Original article

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Evaluation of the mater code protocol in critical obstetric patients in a hospital in Northwest Mexico

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Abstract

***Introduction*: Maternal mortality, a reflection of a country's socioeconomic development, continues to be a global challenge, with significant disparities between high- and low-income countries. In Mexico, the implementation of protocols such as the mater code seeks to reduce these figures.**

***Objective*: To evaluate maternal mortality in the implementation of the mater code in a hospital in Mazatlán.**

***Material and methods*: A cross-sectional study was conducted, integrating cases of activation of the mater code during 2023 to 2024 at the General Hospital of Mazatlán. Variables related to the activation of the mater code were integrated, and the analysis was carried out using the statistical program Stata version 13.0 Special Edition (College Station, Texas 77845 USA), with statistical significance set at $p<0.05$.**

***Results*: Preeclampsia was the main cause of activation of the mater code (44.2%), followed by obstetric hemorrhage (13.51%). Severe dengue emerged as the most frequent cause of maternal mortality (50%), surpassing traditional causes such as eclampsia and hemorrhage. Cesarean section was the most common surgical procedure (58.1%), and 72.59% of patients required hospitalization in the obstetric intensive care unit.**

***Conclusions*: The findings suggest that implementing the mater code was associated with a decrease in maternal mortality at the hospital. Although severe dengue poses an emerging challenge, it is recommended to strengthen dengue prevention and control strategies for pregnant women and to improve coordination between levels of care to ensure timely access to specialized services.**

Keywords: Mater code, maternal mortality, obstetric intensive care unit.

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Introduction

In Mexico, the maternal mortality rate for the year 2024 was 26.1 per 100,000 births, with the leading causes of death being hypertensive diseases in pregnancy, obstetric hemorrhages, abortion, and complications in pregnancy. Likewise, maternal mortality decreased by 4.9% compared to 2023. (1,2)

Globally, among the main causes of maternal mortality, which comprise up to 75% of all pregnancy-associated deaths, we can find: severe bleeding, infections, hypertensive disorders of pregnancy, complications during childbirth, and unsafe abortions. (3)

Since its inception in 1980, the mater code has had a significant impact on maternal mortality, which is sought to be reduced worldwide and has been recognized by the World Health Organization since 2015 as one of the Sustainable Development Goals. (4,5)

Although the maternal code strategy is integrated into hospital care plans, the scope it has had is different for each region of the world, which is based on the proper functioning of the obstetric immediate response team, which is linked to the proper integration of the team and the ease with which it was possible to confirm the reporting of cases among staff medical and administrative within the institutions, as well as the factors that could hinder the process by delaying decision-making. (6)

The main states that contribute cases to the national statistics are the State of Mexico, Jalisco, Chiapas, Guerrero, and Veracruz; however, when comparing mortality rates among total patients attended, Guerrero, Chihuahua, Campeche, Tabasco, and Durango stand out above the national rate. (7)

The purpose of this research was to analyze maternal mortality after the implementation of the mater code protocol at the General Hospital of Mazatlán "Dr. Martiniano Carvajal".

Materials and methods

All the clinical records of patients whose pregnancy evolution required activation of the mater code at the Mazatlán General Hospital "Dr. Martiniano Carvajal" during the period from January 2023 to January 2024 were reviewed. If the inclusion criteria were met, the necessary information was obtained and recorded in an Excel™ database: age, number of pregnancies, reason for activation of the mater code, and cause of death. Finally, using all the data from the collection sheet, a summary was prepared to present the information in graphs and tables.

Statistical analysis

A descriptive analysis of the data obtained from patients treated after the activation of the mater code at the General Hospital of Mazatlán "Dr. Martiniano Carvajal", Sinaloa, Mexico. Measures of central tendency and mean dispersion, median, standard deviation, and interquartile ranges were obtained for continuous or discrete quantitative variables, and frequencies and percentages were obtained for qualitative variables. The analysis was performed using the statistical program Stata version 13.0 Special Edition (College Station, Texas 77845 USA).

Inclusion criteria

Patients who were pregnant and postpartum women diagnosed with hemorrhage with preeclampsia, with criteria of severity, obstetric hemorrhage, sepsis, or any other diagnosis that required activation of the mater code.

Exclusion criteria

Non-pregnant patients, patients treated outside the study period, patients without complete records, or patients referred to another medical unit.

Study design

Retrospective, cross-sectional, descriptive.

Type of study

Descriptive observational study.

Target population

Patients who required the activation of the mater code of the General Hospital of Mazatlan "Dr. Martiniano Carvajal".

Sampling method

Non-probabilistic for convenience.

Instruments or techniques

Data collection was carried out in the digitized clinical records of the SIGHO system (management and operation system) of patients who required activation of the mater code, according to the registry of the General Hospital of Mazatlán "Dr. Martiniano Carvajal". The author of the study was responsible for data collection.

Ethical issues

No risks have been considered, and no fundamental principles have been violated in the conduct of this investigation, which has been carried out solely by collecting information from existing records and medical records/electronic files, and the confidentiality of the information has been maintained. Thus, the researcher was the only one authorized to handle the data obtained exclusively for the study and reg-

istered before the ethics committee of the General Hospital of Mazatlán "Dr. Martiniano Carvajal", with folio CEI-2025-03.

Results

A sample of 259 patients who attended or were referred to the General Hospital of Mazatlán "Dr. Martiniano Carvajal" was studied, the mean age was 25.67 years (standard deviation [SD] 6.83), with a mean of pregnancies of 2.22 (SD 1.41), the mean weeks of gestation at the time of admission to the hospital was 32.1 weeks (SD 9.12). Of the total sample, 8.88% (n=23) had the first trimester of pregnancy, 21.23% (n=12.35) had the second trimester, and 78.76% (n=204) had the third trimester. Regarding the prenatal control (total number of consultations), 71.81% (n=186) of the patients did not attend any control consultation, 14.26% (n=37) only attended one consultation, 6.18% (n=16) two consultations, 5.42% (n=14) three consultations, 1.16% (n=3) attended 5 consultations, and 1.16% (n=3) attended more than six consultations.

The most frequent reference place was Mazatlán, with 61.4% (n=159), followed by Villa Unión with 14.7% (n=38), and third place was the Municipality of Escuinapa with 10.4% (n=27) (**Table 1**).

The three main sending diagnoses were first hypertensive states of pregnancy in 48% (n=124) of cases, followed by dengue/febrile syndromes in 10.42% (n=27), and ectopic pregnancy in 7.34% (n=19) (**Table 2**). The main causes reported for activation of the mater code upon admission of the patients were preeclampsia with severity criteria in 44.02% (n=114) of the cases, dengue in 13.58% (n=22) of the cases, and, in the third place, obstetric hemorrhage in 13.51% (n=35) of the cases (**Table 3**).

The three main procedures performed according to the diagnosis of admission by activation of the mater code, 149 (58.1%) patients underwent emergency cesarean section, 22 (8.58%) of the patients, in addition to cesarean section, required obstetric hysterectomy, and 26 (10.0%) of the patients required exploratory laparotomy. In contrast, 33 (13.8%) of the patients only required observation, and one patient requested voluntary discharge (**Table 4**).

Of the total sample, 72.59% (n=188) of the patients required admission to the Intensive Therapy Unit, and 27.41% (n=71) required hospitalization in pavilions of the gynecology and obstetrics area. Upon admission, only 56.76% (n=147) attended a follow-up appointment, while 43.24% (n=112) did not attend despite being provided one. It should be noted that a total of 173 (66.8%) of the patients had their pregnancies satisfactorily resolved, while 27.8% (n=72) ended in abortion, and 5.41% (n=14) were neonatal deaths.

Regarding the distribution of discharge type among pregnant and postpartum women treated in a hospital in Mazatlán before the implementation of the mater code, most patients (98.5%, n=255) were discharged with 98.5% improvement, while 1.5% (n=4) died. **Table 5** shows that the causes of mortality were statistically significant ($p<0.05$), of which 50% of deaths were the result of severe dengue, and with a similar percentage of 25% in eclampsia and hemorrhage (95% CI 1.320–2.774).

Discussion

The present study shows that hypertensive disorders of pregnancy, especially preeclampsia, were the main cause of activation of the mater code (46.3%), as reported in other research that identifies hypertensive disorders of pregnancy as a leading cause of maternal mortality worldwide. (3,8) However, it is crucial to recognize that, although preeclampsia is not invariably fatal, its high incidence underscores the need to design early detection strategies and multidisciplinary management to prevent severe complications, such as eclampsia, hemolysis, elevated liver enzymes, and low platelets (HELLP) syndrome, and multiorgan failure; likewise, to emphasize the importance of surveillance that transcends the prenatal period, extending to the postpartum period.

Regarding obstetric hemorrhage as the second most frequent cause of activation of the mater code (18.5%), the importance of recognizing postpartum hemorrhage as the main cause of maternal mortality in low-income countries (9), as well as its significant impact at the global level, (10) to optimize the mater code, it is imperative to focus on the early identification and management of risk factors associated with hemorrhage, such as uterine atony, obstetric trauma, and retention of placental remains. (10) This reinforces the importance of maintaining staff training in techniques such as the use of the Bakri balloon, obstetric hysterectomy, and rapid transfusion management. (9,11)

The factors that contribute to hemorrhage are well known in obstetrics through the mnemonic "4 T's" (tone, trauma, tissue, thrombin) (12) and should be investigated and applied systematically by the multidisciplinary team. However, ruptured ectopic (8.5%) is less frequent; its lethality is potentially high if not detected and treated immediately. (13,14) In Mexico, several studies have indicated that almost half of serious obstetric emergencies are due to this condition, (7,15) confirming that early detection and management should remain a priority.

Early detection and proper management of ectopic pregnancy are essential to prevent internal bleeding and maternal death. At the same time, the prevalence of dengue in this cohort requires special attention, the geographical location of the hospital, located in an endemic area, requires reinforced measures for prevention and vector control, as well as exhaustive training of health care personnel in the diagnosis and timely treatment of severe dengue in pregnant women, this finding contradicts the widespread view, mentioned in other studies, which often underestimates the impact of dengue on maternal health, which is why it is important to underscore the need for greater awareness and surveillance to identify and address this emerging complication quickly, so it would be pertinent for the mater code to integrate specific protocols for this type of case. (16,17)

The activation of the mater code for dengue in pregnancy reinforces its value as a tool that not only treats classic obstetric complications, but also less common, but equally serious emergencies. Other identified causes, such as sepsis and HELLP syndrome, although less prevalent, remain a significant clinical challenge, as they can rapidly evolve into critical states and require intensive hospital management. In endemic areas, dengue during pregnancy has been associated with an increased risk of serious complications and adverse outcomes, which raises the need for the protocol to include a specific approach for serious infectious pathologies in pregnant women. Experience from other contexts with high endemicity shows that communicable diseases can change the profile of maternal mortality and that their control requires a coordinated approach between obstetrics, internal medicine, and epidemiology services. (18)

This divergence with the traditional literature, which identifies hypertensive disorders and hemorrhage as the most frequent causes, (3) requires a reevaluation of strategies for the prevention and management of maternal mortality in the specific context of Mazatlán.

In line with the literature highlighting the impact of continuous multidisciplinary team training, (16) it is essential to ensure that all health care personnel are trained in the application of the mater code and the management of obstetric emergencies. Emphasis should be placed on early recognition of severe dengue and the implementation of evidence-based treatment protocols.

Table 4, which describes the demographic variables of the patients, shows a mean age of 25.59 years, with a wide range that included adolescent patients and women at extreme ages of reproductive life, and an average of 2.20 gestations. These data are consistent with the demographic profile of women of reproductive age in Mexico. However, the median number of consultations was very low, which indicates insufficient follow-up during pregnancy in a significant percentage of cases, which is relevant because the literature has documented that both adolescence and multiparity, added to deficient prenatal surveillance, increase the risk of serious complications and the probability of requiring urgent care. (1,7,19) Therefore, according to statisticians, a more exhaustive analysis is needed to identify specific patterns and risk factors in this population.

When comparing the results of a previous study in the same hospital, it was observed that in that period, eclampsia and obstetric hemorrhage were the main causes of mortality, with 40% each. (20) In contrast, in the present study, severe dengue ranked first (50%), followed by eclampsia (25%), and hemorrhage (25%). This difference reflects a change in the local epidemiological profile, in which vector-borne diseases have become more relevant, while classic obstetric causes have decreased in relative frequency. These variations coincide with those indicated by the Pan American Health Organization (PAHO) and the World Health Organization (WHO), which emphasize the need to adapt obstetric response protocols to the epidemiological conditions of each region. (6,18,21,22)

The findings of this study have relevant practical implications. On the one hand, they support the permanence and strengthening of the mater code as an essential strategy for the care of obstetric emergencies, while on the other hand, they point out the need to expand its scope to include the rapid diagnosis and treatment of non-obstetric pathologies with high mortality in pregnant women, especially in regions with a high burden of infectious diseases. It is also identified as a priority to improve post-discharge follow-up, establish agile referral and counter-referral mechanisms, and implement periodic audits to identify delays or deficiencies in care.

Conclusions

The findings suggest that implementing the mater code was associated with a decrease in maternal mortality at the hospital. Although severe dengue poses an emerging challenge, it is recommended to strengthen dengue prevention and control strategies for pregnant women and to improve coordination between levels of care to ensure timely access to specialized services.

Conflicts of interest

None of the authors has any proprietary interests or conflicts of interest related to this submission.

Table 1. Reference place for pregnant and postpartum women

Referred from	f (%)
Mazatlan	159 (61.4)
Rosario	15 (5.8)
Concordia	6 (2.3)
Escuinapa	27 (10.3)
El Salto	1 (0.4)
Villa Union	38 (14.7)
The Cross	11 (4.2)
San Ignacio	1 (0.4)
Culiacan	1 (0.4)

Source: SIGHO (Hospital Management Information System used by the Sinaloa Health Services) (n=259).

Table 2. Diagnosis of the shipment of pregnant and postpartum women

Shipping diagnostics	f (%)
Dengue/febrile syndrome	27 (10.42)
Hypertensive states of pregnancy	124 (48.26)
Ectopic pregnancy	19 (7.34)
Immediate pathological puerperium/postpartum hemorrhage	4 (1.55)
Sepsis/septic shock	9 (3.47)
Placenta previa/placenta accreta spectrum	6 (2.32)
Miscellaneous	13 (5.04)

Source: SIGHO (Hospital Management Information System used by the Sinaloa Health Services) (n=259).

Table 3. Causes of activation of the mater code upon entry

Diagnosis	f (%)
Severe dengue	33 (13.59)
Preeclampsia with severity criteria	114 (44.02)
Eclampsia	10 (3.86)
Placenta previa/placenta accreta spectrum	11 (4.25)
Ectopic pregnancy	18 (6.95)
HELLP syndrome	9 (3.47)
Sepsis	11 (4.25)
Miscellaneous	13 (5.02)
Obstetric hemorrhage	35 (13.51)
Hypovolemic shock	3 (1.16)

Legend: HELLP=hemolysis, elevated liver enzymes, and low platelets.
Source: SIGHO (Hospital Management Information System used by the Sinaloa Health Services) (n=259).

Table 4. Main procedures performed after the activation of the mater code

Procedure	f (%)
Voluntary discharge	1 (0.3)
Manual uterine aspiration	2 (0.7)
Bakri balloon placement	1 (0.3)
Caesarean section	149 (58.1)
Cesarean section + obstetric hysterectomy	22 (8.58)
Exploratory laparotomy	26 (10.0)
Instrumented uterine curettage	3 (1.1)
Cavity check	10 (3.9)
Observation	33 (13.8)
Parturition	12 (4.6)

Source: SIGHO (Hospital Management Information System used by the Sinaloa Health Services) (n=259).

Table 5. Prevalence of maternal mortality in pregnant and postpartum women due to the implementation of the mater code

Causes of death	f	%	CI 95%		X2	p-value
			Lower limit	Upper limit		
Dengue fever Eclampsia Obstetric hemorrhage	2 1 1	50.0 25.0 25.0	1.320	2.774	243.247	0.001

Legend: CI=confidence interval.
Source: SIGHO (Hospital Management Information System used by the Sinaloa Health Services) (n=259).

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