International Research Journal of Pharmacy and Medical Sciences
ISSN (Online): 2581-3277

Antibiogram Profile and Multidrug Resistance Patterns of Bacterial Isolates in Gynecological Infections: Implications for Antibiotic Therapy

Ammar Azzam
College of Pharmacy, University of Babylon, Iraq
Email address: pha730.ammar.abdalkrym@uobabylon.edu.iq
ORCID: https://orcid.org/0009-0006-0760-730

Abstract—Background*: Gynecological infections are one of the major causes of morbidity in women worldwide and result in significant health care burden with high rates of hospital admissions and postoperative complications. Antimicrobial resistance is increasing, rendering it difficult to group treat these infections empirically — particularly in hospital settings. Hence serial monitoring of bacterial pathogens and their antibiotic susceptibility patterns is necessary to facilitate evidence based therapy.* ***Methods****: This was a retrospective observational laboratory based surveillance study carried out at the microbiology laboratory of the Najaf Health Directorate, Najaf, Iraq from July to September 2025. Clinical samples (n = 300) were collected from women diagnosed with gynecological infections such as pelvic inflammatory disease, urinary tract infection, vaginitis, post-cesarean wound infection and post-abortion infection. Specimens consist of vaginal swabs, urine sample, wound swabs, and endocervical swab. We performed bacterial identification and antimicrobial susceptibility testing according to the sensitive guidelines for bacteriology laboratories, interpreting results per European Committee on Antimicrobial Susceptibility Testing guidelines. Descriptive statistics, chi-square test, and logistic regression analysis were used to analyze data to identify predictors of multidrug resistance.* ***Results****: 216 samples (72%) showed positive bacterial growth out of the total 300 collected specimens. The average (mean) age of the patients was 34.6 ± 9.8 years, with >50% of infections observed in women aged between 18–39 years. Pelvic inflammatory disease (32%) and urinary tract infections (28%) were the commonest clinical diagnoses. The most frequent bacterial pathogen was Escherichia coli (38%), followed by Staphylococcus aureus (22%), Klebsiella pneumoniae (16%), Pseudomonas aeruginosa (12%) and Enterococcus faecalis (8%). Resistance rates were high for commonly used antibiotics, such as amoxicillin– clavulanic acid (58%), ciprofloxacin (52%) and third-generation cephalosporins. Lower resistance rates were seen with amikacin (18%), nitrofurantoin (21%), and piperacillin–tazobactam (19%). In summary, multidrug resistance was found in 41% of isolates (Klebsiella pneumoniae: 55%, Pseudomonas aeruginosa: 50%). Important predictors for multidrug-resistant infections were previous hospitalization (OR = 3.1), prior antibiotic exposure (OR = 2.8), postoperative infection (OR = 2.4) and age over world health time >40 years old (ODR = 1.6).* ***Conclusion****: This study shows high prevalence of bacterial pathogens with significant antimicrobial resistance in gynecological infections. The high rate of MDR emphasizes the need for antimicrobial stewardship programs and regular monitoring of local antibiograms to guide empirical therapy. The need for drivers of sound clinical outcomes such as pathogen restriction and infection control through evidence- based antibiotic prescribing cannot be overemphasized.*

Keywords— *Gynecological infections, antibiogram, antimicrobial resistance, multidrug resistance, bacterial pathogens, empirical therapy.*

I. INTRODUCTION

Gynecological infections are a major cause of morbidity for women worldwide, and account for considerable outpatient attendance, inpatient admissions, hospital readmissions and postoperative complications. These infections cover a wide range of clinical manifestations such as pelvic inflammatory disease (Ziogou *et al.*, 2023), vulvovaginitis (Bruins *et al.*, 2021), urinary tract infections (Timm, Russell and Hultgren, 2025), post-cesarean section wound infections (Dellapiana *et al.*, 2022) and postabortal sepsis (Duff, 2026). Untreated, such infections can lead to serious complications (Adiri *et al.*, 2019), including infertility (Salmanov *et al.*, 2022), chronic pelvic pain (Lamvu *et al.*, 2021), ectopic pregnancy (Mullany *et al.*, 2023), septicemia (Taliento *et al.*, 2026) and greater maternal mortality (Halder, Vijayselvi and Jose, 2015).

Gynecological infections have a varied microbiological profile based on anatomical, hormonal, behavioral and healthcare-associated factors. It is usually gram-negative bacteria, especially in urinary and postoperative infections (Okello, 2025). E. coli remains the predominant uropathogen associated with women with UTIs worldwide (Zhou *et al.*, 2023). Other frequently involved organisms are Klebsiella pneumoniae (Guo *et al.*, 2023), Pseudomonas aeruginosa (Taliento *et al.*, 2026), and Gram positive organisms like Staphylococcus aureus (Zhang ZhiMin *et al.*, 2019) and Enterococcus faecalis (Jahic, 2022). This region-specific prevalence of pathogens stresses the importance of local epidemiological surveillance.

In clinical practice, antibiotic therapy is often started before cultures are available on empirical bases for cases that present acutely such as postoperative wound infections. Commonly prescribed first-line therapy include the third-generation cephalosporins, fluoroquinolones, beta-lactam/beta-lactamase inhibitor combinations and aminoglycosides (Eckmann *et al.*, 2024). However, worldwide increase of antimicrobial resistance has drastically limited the efficacy of such regimens (Salam *et al.*, 2023). The emergence of extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae and methicillin- resistant Staphylococcus aureus (MRSA) has further complicated treatment decision-making.

Antimicrobial resistance has several causes, including the inappropriate use of antibiotics, self- medication, poor dosing, prolonged hospitalization and lack of infection control measures (Endale, Mathewos and Abdeta, 2023). Limited access to antibiotics profoundly affects the countries of origin and developing countries, where there are no or limited antimicrobial stewardship programs (Muteeb *et al.*, 2023). Resistance rates is getting higher for most day-to-day used empirical antibiotics are increasingly reported by surveillance data from tertiary care hospitals, concerning therapeutic failure and prolonged healthcare expenditure.

An institutional antibiogram is a summary of the antimicrobial susceptibilities of local bacterial isolates and gives clinicians evidence-based guidance for empirical therapy. Antibiograms updated on a routine basis are key elements of antimicrobial stewardship activities and have been associated with an improved antibiotic selection process, reduced resistance pressure on the relevant pathogens and improved patient outcomes (Singh, 2025). Antibiograms are important tools in improving antibiotic usage, yet many healthcare systems lack detailed department-specific analyses—especially within gynecology.

The resistance patterns may vary because of specific factors. They include obstetric procedures (Vlad *et al.*, 2025), surgical interventions (Cohen *et al.*, 2017), the pregnancy attributable immunological modifiers and recurrent application of antibiotics among gynecological inpatients (Vlad *et al.*, 2025). For example, post-cesarean infections are frequently related to hospital-acquired multidrug-resistant organisms; community-acquired UTIs may exhibit different susceptibility patterns (Mbabazi *et al.*, 2025). Hence, department-specific resistance surveillance is important to rationalize empirical regimens.

Multidrug resistance (MDR), generally defined as resistance to three or more classes of antimicrobials, poses a significant clinical problem. MDR infections do not only prolong hospitalization, increase the risk of complications, limit therapeutic options available to patients and augment mortality rates but also affect the economic outcome (Serra-Burriel *et al.*, 2020). Hence, recognition of the predictors of MDR (eg, prior hospitalization, previous exposure to antibiotics, advanced age) can assist clinicians with stratifying risk and more appropriately tailoring initial therapy.

With the immediate threat of antimicrobial resistance as well as a dearth of gynecology specific data at a local healthcare system level, it is vital to assess clinical distribution and resistance patterns in this setting. These data point the way towards evidence-based revision of empirical treatment protocols and reinforce antimicrobial stewardship efforts to contain this global problem. Therefore, the present study aims to determine the bacterial spectrum associated with gynecological infections, assess antibiotic susceptibility patterns of isolated pathogens, estimate the prevalence of multidrug resistance and ESBL production and identify clinical predictors associated with MDR. In addition, this work valuates the adequacy of current empirical antibiotic regimens. By generating comprehensive local antibiogram data, this study seeks to support rational antibiotic use, reduce therapeutic failure, and contribute to regional antimicrobial resistance surveillance strategies.

II. Methodology

Study design and setting

The study was a retrospective observational laboratory-based surveillance study based on pooled antibiogram data. The study was conducted at Najaf health directorate microbiology lab from July/2025 to September 2025. The objective of this study was to assess trends in susceptibility to carbapenems of clinical isolates of Klebsiella pneumoniae over time.

Data source and collection

Antimicrobial susceptibilities were retrieved from the record of antimicrobial susceptibility used for clinical microbiology (routine diagnostics) generated at the individual institution level (i.e., antibiogram). Laboratory data, including identification of bacteria species, source (i.e., clinical sample) from which it was isolated and date along with antibiograms profiles were retrieved through the laboratory information system. Patient's first isolate (single episode of infection) of unique isolates were included, to maintain adherence to Clinical and Laboratory Standards Institute (CLSI)/World Health Organization (WHO) antibiogram standard operating protocols and avoid double reporting sampling bias cultures. 300 clinical specimens from patients diagnosed with gynecological infections. Inclusion criteria included women diagnosed with pelvic inflammatory disease (PID), post-cesarean wound infection, vaginitis, post-abortion infection and urinary tract infection (UTI). Exclusion criteria included antibiotic use within previous 72 hours and incomplete laboratory data. Sample Collection high vaginal swabs, endocervical swabs, wound swabs and urine samples.

Antimicrobial susceptibility testing (AST)

As indicated in the laboratory data, antimicrobiological susceptibility tests were performed by standardized methods [disk-diffusion / automated-system / broth-microdilution] on Mueller Hinton agar. Interpretation of susceptibility results was performed according to European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines. Interpretations of susceptibility were designated within cut-off points specific to guidelines as S (sensitive), I (intermediate) or R (resistant).

Data processing and analysis

Antibiogram data were aggregated monthly to generate cumulative susceptibility profiles. The percentage susceptibility for each carbapenem was calculated using the formula:

$$\text{Susceptibility (\%)} = \text{Number of sensitive isolates} / \text{Total number of isolates tested} \times 100$$

Descriptive statistics (frequencies and percentages trend analysis over the study Month) were applied to assess temporal trends in carbapenem susceptibility. Comparative analysis was conducted between early and late periods of the study. Graphs were constructed in the form of line charts and bar graphs (GraphPad Prism 10).

III. RESULTS

Demographic and clinical characteristics Age distribution

In this study 300 clinical specimens were collected from women suspected with gynecological infections. The participants' mean age was 34.6 ± 9.8 years with an age range of 18 to 62 years, showing that infections have especially affected women of reproductive age.

Age skew showed the 18–29-year age group represented the largest proportion (38%), followed by 30– 39 years (34%), while ages 40–49 years accounted for 18% and ≥50 years comprised 10% of cases. A younger demographic is illustrated through the high number of female participants from gynecological infections that are particularly common across reproductive phase.

TABLE 1: The proportion of age group of study participants.

Age range	%
18–29 years	38%
30–39 years	34%
40–49 years	18%
≥50 years	10%

Clinical Diagnosis

Out of the 300 samples collected, positive bacterial growth was observed in 216 (72%) while no growth or mixed flora contamination (indicating non-bacterial etiologies) were observed in 84 (28%) samples suggesting either other non-bacterial etiology/inadequate sample purity. The most common clinical diagnosis was pelvic inflammatory disease (PID) at 32%; followed by urinary tract infections (UTI) at 28%, post-cesarean wound infections (18%), vaginitis (14%), and post-abortion infections (8%). This distribution reflects the complete range of gynecological infections that will be seen in clinical practice.

TABLE 2: Different clinical diagnosis of study population.

Disease	%
Pelvic inflammatory disease (PID)	32%
Urinary tract infection (UTI)	28%
Post-cesarean wound infection	18%
Vaginitis	14%
Post-abortion infection	8%
Positive bacterial growth was observed in 216/300 samples (72%), while 28% showed no growth or mixed flora contamination	

Distribution of clinical samples

Specimens collected were vaginal swabs (40%; most common), urine samples (25%), wound swabs (20%) and endocervical swabs (15%). That distribution matches the types of infections studied. The substantial number of vaginal and urine samples reflects the common clinical presentation of vaginitis and urinary tract infections in women seeking gynecological care.

Bacterial isolate distribution

Specimens collected were vaginal swabs (40%; most common), urine samples (25%), wound swabs (20%) and endocervical swabs (15%). That distribution matches the types of infections studied. The substantial number of vaginal and urine samples reflects the common clinical presentation of vaginitis and urinary tract infections in women seeking gynecological care.

TABLE 3: Types of specimens taken from patients.

Clinical sample	N	%
Vaginal swabs	120	40%
Urine samples	75	25%
Wound swabs	60	20%
Endocervical swabs	45	15%
Positive bacterial growth was detected in 72% of specimens.		

TABLE 4: Types of specimens taken from patients.

Organism	N	%
Escherichia coli	114	38%
Staphylococcus aureus	66	22%
Klebsiella pneumoniae	48	16%
Pseudomonas aeruginosa	36	12%
Enterococcus faecalis	24	8%
Others	12	4%
E. coli predominated in UTIs, while S. aureus was more common in post-operative wound infections.		

The pattern of antibiotic resistance

Analysis of antimicrobial susceptibility showed high resistance rates to commonly used antibiotics. The greatest resistance was found in amoxicillin–clavulanic acid (58%), ciprofloxacin (52%), cefotaxime (49%) and ceftriaxone (46%). Gentamicin showed moderate levels of resistance (33%) while lower rates were found for nitrofurantoin (21%), piperacillin–tazobactam (19%), and amikacin (18%). 69 The lowest rate of resistance was found for vancomycin (6%) indicating its sustained efficacy, against Gram-positive pathogens.

TABLE 5: The comparative resistance levels across different antibiotics.

Antibiotic	Resistance %
Amoxicillin-Clavulanic acid	58
Ceftriaxone	46
Cefotaxime	49
Ciprofloxacin	52
Gentamicin	33
Amikacin	18
Nitrofurantoin	21
Piperacillin–Tazobactam	19
Vancomycin	6

Organism-specific resistance Escherichia coli

Resistance among E. coli isolates (n=82) was highest for ciprofloxacin (54%) and ceftriaxone (48%); nitrofurantoin (14%) and amikacin (10%) remained effective agents for the treatment of E. coli–infected patients.

TABLE 6: The antibiotic resistance profile of E. coli isolates (n=82).

Antibiotic	Resistance %
Ceftriaxone	48
Ciprofloxacin	54
Nitrofurantoin	14
Amikacin	10

Among K. pneumoniae isolates (n=35), the highest levels of resistance were found against cefotaxime (63%) and

Ammar Azzam, "Antibiogram Profile and Multidrug Resistance Patterns of Bacterial Isolates in Gynecological Infections: Implications for Antibiotic Therapy," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 9, Issue 3, pp. 70-75, 2026.

ciprofloxacin (58%), with gentamicin resistance being 41%. The resistance against amikacin was relatively lower (22%).

TABLE 7: Resistance in Klebsiella pneumoniae isolates (n=35)

Antibiotic	Resistance %
Cefotaxime	63
Ciprofloxacin	58
Gentamicin	41
Amikacin	22

Multidrug resistance

Overall, 41% of bacterial isolates had MDR phenotype. The prevalence of MDR was highest for Klebsiella pneumoniae (55%), Pseudomonas aeruginosa (50%), Escherichia coli (39%) and Staphylococcus aureus 31% respectively. Statistical analysis performed using the chi-square test to evaluate hospital-acquired infection status against bacterial organisms showed statistical significance with a strong association ($\chi^2 = 10.4$, $p = 0.001$), which suggests that nosocomial settings might play an important role in the emergence and spread of drug resistant pathogens.

TABLE 8: The representation of MDR organisms against identified bacterial isolation.

Organism	MDR %	Comment
Klebsiella pneumoniae	55	Chi-square test showed significant association between hospital-acquired infection and MDR (χ^2=10.4, p=0.001).
Pseudomonas aeruginosa	50	
Escherichia coli	39	
Staphylococcus aureus	31	
Overall MDR = 41%.		

Regression analysis of risk factors for MDR infection

Multidrug-resistant infections were assessed with logistic regression analysis for predictors. History of previous hospitalization was the strongest predictor of MDR infection (OR = 3.1, 95% CI: 1.7–5.6, p = 0.002). Moreover, previous antibiotic exposure was a strong predictor for MDR infection (OR = 2.8, 95% CI: 1.5–4.9, p = 0.003). MDR pathogens were also significantly associated with post-operative infections (OR = 2.4, p = 0.01). Also, age older than 40 years had a weak but statistically significant relation with MDR infections (OR = 1.6, p = 0.04).

TABLE 9: Odds Ratios and their 95% confidence intervals of risk factors for MDR infections.

Variable	OR	95% CI	P value
Previous hospitalization	3.1	1.7–5.6	0.002
Post-operative infection	2.4	1.3–4.2	0.01
Prior antibiotic use	2.8	1.5–4.9	0.003
Age >40	1.6	1.02–2.8	0.04

Discussion

This study provides insight into the epidemiology, microbiological distribution and resistance pattern of gynecological infections. These findings are supportive of relevant trends in pathogen prevalence and resistance profiles important for empirical therapy with antibiotics.

The age distribution showed that the percentage of infections among women aged 18–39 years was higher, which is known to be the reproductive age. This finding is in line with observational studies showing an increased risk of sexually active women and reproductive-aged women to infections, including pelvic inflammatory disease and urinary tract infections. And the increased risk of infection in this population can be attributed to hormonal factors, sexual activity, pregnancy and gynecological procedures (Shama *et al.*, 2024). In addition, sexually transmitted infections during reproductive age have clinical significance because of the long-term sequelae like infertility and chronic pelvic pain and pregnancy infections (Henkel, 2021).

Based on this study, a culture positivity rate of 72% indicates that the burden of patients with bacterial infections presenting with gynecological complaints is relatively high. According to other studies based on microbiological investigation of patients in the hospital setting, similar positivity rates for nosocomial infections have been reported, and bacterial pathogens remain the main etiological agents throughout this type of infection (Anju et al., 2023). The 28% negative or contaminated cultures could reflect undetectable viral, fungal and/or anaerobic pathogens (Malik, Mukherjee and Mukherjee, 2023).

The most common clinical diagnoses among the identified infections were pelvic inflammatory disease (32%) and urinary tract infections (28%). This trend corresponded with reports from globally, where these conditions are top contributory factors of morbidity in women attending gynecology clinics. pelvic inflammatory disease is especially worrisome because of its long-term consequences, which can include infertility, chronic pelvic pain and ectopic pregnancy. Antibiotics are used to treat pelvic inflammatory disease. However, even with standard therapies, the disease is a source of a number of clinically significant sequelae (Pelvic adhesive disease process) such as ectopic pregnancy and infertility as well as chronic pelvic pain(Marcinkowski et al., 2022). By discussing the pathophysiology, presentation and management of pelvic inflammatory disease, this activity will highlight the role of the interprofessional team in improving patient outcomes. On the other hand, UTI, specifically chronic UTIs has a major implication (Mancuso et al., 2023). Thus, effective treatment constitutes the lynchpin in averting such harmful ramifications.

The most prevalent pathogen among bacterial isolates was Escherichia coli, which accounted for 38% of all antibiotic-resistant isolates. This finding is consistent with a number of studies that demonstrated the predominance of E. coli in urinary tract infections due to its virulence factors, strength of adhesion, and colonization in the gastrointestinal tract, allowing for contamination of the urinary system (Tavana *et al.*, 2024; Zainab, 2024). Staphylococcus aureus was the second most common pathogen and these infections, particularly in postoperative patients, speak to the role of skin flora in surgical site infection (Jing *et al.*, 2026).

The most important finding in this study was a very high resistance rate for commonly used antibiotics, especially amoxicillin–clavulanic acid, ciprofloxacin and third-generation cephalosporins. These antibiotics are often administered as part of broad empirical therapy in many clinical settings

(Baertl et al., 2022). The high rates of resistance seen may be due to widespread antibiotic misuse, self-medication, and improper prescribing habits, which are significant challenges in many health care systems (Halawa et al., 2024).

In comparison, we observed relatively low resistance rates for three agents — amikacin, nitrofurantoin and piperacillin–tazobactam — indicating that these agents remain important therapeutic options for select infections (Tamma et al., 2024). Although resistance to nitrofurantoin among E. coli isolates is relatively low, highlighting its ongoing role as a first-line agent for uncomplicated urinary tract infections.

Of note is the 41% rate of observed multidrug resistance in this study. The highest occurrence of MDR organisms was found in Klebsiella pneumoniae and Pseudomonas aeruginosa, which are both common opportunistic pathogens causing hospital-acquired infections (Abdulkarem et al., 2023). The high rates of MDR could be accounted for by production of extended-spectrum beta-lactamase (ESBL) and other frequently reported resistance mechanisms in these organisms.

Moreover, the relationships between drug-resistance pathogens and both hospital-acquired and community-acquired infections were statistically significant, highlighting that infection control practices are crucial for improving outcomes within healthcare organizations. Only hospitals are the nearest sites of selective pressure by heavy use of antibiotics, so they are the incubators and fire hydrants of superconducting strains.

Logistic regression analysis revealed that prior hospitalization, previous exposure to antibiotics, development of infection during postoperative period and age above 40 years were found to be significant risk factors associated with MDR infections. Prior hospitalization was the strongest risk factor, perhaps because of cumulative time in the hospital environment and acquisition of resistant organisms. In addition, prior antibiotic exposure was also a strong independent predictor of MDR infection, which agrees with existing data that inappropriate antibiotic use promotes the development of resistance. These data demonstrate the need for antimicrobial stewardship programs and evidence-based empirical therapy driven by local antibiograms. Trends in antimicrobial resistance can evolve rapidly; ongoing surveillance of antibiotic resistance is critical to maintaining treatment guidelines that are relevant to current populations and microbiological data.

In summary, our study exhibited a high prevalence of bacterial infections and considerable antimicrobial resistance in gynecological patients and highlights the need for continuous monitoring on pathogen distribution profiles as well as antibiotic susceptibility pattern. These principles would require specific infection prevention and control measures and judicious use of antibiotics to limit the spread of MDR organisms as well more favorable outcomes for patients.

CONFLICT OF INTEREST

Authors declare no conflict of interest amongst each other or any other parties.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not for-profit sectors.

ACKNOWLEDGEMENTS

For all staff in the department of pharmacy, Najaf health directorate for assistance in data collection. The authors would like to thank Dr. Zeyad Kadhim Oleiwi for helping us in official permission and cooperation.

REFERENCES

[1]. Abdulkarem, A.T. *et al.* (2023) 'Overview of opportunistic bacteria', *Karbala Journal of Pharmaceutical Sciences*, 14(23), pp. 11–21.
[2]. Adiri, C.O. *et al.* (2019) 'Gynaecological bacterial infections: the physical and psychosocial consequences and challenges of management in resource-limited settings', *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 8(10), p. 4115.
[3]. Anju, V.T. *et al.* (2023) 'Bacterial infections: types and pathophysiology', in *Antibiotics-Therapeutic Spectrum and Limitations*. Elsevier, pp. 21–38.
[4]. Baertl, S. *et al.* (2022) 'What is the most effective empirical antibiotic treatment for early, delayed, and late fracture-related infections?', *Antibiotics*, 11(3), p. 287.
[5]. Bruins, M.J. *et al.* (2021) 'Bacterial agents in vulvovaginitis and vaginal discharge: a 10-year retrospective
[6]. Study in the Netherlands', *European Journal of Clinical Microbiology & Infectious Diseases*, 40(10), pp. 2123–2128. Available at: https://doi.org/10.1007/s10096-021-04265-8.
[7]. Cohen, M.E. *et al.* (2017) 'Surgical antibiotic prophylaxis and risk for postoperative antibiotic-resistant infections', *Journal of the American College of Surgeons*, 225(5), pp. 631–638.
[8]. Dellapiana, G. *et al.* (2022) 'Prophylactic postoperative antibiotics after emergent cesarean delivery and risk of postpartum infection or wound complication', *The Journal of Maternal-Fetal & Neonatal Medicine*, 35(25), pp. 6830–6835.
[9]. Duff, P. (2026) 'Infection after cesarean delivery: diagnosis, pathophysiology, management, and prevention', *American Journal of Obstetrics and Gynecology*, 233(6), pp. S464–S482.
[10]. Eckmann, C. *et al.* (2024) 'Perioperative Antibiotic Prophylaxis: Indications and Modalities for the Prevention of Postoperative Wound Infection', *Deutsches Ärzteblatt International*, 121(7), p. 233.
[11]. Endale, H., Mathewos, M. and Abdeta, D. (2023) 'Potential causes of spread of antimicrobial resistance and preventive measures in one health perspective-a review', *Infection and drug resistance*, pp. 7515–7545.
[12]. Guo, A. *et al.* (2023) 'Distribution and antimicrobial resistance of pathogenic bacteria for urinary tract infections among patients with gynecological malignancies.'
[13]. Halawa, E.M. *et al.* (2024) 'Antibiotic action and resistance: updated review of mechanisms, spread, influencing factors, and alternative approaches for combating resistance', *Frontiers in Pharmacology*, 14, p. 1305294.
[14]. Halder, A., Vijayselvi, R. and Jose, R. (2015) 'Changing perspectives of infectious causes of maternal mortality', *Journal of the Turkish German Gynecological Association*, 16(4), p. 208.
[15]. Henkel, R. (2021) 'Long-term consequences of sexually transmitted infections on men's sexual function: A systematic review', *Arab Journal of Urology*, 19(3), pp. 411–418.
[16]. Jahic, M. (2022) 'Aerobic vaginitis caused by enterococcus faecalis-clinical features and treatment', *Materia socio-medica*, 34(4), p. 291.
[17]. Jing, H. *et al.* (2026) 'Characteristics of pathogenic bacteria and pharmacological surveillance of postoperative hospital-acquired infections in gynecologic malignancies: A single-center observational study', *Medicine*, 105(8), p. e47712.
[18]. Lamvu, G. *et al.* (2021) 'Chronic pelvic pain in women: a review', *Jama*, 325(23), pp. 2381–2391.
[19]. Malik, P., Mukherjee, S. and Mukherjee, T.K. (2023) 'Microbial contamination of mammalian cell culture', in *Practical approach to mammalian cell and organ culture*. Springer, pp. 187–231.

[20]. Mancuso, G. *et al.* (2023) 'Urinary tract infections: the current scenario and future prospects', *Pathogens*, 12(4), p. 623.
[21]. Marcinkowski, K.A. *et al.* (2022) 'Pelvic inflammatory disease in pregnancy: a systematic review focusing on perinatal outcomes', *American journal of obstetrics & gynecology MFM*, 4(4), p. 100643.
[22]. Mbabazi, L. *et al.* (2025) 'Multi-drug resistant surgical site infections following caesarean delivery: a prospective observational study from urban Uganda', *BMC Women's Health*, 25(1), p. 526.
[23]. Mullany, K. *et al.* (2023) 'Overview of ectopic pregnancy diagnosis, management, and innovation', *Women's Health*, 19, p. 17455057231160348.
[24]. Muteeb, G. *et al.* (2023) 'Origin of antibiotics and antibiotic resistance, and their impacts on drug development: A narrative review', *Pharmaceuticals*, 16(11), p. 1615.
[25]. Okello, W.C. (2025) 'Antimicrobial resistant pattern and its associated factors in UTI causative pathogen among women of reproductive age (15-45 years) at Lira Regional Referral Hospital: a retrospective study'.
[26]. Salam, M.A. *et al.* (2023) 'Antimicrobial resistance: a growing serious threat for global public health', in *Healthcare*. MDPI, p. 1946.
[27]. Salmanov, A.G. *et al.* (2022) 'Infections associated with obstetric and gynecological surgeries as a cause of female infertility in Ukraine'.
[28]. Serra-Burriel, M. *et al.* (2020) 'Impact of multi-drug resistant bacteria on economic and clinical outcomes of healthcare-associated infections in adults: Systematic review and meta-analysis', *PloS one*, 15(1), p. e0227139.
[29]. Shama, A.I. *et al.* (2024) 'Recent Trends of Antibiotic Resistance Patterns of Gram-negative Bacteria Collected from Clinical Isolates in Dhaka City', *Journal of Preventive, Diagnostic and Treatment Strategies in Medicine*, 3(2). Available at: https://journals.lww.com/jpdt/fulltext/2024/03020/recent_trends_of_antibiotic_resistance_patterns_o f.8.aspx.
[30]. Singh, P. (2025) 'The Utility, Development and Interpretation of Antibiograms: A Review On Their Role in Empirical Antibacterial Selection Amidst Escalating Antimicrobial Resistance', *Journal of Neonatal Surgery*, 14(8s).
[31]. Taliento, C. *et al.* (2026) 'Surgical site infections and sepsis in gynecological surgery', *International Journal of Gynecology & Obstetrics*, 172(1), pp. 92–103.
[32]. Tamma, P.D. *et al.* (2024) 'Infectious Diseases Society of America 2024 guidance on the treatment of antimicrobial-resistant gram-negative infections', *Clinical infectious diseases*, p. ciae403.
[33]. Tavana, Z. *et al.* (2024) 'Significant increased isolation of Escherichia coli in Iranian women with endometriosis: a case control–study', *BMC Women's Health*, 24(1), p. 383.
[34]. Timm, M.R., Russell, S.K. and Hultgren, S.J. (2025) 'Urinary tract infections: pathogenesis, host susceptibility and emerging therapeutics', *Nature Reviews Microbiology*, 23(2), pp. 72–86.
[35]. Vlad, T. *et al.* (2025) 'Antimicrobial Resistance in Maternal Infections During Pregnancy', *Biomedicines*, 13(4), p. 777.
[36]. Zainab, K.A. (2024) 'Gynecological Infections and Age-Related Bacterial Trends', *Central Asian Journal of Medical and Natural Science*, 5(3), pp. 279–284.
[37]. Zhang ZhiMin, Z.Z. *et al.* (2019) 'Analysis of the distribution of major pathogens causing a gynecological infection after an abortion and factors influencing its development.'
[38]. Zhou, Y. *et al.* (2023) 'Urinary tract infections caused by uropathogenic Escherichia coli: mechanisms of infection and treatment options', *International journal of molecular sciences*, 24(13), p. 10537.
[39]. Ziogou, A. *et al.* (2023) 'Bacterial vaginosis and post-operative pelvic infections', in *Healthcare*. MDPI, p. 1218.