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# Итоги мониторинга случаев критических акушерских состояний (maternal near miss) в Северо-Западном федеральном округе Российской Федерации в 2018–2019 гг.

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В статье представлен материал мониторинга случаев критических акушерских состояний (maternal near miss) с целью аудита качества оказания медицинской помощи и профилактики материнской смертности, полученный на основании анализа статистических данных одиннадцати субъектов Северо-Западного федерального округа Российской Федерации за 2018–2019 гг. Дана характеристика группы критических акушерских состояний, которые позволяют избежать случаев материнской смертности, наиболее часто в современной юридической практике являющихся предметом судебно-медицинских экспертиз по факту оказания акушерско-гинекологической медицинской помощи ненадлежащего качества. Определены основные причины их возникновения (с суммарной долей 83,1 % в 2018 г. и 84,0 % в 2019 г.): массивные акушерские кровотечения и осложнения тяжелой преэклампсии, которые чаще развивались во время родов и в течение первых суток послеродового периода. Все пациентки, пережившие близкое к смерти состояние, относились к группе высокого акушерского и перинатального риска, но большинство из них были родоразрешены в акушерских стационарах второго уровня, более половины — операцией кесарева сечения.

Рассмотрены основные пути профилактики и снижения частоты критических акушерских состояний и материнской смертности на основе совершенствования современной интегральной модели внутреннего контроля качества медицинской помощи в родовспомогательных учреждениях, внедрения в практику как медицинских, так и организационно-методических (в том числе телекоммуникационных и иных) технологий по работе с регионами с целью повышения профессиональных компетенций. Обращено внимание на необходимость систематизации и разработки единых четких критериев оценки критических акушерских состояний.

**Ключевые слова:** мониторинг maternal near miss; критические акушерские состояния; едва не умершие женщины; дефекты медицинской помощи; Северо-Западный федеральный округ Российской Федерации.

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# Monitoring in obstetric critical care (“maternal near miss”) in the Northwestern Federal District of the Russian Federation in 2018–2019

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This article presents data of monitoring critical obstetric conditions (maternal near miss) for the purpose of auditing the quality of medical care and prevention of maternal mortality, obtained on the basis of an analysis of statistical data from eleven federal subjects of the Northwestern Federal District of the Russian Federation for 2018–2019. We characterized the critical obstetric conditions that allow avoiding maternal mortality cases, which, in modern legal practice, most often require forensic examinations on the fact of providing obstetric and gynecological medical care of inadequate quality. We determined that the main causes of maternal mortality cases (83.1% in 2018 and 84.0% in 2019) were massive obstetric bleeding and complications of severe preeclampsia, which more often occurred during childbirth and the first days of the postpartum period. All patients who survived a near death condition belonged to the group of high obstetric and perinatal risk, but most of them were delivered in obstetric hospitals of the second level, with more than half of the women by caesarean section.

We discussed the main ways of preventing and reducing the incidence of critical obstetric conditions and maternal mortality based on the improved modern integral model of internal quality control of medical care in obstetric institutions. We also discussed the findings based on the introduction into practice of medical, organizational and methodological (including telecommunication and other) technologies aimed at increasing professional competencies in the regions of the country. Special attention is drawn in this article to the need to systematize and develop uniform and clear criteria for assessing critical obstetric conditions.

**Keywords:** maternal near miss monitoring; critical obstetric conditions; nearly dead women; defects in medical care; the Northwestern Federal District of the Russian Federation.

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## INTRODUCTION

The efficiency of maternal and child health services, which include an assessment of numerous parameters of women's reproductive health and the health of newborns, depends on the effectiveness of the interaction of socio-economic, environmental, informational, and other factors [1–6]. Their efficiency represents an integral indicator of the development level of a health care system in a state as a whole; as a result, indicators can be comparatively assessed at the international level, and the work of obstetric services in regions can be internally audited [1–6].

Indicators that characterize critical obstetric conditions (COC), along with the indicators of perinatal and maternal mortality (MM), have been widely explored. Consequently, a woman who is on the verge of death can survive even though she experiences severe complications during pregnancy, during childbirth, or postpartum.

COC is defined as a “near miss maternal morbidity.” COC cases differ from MM cases in terms of a favorable clinical outcome (failed death). According to the WHO definition, near miss (“almost dead” or “almost lost”) refers to “women who were dying but survived after a complication that occurred during pregnancy, childbirth, or within 42 days after the end of pregnancy” [4, 5, 7].

With the continuous audit and monitoring of COC cases with a successful outcome, the quality of medical care provided can be objectively assessed [3, 8–11]. Furthermore, the most significant factors can be identified by searching for not only medical factors (e.g., qualifications of medical personnel, knowledge of contemporary clinical treatment protocols, and proficiency in the necessary professional competencies) but also organizational and methodological (e.g., coordination of the work of outpatient and inpatient segments, clear routing, and functioning of a three-tier system of care), demographic (migratory population increase, unsatisfactory family relations, and high parity), socio-economic (low social status and low gross product of a federal district [region or city]), and other objective causes, leading to near miss and MM [3, 8–11].

COC cases should be monitored to assess the quality of medical care. This procedure has a number of advantages over analyzing the causes of MM because near miss cases occur more often; therefore, a large array of cases can be studied; the consequences of medical errors in these situations may not be so serious; information obtained from women who underwent COC and survivors contains an assessment of the quality of medical care; analysis of defects in the provision of medical care in near miss should be used to improve professional competence in the provision of medical care of appropriate quality [8].

The outcome of pregnancy depends directly on the quality of medical care, which determines the possibility of

reducing maternal and perinatal mortality [5, 6, 8, 11, 12]. In this regard, COC cases often lead to complaints, lawsuits, and forensic medical examinations [13, 14]. Death or a critical condition caused by a severe pathological process is considered from the perspective of the consequences of poor medical care. In the Russian Federation, more than 70% of MM cases can be prevented because they are often associated with diagnostic defects, lack of uniform protocols for the management of female patients with extragenital pathology, insufficient number of specialized medical centers, shortage of beds, and inadequate awareness of doctors of other specialties, especially district therapists and emergency doctors, about the peculiarities of the pathology of pregnancy and childbirth [8–10, 12–15].

COC in near miss cases in the constituent entities of the Northwestern Federal District of the Russian Federation (NWFD of the Russian Federation) has been audited and monitored since 2013. These procedures serve as an important link in the prevention of MM and enhance the understanding of the mechanisms of the development of pregnancy-related COCs; they also contribute to the detailed assessment of medical care quality and causes of inadequate medical care provision to determine ways on optimizing pregnancy outcomes [4, 8–10, 13].

## MATERIALS AND METHODS

A total of 280 COC cases were comparatively analyzed in 11 constituent entities of the NWFD of the Russian Federation in 2018–2019. COC in the Russian Federation was audited and monitored primarily by examining the data on Reporting Form No. 32 “Information on medical care for pregnant women, women in labor, and parturient women” and its insert “Information on the regionalization of obstetric and perinatal care in maternity hospitals (departments) and perinatal centers.” Four main causes of COC were examined: uterine rupture; severe eclampsia and preeclampsia; postpartum sepsis and generalized postpartum infection; and hemorrhage during pregnancy, labor, and postpartum period [16].

Appendix No. 13, or the “Rules for organizing the activities of an obstetric remote consultative center with mobile anesthesia and resuscitation obstetric teams for the provision of emergency and urgent medical care of the perinatal center and maternity hospital” to the current “Procedure for the provision of medical care in the field of Obstetrics and Gynecology” (cl. 7.1) of 2018–2020, was considered. In particular, the following life-threatening diseases or clinical situations complicating the course of pregnancy, childbirth, and postpartum period were presented in a broader range: preeclampsia and eclampsia; HELLP syndrome; acute fatty hepatitis of pregnant women; placenta previa with hemorrhage episodes in previous

periods of pregnancy; premature placental abruption with blood loss of more than 1000 ml; scar on the uterus with clinical or instrumental manifestations of failure; severe vomiting of pregnant women; extra-uterine pregnancy with blood loss of more than 1000 ml; cervical-isthmus pregnancy; postpartum (post-abortion) blood loss of more than 1000 ml; intraoperative complications associated with injury to adjacent organs or massive blood loss (more than 1500 ml); severe septic postpartum (postoperative) metroendometritis; postoperative (postpartum) peritonitis; postpartum sepsis; sepsis of any etiology during pregnancy; iatrogenic complications (complications of anesthesia, transfusion complications, etc.); degree II hypertension with a persistent increase in pressure over 160/100 mm Hg or episodic hypertension up to 200/120 mm Hg; cardiac defects with degree I circulatory disorders, pulmonary hypertension, or other manifestations of decompensation; myocardial dystrophy, cardiomyopathy with rhythm disturbances, or circulatory failure; severe pyelonephritis with impaired passage of urine, carbuncle, renal apostematosis, and pyelonephritis of a solitary kidney; severe hormone-dependent bronchial asthma; other lung diseases with symptoms of moderate respiratory failure; diabetes mellitus with difficulty in correcting blood sugar levels and a tendency to experience ketoacidosis; severe anemia of any genesis; thrombocytopenia of any origin; acute disorders of cerebral

circulation and cerebral hemorrhage; severe epilepsy; and myasthenia [17].

In addition, the WHO Recommendations (2008) specified the identification criteria for the organ pathology of this category of maternal morbidity (COC [maternal near miss]) as follows: "Identification criteria for cases of severe obstetric complications that almost ended in death" (Table 1) [18, 19].

According to a manual developed by WHO experts in 2016 for the analysis of COC, the updated criteria for maternal near miss situations include the following: massive postpartum hemorrhage, severe preeclampsia, eclampsia, sepsis, uterine rupture, and severe complications of abortion; critical interventions or transfer of a patient to anesthesiology and resuscitation departments; invasive radiology; laparotomy (including hysterectomy and excluding cesarean section); and use of blood products [4].

In the modern online space, the obstetric and gynecological service of the Russian Federation regions has a broad information and analytical resource for presenting data on COC, but it complicates the objectification and standardization of information on cases of maternal near miss to some extent.

Data on analytical units are unavailable in the executive authorities of the constituent entities of the Russian Federation in the field of health for the statistical accounting of the collection of information on COCs. Consequently,

**Table 1.** Identification criteria for cases of almost fatal severe obstetric complications

Dysfunction system	Clinical and laboratory signs
Cardiovascular dysfunction	<ul style="list-style-type: none"> <li>• Shock;</li> <li>• cardiac arrest;</li> <li>• severe hyperfusion (lactate &gt;5 mmol/l);</li> <li>• severe acidosis (pH &lt;7.1);</li> <li>• continuous use of vasoactive drugs;</li> <li>• cardiopulmonary resuscitation</li> </ul>
Respiratory dysfunction	<ul style="list-style-type: none"> <li>• Acute cyanosis;</li> <li>• dyspnea;</li> <li>• severe tachypnea;</li> <li>• severe hypoxemia (O<sub>2</sub> saturation &lt;90% for 60 min);</li> <li>• intubation and artificial pulmonary ventilation not associated with anesthesia</li> </ul>
Renal dysfunction	<ul style="list-style-type: none"> <li>• Oliguria not responding to diuretics;</li> <li>• severe acute azotemia (creatinine level &gt;300 μmol/ml);</li> <li>• dialysis for acute renal failure</li> </ul>
Blood coagulation dysfunction	<ul style="list-style-type: none"> <li>• Clotting inability;</li> <li>• severe acute thrombocytopenia (50,000 platelets/ml);</li> <li>• massive hemotransfusion (&gt;5 units)</li> </ul>
Liver dysfunction	<ul style="list-style-type: none"> <li>• Jaundice with preeclampsia;</li> <li>• severe acute hyperbilirubinemia (bilirubin level &gt;100 μmol/l)</li> </ul>
Neurological dysfunction	<ul style="list-style-type: none"> <li>• Prolonged loss of consciousness or coma (duration &gt;12 h);</li> <li>• paralysis;</li> <li>• uncontrolled posture/epileptic status;</li> <li>• global paralysis</li> </ul>
Uterine dysfunction	<ul style="list-style-type: none"> <li>• Hysterectomy due to uterine infection or hemorrhage</li> </ul>

the assessment of the true number of maternal near miss cases becomes complex. Similarly, implementing the ultimate practical aim, namely, the identification, analysis, and standardization of the direct and indirect causes of COC and MM, is challenging, thereby hindering the improvement of the quality of medical care provided by practical obstetrics at various levels.

## RESULTS AND DISCUSSION

COC cases were comparatively analyzed in 11 constituent entities of the NWFD in 2018–2019.

Based on the processed statistical forms of registration (Reporting Form No. 32 and its insert) in the NWFD of the Russian Federation, 130 cases of COC were registered in 2019 (0.1% of the total number of births and 1.1‰ of the total number of live births). By comparison, 150 cases were documented in 2018 (0.1% of the total number of births and 1.1‰ of the total number of live births). Despite the decrease in the absolute number, changes in the indicator were practically absent in time.

The following statistical indicators are essential for the assessment of the monitoring indicators of MM and COC (Table 2).

### 1. Number of COC cases per 1000 live births

The incidence of COC cases in the NWFD constituent entities in 2019 was 1.1 per 1000 live births, indicating the lack of change in this indicator. In 2018 and 2019, this indicator in 11 constituent entities of the NWFD varied within a wide range from 0.3 (1 case in 2019) in the Novgorod region (likely suggesting an error in information collection) to 6.8 in the Pskov Region (7.1 in 2018) and 5.9 in the Nenets Autonomous District (7.1 in 2018).

Regions with a low indicator ( $\leq 1.0$ ) of COC per 1000 live births in 2018 (St. Petersburg and Vologda, Kaliningrad, Leningrad, and Novgorod regions) recorded the same low indicator in 2019. In the Komi Republic, the indicator decreased in dynamics from 2.2 in 2018 to 1.8 in 2019 (1.2 times). The statistical analysis in the Republic of Karelia indicated that the indicator slightly increased from 1.6 in 2018 to 1.8 in 2019. In the Arkhangelsk Region, the indicator decreased significantly by 5.3 times in 2019 (0.4) compared with that in 2018 (1.7). The highest rates in 2019 were registered in the Pskov Region (6.8), the Nenets Autonomous District (5.9), and the Murmansk Region (3.4), indicating the indirect possible problems in the provision of medical care in the form of nonobservance and noncompliance with clinical protocols and lack of the implementation of effective routing of patients with a high risk of obstetric complications.

Although the collection and statistical processing of information were problematic, a group of three constituent entities of the NWFD could be distinguished. This indicator remained high in 2018 and 2019 in the Nenets Autonomous

**Table 2.** General integral indicators of critical obstetric conditions and maternal mortality in the constituent entities of the Northwestern Federal District of the Russian Federation in 2018 and 2019

Indicator	Constituent entities of the NWFD of the Russian Federation											Total in NWFD RF	Year
	Republic of Karelia	Komi Republic	Arkhangelsk Region	Nenets Autonomous District	Vologda Region	Kaliningrad Region	Leningrad Region	Murmansk Region	Novgorod Region	Pskov Region	St. Petersburg		
COC without fatal outcome (number of cases/COC indicator, ‰)	9/1.8	13/1.8	3/0.4	3/5.9	4/0.5	9/1.1	5/0.5	22/3.6	1/0.3	35/6.8	26/0.5	130/1.1	2019
	9/1.6	18/2.2	17/1.7	4/7.1	7/0.7	5/0.6	5/0.5	24/3.6	5/1.0	40/7.1	18/0.4	150/1.1	2018
MM (number of cases/MM indicator)	0	1/12.6	0	0	0	2/21.7	2/16.0	0	0	3/17.5	8/13.5	16/7.39	2019
	2/33.1	0	0	0	1/8.0	0	2/14.1	1/13.7	1/17.1	1/57.4	7/10.95	15/10.3	2018
COC:MM	0	13/1	0	0	0	4.5:1	2.5/1	0	0	11.7/1	3.3/1	8.1/1	2019
	4.5/1	0	0	0	7:1	0	2.5/1	24/1	5/1	40/1	2.6/1	10.0/1	2018
Mortality index	0	7.1	0	0	0	18.2	28.6	0	0	7.9	23.5	11.0	2019
	0	0	0	0	12.5	0	28.6	4.0	16.7	2.4	28.0	9.1	2018

Note. NWFD RF, Northwestern Federal District of the Russian Federation; MM, maternal mortality; COC, critical obstetric conditions; and MI, mortality index.



**Table 3.** Distribution of cases with critical obstetric conditions (*n* per 1000 live births) in the constituent entities of the Northwestern Federal District of the Russian Federation in 2018–2019 in relation to the level of obstetric medical organizations (%)

Constituent entity of the NWFD	Level I		Level II		Level III		Total	
	2018	2019	2018	2019	2018	2019	2018	2019
	Republic of Karelia	–	5.0	1.7	2.9	–	0.7	1.5
Komi Republic	6.1	4.3	0.8	1.6	1.1	1.6	2.1	1.7
Arkhangelsk Region	–	–	0.5	–	2.5	0.9	1.6	0.3
Nenets Autonomous District	–	–	7.0	5.8	–	–	7.0	5.8
Vologda Region	–	–	0.9	0.4	–	0.4	0.6	0.4
Kaliningrad region	–	–	0.6	0.2	0.3	1.7	0.5	1.0
Leningrad Region	–	0.5	0.3	0.4	7.0	0.5	0.4	0.4
Murmansk Region	12.1	9.1	0.8	6.2	5.8	2.0	3.5	3.5
Novgorod Region	–	–	4.6	–	0.2	0.25	0.9	0.2
Pskov Region	–	6.1	3.7	7.1	9.3	6.6	7.0	6.7
St. Petersburg	–	–	0.2	0.5	1.2	0.4	0.3	0.4
NWFD RF	1.7	1.9	0.6	0.75	2.3	1.4	1.05	1.0

Note. NWFD RF, Northwestern Federal District of the Russian Federation.

District (7.1 and 5.9), the Murmansk Region (3.6 and 3.6), and the Pskov Region (7.1 and 6.8).

## 2. Ratio of cases of COC and MM

The ratio of cases of COC and MM (COC:MM) is an important indicator of the audit of medical care quality; that is, the higher the ratio, the more favorable the situation with the provision of medical care in general. In 11 constituent entities of the NWFD of the Russian Federation, 15 and 150 cases of MM and COC were recorded in 2018, respectively; in 2019, 16 and 130 cases of MM and COC were documented, respectively. Overall, the ratios of COC and MM cases were 10.0:1 and 8.1:1 in 2018 and 2019 in the region, respectively. This finding might indirectly indicate that the quality of medical care possibly decreased even though the absolute number of COC cases decreased.

## 3. Mortality index

Mortality index (MI) is calculated as follows [4]:

$$MI = \frac{\text{number of cases of MM}}{\text{number of cases of COC} + \text{number of cases of MM}} \cdot 100.$$

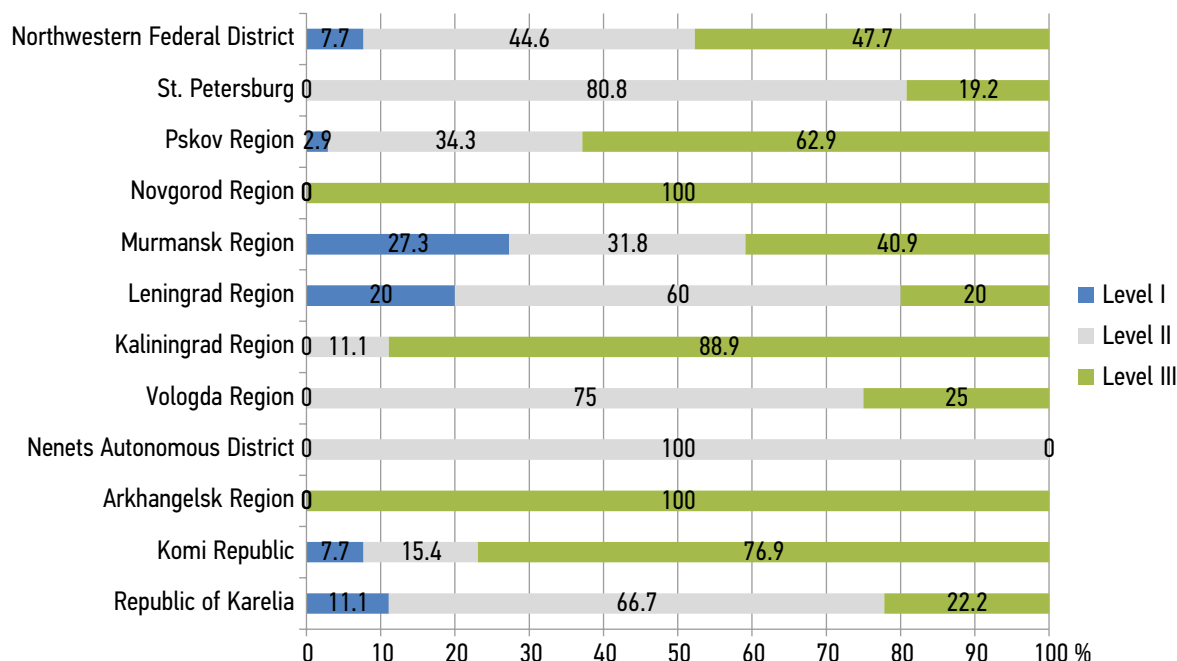
In 2019, the overall MI of the NWFD of the Russian Federation was 11.0. By comparison, the MI in 2018 was 9.1.

A high MI (>20) indicates an insufficient quality of medical care if medical statistics, primarily those associated with COC cases, is completely monitored in high quality because of an increase in COC:MM. Conversely, a low MI (<5) implies that the quality of medical care is sufficient; that is, through medical care, the life of women can be saved in the event of severe and potentially fatal maternal complications. Low MIs (<5) were recorded in the Murmansk (4.0 and 0) and Pskov (2.4 and 7.9) regions in 2018–2019. MIs lower than 20 but greater than 5 were noted in the Republic of Karelia (18.2 and 0), the Komi Republic (0 and 7.1), and Kaliningrad (0 and 18.2), Vologda (12.5 and 0), and Novgorod (16.7 and 0) regions. High MIs (>20) were documented the Leningrad Region (28.6 and 28.6) and St. Petersburg (28 and 23.5) in 2018–2019.

The distribution of the incidence of COC cases in the NWFD in 2019 in relation to the level of obstetrics in healthcare organizations (HO) is presented in Table 3 and Figures 1 and 2.

The high incidence of COC in levels I and II HOs indicates errors in the provision of medical care. These errors include nonobservance and noncompliance with clinical protocols at outpatient and inpatient stages and the lack of an effective routing protocol of patients with a high risk of obstetric complications. In regions where an effective model of the routing of obstetric and gynecological patients is being implemented, the rate of COC and MM cases of level III HOs should be higher than those of other levels.

The incidences of COC in level I HOs in 2018–2019 in the NWFD of the Russian Federation were 1.7 and 1.9 per 1000 live births (%). The highest rate in this group was registered in the



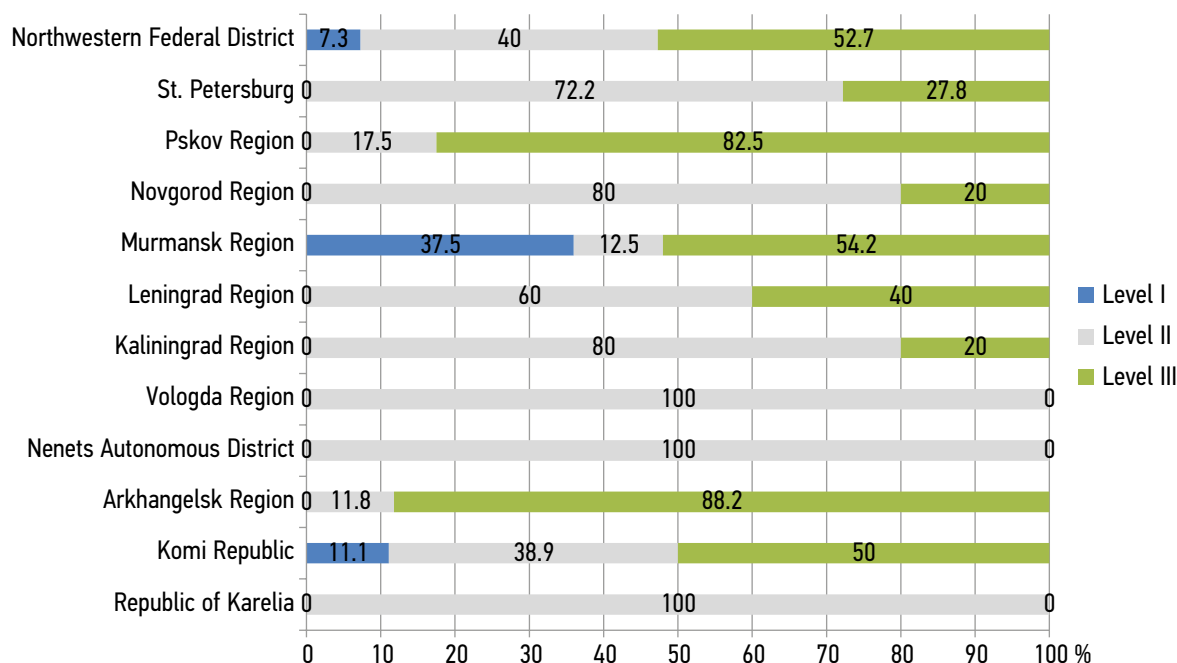
**Fig. 1.** Specific frequency of cases with critical obstetric conditions in the constituent entities of the Northwestern Federal District of the Russian Federation in 2019 in relation to the level of obstetric medical organizations

HOs of in Murmansk Region (1 and 9.1‰), the Pskov Region (0 and 6.1‰), and the Republic of Karelia (0 and 5.0‰). In the Komi Republic, the rate decreased (6.1 and 4.3‰).

The overall incidences of COC in level II HOs in 2018–2019 in the district were 0.6 and 0.75 per 1000 live births. The highest rates in this group were recorded in the HOs of the Pskov Region (3.7 and 7.1‰), the Murmansk Region (0.8 and 6.2‰), and the Nenets Autonomous District (7.0 and 5.8‰).

The overall incidences of COC in level III HOs in 2018–2019 in the district were 2.3 and 1.4 per 1000 live births. The highest rates in this group were noted in the HOs of the Pskov Region (9.3 and 6.6‰) and the Murmansk Region (5.8 and 2.0‰).

The specific weight (%) of COC cases was analyzed on the basis of the level of HOs in 2018–2019 in the NWFD of the Russian Federation. The results did not reveal significant dynamic changes. However, a positive trend was observed



**Fig. 2.** Specific frequency of cases with critical obstetric conditions in the constituent entities of the Northwestern Federal District of the Russian Federation in 2018 in relation to the level of obstetric medical organizations

**Table 4.** Etiology of critical obstetric conditions in the constituent entities of the Northwestern Federal District of the Russian Federation in 2018 and 2019

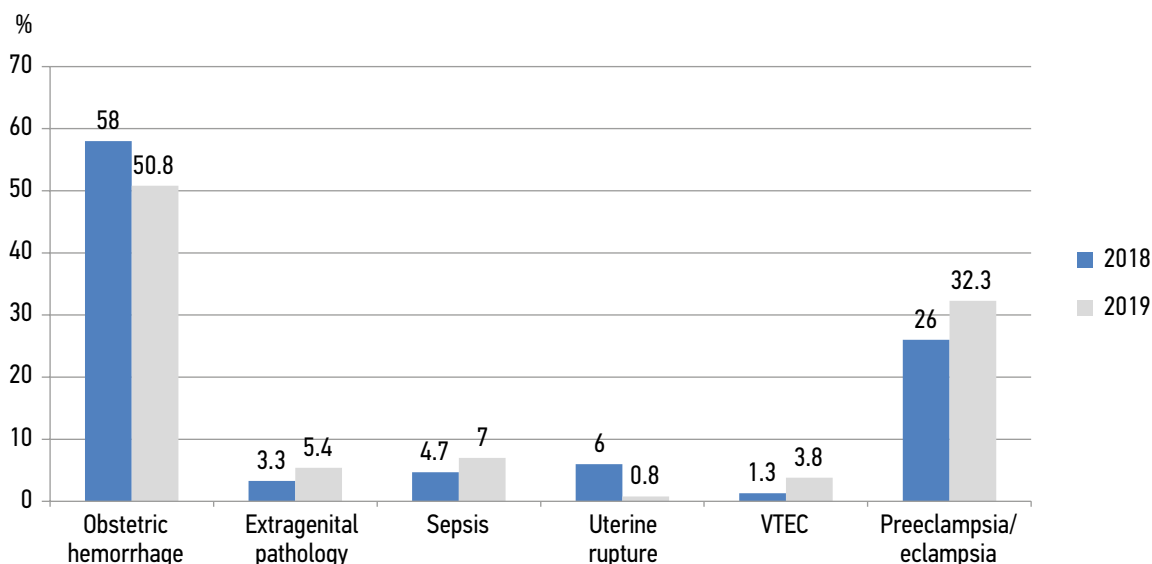
Causes	Constituent entities of the NWFD of the Russian Federation										Total in the NWFD n per 1000 live births	Year	
	Republic of Karelia	Komi Republic	Arkhangelsk Region	Nenets Autonomous District	Vologda Region	Kaliningrad Region	Leningrad Region	Murmansk Region	Novgorod Region	Pskov Region			St. Petersburg
COC without lethal outcome (n)	9	13	3	3	4	9	5	22	1	35	26	130/1.1	2019
Hemorrhage (n/%)	9	18	17	4	7	5	5	24	5	40	18	150/1.1	2018
	4/44	7/54	1/33	1/33	2/50	4/44	4/80	15/68	0	14/40	14/53.8	66/50.8	2019
	7/78	9/50	8/47	3/75	5/71	3/60	1/20	19/79	3/60	22/55	7/39	87/58	2018
Extragenital pathology (n/%)	-	-	1/33	1/33	-	1/11	-	1/4.5	-	-	3/11.5	7/5.4	2019
	-	-	3/18	-	-	1/20	-	-	-	-	1/5.6	5/3.3	2018
Sepsis (n/%)	0	5/38	-	1/33	-	1/11	-	-	-	-	2/7.7	9/7	2019
	1/11	2/11	-	-	-	-	2/40	-	-	-	2/11	7/4.7	2018
Uterine rupture (n/%)	-	-	-	-	-	-	-	-	-	-	1/3.8	1/0.8	2019
	-	-	-	1/25	1/14	-	-	1/4.2	1/20	1/2.5	4/22	9/6	2018
VTEC (n/%)	1/11	1/7.7	-	-	-	-	-	2/9	-	-	1/3.8	5/3.8	2019
	0	-	1/6	-	-	-	-	-	-	-	1/5.6	2/1.3	2018
Preeclampsia and eclampsia (n/%)	4/44	-	1/33	-	2/50	3/33.3	1:20	4:18	1/100	21/60	5/19.2	42/32.3	2019
	1/11	4/22	5/29	-	1/14	1/20	2/40	4/16.7	1/20	17/42.5	3/16.7	39/26	2018

**Table 5.** Incidence of critical obstetric conditions (n per 1000 live births) in the constituent entities of the Northwestern Federal District of the Russian Federation in 2018–2019

Causes	Constituent entities of the NWFD of the Russian Federation										Total in the NWFD n per 1000 live births	Year	
	Republic of Karelia	Komi Republic	Arkhangelsk Region	Nenets Autonomous District	Vologda Region	Kaliningrad Region	Leningrad Region	Murmansk Region	Novgorod Region	Pskov Region			St. Petersburg
Total number of births	5340	7858	9463	516	11 074	9097	11 740	6309	5189	5190	59 377	131 177	2019
	5935	8495	10 420	568	12 170	10 114	12 080	6927	5785	5675	64 363	142 532	2018
Hemorrhage (n/%)	4/0.8	7/0.9	1/0.1	1/1.9	2/0.2	4/0.4	4/0.3	15/2.4	-	14/2.7	14/0.2	66/0.5	2019
	7/1.2	9/1.1	8/0.8	3/5.3	5/0.4	3/0.3	1/0.1	19/2.7	3/0.5	22/3.9	7/0.1	87/0.6	2018
Extragenital pathology (n/%)	-	-	1/0.1	1/1.9	-	1/0.1	-	1/0.2	-	-	3/0.1	7/0.1	2019
	-	-	3/0.3	-	-	1/0.1	-	-	-	-	1/0.02	5/0.04	2018
Sepsis (n/%)	0	5/0.6	-	1/1.9	-	1/0.1	-	-	-	-	2/0.03	9/0.07	2019
	1/0.2	2/0.2	-	-	-	-	2/0.2	-	-	-	2/0.03	7/0.05	2018
Uterine rupture (n/%)	-	-	-	-	-	-	-	-	-	-	1/0.02	1/0.008	2019
	-	-	-	1/1.9	1/0.09	-	-	1/0.1	1/0.2	1/0.2	4/0.06	9/0.006	2018
VTEC (n/%)	1/0.2	1/0.1	-	-	-	-	-	2/0.3	-	-	1/0.02	5/0.04	2019
	0	-	1/0.1	-	-	-	-	-	-	-	1/5.6	2/0.02	2018
Preeclampsia and eclampsia (n/%)	4/0.7	-	1/0.1	-	2/0.2	3/0.3	1/0.1	4/0.6	1/0.2	21/4.0	5/0.08	42/0.3	2019
	1/0.2	4/0.5	5/0.5	-	1/0.08	1/0.1	2/0.2	4/0.6	1/0.2	17/3.0	3/0.05	39/0.3	2018

Note. NWFD RF, Northwestern Federal District of the Russian Federation; VTEC, venous thromboembolic complications.





**Fig. 3.** Structure of critical obstetric conditions in the constituent entities of the Northwestern Federal District of the Russian Federation in 2018–2019. VTEC, venous thromboembolic complications

in HOs in several regions. In the Murmansk Region and the Komi Republic, the incidences of COC in level I HOs decreased from 37.5% to 27.3% and from 11.1% to 7.7%, respectively. Furthermore, the incidence of COC in level III HOs in the Komi Republic increased from 50% to 76.9%. Similarly, the incidences of COC in level III HOs in Arkhangelsk, Vologda, and Novgorod regions increased from 88.2% to 100%, 0% to 25%, and 20% to 100%, respectively. The incidences of COC in level I HOs in the Leningrad Region, the Pskov Region, and the Republic of Karelia also increased from 0% to 20%, 0% to 2.9%, and 0% to 11.1%, respectively.

Overall, the region should address issues on the quality of medical care in level I HOs primarily by implementing an effective routing protocol of patients with a high risk of obstetric complications.

The etiology of COC cases is presented in Table 4 and Figure 3. In the range of the main causes or etiology of COC, the cases of *obstetric hemorrhage* during childbirth and in the postpartum period ranked first, i.e., 50.8% in 2019 and 58% in 2018, which showed that the indicator decreased by 1.1 times. *Cases of severe preeclampsia/eclampsia* ranked second in terms of the frequency of the registration of the cause of COC (32.3% in 2019 and 26% in 2018). On the contrary, the proportion of COC cases increased by 1.2 times. COC cases due to *sepsis and severe septic complications* ranked third, and their incidence in 2019 (7%) increased by 1.5 times compared with that in 2018 (4.7%).

The incidence of severe extragenital pathology that caused COC increased by 1.6 times in 2019 (5.4%) compared with that in 2018 (3.3%). The causes of seven cases of COC due to severe *extragenital pathology* were the pathology of the cardiovascular system (chronic arterial hypertension and congenital heart disease in the stage of sub- and decompensation [patent arterial duct and atrial septal defect]

in combination with cardiac arrhythmias), oncohematology (Hodgkin’s lymphoma), and one case of rupture of the spleen vessel aneurysm. The incidence of venous thromboembolic complications (based on pulmonary embolism) in 2019 (3.8%) also increased by 2.9 times compared with that in 2018 (1.3%). The frequency of uterine ruptures that caused COC cases in 2019 (1 case, 0.8%) was 7.5 times lower than that in 2018 (9 cases, 6%). Indeed, 85% of uterine rupture cases in 2018 and 100% of cases (1 case) in 2019 were caused by the histopathologic type of uterine rupture “along the scar” after a previous cesarean section. The delivery was vaginal with a favorable perinatal outcome and subsequent laparotomy and metroplasty.

The analysis of the structure of COC cases in terms of the incidence per 1000 births in the constituent entities of the NWFD of the Russian Federation is presented in Table 5.

In the group of obstetric hemorrhage in 2018–2019, the highest rates were registered in the Nenets Autonomous District (5.3 and 1.9‰), the Murmansk Region (2.7 and 2.4), and the Pskov Region (3.9 and 2.7). The analyzed indicators in all the HOs of the indicated constituent entities decreased by 2.8, 1.1, and 1.4 times, respectively. In the COC group, the highest level of preeclampsia/eclampsia frequency was recorded in the Pskov Region (3.0‰ and 4.0‰), i.e., it increased by 1.3 times in 2019 compared with that in 2018.

The causes of COC due to obstetric hemorrhage was discussed in detail because they ranked first for a long time. The total incidences of COC caused by massive obstetric blood loss (more than 1500 ml) and hemorrhagic shock in the constituent entities of the NWFD of the Russian Federation were 0.6 and 0.5 per 1000 births in 2018 and 2019, respectively. Thus, some positive dynamics were observed in the decrease in the incidence of COC for the analyzed group

of causes. In particular, the following incidences were found in 2018 and 2019:

- placenta increta with its full presentation (with and without a scar on the uterus after a previous cesarean section);
- premature separation of the normally located placenta with or without the formation of retroplacental hematoma and uteroplacental apoplexy (Couvelaire uterus; with the main event of severe preeclampsia);
- hypotonic hemorrhage in the early postpartum period or intraoperatively (in case of a cesarean section) and isolated cases of late postpartum hemorrhage or hemorrhage associated with massive trauma to the soft birth canal after vaginal delivery.

The analysis of COC cases in 2018 and 2019 revealed that the clinical characteristics of patients in the NWFD of the Russian Federation did not differ. In 2018 and 2019, 90.8% and 89.4% of patients were respectively registered in the antenatal clinic for pregnancy and regularly examined by an obstetrician-gynecologist. These patients had average age of 29.6 and 29.5 years, respectively. All the cases of COC were recorded with a gestational age of more than 22 weeks, the average gestational term at the time of the COC event was 32–37 weeks, and most of the deliveries occurred at a term of 38 weeks of gestation.

All pregnant women may be subjected to an emergency or scheduled cesarean section as a result of obstetric situations. In case of massive obstetric blood loss due to hypotonic uterine hemorrhage in the early or late postpartum period, pregnant women undergo laparotomy followed by surgical hemostasis (hemostatic sutures on the uterus and bilateral uterine vascular ligation). In this study, the internal iliac arteries of 5.6% (2018) and 10% (2019) of cases were ligated. In particular, this procedure was performed in 53.8% (2018) and 64% (2019) of cases in St. Petersburg. Total hysterectomy with resuscitation measures was carried out in 58% (2018) and 52% (2019) of cases and in 23% (2018) and 14% (2019) cases in St. Petersburg. Relaparotomy, opening, and drainage of parametric hematomas were performed in 25% (2018) and 21% (2019) of cases in the postoperative period (15% of cases in 2018, 25% of cases in 2019) due to the current clinical situation. In 75% of cases in 2019 and 90% of cases in 2018, total (25% in 2019 and 75% in 2018) or subtotal (50% in 2019 and 10% in 2018) hysterectomy was conducted. All measures for surgical hemostasis were performed with adequate infusion–transfusion therapy. In 26.5% of cases, these measures were carried out using modern blood-saving technologies (hardware reinfusion of autoerythrocytes; 64% in St. Petersburg).

The analysis of the records of the COC cases revealed the following shortcomings and errors in the provision of qualified medical care in almost all constituent entities of the federal district.

1. Routine clinical practices in HOs are inconsistent with federal clinical guidelines (protocols) and in standards and procedures for the provision of medical care:
  - lack of a clear algorithm of actions in the event of obstetric hemorrhage;
  - delayed decisions on laparotomy or relaparotomy;
  - failure to perform consistent surgical hemostasis (most often, the absence of bilateral ligation of internal iliac arteries);
  - underestimation of the actual volume of blood loss
  - lack of adequate infusion–transfusion therapy.
2. The effective routing of patients in an already defined high perinatal risk group is impaired; in some cases, the revision of the perinatal risk group in case of additional complications during pregnancy is lacking, thereby resulting in routing impairment (level I HOs).
3. The quality control of medical care in Hos is subjected to insufficient internal audit and monitoring; furthermore, violations and errors in medical and organizational technologies (violation of information collection and continuity) are not identified or smoothed.

## FINDINGS AND CONCLUSION

Based on the audit of COC cases in the NWFD of the Russian Federation in 2019 in comparison with that in 2018, the following conclusions can be drawn.

1. The frequency of COC cases in 11 constituent entities of the NWFD for the analyzed period (0.1% of the total number of births in 2018 and 2019) indicated a satisfactory level of organization of the obstetric service of the district.
2. The assessment of the statistical indicators of MM and COC monitoring revealed that the number of COC cases per 1000 live births as an indicator for the region as a whole in 2019 (1.1) corresponded to the indicator of the previous year (1.1 in 2018). Therefore, the level of medical care for female patients in critical conditions was satisfactory. A group of three constituent entities of the NWFD should be singled out. This indicator remained high in 2018 and 2019 in the Nenets Autonomous District (7.1–5.9), the Murmansk Region (3.6–3.6), and the Pskov Region (7.1–6.8).
3. The ratios of COC and MM cases, which were 8.1:1 in 2019 and 10.0:1 in 2018, suggested that the volumes of unimplemented reserves were sufficient for the provision of qualified medical care to obstetric patients in the region, given that this indicator should be higher.
4. The specific weight (%) of COC cases was analyzed on the basis of the level of HOs in 2018–2019. In general, significant dynamic changes were not observed in the NWFD of the Russian Federation. However, a positive tendency in HOs in the Murmansk Region should be

noted (a decrease in the incidence of COC in level I HOs, 37.5–27.3%) and in the Komi Republic (a decrease in the incidence of COC cases in level I HOs, 11.1%–7.7%; and an increase in the incidence of COC in level III HOs, 50%–76.9%), and an increase in the incidence of COC in level III HOs in Arkhangelsk (88.2%–100%), Vologda (0%–25%), and Novgorod (20%–100%) regions. The incidence of COCs in level I HOs in the Leningrad Region (0%–20%), the Pskov Region (0%–2.9%), and the Republic of Karelia HOs (0%–11.1%) increased. Thus, the region should address issues hindering the improvement of the quality of medical care in level I HOs primarily because of the effective routing of patients with a high risk of obstetric complications.

5. The prevalence of the incidence of COC in level I HOs compared with that in levels II and III HOs was noted in the region as a whole in 2019 (1.9; 0.75; 1.4‰) and in the Murmansk Region (9.1; 6.2; 2.0‰), the Republic of Karelia (5.0; 2.9; 0.7‰) and the Komi Republic (4.3; 1.6; 1.6‰). In the Pskov Region (6.1; 7.1; 6.6‰), this indicator was high and did not correspond to the target indicator ( $\leq 5‰$ ).
  6. The structure of COC cases in 2019 did not differ significantly from that in 2018. The cases of obstetric hemorrhage during childbirth and in the postpartum (post-operative) period ranked first (50.8% in 2019 and 58% in 2018). The cases of severe preeclampsia/eclampsia ranked second in the frequency of registration of the cause of COC (32.3% in 2019 and 26% in 2018; an increase of 1.3 times). COC cases caused by sepsis and septic complications ranked third among the causes of COC, namely, 7% of cases in 2019 and 4.7% in 2018 (an increase of 1.5 times).
  7. In three NWFD constituent entities of the Russian Federation in 2019, the number of COC cases associated with massive obstetric blood loss increased in the Komi Republic (by 1.1 times), the Leningrad Region (by 4 times), and St. Petersburg (by 4 times). In eight constituent entities, this indicator decreased: the Republic of Karelia (by 1.8 times); Arkhangelsk (by 1.4 times), Vologda (by 1.4 times), Kaliningrad (by 1.4 times), Murmansk (by 1.2 times), Novgorod (0%–100%), and Pskov (by 1.4 times) regions; and the Nenets Autonomous District (by 2.3 times).
  8. In 7 out of 11 constituent entities of the NWFD in 2019, the number of cases of severe preeclampsia/eclampsia increased compared with that in 2018: the Republic of Karelia (by 4 times); Arkhangelsk (by 1.1 times), Vologda (by 3.6 times), Kaliningrad (by 1.7 times), Novgorod (by 5 times), and Pskov (by 1.4 times) regions; and St. Petersburg (by 1.1 times).
  9. The number of COC cases due to septic complications decreased in the Republic of Karelia (11%–0%), the Leningrad Region (40%–0%), and St. Petersburg (11%–7.7%). In three constituent entities of the district (the Komi Republic [11–38%], the Nenets Autonomous District [0%–33%] and the Kaliningrad Region [0%–11%]), the number of sepsis-associated cases of COC increased.
  10. The analysis of defects in the provision of medical care during the registration of COC showed that most of them were associated with defects in the monitoring of risk groups for possible complications of pregnancy and delivery, diagnostics of complications (assessment of the risk of obstetric hemorrhage, underestimation of the volume of blood loss, and untimely diagnostics of systemic inflammatory response syndrome) or defects in the implementation of modern clinical treatment protocols (obstetric hemorrhage, hypertensive conditions and preeclampsia, septic complications). Consequently, these errors led to an incorrect assessment of a patient's condition and were accompanied with an inadequate use of medical and organizational technologies required for a specific obstetric situation (delayed delivery in severe preeclampsia or delay in deciding on surgical hemostasis or surgical debridement of the focus of infection).
- Based on the analysis of the COC monitoring in the NWFD regions of the Russian Federation, the following set of measures should be implemented to prevent and reduce their occurrence in the long term.
1. Issue (revise) regional regulatory documents on the approval of routing schemes for obstetric patients in the high-obstetric-risk group and ensure control over their implementation in all constituent entities of the NWFD of the Russian Federation.
  2. Ensure the absolute coverage of training in simulation and training centers for medical specialists in maternity hospitals/perinatal centers (obstetricians–gynecologists, neonatologists, anesthesiologists–resuscitators, and paramedical personnel) at universities of the NWFD constituent entities (St. Petersburg, Arkhangelsk, and Petrozavodsk).
  3. Instruct all medical workers on the algorithm of actions for hemorrhage during pregnancy (placenta previa and premature detachment of a normally located placenta), in childbirth (rupture of the uterus), in the postpartum period (hypotonic hemorrhage), and in eclampsia.
  4. Organize the monitoring of knowledge and skills of nurses and delivery nurses to control uterine contractions and assess blood loss.
  5. Ensure the strict implementation of clinical recommendations (algorithms and treatment protocols) approved by the Scientific and Practical Council of the Ministry of Health of Russia.
  6. Complete the introduction into practice of obstetric institutions of contemporary medical technologies to prevent MM and prevent and treat COC in obstetric and

- gynecological practice by using blood-saving technologies, such as autodonation (e.g., autoplasm and autohemotransfusion) during a planned assisted delivery and methods of hardware blood-saving technologies (e.g., reinfusion of autoerythrocyte suspension).
7. Organize the monitoring of COC (maternal near miss) cases by using state health information systems in the constituent entities of the NWF.
  8. Apply for the publication of a methodological letter with the stamp of the Ministry of Health of Russia on the rules, conditions, and criteria for analyzing COC in Russia to ensure a unified interpretation, correct statistical analysis, and audit of COC cases.
  9. Ensure and improve the system of internal and external audit and the departmental quality control and safety of medical activities in the system of medical care in obstetric facilities of groups I and II through visits by specialists of group III institutions under the direct supervision of chief freelance specialists of the constituent entities of the district.
  10. Ensure the conduct of a comprehensive interdisciplinary medical consultation as soon as necessary.
  11. Introduce and improve the systems of telecommunication medical technologies through the interaction of regional obstetric remote centers with federal telemedicine units by considering the disease profile.
  12. Analyze the efficiency of the medical evacuation system, including air transport, in the constituent entities of the Russian Federation and submit proposals for its improvement.

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