Assessment of compliance with a color coded protocol for non-elective cesarean section in a maternity ward in France.

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Abstract

Purpose: The aim of a color coded protocol for non-elective cesarean-sections is to improve decision-delivery interval by better organization of care in a maternity unit. We set out to assess compliance of a color coded protocol and its impact on maternal and neonatal outcomes since its implementation in our maternity ward. Materials and methods: This was a retrospective study including a sample of 200 patients per year who underwent an non-elective cesarean section delivery in Rennes University Hospital from January 1, 2015 to December 31, 2018. Patients were grouped by year and by color code (red, orange or green). The main outcome was compliance with the protocol (color code in accordance with indication for cesarean section) and compliance with the corresponding decision-delivery interval. Secondary outcomes were maternal and neonatal outcomes. The statistical tests performed were Fisher's test for qualitative parameters and Kruskal-Wallis test for quantitative parameters. Results: Eight hundred patients were included during the study period. There was no significant difference in patient characteristics over the years. There was a significant improvement in protocol compliance: full compliance increased from 22.4% in 2015 to 76.5% in 2018 (p<0.0001). No difference was observed in the decision-delivery interval overall but compliance with the 15-minute decision-delivery interval imposed by a red coded protocol increased between 2015 and 2018 (p=0.0020). Conclusion: We observed a significant improvement in compliance with the color coded protocol between 2015 and 2018 and in the 15-minute decision-delivery deadline for the red code.

Original article

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Condensation

The implementation of a color coded protocol in our maternity has improved the decision-delivery interval by promoting communication within the team.

Running Head

Color coded protocol for non-elective c-section.

Words count : 2896 ; Figures count : 2 ; Tables count : 9

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Methods: This was a retrospective study including a sample of 200 patients per year who underwent an non-elective cesarean section delivery in Rennes University Hospital from January 1, 2015 to December 31, 2018. Patients were grouped by year and by color code (red, orange or green). The main outcome was compliance with the protocol (color code in accordance with indication for cesarean section) and compliance with the corresponding decision-delivery interval. Secondary outcomes were maternal and neonatal outcomes. The statistical tests performed were Fisher's test for qualitative parameters and Kruskal-Wallis test for quantitative parameters.

Results: Eight hundred patients were included during the study period. There was no significant difference in patient characteristics over the years. There was a significant improvement in protocol compliance: full compliance increased from 22.4% in 2015 to 76.5% in 2018 ($p<0.0001$). No difference was observed in the decision-delivery interval overall but compliance with the 15-minute decision-delivery interval imposed by a red coded protocol increased between 2015 and 2018 ($p=0.0020$).

Conclusion: We observed a significant improvement in compliance with the color coded protocol between 2015 and 2018 and in the 15-minute decision-delivery deadline for the red code.

Keywords : Cesarean section ; color coded protocol ; decision-to-delivery interval : timeframe ; maternal outcomes : neonatal outcomes.

Main Body of Text

Introduction

Cesarean section is one of the most frequent surgical procedures performed in the world (1) and represents 20.2% of all births in France in 2016 (2). Emergency cesarean sections may occur in different clinical situations with varying degrees of emergency (3). Many studies have tried to find the acceptable time frame for an emergency cesarean section, but there is no international consensus to date (4). Some learned societies advocate an acceptable decision-delivery interval, such as in the United Kingdom or Germany (5,6).

In France, Dupuis et al developed a tool to classify emergency cesarean sections in 2000 (7). This tool is based on medical indications identified by Lucas et al. and comprises three color coded categories (3,8):

- **Green:** Non-urgent cesarean section with a decision-delivery interval [?]1 hour. - **Orange:** Urgent cesarean section with a decision-delivery interval [?]30 minutes. - **Red:** Cesarean section to be performed in extreme emergency with a decision-delivery [?]15 minutes.

The aim of this study was to evaluate compliance with the color coded protocol in terms of indication and decision-delivery intervals since its implementation in our maternity ward in 2014, and its impact on maternal and fetal outcomes.

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Methods

Design of the study

This was a single-center retrospective study conducted in the maternity unit of Rennes University Hospital, France. This maternity unit is a tertiary maternofetal center with neonatal intensive care facilities and performs 3654 deliveries per year, 201 of which are non-elective cesarean sections.

Population

The patient inclusion period was from January 1, 2015 to December 31, 2018. The inclusion criteria were: women who underwent a non-elective cesarean section at >24 weeks of gestation, with no documented opposition to participate in research. Patients received a letter to inform them that their data would be collected and if they wanted, they could oppose to the data collection. The exclusion criteria were: patients undergoing elective cesarean section, and women who were under legal protection (patients under guardianship)

Protocol

The obstetric team consists of five delivery room midwives, two obstetricians, two obstetric interns, an anesthetist and anesthetist intern on site, and a pediatrician. The maternity ward is composed of 14 delivery rooms and three operating theatres specifically designated for cesarean sections.

A written color coded protocol according to Dupuis et al. was introduced in our maternity ward during 2014 (8). It defines indications for each color code, the decision-delivery interval for each color, and the role per color code of each member of the team. The color coded protocol is presented in **Table 1.**

Data collected

The data were collected from medical digital files via DxCare(r) software, using the keywords "cesarean section during labor - laparotomy" and "emergency cesarean section except labor- laparotomy" and, if necessary, from paper files including the partogram.

The clinical data collected were : maternal age, pre-pregnancy body mass index (BMI) [weight in kg/size2 in metres], gravidity, parity, uni- or multi-scarred uterus. Obstetric data collected were: gestational complications and their type, type of pregnancy (single or multiple), occurrence of fetal death in utero or therapeutic termination of pregnancy, gestational age at which cesarean section was performed, occurrence during labor, and labor induction. Peroperative data comprised: incision time, the surgical technique used, possible presence of surgical difficulties, the occurrence of postpartum hemorrhage (defined by the presence of blood loss >500 mL), total peroperative blood loss, and operating time. The following data on anesthesia were also collected: epidural anesthesia administered prior to cesarean section, type of anesthesia performed during the cesarean section, any changes in anesthesia during cesarean section and their reasons.

Neonatal data collected included: birth weight, sex of child, arterial pH and arterial lactates collected from the cord after birth, Apgar score at 1, 5 and 10 minutes, the need for neonatal resuscitation, the need for hospitalization in the neonatal unit including the reason and duration, and the occurrence of a neonatal death. Post-operative maternal data collected were: length of stay, maternal postpartum anemia (defined by hemoglobinemia below 11 g/dL), the need for transfusion, maternal complications and their type (venous thromboembolic event, surgical site infection, hemorrhagic complication, digestive or bladder), and the need for surgery.

To assess protocol compliance the color code indicated by the on-call obstetrician was noted for each patient, as well as the indication for the cesarean section mentioned in the cesarean section report. Based on this information, we checked that the color code was in line with the indication according to the protocol. We also noted any lack of mention of a color code in the file. In the event of non-compliance with the protocol or the absence of mention of a color code, we allocated a code according to the indication noted on the operational

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report. The decision-delivery interval was calculated by calculating the time between the decision to perform a cesarean section and the time of delivery. Compliance with the decision-delivery interval was verified according to the color code used by the on-call team.

Primary outcome

The primary outcome was compliance with the protocol, i.e. the use of the appropriate color code for the indication of cesarean section and compliance with the decision-delivery interval imposed by the protocol.

Four situations were identified in the event of non-compliance with the protocol:

-        Color code used did not correspond to that proposed by the protocol for a given indication. -   Decision-delivery interval greater than that indicated in the protocol. -   Simultaneous presence of the two situations mentioned above (total non-compliance with protocol) -   No mention of a color code or time of decision in the medical file, whether computerized or paper ("missing data" group).

Based on these five situations, we categorized patients into five categories to make it easier to read the results:

-        Category 1: Full compliance with protocol -   Category 2: Decision-delivery interval greater than that indicated by the protocol -   Category 3: The color code used did not match that provided by the protocol -   Category 4: Non-compliance with the protocol in both cases (inappropriate color code and decision-delivery interval greater than the maximum time imposed by the protocol) -   Category 5: Missing data (decision time and/or color code not mentioned in medical record)

Statistical analysis

Quantitative variables are described as follows: N, average - standard deviation, minimum - Q1 - median - Q3 - maximum. For qualitative variables, the effective (N) and the percentage (%) are presented for each modality. To compare the different populations, the following statistical tests were used: Fisher (F) test for qualitative parameters and Kruskal-Wallis (KW) test for quantitative parameters. In case of $p < 0.05$, 2 to 2 tests with a correction of the threshold of significance according to the method of Bonferroni (for Fisher) or Dwass, Steel, Critchow-Fligner (for Kruskal-Wallis) were carried out. The analyses were carried out with the SAS software, version 9.4.

Ethics

The local ethics committee approved the study (Reference: 20.119).

Results

1 971 patients underwent an non-elective cesarean section from January 1, 2015 to December 31, 2018. Of these, 201 patients were randomly selected for each year, corresponding to 800 patients included in the study (four patients excluded due to missing files). The details of patient selection can be seen in the patient flow chart **(Figure 1)** .

Population Characteristics

Table 2 presents the characteristics of the overall population and per year.   There was no significant difference between the years except for primiparity, a history of scarred uterus, and cesarean section during labor. These data are different for the year 2017 compared to other years ($p < 0.05$).

Overall, 250 of the 800 cesarean sections were coded green (31.3%), 263 orange (32.9%), and 85 red (10.6%). For 202 patients (25.3%), the color code was missing from the medical record, whether computerized or paper. These data are presented in **Table 3** . Between 2015 and 2018, the number of patients for whom a color code was not mentioned in the file decreased significantly (p<0.0001). These were mainly for green and orange coded cesarean sections, for which the number increased significantly over the years ($p < 0.0001$). Conversely, there was no significant difference in the number of red code cesarean sections.

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Results on the primary outcome

Between 2015 and 2018, there was a significant decrease in patients with missing data ($p < 0.0001$) and a significant improvement in full compliance with the protocol ($p < 0.0001$).

For patients for whom the color code was inappropriate (patients belonging to categories 3 and 4, i.e. 69 patients in total), 15.9% were under-evaluated according to the clinical situation (reassessed color code required faster management). **Figure 2** shows how compliance with the protocol changed from 2015 to 2018.

Table 4 shows compliance with color codes according to the indication for a cesarean section. There was significant agreement between the initial color code and the re-evaluated color code for each of the three color codes with a global Kappa match test of 0.82 (0.79 - 0.87).

Table 5 presents the average decision-delivery interval based on the color code and year. There was no significant difference between the years on the decision-delivery interval regardless of the color code used. The rate of compliance of red code cesarean sections (with a decision-delivery interval of [?]15 mins) was 85.9% and increased significantly over the years to 100% in 2018 ($p = 0.0020$).

Most of the missing data was for color code only (83.6% of patients). For these patients, the decision-delivery interval was met for 73.7% after re-evaluation of the color code (using the indication noted on the operating report). When the decision-delivery interval was missing but the color code present, the color code was in line with the indication for 69.2% of the patients.

Outcomes of red code cesarean sections

Over the study period, 86 patients received a red code cesarean section for the following indications: fetal bradycardia (33 patients, i.e. 38.4%), fetal heart rhythm abnormalities (16 patients, i.e. 18.6%), retroplacental hematoma (13 patients, i.e. 15.1%), cord prolapse (10 patients, i.e. 11.6%), failure of instrumental extraction with fetal heart rhythm abnormalities (6 patients, i.e. 7%), uterine rupture (4 patients, i.e. 4.7%), Benckiser hemorrhage (1 patient, i.e. 1.2%), other indications (2 patients, i.e. 2.3%).

Most of the red code cesarean sections were therefore performed for actual red code indications. However, 17 patients (19.8%) received a red code cesarean section while the indication corresponded to a different code: 16 patients with an indication corresponding to an orange code, and one patient with an indication corresponding to a green code (forehead presentation for a first twin). One patient had an indication not mentioned in the protocol (cervical retraction after birth of first twin).

Data on red code cesarean sections are presented in **Table 6**. The average decision-delivery interval decreased over the years without reaching significance. There was a significant improvement in the compliance with the 15-minute decision-delivery interval imposed by the protocol with 100% compliance in 2018 ($p = 0.0020$). There was no significant difference in the type of anesthesia for red code cesarean sections between the different years or for neonatal outcome.

Neonatal Results

Neonatal results are presented in **Table 7**. Arterial pH was missing for 54 newborns and therefore not included in the arterial pH results.

There was a significant increase in average pH at birth over the years ($p = 0.0114$) but no significant difference in the number of infants with an arterial pH <7. Eight neonatal deaths were recorded: five newborns died from severe complications linked to prematurity (ulcerative enterocolitis or severe bronchopulmonary dysplasia); three of complications related to neonatal acidosis; two of complications related to severe sepsis due to an intrauterine infection; and one of malformations in relation to maternal type 1 diabetes.

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Maternal Complications

Maternal complications are presented in **Table 8.** Total operating blood loss was 434.7 +- 322 mL. The average operating time was 41.2 +- 14.1 minutes. The overall postpartum hemorrhage rate was 36.4%, and 9.1% cases of postpartum hemorrhage over 1L were noted. There was no significant difference over the years in the rate of postpartum hemorrhage, whether severe or not. Five per cent of patients received a transfusion (globular or platelet). The average length of hospitalization was 6.3 +- 2.7 nights. The rate of post-operative infection was 3% with no significant difference between years. The surgical recovery rate was 1.5%. Only one patient had a venous thromboembolic complication consisting of a pulmonary embolism.

Anesthesia Results

Table 9 refers to anesthesia data overall and by color code used. 533 (66.7%) patients had epidural analgesia before the cesarean section. There was no significant difference in the number of conversions to general anesthesia based on the color code used. Lack of analgesia was the main reason for conversion to general anesthesia (61 patients, i.e. 85.9%). Four patients received general anesthesia due to hemodynamic instability during cesarean section (occurrence of a vascular injury). Four patients developed a complication of epidural anesthesia requiring general anesthesia. Two patients underwent general anesthesia after failure of epidural anesthesia.

Discussion

Principal findings

Full compliance with a color coded protocol for non-elective cesarean sections improved significantly between 2015 and 2018 in our maternity ward to reach a rate of 76.5% in 2018 ($p < 0.0001$). There was also a significant decrease in the number patients with missing data in their medical records, with only 3.5% of data missing in 2018 compared to almost 27% in 2015 ($p < 0.0001$).

Results in the context of what is known

Several studies have studied the clinical impact of this color coded protocol on the decision-delivery interval since its introduction in 2014. They have shown that color coding optimizes the organization and communication in the team regardless of the type of structure (9–13). Indeed, in the absence of a protocol, it is difficult to meet the recommended decision-delivery intervals (14).

Clinical implications

We observed a significant increase in compliance with the protocol for red code cesarean sections to reach full compliance in 2018 ($p = 0.0020$). However, despite better compliance with the decision-delivery interval imposed by the protocol, there was no significant difference in neonatal morbidity. This is in accordance with a literature review by Pierre and al. who report that the pathology leading to emergency cesarean section outweighs the neonatal prognosis over the mere adherence to a short decision-delivery interval (15).

While there was no significant difference in neonatal mortality outcomes in our population overall in terms of compliance with the protocol, there appeared to be a trend towards a decrease in the number of newborns with an arterial pH of less than 7 at birth, an Apgar score of less than 7 at 5 minutes of birth, and neonatal deaths between 2015 and 2018. It can then be assumed that adherence to the protocol leads to a decrease in the number of cases of neonatal asphyxia. This lack of significance of the results can be explained by inadequate power of our study to demonstrate this point. It would therefore be interesting to conduct a study with higher numbers to confirm this hypothesis.

Our study revealed that some indications of non-elective cesarean sections did not appear in the protocol. These non-protocol indications included preeclampsia, HELLP syndrome, intrauterine infection, and maternal shock, pathologies which don not necessarily require a cesarean section depending on the severity of the pathology. This underlines one of the limitations of the protocol in that a specific color code is not always

adequate. It is important thus to remember that while such a protocol assists decision making in current practice, it is crucial to adapt management to each clinical situation for optimal outcome.

Research Implications

To improve protocol compliance, it would be interesting to study the elements that lead to non-compliance and thus improve our decision-delivery interval. In some studies, these elements appear to be the time between the decision to perform a cesarean section and entry into the operating room, organizational deficiencies, or anesthesia difficulties (8,16). Protocol compliance could also be improved by team simulation training which has been shown to be effective in improving the management of many pathologies in obstetrics, especially when requiring coordinated teamwork (17–20).

Strengths and limitations

The main strength of our study is the large patient sample which ensures robustness of the results on the main judgment criterion. Our population of 800 patients undergoing non-elective cesarean section is one of the largest series studying color codes in this setting. On the other hand, a higher power would have been required to demonstrate the decrease in the rate of per-partum asphyxia following the implementation of the protocol. The main weakness of our study lies in its retrospective design implying the usual biases inherent to this type of study mainly due to missing data. It is more than possible that some data, such as the color code, were announced orally at the time of the cesarean section decision but not recorded in the medical records. A prospective study would help to overcome this bias and to assess current practices as accurately as possible.

Conclusion

We observed an improvement in compliance with the color coded protocol over the years. Our results suggest that the implementation of such a protocol in our maternity has improved the decision-delivery interval by promoting communication within the team. The ensuing decrease in the rate of per-partum asphyxia remains to be demonstrated.

Ethics Approval

The local ethics committee approved the study (Reference: 20.119)

Justification of the study

Why was this study conducted ?

Many studies have tried to find the acceptable time frame for an emergency cesarean section. The implementation of a color coded protocol to manage decision-to-delivery interval may respond to this question.

What are the key findings ?

First there was a significant improvement in color coded protocol compliance over the years and it shortened the decision-delivery interval. Second, our results may suggest improved neonatal outcome due to the implementation of a color coded protocol.

What does this study add to what is already know ?

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This study offers of a color coded protocol to manage decision-to-delivery interval in cesarean deliveries and shows how its implementation reduces this interval and may positively impact neonatal issues.

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Legends tables and figures

Figures

Figure 1. Patients flow chart.

Figure 2. Change in the compliance with the protocol from 2015 to 2018.

Tables

Table 1. Color coded protocol used in our maternity ward.

Table 2. Characteristics of the general population per year.

Table 3. Color codes per year.

Table 4. Compliance of color codes according to the cesarean section indication.

Table 5. Average decision-delivery interval per year and color code.

Table 6. Data for red code cesarean sections.

Table 7. Changes in neonatal parameters over the years.

Table 8. Data on maternal complications per year.

Table 9. Type of anesthesia according to color codes.

Tables

Table 1. Color coded protocol used in our maternity ward.

« RED Code » Extreme emergency: Immediate threat to the maternel and/or fetal vital prognosis
Objective of fetal extraction : [?]15 minutes   Fetal bradycardia (without recovery of the fetal heart rhythm within 10 minutes) Failed operative delivery with abnormal f...   Obstetric situations are given as an indication

Table 2. Characteristics of the general population per year

	Global population n = 800	2015 n = 201	2016 n = 198	2017 n = 201	2018 n = 200	p
Age (years)	31.2 ± 5.9	30.8 ± 5.9	31.4 ±5.4	30.5 ±6.3	31.9 ±5.7	0.0654
BMI	25.5 ±5.9	24.8 ±5.5	25.9 ±6.9	25.3 ±5.4	25.8 ±5.8	0.2373
Primiparous	405 50.6 %	101 50.2%	94 47.5%	122 60.7%	88 44%	**0.0059**
Scarred uterus	230 28.8%	55 27.4%	58 29.3%	44 21.9%	73 36.5%	**0.0135**
Therapeutic termination of pregnancy or fetal death in utero	4 0.5%	1 0.5%	2 1%	0 0%	1 0.5%	0.4342
Cesarean section during labor	658 82.3%	168 83.6%	172 86.9%	149 74.1%	169 84.5%	**0.0048**
Induction of labor	317 36.9%	67 33.3%	87 43.9%	89 44.3%	74 37.0%	0.0640
Term (in weeks of gestation)	38.3 ±3.5	38.5 ±3.6	38.6 ±3.1	38.0 ±3.8	38.1 ±3.6	0.2502

BMI : body mass index. Results expressed on average, standard deviation and n (%), significant results in bold.

Table 3. Color codes per year.

	Global population n = 800	2015 n = 201	2016 n = 198	2017 n = 201	2018 n = 200	p
Green code	250 31.25%	7 3.5%	53 26.8%	86 42.8%	104 52.0%	**0.0001**
Orange code	262 32.75%	40 19.9%	64 32.3%	86 42.8%	72 36.0%	**0.0001**
Red code	86 10.75%	24 11.9%	24 12.1%	22 10.9%	16 8.0%	0.5143
No mention of color code in the medical record	202 25.25%	130 64.7%	56 28.3%	7 3.5%	8 4.0%	**0.0001**

Results expressed in n (%), significant results in bold.

Table 4. Compliance of color codes according to the cesarean section indication

Re-evaluated code Initial code	Green code	Orange code	Red code
Green code n = 250	**240 96%**	10 4%	0 0%
Orange code n = 263	42 16%	**217 82.5%**	4 1.5%
Red code n = 86	1 1.2%	16 18.6 %	**69 80.2%**

Concordance test: Kappa coefficient = 0.8298 [0.7922; 0.8674], p < 0.0001

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In bold: percentage of color codes for which the indication was justified.

Table 5. Average decision-delivery interval per year and color code

	Global population n = 586	**2015 n = 71**	**2016 n = 139**	**2017 n = 184**	**2018 n = 192**	**p**
Green codes DDI (minutes)	n = 243 **51.1 ±35.5**	n = 7 38.7 ±15.8	n = 53 48.8±34.6	n = 79 51.5±33.3	n = 104 52.9±38.6	0.4813
Respect for DDI [?]60 minutes	194 79.8%	6 85.7%	43 81.1%	62 78.5%	83 79.8%	0.3118
Orange Codes DDI (minutes)	n = 258 **26.6 ±10.5**	n = 40 28.6±14	n = 63 25.3±7.4	n = 83 28±12	n = 72 25±8.2	0.3118
Respect for DDI [?]30 minutes	200 77.5%	30 75%	50 79.4%	61 73.5%	59 81.9%	0.6042
Red Codes DDI (minutes)	n = 85 **12.6±3.5**	n = 24 13.6 ±5	n = 23 13.3±2.4	n = 22 11.8±3	n = 16 11±2.2	0.0531
Respect for DDI [?]15 minutes	73 85.9%	15 62.5%	21 91.3%	21 95.5%	16 100%	**0.0020**

DDI: decision-delivery interval (in minutes)

Results expressed on average - standard deviation and n (%), significant results in bold.

Table 6. Data for red code cesarean sections

	Global population n = 86	**Global population n = 86**	**2015 n = 24**	**2016 n = 24**	**2016 n = 24**	**2017 n = 22**	**2018 n = 16**	**p**	
Justified red code indication	69 80.2%	18 75%	18 75%	20 83.3%	15 68.2%	15 68.2%	16 100%	0.0612	0.0
Average DDI (in minutes)	12.6 ±3.5	13.6 ±5	13.6 ±5	13.3 ±2.4	11.8 ±3	11.8 ±3	11 ±2.2	0.0531	0.0
Respect of DDI [?]15 minutes	73 85.9%	15 62.5%	15 62.5%	21 91.3%	21 95.5%	21 95.5%	16 100%	**0.0020**	**0.0**

	Global population n = 86	Global population n = 86	2015 n = 24	2016 n = 24	2016 n = 24	2017 n = 22	2018 n = 16	p	
Type of anesthesia: - Peridural anesthesia - Spinal anesthesia - General anesthesia	28 32.6% 1 1.2% 57 66.2%	10 41.7% 0 0% 14 58.3%	10 41.7% 0 0% 14 58.3%	6 25% 1 4.1% 17 70.9%	8 36.4% 0 0% 14 63.6%	8 36.4% 0 0% 14 63.6%	4 25% 0 0% 12 75%	0.7210	0.7
Arterial pH <7	n = 77 11 14.3%	n = 18 4 22.2%	n = 18 4 22.2%	n = 22 3 13.6%	n = 22 2 9.1%	n = 22 2 9.1%	n = 15 2 12.5%	0.7130	0.7
Apgar score <7 at 5 minutes	16 18.6%	4 16.7%	4 16.7%	5 20.8%	5 22.7%	5 22.7%	2 12.5%	0.8964	0.8
Neonatal death	4 4.7%	1 4.2%	1 4.2%	1 4.2%	2 9.1%	2 9.1%	0 0%	0.7673	0.7

DDI: decision-delivery interval. Respect of DDI for the red code cesarean is defined by a delay between decision of cesarean and birth less than 15 minutes.

Results expressed on average - standard deviation and n (%), significant results in bold.

Table 7. Changes in neonatal parameters over the years

	Global population n = 800	2015 n = 201	2016 n =198	2017 n = 201	2018 n =200	p
Average birth weight (grams)	3028±880	3076± 878	3070±809	2985± 916	2982± 915	0.5609
Prematurity (<37WG)	185 23.1%	43 21.4%	42 21.2%	53 26.4%	47 23.5%	0.5070
Average arterial pH	7,219 ± 0.120	7.202 ± 0.121	7.206 ± 0.121	7,231 ± 0.117	7,235 ± 0.120	**0.0114**
Arterial pH <7	37 5.0%	13 7.1%	8 4.5%	8 4.1%	8 4.2%	0.4823
Average Apgar score at 5 minutes	9.1±1.8	9.0±1.9	9.2±1.6	9.1±2.0	9.3±1.5	0.4542
Apgar at 5 minutes <7	63 7.9%	19 9.5%	15 7.6%	21 10.4%	8 4.0%	0.0820
Hospitalization in neonatal unit	238 29.8%	60 29.9%	58 28.4%	66 32.8%	54 28.0%	0.6417

	Global population n = 800	2015 n = 201	2016 n =198	2017 n = 201	2018 n =200	p
Neonatal death	11 1.4%	5 2.5%	3 1.5%	2 1.0%	1 0.5%	0.3556

WG: weeks of gestation, neonatal death: death of a newborn in the first 28 days of life (Source INED).

Results expressed on average - standard deviation and n (%), significant results in bold.

Table 8. Data on maternal complications per year.

	Global population n = 800	2015 n = 201	2016 n = 198	2017 n = 201	2018 n = 200	P	P
Total blood loss during cesarean section (in mL)	434.4± 322	442.5± 302	485.9± 351	430±327	379.8±300	379.8±300	**0.0118**
Operating time (in minutes)	41.2±14.1	42.2± 13.8	42.8±15	40.8± 14.7	38.9±12.8	38.9±12.8	**0.0259**
PPH	272 34.0%	76 37.8%	70 35.4%	65 32.3%	61 30.5%	61 30.5%	0.4232
Severe PPH	72 9.0%	15 7.5%	23 11.6%	23 11.4%	11 5.5%	11 5.5%	0.0824
Transfusion	40 5%	8 4%	14 7,1%	12 6%	6 3%	6 3%	0.2299
Length of hospitalization in maternity (nights)	6.3 ± 2.7	6.3 ±2.6	6.1 ± 2.3	6.5 ± 2.9	6.1 ± 3.1	6.1 ± 3.1	0.4765
Post-operative infection	24 3.0%	8 4.0%	9 4.5%	3 1.5%	4 2.0%	4 2.0%	0.2083
Surgical recovery	12 1.5%	3 1.5%	3 1.5%	4 2.0%	2 1.0%	2 1.0%	0.9263
Venous thromboembolic complication	1 0.13%	1 0.5%	0 0%	0 0%	0 0%	0 0%	1.0000

mL: milliliters; PPH: postpartum hemorrhage.

Results expressed on average - standard deviation and n (%), significant results in bold.

Table 9. Type of anesthesia according to color codes.

Type of anesthesia	Global population n = 800	Green code n = 250	Green code n = 250	Orange code n = 263	Orange code n = 263	Red code n = 86	Red code n = 86	p	p
Peridural anesthesia before cesarean section	533 66.7%	172 68.8%			194 73.8%	48 57.1%		**0.0155**	**0.0155**
Peridural anesthesia during cesarean section	518 64.7%	172 68.8%			194 73.8%	34 39.5%		**0.0001**	**0.0001**
Spinal anesthesia during cesarean section	197 24.7%	72 28.8%			55 20.9%	4 4.65%		**0.0001**	**0.0001**
General anesthesia at the beginning	85 10.6%	6 2.4%			14 5.3%	48 55.85%		**0.0001**	**0.0001**
Conversion to general anesthesia	71 8.9%	21 8.4%			31 11.8%	9 10.5%		0.2996	0.2996

Results expressed in n (%), significant results in bold.

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