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AVERTING MATERNAL DEATH AND DISABILITY

Lost opportunities for effective management of obstetric conditions to reduce maternal mortality and severe maternal morbidity in Argentina and Uruguay

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ABSTRACT

Objective: To review the use of evidence-based practices in the care of mothers who died or had severe morbidity attending public hospitals in two Latin American countries. *Methods:* This study is part of a multicenter intervention to increase the use of evidence-based obstetric practice. Data on maternal deaths and women admitted to intensive care units whose deliveries occurred in 24 hospitals in Argentina and Uruguay were analyzed. Primary outcomes were use rates of effective interventions to reduce maternal mortality (MM) and severe maternal morbidity (SMM). *Results:* A total of 106 women were included: 26 maternal deaths and 80 women with SMM. Some effective interventions for severe acute hemorrhage had a high use rate, such as blood transfusion (91%) and timely cesarean delivery (75%), while active management of the third stage of labor (25%) showed a lower rate. The overall use rate of effective interventions was 58% (95% CI, 49%–67%). This implies that 42% of the women did not receive one of the effective interventions to reduce MM and SMM. *Conclusion:* This study shows a low use of effective interventions to reduce MM and SMM in public hospitals in Argentina and Uruguay. Dissemination and implementation of evidence-based practices must be guaranteed to effectively achieve progress on maternal health.

1. Introduction

There is general consensus that increasing women's access to good quality obstetric care is one key approach to decrease global maternal mortality [1].

Evidence-based health care fosters the identification and implementation of good obstetric practices. Many efforts have been made to identify and disseminate effective healthcare practices that should be implemented to prevent maternal deaths [1–3]. However, approximately half of the health services of 49 low-resource countries lack the capacity (including policy, resources, monitoring, health promotion, and training) to implement these effective interventions [4]. In addition, there is a recognized gap in the implementation of evidence-based practices even when there are no other barriers to this [5].

We report the results of a study that measured the use of evidence-based obstetric practices in public hospitals in two Latin American countries. This paper focuses on those mothers who died or had severe morbidity (near-miss).

2. Materials and methods

2.1. The Guidelines Trial

We conducted an international, multicenter, prospective, descriptive study, nested in the cohort of women who were subjects in the "Guidelines Trial" (Guidelines Trial professionals are listed at the end of the paper). This study was a cluster randomized clinical trial of a behavioral intervention to facilitate the development and implementation of clinical practice guidelines in Latin American maternity hospitals [6]. Twenty-four public hospitals participated: 20 hospitals in Argentina (15 hospitals in the Province of Buenos Aires, 4 in the city of Rosario, and 1 in the city of Buenos Aires) and 4 in Uruguay (2 in Montevideo, and 1 each in Salto and Paysandú). Public hospitals in Argentina and Uruguay attend low- and middle-income populations, representing 64% of pregnant women and 85% of maternal deaths in the region [7,8].

Details of methods of the trial can be read elsewhere [6]. Briefly, the "Guidelines Trial" included collection of detailed maternal and perinatal data on all births occurring at participating hospitals during the study period. Every maternal death, all women admitted to an intensive care unit (ICU), and referrals were reported to the trial data center within 48 hours of occurrence. Information on maternal history, pregnancy,

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and delivery was recorded on standardized forms in a standardized perinatal clinical record used by all hospitals [9].

2.2. The maternal mortality and severe morbidity study

Nested within the Guidelines Trial was a study of maternal deaths and severe morbidities. Eligible criteria for inclusion in the study were:

- Maternal deaths that occurred in women who gave birth between September 1, 2003, and December 31, 2005, in any of the 24 participating hospitals (total number of deliveries: 89 995);
- Women who were admitted to an ICU with severe maternal morbidity (SMM) and gave birth between January 1, 2005, and December 31, 2005, in the same hospitals (total number of deliveries: 27 206).

A longer recruitment period was needed for maternal deaths to increase the sample size. Women with severe abortion morbidities were not included since only pregnancies of more than 22 weeks were included in the Guidelines Trial.

A maternal death was defined as a death occurring during pregnancy or within 42 days of its termination, irrespective of its duration and site, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes [10]. SMM was defined as ICU admission during pregnancy or the postpartum period, before discharge from the hospital [11]. Maternal deaths and SMM were classified according to WHO International Classification of Diseases (ICD-10) [10], and to the codes proposed in the WHO systematic review of maternal morbidity and mortality [11].

2.3. Preventive interventions reviewed

We selected 3 effective preventive interventions during pregnancy, delivery, and the immediate postpartum period that have been proven to reduce maternal mortality and severe morbidity: active management of the third stage of labor (AMTSL) [12]; the administration of magnesium sulfate for women with pre-eclampsia [13]; and the administration of antibiotics for preterm premature rupture of membranes (pPROM) [14]. Preventive interventions for obstructed or prolonged labor were not included because about 99% of deliveries are attended in health facilities and, therefore, it is an infrequent cause of MM in Argentina and Uruguay.

AMTSL to reduce postpartum hemorrhage was defined considering only the component prophylactic administration of 10 IU of oxytocin immediately after delivery of the neonate in a vaginal delivery to prevent hemorrhage (the other components of AMTSL are not recorded) [12,15].

Administration of magnesium sulfate for women with pre-eclampsia to prevent eclampsia was defined as one of two magnesium sulfate regimens. The intravenous (IV) regimen consisted of a loading dose of slow IV injection of 4 g followed by a maintenance regimen of 1–2 g/hour in 100 mL of maintenance solution. The intramuscular (IM) regimen consisted of 5 g to each buttock, followed by 5 g every 4 hours to alternate buttocks [13,16].

Administration of antibiotics for pPROM was defined as the use of either penicillin or erythromycin to prevent infection [17].

2.4. Treatment interventions

Three other beneficial forms of care in the presence of life-threatening conditions were evaluated: performing timely cesarean delivery, the administration of magnesium sulfate in women with eclampsia [18,19], and providing blood transfusions in cases of severe acute hemorrhage. Timely cesarean delivery was defined as all procedures in cases of antepartum or intrapartum hemorrhage performed in less than 30 minutes between admission to the hospital or diagnosis of the hemorrhage and delivery.

Once maternal deaths and SMM cases had been identified and clinical records located, a research assistant completed specific data forms. To preserve anonymity, cases were identified only by study enrollment numbers.

Two independent researchers—obstetrician and junior investigator—analyzed each clinical record to check the reliability of classification and to assess the main and secondary causes of death or morbidity. In case of disagreement, the principal investigator (an obstetrician) made the final decision. The clinical record was classified as "high quality" when the main causes of MM or SMM, and the use of effective interventions were clearly identified.

2.5. Outcome variables

Three primary outcome variables were used.

2.5.1. Specific Use Rate

The Specific Use Rate for each intervention to reduce specific causes of death and morbidity was defined as: the number of complication-specific interventions used (in women who died or were admitted to the ICU) divided by the total number of opportunities to use complication-specific interventions (in women who died or were admitted to the ICU).

2.5.2. Overall Use Rate

The Overall Use Rate of effective interventions to reduce MM and SMM was defined as: the total number of effective interventions used for all complications (in women who died or were admitted to the ICU) divided by the total number of opportunities to use effective interventions for all complications (in women who died or were admitted to the ICU).

2.5.3. Lost Opportunities Rate

The Lost Opportunities Rate to use effective interventions to reduce mortality and severe morbidity was defined as the complement of the Overall Use Rate.

2.6. Secondary outcome variables

2.6.1. Hospital Maternal Death Ratio (HMDR)

The HMDR was the number of maternal deaths during a given period of time per 100 000 live births in the same hospitals in the same time period.

2.6.2. Severe Maternal Morbidity Ratio (SMMR)

The SMMR for all hospitals included in 2005 was the number of SMM cases per 1000 live births during the same time period.

2.6.3. Case-Fatality Rate

This was the proportion of women who presented with SMM and then died [20].

2.6.4. Proportional distribution of complications

This was the contribution each complication made to overall severe morbidity and mortality. Causes were classified as main or secondary causes, taking into account the most prevalent causes of MM and SMM in Argentina [7]. The main causes were direct obstetric: hemorrhage; infection/sepsis; and hypertensive disorders. We considered all other direct and indirect obstetric causes as secondary.

2.7. Data management and statistical analysis

The information available for all MM and SMM cases was entered into an Epi-Info 2000 database (CDC, Atlanta, GA, USA). Descriptive statistics (rates and ratios) were calculated, with their respective 95% confidence intervals and frequency distributions of MM and SMM

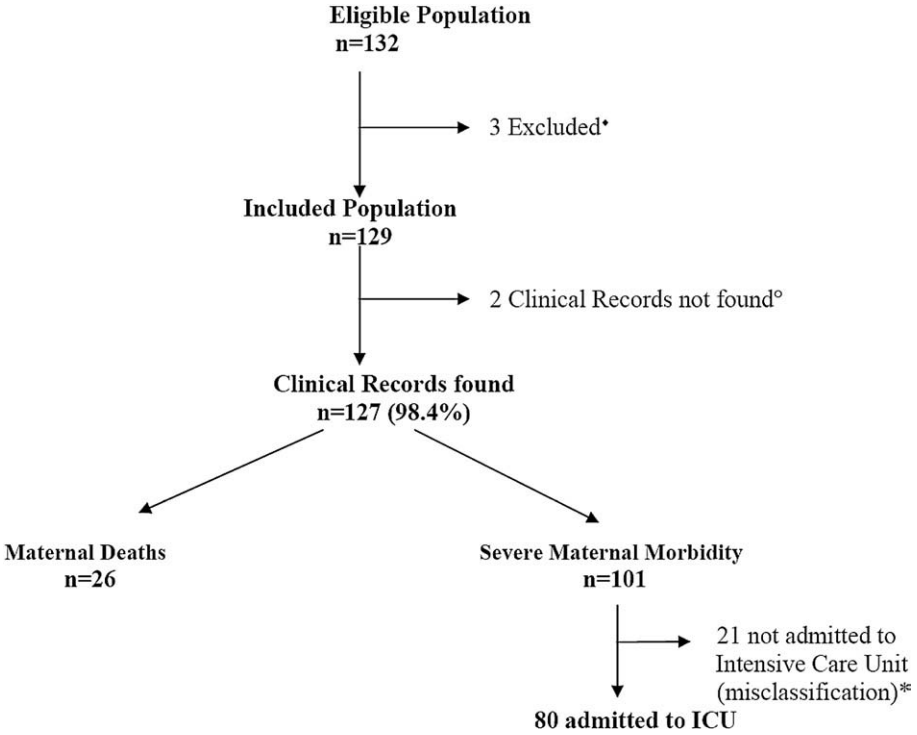

Fig. 1. Study Profile: Maternal Deaths and Women with Severe Maternal Morbidity Recruitment. ♦ Two maternal deaths excluded: 1 because delivery was attended in a non-participating hospital; 1 because it was an incidental death (suicide). One patient with severe maternal morbidity was excluded because she was attended by a private practitioner and not by hospital staff. ° Both were women with Severe Maternal Morbidity. * Misclassification was considered when a case in the database was reported as an admission to an Intensive Care Unit, but in the Clinical Record analysis no admission to ICU was confirmed.

causes. The hospital maternal death ratio per 100 000 live births and the severe maternal morbidity ratio per 1000 live births were also calculated. To estimate the 95% confidence intervals for MMR and SMMR, we assumed a Poisson distribution [21]. STATA version 8.0 (Stata Corp, College Station, TX, USA) statistical software was used.

2.8. Ethical review

Ethical clearance was given by the Tulane Health Sciences Center Institutional Review Board (00002055), the Ethics Committee of the Center for Medical Education and Clinical Research (CEMIC IRB 00001745), and the Ethics Committee of the Durand Hospital. Confidentiality was preserved. Informed consent was not used, because the information collected is routinely collected at the maternity hospitals, and no personal identifiers were included in the data forms.

3. Results

Between September 1, 2003, and December 31, 2005, 28 maternal deaths were identified in the 24 participating hospitals. Among births occurring during 2005, 80 women with SMM were identified. Only 2 clinical records of women with SMM were not found. Three cases were excluded: 2 maternal deaths and 1 case of SMM (reasons for exclusion are stated in Fig. 1). A total of 106 women were included in the study: 26 maternal deaths and 80 cases of SMM (Fig. 1).

The HMDR was 47.8 per 100 000 live births (95% CI, 25.4–81.7) and the SMMR was 3.4 per 1000 live births (95% CI, 2.7–4.1). The Case-Fatality Rate was 13% (95% CI, 7.0–22.0).

Table 1 shows the baseline characteristics of the study population; 83% of the women had at least one antenatal visit and 84% had a cesarean delivery. The cesarean rate overall for the included population of the Guidelines Trial for 2005 was 23%. The major cesarean delivery indications in the current study were: eclampsia (25%); pre-eclampsia complications, e.g. hypertensive emergencies or HELLP syndrome (18%); 2 or more previous cesarean deliveries, whether or not associated with placenta accreta (16%); abruptio placentae (12%); fetal bradycardia (7%); and other reasons (22%). There were no cases of prolonged or obstructed labor.

The main causes of MM and SMM are shown in Table 2. Half were hypertensive disorders, more than a quarter were hemorrhages, and

Table 1
Baseline characteristics of the study population (n = 106).[a]

	Maternal deaths (n = 26)	Women with Severe Maternal Morbidity (n = 80)	Total (n = 106)
Age, y			
<20	3.8	27.5	22.0
20–34	69.2	46.2	52.0
>34	27.0	26.3	26.0
Parity			
1	23.1	43.7	38.7
2–3	30.7	20.0	22.6
>3	46.2	36.3	38.7
Mode of delivery			
Cesarean delivery	80.8	85.0	84.0
Vaginal delivery	19.2	15.0	16.0
Antenatal care			
No visits	5.3	20.0	16.7
1–4 visits	57.9	30.8	36.9
5 or more visits	36.8	49.2	46.4
Previous obstetric complications history			
No	57.7	58.7	58.5
Yes	19.2	36.3	32.1
Missing	23.1	5.0	9.4
Gestational age at event, wk	35 (33–38)	35 (32–38)	35 (32–38)

[a] Values are given as percentage or median (interquartile range).

Table 2
Main causes of maternal deaths and severe maternal morbidity.[a]

Main causes	Maternal deaths (n = 26)	Severe Maternal Morbidity (n = 80)	Total (n = 106)
Hypertensive disorders	5 (19.2)	48 (60.0)	53 (50.0)
Hemorrhage	8 (30.8)	20 (25.0)	28 (26.4)
Sepsis/infections	7 (26.9)	3 (3.8)	10 (9.4)
Other causes	6 (23.1)	9 (11.2)	15 (14.2)

[a] Values are given as number (percentage).

more than 10% were sepsis/infections. Eclampsia and pre-eclampsia represented approximately 90% of hypertensive disorders (47/53). Regarding hemorrhage, third trimester bleeding accounted for 80% (22/28) of cases, while postpartum hemorrhage accounted for 15% (4/28) of cases. The vast majority of infections occurred during the postpartum period (8/10): 7 infections were puerperal sepsis (4 maternal deaths and 3 SMM cases), and 4 of these were due to pPROM.

Considering the total number of causes of MM and SMM, 59.4% were antepartum, 8.5% were intrapartum, and 30.1% were postpartum. The detailed distribution of the main causes of MM and SMM are shown in Table 3.

Table 4 shows the primary outcomes of the study. Some interventions for severe acute hemorrhage had the highest specific use rate: blood transfusion was used in 90% of cases and timely cesarean delivery in 75% of cases. Active management of the third stage of labor was used in less than one-third of the cases (out of 17 vaginal deliveries with hemorrhage, only 1 had received AMTSL). For hypertensive disorders, the specific use rate of magnesium sulfate in eclampsia was about 60%, and the specific use rate of magnesium sulfate in pre-eclampsia was 33%. No women with pPROM received antibiotics. The overall use rate of effective interventions was 58%, meaning a rate of 42% of lost opportunities to reduce MM and SMM.

Sixty-one secondary causes of MM and SMM were identified: 15 of 26 maternal deaths and 46 of 80 women with SMM. About 15% (9/61) were direct complications of cesarean delivery (including injury to adjacent organs and/or subsequent hysterectomy).

The agreement between both independent researchers to establish the main complication was 89.6% (95/106): for MM the rate was 81.8% (21/26), and for SMM the rate was 92.5% (74/80).

Table 3
Detailed distribution of main causes of maternal mortality and severe maternal morbidity.[a]

Causes	Maternal Deaths (n = 26)	Severe Maternal Morbidity cases (n = 80)	Total (n = 106)
Hypertensive disorders	5 (19.2)	48 (60.0)	53 (50.0)
Pre-eclampsia	2 (7.7)	21 (26.2)	23 (21.7)
Eclampsia	3 (11.5)	21 (26.2)	24 (22.7)
Pregnancy-induced hypertension	-	5 (6.3)	5 (4.7)
HELLP Syndrome	-	1 (1.3)	1 (0.9)
Hemorrhage	8 (30.8)	20 (25.0)	28 (26.4)
Placenta accreta	2 (7.7)	4 (5.0)	6 (5.7)
Uterine atony	2 (7.7)	5 (6.3)	7 (6.6)
Abruptio placentae	-	3 (3.7)	3 (2.8)
Intrapartum hemorrhage	-	1 (1.3)	1 (0.9)
Postpartum hemorrhage	1 (3.8)	3 (3.7)	4 (3.8)
Placenta previa	2 (7.7)	4 (5.0)	6 (5.7)
Uterine rupture	1 (3.8)	-	1 (0.9)
Sepsis/infections	7 (26.9)	3 (3.8)	10 (9.4)
Puerperal sepsis	4 (15.4)	3 (3.8)	7 (6.6)
Other puerperal infections	1 (3.9)	-	1 (0.9)
Other infections	2 (7.7)	-	2 (1.9)
Other causes	6 (23.1)	9 (11.2)	15 (14.2)
Direct complications of cesarean delivery	-	1 (1.3)	1 (0.9)
HIV/AIDS	1 (3.9)		1 (0.9)
Obstetric embolism	-	1 (1.3)	1 (0.9)
Heart diseases	1 (3.9)	-	1 (0.9)
Respiratory diseases	-	1 (1.3)	1 (0.9)
Other conditions	4 (15.4)	6 (7.5)	10 (9.4)

[a] Values are given as number (percentage).

Table 4
Use of effective interventions to reduce maternal mortality and severe maternal morbidity.

Cause	Intervention	Indicator [a]	Specific Use Rate (%)	95% CI
Hypertensive disorders	Magnesium sulfate in pre-eclampsia	13/39	33.3	19.1–50.2
	Magnesium sulfate in eclampsia	14/24	58.3	36.6–77.9
Hemorrhage	Timely cesarean delivery	15/20	75.0	50.9–91.3
	Blood transfusion	29/32	90.6	75.0–98.0
	Active Management of the Third Stage of Labor	1/4	25.0	0.6–80.6
Sepsis/ infections	Antibiotics for preterm rupture of membranes	0/4	0.0	–
Overall Use Rate [b]		72/123	58.5	49.3–67.3

[a] Indicator to calculate Specific Use Rate: Number of effective interventions used for each complication (in MD & women with SMM) / Total of opportunities to use effective interventions for each complication (in MD & women with SMM).

[b] Overall Use Rate: Total of effective interventions used for all complications (in MD & women with SMM) / Total of opportunities to use effective interventions for all complications (in MD & women with SMM).

4. Discussion

The results show a low use (58%) of selected evidence-based practices for pregnant women who died or had severe morbidity in hospitals in two Latin American countries.

Our study was able to identify every maternal death and admission to ICU among the whole population of women included in the "Guidelines Trial." From these cases, we found 98.4% of the clinical records, and more than 80% were classified as "high-quality" clinical records.

The main causes of MM and SMM were similar to other studies [1]. However, our study showed a higher proportion of sepsis/infections among maternal deaths compared with the results of other studies in similar populations [8,22]. We also found a higher proportion of hypertensive disorders among women with SMM [23,24].

The study has potential limitations. Pooling data across randomization arms may create biases. Although the original study was not specifically designed to introduce interventions to reduce maternal morbidity or mortality, the expectation is that the original intervention may also affect maternal mortality and morbidity inputs, processes, and outcomes. The primary study randomized hospitals to receive, among other things, special training in AMTSL. The fact that the providers in half of the participating hospitals received this training, could bias the study toward fewer postpartum hemorrhages and thus better outcomes in this category. Another limitation of the study is the definition of SMM. The threshold for admission to the ICU may vary among hospitals.

We cannot assume that solely the use of evidence-based practices would prevent maternal death or the severity of cases, but our results suggest that the quality of care provided to women within healthcare facilities is not adequate. It can be assumed that there were ample opportunities to apply the interventions, as all deliveries occurred in hospitals and 83% of the women had at least one antenatal visit. In addition, the participating hospitals had the supplies to implement the interventions (magnesium sulfate ampoules, blood banks, antibiotics, oxytocin, and the capacity for cesarean deliveries).

Regular audits of every maternal death and SMM case (e.g. postpartum hemorrhage to assess whether AMTSL was performed,

complications of every cesarean delivery to review the indications, find the source of every infection) is an alternative way to improve the quality of health care. Many hospitals in Argentina are already conducting these maternal mortality and morbidity audits, as well as developing and implementing clinical guidelines. These two strategies could help to increase the use of beneficial practices to reduce MM and SMM.

The proportion of MM cases reported in Ronsman and Graham [1] in which substandard care played a substantial role is often more than one-third. The United Kingdom Confidential Enquiries showed that more than 50% of the women who died had some aspect of substandard clinical care as some died because their condition was not diagnosed or they received ineffective and/or improper treatment [25].

The use of evidence-based practices in women with severe complications of pregnancy linked with death or near-miss demonstrated in this article did not differ substantially from the ones observed in the general population. In the participating maternity hospitals within the two South American countries in this study, we have shown that the overall use of evidence-based practices in maternal care is below 60% [26,27].

Two different professional behavior profiles can be described. In obstetric emergencies that require actions for treatment, we found high use rates of treatments including blood transfusions, timely cesarean delivery, and the administration of magnesium sulfate in eclampsia. On the other hand, for preventive interventions that often do not have immediate effects (e.g., the administration of magnesium sulfate in pre-eclampsia, AMTSL, or the administration of antibiotics for pPROM), use rates were lower than 30%.

No antibiotics were used for pPROM, but this is based on 0 out of 4 cases. Although 4 cases are too few to draw major conclusions, the lack of prophylaxis could have influenced the adverse maternal outcomes observed (maternal sepsis). The evidence supporting antibiotic prophylaxis following pPROM is based on reduction in chorioamnionitis, and in neonatal infections. Kenyon et al. [14] showed a reduction in maternal and neonatal morbidity, but not a statistically significant reduction in perinatal mortality, although a trend toward a beneficial effect was shown. In addition, a clear reduction in major markers of maternal and neonatal morbidity when antibiotics are administered makes a reduction in death possible [15].

Cesarean delivery was widely used as a life-saving procedure; however, about 15% of secondary causes of MM and SMM were direct complications of cesarean. Improved understanding of the indications and techniques for cesarean may have a significant impact on maternal morbidity and mortality. A rationale for the use of cesarean delivery is needed, since overuse can cause more harm than benefit [28,29].

Future research should be done so that we can identify the reason for the gap between providers' knowledge of evidence-based practices and the low percentage of their use when focusing on complications during pregnancy, delivery, and the postpartum period, especially for those women referred for preventive interventions.

Everyone involved in maternal care needs to be committed to guarantee the highest possible quality of care. Dissemination and implementation of evidence-based practices must be guaranteed. This implies not only the knowledge of the practices and the availability of resources but also the effective and timely implementation of them. Strategies to guarantee such diffusion should be assessed to effectively achieve progress on maternal health.

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Conflict of interest

None declared.

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