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Effect of a model based on education and teleassistance for the management of obstetric emergencies in 10 rural populations from Colombia

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Abstract

Introduction: Pregnant women and health providers in rural areas of low-income and middle-income countries face multiple problems concerning high-quality obstetric care. This study was performed to identify changes in maternal and perinatal indicators after implementing a model based on education and telecare between a high-complexity hospital in 10 low-complexity hospitals in a southwestern region of Colombia.

Methods: A quasiexperimental study with a historic control group and without a pretest was conducted between 2017 and 2019 to make comparisons before and after obstetric emergency care through the use of teleassistance from 10 primary care centers to the referral center (Fundación Valle del Lili, FVL).

Results: A total of 470 patients were treated before teleassistance implementation and 154 patients were treated after teleassistance implementation. After program implementation, the maternal clinical indicators showed a 65% reduction in the number of obstetric patients who were referred with obstetric emergencies. The severity of maternal disease that was measured at the time of admission to level IV through the Modified Early Obstetric Warning System score was observed to decrease.

Conclusion: The implementation of a model based on education and teleassistance between low-complexity hospitals and tertiary care centers generated changes in indicators that reflect greater access to rural areas, lower morbidity at the time of admission, and a decrease in the total number of emergency events.

Keywords

Telehealth, pregnancy, women health, public health, digital health, education

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Introduction

There are multiple problems faced by pregnant women and health providers concerning high-quality obstetric care in rural areas of low-income and middle-income countries (LMICs). The health sector crisis, restriction of resources, and administrative and access barriers are some of the determinants of maternal and perinatal mortality and morbidity, especially in areas of armed conflict.[1–3] Additionally, obstetric patients with highly complex pathologies in these areas require up-to-date and expeditious knowledge in primary care, which subsequently requires a process of permanent academic updating by the doctors and nursing professionals in charge, many of whom do not have access to updates in the management of obstetric emergencies.

Globally, in 2019, a maternal mortality ratio (MMR) of 211 maternal mortalities per 100,000 live births (LB) was reported.[4] Hemorrhage, hypertensive disorders, and sepsis are responsible for more than half of all maternal deaths worldwide.[2] In parallel, it is estimated that 50 to 100 women experience maternal near miss (MNM) for every maternal death,[3] and there are 2.6 million stillbirths and 2.7 million neonatal deaths worldwide each year.[5, 6] The COVID-19 pandemic has had a global impact on maternal and perinatal health, with an increase in MMR and perinatal mortality rates, with mortality being more significant in LMICs.[7, 8] In Colombia (a middle-income country), 2 years after the start of the COVID-19 pandemic, the preliminary national MMR was 78.3 deaths per 100,000 LBs in 2021, and an MMR greater than 100 deaths per 100,000 LBs was observed in the nine territorial entities, which represents a significant increase in the MMR compared to previous years.[9] Moreover, the MMR (71/100,000 LB) and the MNM ratio (52/1000 LB) of Cauca are higher than the national average (MMR: 65/100,000 LB and MNM 38/1000 LB).[10]

The improvement in the quality of maternal health care for women is a necessary step toward achieving the health targets of the Sustainable Development Goals (SDGs) (1), especially after the COVID-19 scenario. Additionally, in this scenario of great academic demand, of great responsibility for health professionals, and little availability of economic resources in rural areas of LMICs, informatics strategies can be a fundamental tool for a cost-effective solution. Digital health (also known as eHealth) is defined as information and communication technology in health services and the surveillance of diseases of public health interest. Its implementation has cultural, technological, and financial barriers associated with transmitting video, audio, and images in LMICs.[11] The Resolution of the World Health Assembly on Digital Health (which was approved by the members of the WHO in 2018) recognized the value of digital technologies in contributing to the achievement of the SDGs, specifically by establishing the use of telemedicine between trained and certified providers (hospitals) as one of the strategies with the most significant impact.[12] Access to a low number of qualified health workers, geographic inaccessibility, and unequal distribution of workers contribute to limitations in the adequate coverage of human resources for health, which are barriers intended to be overcome via telemedicine.

The High-Complexity Obstetric Unit (HCOU) of the Fundación Valle del Lili (FVL)[13] provides level IV care and has a high number of referrals of patients in critical conditions from the southwest region of Colombia, including municipalities in rural areas of the department of Cauca. This area has high maternal morbidity and mortality related to poor access by the rural population to health services, high poverty and displacement rates, armed conflict, a low educational level, and the lack of adherence to prenatal control programs by indigenous and Afro-descendant communities in the region. For this reason, in 2018, an intervention model based on education and teleassistance was implemented at FVL and 10 rural hospitals. Teleassistance through the use of WhatsApp was implemented between a professional who attended the woman with an obstetric emergency (maternal and perinatal emergencies) and a gynecology subspecialist in critical medicine and intensive care in a remote manner to monitor the management of patients and to ensure a timely referral. Therefore, the objective of this study was to establish the effect of the model implementation on maternal and perinatal mortality of patients who were jointly treated for obstetric emergencies between institutions and those referred patients from these 10 hospitals to the FVL. Additionally, we examined changes in the maternal and perinatal morbidity indicators of this group of patients.

Methods

Design

The study was quasiexperimental and was developed between FVL (which is a nonprofit university hospital serving as a reference healthcare facility for the southwestern region of Colombia) and 10 hospitals belonging to the following rural municipalities of Cauca: Timba, Suarez, Buenos Aires, Toribio, Jambalo, Tacueyo, Silvia, Puerto Tejada, Padilla, and Villa Rica.

Study population and time

The study was developed in two periods of time, in which pregnant women with obstetric emergencies were contemplated in both, to evaluate maternal and perinatal outcomes, before and after the implementation of the educational and telecare model:

1. Period 1, which ranged from March 1, 2017 to July 31, 2018, before the implementation of the educational and telecare model. The outcomes of pregnant women with obstetric emergencies referred for management in FVL were evaluated.
2. Period 2, which ranged from August 1, 2018 to December 21, 2019, when the telecare and education processes had begun. The outcomes of pregnant women referred to FVL after being treated in hospitals in Cauca with the support of the telecare service were evaluated, and those patients referred to FVL without being previously discussed by telecare were excluded.

For both time periods, patients with obstetric emergencies who were referred to other institutions other than FVL were excluded.

Intervention model based on telehealth and education

Initially, visits were made by the FVL medical group to determine the hospitals' installed capacity for obstetric emergencies and the adoption of a teleassistance service. Subsequently, a concerted improvement plan was developed between the institutions based on quality policies in the care processes arranged for Colombia,[14] including the structuring of a program with onsite education supported by simulation strategies and continuous monitoring via WhatsApp chat.

A group that consisted of nursing assistants, nurses, and general practitioners, received the coaching program taught by obstetricians who were specializing in intensive care and who had experience in face-to-face and online teaching; these educational modules included 6–12-hour workshops consisting of interactive talks and low-fidelity activities supported by the institutional FVL protocols, with the workshops emphasizing communication strategies and nontechnical skills. These trainings also included counseling to change the behavior of the teams in the presence of critical events in pregnant women, as well as the adoption of telehealth strategies and the use of the Modified Early Obstetric Warning System (MEOWS) scale to detect clinical signs of deterioration in pregnant women with critical illnesses.[15,16] All of the abovementioned strategies had the aims of improving safe delivery care, achieving timely identification and management of obstetric emergencies (postpartum hemorrhage (PPH), hypertensive disorders of pregnancy, and maternal sepsis), maternal cardiorespiratory arrest, and neonatal resuscitation. In each module, the FVL team evaluated attendance with pretraining and posttraining test to establish the change in knowledge; additionally, at least once every 3 months, follow-ups were conducted through teleconferences to analyze the implementation, compliance, and presented difficulties.

The teleassistance system was formalized with the creation of chats for each institution that were available 24 hours a day for every day of the week. This method, allowed for communication between professionals who were working among the 10 hospitals and the intensivist gynecologists of FVL through call or video call consultations for obstetric and perinatal emergencies; as well as for the purpose of sending educational support for its management. The transfer of patients to the corresponding level of complexity for care was conducted according to their clinical situation (urgency or emergency situations), the insurer's networks, and the government for this purpose.

Variables

Information on the sociodemographic and clinical characteristics, as well as the maternal and perinatal outcomes, was collected. The variables were defined as follows:

- PPH: a cumulative blood loss of ≥500 mL during vaginal birth or >1000 mL after a cesarean birth, accompanied by signs or symptoms of hemodynamic instability.[17]
- Major surgery: procedure other than childbirth or cesarean section for the management of an obstetric complication or any condition generated as a consequence of a serious commitment of the woman.[18]
- Eclampsia: a new onset of generalized, tonic-clonic seizures or coma in a pregnant woman with preeclampsia.[19]
- Hypertensive crisis: acute-onset and persistent high blood pressure (systolic blood pressure > 160 mmHg or diastolic blood pressure >110 mmHg) in the setting of preeclampsia or eclampsia.[20]
- Sepsis: a life-threatening condition defined as organ dysfunction caused by an infection during pregnancy, delivery, or puerperium or after an abortion.[21]
- MNM: when a woman nearly dies but survives a complication during pregnancy or childbirth or within 42 days of the termination of pregnancy; additionally, the criteria were defined according to the guidelines of the Colombian Ministry of Health.[22,23]
- Maternal mortality: female deaths from any cause related to or aggravated by the pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of the termination of pregnancy, irrespective of the duration and site of the pregnancy.[7]
- Perinatal mortality: the number of fetal deaths over 22 completed weeks of pregnancy plus the number of deaths among live-born children up to 7 completed days of life per 1000 total births (LB and stillbirths) [24]
- MEOWS at admission: MEOWS composed of physiological parameters with a predetermined threshold that determines evaluation, treatment, or intervention.[25]

The study was approved by the Institutional Ethics Committee at the FVL, on July 29, 2020 (approval number 1587). This study was conducted in conjunction with the international recommendations of biomedical research recorded in the Helsinki Declaration and the Council for International Organizations of Medical Sciences (CIOMS).

Statistical analysis

A descriptive analysis of the variables was expressed by percentages and absolute frequencies for the qualitative variables and medians and interquartile ranges (IQRs) for the quantitative variables without a normal distribution. For comparisons of indicators between the two time periods, the Mann–Whitney U test and the chi-square test

Table 1. Comparison between the implementation periods regarding the sociodemographic characteristics of the patients with obstetric emergencies.

Characteristics	Period 1 N = 470	Period 2 N = 154	*p* Value
Age (years)*	22 (18–28)	23 (19–30)	0.133
Affiliation regimen*			
Government health insurance	347 (77.9)	106 (70.6)	0.031
Contributive	68 (15.2)	23 (15.3)	
Particular/linked	19 (4.2)	16 (10.6)	
Special	11 (2.4)	5 (3.3)	
Area of origin*			
Urban	223 (51.6)	48 (34.0)	<0.014
Rural	209 (48.3)	93 (65.9)	
Occupation*			
Unemployed	15 (4.3)	5 (4.2)	0.463
Employed	34 (9.8)	14 (11.7)	
Independent	15 (4.3)	4 (3.3)	
Housewife	232 (66.8)	86 (72.2)	
Other	51 (14.7)	10 (8.4)	

*Estimated for the number of women seen, N = 595. Period 1 (N = 445) and Period 2 (N = 150).
The results are expressed as the median [IQR] or number (%). IQR: interquartile range.

Table 2. Comparison between the implementation periods regarding the pregnancy characteristics of the patients with obstetric emergencies.

Characteristics	Period 1 N = 470	Period 2 N = 154	*p* Value
Gravidity, median [IQR]*	2 [1–3]	2 [1–3]	
1	200 (44.9)	66 (44.0)	0.997
2	114 (25.6)	39 (26.0)	
3	77 (17.3)	26 (17.3)	
≥ 4	54 (12.1)	19 (12.6)	
Parity			
0	220 (46.8)	68 (44.1)	0.411
1	135 (28.7)	38 (24.6)	
2	66 (14.0)	27 (17.5)	
≥ 3	49 (10.4)	21 (13.6)	
Gestational age at admission (weeks), median [IQR]	36.6 [33.1–39.1]	37 [34.1–39]	0.491
Gestational age at discharge (weeks), median [IQR]	37.5 [35–39.3]	38 [36–39.3]	0.342
Referring hospital			
Timba	32 (6.8)	12 (7.7)	-
Suarez	119 (25.3)	41 (26.6)	
Buenos Aires	48 (10.2)	30 (19.4)	
Silvia	0 (0)	1 (0.6)	
Toribio	16 (3.4)	9 (5.8)	
Jambalo	3 (0.6)	1 (0.6)	
Tacueyo	7 (1.4)	5 (3.2)	
Puerto Tejada	158 (33.6)	35 (22.7)	
Padilla	46 (9.7)	11 (7.1)	
Villa Rica	41 (8.7)	9 (5.8)	

*Estimated for the number of women seen, N = 595. Period 1 (N = 445) and Period 2 (N = 150).
The results are expressed as the median [IQR] or number (%). IQR: interquartile range.

Table 3. Comparison between the implementation periods regarding the clinical characteristics and maternal and perinatal indicators of the care of patients referred from 10 hospitals to FVL in obstetric emergencies.

Characteristics	Period 1 N = 470	Period 2 N = 154	*p* Value
Medical history	135 (28.7)	42 (27.3)	0.731
MEOWS at admission to FVL			
Score of 0	35 (7.4)	21 (13.7)	0.053
Score of 1–3	386 (82.1)	123 (80.3)	
Score of 4–5	31 (6.6)	6 (3.9)	
Score of ≥6	18 (3.8)	3 (1.9)	
Diagnosis of obstetric emergency at the time of referral			
PPH	4 (0.8)	6 (3.9)	NA
Hypertensive disorder	167 (35.5)	55 (35.7)	
Sepsis	7 (1.4)	0 (0)	
Miscarriage	5 (1.0)	1 (0.6)	
Preterm labor	76 (16.1)	23 (14.9)	
PROM	47 (10.0)	19 (12.3)	
Other	164 (34.9)	50 (32.5)	
Complications during hospitalization			
PPH	38 (8.0)	16 (10.3)	0.384
Need for blood and blood components	19 (4.04)	3 (1.95)	0.221
Eclampsia	7 (1.4)	1 (0.6)	0.697
Hypertensive crisis	88 (18.7)	26 (16.9)	0.613
Final stage of pregnancy			
Vaginal delivery	257 (54.6)	81 (52.6)	0.921
Cesarean section	134 (28.5)	48 (31.1)	
Miscarriage	8 (1.7)	1 (0.6)	
Ectopic pregnancy	2 (0.4)	1 (0.6)	
Still pregnant	62 (13.1)	21 (13.6)	
Vaginal delivery at FVL	250 (63.9)	68 (53.5)	0.037
Complication during labor/cesarean section	85 (20.9)	50 (36.7)	<0.010

(continued)

Table 3. Continued.

Characteristics	Period 1 N = 470	Period 2 N = 154	*p* Value
ICU admission	143 (30.4)	42 (27.2)	0.465
ICU/Obstetric ICU length of stay (days), median (IQR)	2 [2–3]	2 [2–3]	0.459
HCOU admission	461 (98.0)	147 (95.4)	0.073
HCOU length of stay (days), median [IQR]	2 [2–3]	2 [1–3]	0.586
Maternal near miss	200 (42.5)	57 (37.0)	0.225
Maternal mortality	0	0	-

The results are expressed as the mean (± SD), median [IQR], or number (%). FVL: Fundación Valle del Lili; HCOU: High-Complexity Obstetric Unit; ICU: intensive care unit; IQR: interquartile range; MEOWS: Modified Early Obstetric Warning System; PPH: postpartum hemorrhage; PROM: prelabor rupture of membranes.

Table 4. Comparison between the implementation periods regarding perinatal indicators of the care of patients referred from 10 hospitals to FVL in obstetric emergencies.

Characteristics	Period 1 N = 470	Period 2 N = 154	*p* Value
Newborn weight (g)			
<1500	37 (9.6)	6 (4.9)	0.246
1500–2499	82 (21.3)	30 (24.7)	
≥2500	265 (69.0)	85 (70.2)	
NICU admission	164 (34.8)	50 (32.4)	0.582
NICU length of stay (days), median [IQR]	5 [3–10]	4 [3–11]	0.865
Perinatal mortality	28 (6.7)	7 (4.8)	0.411
Antepartum	17 (62.9)	2 (28.5)	0.263
Intrapartum	2 (7.4)	1 (14.2)	
Postpartum	8 (29.6)	4 (57.1)	

The results are expressed as the mean (± SD), median [IQR], or number (%). FVL: Fundación Valle del Lili; IQR: interquartile range; NICU: neonatal intensive care unit.

Table 5. Effect of telemedicine program implementation on maternal outcomes and perinatal mortality.

Outcome	OR crude (95% CI); *p* value	OR adjusted (95% CI); *p* value adjusted FDR
Maternal outcomes	0.86 (0.58 – 1.27); 0.44	0.96[a] (0.60 – 1.52); 0.86
Perinatal mortality	0.70 (0.25 – 1.69); 0.41	0.19[b] (0.03–1.32); 0.19

[a]OR adjusted for area of origin, health insurance, occupation, parity >3, level of education, and medical history.
[b]OR adjusted for area of origin, health insurance, occupation, parity >3, level of education, medical history, and cesarean section-like pregnancy outcomes.
95% CI: 95% confidence interval; FDR, false-discovery rate; OR: odds ratio.

or Fisher's exact tests were conducted. A p value of <0.05 was considered to be statistically significant. The statistical package that was utilized was Stata v.14 (StataCorp LLC, College Station, Texas, USA). A multiple logistic regression was employed to estimate the effect of the adjusted teleassistance care model on the maternal outcome. This variable indicated whether a woman's pregnancy presented PPH, needs for blood and blood components, eclampsia, hypertensive crisis, MNM, or maternal mortality. A multivariate skewed logistic regression was used to estimate the odds ratio (OR) adjusted for the telemedicine program on perinatal mortality. Regression adjustments by area of origin, health insurance, occupation, parity (<3 or >3), level of education, and medical history (specifically for perinatal mortality) were added to the cesarean section-like pregnancy outcomes. We adjusted the p values for multiplicity with the false-discovery rate method.

Results

Records for 624 medical consultations were obtained from a total of 595 patients with obstetric emergencies from the 10 hospitals (470 records in Period 1 and 154 records in Period 2).

We observed a reduction of 316 (67%) patients admitted to the FVL due to obstetric emergencies in Period 2; they

were referred from the 10 municipalities where the intervention was performed. For patients seen at FVL, the median maternal age was 22 years (IQR: 18–30), and 76% (453) of the patients had government health insurance. Comparisons between the two periods are displayed in Table 1. Statistically significant, differences were identified in the origin area: for Period 2, there was an increase in the number of patients from rural areas (66%) compared with Period 1 (48%). The other characteristics were similar between the two periods (Tables 1 and 2).

Regarding the clinical characteristics, 28% of the patients had some medical conditions. Obstetric emergencies at the time of referral were mainly due to hypertensive disorders of pregnancy (35.6%). Moreover, 53% of the patients had a vaginal delivery, and 30% of the patients had a cesarean section. There were no statistically significant differences between the periods in terms of personal history, pathologies that implied the development of an obstetric emergency in terms of proportions, or driving conditions in the HCOU (Table 3).

Regarding the MEOWS score upon admission to FVL after the implementation of teleassistance, there was an increase in cases with a score = 0 (Period 1: 7.5% and Period 2: 13.7%) and a reduction in the percentage of women with a score of 4 to 5 (6.6% vs. 3.9%) and 6 (3.8% vs. 2.0%); however, these differences were not significant. There was a significant reduction in Period 2 in the number of deliveries at FVL (64% vs. 53%) and a higher proportion of complications during labor and cesarean section (20.9% vs. 36.8%). Regarding the MNM indicator, there were no significant differences between the two periods. Additionally, there were no maternal deaths in either of the two periods (Table 3). Moreover, there were also no differences in the delivery route, newborn weight, admission, and days of stay in the intensive care unit (ICU) and neonatal intensive care unit (Tables 3 and 4).

We found a 95% confidence interval (CI) in which the OR adjusted for maternal outcomes spanned from a reduction of 40% to a considerable increase of 52% after the implementation of the telemedicine program; this increase suggests that there was no significant difference between the two periods. Similarly, we observed that the 95% CI of OR adjusted for perinatal mortality showed a decrease of 97% and an increase of 32% (Table 5).

Discussion

The municipalities included in the study are home to a large part of the indigenous (190,069 people, approximately 20% of the total) and Afro-descendant population of Cauca.[26,27] Additionally, the Unsatisfied Basic Needs indicator that is used in Colombia to measure poverty is reported to be 46.6% for this area,[28] and most of these municipalities are characterized as having a very high armed conflict intensity index.[29] The MMRs that have accumulated in 10 years before the start of the project and that have been officially reported for these municipalities are Padilla at 318/100,000 LB, Jambalo at 301/100,000 LB, Silvia at 275/100,000 LB, Toribio at 142/100,000 LB, Suarez at 88/100,000 LB, Villa Rica at 93/100,000 LB, and Puerto Tejada at 60/100,000 LB.[30]

The institutional factors that directly impact the MMR and the preventable MNM in up to 90% of the events include the availability of qualified human resources and the logistic conditions of care that allow for complete and adequate management.[2] This study showed that a model based on education and teleassistance for managing obstetric emergencies among 10 low-complexity hospitals and a level IV hospital reduced the number of referrals due to obstetric emergencies by 65%. Moreover, the proportion of patients from rural areas with difficult access and the number of patients with complications at birth increased, and the severity of maternal disease measured at the time of admission to level IV hospitals through the MEOWS scale decreased.

The use of telemedicine and teleassistance in rural areas has shown a decrease in inequity in access to health, with increased services and decreased costs[31,32] as well as educational impact on sexual and reproductive and neonatal health,[33] being observed. In addition, telehealth in rural and remote emergency services has proven to be effective in achieving favorable patterns of service use, improved or equivalent clinical care, appropriate care processes, and (depending on the context) reduced time in the hospital. Clinical efficacy for this rural population is sensitive to patient time and connection, the ability to refer, local hospital admission, length of stay, and stay in the emergency department.[34] After the implementation of the project, a 65% reduction in the admission of pregnant women under emergency conditions was observed in the intervention municipalities. Although there were no significant differences in the proportion of clinical events treated in the FVL, this reduction included cases of PPH, patients without massive transfusion requirements, eclampsia, hypertensive crisis, and the MNM ratio. The project allows for an efficient redistribution of the burden of disease of pregnant women with greater maternal and perinatal risks within the health system; additionally, this project decongests hospitals with limited services, and ensures the system's economic sustainability. Finally, none of the municipalities in the intervention presented cases of maternal mortality from 2019 to 2022, which represented a fundamental change in the cities, such as Silvia, where there were two cases of Maternal death in 2018.

The increased coverage of highly complex services for pregnant women with obstetric emergencies in a more significant number of rural areas of the intervention zone was considered to be a positive effect of the model. The coverage of accompaniment was increased for populations with greater social and economic vulnerabilities in the arming

conflict situation of the intervention zone. MMR and MNM are directly correlated with the vulnerability of pregnant women in the context of the armed conflict and less access to health services, especially regarding prenatal care.[35] In Colombia, armed conflict is a determinant of maternal mortality, whereby it increases MMR in municipalities with quintiles 4 and 5 of IIC, despite the MMR reduction at the country level. Some of the cities included in the intervention area, such as Suarez, are located in a municipality with a high IIC.[29]

There was no availability of a gynecologist or obstetrician; therefore, there was no ability to perform cesarean sections in the hospitals where the model was implemented. This may explain why, despite fewer births having occurred, we observed a significant difference in complications related to delivery and cesarean section. This specialized care in childbirth can represent the difference between life and death. Poverty, rurality, ignorance of obstetric emergency warning signs, and late referrals have been established as being risk factors for childbirth complications and lethal conditions for the mother and fetus, especially in Latin America.[36] These conditions are part of the context of the intervention area.

The implementation of clinical instruments based on the identification of abnormal signs and symptoms that allow for the early detection of patients who may require aggressive interventions or transfers to more complex centers is known as early warning systems (EWSs). Physiological changes in the obstetric population can explain the variations in most of the items included in the EWS, which is why the MEOWS was adapted for the obstetric population and is recommended for pregnant or postpartum women with ongoing critical conditions.[15,37] When implemented, it has a sensitivity of 89% (95% CI: 81−95) and a specificity of 79% (95% CI: 76−82) for admission to the ICU. For this reason, we decided to use this scale as an objective measure to determine the severity of patients at the time of remission and admission. However, data collection was not possible at level I hospitals. The obtaining of a substantial reduction in cases with an MEOWS score >6 at the time of admission of pregnant women after the implementation of the model may indicate an improvement in the quality of care that the patient received when she was seen remotely.

According to the evidence, there is a regionalization model for obstetric care by levels in Colombia, whereby there is a concentration of very high-risk patients in very high-complexity centers. In 2015, the American College of Obstetricians and Gynecologists and the Society of Maternal-Fetal Medicine established levels of maternal care.[38] Obstetric complications have been observed to increase in hospitals with a low number of deliveries and high-risk patients. Almost 59% of births occur in hospitals with fewer than 1000 deliveries per year, where obstetric emergency events occur. Therefore, efforts to reduce delays in the management of emergency events in obstetrics must be made at all institutions, regardless of the level or volume of care. Therefore, remote supervision from obstetric ICU staff optimizes the skills of the available human resources.[39] The development of solid strategic alliances between FVL and the 10 hospitals and the commitment of the health secretaries of the department of Cauca allowed for the consolidation of this strategy. The education and preparation processes, which were designed between the institutions, were essential for the project's success. The implementation of FVL intervention packages with the development of checklists, procedural documentation templates, and simulation education modules allowed the judicious organization of teams in remote hospitals and the early adoption of the telecare model.[18,40,41] However, the change in medical teams' actions by using all of these inputs is only possible if they incorporate communication, teamwork, and safety culture. In our case, permanent monitoring from a more complex level allowed for hospital teams to understand and incorporate these concepts to recover security and reliability in the health system. During the course of the implementation, more adherence to the project was gained, especially when the team was recognized for good results.

Our study had the weaknesses inherent to the absence of randomization, which makes it difficult to determine whether differences in maternal and perinatal outcomes were due to the teleassistance care model or due to other differences. However, the use of a historical comparison group helped to prevent threats to validity through statistical adjustment for confounding factors, such as area of origin, health insurance, occupation, parity, level of education, and medical history, for which the frequencies between the periods may have been different and may have affected the occurrence probability of maternal and perinatal outcomes.

This study shows that technology can be used to support medical care in rural areas, with a positive impact on improving the quality of care and allowing early identification of patients who need to be referred to a high complexity care unit. For future projects, it will be essential to establish a qualitative measurement of the impact that this program has on every team, which would support the results of the implementation of technology between two health institutions.

Conclusion

Maternal health care services (particularly in LMICs) in rural areas with difficult access or armed conflict need to support the timely referral management of pregnant women in obstetric emergencies. Physicians and nurses at lower complexity levels also require permanent updates on evidence-based recommendations to inform clinical policies and practices to optimize care quality and to enable improved healthcare outcomes. Efforts to reduce morbidity and mortality in pregnancy can include innovative models

supported in education and telecommunications. At this time, we are experiencing the devastating results of the COVID-19 pandemic in LMICs; thus, it is essential to consider alternatives that can reduce the profound inequities in maternal health throughout the world.

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