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AVERTING MATERNAL DEATH AND DISABILITY

Declining maternal mortality ratio in Uganda: Priority interventions to achieve the Millennium Development Goal

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Abstract

Purpose: We conducted a survey to determine availability of emergency obstetric care (EmOC) and to provide data for advocating for improved maternal and newborn health in Uganda. **Methods:** The survey, covering 54 districts and 553 health facilities, assessed availability of EmOC signal functions, documented maternal deaths and the related causes. Three levels of health facilities were covered. **Findings:** Few health units had running water; electricity or a functional operating theater. Yet having these items had a protective effect on maternal deaths as follows: theater (OR 0.56, $P < 0.0001$); electricity (OR 0.39, $P < 0.0001$); laboratory (OR 0.71, $P < 0.0001$) and staffing levels (midwives) OR 0.20, $P < 0.0001$. The availability of midwives had the highest protective effect on maternal deaths, reducing the case fatality rate by 80%. Further, most (97.2%) health facilities expected to offer basic EmOC, were not doing so. This is the likely explanation for the high health facility-based maternal death rate of 671/100,000 live births in Uganda. **Conclusion:** Addressing health system issues, especially human resources, and increasing

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access to EmOC could reduce maternal mortality in Uganda and enable the country to achieve the Millennium Development Goal (MDG).

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1. Introduction

Uganda has registered a decline in maternal mortality ratio (MMR: maternal deaths per 100,000 live births) over the past 10 years. MMR was 557 live births in 1995, this declined to 505 in 2001 and to 435 in 2006 [1]. Of concern to policy makers and program managers is whether Uganda will achieve the Millennium Development Goal (MDG) target of 162 in 2015.

Previously we have reported that using the sector-wide approach (SWAp), Uganda has prioritized emergency obstetric care (EmOC), revitalization of family planning programs, and increasing skilled attendance at delivery [2,3]. A high unmet need for EmOC has already been documented [2,3]. Lack of emergency care was highly associated with maternal deaths in health facilities. Specifically, removal of retained products, assisted vaginal delivery and lack of blood transfusion were the key EmOC signal functions related to maternal deaths [3]. It is therefore important to assess other factors related to maternal mortality and provide data for effective advocacy on maternal health especially prioritization and resource allocation. This article focuses on the effect of health system factors on maternal deaths especially the state of health infrastructure, basic supplies, and staffing levels, since these are neglected issues in the advocacy strategy for maternal health in Uganda.

The importance of reducing maternal and child mortality in low income countries has been well recognized [4]. Maternal and infant mortality rates in a particular country reveal more about the state of the health system than any other indicators. It has been concluded that achieving low maternal and infant mortality rates requires a well-functioning health care delivery system that reaches communities with education and counseling, helps people avoid unwanted pregnancies, promotes good nutrition, screen risks, and responds to obstetric emergencies [4]. A health system has been defined as any set of activities whose primary intent is to improve or maintain health. The health system includes resources, actors and institutions related to financing, regulation and provision of health [11,12].

Efforts to achieve the MDGs, especially on child and maternal mortality in Uganda, have resulted in the development of a road map to reduce maternal mortality and neonatal health. This strategy focuses on improving health systems like staffing levels, infrastructure, quality of care and community mobilization to create demand for services. The key interventions in this strategy are increasing access to EmOC, revitalization of family planning, and increasing antenatal care and skilled attendance at delivery [5].

How well a health system responds to obstetric emergencies is determined by many factors, as previous studies have shown [6–10]. Emergency obstetric care refers to care given to complications that threaten the lives of the mother and newborn [9]. In Uganda poor access to EmOC has already been documented [2,3]. This was attributed to poor quality of care at health units but could be a reflection of

inadequate health systems including community factors. To get baseline data for monitoring the scale-up of EmOC services in Uganda, a needs assessment on signal functions of EmOC was carried out. Data on maternal deaths and other health system factors were collected. This article highlights health system factors and presents a case for focusing on human resources and availability of EmOC if Uganda is to meet the MDG targets.

2. Materials and methods

2.1. The EmOC needs assessment

The Ugandan Ministry of Health, UNICEF and other partners carried out an EmOC needs assessment during February and March 2003, using the UN Guidelines for monitoring obstetric service [5]. The details of the methods have been previously published [2,3]. Briefly, the country was divided into 4 zones: Central, Eastern, Western, and Northern. We surveyed 54 districts omitting 2 districts for security reasons.

The health care delivery system in Uganda has been described earlier [2,3]. Briefly, level III health centers (HCIII) should be able to provide basic EmOC and level IV health centers (HCIV) should be able to provide comprehensive EmOC [14]. In practice, however, staffing levels and services provided often fall short of guidelines. All hospitals ($n=87$) and HCIVs ($n=107$), and a representative 50% sample of HCIIIs ($n=359$) were included in the sample.

Data on maternal deaths and the related factors were collected using a structured questionnaire that captured data on:

- Number of health workers in the health facilities by category.
- Emergency obstetric care services (signal functions).
- Maternal deaths and obstetric complications.
- Status of health infrastructure like availability of running water, supply of electricity, telephone facilities, waste disposal facilities and accommodation for staff.
- Furniture and linen facilities.
- Availability of basic equipment.
- Availability of essential drugs.

2.2. Statistical analyses

Data were entered into EpiInfo version 6.0 (CDC, Atlanta, GA, USA), cleaned and transferred to Stata version 8.2 (Stata Corp. College Station, Texas, USA) for analysis. Univariate and bivariate analyses were performed to calculate the availability of EmOC and factors related to maternal deaths. Poisson regression model was used to establish the determinant factors to maternal deaths in health units in Uganda. The dependent variable was the number of deaths registered at the facility. The independent variables included the number of staff at the facility, availability of equipment, basic drugs, and the number of obstetric complications in the facility. The number of staff at the health unit was treated as a numeric variable. To assess laboratory equipment, we used the availability of a microscope, glass rods and field stains A and B. For basic diagnostic

Table 1 Availability of basic facilities, equipment and supplies in health units in Uganda, 2003

Facility, equipment or supply	Percentage of health units with facility, equipment or supply			
	HCIII	HCIV	Hospital	All
	n=359	n=107	n=87	n=553
Running water	1.4	19.6	46.0	11.9
Electricity	2.2	29.0	60.9	16.8
Theater	Not applicable	15.9	35.6	24.7
Laboratory with reagents	49.9	84.1	100.0	64.4
Sulfadoxine–pyrimethamine*	87.5	91.6	96.6	89.7
Chloroquine (injectable)*	79.9	81.3	95.4	82.6
Approved staff positions filled (midwives)	98.9	73.8	93.1	93.1

Abbreviations: HCIII, level III health center; HCIV, level IV health center.

*To treat malaria.

equipment and drugs, the model used a dummy variable with 0 as value for non-existence of either the equipment or the drug and a 1 for the existence of the equipment or the drug. We also used the region as one of the independent variables. The 4 regions of Uganda are: Central, East, North and Western. The Western region was taken as a reference category since it is believed to have a low maternal mortality ratio. The proportion of averted maternal deaths was calculated as 100 (1-risk ratio). Poisson regression model was preferred because the dependent variable is a count of the number of deaths registered at a given

Table 2 Availability of EmOC signal functions in health units in Uganda, 2003

EmOC signal function	Percentage of health units providing the signal function			
	HCIII	HCIV	Hospital	Total
	n=359	n=107	n=87	n=553
Parenteral antibiotics	80.2	87.9	98.9	84.6
Parenteral oxytocin	74.4	82.2	96.6	79.4
Parenteral sedatives	37.9	42.1	87.4	46.5
Manual removal of retained placenta	34.8	49.5	86.2	45.8
Removal of retained products	37.3	59.8	95.4	50.8
Assisted vaginal delivery	5.0	15.9	62.1	16.1
All of the above	3.1	7.5	52.9	11.8
Blood transfusions	NA	13.1	86.2	45.9
Cesarean delivery	NA	9.3	86.1	43.8

Abbreviations: EmOC, emergency obstetric care; HCIII, level III health center; HCIV, level IV health center.

facility. The model in general was found to be significant at 95% level of confidence with $P < 0.00001$.

3. Results

Availability of basic facilities and supplies was assessed in all 553 health units and is shown in Table 1.

3.1. Health centers III

Most HCIIs had no running water and electricity. On the other hand, almost half of them had a functional laboratory as well as sulfadoxine–pyrimethamine, chloroquine. And most had filled approved staff positions (midwives).

Only 11 of 359 (3.1%) HCIIs were offering basic EmOC. The signal functions most often missing were assisted vaginal delivery (95.0%), removal of retained products (62.7%) and manual removal of retained placenta (65.2%) (Table 2).

3.2. Health centers IV and hospitals

Most HCIVs were marginally more likely to offer the signal functions to qualify them as basic EmOC facilities, but few HCIVs offered either blood transfusion (13.1%) or cesarean

Table 3 Obstetric complications, deaths and cause-specific case fatality rates recorded in health units in Uganda, 2003

	Obstetric complications (a)	Maternal deaths (b)	Case fatality rate (maternal deaths as a proportion of obstetric complications) (b)/(a)
Direct causes			
Ruptured uterus	590	83	14.1
Hemorrhage	5766	356	6.2
Postpartum sepsis	1628	60	3.7
Ectopic pregnancy	584	14	2.4
Pre-eclampsia/eclampsia	2603	49	1.9
Obstructed/prolonged labor	14,824	187	1.3
Complications of abortion	16,394	93	0.6
Total direct causes	38,677	842	2.2
Indirect causes			
HIV/AIDS	287	59	20.6
Sickle cell disease	61	6	9.8
Anemia	2794	89	2.1
Malaria	23,657	306	1.3
Total indirect causes	26,799	460	1.7

Table 4 Number of deliveries, complications and deaths recorded in three levels of health units in Uganda, 2003

Maternal health indicator	HCIII <i>n</i> = 359	HCIV <i>n</i> = 107	Hospital <i>n</i> = 87	Total <i>n</i> = 553
Deliveries				
Number	43,202	33,066	117,761	194,029
Percent	22.3	17.0	60.7	100.0
Obstetric complications				
Number	15,576	11,318	38,582	65,476
Percent	23.8	17.2	58.9	100.0
Direct obstetric				
Number	4392	4514	29,771	38,677
Percent	11.4	11.7	76.9	100.0
Indirect obstetric				
Number	11,184	6804	8811	26,799
Percent	41.7	25.4	32.9	100.0
Maternal deaths (number)	378	293	631	1302
Percent	29.0	22.5	48.5	100.0
Direct obstetric	111	284	447	842
Percent	13.2	33.7	53.1	100.0
Indirect obstetric	267	9	184	460
Percent	58.0	2.0	40.0	100.0
Case fatality rate				
All maternal causes	2.4	2.6	1.6	2.0
Direct obstetric causes	2.5	6.3	1.5	2.2
Indirect obstetric causes	2.4	0.1	2.1	1.7

section (9.3%). However, most hospitals did offer blood transfusion (86.2%) and cesarean delivery (86.2%).

3.3. Maternal deaths

Causes (direct and indirect) of maternal deaths were recorded in all 553 health units (Table 3).

3.3.1. Case fatality rates

Table 3 shows maternal deaths as a proportion of obstetric complications – the case fatality rate (CFR). HIV/AIDS had the highest case fatality rate (20.6%), followed by ruptured uterus (14.1%), and sickle cell disease (9.8%). Note that all

CFRs but one (abortion complications) exceeded the standard set in the UN Process Indicators of 1%.

3.3.2. Proportional mortality (data not shown)

Hemorrhage was the most common direct cause (42.3%) of maternal deaths, followed by obstructed labor (22.2%). Complications of abortion were responsible for 11.1% and ruptured uterus accounted for 9.9% of the deaths. Among the indirect causes of maternal deaths, malaria accounted for 65.5% of the cases, followed by anemia (19.3%) and HIV/AIDS (12.8%).

Nearly half (48.5%) the deaths took place in hospitals; 22.5% occurred in HCIVs and 29.0% in HCIIIs (Table 4).

Table 5 Factors associated with maternal deaths in health facilities in Uganda

Covariates	Odds ratios (95% CI)	Level of significance	Percentage of maternal deaths averted 100 (1-risk ratio)
Central region	1.1 (0.9–1.3)	<i>P</i> > 0.465	–
Northern region	0.9 (0.7–1.2)	<i>P</i> > 0.52	–
Eastern region	3.7 (3.2–4.3)	<i>P</i> < 0.0001	–
Western (reference)	–	–	–
Availability of staff (midwives)	0.20 (0.17–0.23)	<i>P</i> < 0.0001	80%
Availability of electricity	0.39 (0.34–0.45)	<i>P</i> < 0.0001	61%
Availability of a theater	0.56 (0.48–0.67)	<i>P</i> < 0.0001	44%
Availability of a laboratory	0.71 (0.32–0.79)	<i>P</i> < 0.0001	29%
Availability of sulfadoxine–pyrimethamine	0.68 (0.58–0.81)	<i>P</i> < 0.002	32%
HCIIIs	2.4 (1.5–5.3)	<i>P</i> < 0.002	–
HCIVs	3.9 (1.3–8.5)	<i>P</i> < 0.001	–
Hospitals (reference)	–	–	–

Abbreviations: HCIII, level III health center; HCIV, level IV health center.

However, 58.9% of complications were treated in hospitals compared with 23.8% in HCIIIs and 17.2% in HCIVs.

3.4. Institutional risk factors

Factors related to maternal deaths in health facilities were assessed.

3.4.1. Geographical factors

Using the Western region as the reference, health facilities in the eastern region had an elevated risk of maternal death (OR 3.7, $P < 0.0001$), compared with those in the central and northern regions.

3.4.2. Level of health care

Women at HCIVs had a higher risk of maternal deaths (OR 3.9, $P < 0.01$) compared with those at HCIIIs (OR 2.4, $P < 0.002$) and hospitals (reference) (Table 5).

3.4.3. Available resources

Availability of midwives (OR 0.20, $P < 0.0001$), theater (OR 0.56, $P < 0.0001$), electricity (OR 0.39, $P < 0.0001$), laboratory (OR 0.71, $P < 0.0001$) and sulfadoxine–pyrimethamine (OR 0.68, $P < 0.002$) were protective for maternal deaths at health facilities (Table 5).

4. Discussion

Our results show that most health facilities – at all levels – in Uganda lack basic equipment and infrastructure necessary to provide quality of care. Availability of running water, electricity, and functional operating theaters in facilities expected to have them was lacking. The implication of these findings is that unless resources are allocated to the development of health infrastructure and improving human resources, Uganda is unlikely to meet the MDG on maternal health.

Most (97.2%) health facilities expected to offer basic EmOC services were not able to do so at the time of the study. Most HCIVs were not functional and therefore not able to provide comprehensive EmOC. Indeed, barely half of hospitals were able to provide all the elements of basic EmOC (assisted vaginal delivery was not practiced in many). To address the issue of high maternal mortality, these centers need to be operational as they are more likely than hospitals to be within the reach of most pregnant women. In the recent past, the Ministry of Health in Uganda has constructed theaters at HCIVs but these still need to be equipped and staffed by appropriate personnel recruited and motivated to provide services [5].

In many countries of sub-Saharan Africa, high levels of maternal mortality now coexist with high levels of HIV prevalence. HIV/AIDS may increase pregnancy related mortality directly (puerperal sepsis) or indirectly (anemia or tuberculosis) [13]. Table 3 shows that HIV/AIDS had the highest CFR among all causes of maternal deaths. This finding has implications for women accessing information and services for family planning, voluntary counseling and testing (VCT) for HIV and antiretroviral drugs. Uganda has had a success in reducing HIV prevalence among pregnant women [18,19]; but uptake of VCT has been notably low [18]. There is need to focus on integrating VCT into antenatal care to reduce high AIDS-related maternal mortality in Uganda.

Analysis of local data at facility level is important in two ways; one is to provide data for decision making, prioritization and resource allocation, and second to provide evidence for monitoring the implementation of activities such as the integration of services and quality of care. All these have policy implications and create opportunities for policy reviews. Continuing analysis of the magnitude of maternal mortality and the related causes is necessary to monitor national and international commitments to improve maternal health to acceptable levels.

This research found a facility-based maternal death rate of 671/100,000 live births. Although this figure is not representative of all women in Uganda, it highlights a problem in the quality of care women receive once they reach the health units. Women in eastern Uganda seem to have a high risk of death compared with the central and western regions. The protracted armed conflict in this region has led to collapse of infrastructure and difficulty in accessing care, pregnant women (and others) are therefore more likely to present with more severe complications. Health seeking behavior in conflict areas and how emergency care can be delivered under such circumstances needs further study and action. Surprisingly women in the northern region were less likely to die at health units although this is a conflict area. This has been attributed to the close proximity of internally displaced camps to HCIIIs; and this region has previously recorded a high proportion of facility deliveries [20].

The importance of the health system in delivery of quality of care cannot be overemphasized. Previous studies have highlighted the impact of this on maternal and child health [15–17]. This study highlights the role of human resources especially the effect of staffing levels (midwives) on maternal mortality. The policy implication of these findings is that the Ministry of Health, the Ministry of Finance and other development partners need to prioritize and allocate more resources to the development of infrastructure and human resources and to improve quality of care especially the availability of basic supplies and equipment.

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