Evaluation of the Modified Early Obstetric Warning System (MEOWS) as an early detection tool for critically ill obstetric patients in Rwanda

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Abstract

Rwanda's maternal mortality rate (MMR) was the 44th highest in the world with an estimated 248 deaths per 100,000 live births in 2017. The most common causes of maternal mortality in Rwanda are postpartum hemorrhage (PPH), eclampsia, sepsis (infection), obstructed labor, and malaria. In order to achieve goal 3 of the United Nations Sustainable Development Goals, which aims to decrease the MMR to less than 70 maternal deaths per 100,000 live births by 2030, healthcare providers in Rwanda must direct their attention to screening for risk factors of maternal death and managing delivery-related complications. A sample of 800 medical records were analyzed with 364 MEOWS and 436 No MEOWS cases. **The aim was to determine if the protocol decreased delay in care pre-delivery thus reducing maternal morbidity and mortality.** No significant relationship was found between the implementation of the MEOWS tool and a decreased delay in detection and management of critically ill obstetric patients in Rwandan district hospitals amongst all treatments analyzed. Although the results of this study remain inconclusive, this study emphasizes the need for a standardized triage and a screening protocol for obstetric patients within district hospitals. Further studies should be conducted with a focus on groups that receive medications pre-partum to most effectively analyze the tool.

Introduction

The global campaign to reduce maternal mortality was launched in 1987 when three United Nations agencies–the World Health Organization, the U.N. Population Fund, and the World Bank–sponsored the International Safe Motherhood Conference.[1] The event's goal was to raise awareness about the high number of women that die each year due to complications of pregnancy and childbirth.[1] By 2015, reports indicate that only 18 out of 43 countries met the U.N. Millennium Development Goal 5 in Sub-Saharan Africa.[2] Rwanda was one of the 18 countries. Throughout recent decades Rwanda has expressed a commitment to improving maternal health outcomes, significantly reducing their maternal mortality rate (MMR) from 1,300 deaths to 290 deaths per 100,000 live births from 1990 to 2015, respectively.[2] This reduction was due in large part to the increased number of women who gave birth in a health-care facility attended by a qualified healthcare professional from 59% in 1990 to more than 71% in 2014.[3]

As of 2017, Rwanda's MMR was the 44th highest in the world with an estimated 248 deaths per 100,000 live births. The most common causes of maternal mortality in Rwanda are postpartum hemorrhage (PPH), eclampsia, sepsis (infection), obstructed labor, and malaria. The overwhelming majority of maternal deaths or near-misses at the Centre Hospitalier de Kigali (CHUK) occur after the patient has been transferred from district hospitals (DHs), mostly due to infection (32%) or PPH (20%).[4] The United Nations Sustainable Development Goal 3 aims to decrease the MMR to less than 70 maternal deaths per 100,000 live births by 2030. To achieve SDG 3, healthcare providers in Rwanda must direct their attention to screening and managing risk factors of maternal death and delivery-related complications. Deaths caused by PPH and sepsis are shown to be preventable through training and the use of guidelines to screen for risk factors and manage complications.[5] The Modified Early Obstetric Warning System (MEOWS) was developed in the United Kingdom as a fast and effective triage system originally for midwives when managing critically ill obstetric patients.[6] Dr. Honorine Ingabire adapted the triage system to be utilized in Rwandan district hospitals. The tool determines the patient's risk of experiencing PPH, pre-eclampsia, and sepsis and to prompt timely response and appropriate care for critically ill obstetric patients.[7] The primary medications administered in district hospitals for the morbidities of PPH, pre-eclampsia, and sepsis include transfusion, Nifedipine and MgSO4, and antibiotics. Medications were delivered based on risk factors. Blood transfusions were administered to patients hemorrhaging on arrival to manage PPH. Nifedipine is an anti-hypertensive which treats high blood pressure, a risk factor of pre-eclampsia. MgSO4 is the agent most commonly used for severe pre-eclampsia to prevent eclampsia. Antibiotics were administered to patients presenting with risk factors relating to infection (sepsis) which include, but are not limited to, tachycardia, hypotension, and fever.

Although the most common obstetric complications in Rwanda are known, the tools to prevent these complications have not been used as effectively as they could be. Each hospital uses their own triage system; however, observations discovered that usage of these protocols is not standardized within each hospital nor across district hospitals and that they are often left incomplete.

The primary objectives of this study include (a) to determine whether the use of the MEOWS tool can improve patient outcomes by decreasing the delay in detection and management of critically ill obstetric patients and (b) to determine whether the MEOWS tool predicts morbidity. This objective was pursued by this research team. An additional objective (c) is to determine whether the implementation of the MEOWS tool is feasible and accepted in the district hospital setting. This objective will be completed by Dr. Honorine Ingabire, who designed this project, at a later date.

Methods

This research study was divided into two parts: interviews and retrospective chart review. Interviews of the health care staff are yet to be conducted by Dr. Ingabire as a qualitative assessment of the feasibility and acceptability of the

MEOWS protocol (Objective c). The research team quantitatively analyzed obstetric charts within the allotted time interval to assess if the MEOWS protocol decreased delay in detection and management (Objective a) as well as morbidity (Objective b) of critically ill obstetric patients.

The adaption of the MEOWS tool used in Rwanda DHs is a two part quantitative and qualitative assessment. The qualitative assessment evaluates a patient's physical symptoms and pertinent medical history and categorizes her risk for postpartum hemorrhage, pre-eclampsia, or infection as high, moderate, or low based on those findings. The quantitative assessment assesses a patient's vital signs upon admission and categorizes each vital sign with a score based on the degree to which the vital sign is out of the normal range. Vital signs assessed are heart rate, blood pressure, respiratory rate, temperature, AVPU, and urine output. Scores for each vital sign are added to get a total MEOWS score and then categorized as low, moderate, or high. Patients with higher MEOWS scores would be considered at higher risk for postpartum complications. The adaption of the MEOWS as used in DHs can be seen in Appendix A.

Data collection for this retrospective study took place in four district hospitals: Kibagabaga, Muhima, Nyanza, and Kabutare. Each obstetric patient was randomly assigned as a MEOWS or No MEOWS patient. These classifications detailed whether the patients were assessed using the MEOWS protocol or the hospital's existing triage system. The information was first recorded on paper and in excel spreadsheets, but was later transferred to the Center for Disease Control's software EpiInfo. The total sample size was 800 paper records, with 364 MEOWS and 436 No MEOWS cases. Individual sample sizes were predetermined by hospital staff resulting in sample size discrepancies. Of the 800 records, 241 were from Kibagabaga District Hospital in Kigali, 109 from Muhima District Hospital in Kigali, 241 from Kabutare District Hospital in Butare, and 204 from Nyanza District Hospital in Nyanza, and two charts were recorded without hospital specification. This demonstrates the variance in district hospital size. The sample size was restricted to chart recordings by hospital staff between April 11th, 2019 and July 7th, 2019. Retrospective data collection took place in July 2019. Each district hospital had variations of documentation strategies and file organization. Charts were predominantly written in a combination of English and French, in addition to occasional notes written in the native language Kinyarwanda. Navigating documentation styles and language, demographic information, time of admission, delivery and drug administration, length of stay, and postpartum complications including morbidity (postpartum hemorrhage, infection, pre-eclampsia, and other) and outcome (referral, reoperation, death, and other) were recorded in each of the district hospitals. Data analysis was done in excel after exporting the data from Epi-Info back into an Excel document. Analysis primarily focused on delay in medication administration post admission and pre-partum to evaluate vigilance of the health care staff.

Outcomes

Data collected across all four hospitals were analyzed to understand morbidity rate amongst patients who received the MEOWS protocol upon admission to the maternity ward of each hospital and those who underwent the hospital's own triage assessment to better understand the efficacy of the MEOWS protocol. The 800 cases were analyzed collectively without hospital specification because population sizes of morbidity rates were too small when analyzed in respect to hospital.
The 800 cases were first categorized as MEOWS (n = 364) and No MEOWS (n = 436). Population size was subsequently analyzed to classify patient morbidity (defined as infection, pre-eclampsia, postpartum hemorrhage, or other) and outcomes (ICU admission, referral, and reoperation). This can be seen in Table 1.

To understand the efficacy of the MEOWS protocol, analysis of the time between admission and administration of medications was conducted. In order to evaluate the success of the protocol as a pre-partum triage tool and its role in identifying symptoms of morbidity in time to allow medical teams to administer interventions prior to delivery, only the patients that received medications before

delivery were analyzed to compare the outcomes of the MEOWS and the No MEOWS populations. Table 2 details the number of patients who received medications within each subgroup, both overall and pre-partum.

The average time delay of administration of medications pre-partum within the MEOWS and No MEOWS subgroups was conducted amongst patients who were recorded as having a positive morbidity and compared against patients who were not. Time delay was calculated by subtracting the time of medication administration from the time of admission, which was when the MEOWS or other hospital triage protocols would have been completed. Analysis was conducted amongst each subgroup for each population that received any treatment pre-partum associated with the studied morbidities. These medications include any antibiotic for infection, MgSO4 (Magnesium Sulfate) and/or Nifedipine for pre-eclampsia, or a blood transfusion for PPH. A 95% confidence interval was established for each average to determine an upper and lower value and give context to each average delay. Only three patients across the four district hospitals received a transfusion pre-partum. All the patients were in the No MEOWS sample, so comparative analysis was unable to be conducted. Results are detailed in Tables 3-5.

Discussion

This preliminary study aimed to evaluate the efficacy of a Modified Early Obstetric Warning System protocol for four district hospitals in Rwanda. In the instance of pre-partum administration of MgSO4 and Nifedipine, there is a positive correlation between the groups that received the MEOWS protocol and a decreased delay in administration of medications. However, this same correlation cannot be seen clearly amongst any other groups. Ultimately, population sizes that received medications pre-partum were too small to definitively determine that the MEOWS protocol decreases the delay in detection and management of critically ill obstetric patients within Rwandan district hospitals. Data results regarding the feasibility of the protocol within the hospitals of Kibagaga, Muhima, Kabutare, and Nyanza are pending and are being conducted outside the period of data collection, but will provide valuable insight into how each hospital's medical staff interacted with the protocol. This protocol was more extensive than any pre-established protocol seen in charts of No MEOWS patients. Therefore, further training of the protocol should be conducted within district hospitals before hospital triage teams use them.

While gathering data during the collection phase, discrepancies of use amongst each hospital were noticed. Most notable was the inconsistency of documenting any patient receiving a scheduled C-section as "high risk" for infection as described in the criteria of the qualitative "Infection" section of the MEOWS protocol. Most hospitals did not take this risk into account which lead researchers to infer that this part of the assessment was not understood. There was a high amount of elective c-sections amongst the 800 patient sample population, therefore this classification as seen in the MEOWS protocol is important to note. Similarly, the protocol should also exist in Kinyarwanda and French in addition to English, which would further the understanding of the protocol for hospital staff, who's linguistic abilities reflect the linguistic diversity of Rwanda, in general.

Ultimately, the results of this study are inconclusive and future studies should be conducted with an increased total population size to further understand the efficacy of the MEOWS protocol. Although the analyzed population subgroups were small, morbidity rates were consistent amongst both subgroups.

Conclusion

Morbidity rates between the MEOWS and No MEOWS groups were relatively the same. Although the results of this assessment do not definitively evaluate the MEOWS protocol as a helpful or unhelpful tool in the Rwandan district hospital setting, our results highlight the need for a standardized and effective protocol to be implemented at this level of care, as well as recommendations to make the use of the protocol

most comprehensive. MEOWS samples treated pre-partum for pre-eclampsia showed a decrease in morbidity rate. Given the success of this aspect of the protocol, increased training on the proper use of the MEOWS protocol can potentially replicate these results amongst other morbidities. One can infer that these problems are nation-wide given the geographic diversity of the district hospitals studied. In conclusion, this study can be used as a preliminary case study for the management of critically ill obstetric patients in Rwanda and can benefit future studies that seek to improve the care of obstetric patients in Rwanda.

Tables 1-5

Stats Regarding Total Morbidity and Outcome Rates			
	Total Population (%) n=800	MEOWS Population (%) n=364	No MEOWS Population (%) n=436
Morbidity			
Infection	35 (4.38%)	18 (4.95%)	17 (3.90%)
Preclampsia	38 (4.75%)	14 (3.85%)	24 (5.50%)
PPH	19 (2.38%)	10 (2.75%)	9 (2.06%)
Other	22 (2.75%)	11 (3.02%)	11 (2.52%)
Outcome			
ICU Admission	10 (1.25%)	6 (1.65%)	4 (0.92%)
Referral	20 (2.50%	13 (3.75%)	9 (2.06%)
Reoperation	2 (0.25%)	2 (0.55%)	

Table 1: Total morbidity and outcome rates across all four hospitals

Pt's who receive medication MEOWS v. No MEOWS			
	Sample Population (%) n=800	Pt's who receive medications	Pt's who receive medication prepartum
MEOWS	364 (45.5%)	140 (38.5%)	28 (20%)
NO MEOWS	436 (54.4%)	167 (38.3%)	41 (25%)

Table 2: Comparison of subgroups and medication administration

Average time between Admission and Administration of Antibiotics between all four hospitals				
	MEOWS (+) Infection	No MEOWS (+) Infection	MOEWS (-) Infection	No MEOWS (-) Infection
Average	11:20:30	23:05:00	10:18:17	6:04:04
Standard Deviation	0.671	0.827	0.554	0.258
95% Confidence	0.465	0.662	0.411	0.135
Upper Value	**22:30:29**	**14:58:21**	**20:09:45**	**9:18:23**
Lower Value	0:10:31	7:11:39	0:26:49	2:49:46
Population Size (Patients)	8	5	7	14

Table 3: Time to antibiotic

Average time between Admission and Administration of Nifedipine between all four hospitals				
	MEOWS (+) Preclampsia	No MEOWS (+) Preclampsia	MOEWS (-) Preclampsia	No MEOWS (-) Preclamsia
Average	1:31:24	11:24:49	6:27:00	9:02:40
Standard Deviation	0.035	0.364	0.157	0.323
95% Confidence	0.031	0.215	0.137	0.258
Upper Value	**2:16:07**	**16:34:51**	**9:44:48**	**15:14:57**
Lower Value	0:46:41	6:14:47	3:09:12	2:50:23
Population Size (Patients)	5	11	5	6

Table 4: Time to Nifedipine

Average time between Admission and Administration of MgSO between all four hospitals				
	MEOWS (+) Preclampsia	No MEOWS (+) Preclampsia	MOEWS (-) Preclampsia	No MEOWS (-) Preclamsia
Average	**2:09:15**	**8:53:54**	**n/a**	**n/a**
Standard Deviation	0.038	0.243	n/a	n/a
95% Confidence	0.375	0.151	n/a	n/a
Upper Value	**3:03:13**	**12:31:04**	**n/a**	**n/a**
Lower Value	**1:15:17**	**5:16:44**	**n/a**	**n/a**
Population Size (Patients)	4	10	0	0

Table 5: Time to MgSO4

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