant ethical considerations, and definitions of obstetric complications to ensure a thorough understanding by the trainees.

In each HZ, the Principal Investigator (PI) organised a data collection schedule in consultation with the heads of selected facilities. The PI supervised data collection, which followed a top-down order in every HZ (i.e., RHs first, then RHCs and HCs. Data on births, pregnancy-related and neonatal complications, and maternal and perinatal deaths were extracted from the registries available in the relevant facility units (delivery room, maternity ward, operation theatre, newborn and post-abortion units). Items of interest missing in these records were searched for in the patients' records. Facility walk-throughs and interviews were carried out to ascertain the provision of signal functions during the last 3 months, and the availability of facilities, supplies, and health providers for EmONC services. Interviews were conducted with heads of facilities and in-charges of maternity ward, delivery room, operation theatre, pharmacy, and laboratory. The PI reviewed the completeness of questionnaires and addressed any incongruity while still in the field, and health facilities were revisited when necessary.

Data management and analysis

During data collection, a number was attributed to each facility and written at the top of every page of each module, starting with RH, then RHC and HC, in Goma, Karisimbi, and Rutshuru, respectively. EpiData 3.1 was used to create data entry fields with in-build checks and each module had its own file. Data were double entered by 2 trained data entry operators and discordances were sorted out by revisiting the respective questionnaires.

Data keyed in using EpiData were exported to Stata 15 for data handling and analysis. Descriptive statistics including means and medians for continuous variables, and frequencies and proportions for categorical variables were performed as appropriate. Analyses were guided by the Handbook on Monitoring Emergency Obstetric Care by UN partners and the AMDD programme to assess the performance of signal functions and calculate indicators of availability, use, and quality of EmONC services in these health zones. Estimates of the expected live births were used to compute EmONC indicators.

Ethical considerations

This study was approved by Kyoto University Graduate School and Faculty of Medicine, Ethics Committee, as well as by the Ethics Committee of the University of Kinshasa School of Public Health.

Table 2
Public health facilities providing maternal and neonatal care per level and per study Health Zones (HZ) in the North-Kivu province of Eastern Democratic Republic of the Congo, 2017.

Health Zone (HZ)	Population	Expected number of live births*	Referral hospitals (RH)	Referral health centres (RHC)	Health centres (HC)
Goma	243,685	9,869	Hôpital Provincial du Nord-Kivu†	CSR Carmel†	CS Mapendo
			Hôpital Général Charité Maternelle†	CSR Heal Africa†	CS Buhimba
				CSR Keshero†	CS Casop
				CH Bethesda†	CS Afia Himbi
					CS Kasika
Karisimbi	461,089	21,164	Hôpital Général Virunga	CSR Kahembe	CS Murara
			Hôpital Militaire Régional	CSR Albert Barthel	CS Bujovu
				CH Notre dame d'Afrique	CS Majengo
				CH La Résurrection	CS Lubango
					CS La solidarité
					CS Virunga
					CS Mabanga
					CS Katoyi
Rutshuru	283,432	13,009	Hôpital Général de Rutshuru‡	CSR Kinyandonyi	CS Rutshuru
				CSR Kiwanja	CS Biruma
				CSR Mapendo	CS Buturande
				CSR Rubare	CS Kalengera
				CSR Vitshumbi	CS Kakomero
					CS Katale
					CS Kibututu
					CS Mabungo
					CS Murambi
					CS Rugari
					CS Umoja
Total	988,206	44,042	5	13	24

Source: Central bureau of the Health Zones (CBHZ)

*calculated as population x crude birth rates (CBR, as reported in the 2013–2014 DRC Demographic Health Survey [42])

CSR: centre de santé de référence, CH: centre hospitalier, CS: centre de santé

†Non-for-profit health facilities including 5 faith-based and 1 NGO owned (CSR Heal Africa)

‡Médecin Sans Frontières-run public RH

Results

Profile of surveyed health facilities and volume of deliveries

Of the 42 public health facilities surveyed in the 3 HZs, 24 were health centres, all owned and managed by the state, and 18 were referral institutions, of which 5 were RHs and 13 were RHCs (Table 2). In the HZ of Goma, most referral facilities (5/6; 83%) were owned and managed by private non-for-profit organizations (NFPO) including 1 RH by the Catholic, 3 RHCs by Protestant churches, and 1 RHC by a non-governmental organisation. In the HZ of Karisimbi, half of referral facilities were non-for-profit organisations managed by Protestant churches. All referral facilities in the HZ of Rutshuru were state owned.

However, as part of the humanitarian response to conflict-related health crises, the RH of the HZ of Rutshuru was run by Médecins Sans Frontières (MSF), dating back to 2005. In this HZ, MSF built a maternity-waiting home and was providing, among other things, full exemption from user fees for CS and charging a flat-fee of USD 5 for vaginal deliveries. In 2016, 36.7% (4,578/12,462) of deliveries and 83% of CS (1491/1,797) in Rutshuru took place at its RH. Relatedly, in the HZs of Goma and Karisimbi, NFPO facilities attended 45,8% (10,459/22,821) of deliveries and 73.2% (2,446/3,337) of Cs in 2016.

Provision of signal functions

Only 17% (3/18) of the referral—which included 1 faith-based RHC and the government RH in Goma and 1 faith-based RHC in Karisimbi—provided the nine signal functions within the last 3 months prior to the survey and thus met the criteria for functioning cEmONC facilities (see Table 3). All the remaining (83%; 15/18) were partial cEmONC facilities (i.e., 8 or fewer signal functions provided). Of these, 20% (3/15) were short of one signal function (the provision of AVD) to qualified as functioning cEmONC facilities, which included 1 faith-based RHC and the government RH in Goma, and 1faith-based RHC in Karisimbi.

None of the health centres (HCs) qualified as basic EmONC or could offer EmONC services 24 hours, 7days a week (24/7). All the HCs in Rutshuru and 88% (7/8) of the HCs in Karisimbi performed only 1 to 3 signal functions of bEmONC during the last 3 months, whereas 80% (4/5) of the HCs in Goma performed 4 to 6 basic signal functions. Assisted vaginal delivery (AVD) was the least performed signal function (7.1%; 3/42), followed by parental administration of anticonvulsants (33.3%; 14/42) and neonatal resuscitation (45.2%; 19/42) (Table 3) .

Table 3
Signal functions performed by designated EmONC facilities per level in the 3 health zones (HZs) in the North-Kivu Province of Eastern Democratic Republic of Congo (DRC), 2017

Health zones	#1.Antibiotics	#2.Oxytocics	#3.Anti-convulsants	#4. MRP	#5. RRP	#6. AVD	#7. Neonatal resuscitation	#8. Caesarean section	#9. Blood transfusion	Facilities performing all signal function*	Facilit provid servic 24 ho a day and 7days week
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Goma											
RH and RHC (n = 6)	6 (100)	6 (100)	6 (100)	6 (100)	6 (100)	2 (33.3)	6 (100)	6 (100)	5 (83.3)	2 (33.3)	6 (100
HC (n = 5)	5 (100)	5 (100)	3 (60.0)	5 (100)	4 (80.0)	0 (0)	3 (60.0)	NA	NA	0 (0)	0 (0)
Karisimbi											
RH and RHC (n = 6)	6 (100)	6 (100)	3 (50.0)	6 (100)	6 (100)	0 (0)	6 (100)	6 (100)	4 (66.7)	0 (0)	6 (100
HC (n = 8)	5 (62.5)	8 (100)	0 (0)	8 (100)	2 (25.0)	0 (0)	1 (12.5)	NA	NA	0 (0)	0 (0)
Rutshuru											
RH and RHC (n = 6)	3 (50.0)	6 (100)	2 (33.3)	5 (83.3)	5 (83.3)	1 (16.7)	2 (33.3)	4 (66.7)	1 (16.7)	1 (16.7)	4 (66.
HC (n = 11)	0 (0)	11 (100)	0 (0)	11 (100)	1 (9.1)	0 (0)	1 (9.1)	NA	NA	0 (0)	0 (0)
All HZs											
RH and RHC (n = 18)	15 (83.3)	18 (100)	11 (61.1)	17 (94.4)	17 (94.4)	3 (16.7)	14 (77.8)	16 (88.9)	10 (56)	3 (16.7)	16 (88
HC (n = 24)	10 (41.7)	24 (100)	3 (12.5)	24 (100)	7 (29.2)	0 (0)	5 (20.8)	NA	NA	0 (0)	0 (0)
Total (n = 42)	25 (59.5)	42 (100)	14 (33.3)	41 (97.6)	24 (57.1)	3 (7.1)	19 (45.2)	16 (88.9†)	10 (55.6†)	3 (7.1)	16 (38

MRP: manual removal of placenta, RRP: removal of retained placenta, AVD: assisted vaginal delivery

HC: health centres, RHC: referral health centre, RH: referral hospital

* #1-#7 for HC and #1-#9 for R and RHC

†Calculated with the total number (n = 18) of RH and RHC as the denominator

NA: not applicable

Among facilities that could not performe AVD, 'policy issue' (i.e., HZ policies not allowing a signal function to be performed at targeted facilities) was the most frequently reported reason (74%; 29/39), mainly in facilities located in Rutshuru (88%; 15/17) and Karisimbi (71%; 10/14). 'No indication' (i.e., no patient needing this procedure came to the facility during the last 3 months) was the most frequently reported reason for not providing parental anticonvulsants (71%; 20/28) and neonatal resuscitation (70%; 16/23), followed by 'policy issue' in 18% (5/28) and 26% (6/23) of cases, respectively.

Further analyses showed that nearly all the facilities that reported 'no indication' for parenteral administration of anticonvulsants (95%; 19/20) didn't provide this signal function even during the past 12 months. Also, 63% (10/16) and 50% (4/8) of facilities that didn't provide neonatal resuscitation (NR) and AVD due

to no indication, respectively, didn't have the necessary equipment to perform these signal functions (i.e., neonatal bag and mask for NR and vacuum extractor or forceps for AVD).

Table 4
Distribution of EmONC facilities in the study health zones (HZs) in the North-Kivu Province of eastern Democratic Republic of the Congo (DRC) in comparison with the minimum number of facilities required by the World Health Organization (WHO), 2017

Health zones	Total population	Minimum number of EmONC facilities for 500,000 population as per the WHO†[a]	Number of designated cEmONC facilities for 500,000 population in the study HZs‡	Number of designated bEmONC facilities for 500,000 population in the study HZs‡	cEmONC facilities as per 500,000 population		bEmONC facilities as per 500,000 population		Functioning EmONC facilities as a proportion of the minimum number recommended by the WHO ([b + c]/a, %)
					Minimum number acceptable by the WHO	Number of functioning cEmONC facilities in the study HZs [b]	Minimum number acceptable by the WHO	Number of functioning bEmONC facilities in the study HZs [c]	
Goma	243,685	3	12	10	1	2	2	0	66.7
Karisimbi	461,089	5	7	9	1	0	4	0	0.0
Rutshuru	283,432	3	11	19	1	1	2	0	33.3
All HZs	988,206	10	9	12	2	3	8	0	30.0

cEmONC: comprehensive emergency obstetric and newborn care, bEmONC: basic emergency obstetric and newborn care

†Calculated as population/500,000 × 5 (rounded up)

‡Calculated as 500,000/population x number of designated EmONC or bEmONC facilities

Indicators of EmONC

Table 4 compares the minimum number of functioning EmONC facilities as per 500,000 population required by the WHO with the situation in the study HZs. The existing public health facilities designated to provide EmONC services exceeded considerably the minimum number of EmONC delivery points needed per 500,000 population in the 3 HZs. However, none of the health zones achieved the minimum number of functioning EmONC facilities as per the WHO recommendations, with an unmet need less pronounced in the HZ of Goma (Tables 4 and 5).

Overall, 14.3% (6,331/44,042) of births in 2016 occurred in functioning EmONC facilities (Table 5). In the HZ of Rutshuru, this proportion (35.2%; 4,578/13,009) was about twice as high as in the HZ of Goma (17.8%; 1,753/9,869). Deliveries in surveyed facilities in the 3 HZs (i.e., institutional deliveries) represented 80.1% (35,283/44,042) of births in 2016. In Goma, Karisimbi, and Rutshuru, the institutional delivery rate was 79.3% (7,824/9,869), 70.9% (14,997/21,164), and 95.8% (12,462/13,009), respectively (Table 5).

The proportion of MDOC managed in functioning EmONC facilities was only 3.1% (202/6,606) overall (Table 5). This proportion was 6.6% (97/1480) in the HZ of Goma and 5.4% (105/195) in the HZ Rutshuru. In contrast, the proportion of births by caesarean sections that took place in functioning EmONC facilities was 5.0% (2206/44,042) overall; 7.2% (715/9,869) in the HZ of Goma and 11.5% (1,491/13,009) in the HZ of Rutshuru. Caesarean sections in all RH and RHC surveyed (i.e., population based caesarean section rate [PCSR]) represented 11.7% (5,134/44,042) of births. In Goma, Karisimbi, and Rutshuru, the PCSR was 22.9% (2261/9,869), 5.1% (1,076/21,164), and 13.8% (1,797/13,009), respectively (Table 5).

With regards to the quality of EmONC, the direct obstetric case fatality rate (DOCFR) and the intrapartum and very early neonatal death rate (INDR) in EmONC facilities were 4.5% (9/202) and 1.9% (119/6,331), respectively (Table 5). The DOCFR in Goma was higher (5.2%;5/97) than that in Rutshuru (3.8%;4/105) and the INDR (1.2%;21/1753) about half of that in Rutshuru (2.0%;95/4578). When including all facilities surveyed, the INDR was 1.5% (532/35,283), with very little variation between the HZs, and the DOCFR was 5.1% (28/545). The highest DOCFR was in Karismbi (7.4%; 9/121). Major direct obstetric complications (MDOC) by causes and related maternal deaths in the 3 HZ are shown in Table 6.

Table 5
Indicators of EmONC in the study health zones (HZs) in the North-Kivu Province of Eastern Democratic Republic of Congo (DRC), 2016–2017

Indicators	Description*	HZ of Goma			HZ of Karisimbi			HZ of Rutshuru			Overall		
		MAL	LFF	DAF (n = 11)	MAL	LFF	DAF (n = 14)	MAL	LFF	DAF (n = 17)	MAL	LFF	DAF (n = 42)
Availability of functioning EmONC	At least 5 functioning EmONC facilities per 500,000 population including with at least 1 functioning cEmONC facility.	3	2	NA	5	0	NA	3	1	NA	10	3	NA
Proportion of all births in functioning EmONC facilities	Proportion of births in functioning EmONC facilities among expected number of births in a population[a]	15%	17.8% (1,753 /9,869)	79.3% (7,824/ 9,869)	15%		70.9% (14,997/ 21,164)	15%	35.2% (4,578/ 13,009)	95.8% (12,462/ 13,009)	15%	14.4% (6,331/ 44,042)	80.1% (35,283/ 44,042)
Met need for EmONC	Proportion of women with direct obstetric complications (DOC) treated in functioning EmONC facilities among all expected number of women with DOC [b]	100%	6.6% (97 /1,480)	17.2% (254/ 1,480)	100%		4.9% (154/ 3175)	100%	5.4% (105/ 1,951)	7.0% (137/ 1,951)	100%	3.1% (202/ 6,606)	8.3% (545/ 6,606)
Caesarean sections as a proportion of all births	Proportion of caesarean section occurring in EmONC facilities among expected number of live births in a population[c]	5–15%	7.2% (715/ 9,869)	22.9% (2,261/ 9,869)	5–15%		5.1% (1,076/ 21,164)	5–15%	11.5% (1,491/ 13,009)	13.8% (1,797/ 13,009)	5–15%	5.0% (2,206/ 44,042)	11.7% (5,134/ 44,042)
Direct obstetric case fatality rate (DOCFR)	Proportion of women with MDOC who died in EmONC facilities	< 1%	5.2% (5/97)	4.7% (12/254)	< 1%		7.4% (9/121)	< 1%	3.8% (4/105)	5.1% (7/137)	< 1%	4.5% (9/202)	5.1% (28/545)
Intrapartum and very early neonatal death rate (INDR)	Proportion of births that result in a very early neonatal death or an intrapartum death among the births occurred in functioning EmONC facilities	‡	1.2% (21/ 1,753)	2.1% (167/ 7,824)	‡		1.7% (258/ 14,997)	‡	2.0% (95/ 4,578)	0.9% (107/ 12,462)	‡	1.9% (119/ 6,331)	1.5% (532/ 35,283)

*Source: Monitoring emergency obstetric care: a handbook. WHO, 2009 [26].

EmONC: emergency obstetric and newborn care, cEmNOC: comprehensive EmONC, MAL: minimum acceptable level, LFF: Level met by functioning facilities, DAF: data for all facilities

[a] Calculated as number of births in functioning EmONC/expected live births x 100 (for expected live birth see Table 2)

[b] Expected number of women with MDOC was calculated multiplying 15% with expected number of births in Table 2

Indicators	Description*	HZ of Goma	HZ of Karisimbi	HZ of Rutshuru	Overall
[c] Calculated as number of CS/expected number of births x 100					
‡ Not set					
NA: not applicable, _: not calculated					

Table 6
Causes of Major Direct Obstetric Complications (MDOC) and related deaths in the 3 health zones (HZ) in the North-Kivu Province of Eastern Democratic Republic of Congo (DRC), 2016

MDOC diagnosed in the facilities surveyed	Occurrences of MDOC by causes n (%)	Deaths related to MDOC n (%)
Ante or postpartum haemorrhage	261 (47.9)	14 (50.0)
Retained placenta	6 (1.1)	1 (3.6)
Ruptured uterus	56 (10.3)	4 (14.3)
Postpartum sepsis	82 (15.0)	4 (14.3)
Severe pre-/eclampsia	95 (17.4)	3 (10.7)
Abortion complications	40 (7.3)	1 (3.6)
Ectopic pregnancy	5 (0.9)	1 (3.6)
Total	545 (100)	28 (100)

Staff, supplies and equipment for EmONC

The staff for EmONC available in the establishments surveyed consisted of nurses (63%; 325/519); medical doctors (25%; 30/519), of which 87% (113/130) were general practitioners and 13% (17/130) were specialists (obstetricians and paediatricians); and midwives (12%; 64/519) (Table 7). Of these, 59% (77/130) of medical doctors and 39% of midwives (25/64) were practicing in the HZ of Goma. Not-for-profit referral facilities in the HZs of Goma and Karisimbi together employed more midwives (83%; 24/29), specialists (75%;12/16), and maternity nurses (58%;58/102) than did government referral facilities. In the HZ of Rutshuru, 58% (14/24) of medical doctors were working at the referral hospital.

On average, there were fewer nurses on staff in the HCs located in the HZ of Rutshuru (median = 4, IQR = 2–5) than in those located the HZs of Goma (median = 7, IQR = 6–12) and Karisimbi (median = 7, IQR = 5–9). The average number of medical doctors in referral facilities was higher in the rural HZ of Goma (median = 9.5, IQR = 8–13) than in the HZs of Karisimbi (median = 3, IQR = 2–8) and Rutshuru (median = 2, IQR = 2–3) (Table 7).

Table 7 Availability of staff for emergency obstetric and newborn care (EmONC) services per level of facilities and per study health zones (HZ) in the North-Kivu Province of Eastern Democratic Republic of Congo (DRC), 2017

Health zones and facilities	Staff for EmONC services				
	All	Nurses n(%)	Midwives‡ n(%)	Medical doctors n(%)	
Overall	519	325 (63)	64 (12)	130 (25)	
				Specialists†	General Practitioners
RH and RHC (n=18)	384	204 (63†)	50 (78†)	17	113
HC (n=24)	135	121 (37†)	14 (22†)	NA	NA
Median number per facility	_	6 (IQR=4-8)	2* (IQR=1.5-4)	3.5** (IQR=2-10)	
Goma	198	96 (48)	25 (13)	77 (39)	
RH and RHC (n=6)	163	63 (66†)	23 (92†)	16	61
HC (n=5)	35	33 (33†)	2 (8†)	NA	NA
Median number per facility	_	7 (IQR=6-12)	4* (IQR=2-4)	9.5** (IQR=8-13)	
Karisimbi	150	102 (68)	19 (13)	29 (19)	
RHC and RH (n=6)	105	63 (62†)	13 (68†)	0	29
HC (n=8)	45	39 (38†)	6 (32†)	NA	NA
Median number per facility	_	7 (IQR=5-9)	2* (IQR=1-3)	3** (IQR=2-8)	
Rutshuru	171	127 (74)	20 (12)	24 (14)	
RHC and RH (n=6)	116	78 (61†)	14 (70†)	1	23
HC (n=11)	55	49 (39†)	6 (30†)	NA	NA
Median number per facility	_	4 (IQR=3-5)	2* (IQR=1.5-3.5)	2** (IQR=2-3)	
HC: health centres, RHC: referral health centres, RH: referral hospitals, IQR: interquartile range					
†Percentages of cadres per level of facilities					
‡Not available in 18 facilities (5 HCs in Goma, 5HCs in Karisimbi, 2 RHCs and 7 HCs in Rutshuru)					
†Obstetricians and paediatricians					
*In facilities with midwives (n=24)					
**In RH and RHC only					
NA: not applicable, _: not calculated					

Regarding the availability of essential drugs, equipment in the facilities surveyed, magnesium sulphate was the least available drug in the facilities surveyed (45.2%;19/42). Vacuum extractors were the least available equipment (21.4%;9/42), followed by filled oxygen cylinders and neonatal intravenous fluid sets (Table 8). These drugs and equipment were more frequently unavailable in HCs located in the HZs of Karisimbi and Rutshuru. There was a pattern whereby essential drugs and equipment for EmONC were more likely to be available in facilities located in the HZ of Goma. In the HZ of Rutshuru, 33% (2/6) of the referral facilities, and 36% (4/11) of the HCs did not have an operational laboratory for lack of equipment or technicians.

Transport and communication systems for referral

Overall, 23.8% (10/42) of the facilities surveyed had an ambulance (car or motorcycle) on-site; nearly all of these were referral facilities, of which two thirds of the referral facilities in Rutshuru, and half of the referral facilities both in Goma and Karismbi (**Tale 7**). Similarly, 16% (26/42) of the facilities had a means of communication (cell phone or two-way radio) for referral purposes. The vast majority of them were referral facilities. All the referral facilities that had an operational ambulance on-site reported charging fees for its use when an institutional referral was requested in their respective HZs, except for the referral hospital of Rutshuru, whose ambulance was operational through MSF support.

Table 8
Availability of essential drugs, equipment, ambulance and communication means in the facilities surveyed in the 3 health zones (HZs) in the North-Kivu Province of Eastern DRC, 2017

Drugs, equipment and other infrastructures	All facilities	HZ of Goma		HZ of Karisimbi		HZ of Rutshuru	
	(n = 42)	RH and RHC (n = 6)	HC (n = 5)	RH and RHC (n = 6)	HC (n = 8)	RH and HC (n = 6)	HC (n = 11)
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Drugs							
Injectable beta-lactams	42 (100)	6 (100)	5 (100)	6 (100)	8 (100)	6 (100)	11 (100)
Injectable metronidazole	33 (78.6)	6 (100)	5 (100)	6 (100)	6 (75.0)	6 (100)	4 (36.4)
Magnesium sulphate	19 (45.2)	6 (100)	3 (60)	6 (100)	2 (25.0)	5 (83.3)	0 (0)
Diazepam	39 (92.8)	6 (100)	3 (60.0)	6 (100)	8 (100)	6 (100)	10 (90.9)
Anti-hypertensive drugs	26 (61.9)	6 (100)	2 (40.0)	6 (100)	6 (75.0)	5 (83.3)	1 (9.1)
Oxytocics	42 (100)	6 (100)	5 (100)	6 (100)	8 (100)	6 (100)	11 (100)
Crystalloid fluids	42 (100)	6 (100)	5 (100)	6 (100)	8 (100)	6 (100)	11 (100)
Equipment							
Foetal stethoscope	42 (100)	6 (100)	5 (100)	6 (100)	8 (100)	6 (100)	11 (100)
Blood pressure cuff	42 (100)	6 (100)	5 (100)	6 (100)	8 (100)	6 (100)	11 (100)
Filled oxygen cylinder	12 (28.9)	6 (100)	0 (0)	3 (50.0)	0 (0)	3 (50.0)	0 (0)
Catheter for IV line	40 (95.2)	6 (100)	5 (100)	6 (100)	7 (87.5)	6 (100)	10 (90.9)
Uristix	26 (61.9)	3 (50.0)	2 (40.0)	6 (100)	5 (62.5)	6 (100)	4 (36.4)
Neonatal IV fluid set	22 (52.4)	6 (100)	3 (60.0)	6 (100)	3 (37.5)	4 (66.7)	0 (0)
Neonatal bag and mask	27 (64.3)	6 (100)	2 (40.0)	6 (100)	4 (50.0)	6 (100)	3 (27.3)
Kit for uterine evacuation	28 (66.7)	4 (66.7)	4 (80.0)	5 (83.3)	4 (50.0)	6 (100)	5 (45.5)
Aspirator	35 (83.3)	6 (100)	5 (100)	6 (100)	7 (87.5)	6 (100)	5 (45.5)
Vacuum extractor	9 (21.4)	6 (100)	1 (20.0)	1 (16.7)	0 (0)	1 (16.7)	0 (0)
Resuscitation table	35 (83.3)	6 (100)	4 (80.0)	6 (100)	8 (100)	6 (100)	5 (45.5)
Other infrastructures							
Ambulance†	10 (23.8)	3 (50.0)	0 (0)	3 (50.0)	0 (0)	4 (66.7)	0 (0)
Communication means for referral‡	16 (38.1)	6 (100)	0 (0)	6 (1009	0 (0)	3 (50)	1 (9)

RH: referral hospital, RHC: referral health centre, HC: health centre, IV: intravenous

†Car or motorcycle

‡Cell phone or two-way radio

Discussion

The delivery of all EmONC services over the past 3 months by at least 5 facilities serving 500,000 inhabitants indicates that pregnancy-related complications are managed by trained personnel, medical equipment and supplies are sufficient, and skills are maintained (26). Our findings show that the availability of functioning EmONC facilities in the study HZs fell short of the WHO standards. They met only 30% of the minimum acceptable number EmONC facilities, with an availability gap less marked in the HZ of Goma than in the HZs of Rutshuru and Karisimbi, respectively. Relatedly, none of the minimum levels of use and quality of EmONC were met, except for the proportion of births by Caesarean Section in both functioning and partial EmONC facilities in the 3 HZs. Resources needed for EmONC and institutional referral were scarce in surveyed HCs, more so in Rutshuru and Karisimbi than in Goma.

None of the surveyed HCs could offer EmONC 24 hours a day and 7 days a week (24/7). It is conceivable that this finding is related to the impact of residual insecurity that characterize post-conflict settings (44). This situation impedes patients' admission or referral within the health system and tend to limit the

availability of skilled health personnel to provide EmONC 24/7, especially in primary healthcare facilities, as suggested in previous studies in post-conflict SSA (45–47). A high priority needs to be placed on further addressing residual insecurity in the 3 HZs, which is paramount in reducing preventable mortality in conflict-affected populations (27).

The great majority of the facilities surveyed in the 3 HZs had not performed all the 7 basic signal functions in the past 3 months, with all of them not having performed AVD. This parallels the findings of a previous survey on the provision of key health services in a national sample of health facilities in DRC. It revealed that less than 12% of those offering maternity services were performing all basic EmONC services (48). Also, the finding that AVD is the least likely signal function to be reported, especially in HCs, is consistent with existing literature on the subject in SSA (49,50).

If we were to ignore AVD, the 3 HZs could meet the target of 5 functioning EmONC facilities for 500,000 people. While most facilities couldn't offer this signal function on policy grounds, half of the facilities that reported 'no indication' didn't have a vacuum extractor for instrumental vaginal delivery. Restrictive policies targeted mainly HCs regardless of their location, illustrating a perceived lack of trained operators at that level of care. Moreover, 50% of facilities that owned a vacuum extractor did not indicate any AVD, which might reflect unfamiliarity with this technique. Lack of equipment and limited staff training and exposure are common obstacles to the performance of AVD in resource-poor settings (51–54). Similarly, restrictive policies and the lack of equipment/drugs were the main reasons why neonatal resuscitation and parenteral administration of anticonvulsants could not be performed.

Restrictive policies raise a serious issue as to training and practice opportunities for health providers, especially those working in HCs. These restrictions, along with a lack of equipment, compromise chances for health providers to acquire skills and help maintain a situation where targeted services remain virtually unavailable at the primary care level (53). In line with the WHO guidelines (55), measures prioritising competency-based training for first-line providers and the use of simple and cost-effective equipment have been proved effective (56,57). Such programming offers a possible alternative to restrictive policies and is conducive to better access to quality primary care deemed essential in post-conflict recovery contexts (45,58).

In Karisimbi and Rutshuru, none of the HCs administered anticonvulsants and, very few had stocked magnesium sulphate, the anticonvulsant of choice, shown to avert up to 85% of severe pre-/eclampsia (SPE) related deaths and disabilities (59). This suggests that pregnant women with SPE were referred without being administered the loading dose of magnesium sulphate (10 mg). In rural Bangladesh, Shamsuddin et al. found better maternal and perinatal prognoses in pregnant women who received the loading dose before referral than in those that didn't (60). Besides, the inadequate referral system in these non-urban HZs was likely to occasion delays in reaching the appropriate facility and receiving care, which might have been compounded by probable residual insecurity. These factors are highlighted in the 3-delay model (61,62).

Health facilities in Goma outperformed those in Karisimbi and Rutshuru in terms of service provision, overall. The performance of more EmONC signal functions in urban settings has already been reported in SSA (63) and in South-East Asia (64), a disparity that might illustrate an imbalance in the procurement of medical supplies and equipment, in training opportunities, and in the posting and retention of skilled health staff. Besides, two of the three functioning cEmONC facilities catered to the urban population, which might appear to imply better access to comprehensive life-saving care for pregnant women in Goma. Of note, the presence of a functioning cEmONC facility in Rutshuru is consistent with a previous study in rural humanitarian settings in the North Kivu province of eastern DRC (63).

The inadequacies of the EmONC system found in state-run facilities in the study HZs are concordant with the available related literature in DRC (63–65). They appear to be systemic in nature and might reflect the impact of resource allocation for the health system. Available evidence points to this analysis. The DRC government expenditure on health (USD 12–13 per capita) is one the lowest in SSA (66), with a health budgetary allocation (4–5%) far below the 2001 Abuja declaration target of at 15% of the national budget to be allocated to health to ensure universal care coverage (67,68). Also, studies in DRC showed other factors related to persistent fragility that create bottlenecks in the functioning of the health system, including dependence on user fees and fragmented/vertical multi-donor inputs, inefficient budget preparation approaches, unmonitored budget execution, and poor governance (69–71). Previously identified barriers to the delivery of EmONC in post-conflict SSA included systemic and human resource factors such as limited infrastructures and procurements, insignificant and erratic pay, and poor living and working conditions (45).

Our results show that a higher proportion of health staff in Goma and Karisimbi were working in private not-for-profit organizations (NFPO), about half of facility births in both HZs took place in these institutions, and NFPOs had larger volumes of deliveries. This might point to women's self-referral behaviour to seek maternal care where better quality is perceived, as shown in previous work (73–75), as well as to the availability of sufficient resources and facilities in NFPOs. A study by Tabatabai P et al. in southern Tanzania comparing faith-based organisations (FBO) and public hospitals found that maternal health service capacity was more appropriate in FBOs (76). Similar studies in SSA concluded that even though maternal and neonatal services provided by FBOs and state facilities were comparable, better quality and satisfaction of care were reported in FBOs (77,78).

In the rural HZ of Rutshuru, the RH attended over a third of deliveries and four fifths of CS and hired the majority of health personnel across the HZ. These findings reflect the impact of humanitarian assistance through financial and technical support that this RH was receiving from MSF. For example, in a rural conflict-affected district in Afghanistan, Lagrou D et al. found a steady increase in caseload at a cEmONC facility run by MSF(79). In Rutshuru, MSF offered user fee exemption for CS and a maternity-waiting home, measures that help address inequities in facility births (80,81). However, this assistance comes with potential downsides. First, by absorbing the majority of cases within a health district, humanitarian-assisted hospitals deprive other facilities, particularly primary care ones, of being exposed to case management, undermining the acquisition and maintenance of necessary skills. Also, it raises sustainability, given the time-bound nature of its implementation (82).

In the surveyed HZs, all the indicators pertaining to the quality of EmONC didn't meet the WHO standards. Similar findings were reported in DRC and other SSA countries (53,65,66,83–85). However, it is important to note that although indicators such as DOCFR and INMR help ascertain whether EmONC meets quality standards, they need to be interpreted cautiously. This is due to the lack of comparability among health facilities that can result in selection bias. In resource-

limited settings, there is an observed tendency to routinely and inadequately refer women presenting with severe complications to higher-level facilities, where they often arrive late and eventually die, therefore inflating mortality in these facilities (60). Indeed, all maternal deaths in the study HZs took place at referral facilities.

The population-based CS rate was the only process indicator found to be within an acceptable range in 2 of our study HZs. This is in contrast with findings from an EmONC study in Lubumbashi, the second largest city in DRC, barely affected by the 2006–2013 conflict episodes, that revealed an unmet need for CS deliveries (67). These CS rates in the study are rather encouraging. They can be explained by the humanitarian presence in the region, on the one hand, and by the extent of the integration of state and NPOs owned health facilities that was observed, on the other hand. As a consequence, even in the HZ of Karisimbi where none of the facilities qualified as functioning EmONC facility, the CS rate met WHO standards.

Since only a little over one-sixth of deliveries occurred in functioning EmONC and given the shortcomings in referral capabilities and unmet minimum levels of use and quality, one can surmise that most pregnancy-related complications had likely received substandard or delayed care. One systematic review found an inverse correlation between the met need for EmONC and maternal mortality ratio (86), highlighting the impact of better access to quality EmONC to reduce preventable mortality, a key element in post-conflict recovery. A study in Nigeria identified factors contributing to maternal mortality, including a dysfunctional referral system and limited intensive care capabilities leading to delays in providing EmONC (87).

This study has some limitations. First, only three out of the 34 HZs in the North-Kivu Province were included in a purposive manner and, therefore, our findings and analyses cannot be generalized to the whole Province. Second, profit-run health facilities were not selected, which very likely underestimated the provision and capacity of EmONC as well as facility deliveries in the 3 HZs. Third, we did not assess staff knowledge of EmONC procedures and standards of care, leaving gaps in the actual ability to provide quality care in the study HZs and calling for further research. Fourth, the period that covered our data collection might raise concerns as to the current pertinence of our findings. Nevertheless, recent qualitative findings on health services for women, children, and adolescents in North Kivu, highlighting human resource and logistic barriers, might suggest that this study remains relevant (88).

Conclusion

This study gives for the first time a quantitative assessment of the post-conflict status of EmONC in the North-Kivu Province in eastern DRC. It raises the prospect of evidence-based policies and programming, as well as coordinated EmONC interventions, which should encourage local and external stakeholders to improve maternal and neonatal health in the province as part of the post-conflict recovery efforts. Despite the fact that most process/performance indicators didn't meet the WHO standards, EmONC services were provided to a degree that appeared to be more advantageous for urban populations and more comprehensive in public referral facilities, especially where the NFPO or humanitarian partners were involved. Particular attention to basic EmONC is required, focusing on strengthening human resources, equipment, supply chains, and referral capacity, on the one hand, and on tackling residual insecurities that might hinder 24/7 staff availability, on the other hand. Also, given that the number of designated bEmNOC facilities was higher than the minimum recommended by WHO, health authorities should focus on upgrading a few HCs based on geographic location to meet bEmONC standards instead of trying to upgrade all the designated facilities.

Abbreviations

EmONC: emergency obstetric and newborn care; NKP: North Kivu Province; DRC: Democratic Republic of the Congo; HZ: Health zone; SSA: Sub-Saharan Africa; IAWG: The Inter-Agency Working Group for Reproductive Health; SRH: sexual and reproductive health; UN: United Nations; MRP: Manual removal of placenta; RRP: Removal of retained products of conception; AVD: Assisted vaginal delivery; NR: Neonatal resuscitation; CS: Caesarean section; CNDP: Congrès National pour la Défense du Peuple; M23: Mouvement du 23 Mars; CBHZ: Central Bureau of the Health Zone; HC: Health centre; RHC: Referral health centre; RH: Referral hospital; MOH: Minister of Health; AMDD: Averting Maternal Death and Disability; WHO: World Health Organization; UN: United Nations; UNICEF: United Nations' Children Fund; UNFPA: United Nations Population Funds; CMO: Chief Medical Officer; PI: Principal investigator; NFPO: non-for-profit organisations; MSF: Médecins Sans Frontières; USD: United States Dollars; MDOC: Major direct obstetric complications; DOCFR: Direct obstetric case facility rate; INMR: Intrapartum and very early neonatal death rate. IQR: Interquartile Range; SPE: Severe pre-/eclampsia

Declarations

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Authors' contributions

SAM, KM, CW conceived of the study. SAM, KM, PMM, KOM, and CW contributed to study and survey design. SAM and GM contributed to pilot testing, study implementation and data collection. SAM, KM, CW and PMM contributed to data analysis; SAM, PMM, CW, KM and KOM contributed to data interpretation. SAM drafted the initial manuscript; all authors contributed to manuscript revision and have approved the final version.

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Availability of data and materials

The minimal dataset necessary to interpret and build upon our findings is included in this article. Further dataset inquiry can be submitted to the corresponding author upon reasonable request.

Ethics approval and consent to participate

This study was approved by Kyoto University Graduate School and Faculty of Medicine, Ethics Committee, Japan, as well as by the Ethics Committee of the University of Kinshasa School of Public Health, DRC. Written consent was obtained from all study interviewed participants before initiating data collection.

Consent for publication

Not applicable.

Competing interests

None.

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