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Strategies to reduce the caesarean section rate in a private hospital and their impact

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ABSTRACT

There is a concern around the world of an increasing caesarean section rate. It was estimated that between 2010 and 2015, caesarean section rates increased by almost 50%. There are several implications for this, considering that caesarean sections are associated with higher costs and worse clinical outcomes. In this context, several interventions have been considered to increase vaginal delivery rates, including the Adequate Childbirth Project (PPA) in Brazil. This study aimed to verify the impact of the strategies adopted internally in the Hospital Israelita Albert Einstein (HIAE) located in São Paulo, Brazil, regarding the reduction of caesarean sections and their perinatal results. Actions to support our study were implemented in two phases based on the PPA schedule. These actions involved three axes: a multidisciplinary team, pregnant women and facility improvements. All pregnant women admitted for childbirth at the HIAE between 2014 and 2019 were included in this study. The overall rate of vaginal delivery in this study population and among primiparous women and the percentage of admissions to the neonatal intensive care unit (NICU) were analysed in three periods: before the implementation of PPA actions (period A), after the first phase of the project (period B) and after its second phase (period C). The results showed an increase in the average vaginal delivery rate from 23.57% in period A to 27.88% in period B, and to 30.06% in period C (AxB, p<0.001; BxC, p=0.004). There was a decrease in the average of NICU admissions over the periods (period A 19.22%, period B 18.71% and period C 13.22%); a significant reduction was observed when periods B and C (p<0.001) were compared.

INTRODUCTION

The rise in the number of caesarean sections (C-sections) that has been reported worldwide in recent years is concerning. In 2015, C-section was the mode of delivery in 29.7 million (21.1%) births, which represented approximately twice the number of births in 2000 (12.1%).[1 2]

This scenario has been observed in several countries. In Brazil, for example, between 1996 and 2018, the rate of C-sections increased from 40% to 56%, making the country one of those with the highest C-section rates in the world. In the USA, this increase was from 20% to 33% in the same period; however, it was associated with better neonatal outcomes. It is important to note that the rate considered as an adjusted reference for the Brazilian population should be between 25% and 30%, but also that WHO considers the ideal rate to be between 10% and 15%.[2–5]

Several factors may have contributed to this scenario, including women having improved access to healthcare institutions, judicialisation of healthcare, individualised care (including antenatal care and delivery), fear of painful processes and an increase in the performance of procedures without medical indications such as C-sections, among others.[6–8]

The implications of these high rates of C-sections are many because they are associated with worsening clinical results and higher costs.[9] It is also worth mentioning that there is no scientific basis to justify this procedure as the first option for birth.[8–11] The budgetary impact of elective C-sections without a clinical indication in Brazil between 2016 and 2020 was estimated to be more than US$80 million per year for the Unified Health System, the Brazil National Public System, which serves almost 70% of the population.[12]

C-sections were associated with worse clinical results for both mothers and neonates compared with vaginal delivery. Women undergoing C-sections have a higher risk of infections, greater complications related to the surgical wound, greater chances of maternal admission to the intensive care unit (ICU), increased risk of maternal death and higher risk of adverse outcomes during the subsequent pregnancies compared with those who have vaginal delivery.[13] Regarding neonatal outcomes, studies have associated C-sections with increased respiratory complications and higher rates of fetal mortality and neonatal ICU (NICU) admissions.[13–16]

On the other hand, one cannot deny that an increase in the number of C-sections performed is correlated with a reduction in maternal and perinatal mortality and morbidity, mainly in places where this procedure is underused. However, as previous studies have revealed, the unrestricted use of C-sections lacks proof of benefits.[17]

Countless interventions have been proposed worldwide to reduce the number of unnecessary C-sections, and they have yielded different results. A series of three studies on caesarean optimisation showed that implementing only clinical interventions, such as protocols or teaching activities, does not cause a significant reduction in surgical delivery rates; clinical interventions must be complemented by non-clinical actions to obtain better results.[17–19] These include acting on aspects of women's culture, their families and the community. Factors inherent to health professionals, health organisations, facilities and systems must also be considered.[20–22]

Among the interventions that cover all these aspects in trying to reduce the C-section rate, the Adequate Childbirth Project (PPA) deserves mention. This project resulted from a partnership between the National Agency for Supplementary Health, Hospital Israelita Albert Einstein (HIAE) and the Institute for Healthcare Improvement (IHI); the first phase of this project was launched in May 2015, and its second phase in January 2017.

The PPA involves several private and volunteer hospitals in Brazil and has emerged as a proposal for changes in the model of childbirth care based on scientific evidence and by using the science of improvement. The hospitals were organised in hubs to exchange positive and negative experiences. Although the PPA involves group discussions, actions were adopted on an individual basis for each hospital depending on their particularities, and it involved the participation of pregnant women, a multidisciplinary team, health establishments and health insurance agencies. Such actions contributed to reducing the number of unnecessary C-sections and the risks associated with this procedure, as well as to the growth of good health practices focusing on delivery and childbirth.[23]

Respecting the individualities of each institution, the results differed among the participating hospitals. The present study aims to report the actions taken at HIAE, a private hospital that is open to external professionals, and to verify their impact on the maternal–fetal binomial.

METHODOLOGY

The HIAE, a private hospital in the city of São Paulo, Brazil, as the leader of the PPA, adopted a set of proposed actions. Their various actions were implemented in two phases according to the schedule established in the PPA. In each phase, the plan involved a group of actions that were initially designed by the coordinators, based on guidelines learnt from IHI's Presential Learning Sections and published literature, and inspired by other successful similar experiences.[6 13] In both the first and second phases of the project, the actions involved three axes: a multidisciplinary team, pregnant women and facility improvements.

Actions: first phase

The first phase actions are summarised in table 1 as described below.

Multidisciplinary focus

Meetings with professionals were held quarterly since the beginning of the adopted measures. Such meetings were guided by the explanation of the plan-do-study-act method (PDSA) to structure the learning process and sharing of the professionals' experiences, aiming at continuous improvements in their skills. These meetings also allowed the team to first test the actions before implementing them.

Table 1 First phase actions of the PPA

Components	Actions
Multidisciplinary team	► Learning sessions. ► Quality committees. ► Quarterly clinical meetings. ► Disclosure of service offerings. ► Nurse team expansion. ► Structured protocols. ► Disclosure of birth rates. ► Delivery monitoring bundles. ► Medical relationship scoring programme for obstetric performance. ► Training at realistic simulation centre. ► C-section scheduling policy. ► Group-based communication on WhatsApp.
Pregnant women	► Hospital website remodelling. ► Home care for early discharge.
Facility	► Electronic medical records. ► Standard prescriptions.

PPA, Adequate Childbirth Project.

All actions were tested in each phase before being completely adopted in routine practice. The PDSA cycles were applied to each action. The application of the cycles was important because all members of the team were able to understand the methodology and its importance in changing the processes.

Furthermore, two improvement projects with the learnt methodology were developed per year. These were counted with the participation of the leaders, and they were shared with the hubs to serve as examples in future. The indicators obtained in these projects would be used in the construction of safety dashboards and setting of hospital targets.

With a multidisciplinary focus, and to improve clinical practice, monthly meetings to present the results of the project and the adopted strategies were organised with the hospital's quality of care committee, which includes board members, directors and patient representatives. This committee was responsible for improving and validating the actions. Another planned strategy in those meetings was the disclosure of birth rates, where normal birth and C-section rates were presented. Subsequently, a retrospective analysis of some real scenarios was performed, proposing measures that could have been taken to avoid unnecessary C-sections in those cases.

In parallel, multidisciplinary meetings to discuss the scientific evidence related to birth and new care models were held every 3 months. In these meetings, the clinical staff shared their difficulties and desires. From these discussions, new standard care protocols were developed to create standards for targeted actions, including premature rupture of membranes, labour analgesia, labour induction, pregnancy-induced hypertension, episiotomy, premature labour and delivery.

Considering the nature of the hospital's staff, including internal and external doctors as well as the Brazilian culture that foresees the presence of a responsible doctor at the time of delivery, pregnancy and labour care models were proposed to facilitate coordination between labour monitoring, care and the doctors' daily activities.

These care models included antenatal care not centred on a single professional and rotated the team of doctors to increase the chances that one of them would be available at the time of delivery. Furthermore, teams with more than one medical professional were organised to assist labour and delivery so as to promote the sharing of decision-making processes, greater inclusion of midwives and doula support in childbirth care. These professionals provided support to the process until it was close to the time of delivery, allowing the doctor to carry on normally with his/her agenda, and also to be present during the imminent delivery. Each model was tested in one respective group of obstetrician partners using an available patient as a model. More midwives were hired exclusively for the birth centre to provide multidisciplinary support to doctors.

Notwithstanding the above, nurses providing labour care were standardised by bundles, as shown in table 2. Each bundle was tested individually in a PDSA cycle, including the first patient as a sample for each bundle. Furthermore, to improve the security of the team in this type of care, we created the yellow obstetric code, which consists of an immediate signal to call the on-duty doctor via a mobile extension when the nurse detects any acute change in vital parameters and/or life-threatening situations to the parturient or fetus.

To encourage vaginal delivery, the percentage of this route of delivery was incorporated into the hospital relationship programme with doctors: professionals who conducted more vaginal deliveries had higher scores in the programme. Points are reverted into benefits, such as discounts, complimentary exams and personal and/or family hospital admissions.

Courses, workshops and different technical trainings focused on childbirth care were held at our institution's Realistic Simulation Centre. Among these workshops, there were practices related to instrumental delivery (forceps) and vacuum extraction, breech delivery, postpartum haemorrhage, shoulder dystocia, eclampsia, delivery positions, as well as theoretical classes dealing with near miss and cardiotocography. These educational activities aimed at promoting the rapid mobilisation of professionals in critical settings have been reported in the published literature as interventions that successfully improve safety in maternity hospitals and provide quick and assertive actions in emergencies.[24] All doctors and nurses at the hospital were invited to attend these trainings, and attendance was also counted as a point in the medical relationship programme. A total of 438 doctors and 263 nurses were trained.

Furthermore, safety hurdles were adopted in the maternity unit three times a day, allowing improvement in communication among members of working teams and the development of prompt solutions to the most diverse adversities.

Another important action was the establishment of a policy to schedule C-sections; elective C-sections without medical indications (maternal request) were only permitted after 39 weeks. Therefore, all cases where women not in labour were to undergo C-sections when they were below the gestational age needed the approval of the maternity coordinator after contact with the doctor, and such permission was based on technical criteria. This also became an indicator on the hospital's safety dashboard and an item in the hospital relationship programme with doctors.

The maternity coordinators also created a WhatsApp group, including the most active obstetricians, anaesthetists and midwives in the institution. This group intended to share the actions with a positive impact on vaginal delivery rates and the published scientific literature showing the importance of this practice. This group also allowed discussions about cases and the rapid resolution of problems.

Table 2 Bundles to assist labour

Bundles	Rational
(1) Presence of a companion throughout the entire process of labour, whether family or health professional.	During the period of contractions or pain, the patient needs emotional support, whether from a family member or a doula. If there is need for the companion to leave, he/she should ask another person to replace him/her to guarantee that the patient will feel safe. Hospital's nursing professionals or staff and doctors also provide emotional support to the patients.
(2) Avoid early admission, do so only in the active phase of labour.	The latent phase of labour can last up to 20 hours in primiparous women. The ideal time for admission is during the active phase of labour, with 4 cm dilation and two contractions/10 min. During the latent phase, support and comfort should be provided to the patient at alternative places outside the hospital.
(3) Labour monitoring with minimal intervention: avoid fasting, venous access, early rupture of membranes. Vaginal digital examination every 3–4 hours, intermittent fetal monitoring. Avoid indiscriminate use of oxytocin.	a. Maintain a liquid diet until 2 hours before analgesia. b. Instal venous access only when necessary. c. Vaginal digital exams must be at least 3 hours apart. d. Keep the bag of waters intact if possible. e. Fetal heart rate monitoring should be intermittent, every 30 min if a fetus is at low risk and every 15 min it the fetus is at high risk, listening during and after contractions. If in doubt, cardiotocography must be performed every 20 min. f. Augmentation of labour with exogenous oxytocin should only be performed under conditions of 'static labour', which is defined as the need to correct the pattern of contractions after 6 hours without the evolution of dilation and after all non-pharmacological measures (walking, exercise on the ball) have been tried.
(4) As non-pharmacological methods of pain relief, encourage walking, the use of the ball and shower, at least for 30 min each.	The non-pharmacological methods of pain relief provide comfort to the patient, allow for pharmacological analgesia to be performed at an opportune time, when labour has set in. At the beginning of labour, stimulate walking, and when the patient needs to rest, use the Pilates ball.
(5) Always perform labour analgesia before indicating directly a C-section delivery.	In cases where there is no urgency or indication of C-section due to fetal distress or maternal disease, it is recommended that pharmacological analgesia (combined/epidural analgesia) be administered to correct labour dystocia before caesarean delivery is finally indicated.
(6) Respect the two phases of the second stage of labour, avoiding the pushing and operative delivery if the parturient is in the passive phase.	During the passive phase, use vertical positions, encourage walking, use a stool for the patient's comfort and to lower the presentation. Avoid keeping the patient in horizontal dorsal decubitus, avoid unnecessary pushing and avoid early lithotomy positions.

Pregnant women focus

An exclusive and updated link dedicated to promoting vaginal delivery was created on the hospital's website; there, the population and professionals have free access to information about motherhood, preparation for childbirth and parenting, puerperium, breast feeding, newborn care, as well as frequently asked questions and other information regarding the admission process and childbirth preparation courses.

Childbirth care in Brazil is almost entirely done inside the hospital, although some women are not comfortable in that environment. Therefore, to align the expectations of those requiring a different environment with the medical fears related to early hospital discharge, a home care visit was offered to those who needed it.

Facility focus

Not only childbirth care protocols were created but also a strategy to implement them efficiently. For this, a hospital data management system named Cerner was used. This system contains standard prescriptions and decision-making support tools.

Electronic medical records also allowed us to build up individual and collective performance reports. Thereafter, an internal disclosure form of the medical indicators related to C-section rates, neonatal results and hospital goals was shared.

The results achieved by the group of professionals were published monthly on the maternity boards, while the individual results, including the comparison with the average of the other professionals, were sent by email every 6 months to every obstetrician/gynaecologist working at the institution. First, reports were sent to 10 OBGYNs (Obstetricians and Gynecologists) with the highest delivery indices, and this strategy was adopted for all OBGYN staff.

Table 3 Second phase actions of the PPA

Components	Actions
Multidisciplinary team	► Individual feedback on the coordination. ► Medical record audits. ► Forwarding of non-conformities to the medical practitioner. ► New postpartum haemorrhage protocol.
Pregnant women	► Specific consent form for delivery. ► Videos about the processes of admission and birth delivery. ► Update of the childbirth preparatory course.
Facility	► Creation of an exclusive birth centre for vaginal delivery. ► Improvements in the electronic medical records system. ► Cardiotocography monitoring centre.

PPA, Adequate Childbirth Project.

Actions: second phase

In the second phase of project implementation, which started in 2017, new actions were added to those already adopted (table 3).

Multidisciplinary focus

An individual feedback plan was initiated by the managers and coordinators. Doctors with high C-section rates (>80%) and a high number of deliveries (≥15 within the last 12 months) were individually invited to join a meeting with a senior manager. The goal of this meeting was to promote the understanding of the context of the doctors' practices and seek measures to align them with the hospital's objectives in the context of the PPA.

A field regarding the C-section indications was created in the electronic medical records system Cerner) and it was a requirement for it to be filled. This allowed auditing and checking of compliance according to institutional protocols and policies for scheduling C-sections. Cases of non-conformity were to be referred to the hospital's medical practice sector, and this was responsible for contacting the doctor and establishing the need for penalties after discussion.

In this phase, a postpartum haemorrhage protocol was developed to allow the identification of patients at risk and the rapid recognition and management of the worsening cases.

Focus on pregnant women

The consent form was updated, including relevant information regarding the birth plan and the risks and benefits of each mode of delivery.

Furthermore, an informative video was produced that contained information about some processes carried out at the hospital during hospitalisation. The video included information about the PPA and presented the optimal structure of the hospital for pregnant women attempting to have a vaginal delivery. This allowed the information to reach a greater number of women, including those who were unable to have face-to-face visits.

Important updates were done in the childbirth preparatory course, which was previously carried out by an external institution; now, the course is part of a programme offered by our facility. Free theoretical content, focusing on vaginal delivery and its benefits, was made available online for those taking the course. In the hands-on practical course, stations were created specifically to simulate vaginal delivery. The course includes instructions from a midwife on the various possible positions for labour and delivery, as well as information from a physiotherapist who lets pregnant women know of the exercises to prepare and strengthen the pelvic floor.

Facility focus

One of the main focuses of our facility was the creation of an exclusive birth centre. The centre contains a large labour and delivery room that was set up for noise reduction and is equipped with non-pharmacological methods of pain relief, including music therapy, chromotherapy, space for disposable bathtubs, showers for sprinkling baths, pilates balls and ling bars.

A cardiotocography monitoring centre at a nursing station was also created. The implementation of this monitoring centre allows us to show exams on the monitors as the procedures a performed, and this allows for early change identification.

Population

All pregnant women admitted for childbirth at HIAE between 2014 and 2019 were included in the study. We excluded non-pregnant women and parturient women who gave birth to fetuses weighing less than 500 g.

To accomplish the proposed interventions, the entire multidisciplinary team working in the maternity unit was involved in the actions of this study under guidance and continuous training.

As mentioned previously, the actions were implemented in two phases and according to the PPA schedule. The first phase started in May 2015, while the second phase was implemented in January 2017. Therefore, the rates of vaginal delivery and C-sections in the overall population and primiparous women, in addition to the percentage of admissions in the NICU, were analysed in three periods:

- Period A: control group, between January 2014 and April 2015, that is, the period before the launch of the project.

Table 4 Demographic and obstetric profile of the analysed population per period

Period	Mean maternal age in years (SD)
Period A	34.07 (3.89)
Period B	34.28 (3.90)
Period C	34.69 (3.98)
Period	Average fetal weight in grams (SD)
Period A	3119.13 (538.19)
Period B	3149.68 (546.93)
Period C	3149.60 (541.03)
Period	Average gestational age in weeks (SD)
Period A	38.42 (2.05)
Period B	38.14 (2.01)
Period C	38.57 (1.93)
Period	Multiple pregnancy rate in % (SD)
Period A	3.58 (0.87)
Period B	3.54 (0.78)
Period C	3.43 (1.06)

- Period B: between May 2015 and December 2016, the period after the implementation of the first phase that aimed to verify the impact of the actions.
- Period C: between January 2017 and December 2019, the period after the implementation of the second phase that aimed to verify the impact of the actions compared with the results of period B.

For statistical analysis, we used the Shapiro-Wilk test on the database of the variables of interest, using the IBM SPSS Statistics 26 Subscription software (11–2018), to verify whether the values were normally distributed, considering a significance of 5% (p<0.05). The normality of the data was considered as a test with p>0.05.

If a normal distribution was found, a t-test was applied for independent samples after checking the consistency of the variation with the application of the F-test. For all analyses, a significance level of 5% (p<0,05) was considered.

RESULTS

A total of 26094 parturient women were enrolled. Of these, 6006 women were enrolled from January 2014 to April 2015, the period before the implementation of the project's actions, 7398 women enrolled from May 2015 to December 2016, after the implementation of the first phase, and 12689 women enrolled from January 2017 to December 2019, after the adoption of the actions from the second phase of the project.

The demographic and obstetric profiles of the population analysed in this study were similar and are described in table 4. No significant variation in the characteristics of the study population was observed during the three evaluated periods. The mean age of the patients was 34 years, the average fetal weight 3150 g, the average gestational age 38 weeks, and the average rate of multiple pregnancies approximately 3.5%.

After checking the vaginal delivery rates monthly, the Shapiro-Wilk test was applied to confirm the normal distribution of the data in the three analysed groups. The p-test values found for groups A, B, and C were 0.975, 0.428 and 0.192, respectively.

After confirming that the data from the three groups had a normal distribution, the t-test of two independent samples was used to check whether the difference in the mean of vaginal deliveries found in the three periods was significant.

The results are shown in table 5 and they reflect an increase in the average vaginal delivery rate from 23.57% (period A), before the implementation of the project, to 27.88% (period B) and to 30.06% in the period after the second phase of action, while C-sections decreased from 76.43% (period A), to 71.12% (period B) and to 69.94% (period C). The difference in the averages in the periods was statistically significant between periods A and B (p<0.001) and between periods B and C (p=0.004), considering an acceptable error of less than 5% (p<0.05). Considering only 15 doctors with more deliveries at the hospital, the vaginal delivery rates were 38.86% for period A, 41.64% for period B and 42.2% for period C.

Considering only primiparous women, an increase in the average vaginal deliveries was observed (21.81% in period A, 26.74% in period B and 30.41% in period C). This increase was significant when the analysed periods were compared (AxB, p<0.001 and BxC, p=0.002), as described in table 4.

Regarding the average rate of NICU admissions, there was a decrease in the average admission in this unit over the analysed periods, with a significant reduction when periods B and C (p<0.001) were compared (table 6).

Table 5 Mean C-section and vaginal delivery rates per period

	Period A		Period B		Period C	
	Vaginal delivery	C-section	Vaginal delivery	C-section	Vaginal delivery	C-section
Mean	23.57%	76.43%	27.88%	72.12%	30.06%	69.94%
SD	0.023		0.019		0.034	
Shapiro-Wilk	P=0.975		P=0.428		P=0.192	
T-test	P<0.001			P=0.004		

Table 6 NICU admissions

NICU admission rates			
	Period A	Period B	Period C
Mean	19.22%	18.71%	13.22%
SD	0.043	0.042	0.023
Shapiro-Wilk	P=0.187	P=0.800	P=0.525
T-test	P=0.719		P<0.001

NICU, neonatal intensive care unit.

DISCUSSION

This study enrolled pregnant women with similar obstetrics and sociodemographic characteristics; however, the profiles of these women probably do not explain the differences found in the analysed variables.

Our results suggest that the reduction in C-section rates, associated with improvement in neonatal outcomes rates over the years, is related to the actions included in the model of childbirth and perinatal care proposed in the PPA.

This result is aligned with those found in the study by Borem *et al*[23], who reported a change in the number of vaginal deliveries in eight Brazilian hospitals after the interventions described in the PPA.

In the strategy described by Borem *et al*[23], the increase in the number of vaginal deliveries was associated with changes in four pillars related to childbirth care: extensive coalition, a model of care centred on vaginal delivery, women's participation in decision making and a space for learning.

In the PPA, these modifications were achieved when methods were developed to increase the interrelationship among the multidisciplinary team, which carried out training in childbirth care, with the use of numerous approaches to encourage vaginal delivery, such as feedback and reports that allowed the opportunity for continuous changes. These premises are key to the action plan.

In the model adopted in this study, we observed that most of the actions were focused on improving the performance of the multidisciplinary team, given that health workers' advice has a significant impact on the choices pregnant women make. In this sense, actions were performed on three fronts: training of professionals through courses in realistic simulation by creating bundles and service protocols, implementing standard management with a scientific basis by promoting feedback actions that included the hospital's objectives and professional adequacy to them, and controlling the practice by adopting strategies such as the scheduling of C-sections. The creation of a WhatsApp group also served as an important tool to share positive results and as quick technical support in case of difficulties. Multidisciplinary training, including behaviour skill exercises, simulation training and the creation of a space for sharing information, may promote updates and improve the practices of professionals. These factors were identified as safety characteristics to be promoted in maternity hospitals as stated in the study conducted by Liberati *et al*[24]

According to a literature review by ACOG (American College of Obstetricians and Gynecologists), delivery dystocia and abnormal or undetermined fetal heart rate cardiotocographic traces are the most common indications of C-sections.[20] In this context, the courses carried out in a realistic simulation centre served as a subsidy both in terms of preparation for managing deliveries with dystocia and for a better interpretation of the cardiotocography exam. Simulation may also promote more assertive interventions and reduce the number of unnecessary C-sections.

Such courses may improve the confidence of obstetricians to conduct vaginal delivery. The training, along with the demonstration of the hospital's objectives by the management team in meetings scheduled with some doctors, and the disclosure of individual and collective results, led to a reduction in the scheduling of C-sections and a decrease in the performance of these procedures in the initial phase of labour.

Action implementation was favoured by the inclusion of the results related to childbirth in the scoring system of the hospital medical relationship programme with doctors, and by the active participation of the hospital's top managers in all stages of the process.

The reduced intervention in the decision-making process of pregnant women was a critical pillar for reducing the number of C-sections. There is an essential need to implement actions to increase the participation of women in making decisions with the healthcare team. Furthermore, there is a need to create a communication channel to allow feedback from patients to the team so that actions may be continuously improved. Previous experiences involved the disclosure of the rights of pregnant women and sharing of information about analgesia, and these actions can be included in later stages.[7]

Although related to the facility, the creation of an exclusive and structured birth centre probably improved the comfort and confidence of pregnant women to face labour. The centre associated with home care visits may have constituted the attractive actions for pregnant women who sympathise with fewer interventions.

To reinforce the safety of vaginal delivery, we should mention that despite the changes in the rates of the mode of delivery and the increase in vaginal delivery after project implementation, no significant differences were observed in the number of NICU admissions in the first phase of the project, and a decrease in the rate of NICU admissions was observed after the second phase. Similar results were also reported in an analysis of perinatal results that compared different modes of delivery in term pregnancies in a referral maternity hospital in southeastern Brazil. In that study, lower rates of admission to the NICU were observed after an increase in vaginal delivery in comparison to elective C-sections.[14]

A similar result was also reported by Torres *et al*[13]: no statistically significant difference was seen in the ratio

of adverse neonatal outcomes with a reduction in the number of C-sections. Furthermore, the increased rate of vaginal delivery was positively related to neonatal care and enabled early skin-to-skin contact, breast feeding within the first hour after delivery, joint accommodation and discharge on exclusive breast feeding. These characteristics were more frequently observed in the hospitals that underwent interventions similar to those in that study.[13]

These previous results regarding neonatal outcomes are consistent with those published in the literature that correlate C-sections with a higher rate of respiratory distress in newborns and, consequently, higher rates of hospitalisation in an ICU.[11] Furthermore, a systematic review by Boatin *et al*[21] showed that a decrease in C-section rates did not result in a concomitant increase in neonatal morbidity or other adverse results.

According to strategies highlighted in the published literature, this project included the use of evidence-based protocols and flowcharts, which served as a subsidy in decision making and was shown to be a supporting mechanism to increase vaginal delivery rates. The precise definition of the indications for C-sections is also considered as an important intervention. In this sense, the strategies implemented in our study, such as the creation of a menu of indications in the electronic medical records (Cerner) as a mandatory field to be completed by doctors, as well as the identification of the professionals who performed C-sections without an indication or below the recommended gestational age proved to be useful.[25]

Regarding the assistance provided by the team of midwives, the published literature has already shown better outcomes in vaginal deliveries when these professionals are involved.[13 26]

In our project, although midwives were not directly responsible for delivering the babies, their active participation during labour may have contributed to the reduction in the number of C-sections.

A limitation of this study was the lack of assessment of the impact of the actions in isolation. Therefore, we identified the most effective strategy and how each action interacted with the other. This is because the implemented care model in this project included complex and multifaceted interventions with elements regarding management, facility improvement, and change in the behaviour of health professionals and pregnant women.

Finally, another difficulty was due to the current practice model adopted by obstetricians in the private healthcare sector in Brazil, in which prenatal and childbirth care is often provided by the same doctors. This model poses barriers to care involving multidisciplinary teams and adherence to standardised practices, such as those aimed at better care in case of vaginal deliveries. In the short or medium term, this reality is expected to change and give room for a form of value-based care that enables more control.

CONCLUSION

The results of this study suggest that changes based on scientific evidence to the perinatal care model by involving a multidisciplinary team, pregnant women and hospital facilities can reduce the number of unnecessary C-sections without increasing adverse neonatal outcomes, and this evidence-based model may increase the use of good care practices in childbirth.

The variation in the analysed indicators with a decrease in C-sections after the implementation of the PPA suggests an association between the applied actions and favourable outcomes. Furthermore, our findings indicate that these transformations in the care model are relevant for optimising the practice of C-sections. The satisfactory results obtained after implementing PPA actions can be encouraging to other institutions seeking to modify their institutional labour intervention. Our model was able to improve delivery care rates and increase the number of vaginal deliveries.

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