Pol Merkur Lek, 2023; LI, 4: 299-305

ORIGINAL ARTICLE

**DOI:** 10.36740/Merkur202304101

# POSTOPERATIVE INFECTIONS AFTER GYNECOLOGICAL SURGERIES IN UKRAINE

Aidyn G. Salmanov[1,2], Valerii V. Kostikov[3], Olena Lytvak[4], Oleksandr A. Voloshyn[1,7], Boleslav Lysenko[4], Tetiana Struk[5], Olga Gordiichuk[6]

[1]SHUPYK NATIONAL HEALTHCARE UNIVERSITY OF UKRAINE, KYIV, UKRAINE
[2]INSTITUTE OF PEDIATRICS, OBSTETRICS AND GYNECOLOGY OF THE NATIONAL ACADEMY OF MEDICAL SCIENCES OF UKRAINE, KYIV, UKRAINE
[3]NATIONAL CANCER INSTITUTE, KYIV, UKRAINE
[4]STATE SCIENTIFIC INSTITUTION "SCIENTIFIC AND PRACTICAL CENTER OF PREVENTIVE AND CLINICAL MEDICINE" OF THE AGENCY OF STATE AFFAIRS, KYIV, UKRAINE
[5]KHARKIV NATIONAL MEDICAL UNIVERSITY, KHARKIV, UKRAINE
[6]NATIONAL PIROGOV MEMORIAL MEDICAL UNIVERSITY, VINNYTSIA, UKRAINE
[7]KYIV REGIONAL MATERNITY HOSPITAL, KYIV, UKRAINE

**ABSTRACT**

**Aim:** To determine the current prevalence of surgical site infections (SSIs) after gynecological surgeries and antimicrobial resistance of causing pathogens in Ukraine.

**Materials and Methods:** Multicenter prospective observational cohort study was conducted from January 2020 to December 2022 in nine hospitals from eight regions of Ukraine. Definitions of HAIs 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:** A total 12.2% (420/3450) patients who undergoing gynecological surgeries were found to have SSIs. The difference in SSI rates between the three subgroups by route of surgery was not statistically significant, being 12.0% for the abdominal group,11.1% for the vaginal group, and 12.5% for the combined group. The most common causing pathogens of SSIs was *Escherichia coli, Pseudomonas aeruginosa, Enterobacter spp., Streptococcus spp., and Klebsiella pneumoniae*. Many Gram-negative pathogens isolated from SSI cases were found to be multidrug resistant.

**Conclusions:** This study showed that SSIs remains the common complication after gynecological procedures in Ukraine. Best practices should be established and followed to reduce the risk of SSIs associated with gynecologic surgery. Optimizing the antibiotic prophylaxis and empirical antimicrobial therapy may reduce the burden of SSIs in gynecological surgeries, but prevention is the key element.

**KEY WORDS:** Surgical site infection, gynecological surgery, abdominal surgery, vaginal surgery, antibiotic prophylaxis, antimicrobial resistance

## Introduction

Postoperative infection is the most commonly seen complication of surgery in gynecology. The most common infections after gynecological surgery include Endometritis, Parametritis, Vaginal cuff infection, Salpingitis, Oophoritis, Adnexa utery, Chorioamnionitis, and Pelvic abscess or cellulitis. Occurrence this infection is associated with the highest incidence of reoperation, the longest duration of hospitalization, and the greatest increase in cost of any postoperative gynecologic complication. According to literature, the prevalence of reproductive tract infection after gynecological surgery varies from country to country and ranges from 1.8% to 37.8% [1-3].

According to literature, postoperative infections after gynecological surgeries, and induced abortion is closely associated with a higher risk of infertility in women of reproductive age [4]. The results of study revealed high level the prevalence rate of SSI among infertile women of reproductive age in Ukraine is high. This applies to both primary and secondary infertility group women's [5, 6].

Antibiotic prophylaxis has been proved to decrease the infectious morbidity for vaginal procedures. Current international guidelines for the management of pelvic inflammatory disease recommend the prescription of antibiotics for prophylactic and treatment [1, 7, 8].

The use of antibiotic prophylaxis in gynecological surgery has greatly decreased though not completely eliminated this adverse outcome. In addition, the appointment of an inadequate starting therapy decreases the effectiveness of treatment. Irrational use of antibiotics is rampant. Antimicrobial resistance (AMR) is a global problem. One of the reasons for emergence of AMR is injudicious use of antibiotics. Irrational use of antibiotics is rampant. Guidelines recommend administration of single dose of antibiotic for surgical antimicrobial prophylaxis for elective gynecological surgeries. There is no evidence to support prolonged use of antibiotics postoperatively in clean or clean-contaminated surgeries for prevention of post-operative infections. However, it is not usually adhered to in practice [9, 10]. Clinicians often overprescribe antibiotics presurgery and postsurgery sometimes for several days after surgery to overcome the fear of breach in asepsis during surgery and resultant SSI. Irrational antibiotic use might be harmful by altering the resident flora from susceptible to resistant strains.

Compliance with clinical practice guidelines is crucial for ensuring the appropriate and effective use of antibiotics. These guidelines offer recommendations for the selection, timing, and duration of antibiotic prophylaxis based on patient characteristics and the surgical procedure [11]. However, reports from Ukraine have shown that broader spectrum antibiotics, unnecessary combinations of antibiotics, suboptimal timing, and prolonged duration of surgical antibiotic prophylaxis are being used.

## AIM

The aim this study to determine the current prevalence of postoperative infections after gynecological surgeries and antimicrobial resistance of causing pathogens in Ukraine.

## MATERIALS AND METHODS

### STUDY DESIGN, SETTINGS AND PARTICIPANTS

We performed a multicenter prospective observational cohort study was conducted from January 2020 to December 2022. Over study period, women who undergoing abdominal and vaginal surgery for benign gynecologic indications at nine hospitals from eight regions of Ukraine were included. Criteria for inclusion were those patients undergoing abdominal and vaginal procedures who were older than18 years of age and who had elective gynecologic surgery for nonmalignant pathology. Laparoscopic procedures were excluded unless combined with open surgery.

### DEFINITION

An SSI was defined as an infection arising >48 h after surgery procedure and not present or incubating on admission, unless the patient had been discharged from hospital within a defined period. The criteria for specific type of SSI were adapted from the Centers for Disease Control and Prevention's (CDC) and National Healthcare Safety Network's (NHSN) case definitions. An incident SSI was defined by microbiologically confirmed CDC/NHSN HAI epidemiological case definitions. In addition, institution of antimicrobial treatment by a physician was not considered to be sufficient for diagnosis of an SSI because of widespread use of empiric antimicrobial therapy in Ukrainian hospitals.

### MICROBIOLOGICAL METHODS

Species identification was performed with standard microbial methods. Antibiotic susceptibility testing of bacteria was determined by Kirby-Bauer disc diffusion test according to the protocol of the European Committee on Antimicrobial Susceptibility Testing (EUCAST) (http://eucast.org). An isolate is considered resistant to an antimicrobial agent when tested and interpreted as R in accordance with the EUCAST clinical breakpoint criteria used by the local laboratory. When combining results for antimicrobial agents representing an antimicrobial group, the outcome is based on the most resistant result.

### DATA COLLECTION

Patients undergoing elective gynecological surgery and patients with SSI occurring within 30 days after the operation were involved in the study. Patients not willing to participate, patients below 18 years and above 60 years, patients who underwent re-exploration surgery, and patients who were operated on elsewhere and were referred for SSI or any other reason were not involved in the study. Patients were informed of the symptoms of SSI and advised to notify the observer right away after seeing the first SSI symptom for a month. The discharged patients were advised for ongoing follow-up care for a month in the outpatient department. Information regarding the postoperative course following discharge was obtained from the outpatient records and from records documenting postoperative follow-up by referring gynecologists or primary care physicians. Data were analyzed to document and classify all infectious morbidity and wound infection rates, and operative site infections were specifically documented for this analysis. In our study prophylactic antibiotic administration consisted of a second-or third-generation cephalosporin administered in a single preoperative dose.

### ETHICS

The study was initiated after approval by the Institutional Ethics Committee of the Shupyk National Healthcare University of Ukraine (Kyiv, Ukraine). Patients selected for the study were required to sign an informed consent.

### STATISTICAL ANALYSIS

All clinical and microbiological data results were entered in an Excel (Microsoft Corp., Redmond, WA, USA) database for statistical analysis. Continuous variables are expressed as mean and standard deviation (SD) or as median. Categorical variables are expressed as numbers and percentages. Data were analyzed to document and classify all infectious morbidity and wound infection rates, and operative site infections were specifically documented for this analysis. The factors used for subsequent analysis in each patient were the use of preoperative antibiotics, body mass index (BMI), presence of known diabetes mellitus, route of surgery, and history of smoking. We analyzed the association of these factors with infectious morbidity using Fischer's exact test. In our study significance was based on $P<0.05$.

## RESULTS

### POSTOPERATIVE INFECTIONS

A total in during study period based on our inclusion criteria, in total 3512 patients were eligible for analysis. Among the 3512 patients were 3450 for whom there were sufficiently detailed follow-up records to allow inclusion in this study

**Table 1.** Characteristics of surgical site infection (SSI) after gynecological surgery in Ukrainian hospitals (2020-2022)

| Variables | All of Procedure n | SSI Yes N (%) | SSI No N (%) | P- value |
|---|---|---|---|---|
| **Abdominal surgery** | | | | |
| Number of cases | 2.250 | 270 | 1.890 | 0.079 |
| Antibiotic prophylaxis | 1.710 | 150 (5.55) | 1.560 (82.5) | |
| Rehospitalization | 150 | 120 | 30 | |
| Repeat surgery | 150 | 120 | 60 | |
| **Vaginal surgery** | | | | |
| Number of cases | 810 | 90 | 720 | 0.49 |
| Antibiotic prophylaxis | 660 | 60 (66.7) | 600 (83.3) | |
| Rehospitalization | 60 | 60 | 0 | |
| Repeat surgery | 30 | 30 | 0 | |
| **Combined surgery** | | | | |
| Number of cases | 480 | 60 | 420 | 0.083 |
| Antibiotic prophylaxis | 300 | 0 (0) | 300 (71.4) | |
| Rehospitalization | 60 | 30 | 30 | |
| Repeat surgery | 0 | 0 | 0 | |
| **Combined data** | | | | |
| Number of cases | 3450 | 420 | 3030 | 0.012 |
| Antibiotic prophylaxis | 2670 | 210 (50.0) | 2460 (81.2) | |
| Rehospitalization | 270 | 210 | 60 | |
| Repeat surgery | 240 | 150 | 90 | |

(i.e., we were unable to obtain adequate postoperative records for the remainder). Among these, 2250 had abdominal surgery, 810 had vaginal surgery, and 480 had undergone combined vaginal and abdominal procedures. The average age of the patients was 41 years (range 24-68 years). The average height was 162.5 cm, and the average weight was 71.2 kg, with an average BMI of 27.31.

There were 420 patients with surgical site infection (SSI) among the 3450 total patients, an overall infection rate of 12.2%. The difference in SSI rates between the three subgroups by route of surgery was not statistically significant, being 12.0% (270/2250) for the abdominal group,11.1% (90/810) for the vaginal group, and 12.5% (60/480) for the combined group. Only of these 420 cases was detected in the initial hospital stay; the remaining 390 were identified only through examination of records of subsequent care after hospitalization. In this study fifty percent of the patients with infection required repeat hospitalization compared to only 1.98% patients without infection. 150 of the 420 patients with infection required a repeat surgical procedure directly related to the postoperative infection. The results of this are summarized in Tables 1 and 2.

## ANTIBIOTIC PROPHYLAXIS

Among all subjects, 2670 patients received preoperative antibiotic prophylaxis. Of those who received antibiotic prophylaxis, 7.9% developed SSI (210/2670), whereas, among those who did not receive any antibiotic prophylaxis, 26.9% developed a postoperative infection. This difference was statistically significant (P=0.0123, RR=0.26, with a CI of 0.10-0.72) (Table 3).

## LOGISTIC REGRESSION

We analyzed the data by logistic regression and found that after stepwise adjustment only antibiotic prophylaxis was a significant variable (P= 0.012, RR=0.28, with CI 0.11-0.72), whereas a history of diabetes mellitus, smoking, route of surgery, and BMI were not significant predictors of wound infection. These data are shown in Table 3.

## ABDOMINAL SURGERY

There were nine wound or operative site infections among the 2250 patients with an exclusively abdominal route for surgery (12.5%). 150 patients with infections were readmitted, received intravenous antibiotics, and underwent wound incision and drain age of vaginal cuff abscess. Ten patients without operative site infection were readmitted for treatment of pneumonia, and 20 other patients in this group underwent repeat surgery for small bowel obstruction (un associated with the surgical wound). Among the 2250 patients, 1710 received antibiotic prophylaxis, and 450 did not receive antibiotic prophylaxis. Among

**Table 2.** Risk of surgical site infection (SSI) related to antibiotic prophylaxis in gynecological surgery in Ukrainian hospitals (2020-2022)

| Variables | Number of women | Antibiotic prophylaxis given | No antibiotic prophylaxis | P-value |
|---|---|---|---|---|
| **Abdominal surgery** | | | | |
| SSI | 270 | 150 | 120 | 0.079 |
| No SSI | 1890 | 1560 | 330 | |
| Total | 2160 | 1710 | 450 | |
| **Vaginal surgery** | | | | |
| SSI | 90 | 60 | 30 | 0.49 |
| No SSI | 720 | 600 | 120 | |
| Total | 810 | 660 | 150 | |
| **Combined Surgery** | | | | |
| SSI | 60 | 0 | 60 | 0.083 |
| No SSI | 420 | 300 | 120 | |
| Total | 480 | 300 | 180 | |
| **Combined Data** | | | | |
| SSI | 420 | 210 | 210 | 0.012 |
| No SSI | 3030 | 2460 | 570 | |
| **Total** | 3450 | 2670 | 780 | |

**Table 3.** Analysis of variables of Surgical Site Infection (SSI) by logistic regression

| Variable | P- value |
|---|---|
| Antibiotic prophylaxis | 0.012 |
| Route of surgery | 0.980 |
| Body mass index | 0.370 |
| Smoking | 0.330 |
| Diabetes mellitus | 0.293 |

**Table 4.** Bacterial pathogens (n=1,196) isolated from patients with Surgical Site Infection (SSI) after gynecological surgery in Ukrainian hospitals (2020-2022) (P < 0.05)

| Microorganism | All isolates | | Abdominal surgery | | Vaginal surgery | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| **Gram-positive cocci** | **355** | **29.7** | **143** | **12.0** | **212** | **17.7** |
| *Staphylococcus aureus* | 46 | 3.8 | 38 | 3.2 | 8 | 0.7 |
| *Staphylococcus epidermidis* | 18 | 1.5 | 7 | 0.6 | 11 | 0.9 |
| *Staphylococcus haemolyticus* | 14 | 1.2 | 6 | 0.5 | 8 | 0.7 |
| *Streptococcus spp.* | 96 | 8.0 | 28 | 2.3 | 68 | 5.7 |
| *Enterococcus faecalis* | 181 | 15.1 | 64 | 5.4 | 117 | 9.8 |
| **Gram-negative bacilli** | **841** | **70.3** | **281** | **23.5** | **560** | **46.8** |
| *Escherichia coli* | 412 | 34.4 | 137 | 11.5 | 275 | 23.0 |
| *Klebsiella pneumoniae* | 86 | 7.2 | 25 | 2.1 | 61 | 5.1 |
| *Klebsiella oxytoca* | 14 | 1.2 | 3 | 0.3 | 11 | 0.9 |
| *Enterobacter spp.* | 96 | 8.0 | 31 | 2.6 | 65 | 5.4 |
| *Proteus mirabilis* | 62 | 5.2 | 3 | 0.3 | 59 | 4.9 |
| *Serratia marcescens* | 28 | 2.3 | 13 | 1.1 | 15 | 1.3 |
| *Pseudomonas aeruginosa* | 102 | 8.5 | 46 | 3.8 | 56 | 4.7 |
| *Acinetibacter spp.* | 23 | 1.9 | 16 | 1.3 | 7 | 0.6 |
| *Stenotrophomonas maltophilia* | 18 | 1.5 | 7 | 0.6 | 11 | 0.9 |
| **Total** | **1,196** | **100.0** | **424** | **35.5** | **772** | **64.5** |

those receiving preoperative antibiotics, 8.9% developed an infection compared to 26.7% among those who did not. The difference in infection rates among women managed with or without antibiotic prophylaxis approached statistical significance (P=0.079, RR=0.32, with CI of 0.10-1.06). The average length of stay (LOS) was increased from 3.2 days to 5 days among those women who experienced wound or operative site infections.

### VAGINAL SURGERY

In this study the observed rate of SSI was 11.1% (90/810). 60 patients in the infection group were rehospitalized and treated with intravenous antibiotics, and one of the two underwent transvaginal drainage of a cuff abscess in the ward. Of the 810 patients undergoing an exclusively vaginal procedure, 660 received preoperative antibiotics, and 150 did not. Among those who received preoperative antibiotics, the wound infection rate was 9.1% compared to 20% among those who did not receive prophylaxis (P=0.49, RR=0.48, with CI of 0.05-4.27). Infection increased the average LOS by 3.6 days in this group.

### COMBINED SURGERY

The average rate of infection was 12.5% (60/480). 30 patients in each group were readmitted. In both groups, the reason for admission was unrelated to the surgical wound. Of note, none of the patients with infection received prophylaxis compared to 71.4% (300/420) of the patients without infection. There were no infections among those treated with antibiotic prophylaxis is compared to 33.33% among those who did not receive antibiotics (P=0.083). Again, an increase in average LOS from 2.3 to 4.5 days was seen with infection.

### CAUSATIVE AGENTS AND ANTIMICROBIAL RESISTANCE

A total of 1,196 microorganisms were isolated from surgical wound secretion. The most frequent microorganism isolated was Escherichia coli (412 isolates), Pseudomonas aeruginosa (102 isolates), Enterobacter spp. (96 isolates), Streptococcus spp. (96 isolates) and Klebsiella pneumoniae (86 isolates). In this study of all SSIs cases 81.2% (341/420) were reported to be polymicrobial. Gram-negative bacteria predominated (70.3% of all organisms). The distribution of the microorganisms differed according to the after abdominal or after vaginal surgeries of the infection (Table 4).

Regarding the bacterial resistance, the main bacteria found were analyzed. In this study among the antimicrobial agents tested, the carbapenems (ertapenem) and piperacillin/tazobactam, and cefotaxim were the most consistently active in vitro against Enterobacteriales in both vaginal surgeries and after abdominal surgery infections. Proportion of extended spectrum beta-lactamase (ESBL) production among Enterobacteriales was 17.5% and of methicillin-resistance in Staphylococcus aureus (MRSA) 9.7%. No vancomycin-resistance *Enterococcus faecalis* (VRE) strains were isolated. Vancomycin, teicoplanin, linezolid and fosfomycin, were the most consistently active *in vitro* in both vaginal surgery and abdominal surgeries infections, due to the strains of *E. faecalis*.

In the analysis for aminoglycosides against *E. coli*, the resistance was 8% for amikacin, 23% for gentamicin and 36% for tobramycin. When analyzing beta-lactams, the resistances were 11-81%, for carbapenems, 0-8% for furans and was 3%, specifically, for nitrofurantoin. Against *P. aeruginosa*, the carbapenems (meropenem, ertapenem, and imipenem), trimethroprim/sulfamethoxazole, amikacin and ticarcillin were the most active agents in vaginal surgery infections, while meropenem, ertapenem, and trimethroprim/sulfamethoxazole were the most active agents in abdominal surgery infection cases.

## DISCUSSION

In this study we sought to determine the postoperative wound infection rate among patients undergoing elective gynecologic surgery and antimicrobial resistance of causing pathogens, and to determine the predictive value of various factors that contribute to infection in Ukraine. We further investigated the adequacy of hospital records in documenting infection rates as well as the timing of presentation of wound infections. The records of 3450 patients undergoing elective gynecologic surgery at nine regional women hospitals of Ukraine were reviewed. All patients were further subdivided based on route of surgery. We analyzed the importance of antibiotic prophylaxis, route of surgery, smoking, diabetes, and BMI. The overall SSI rate was 12.2% with no significant difference in the subgroups by route of surgery. Overall, antibiotic prophylaxis significantly decreased SSI rates, but the route of surgery, BMI, smoking, and diabetes were not significant predictors of infection. Only one case of infection was detected during the initial hospital stay (6.1%). Fifty percent of the patients with infection required readmission, and of these 35.7% required an additional surgical procedure. The average length of hospital stay was 2.4 days longer in patients with SSI.

According to literature, SSI is one of the most common complications in gynecologic surgery. Opening the lower genital tract exposes the pelvic operative site and the abdominal wound to vaginal flora in spite of preoperative vaginal preparation [12]. In our study of SSI rate after gynecological surgeries were 12.2%. Previous studies have shown that prevalence of SSI after gynecological surgeries in Ukraine was 4.6-38.8% [2, 3, 13-15].

Antibiotic resistance of microorganisms that cause infections of the urogenital tract is a clinically relevant problem in obstetrics and gynecology. Although the introduction of antibiotics allowed a marked increase in hope of life, it also increased alarmingly the bacterial resistance that threatens to impede this advance and poses significant risks to the safety of public health worldwide [16].

In the present study, the high level of resistance to multiple antibiotics is of great concern. The potential production of ESBLs detected is alarming. This condition represents an indication of seriously limited options for the treatment of patients infected with those microorganisms. Among Gram-negative bacteria, *E. coli*, *P. aeruginosa*, and *K. pneumoniae* were the most frequently reported. This finding is of particular concern, since these organisms are often involved in outbreaks that require the activation of an organizational response until the outbreak is under control. Due to methodological difficulties, resistance testing is rarely used for the management of these infections. Therefore, solid epidemiological data on resistance rates of most involved pathogens are scarce. Antibiotic resistance of several microorganisms appears to be increasing in various areas of the world. The presence of antibiotic resistance should therefore be considered in patients with an unfavorable course despite adequate antibiotic therapy. In light of the growing problem of antibiotic resistance and the large gaps in our knowledge in this particular area, research efforts in the field of anti-biotic resistance in gynecological infections should be markedly intensified.

The use of antimicrobial prophylaxis in obstetric and gynecologic surgeries varies considerably according to geographical areas and socioeconomic and cultural contexts [17]. The use of antibiotic prophylaxis has greatly decreased though not completely eliminated this adverse outcome. Antibiotic prophylaxis should be given to prevent SSI prior to gynecological surgery or procedures that enter the reproductive tract, ideally 60 minutes prior to skin incision. For procedures such as hysterectomy, antibiotic prophylaxis is clearly indicated, for others such as diagnostic laparoscopy, antibiotic prophylaxis is usually not required. For other procedures the evidence is less clear, and recommendations are based on expert agreement until further research evidence becomes available. Surgeons should consider each patient's individual requirements before prescribing the recommended antibiotic. The patient's risk factors for postoperative infection are predictable and need to be taken into account prior to any surgery, such as smoking status, diabetes, obesity, nutritional status, co-existent infection at a remote body site, vaginal colonisation with micro-organisms and immunodeficiency [8].

Postoperative infections observed after gynecologic surgical procedures are polymicrobial and require parenteral broad-spectrum antimicrobial therapy until the patient has cleared all symptoms of the infection. Broad-spectrum antibiotics should be initiated as soon as possible when diagnosis of postoperative infection is made; most patients will respond to treatment within 24 to 48 hours when appropriate antibiotics are selected. In addition, therapy should be tailored to the specific infection and patient response thereto.

The vagina contains more microorganisms than any other site in the body except the bowel. Uterine manipulation through the vagina, e.g., surgical termination of pregnancy, or operations that open the vagina, e.g., hysterectomy, will result in contamination of normally sterile sites by bacteria that are normally resident in the vagina. Whether these organisms become established and cause infection and inflammation depends on a mixture of surgical and host-related factors, including low socioeconomic status, poor nutrition, smoking, or preexisting medical conditions, such as impaired immunocompetence [8]. It is important to consider the likely source of pathogens in each type of surgery. Prior to any surgery, there is preparation with history, examination and appropriate investigations. Prior to gynecological surgery, screening for genital tract infection is not required; however, women with symptoms or risk factors should be tested and treated for sexually transmitted infections (chlamydia and gonorrhoea) and bacterial vaginosis. These have been associated with an increased risk of infection, endometritis with chlamydia and gonorrhoea following termination and vaginal cuff infection following hysterectomy with bacterial vaginosis [8].

Our study showed that postoperative infections after gynecologic surgical procedures can occur during the immediate postoperative period or after discharge from the hospital. As many as 50 per cent of these infections may occur after the patient is discharged from the hospital. Without question, the most appropriate means of objectively identifying infection rates, appropriate and inappropriate use of antimicrobials, and trends in morbidity is with an infection control program, usually consisting of an epidemiologist or specially trained nurses. Their contribution to appropriate patient care is significant. Implementing programs to reduce infections in the surgical field requires a collaborative approach involving clinicians, nurses, and staff.

### STRENGTHS AND LIMITATIONS

The strengths of the study lie in the prospective nature, and application of CDS/NHSN methodology. It is well known that indicators of SSIs provided by surveillance activities require comparison with adequate reference data to stimulate further infection control actions and to enhance quality of care. Particular limitations in this study should be acknowledged when interpreting our findings. The limitations of this study include in conduct at a 33.3% region (8 from 24) in Ukraine. The results may not be representative of other regions of Ukraine with different distributions of SSI cases and antimicrobial resistance of responsible pathogens of infections after gynecological surgeries.

## CONCLUSIONS

This study showed that SSIs remains the common complication after gynecological procedures in Ukraine. Most postoperative infections in gynecological surgery are treated empirically with antibiotics, making comprehensive resistance surveillance data essential to guide empiric regimens. Best practices should be established and followed to reduce the risk of SSIs associated with gynecologic surgery. Optimizing the antibiotic prophylaxis and empirical antimicrobial therapy may reduce the burden of SSIs in gynecological surgeries, but prevention is the key element.

## REFERENCES


1. Ross J. Antibiotic therapy for pelvic inflammatory disease. Cochrane Database Syst Rev. 2017;4(4):CD010285. doi: 10.1002/14651858.CD010285.pub2.
2. Salmanov A, Shchehlov D, Svyrydiuk O et al. Epidemiology of healthcare-associated infections and mechanisms of antimicrobial resistance of responsible pathogens in Ukraine: a multicentre study. J Hosp Infect. 2023;131:129-138. doi: 10.1016/j.jhin.2022.10.007.
3. Salmanov AG, Suslikova LV, Pandei SA et al. Healthcare associated Deep pelvic tissue infection and other infections of the female reproductive tract in Ukraine. Wiad Lek. 2021;74(3 cz 1):406-412. doi:10.36740/WLek202103105.
4. Liang S, Chen Y, Wang Q et al. Prevalence and associated factors of infertility among 20–49 year old women in Henan Province, China. Reproductive Health. 2021;18:254. doi: 10.1186/s12978-021-01298-2.
5. 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.
6. Salmanov AG, Vitiuk AD, Kovalyshyn OA et al. Prevalence and risk factors of infertility in Ukraine: results a melticenter study (2019-2021). Wiad Lek. 2022;75 (5 p 2):1058-1065. doi:10.36740/WLek202205202.
7. Savaris RF, Fuhrich DG, Maissiat J et al. Antibiotic therapy for pelvic inflammatory disease. Cochrane Database Syst Rev. 2020;8:CD010285. doi: 10.1002/14651858. CD010285.pub3.
8. ACOG Practice Bulletin No. 195: Prevention of Infection After Gynecologic Procedures. Obstet Gynecol. 2018;131(6):e172-89.
9. Puri M, Nain S, Gautam A et al. Rational use of antibiotics for major elective gynaecological and obstetrical surgical procedures: quality improvement journey from a tertiary care public facility. BMJ Open Qual. 2022;11(1):e001438. doi: 10.1136/bmjoq-2021-001438.
10. Arteaga-Livias K, Panduro-Correa V, Maguiña JL et al. Compliance with Antibiotic Prophylaxis in Obstetric and Gynecological Surgeries in Two Peruvian Hospitals. Antibiotics (Basel). 2023;12(5):808. doi: 10.3390/antibiotics12050808.
11. Gupta N. Antimicrobial Therapy in Resource-Limited Settings with High Antimicrobial Resistance: A Case-Based Approach. Infez. Med. 2022;30:73–79. doi: 10.53854/liim-3001-8.
12. Lachiewicz MP, Moulton LJ, Jaiyeoba O. Pelvic surgical site infections in gynecologic surgery. Infect Dis Obstet Gynecol. 2015;2015:614950. doi:10.1155/2015/614950.
13. Salmanov AG, Baksheev SM, Kuflovskyi DV et al. Healthcare-associated infection after legal induced abortions in Ukraine: results a multicenter study. Wiad Lek. 2021;74(7):1559-1565. doI: 10.36740/WLek202107103.
14. Salmanov AG, Vitiuk AD, Kovalyshyn OA et al. Surgical site infection after laparoscopic hysterectomy for benign gynecological disease in Ukraine. Wiad Lek. 2022;75(1):251-258. 10.36740/WLek202201218.
15. Salmanov AG, Vitiuk AD, Hrynchuk SYa et al. Vaginal cuff infection after hysterectomy in Ukraine. Wiad Lek. 2021;74(2):196-201. doi:10.36740/WLek202102104.
16. CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC. 2019. doi: 10.15620/cdc:82532.
17. Arteaga-Livias K, Panduro-Correa V, Maguiña JL et al. Compliance with Antibiotic Prophylaxis in Obstetric and Gynecological Surgeries in Two Peruvian Hospitals. Antibiotics (Basel). 2023;12(5):808. doi: 10.3390/antibiotics12050808.


*We thank the participating hospitals and the infection control community for their diligent efforts in performing the prevalence surveys of SSIs after gynecological surgeries in Ukraine. The findings and conclusions in this study are those of the authors.*


**ORCID AND CONTRIBUTIONSHIP***
Aidyn G. Salmanov: 0000-0002-4673-1154[A,C-,F]
Valerii V. Kostikov: 0009-0008-6716-4858[B- D, F]
Olena Lytvak: 0000 0001 5362 670X[B- D, F]
Oleksandr A. Voloshyn: 0000 0002- 6586- 5449[B-D, F]
Boleslav Lysenko: 0000-0003-4020-5337[B-D, F]
Tetiana Struk: 0009-0002-8784-1058[B-D, F]
Olga Gordiichuk: 0009-0003-6565-4195[B- D, F]


**CONFLICT OF INTEREST**
The Authors declare no conflict of interest.


**RECEIVED:** 02.02.2023
**ACCEPTED:** 27.06.2023



**ADDRESS FOR CORRESPONDENCE**
**Aidyn G. Salmanov**
Shupyk National Healthcare University of Ukraine
9 Dorohozhytska St., 04112 Kyiv, Ukraine
e-mail: mozsago@gmail.com




* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.