

Maternal Mortality in Siberia and Far East of Russia

Abstract

Background: Maternal mortality (MM) affects a large part of the world. Annually, 289,000 women die during pregnancy and childbirth (more than one death every 2 minutes). Moreover, an audit of maternal mortality in the world showed significant problems in assessing the maternal mortality rate. **Objectives:** The objective of this study was to analyze maternal deaths in the Siberian and Far Eastern Federal Districts over 5 years from 2014 to 2018. **Materials and Methods:** An analysis of 165 emergency notifications of cases of maternal mortality over a 5-year period from 2014 to 2018 was carried out. Additionally, 26 case histories/births of maternal deaths in the Siberian Federal District for 2018 are analyzed, and 52 emergency notifications from 2014-2018 in the Far Eastern Federal District were also included. **Results:** For the period between 2014 and 2018, a decrease in maternal mortality (MM) in the Siberian and Far Eastern Federal Districts was recorded, and the year 2018 was characterized by an increase in MM because of social factors. Extragenital disease was the predominant cause of MM in these subjects; however, some differences were noted in the Siberian Federal District where the leading causes were embolism and placental abruption, and in the Far Eastern Federal District where hypertensive disorders and obstetric bleeding predominated. **Conclusions:** The main point being made here is that patients will be better served by closing low-tier medical institutions that are potentially dangerous in terms of MM, and relocating the patients to superior medical facilities. It is necessary to further introduce clinical recommendations and develop teamwork skills in simulation training centers.

Keywords: Embolism, extragenital diseases, Far Eastern Federal District, maternal mortality, obstetric hemorrhage, preeclampsia, sepsis, Siberian Federal District

Introduction

Maternal mortality (MM) affects a large part of the world.^[1] Annually, 289,000 women die during pregnancy and childbirth (more than one death every 2 min). At the same time, 28% of maternal deaths occur from nonobstetric causes, including malaria, HIV, CVD, obesity, whereas 8% of deaths result from unsafe abortion. Every day, about 830 women die from preventable causes related to pregnancy and childbirth. Developing countries account for 99% of all maternal deaths. MM is higher among women living in rural areas and among the poor. In addition, adolescents are at a higher risk of complications and death.^[2] As an example, in 2015, there were 303,000 cases of MM, which corresponds to the total global MM rate of 216 cases of MM per 100,000 live births.^[1] Moreover, an audit of MM in the world showed significant problems

in assessing the MM rate. For example, in the UK, an audit of maternal deaths, which included a survey of midwives, doctors, coroners, public figures, media, and civil registration authorities, revealed an underestimation of 47% of the dead and in Canada 41% of the dead.^[3]

Between 1990 and 2015, MM in the world decreased by approximately 44%.^[2] It is proven that skilled care before, during, and after childbirth can save the lives of women and newborns. Between 2016 and 2030, as a part of the Sustainable Development Goals, the goal is to reduce the global MM rate to less than 70 per 100,000 live births.^[2]

Over the last few years, Russia has registered a decrease in the MM rate attaining 78.7% compliance with the United Nations Millennium Goal No. 5 recorded for 2015 relative to 2014. In 2018, an increase in MM by 12.5% was recorded as compared with 2017. Moreover, in 2018,

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cases of maternal death were not registered in 20 regions of the Russian Federation. In 2018, MM was less than 10 per 100 thousand live births^[4] in 26 regions of the Russian Federation compared with 34 regions in 2017.

The regional breakdown of MM in the Russian Federation in 2018 is presented in Figure 1.

The largest contribution to the MM in 2018 was made by the Central (23.6%), Volga (18.0%), and Siberian (14.9%) Federal districts.

The Siberian Federal District was established by a presidential decree on May 13, 2000, and this territory constitutes 25.5% of the total land area of the Russian Federation and has a population of 17.174 million as of January 1, 2019. Currently, the Siberian Federal District includes 10 constituent political entities: three republics (Altai, Tyva, and Khakassia), two territories (Altai and Krasnoyarsk), and five regions (Irkutsk, Kemerovo, Novosibirsk, Omsk, and Tomsk). Until 2018, the Republic of Buryatia and the Transbaikal Territory were part of the Siberian Federal District. By presidential decree No. 632 of November 3, 2018, the Republic of Buryatia and the Transbaikal Territories were made a part of the Far Eastern Federal District.^[5] Thus, the Far Eastern Federal District currently includes 11 entities (Chukotka Autonomous Okrug; two republics: Buryatia and Sakha (Yakutia); four territories: Transbaikal, Kamchatka, Primorsky, and Khabarovsk; and four regions: Amur, Jewish Autonomous, Magadan, and Sakhalin). Today, the Far Eastern Federal District is the largest district in the Russian Federation (40.6% of the land area), and it simultaneously contains the lowest population density (1.18 people/km²). By comparison, the Russian Federation overall has 8.56 people/km², whereas the Siberian Federal District has 3.34 people/km².

This study aimed to analyze maternal deaths in the Siberian and Far Eastern Federal Districts over 5 years from 2014 to 2018.

Methods

A retrospective analysis of 165 emergency notifications of maternal deaths over 5 years from 2014 to 2018, 26 case histories of maternal deaths in the Siberian Federal District for 2018, and 52 emergencies for the period between 2014 and 2018 in the Far Eastern Federal District was conducted.

Results

The number of women who died and the dynamics of MM in the Siberian Federal District from 2014 to 2018 is presented in Figure 2.

From the year 2014 to the year 2018, there is a clear tendency toward the reduction of MM from 14.9 ppm in 2014 to 11.7 ppm in 2018. At the same time, the MM rate

in Siberia increased from 9.3 % (per 1000) in 2017 to 11.7 in 2018.

As shown in Figure 3, over the same period, the absolute number of mothers who died in the Far East was significantly lesser than in Siberia. However, a smaller number of births in the Far Eastern Federal District caused MM rates similar to those found in the Siberian Federal

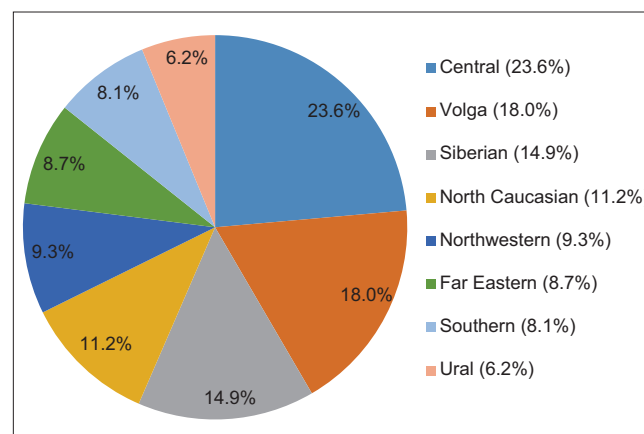


Figure 1: Regional breakdown of maternal mortality in the Russian Federation in 2018

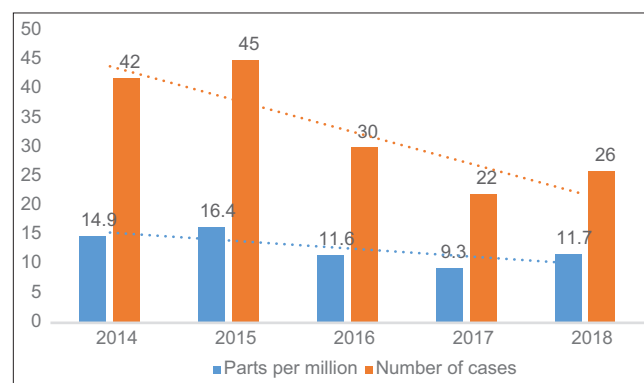


Figure 2: The number of women who died and the dynamics of maternal mortality in the Siberian Federal District for the period between 2014 and 2018

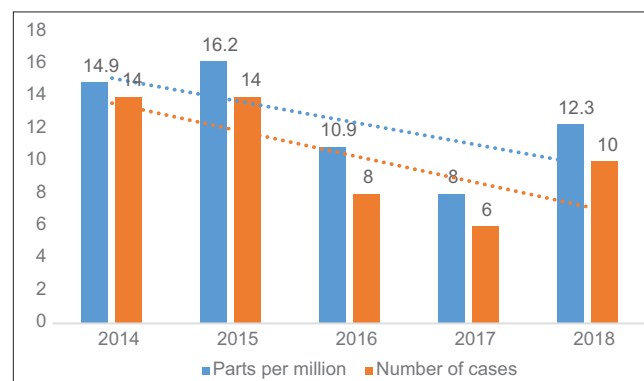


Figure 3: The number of women who died and the dynamics of maternal mortality in the Far Eastern Federal District for the period between 2014 and 2018

District. Comparing the two yields the following results were found: 14.9‰ versus 14.9‰, respectively, in 2014; 16.2‰ versus 16.4 ‰ in 2015; 10.9‰ versus 11.6‰ in 2016; 8.0‰ versus 9.3‰ in 2017; and 12.3‰ versus 11.7‰ in 2018.

Generally, similar to Siberian Federal District, in the Far Eastern Federal District, from the period between 2014 to 2018, there was a decreasing trend in MM from 14.9‰ in 2014 to 12.3‰ in 2018, with an increase in MM in 2018 compared with 2017 (8.0‰).

The structure for MM in the Siberian Federal District for the period between 2014 and 2018 is presented in Table 1.

In the 2014-2018 analysis of MM in the Siberian Federal District (Russia), extragenital disease was the leading cause of death, totaling 65 deaths (39.4% of cases). Among extragenital diseases, the most common cause of death was viral bacterial pneumonia and cardiovascular and oncological diseases. The greatest number of deaths from pneumonia was recorded in 2016—7 women. The year 2016 was characterized by the least number of pregnant women who were vaccinated against influenza. The increase in influenza vaccination rates in 2017 resulted in a MM rate of zero for that year. In 2018, one woman died because of the combined effects of bacterial pneumonia and severe pre-eclampsia. The main problems of assisting pregnant women with extragenital diseases in cases of MM were an insufficient examination of women before planning a pregnancy, lack of pregravid preparation, underestimation of the severity, and clinical symptoms in pregnant women/puerperal women by specialists and/or emergency doctors.

The second most significant factor for MM in Siberia for the period between 2014 and 2018 was obstetric embolism. Twenty cases representing 12.1% of the total cases were embolism with amniotic fluid and thromboembolism. In 2018, in the Siberian Federal District, embolism took first place in the structure of MM data. Women who died from an embolism in level I-II institutions were mainly of late reproductive age, in the postpartum and/or postoperative period (cesarean section/vacuum/laparotomy/tubectomy) and had comorbid diseases or other factors (obesity, fatty hepatosis, acute pancreatitis, alcohol abuse, post-thrombophlebitis syndrome, breast cancer). The main problem in assisting these patients was an underestimation of thrombotic risk, including nonuse or insufficient duration of use of low molecular weight heparins and/or inadequate use of compression hosiery (improper sizing, intermittent use, and insufficient duration of use).

Placing third in the structure of MM in the Siberian Federal District, 18 (10.9%) cases were of bleeding because of either placental detachment or placenta previa. The main logistical problems of assisting with this complication of

Table 1: The structure of maternal mortality in the Siberian Federal District from the year 2014 to 2018

Year	No. of women	Ectopic pregnancy	Medical abortion	Abortion initiated outside the facility	Pre-eclampsia	Bleeding during pregnancy	Bleeding during childbirth and the postpartum period	Sepsis in childbirth and the postpartum period	Obstetric embolism	Uterine rupture	Complications of anesthesia	Extragenital diseases
2014	42	0	0	5	3	8	0	0	0	1	0	25
2015	45	2	2	4	4	1	3	3	7	1	2	16
2016	30	0	0	1	2	2	5	4	3	1	0	12
2017	22	2	0	1	2	3	2	2	2	0	1	7
2018	26	2	1	1	2	4	1	1	8	1	0	5
2014-2018	165	6	3	12	13	18	11	10	20	4	3	65
%	100%	3.6%	1.8%	7.3%	7.9%	10.9%	6.7%	6.1%	12.1%	2.4%	1.8%	39.4%

pregnancy were the long commute time of ambulances, the lack of sufficient blood supplies in level I-II facilities, and delay in treatment time between diagnosis and surgery, primarily in level I facilities. Thus, when examining critical cases, it was found that on average, hospitals that could treat placental abruption had an average time of 67.7 min from admission to surgery^[6] compared with an expected time of approximately 20 min.

Over 5 years, six deaths from an ectopic pregnancy were registered in the Siberian Federal District. Of these six deaths, two cases stand out. The first was a pregnancy of cervical localization, the second was due to pregnancy scars after cesarean section which had not been diagnosed by ultrasound and corrected by medical and surgical methods. Typical problems in assisting these patients included late arrival of emergency medical care, delayed diagnosis and surgical treatment, inadequate volume of surgical intervention, inadequate infusion–transfusion therapy, and inadequate observation in the early postoperative period.

Over the same 5 year period, three deaths from anesthesiologic complications and medical abortion and four deaths from uterine rupture were registered in the Siberian Federal District. In three cases, a uterine rupture occurred at home, and patients did not seek medical help.

The growing importance of social factors in recent years should be noted. In 2018, in the Siberian Federal District, nine women died at home (seven of them before the ambulance arrived), seven women were not registered for pregnancy, three women hid the pregnancy not only from medical workers but also from relatives, five women abused alcohol, and one woman did not know about the presence of pregnancy and died from a rupture of the fallopian tube before the ambulance arrived (the arrival time, in this case, was 57 min).

In addition, one woman died from pulmonary embolism during pregnancy 7 to 8 weeks after alcohol abuse. Another woman died from medical abortion in the second trimester during a frozen pregnancy that arose because of alcohol abuse during the week. In one case, a uterine rupture occurred in a scar while blacked out after alcohol abuse.

In the 2014-2018 Maternal Mortality analysis (Russian Far Eastern District), extragenital diseases were the most common cause, accounting for 24.29% of cases. Pre-eclampsia/eclampsia (including complicated by the hemolysis, elevated liver enzymes, low platelet count [HELLP] syndrome) was in second place with 17.85% of cases attributable to this cause. Third place was taken by obstetric bleeding during pregnancy and in the early postpartum period with 16.79% of cases. Fourth, septic complications 12.15%. Fifth, complications of anesthesia 7.15%. Sixth, obstetric embolism 3.57%. Ectopic pregnancy, fatty degeneration of the liver, and atypical

Table 2: The structure of maternal mortality in the Far Eastern Federal District from the year 2014 to 2018

Year	No. of women	Ectopic pregnancy	Abortion started outside of a health facility	Pre-eclampsia/eclampsia	Obstetric bleeding	Sepsis in childbirth and the puerperium	Amniotic fluid embolism	Uterine rupture	Vomiting pregnant	Acute fatty liver	ThMA* (aHUS [†])	Complications of anesthesia	Extragenital diseases	Other
2014	14	0	0	35.7	21.4	14.3	0	0	7.1	0	0	0	14.3	17.3
2015	14	0	7.1	7.1	21.4	14.3	0	7.1	0	0	0	14.29	28.6	0
2016	8	0	12.5	12.5	37.5	-	-	-	-	-	-	-	-	-
2017	6	0	0	28.6	14.3	0	14.3	0	0	0	0	14.3	14.3	14.3
2018	10	10.0	0	0	10.0	20.0	0	0	0	10.0	10.0	0	40.0	0
2014-2018	52	2.0	3.92	16.78	20.92	9.72	5.36	1.42	1.42	2.0	2.0	5.72	24.44	6.32

*ThMA=Thrombotic microangiopathy, [†]aHUS=Atypical hemolytic-uremic syndrome

hemolytic-uremic syndrome were all tied for seventh place, coming in at 2.5% each. Finally, the least frequent causes of miscarriage started outside the hospital, those being rupture of the uterus, severe vomiting of a pregnant woman (1.8% each).

Table 2 codifies the structure of MM in the Far Eastern Federal District from 2014 to 2018.

In the Far Eastern Federal District, extragenital diseases (24.3%) held the lead in the structure of MM data from 2014 to 2018. Pre-eclampsia/eclampsia (17.9%) was in second place and obstetric bleeding (16.8%) in the third. In addition, sepsis accounted for 12.2% of cases of MM.

Discussion

The goal of implementing the World Health Organization (WHO) Global Women's Health Strategy by 2030 is to eliminate preventable cases of MM.^[2] Primarily, three preventable causes—bleeding, sepsis, and hypertension—are the cause for 52% of maternal deaths (during pregnancy, during childbirth, or immediately after).^[2]

The results of the analysis of MM showed that in the Siberian Federal District and the Far Eastern Federal District for the period 2014 to 2018, a general decrease in MM was recorded, which reflected the situation in the Russian Federation overall, and this was probably the result of significant investments in medical services and the construction of 12 modern perinatal centers (nine in the Siberian Federal District and three in the Far Eastern Federal District). However, it should be noted that the year 2018 was characterized by an increase in MM indicators relative to 2017 (Siberian Federal District increased by 41.9% and the Far Eastern Federal District by 47.4%), which is largely because of staff shortages in most regions of both federal districts. It is noteworthy that in 2018, in the Far Eastern Federal District, the highest rate of MM in the Russian Federation was recorded at 12.3 per 100,000 live births, whereas 20% of cases of MM occurred outside the hospital.^[7]

More than half of the MM analysis for the period 2014 to 2018 in the Siberian Federal District was accounted for by poorly managed causes with extragenital diseases adding up to 39.4%, and embolism responsible for 12.1% of MM. As a cause, embolism has risen since 2018 and now accounts for 30.8% of MM. Extragenital diseases were also leaders in the Far Eastern Federal District (24.3%). In 2018, in Russia, the share of extragenital diseases in the structure of MM was similar to the Siberian Federal District and significantly higher than in the Far Eastern Federal District and amounted to 41%.

Placental abruption was recorded in third place in the Siberian Federal District (10.9%). The main problems in assisting with this complication of pregnancy were associated with long distances to hospitals in the Siberian

Federal District and an insufficient supply of blood at I-II level facilities. The required volumes of blood reserves in a medical organization are regulated by the order of the Ministry of Health of the Russian Federation, dated 07.07.2013, No. 478 n "On Approving the norm for the supply of donated blood and (or) its components, as well as the procedure for its formation and expenditure."^[8]

For many years, in the Far Eastern Federal District, the main cause of MM has been hypertensive disorders: pre-eclampsia, eclampsia, and HELLP syndrome.^[9-11]

In the Russian Federation, in 2018, 40.3% of maternal deaths were caused mainly by three preventable causes—bleeding (18.6%), sepsis (12.4%), and hypertension (9.3%).^[7] In the Siberian Federal District, the share of preventable causes was less (31.6%) and amounted respectively to bleeding (17.6%), sepsis (6.1%), and hypertension (7.6%). The Far Eastern Federal District showed similar results, mainly, because of a significant proportion of hypertensive disorders: bleeding- 16.8%, sepsis- 12.2%, and hypertension- 17.9%.

The analytical structure of MM in Siberia has changed over the last 5 years. Previously, Professor Pekarev (2010) had analyzed 448 emergency notifications on cases of MM for the period between 2003 and 2008 in the Siberian Federal District. It has been established that since 2006 in this district, two poorly controlled causes—extragenital diseases and thromboembolism—have prevailed. During this period, abortion in the structure of MM was solidly in third place (14.3%–16.1%). Local authorities enacted a plan to reduce MM in the Siberian Federal District by educating the public on contraception and family planning as alternatives to abortion.^[12] The proportion of abortions in the structure of MM in the Siberian Federal District for the period between 2014 and 2018 decreased significantly and amounted to 9.1%, falling to 4.5% to 7.7% in the last 2 years. In Russia, for the period 2014 to 2018, 10.6% of maternal deaths were caused by abortions up to 22 weeks of gestation.^[7]

Thus, the problems of assisting women in critical condition in the Siberian Federal District and the Far Eastern Federal District fall generally into the model of three delays of emergency care, which determine the lethal outcome proposed by WHO.^[13,14] The first delay at the stage of deciding on the need for urgent hospitalization (transfer) of the patient to a qualified institution or late treatment. The second delay is the transportation problem, sometimes amounting to such an excessive time for the patient (communication, roads, etc.) that they die en route to the hospital. Thus, according to WHO, there is a positive relationship between the time of transportation to the institution of obstetric care, exceeding 20 min, and hospital mortality (OS 1.17, 95% CI 1.002-1.36). The third delay is the inability of the receiving institution to provide fully qualified emergency

assistance, including operational and resuscitation assistance.^[15]

The problems of assisting are associated, on the one hand, with social factors (alcohol abuse, unreliable implementation of doctor's orders, or refusal of hospitalization or transfer to a level III institution) and, on the other hand, with serious violations that have occurred in the work of experienced doctors with long experience (a consequence of overload and burnout syndrome).

On the basis of the foregoing and taking into account the annual migration losses and depopulation in the Siberian Federal District and the Far Eastern Federal District,^[16] as well as the growing shortage of qualified personnel, looking to the future of maternal and child health services in these regions suggests the following measures: further centralization of care (closure of low-level institutions marked by higher-than-normal maternal and infant mortality); improvement of the routing system; medical evacuation with the development of telemedicine technologies; and full-fledged work of nursing care beds.

At the international level, it is recognized that the state of human resources determines the effectiveness of health care systems, namely, the quality and availability of medical care provided to the population. To prevent the outflow of qualified medical personnel and consolidate young specialists in the Siberian and Far Eastern Federal Districts, state support measures are necessary and include two significant priorities: (1) providing social support and (2) guaranteeing malpractice insurance for medical workers.^[17]

Conclusions

For the period between 2014 and 2018, the data show a decrease in MM in the Siberian and Far Eastern Federal Districts. However, 2018 was characterized by an increase in this indicator. Extragenital diseases predominated in the structure of MM in both districts over this period but with some differences. In the Siberian Federal District, other leading causes of MM were embolism and placental abruption and in the Far Eastern Federal District, the other leading causes were pre-eclampsia and obstetric hemorrhage. The traditional problems of Siberia and the Far East are low population density, long travel distances, poor roads, difficult seasonal accessibility in several territories because of extreme climatic and geographical features, and the low socio-economic level of the population. All of these problems significantly complicate the provision of medical care. In 2018, a significant influence of social factors was recorded, including a large number of deaths at home before the ambulance arrived, violations in the organization of ambulance work, problems of related specialists (general practitioners and paramedics), a significant increase in the structure of pulmonary embolism and placental abruption, as well as death from an ectopic pregnancy. In the future, considering the demographic situation, it is necessary

to prepare for further centralization of medical care and the closure of low-level institutions that are potentially dangerous in terms of MM. Further introduction of clinical recommendations and development of teamwork skills at simulation training centers is needed.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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