UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

Department of Anesthesiology and Critical Care Medicine

OBSTETRIC ADMISSIONS IN INTENSIVE CARE UNITS OF UNIVERSITY TEACHING HOSPITALS OF BUTARE AND KIGALI: PREVALENCE AND OUTCOMES.

Research work submitted in partial fulfillment of the requirements for award of

Masters of medicine degree in Anesthesiology

By

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DECLARATION

I, RUDAKEMWA ALCADE, declare that this dissertation entitled "Obstetric admissions in the intensive care units of University Teaching Hospitals of Butare and Kigali: Prevalence and outcomes" is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature……

Approval for submission by Supervisor:

Dr Théogène TWAGIRUMUGABE

Signature……

Date:..23../..07../2019.

DEDICATION

To God the Almighty, the King of Grace and His son Jesus Christ who is the only Way, Truth and Life.

To my regret parents

To my dearest beloved wife Aline MUKASAMARI

To my sons RUDAKEMWA CYUSA Avidan and RUDAKEMWA GANZA Evan

To my dear brother and sisters

To Professor Jennifer Szerb

To all dear friends

May the Almighty God bless you all.

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ABREVIATIONS

APACHE: Acute, Physiology, Age and Chronic Health Evaluation

AUROC: Area Under the Receiver Operating Characteristic Curve

AVPU: Alert, Voice, Pain, Unresponsive

BP: Blood Pressure

CEMACH: Confidential Enquiry into Maternal and Child Health

CHUB: Centre Hospitalier Universitaire de Butare

CHUK: Centre Hospitalier Universitaire de Kigali

CI: Confidence Interval

CMHS: College of Medicine and Health Sciences

ESICM: European Society of Intensive Care Medicine

HICs: High Income Countries

ICU: Intensive Care Unit

ICUs: Intensive Care Units

IQR: Inter-quartile range

IRB: Institutional Review Board

LICs: Low Income Countries

MEOWS: Modified Early Obstetric Warning Score

mls/h: Milliliters per hour

OR: Odd ratio

p-value: calculated Probability

qSOFA: Quick Sequential Organ Failure Assessment

Ref: Reference

ROC: Receiver Operating Characteristic curve

SCCM: Society of Critical Care Medicine

SOFA: Sequential Organ Failure Assessment

SPSS: Statistical Package for Social Sciences

UR: University of Rwanda

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ABSTRACT

Background

Reasons for obstetric admission in intensive care unit (ICU) vary from a setting to another and may depend on bed availability. Outcomes from ICU and its prediction models are not well explored in Rwanda because of lack of appropriate scores. This study intended to assess epidemiology and evaluate accuracy of mortality predictive tools for obstetric patients admitted in ICU.

Methods

We prospectively collected data from obstetric patients admitted in the two ICUs of public referral hospitals in Rwanda from 1st March 2017 to 28th February 2018 to identify reasons for admissions and factors for prognosis.

Results: In total, 747 cases were admitted to the two ICUs, and of them 94, (12.8%) admitted for obstetric reasons. These obstetric patients were drawn from 4,999 patients who delivered in obstetric departments of the two facilities, indicating that 1.8% of obstetric patients were admitted in ICU. The most common reasons for admission in ICU were respectively sepsis (31.9%), peripartum haemorrhage (25.5%). Mortality within ICU for these obstetric patients was 54.3% while the average length of stay was 6.6 days. When adjusted for reason for admission and Caesarean before admission, MEOWS was an independent predictor of mortality with adjusted OR of 1.25[1.07-1.46]; p=0.005. Similarly, one point of increase of qSOFA increased odds of ICU mortality by 181% [adj.OR:2.81[1.25-6.30]; p=0.012). The AUROC for MEOWS was 0.773[0.666-0.880]; p<0.0001 and 0.764[0.654-0.873]; p<0.0001 for qSOFA.

Conclusion: Sepsis is the most common reason for obstetric admissions to ICU with high risk for mortality in Rwanda. Modified Early Obstetric Warning Score (MEOWS) and qSOFA are good tools for ICU mortality prediction for obstetric patients but needs to be explored in a larger study.

Key words: "Obstetric, intensive care unit, critical care, mortality"

CHAPTER 1 : INTRODUCTION

1.1. Background

The need of intensive care unit (ICU) admissions for obstetric patients is infrequent and little is known about incidence and outcome in low resources countries. A study conducted in the Netherlands showed that the incidence of obstetric admissions to ICU was 0.76% of all deliveries and accounted for 0.70% of all admissions in ICU[1]. In middle income countries like Hong Kong, the obstetric admissions represented 0.13% of all deliveries and accounted for 0.65% of ICU admissions[2]. Similarly, in India, it represented 0.4% of all deliveries and 1.5% of ICU[3]. The situation was a bit different in South Africa, the incidence of ICU admission was 0.95% of all deliveries and 6.7% of all ICU admissions and in Kenya, study showed incidence of 0.24% of all deliveries and 1.25% of ICU admissions[4].

Various reasons for admission of obstetric patients to the ICU have been identified and the prevalence of each admitting diagnosis varies between countries. In the Netherlands, the main indications for ICU admission were hypertensive disorders (62.0%) and obstetric hemorrhage (18.3%) [1]. Data from Hong Kong showed that the most common cause of ICU admission was obstetric hemorrhage (38%) followed by pregnancy-related hypertensive disorders and the most common non-obstetric cause was sepsis (7.14%) [5]. Similarly, data from Nigeria showed that the two most common causes of ICU admissions of obstetric patients were also, massive postpartum hemorrhage (48%) and severe preeclampsia or eclampsia (24%) [6]. In East African countries, in a Kenyan hospital, causes of obstetric admissions to ICU were dominated by obstetric hemorrhage and sepsis accounting for 44% and 26% respectively[4]. A study done in two public referral hospitals in Rwanda showed that sepsis was the leading cause of ICU admission, whereas pre-eclampsia/eclampsia represented 3% and obstetric hemorrhage 8% of all admissions[7].

Mortality among obstetric patients admitted to the ICU remains relatively high in low income countries compared to high income countries, respectively estimated at 3.5% in Netherlands while it was almost 10 times in Kenya and South Africa[4, 8, 9]. Data from Tanzania showed that obstetric complications account for 5.9% of adult ICU admissions with mortality rate of 34.6%[10]. In Rwanda, data from the University Teaching Hospital of Kigali (CHUK) showed that peritonitis was the most leading causes of maternal morbidity (30.2%) followed by hypertensive disorders (28.6%), obstetric hemorrhage (19.3%), and pregnancy related death accounted for 26%[11] .

Maternal mortality prediction remains challenging due to the inaccuracies of the currently used severity of illness scores with regards to obstetric patients. It was shown that Acute Physiology, Age and Chronic Health Evaluation II (APACHE II) and APACHE III are not appropriate tools to predict mortality in obstetric patients admitted to ICU[12, 13]. Rwandan Mortality Probability Model (R-MPM) was developed for general ICU patients with accurate mortality prediction; however, the tool was not specifically applied to obstetric patients[14]. In the 2003-2005 report, Confidential Enquiry into Maternal and Child Health (CEMACH) recommended Modified Early Obstetric Warning Score (MEOWS) as easy predictive tool for early recognition of critical illness in obstetric patients. This tools comprises of seven routine clinical variables (temperature, systolic blood pressure, diastolic blood pressure, heart rate, level of consciousness, respiratory rate and urine output)[34] to early detect physiological derangement in obstetric patients [15,16]. In their study, Singh et al, found that MEOWS (appendix 1) an accurate tool to predict morbidity among obstetric patients with a sensitivity of 89% (95% CI 81-95%) and specificity of 79% (CI 76-82%) [15]. Given its simplicity and affordability, it may be attractive to low income settings.

Mounting evidence, showed that Sequential Organ Failure Assessment (SOFA), another severity of illness scoring tool can predict mortality among critically ill obstetric patients admitted to ICU[17-19].However, this tool seems to be cumbersome with many laboratory investigations and calculations, and especially in a low resource limited setting. The quick Sequential Organ Failure Assessment (qSOFA) [appendix 2] has been published in 2016 by the task force of the Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM)

recommended its use as quick and easy tool to early recognize septic patients and predict outcome[20].

However, there is lack of evidence that these tools may predict outcome for obstetric patients admitted to ICU in Rwanda as there is no specific study evaluating such tools.

There is no specific publication on obstetric admissions to ICU in Rwanda. Therefore, this study was conducted to determine the prevalence of the most common reasons for admission of obstetric patients to the ICU and determine and associated outcomes and evaluate the accuracy of MEOWS and qSOFA in the prediction of mortality in ICU for obstetric patients.

1.2. Objective of the study

1.2.1. General objective

The general objective of our study was to assess epidemiology, outcomes and evaluate mortality prediction tools for obstetric patients admitted to ICUs of CHUB and CHUK.

1.2.2. Specific objectives

The general objective was subdivided into the following specific objectives:

- Determine reasons of admissions of obstetric patients in ICU of CHUB and CHUK.
- Determine various interventions offered to obstetric patients admitted in ICUs of CHUB and CHUK during the period of study.
- Evaluate length of stay of obstetric patients admitted to ICU of CHUB and CHUK.
- Evaluate mortality for obstetric patients admitted to ICU of CHUB and CHUK.
- To evaluate the accuracy of the mortality predictive value of MEOWS and qSOFA for obstetric patients in ICU.

CHAPTER 2: METHODS AND PATIENTS

2.1. Study design

This was a prospective cross-sectional study in two university teaching hospitals in Rwanda over a period of one year from 1st March, 2017 to 28th February 2018.

2.2. Study settings

Our study was conducted in two main public hospitals in Rwanda, both affiliated with the University of Rwanda, namely: Centre Hospitalier Universitaire de Butare (CHUB) and Centre Hospitalier Universitaire de Kigali (CHUK).

CHUB is a teaching hospital located in the Southern Province of Rwanda with 448 beds. It has a mixed Intensive Care Unit (ICU) with 6 beds, 2 trained anesthesiologists with critical care fellowship, 3 anesthesiologists, eighteen nurses and residents rotating in critical care service.

CHUK is a teaching hospital located in Kigali city with 519 beds and a 6 bed multi-disciplinary ICU. The ICU is staffed with 7 anesthesiologists including 1 critical care anesthesiologist fellow, thirty one nurses and residents rotating in critical care service.

2.3. Study population

We enrolled in this study all consecutive obstetric patients admitted to ICUs of CHUB and CHUK during the study period. Obstetric admission was defined as all pregnant ladies or within 42 days after termination of pregnancy who were admitted to ICU irrespective of the affected system.

2.4. Data collection and measurement

Data were collected by an ICU nurse at each hospital and recorded on a data collection sheet then entered in excel spreadsheet. Demographic data (age, gravidity, admitting hospital), clinical

data including vital signs, reason for admission to ICU, interventions done during ICU stay (mechanical ventilation, hemodialysis, vasopressor administration, transfusion), patient outcome and length of stay in ICU. Patients were followed up to discharge from ICU . We also collected data on the overall number of deliveries and general ICU admissions in both hospitals during the period of study.

Collected data at admission were used to manually, calculate Modified Early Obstetric Warning System (MEOWS) and quick Sequential Organ Failure Assessment (qSOFA) scores at admission to ICU. The qSOFA was used as there are limited resources to calculate Sequential Organ Failure Assessment (SOFA) in ICU of study settings. In order to keep confidentiality, data collection sheets were anonymous and kept in a locked area.

2.5. Sample size

Literature searching did not found any publications discussing prevalence and outcome of obstetric admissions in ICU in Rwanda. A study done in Limpopo tertiary hospital, South Africa over a period of 5years, 138 obstetric admissions were included representing 6.7% of all ICU admissions found a mortality rate of 43.8%[8]. Another study done in ICUs of the four public tertiary referral hospitals of Tanzania where 5627 patients participated, 4277 of them were adult patients and 315 were obstetric patients. Results of this study showed that obstetric related diseases complicated in 5.9% of adult patients admitted to ICU with mortality rate of 34.6%[21].

The prevalence of obstetric admission to ICU and associated outcome is not known in our country. We assume the prevalence of obstetric admissions to ICU in Rwanda is close to one in developing countries like Tanzania and South Africa and we hypothetically set it at 7%.
The sample size was calculated based on Cochran's formula [33]:

$$\mathbf{N= \frac{(Z\acute{\alpha}_{½})^2 * P * (1-P)}{(d)^2}}$$

Where **N**: sample size, **P**: proportion of the population and **d**: the precision, $Z_{\alpha 1/2:}$ standard normal deviate (at 5% type I error $p<0.05$) and equal to 1.96.

Calculated sample size = $\frac{(1.96)^2*0.07*0.93}{(0.04)^2} \approx 156$ patients.

The study was done over a period of one year and found only 94 obstetric patients admitted in ICU of both hospitals.

2.6. Statistical analysis

Data were recorded on excel spread sheet and exported to the Statistical Package for the Social Sciences (SPSS) version 25 for analysis. Descriptive statistical variables were reported as mean, standard deviation accordingly and proportions of obstetric patients admitted to ICU were calculated comparing them to all deliveries occurred in both hospitals and all ICU admissions during period of study. Associations between outcome and reasons of admission to ICU were evaluated as odd with respective 95% confidence interval (CI) using the binary logistic regression and independent factors to the outcome by using the multivariable logistic regressions analysis. Accuracy of mortality prediction by MEOWS and qSOFA scores was evaluated by the Receiver Operating Characteristic Curve (ROC) and a 95% CI provided and validation was analyzed by Hosmer-Lemershow model with a p-value lower than 0.05 ($p< 0.05$) considered statistically significant.

2.7. Ethical consideration

Ethical approval was obtained from Institutional Review Board (IRB) of the College of Medicine and Health Sciences (CMHS) at the University of Rwanda (UR) and respective ethical committees of both hospitals (CHUB, CHUK). The consent requirement for individual patient was waived, as the study was determined with minimal risk to patients.

CHAPTER 3: RESULTS

In total, 747 cases were admitted to the CU of University Teaching Hospital of Butare (CHUB) and Kigali (CHUK). Of them, 94(12.8%) were admitted for obstetric reasons. These obstetric patients were drawn from 4,999 patients admitted to the labour unit in the two facilities, indicating that 1.8% of obstetric patients were admitted in ICU.

Table 1: Characteristics of obstetric patients admitted in ICU

Variable		**Frequency (%)**
Mean age (in years)		29.82±6.507
Gravidity at admission	1-2	52(55.3)
	≥3	42 (44.7)
Period of admission	During pregnancy	12 (12.8)
	Post-abortion/ectopic pregnancy	13 (13.8)
	Post-partum	69 (73.4)
Mean length of stay in ICU (in days)		6.6±7.525
Mortality in ICU		51 (54.3)

The above table shows that the majority of obstetric patients admitted in ICU are young and carrying their first or second pregnancy. Majority of obstetric patients were admitted in their post-partum period. The mean length of stay in ICU was 6.06±7.525 days with mortality of 54.3%.

Table 2: MEOWS and qSOFA of obstetric patients at admission to ICU

Severity score	Severity score range	Frequency n(%)	Mean (N=94)	Median (N=94)	IQR (N=94)
MEOWS	0-3	19 (20.2)	7.14	7	6
	4-6	24 (25.5)			
	≥7	51 (54.3)			
qSOFA	0-1	33 (35.1)	1.74	2	1
	2-3	61 (64.9)			

Above table shows that the majority (54.3%) of obstetric patients were severely sick with MEOWS of 7 or more and majority (64.9%), a qSOFA of 2 or more. The average MEOWS and qSOFA scores for all the obstetric patients admitted to ICU were 7.14 and 1.74, respectively.

Table 3: Comparison of means of MEOWS and qSOFA between survivors and non-survivors

Severity score	Survivors (n=43)	Non-survivors (n=51)	p-value (95% CI)
Mean MEOWS	5.56	8.53	0.001
Mean qSOFA	1.47	1.94	0.003

Above table shows that means of MEOWS and qSOFA are statistically significant between survivors and non-survivors.

Table 4: Interventions received by obstetric patients admitted in ICU

Interventions done in ICU	Number of patients	Percentage (%)
Ventilation support	90	95.7
Blood transfusion	33	35.1
Inotropics/vasopressors support	47	50.0
Re-operation	5	5.3
Hemodialysis	4	4.3

Majority of obstetric patients required mechanical ventilation and inotropic or vasopressors support during ICU stay.

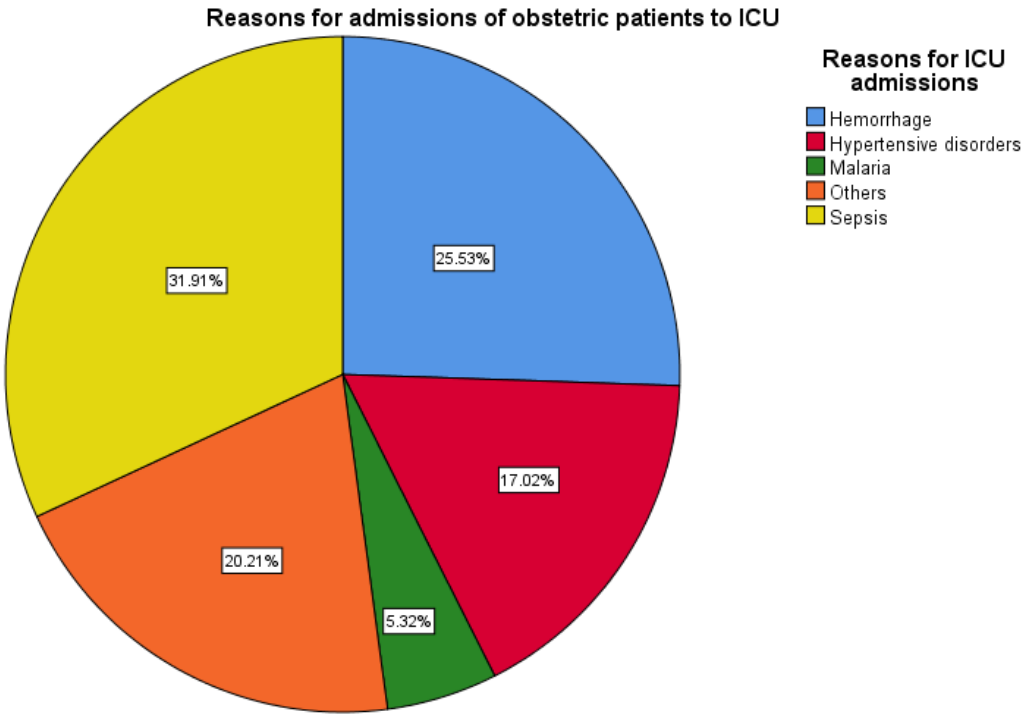

Figure 1. Reasons for obstetric admissions to ICU

According to the reasons of admission of obstetric patients in ICU, sepsis was the most admitting reasons (31.91%) followed by hemorrhage (25.53%), other reasons (20.21%), hypertensive disorders (17.02%) and malaria (5.32%).

Table 5: Outcome of obstetric patients admitted in ICU by hospital

Hospital	Non-survivors n (%)	Survivors n (%)	p-value
CHUB	16 (47.06)	18 (52.94)	0.292
CHUK	35 (58.33)	25 (41.67)	

The above table shows that of 36 obstetric patients admitted at CHUB, 47.06% (16) died; of 60 obstetric patients were admitted in ICU of CHUK, 58.33 % of them died. There is no statistical significance in terms of mortality between both hospitals.

Table 6: Associations between reasons for ICU admissions of obstetric patients and mortality

Reason for ICU admission	N	Survivors, n (%)	Non-survivors, n (%)	Odd ratio [95% CI]	P value
Hemorrhage	24	11 (45.83)	13 (54.17)	1.005 [0.396-2.548]	0.992
Hypertensive disorders of pregnancy	16	9 (56.25)	7 (43.75)	1.664 [0.563-4.921]	0.357
Sepsis	30	9 (30.0)	21 (70.0)	2.644 [1.051-6.652]	0.039
Malaria	5	3 (60.0)	2 (40.0)	1.837 [0.293-11.539]	0.516
Others	19	11 (57.90)	8 (42.10)	1.848 [0.667-5.120]	0.238

Logistic regression of reasons for ICU admissions of obstetric patients shows that sepsis is the most common cause of admissions and a significant independent risk for mortality in ICU.

Table 7: Multivariable logistic regression for MEOWS and mortality prediction in ICU

Variables		Adjusted OR [95%CI]	p-value
MEOWS		1.25[1.07-1.46]	0.005
Caesarean		0.39[0.12-1.22]	0.106
Reason for admission	Hemorrhage	1 (Ref)	
	Sepsis	1.72[0.42-6.94]	0.449
	Others	0.65[0.18-2.39]	0.517

Hemorrhage, sepsis and others causes of ICU admission were considered as potential confounders for ICU mortality. Adjusted Odd ratio of MEOWS for potential confounders is

1.25[95% CI: 1.07-1.46] and p-value=0.005. This shows that an increase of one unit in MEOWS increases the odd of ICU mortality by 1.25 times.

Table 8: Multivariable logistic regression for qSOFA and mortality prediction in ICU

Variables		**Adjusted OR [95%CI]**	**p-value**
qSOFA		2.81[1.25-6.30]	0.012
Caesarean		0.33[0.11-1.02]	0.054
Reason for admission	Hemorrhage	1 (Ref)	
	Sepsis	1.50[0.38-5.93]	0.559
	Others	0.88[0.24-3.31]	0.855

The odd ratio of qSOFA adjusting for potential confounders (reasons for admission and Cesarean section). An increase of one unit in qSOFA increase the odd of ICU mortality by 2.81.

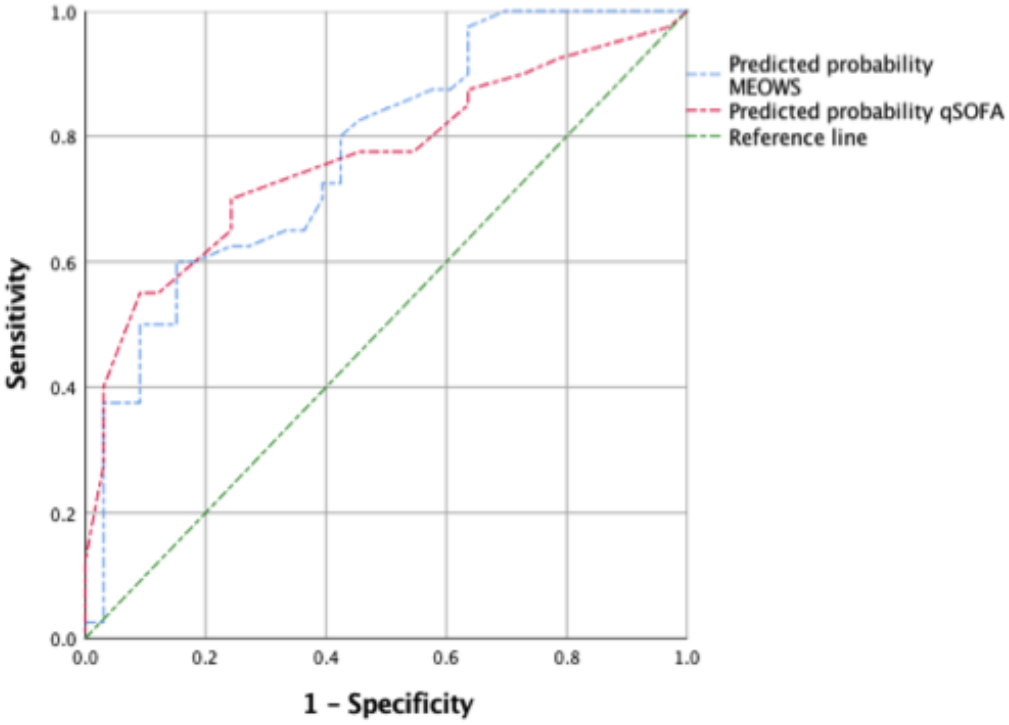

Figure 2: ROC curves for prediction of mortality by MEOWS and qSOFA

The above graph shows that the AUROC for MEOWS is 0.773[0.666-0.880]; p<0.0001 and 0.764[0.654-0.873]; p<0.0001 for qSOFA. The values in the figure show that MEOWS and qSOFA have fair discrimination capacity for mortality prediction.

CHAPTER 4: DISCUSSION

This study had the main objective to assess epidemiology, outcome and evaluate accuracy of predictive mortality prediction tools for obstetric patients admitted to ICUs of the main public hospitals in Rwanda. We found that obstetric admissions to ICU account for 12.8% of all ICU admissions and 1.8% of all deliveries. The major reasons of admission to ICU were sepsis (31.9%) and obstetric hemorrhage (25.5%). The overall mortality was as high as more than 50% and length of stay in ICU was 6.06±7.525 days. The rates of ICU admission for obstetric patients in Rwanda are high compared to high income countries (HICs). The rate of ICU admission of obstetric patients in the United States of America was 0.4% of all delivery that occurred between 1994-2008 with mortality of 1.8% [22]. Research done in England showed that obstetric patients admitted to ICU were 0.22% of all deliveries between years 1994-2015 [23]. Findings show almost twice the number of admissions found in the study done in the Netherland from 1990 to 2001 which showed that incidence of obstetric admission to ICU was 0.76% and mortality of 4.9%. The mortality found in the present study is high compared to high income countries but similar to the one for all ICUs patients in Rwanda (48.7%) [14].

Our rate of obstetric admissions to ICU and length of stay are closer to that found in the middle income countries. Research done in Turkey in 2006-2009 showed that obstetric patients requiring ICU admissions represented 1% of all deliveries. In that study, hypertensive disorders of pregnancy was the most common reason of admission to ICU with mean length of stay in ICU relatively closer to one in our findings (6 days versus 7 days) but the mortality was 12% [24]. A study done in Brazil between the years 2007 and 2009 showed that obstetric patients requiring ICU admission represented 1.27% of all deliveries with the mean length of stay to ICU of 5 days[25]. In our study, the rate of ICU admission to all deliveries might have been higher given the limited capacity of our ICUs representing 1.5% of hospital beds [26] while the number may be more than 10% in the United State between 2000 and 2005 as high income country[27].

Compared to some countries of sub-Saharan Africa, our study showed that the number of obstetric patients requiring ICU admission is also relatively higher. Our results showed these figures to be twice that of South Africa but obstetric patients are rather in small proportions

compared to ours. A study conducted in South Africa in 2008-2012 showed that obstetric patients requiring ICU admission represented 0.95% of all deliveries and 6.7% of all ICU admissions and the overall mortality was 34.8% [8]. This discrepancy may be due to high standards of South African health system though localized in sub-Saharan region. A study done in Nigeria showed that obstetric ICU requiring ICU admissions represent 0.96% of all deliveries and 19.5% of all ICU admissions which has similar results compared to ours [28]. In study done in Kenya found that obstetric patients requiring ICU admission represents 0.24% of all deliveries and 1.25% of all ICU admissions with average length of stay in ICU relatively closer to that in our study[4].

The reasons for admission of our obstetric patients differ from those prevailing in rich countries and this may partly explain the huge discrepancies in mortality as sepsis was one of the commonest cause of admission and it is known that it is associated with a high mortality even in high income countries like in United states(28%)[29]. The second commonest cause of admission is hemorrhage and resulting coagulation disorders related to delayed hemostasis and lack of readily available blood products especially those containing coagulation factors like platelets, cryoprecipitate and concentrates of coagulations factors. In high and middle income countries, hypertensive disorders of pregnancy ranges between 19.3-62.0% and obstetric hemorrhage ranges between 18.3-56.3% [8,22,23,30]. The case fatality for hypertensive disorders was 24.5% in the United States [22] against 56.25% in our study explaining the extremely higher morality observed this study. In our study, the two leading causes of obstetric patients admitted to ICU were sepsis (31.9%) and obstetric hemorrhage (25.5%). These findings are relatively the same as ones in the study conducted in Kenya where obstetric hemorrhage and sepsis constitute two major leading causes of ICU admissions of obstetric patients (44% and 26% , respectively)[4].

Furthermore, given the limited capacity of our ICUs, patients who were admitted were in critical conditions as 95.7% needed ventilator support while 50% were on vasopressors contrasting with finding of Kenyan study by Githae et al, where obstetric patients required ventilation support (33%) and inotropic support were 33% and 30%, respectively[4].

Maternal mortality is relatively higher among obstetric patients in our study compared to recently published works in high and middle countries as early recognition of critically ill

obstetric patients seems challenging. It remains difficult to identify patients who are more likely to benefit from ICU in Low Income Countries (LICs) through an evidence-based process. Similarly, the prediction of the outcomes is challenged by the lack of adequate scales especially for obstetric patients. In our study, the MEOWS and qSOFA were found easy tools as components of these tools are routine clinical assessment. Yet, these predictive tools have good discriminative power with an area under the curve showing their performance (AUROC: 0.773[0.666-0.880], p<0.0001 for MEOWS and 0.764[0.654-0.873], p<0.0001 for qSOFA). Similarly, in a study conducted in Australia among emergency patients with suspected sepsis, it was found that a positive qSOFA (≥2 points) identified those at high risk of in hospital mortality or longer ICU stay[31]. In the study done in India, the AUROC showed good discriminative power with qSOFA in predicting mortality (AUROC: 0.73; 95% CI, 0.69-0.77) among septic patients admitted, both in ICU and non-ICU[32]. Above findings have similarities with our study with regards to qSOFA as predictive model, though, our findings are applied in obstetric patients. Our study evaluated accuracy of MEOWS predictive model. Our findings are comparable to the findings in a research conducted in the United Kingdom which showed that MEOWS had high sensitivity and good specificity to early, detect morbidity among obstetric patients outside ICU [14]. Though different setting, MEOWS as a simple bed side model may be applied to obstetric patients at admission to ICU to predict their outcome.

In this study, data were prospectively collected from two tertiary hospitals which may give its strength to be generalized to whole obstetric population. However, our study had limitations as the sample size was small to be extrapolated to the general population. This caused by limited number of bed in ICU to accommodate many patients including obstetric patients as participants of our study. Furthermore, we could not follow up obstetric patients discharged from ICU for mortality at 28 or 90 days post-discharge.

CONCLUSION

Sepsis and hemorrhage are major reasons for admissions to ICU among obstetric patients.

There were very high ICU mortality rates in part explained by the reasons for admission.

This mortality can be adequately predicted by the Modified Early Obstetric Warning Score (MEOWS) and the quick Sequential Organ Failure Assessment (qSOFA) score but these tools need to be validated in a large study.

RECOMMENDATIONS

In conclusion of this work, we would like to recommend the following:

- To develop mechanisms to prevent surgical site infections as sepsis was the leading cause of admissions with high mortality rate among critically ill obstetric patients.
- To develop protocols and guidelines on management of post-partum hemorrhage within hospitals.
- Routine use of scores in audit of ICU patients
- Improve labour ward care to reduce morbidity that leads to ICU admissions of obstetric patients
- To evaluate root causes of sepsis especial among obstetric patients through quality improvement projects within hospitals.
- Further researches on a large scale to evaluate accuracy of MEOWS and qSOFA in predicting mortality among obstetric patients admitted in ICU.

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APPENDICES

Appendix 1: Modified Early Obstetric Warning Score (MEOWS)

Score	**3**	**2**	**1**	**0**	**1**	**2**	**3**
Temperature (Celsius degree)		<35	35-35.9	36-37.4	37.5-37.9	38.0-38.9	≥39
Systolic BP	≤69		80-89	90-139	140-149	150-159	≥160
Diastolic BP			≤49	50-89	90-99	100-109	≥110
Heart rate		<40	40-49	50-99	100-109	110-129	≥130
Respiratory rate	≤10			11-19	20-24	25-29	≥30
AVPU				Alert	Responds to voice	Responds to pain	Unresponsive
Urine output (mls/h)	<10	<30		Not measured			

Table showing MEOWS template. AVPU: Alert, Voice, Pain and Unresponsive. BP: Blood pressure in mmHg. Reproduced with permission of Bercher C, 2018(18).

Appendix 2: The Quick Sequential Organ Failure Assessment score

Criteria	**Points**
Respiratory rate ≥22	1
Altered level of consciousness	1
Systolic BP ≤100	1

Table showing how to calculate qSOFA score. Reproduced with permission of Singer R. et al, 2016(22).

Appendix 3. Data collection questionnaire

I. DEMOGRAPHIC DATA

1.1. Identification

Age:…. years

ID No:……..

Number of gestations (Gravida):….

Insurance: Yes/No

1.3. Transferring facility: DH ☐

Teaching hospital ☐

Provincial hospital ☐

Private clinic ☐

Health center ☐

From home ☐

1.3. Event before admission to ICU

Length of stay in maternity department before ICU admission: <24hours ☐; >24hours ☐

Deliveried: Yes ☐ No ☐

Mode of delivery: Vaginal ☐ cesarean section ☐

Site of delivery: Health center ☐ District hospital ☐ Private clinic ☐

Home ☐ Teaching hospital (CHU) ☐ Others ☐

Had cardiac arrest ☐

Laparotomy/ re-look ☐

Received vasopressor (Adrenaline, Dopamine, Ephedrine, Norepinephrine) ☐

Mechanical ventilation ☐

Transfusion: Yes/No

II. CHARACTERISTIC AT ADMISSION TO ICU

2. 1. Patient admitted in ICU from: Theatre ☐ Emergency ☐ Maternity ward ☐

2.2. Reason of admission to ICU

Obstetric diagnosis at admission to ICU (Note: tick in front of the diagnosis)	**Co-morbidity (Write name of Pre-existing disease)**
Hemorrhage	
Preeclampsia/eclampsia	
HELP syndrome	
Acute kidney injury	
Sepsis	
Cardiomyopathy	
Pulmonary embolism/Deep venous thrombosis	
Malaria	
Delayed recovery from anesthesia	
Stroke	

2.3. Clinical signs

Systolic BP:……mmHg; Heart rate:…../min; Temperature(^{o}C):……, Respiratory rate:……../min; Oxygen saturation (%): ……with/without oxygen

2.4. Organ failure

Central nervous system: Alert ☐ Reacting to voice ☐ Reacting to pain ☐

Unresponsive ☐

Respiratory: Intubated: Yes/No

Liver: AST:……..IU, ALT: …….IU

Renal: Urine output:……ml/kg/h, Urea:……, Creatinne:…….

Hematology: Hemoglobin:…..g/dl

III. INTERVENTIONS DURING ICU STAY AND OUTCOME

Mechanical ventilation ☐ length of mechanical ventilation:……days

Vasopressors ☐ CPR ☐

Transfusion: Yes/No

Number of Units……., blood product:…….

Re-operation: Yes/No Hemodialysis ☐

2.4. Diagnosis at discharge/death

Primary diagnosis:……

Secondary diagnosis:……..

2.4. Patient outcome: Survived: Yes/No

Thank you very much! / Merci beacoup! /Murakoze cyane!

Appendix 4: Ethical approval

UNIVERSITY OF RWANDA — COLLEGE OF MEDICINE AND HEALTH SCIENCES

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 26/01/2017

Dr RUDAKEMWA Alcade
School of Medicine and Pharmacy, CMHS, UR

Approval Notice: No 118 /CMHS IRB/2017

Your Project Title:*" Obstetric Admissions In Intensive Care Units Of CHUB And CHUK: Prevalence And Outcomes"* has been evaluated by CMHS Institutional Review Board.

		Involved in the decision		
		Yes	No (Reason)	
Name of Members	**Institute**		**Absent**	**Withdrawn from the proceeding**
Prof Kato J. Njunwa	UR-CMHS		X	
Prof Jean Bosco Gahutu	UR-CMHS	X		
Dr Brenda Asiimwe-Kateera	UR-CMHS	X		
Prof Ntaganira Joseph	UR-CMHS		X	
Dr Tumusiime K. David	UR-CMHS		X	
Dr Kayonga N. Egide	UR-CMHS	X		
Mr Kanyoni Maurice	UR-CMHS	X		
Prof Munyanshongore Cyprien	UR-CMHS		X	
Mrs Ruzindana Landrine	Kicukiro district		X	
Dr Gishoma Darius	UR-CMHS	X		
Dr Donatilla Mukamana	UR-CMHS		X	
Prof Kyamanywa Patrick	UR-CMHS		X	
Prof Condo Umutesi Jeannine	UR-CMHS		X	
Dr Nyirazinyoye Laetitia	UR-CMHS	X		
Dr Nkeramihigo Emmanuel	UR-CMHS		X	
Sr Maliboli Marie Josee	CHUK	X		
Dr Mudenge Charles	Centre Psycho-Social	X		

After reviewing your protocol during the IRB meeting of where quorum was met and revisions made on the advice of the CMHS IRB submitted on 17th January 2017, **Approval letter has been granted to your study.**

Please note that approval of the protocol and consent form is valid for **12 months**.
You are responsible for fulfilling the following requirements:

1. Changes, amendments, and addenda to the protocol or consent form must be submitted to the committee for review and approval, prior to activation of the changes.
2. Only approved consent forms are to be used in the enrolment of participants.
3. All consent forms signed by subjects should be retained on file. The IRB may conduct audits of all study records, and consent documentation may be part of such audits.
4. A continuing review application must be submitted to the IRB in a timely fashion and before expiry of this approval
5. Failure to submit a continuing review application will result in termination of the study
6. Notify the IRB committee once the study is finished

Sincerely,

Date of Approval: The 26th January 2017
Expiration date: The 26th January 2018

for Professor Kato J. NJUNWA
Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

Cc:
- Principal College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate Studies, UR