Professional self-determination of future dentists in the modern realities of Ukraine

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ORIGINAL ARTICLES

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Postpartum infections and antimicrobial resistance of responsible pathogens in Ukraine: results a multicenter study (2020-2022)

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ABSTRACT

Aim: To determine the current prevalence of postpartum infections and antimicrobial resistance and antimicrobial resistance of responsible pathogens in Ukraine.

Materials and Methods: Multicenter prospective cohort study was conducted from January 2020 to December 2022 in fifteen hospitals from twelve regions of Ukraine. Definitions of healthcare- associated postpartum infection were adapted from the Centers for Disease Control and Prevention's National Healthcare Safety Network. Antibiotic susceptibility was done by the disc diffusion test as recommended by EUCAST.

Results: Among 21,968 women, 6,175 (28.1%) postpartum infections were observed. Of all postpartum infection cases, 83.1% were detected after hospital discharge. The postpartum infection rates were 17.3% after cesarean section and 10.8% after vaginal delivery. The most common postpartum infection types were endometritis (17.3%), followed by urinary tract Infection (3.5%), mastitis (3.4%), surgical site infection (excluding endometritis) (2.4%), and episiotomy site infection (1.5%). The predominant postpartum infection pathogens in Ukraine were: *Escherichia coli* (10.4%), *Enterococcus* spp. (9.6%), *Staphylococcus aureus* (6.7%), *Pseudomonas aeruginosa* (5.8%), *Enterobacter* spp. (5.8%). In our study pathogens of postpartum infection had differently levels of resistance to antibiotics.

Conclusions: Our results indicate that postpartum infections requiring medical attention are common in Ukraine and that most postpartum infections occur after hospital discharge, so that use of routine inpatient surveillance methods alone will lead to underestimation of postpartum infection rates. Optimizing the antibiotic prophylaxis may reduce the burden of postpartum infection, but prevention is the key element.

KEY WORDS: Cesarean section, vaginal delivery, postpartum infection, responsible pathogens, antibiotic prophylaxis, antimicrobial resistance, Ukraine

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INTRODUCTION

Maternal morbidity and mortality are global socio-economic and healthcare burdens, and postpartum infections account for a significant, and often preventable, portion of that burden. Postpartum infections, primarily caused by bacterial pathogens, leading to poor reproductive perfor mance. Approximately five million cases of pregnancy-related infection occur every year globally, and approximately 75,000 results in death [1]. Postpartum infections are a major cause of prolonged hospital stay and comprise a large burden to our health care system.

The postpartum period is traditionally defined as the six weeks following delivery, and infections are relatively common, affecting an estimated 5 to 7% of women during this time. Postpartum infection is an important preventable cause of maternal morbidity and mortality, with pregnancy-related sepsis accounting for approximately 11% of maternal deaths globally [2]. Recent 2017 Global Burden of Disease data estimate 12.1 million incident cases of maternal sepsis and other maternal infections, including mastitis [3]. Infection also contributes significantly to deaths from other causes and leads to serious consequences, including chronic pelvic inflammatory disease, ectopic pregnancy, and infertility [4, 5]. One study attributed costs of an additional $3700 for wound infection and an additional $4000 for endometritis (in 2008 US dollars, corresponding to $4200 and $4500 today, respectively) [6].

According to literature, the risk factors include poor intrapartum hygiene, low socioeconomic status, primiparity, prolonged rupture of membranes, prolonged labor, and having vaginal exams intrapartum. Most study on postpartum infections has occurred in high resource countries. However, in low-resource settings, risk factors for postpartum infection may differ from high-resource settings due to patient, environmental and healthcare system factors. In addition, most published studies do not include microbiological confirmation of infection or infectious outcomes.

Improved understanding of postpartum maternal infection is key to achieving the sustainable development goals and executing the strategies toward ending preventable maternal and neonatal mortality. These infections are also the most common cause of death following spontaneous or induced abortions. The medical burden of these infections is compounded by the alarmingly rapid increase in bacterial resistance to commonly used antibiotics. Currently, prevalence of postpartum infection in women and the bacteria responsible for these infections have not been adequately studied, nor has the antibiotic susceptibility of the causative bacteria been frequently tested in Ukraine.

AIM

The aim this study to determine the current prevalence of postpartum infections and antimicrobial resistance and antimicrobial resistance of responsible pathogens in Ukraine.

MATERIALS AND METHODS

STUDY DESIGN, SETTING AND POPULATION

We performed a multi-centre prospective cohort study was based on surveillance data for postpartum infection. The study population consisted of all women who had a vaginal delivery or cesarean section from January 1, 2020, to December 31, 2022, and who received postpartum care at fifteen hospitals from twelve regions of Ukraine, which are similar in terms of medical equipment, personnel, and laboratory facilities.

DEFINITION

Postpartum period in this study defined as the six weeks following delivery. An HAPI was defined as an infection arising >48 h after delivery and not present or incubating on admission. Puerperal sepsis is defined as an infection of the genital tract occurring at any time between rupture of membrane or labour and 42 days postpartum in which two or more of the following are present; pelvic pain, fever (temperature ≥38.5°C on any occasion), abnormal vaginal discharge, delay in the rate of uterine involution. The criteria for specific HAI site were adapted from the Centers for Disease Control and Prevention's (CDC) and National Healthcare Safety Network's (NHSN) case definitions [7]. An incident postpartum infection was defined by microbiologically confirmed CDC/NHSN HAI epidemiological case definitions. In this study antimicrobial treatment by a physician was not considered to be sufficient for diagnosis of a postpartum infection because of widespread use of empiric antimicrobial therapy in Ukrainian hospitals. The criteria for determining postpartum infection were the presence of at least 2 clinical symptoms, i.e., abnormal vaginal discharge, pyrexia (oral temperature measurement more than 38.5°C), abnormal smell/foul odour discharge, delay in uterine involution (less than 2 cm per day during the first 8 days after delivery), and pelvic pain, assessed by the trained clinicians.

DATA COLLECTION

In this study endometritis, urinary tract Infection (UTI), mastitis, surgical site infection (excluding endometritis) (SSI), and episiotomy site infection. Clinical data were collected on 21,968 women who delivered at local hospitals. Participants providing written informed consent were followed by research nurses who measured vital signs including heart rate, blood pressure, respiratory rate and temperature approximately every 6 h starting immediately after delivery. All clinical signs and relevant history regarding postpartum problems were also documented. In hospital all women were informed of the symptoms of postpartum infection and advised to notify the observer right away after seeing the first infection symptom for a month. The discharged patients were advised for ongoing follow-up care for a month after delivery in the outpatient department. Information regarding the postpartum period following discharge was obtained from the outpatient records and from records documenting postpartum follow-up by referring gynecologists. Questionnaires and laboratory results were entered into a study database. Data were analyzed to document and classify all type of postpartum infection rates. Antibiotic prophylaxis was identified as a systemic or oral antibiotic was prescribed for

Table 1. Distribution of 6,175 postpartum infections in Ukraine, 2020-2022

Type of delivery	Mastitis n (%)	UTI n (%)	SSI (excluding endometritis) n (%)	Endometritis n (%)	Episiotomy site infection n (%)
Cesarean section	286 (1,3)	329 (1,5)	528 (2,4)	2659 (12,1)	0
Vaginal delivery	461 (2,1)	440 (2,0)	0	1142 (5,2)	330 (1,5)
Total	747 (3,4)	769 (3,5)	528 (2,4)	3801 (17,3)	330 (1,5)

Table 2. Demographics and obstetric history of study participants in Ukraine, 2020-2022

Characteristic	Postpartum infection		P-value
	No n (%)	Yes n (%)	
All women	15,793 (71.9)	6,175 (28.1)	<0.001
Age (years)			<0.001
≤20	1,896 (12.1)	1,482 (23.8)	
21–34	12,475 (79)	4,507 (73.1)	
≥35	1,422 (8.9)	186 (3.1)	
Total number of pregnancies			<0.001
1	5,697 (36.1)	3,402 (55.1)	
2–4	8,067 (51.1)	2,186 (35.4)	
≥5	2,029 (12.8)	587 (9.5)	
Gestational age at delivery			0.45
Preterm (< 37 weeks)	1,617 (10.2)	772 (12.5)	
Term (37–42 weeks)	12,861 (81.4)	4,839 (78.4)	
Post-term (> 42 weeks)	1,315 (8.4)	464 (9.1)	
Peri-Cesarean antibiotic prophylaxis received	15,647 (99.1)	6,144 (99.5)	0.85

women with normal vaginal delivery for an indication to prevent postpartum infections and documented in hospital medical records. Antibiotic prescribing for women after delivery at discharge was also identified as antibiotic prophylaxis.

MICROBIOLOGICAL METHODS

Pathogen strains were identified by an automated microbial identification system. Bacterial isolation, identification, and antimicrobial susceptibility test (AST) were performed. Antibiotic breakpoints were interpreted according to the European Committee on AST (EUCAST) guidelines, version 9.0 [8]. *E. coli* (ATCC-25922), *S. aureus* (ATCC-25923), and *P. aeruginosa* (ATCC 27853) were included as reference strains to assure the quality of antibiotic discs. The quality of the culture media, staining and biochemical test reagents, and antibiotic disc performance was assured by including international standard control strains, such as *E. coli* (ATCC 25922) for Gram-negative bacteria, *S. aureus* (ATCC 25923) for Gram-positive bacteria, throughout all assays.

ETHICS

The study received ethical approval from the Institutional Research Ethics Committee of Shupyk National Healthcare University of Ukraine (Kyiv, Ukraine). All procedures and methods adhered to the relevant guidelines and regulations. Written informed consent was also obtained from the participating women in the study. All data from participants in this study were anonymized prior to analysis.

STATISTICAL ANALYSIS

Infection rates for the entire study population of postpartum women were extrapolated by standard methods from the estimated infection rates for the sample of individual medical records reviewed. The data was entered into a spreadsheet in Microsoft Excel and coded for statistical analysis. All statistical analyses were conducted using Stata 14.2 statistical software (Stata Corp LLC, 4905 Lakeway Drive, College Station, Texas). The prevalence of postpartum infection was calculated as the number of all events or cases of postpartum infection during the study period divided by the total number of women in the population at risk at the beginning

Table 3. Types of microorganisms isolated from postpartum infections in Ukraine, 2020-2022

Microorganisms	All infections	
	n	%
Gram-positive cocci	4,316	23,4
Staphylococcus aureus	1,230	6,7
Enterococcus spp.	1,780	9,6
Coagulase-negative staphylococci	902	4,9
Streptococcus spp.	292	1,6
Other *gram-positive cocci*	112	0.6
Gram-negative bacilli	13,846	75,0
Enterobacteriales	5,019	27,2
Citrobacter spp.	267	1,4
Enterobacter spp.	1,075	5,8
Klebsiella spp.	470	2,5
Proteus spp.	590	3,2
Escherichia coli	1,917	10,4
Serratia spp.	405	2,2
Other *Enterobacteriales*	295	1,6
Non-fermenting gram-negative bacteria	1,904	10,3
Acinetobacter baumannii	595	3,2
Pseudomonas aeruginosa	1,072	5,8
Stenotrophomonas maltophilia	177	1,0
Other *Pseudomonadaceae*	60	0,3
Fungi	295	1,6
Candida spp.	295	1,6
Total no. of isolates	18,457	100

of the study. Descriptive statistics were used to express the frequency and proportion of postpartum infections and bacteria isolated from infected women, as well as the proportion of isolated bacteria that developed resistance to tested antimicrobials. The chi-square ($\chi 2$) test was used to determine the association of postpartum infection with the considered risk factors. Associations were deemed statistically significant if the calculated p-value was below 0.05.

RESULTS

PREVALENCE AND INCIDENCE OF POSTPARTUM INFECTIONS

The study population consisted of 21,968 women who underwent 17,768 vaginal deliveries and 4,200 cesarean sections. During study period 6,175 cases of postpartum infections were observed. Of all postpartum infection cases, 83.1% (5,132/6,175) were detected after hospital discharge. For these post-discharge infections, 35% of patients did not return to the hospital where they delivered for evaluation or treatment. The prevalence of postpartum infection in Ukraine was 28.1% (95% confidence interval [CI] 27.8-28.4). The postpartum infection rates were 17.3% after cesarean section (95% CI 16.7-17.9%) and 10.8% (95% CI 10,6-11.0%) after vaginal delivery. The most common postpartum infection types were Endometritis, followed by Urinary Tract Infection (UTI), Mastitis, Surgical Site Infection (SSI) (excluding endometritis), and Episiotomy site infection. The most frequent specific types of postpartum infection are reported in Table 1.

Among women undergoing cesarean section, the sitespecific infection rates (number of infections/100 deliveries) were mastitis 1.3% (95% CI 1.1-1.5%), urinary tract infection 1.5% (95% CI 1.3- 1.7%), surgical site infection (excluding endometritis) 2.4% (95% CI 2.2-2.6%), and endometritis 12.1% (95% CI 11.6- 12.6%). Following vaginal delivery, the infection rates were mastitis 2.1% (95% CI 2.0-2.2%), urinary tract infection 2.0% (95% CI 1.9- 2.1%), episiotomy site infection 1.5% (95% CI 1.4-1.6%), and endometritis 5.2% (95% CI 5.0-5.4%) (Table 1). The demographics and obstetric history of study participants in Ukraine are shown in Table 2.

RESPONSIBLE PATHOGENS AND ANTIMICROBIAL RESISTANCE

A total 18,457 microorganisms isolated from 6,175 postpartum infections in Ukraine, 2020-2022. By type of pathogen, 4316 strains were Gram-positive bacteria (23.4%), 13846 were Gram-negative bacteria (75%) and 295 were fungi (1.6%). The predominant postpartum infection pathogens in Ukraine were: *Escherichia coli* (10.4%), *Enterococcus* spp. (9.6%), *Staphylococcus aureus* (6.7%), *Pseudomonas aeruginosa* (5.8%), *Enterobacter* spp. (5.8%). Distribution of pathogens isolated from women with postpartum infection are presented in Table 3.

Antimicrobial susceptibility testing data were available for all pathogens causing postpartum infection. Meticillin resistance was found in 11.3% of *S. aureus (*MRSA), and vancomycin resistance was found in 4.8% of enterococci. Antimicrobial resistance to third-generation cephalosporins was detected in 12.5% of all Enterobacterales, and was most common among *K. pneumoniae* (27.4%) and *E. coli* (17.3%). Carbapenem resistance was found in 11.7% of Enterobacterales. Antimicrobial resistance to carbapenems was detected in 42.5% of all non-fermentative, Gram-negative bacteria, and was most common among *A. baumannii* (46.7%), and *P. aeruginosa* (37.4%).

DISCUSSION

The results presented in this study are based on multi-centre prospective surveillance data for prevalence of postpartum infection and antimicrobial resistance of responsible pathogens in Ukraine. This study expands upon the previous reports [9-14] and is the first study to publish frequent postpartum infections and/or characterization of the phenotypic mechanisms of responsible pathogens in Ukraine.

The epidemiology of postpartum infections has not been well characterized. In part this is because of the limitations of surveillance systems, which usually monitor infections that are recognized during hospitalization [15]. Hulton et al. used physician questionnaires for postdischarge surveillance of patients undergoing cesarean section. With only inpatient surveillance, 59% of postpartum infections they ultimately detected would not have been identified. The overall infection rate after postdischarge surveillance was implemented was fourfold higher than the previous rate (6.3% vs. 1.6%) [15]. Our study showed that of all postpartum infection cases, 83.1% were detected after hospital discharge. Studying rates of postpartum infections and their effects is difficult, as most of these infections occur following maternal hospital discharge, and decreasing hospital stay following childbirth further inhibits the detection of postpartum complications, including infection [17]. Therefore, several methods for postdischarge surveillance of postpartum infections have been evaluated. In this study, we used the inpatient and outpatient data to identify postpartum infections and describe the epidemiology of these infections [15]. All of these postpartum infections have been reported to predominantly present after discharge from hospital [18, 19]. The prevalence of infections has therefore been reported to be at various levels, depending on health care systems, the availability of health care, mode of surveillance and different definitions. Surveillance of the prevalence of specific infection after childbirth in Ukraine is difficult, since the obstetric care providers do not routinely follow up regarding infections.

According to the literature, during the puerperium, women have an increased risk of infection. The most common infections associated with childbirth are endometritis, infections in perineal or cesarean wounds, UTI and mastitis [20]. A postpartum infection was related to whether pregnancy was full-term, differences in the mode of delivery, and the labor process.

Infections occurring during pregnancy, childbirth and the puerperium are associated with considerable maternal and perinatal morbidity and mortality. However, global data on the incidence of maternal infection morbidity are scarce. The World Health Organization (WHO) estimates the global incidence of puerperal infections at 4.4% among live births, representing over 5.7 million cases a year [21]. Important variations exist between regions, with higher incidence in low- and middle-income countries (up to 7%) compared to high-income countries where the estimated incidence is lower (1% to 2%) [22]. Surgical site infections (SSI) are relatively common following birth, complicating 2-7% of cesarean deliveries [6]. Postpartum infections are more common in women who underwent cesarean section as opposed to vaginal delivery, and the risk is further increased for women who underwent labor before the cesarean section [12, 23]. Our study identified a high prevalence of postpartum infection (28.1%). The most common postpartum infections in Ukraine include endometritis, urinary tract infections, surgical site infections (excluding endometritis), and wound infections (episiotomy site infection). The postpartum infection rates were 17.3% after cesarean section and 10.8% after vaginal delivery. The most common postpartum infection types were endometritis (17.3%), followed by urinary tract Infection (3.5%), mastitis (3.4%), surgical site infection (excluding endometritis) (2.4%), and episiotomy site infection (1.5%).

According to the literature, bacterial infections around the time of childbirth are generally polymicrobial, including aerobic and anaerobic bacteria, and reflect vaginal colonization [9-14]. In our study by type of pathogen, 23.4% strains were Gram-positive bacteria, 75% were Gram-negative bacteria and 1.6% were fungi The predominant postpartum infection pathogens in Ukraine were: *E. coli, Enterococcus* spp., *S. aureus*, *P. aeruginosa*, and *Enterobacter* spp.

Knowledge of the microbiological profiles of different postpartum infections, local resistance patterns, and the severity of the patient's illness should guide antibiotic choices. As a general rule, antibiotic regimens, particularly in very sick patients, should have a broad-spectrum of antimicrobial coverage at the beginning and should be narrowed as more clinical evidence from cultures or pathology specimens becomes available. The medical burden of these infections is compounded by the alarmingly rapid increase in bacterial resistance to commonly used antibiotics [17]. In present study pathogens of postpartum infection had differently levels of resistance to antibiotics.

Infectious morbidities contribute to considerable maternal and perinatal morbidity and mortality, including women at no apparent increased risk of infection. To reduce the incidence of infections, antibiotics are often administered to women after uncomplicated childbirth, particularly in settings where women are at higher risk of puerperal infectious morbidities [24].

In Ukraine antibiotic prophylaxis is characterised by the use of broad-spectrum antibiotics (e.g. ampicillin, cephalosporin, a combination of antibiotics) effective against the micro-organism most likely to cause infections, to be given before, during or immediately after the procedure and for a short period of time (single dose or for less than 24 hours), and in the absence of any sign of infection. In this study the incidence of postpartum infection was similar in both antibiotic prophylaxis and unprophylaxis women. The results of present study limits conclusions on the benefits of antibiotic intake.

Antibiotic prophylaxis given after normal birth has the potential to further decrease infection risk, particularly in settings where appropriate hygiene, infection-control measures and sanitation during labour, childbirth and the postpartum period are not ensured, or where early detection of puerperal infections and laboratory investigations is limited [24]. The goal of antibiotic prophylaxis is to prevent infection by reaching therapeutic tissue levels at the time microbial contamination is most likely to occur.

Antibiotic prophylaxis after normal vaginal birth could help to prevent maternal infections by ensuring adequate antimicrobial serum and tissue concentrations during the postpartum period. To be effective, such antibiotics have to be active against the predominant organisms that cause postpartum infections and administered for the shortest period to minimise side effects and the impact of its routine use on emerging antimicrobial resistance. Indeed, exposure to antibiotics in the postpartum might cause adverse effects to the mother or the breast-fed neonate, including disruption of the normal flora, increased risk of resistant bacterial infections, allergic reactions as well as increased healthcare costs [25]. There are also concerns about rising resistance to antibiotics at the facility and community level [26]. This might further complicate the choice of suitable prophylactic antibiotics, as generally broad-spectrum antibiotics are required to cover common pathogens.

There are increasing public health concerns about emerging antibiotic resistance following misuse or overuse of antibiotics [26]. This is also applicable to the obstetric populations and the possibility of inadequate response to treatment of puerperal infections due to early exposure to undereffective antibiotic prophylactic regimens. Given the large proportion of women experiencing uncomplicated vaginal birth, a universal application of antibiotics to such women has the potential to lead to substantial clinical benefits in terms of reducing infection risk, but could also lead to direct harm for the woman and indirect harm to the general public with increasing resistance to antibiotics. The increasing trend observed in facility-based births may increase the risk of hospital-acquired infections after normal vaginal birth if not accompanied by improvements in the quality of hygiene and infection-control measures [27]. However, the evidence is unclear about the added effect of antibiotic prophylaxis on the prevention of postpartum infections after an uncomplicated vaginal birth [24].

Our study show that the scarcity of data and inherent limitations observed in studies limit interpretation of the evidence for routine use of antibiotics in cases of normal vaginal births. The available evidence is insufficient to support the use of routine antibiotic prophylaxis in women who had normal vaginal births. More evidence is needed to inform practice. In the interim, a balance among health provider experience, settings, participant characteristics and eventual cost in cases of uncomplicated births, including considerations of the contribution of indiscriminate use of antibiotics to raising antimicrobial resistance, needs to be considered when making routine prescriptions of antibiotic prophylaxis. Lack of evidence on the effect of routine antibiotic prescription for prevention of other postpartum infections, antimicrobial resistance and maternal satisfaction with treatment calls for further research [24].

STRENGTHS AND LIMITATIONS

Strengths of our study include the prospective study design, large sample size, near-complete enrollment of eligible women seeking care at hospitals during the study period, and an in-depth clinical and microbiological evaluation of participants with suspected postpartum infection.

Limitations: Due to resource constraints, we were unable to perform clinical or microbiological testing of participants with chorioamnionitis in labour, puerperal sepsis, and thrombotic phlebitis and thus unable to determine the incidence of these infections. Prolonged rupture of membranes is a known risk factor for postpartum infection but was not directly measured in this study. We collected participant-reported duration of labor as one measurement of prolonged labor but we did not measure duration of membrane rupture directly. We documented whether a woman was prescribed antibiotics on the same day as her cesarean section procedure, but we were unable to confirm whether these were given, nor determine the timing of the prescription relative to the procedure. Future research should address postpartum infections occurring after hospital discharge, incident in-hospital and post-discharge surgical site infection, and the impact of prophylactic antibiotics on incident infection and development of antimicrobial resistance.

CONCLUSIONS

Our results indicate that postpartum infections requiring medical attention are common in Ukraine and that most postpartum infections occur after hospital discharge, so that use of routine inpatient surveillance methods alone will lead to underestimation of postpartum infection rates. Use of information routinely collected by infection control personnel allows efficient identification of women who are very likely to have postpartum infections that are not detected by conventional surveillance. Information resulting from more complete surveillance could be used to identify settings with unusually high or low infection rates to identify practices associated with lower infection rates [15]. This information could then be used to focus, motivate, and assess the effectiveness of infection control practice changes aimed at improving infection rates in all settings.

The most of postpartum infections result from physiologic and iatrogenic trauma to the abdominal wall and reproductive, genital, and urinary tracts that occur during childbirth or abortion, which allows for the introduction of bacteria into these normally sterile environments [17]. The study found that a significant proportion of study population were affected by postpartum infections caused by bacteria developed resistance to several antimicrobials. Therefore, responsible use of antimicrobials is necessary to prevent the emergence of antimicrobial resistance, and further research is needed to understand the mechanisms of antimicrobial resistance. Optimizing the antibiotic prophylaxis may reduce the burden of postpartum infection, but prevention is the key element.

REFERENCES

1. Miller AE, Morgan C, Vyankandondera J. Causes of puerperal and neonatal sepsis in resource-constrained settings and advocacy for an integrated community-based postnatal approach. Int J Gynaecol Obstet. 2013;123(1):10-5. doi: 10.1016/j.ijgo.2013.06.006. DOI
2. Say L, Chou D, Gemmill A et al. Global causes of maternal death: a WHO systematic analysis. The Lancet Global Health. 2014;2(6):e323–e333. doi: 10.1016/S2214-109X(14)70227-X. DOI
3. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2018. doi: 10;392(10159):1789-1858. DOI
4. Bonet M, Pileggi VN, Rijken MJ et al. Towards a consensus definition of maternal sepsis: results of a systematic review and expert consultation. Reproductive Health. 2017;14(1):67. doi:10.1186/s12978-017-0321-6 . DOI
5. Hussein J, Walker L. Puerperal sepsis in low- and middle-income settings: past, present and future. Maternal and Infant Deaths: Chasing Millennium Development Goals 4 and 5. Royal College of Obstetricians and Gynaecologists Study Group. Cambridge: Cambridge University Press. 2010. doi:10.1017/CBO9781107784758.011. DOI
6. Olsen MA, Butler AM, Willers DM et al. Comparison of Costs of Surgical Site Infection and Endometritis after Cesarean Section Using Claims and Medical Record Data. Infect Control Hosp Epidemiol. 2010;31(8):872-5. doi: 10.1086/655435. DOI
7. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control 2008;36:309e32. doi: 10.1016/j.ajic.2008.03.002. DOI
8. European Committee on Antimicrobial Susceptibility Testing. Breakpoint Tables for Interpretation of MICs and Zone Diameters. 2019. https://www.eucast.org/ [Accessed 20 January 2024]
9. Salmanov AG, Savchenko SE, Chaika K et al. Postpartum Mastitis in the Breastfeeding Women and Antimicrobial Resistance of Responsible Pathogens in Ukraine. Wiad Lek. 2020;73(5):895-903. doi: 10.36740/WLek202005111. DOI
10. Salmanov AG, Vitiuk AD, Zhelezov D et al. Prevalence of postpartum endometritis and antimicrobial resistance of responsible pathogens in Ukraine: results a multicenter study (2015-2017). Wiad Lek. 2020;73(6):1177-1183. doi: 10.36740/WLek202006119. DOI
11. Salmanov AG, Voitok TG, Maidannyk IV et al. Episiotomy infections in the puerperium and antimicrobial resistance of responsible pathogens in Ukraine. Wiad Lek. 2020;73(11):2325-2331. doi: 10.36740/WLek202011101. DOI
12. Salmanov AG, Vitiuk AD, Ishchak OM et al. Surgical site infection after cesarean section in Ukraine: results a multicenter study. Wiad Lek. 2021;74(4):934-939. doi: 10.36740/WLek202104123. DOI
13. Salmanov AG, Terekhov VA, Baksheev SM et al. Infections associated with obstetric and gynecological surgeries as a cause of female infertility in Uktaine. Wiad Lek. 2022;75(7):1634-1641. doi: 10.36740/WLek202207104. DOI
14. Salmanov AG, Artyomenko A, Susidko OM et al. Catheter-associated urinary tract infections after caesarean section in Ukraine: Results a multicenter study (2020-2022). Wiad Lek. 2023;76(6):1325-1331. doi: 10.36740/WLek202306101 DOI

15. Hulton LJ, Olmsted RN, Treston-Aurand J et al. Effect of postdischarge surveillance on rates of infectious complications after cesarean section. Am J Infect Control. 1992;20(4):198-201. doi: 10.1016/s0196-6553(05)80146-4. DOI
16. Yokoe DS, Christiansen CL, Johnson R et al. Epidemiology of and surveillance for postpartum infections. Emerg Infect Dis. 2001;7(5):837-41. doi: 10.3201/eid0705.010511. DOI
15. Yokoe DS, Christiansen CL, Johnson R, et al. Epidemiology of and surveillance for postpartum infections. Emerging Infectious Diseases. Sep 1, 2001.
16. Hulton LJ, Olmsted RN, Treston-Aurand J et al. Effect of postdischarge surveillance on rates of infectious complications after cesarean section. Am J Infect Control. 1992;20(4):198-201. doi: 10.1016/s0196-6553(05)80146-4. DOI
17. Boushra M, Rahman O. Postpartum Infection. Treasure Island (FL): StatPearls Publishing, July, 2023.
18. Yokoe DS, Christiansen CL, Johnson R et al. Epidemiology of and surveillance for postpartum infections. Emerg Infect Dis. 2001;7(5):837-41. doi: 10.3201/eid0705.010511. DOI
19. Karsnitz DB. Puerperal infections of the genital tract: a clinical review. J Midwifery Womens Health. 2013;58(6):632-42. doi: 10.1111/jmwh.12119. DOI
20. Maharaj D. Puerperal pyrexia: a review. Part I. Obstet Gynecol Surv. 2007;62(6):393-9. doi: 10.1097/01.ogx.0000265998.40912.5e.
21. World Health Organization. The World Health Report 2005: Make every mother and child count. www.who.int/whr/2005/whr2005_en.pdf 2005 [Accessed 20 January 2024]
22. Dolea C, Stein C. Global Burden of Disease 2000. Evidence and Information for Policy (EIP). Geneva: World Health Organization. 2003.
23. Allen VM, O'Connell CM, Liston RM et al. Maternal morbidity associated with cesarean delivery without labor compared with spontaneous onset of labor at term. Obstet Gynecol. 2003;102(3):477-82. doi: 10.1016/s0029-7844(03)00570-2. DOI
24. Bonet M, Ota E, Chibueze CE et al. Routine antibiotic prophylaxis after normal vaginal birth for reducing maternal infectious morbidity. Cochrane Database Syst Rev. 2017;11(11):CD012137. doi: 10.1002/14651858.CD012137.pub2. DOI
25. ACOG Practice Bulletin No. 120: Use of prophylactic antibiotics in labor and delivery. Obstet Gynecol. 2011;117(6):1472-1483. doi: 10.1097/AOG.0b013e3182238c31. DOI
26. World Health Organization. Antimicrobial Resistance Global Report on Surveillance. Geneva: WHO. 2014.
27. Hussein J, Mavalankar DV, Sharma S, D'Ambruoso L. A review of health system infection control measures in developing countries: what can be learned to reduce maternal mortality. Globalization and Health 2011;7:14.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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