Research Article

Prehospital Emergency Obstetric Care by SAMU in Kigali, Rwanda

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Abstract

Background: In Rwanda, 52% of the population is female and 25% of the population is of childbearing age. We sought to understand the care provided for obstetric and gynecologic emergencies in the prehospital setting in Rwanda.

Methods: Descriptive analysis was performed of demographic, indication, and intervention data for obstetric emergencies between December 2012 to May 2016 collected in a prospective database.

Results: Nearly 16% of 11,161 patients seen by SAMU were for obstetric emergencies. The average age was 26 (+ 9). Delivery-related included labor (76%) and retained placenta (10%). Pre-delivery complications, such as threatened abortion (26%) and miscarriages (24.5%), were 19% of all obstetric cases and 3.5% of cases were postpartum problems such as postpartum hemorrhage (59%) and infection (31%). Of 826 women in labor, the average dilation was 5.8 + 3.1 cm. SAMU staff delivered 317 healthy babies in the prehospital setting.

Conclusion: Obstetric emergencies need early recognition and intervention to support optimal outcomes for both mother and child. In Kigali, Rwanda, SAMU provides needed emergency obstetric care in the prehospital setting. Supporting their training on management of obstetric emergencies is likely to have substantial impact on maternal and fetal outcomes in the country.

Keywords: Obstetrics; Prehospital; Ambulance; Rwanda; LMIC

1. Introduction

Nearly 830 women die each day worldwide from preventable causes related to pregnancy and childbirth [1]. Most maternal mortality (99%) occurs in low-and-middle income countries (LMICs) with hemorrhage and hypertension being the leading causes [2, 3]. In the poorest countries, two-thirds of women deliver at home because in-of-hospital care is lacking and many women having home births cannot access health facilities where life-saving care is available [4]. In sub-Saharan Africa, 50% of births on average were attended by skilled health personnel in 2018 [5].

This means almost all maternal deaths in LMICs are preventable [6]. Based on these findings, the United Nations has set the target global maternal mortality rates at 75% as a fundamental part of the Millennium Development Goals (MDG 5A) [6]. Emergency obstetric care is especially lacking in LMICs. Globally, 951 million women of reproductive age do not have access to emergency obstetric care [7]. Basic emergency obstetric care is a cost effective priority intervention to reduce maternal mortality in poor resource settings [8]. Provision of timely and quality emergency obstetric care by a skilled healthcare professional and functional referral systems can reduce maternal morbidity and mortality [9, 10]. Community health workers are a vital part of the contribution to emergency medical obstetric care by providing a link between the patient and facility based care [11].

However, investment in formal prehospital emergency services is sparse across LMICs. Rwanda is among nine countries considered to have achieved MDG 5A due to improvements in access to care for pregnant women. The country was able to reduce the maternal mortality ratio by 77% between 2000 and 2013 and had the highest average annual rate reduction in maternal deaths compared to the nine other countries achieving MDG 5A (9%) [12]. Rwanda successfully improved maternal care by encouraging an increase in obstetric related healthcare providers and training community health workers to provide primary care in rural areas. The Ministry of Health of Rwanda formally invested in prehospital emergency services in 2007 and has since

built its ambulance service from 2 vehicles to a fleet of over 270. The ambulance service, Service d'Aide Médicale d'Urgence (SAMU), is a division of the Ministry of Health and provides prehospital emergency services for the people of Kigali, Rwanda and surrounding areas including emergency obstetric care. In this paper, we aim to describe the prehospital emergency obstetric care service delivery in the prehospital setting by SAMU in Kigali, Rwanda.

2. Methods

2.1 Study context and setting

Kigali, the capital city of Rwanda, has a population of over 1.3 million [13]. Rwanda has a well-structured health system comprising of the Ministry of Health and the Rwanda Biomedical Center (RBC), 8 referral hospitals, 4 provincial hospitals, 42 district hospitals, 508 health centers, and 406 health posts. The country's villages are served by a network of 45,000 community health workers (CHWs) who carry out community-based prevention and treatment including maternal care [14]. The population is young as 69% are under the age of 31 [15]. SAMU covers all emergencies for the three districts in Kigali City, Nyarugenge, Gasabo and Kicukiro. It also supports interventions outside of the city and in neighboring countries as needed.

SAMU is based out of the University Teaching Hospital of Kigali (CHUK) and two support centers around Kigali. The countrywide emergency number is 912. Calls are received at a central communication center and dispatched to field emergency medical teams. SAMU has 270 ambulances throughout Rwanda at provincial and district hospitals as previously described [16]. Ambulances are staffed by a non-physician anesthetist, a registered nurse, and a BLS trained driver. The nurse and anesthetist have ACLS/BLS certification. Staff has

taken a variety of courses through the collaboration between Virginia Commonwealth University (VCU) and the Ministry of Health of Rwanda including an obstetrics and gynecology course. This course was taught by physicians and paramedic educators from VCU and CHUK. SAMU uses nurses and midwives for assistance during difficult deliveries but performs many deliveries on their own in the field.

2.2 Data collection and patient sample

During each patient encounter, a paper run sheet is filled out by staff on the ambulance containing patient demographic information, history, vital signs, physical exam findings, interventions, and billing information. The paper run sheet is electronically transferred to a REDCap database (Vanderbilt University; Nashville, Tennessee, USA) created in collaboration with Brigham Women's Hospital/Harvard Medical School, VCU, and SAMU. The database creation was previously described in detail [16, 17]. This registry was analyzed for patients transported by SAMU for obstetric and gynecologic related complaints between December 2012 and May 2016.

2.3 Variables

A number of chief complaints were identified on patient run sheets. To improve data analysis, these chief complaints were grouped into pre-delivery, delivery, postpartum and gynecologic related complications. Pre-delivery problems included complete abortion, incomplete abortion, threatened abortion, miscarriage, ectopic pregnancy, preeclampsia, eclampsia, and premature rupture of membranes. Delivery problems included perineal tear, incomplete delivery of placenta, retained placenta, labor, hemorrhage in pregnancy, prolonged rupture of membranes, and uterine rupture. Postpartum problems included postpartum eclampsia,

postpartum hemorrhage, and postpartum infection. Gynecologic problems included Bartholin cyst, cervical cancer, uterine cancer, uterine myoma, metrorrhagia, and non-pregnancy related vaginal bleeding.

Complications to the fetus or newborn were classified as fetal or newborn distress and included neonatal jaundice, newborn postnatal infection, fetal distress, newborn respiratory distress, and APGAR scores < 7. Newborns were assigned APGAR scores when SAMU arrived or as they were delivered. Fetal presentation was described as cephalic, transverse, breech or limb in SAMU documentation. Anything other than cephalic was noted as abnormal for the purposes of this study. Deliveries were marked as complete or incomplete based delivery of placenta. Dilation was assessed and recorded twice by SAMU: first at SAMU team arrival and after transfer to health facilities. Additionally, each case was categorized by SAMU's dispatch staff with an urgency level of absolute, relative, or no urgency based on patient stability. Transport destination included referral hospitals (highest level of care), district hospitals (mid-level care), and health centers (primary care). Primary transportation referred to movement of patients to their initial health facility while secondary transportation referred to transfer of patients between health facilities.

2.4 Data analysis

The data was analyzed using descriptive statistics performed on SPSS version 25. Student's t-Test, ANOVA, and chi square test were run, with $p < 0.05$ considered significant. Significant findings were further quantified by calculating odds ratios. Only patients with recorded values for a given variable were included in analysis.

2.5 Ethical consideration

This project was conducted under a formal memorandum of understanding between the Ministry of Health of Rwanda and VCU to develop emergency care capacity in Rwanda. The Ministry of Health of Rwanda and VCU ethics boards approved the study plan. No informed consent was required since this was a retrospective analysis.

3. Results

3.1 Demographics

SAMU responded to a total of 11,161 patients during the study period, of which 1,781 (16%) were related to obstetrics and gynecology (OB/GYN) complaints. This represented 39% of all women (4,605) seen by SAMU over this time period. The average age of a women presenting with an OB/GYN related issue was 26 (+ 9) years.

3.2 Presentation

Presenting etiologies were divided into pre-delivery, delivery, post-delivery, and gynecology (Table 1). The majority of OB/GYN complaints related to delivery (n=818, 46%). Common causes were labor (n=622, 76%) and retained placenta (n=84, 10%). SAMU performed 409 deliveries. The majority (90%) had cephalic presentation (Table 2). Women over the age of 26 had 2.4 time the odds of having abnormal presentation compared to younger women [1.5, 3.8] ($p <$ 0.001) (Table 3). Patients presented with an average dilation of 5.8cm (+3.1) and station of +3.2 (+1.6) (fetal station scale -5 to +5) (Table 4). For every 1 cm of additional dilation women had 30% increased odds of having a labor complication ([1.2, 1.4], $p < 0.001$) and 12% increased odds of fetal distress ([1.03, 1.21], $p =$ 0.006) (Table 5). Women older than the average age (26) had more pre-delivery, delivery, or post-delivery

complications than younger women (p < 0.001, p < 0.001, p = 0.032) (Table 3). Women 26 or younger, however, had significantly more births complicated by fetal distress (p < 0.001) (Table 3). Furthermore, women with prior cesarean sections had 2.2 times greater odds of having a labor complication [1.5, 3.0] (p < 0.001) (Table 5). Fetal complications are described in table 2. SAMU recorded blood pressure and heart rate upon arrival to the patient. Only 15% (n=243) patients were found to be tachycardic and 4% (n=63) were hypotensive (missing data HR (7%) SBP (9%)). SAMU staff used this information as well as general clinical judgement to assign each case an urgency status of either absolute, relative, or no urgency. Most (n=1,235, 71%) were categorized as relative but 27% (n=464) were noted to have absolute urgency (Table 6). Women with post-delivery complications had 3.2 times the odds of being classified as absolute urgency compared to women with other complications [1.9, 5.2] (p < 0.001) (Table 7).

3.3 Treatment and transportation

The treatments provided are listed in table 8 with the most common intervention being administration of IV fluids (n=317, 18%) followed by oxygen therapy (14%) and manual curettage (7.5%). The most common medications administered were paracetamol (n=42, 2.5%), diclofenac (1.5%), and buscopan (1.5%). Care was provided to 379 newborns. The most frequent interventions performed on newborns were wrapping to prevent hypothermia (337, 90%), care for cord (275, 73%) and oral suction (79, 21%). Patients were transported to 13 different hospitals and health centers and traveled on average 17.7 km (+ 11.1) (table 9). There were 1,726 (97%) patients transported while 1.1% received on-site care only and 0.3% died. Patients were transported for primary purposes 52% (n=924) of the time and secondary purposes 48% (n=853) of the time. The most common hospital for transport was Kibagabaga Hospital (n=414, 24%) followed by Muhima Hospital (n=337, 19.5%).

Presenting Etiology	N (%)
Pre-delivery	334 (19)
Threatened abortion	86 (26)
Miscarriage	82 (24.5)
Incomplete abortion	74 (22)
Premature rupture of membranes	63 (19)
Pre-eclampsia	32 (9.5)
Complete abortion	28 (8)
Ectopic pregnancy	13 (4)

Eclampsia	11 (3)
Delivery	818 (46)
Labor	622 (76)
Retained placenta	84 (10)
Hemorrhage in pregnancy	46 (5.5)
Perineal tear	36 (4.5)
Prolonged rupture of membranes	28 (3.5)
Incomplete delivery of placenta	23 (3)
Uterine rupture	13 (1.5)
Postpartum	64 (3.5)
Postpartum hemorrhage	38 (59)
Postpartum infection	20 (31)
Postpartum eclampsia	7 (11)
Gynecologic	85 (5)
Bartholin cyst	5 (6)
Uterine cancer	1 (1)
Uterine myoma	2 (2)
Cervical cancer	11 (13)
Metrorrhagia	44 (52)
Vaginal bleeding	43 (50)

Diagnoses within each category are not mutually exclusive

Table 1: Presenting etiology of Ob-Gyn patients treated by SAMU.

Fetal and Newborn Distress	N (%)
Newborn respiratory distress	90 (41)
Fetal distress	69 (31.5)
APGAR < 7	54 (25)
Neonatal jaundice	3 (1.5)
Newborn postnatal infection	3 (1.5)
Presentation	N (%)
Cephalic	928 (90)
Breech	53 (6)
Transverse	40 (4)
Limb	9 (1)

Table 2: Fetal and newborn characteristics.

Complication	Average Age of Women with Complication (SD)	Average Age of Women without Complication (SD)	P - value
Abnormal Presentation	29 (9)	25.5 (9)	<0.001
Pre-Delivery	27 (6)	25 (9)	<0.001
Delivery	27 (6)	25 (10.5)	<0.001
Post-Delivery	28 (6.5)	25 (10.5)	0.032
Gynecology	29 (8)	25.5 (9)	0.001
Fetal Distress	16 (13)	27 (7)	<0.001

Table 3: Association of age on complications.

Total Deliveries	409 (23)
Complete	317 (77.5)
Incomplete	93 (22.5)
Dilation	5.8 cm ($\pm$ 3.1)
Station	3.2 cm ($\pm$ 1.6)

Table 4: Delivery characteristics.

Predictor	Outcome	B	SE B	Odds Ratio [95% CI]	P - Value
Dilation at Presentation	Labor Complications	0.273	0.029	1.3 [1.2, 1.4]	<0.001
Prior Cesarean Section	Labor Complications	0.773	0.173	2.2 [1.5, 3.0]	<0.001
Dilation at Presentation	Fetal Distress	0.115	0.04	1.1 [1.1, 1.2]	0.006

Table 5: Associations.

Vital Sign	N (%)
Tachycardia	243 (15)
Hypotension	63 (4)
Urgency Status	
Absolute	464 (27)
Relative	1,235 (71)
No Urgency	82 (2)

Table 6: Presenting information regarding Ob-Gyn patients treated by SAMU.

Complication	Absolute Urgency N (%)	Odds [95% CI}	P – value
Pre-Delivery	109 (33)	1.5 [1.1, 1.9]	0.003
Delivery	182 (23.5)	0.7 [0.6, 0.9]	0.005
Post-Delivery	34 (52)	3.2 [1.9, 5.2]	<0.001
Gynecology	22 (26)	1.0 [0.6, 1.6]	0.9

Table 7: Association of complication with urgency status.

Care for mother	
Administration of IV fluids	317 (18)
Oxygen therapy	252 (14)
Manual curettage	134 (7.5)
Care for newborn	
Wrapping	337 (90)
Care for cord	275 (73)
Oral suction	79 (21)
Medications	
Paracetamol	42
Diclofenac	24
Buscopan	24
Phenobarbital	6
Morphine	5
Ephedrine	3
Ibuprofen	2

Cimetidine	2
Diazepam	2
Hydrocortisone	2
Salbutamol	2
Haemaccel	2
MgSo4	2
Aminophylline	1
Chlorpromazine	1
Charbon actif	1
Dexamethasone	1
Furosemide	1
Pethidine	1
Thiopental Sodium	1
Suxamthoium	1
Aspirin	1
Tramadol	1
Salbutamol	1
Fentanyl	1

Table 8: Management provided by SAMU upon arrival.

Primary Transport	924 (52%)
Secondary Transport	853 (48%)
Receiving hospital	1726 (99%)

Hospital Kibagabaga	414 (24)
Hospital Muhima	337 (19.5)
Hospital Musaka	194 (11)
CHUK	129 (7.5)
Other	652 (38)
On-site care only	20 (1)
Death	4 (.25%)
Death before arrival of SAMU	3 (75%)
Death during transportation	1 (25%)

Table 9: Transport Data.

4. Discussion

Our results show that 39% of all women treated by SAMU had OB/GYN related complaints. Women most commonly presented due to delivery related complications or in labor. Women who waited at home as their labor progressed, as indicated by dilation, had more complicated treatment and worse outcomes compared to women that presented earlier to health centers or hospitals. Labor complications were also more common in women with prior cesarean sections. Delivery in a health facility can reduce complications as well as maternal and neonatal morbidity and mortality [18]. According to a survey in 2007, 70% of Rwandan women delivered at home [19]. Initiatives focused on increasing education and provider access have sought to address this issue and by 2010 nearly 70% of deliveries occurred in health facilities [20]. Rwanda has further tried to combat these issues by training community health workers to provide care and support. Continued efforts are needed to encourage women to present to healthcare providers earlier in order to reduce adverse outcomes. Older women had significantly more pre-delivery, delivery, and post-delivery complications. This is known to be true globally, as advanced maternal age is associated with an increased incidence of adverse pregnancy outcomes [21].. In Cameroon, hospital studies similarly showed that older women suffered more complications during their pregnancies [22]. Despite this, the number of older women giving birth has increased worldwide. In LMICs, childbearing is more common amongst multiparous older women due to ineffective family planning methods and cultural disposition favoring a large family size [22].

Women with post-delivery complications had statistically significantly increased odds of being classified as absolute urgency compared to women with other complications. Most maternal deaths are caused by hemorrhage (severe bleeding after childbirth), post-delivery infections, obstructed (difficult) labor, and

blood pressure disorders during pregnancy. All of these are classified as preventable or treatable conditions [4]. The leading cause of maternal death worldwide is postpartum hemorrhage and this was the most common post-delivery complication encountered by SAMU [23]. Postpartum hemorrhage can result in devastating bleeding that can lead to significant morbidity and mortality if not controlled rapidly. This explains why women with post-delivery complications were more frequently classified as absolute urgency. Postpartum hemorrhage is unfortunately unpredictable and relatively common [24]. SAMU ambulances, similar to ambulances in the United States, cannot administer blood products in the field. Access to more rapidly acting uterotonics (medications to induce contraction and improved tone of the uterus) is needed to improve post-delivery hemorrhage-related maternal outcomes.

To reduce the maternal mortality rate the Rwandan government has been investing in essential health interventions such as family planning, access to reproductive health services, skilled care during pregnancy and childbirth (including emergency obstetric care), and postpartum care. There has been targeted efforts to scaling up key maternal health services from 2005 to 2015 [25]. One of the key strategies has been through the use of prehospital emergency care services (PHECS), which is now fully operational in all districts with 270 ambulances and a call center managing the flow of calls. Additionally, in 2007 a reform was implemented nationwide with the goal of optimizing the role of community health workers in improving access to maternal health interventions. Other strategies have included the use of Rapid SMS (Short Message Service) to monitor mothers during pregnancy and follow-up [14]. Our study was limited to the prehospital setting. There is no outcome

data on the patients brought to the hospital. Follow-up studies could include merging the prehospital data with in-hospital data. Additionally, diagnosis could be presumed in the prehospital setting but not confirmed without extended workup. It is difficult to know the cause of a patient's postpartum hemorrhage in the prehospital setting, such as placental abruption, placenta previa etc. Our study did not investigate patient's pre-delivery care. Additionally, our study did not capture whether patients received the correct treatment for their chief complaint but was a descriptive study. Further research should examine whether patients seen and treated by SAMU had received prenatal care. Data was manually written into patient run sheets and digitized into the REDCap database; data may have been entered erroneously.

5. Conclusion

In conclusion, this study identified that older women and women with delayed labor presentation had increased risk of complications in the prehospital setting in Rwanda. While recent efforts have increased the number of women delivering in healthcare facilities, the proportion of home births remains high and many women in labor delay consulting providers. Women should continue to be counseled on the importance of delivery attendants and the complications that can be associated with pregnancy. Community health workers have been employed to provide family planning education and should continue their work in order to address the relationship between age and complications. The Rwandan Ministry of Health has helped reduce the maternal and child mortality rate throughout the country and additional efforts can further prevent adverse outcomes.

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Conflicts of Interest

There are no conflicts of interest for any of the authors.

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