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Pelvic infections with intrauterine device: microbiological profile and clinical significance

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Intrauterine devices (IUDs) are widely used long-acting method of reversible contraception which has a high efficacy and safety. Around the world, about 22.8% of women use IUDs for birth control. However, the use of these devices is highly associated with an increased risk of pelvic inflammatory diseases, potentially leading to significant health complications.
The objective: **to identify the prevalence of bacterial microorganisms in endocervical swabs from women using IUDs and assess the antibiotic sensitivity profiles of these isolates.**
Materials and methods**. This research is a cross-sectional study starting from June 2022 and ending in June 2024. Both written and verbal consents of 162 women aged 18–48 years who used IUDs as a contraceptive method and attended the private gynecology clinic and Al-Zahrawi hospital in Mosul city, Iraq were provided. Endocervical vaginal swabs were taken and diagnosed by Gram staining method, biochemical testing, and the VITEK 2 system for bacterial identification. Antibiotic sensitivity was assessed using automated methods.**
Results**. Among the 162 participants, 90 (55.56%) women had negative culture results, while 72 (44.44%) patients had positive results. *Escherichia coli* was the predominant microorganism (17.28%), followed by *Klebsiella* spp. (6.79%) and *Staphylococcus aureus* (7.41%). Antibiotic sensitivity test has revealed that meropenem, imipenem, levofloxacin, and colistin were the most effective medications, showing 100% sensitivity. Other antibiotics, including amikacin and ampicillin, displayed high resistance rates (66.67% and 70.83%, respectively). Clinical features like dyspareunia, vaginal discharge, and pelvic pain were significantly associated with positive cultures ($p < 0.05$).**
Conclusions**. The study highlights a substantial prevalence of bacterial infections among women who use IUDs, with *Escherichia coli* as the leading pathogen. Carbapenems (imipenem and meropenem) showed the highest efficacy, suggesting their suitability for treating such infections. Regular monitoring and appropriate antibiotic treatment are recommended to manage IUD-associated infections effectively.**
Keywords: *intrauterine device, bacterial isolates, antibiotic sensitivity, pelvic inflammatory disease, endocervical swabs.*

Запальні захворювання органів малого таза на тлі використання внутрішньоматкової спіралі: мікробіологічний профіль та клінічне значення

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Внутрішньоматкові спіралі (ВМС) є одним із найбільш поширених методів контрацепції тривалої дії, що характеризується високою ефективністю та безпекою. У світі близько 22,8% жінок, які не планують вагітність на певному етапі життя, надають перевагу ВМС як методу контрацепції. Однак використання цих пристроїв значною мірою асоціюється з підвищеним ризиком запальних захворювань органів малого таза, що потенційно може призвести до серйозних ускладнень для здоров'я.
Мета дослідження: виявлення поширеності бактеріальних мікроорганізмів в ендоцервікальних мазках жінок, які використовують ВМС, та оцінка профілю їхньої чутливості до антибіотиків.
Матеріали та методи. Це перехресне дослідження проведене в період із червня 2022 р. по червень 2024 р. Письмову та усну згоду на участь у дослідженні надали 162 жінки віком 18–48 років, які зверталися до приватної гінекологічної клініки та лікарні Аль-Захраві в місті Мосул (Ірак) і використовували ВМС як метод контрацепції. Ендоцервікальні мазки досліджені за допомогою методу фарбування за Грамом, біохімічного тестування та системи VITEK 2 для ідентифікації бактерій. Чутливість до антибіотиків оцінювали автоматизованими методами.
Результати. Серед 162 учасниць дослідження у 90 (55,56%) жінок зафіксовано негативні результати посіву, тоді як у 72 (44,44%) жінок були позитивні результати. *Escherichia coli* була найпоширенішим виявленим мікроорганізмом (17,28%), за нею – *Klebsiella* spp. (6,79%) та *Staphylococcus aureus* (7,41%). Тест на чутливість до антибіотиків засвідчив, що найвищу ефективність продемонстрували меропенем, іміпенем, левофлоксацин і колістин зі 100% чутливістю. Інші антибіотики, включно з амікацином та ампіциліном, виявили високий рівень резистентності (66,67% і 70,83% відповідно). Такі клінічні ознаки, як диспареунія, вагінальні виділення та тазовий біль, мали статистично значущий зв'язок із виявленням позитивних культур ($p < 0,05$).
Висновки. Дослідження підкреслює значну поширеність бактеріальних інфекцій, серед яких провідним патогеном є *Escherichia coli* у жінок, які використовують ВМС. Найвища чутливість із боку мікроорганізмів була виявлена до карбапенемів (іміпенем і меропенем), що свідчить про їхню ефективність у лікуванні подібних інфекцій. Для ефективного лікування інфекцій, пов'язаних із використанням ВМС, рекомендуються регулярний моніторинг та відповідна антибактеріальна терапія.
Ключові слова: *внутрішньоматкова спіраль, бактеріальні ізоляти, чутливість до антибіотиків, запальні захворювання органів малого таза, ендоцервікальні мазки.*

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Intrauterine contraceptive device (IUCD) or simply known as coil, is a small birth controlling method. It usually has T shape form, and it is put into the uterus to prevent pregnancy [1]. The intrauterine device (IUD) is the most popular mean with long-acting and reversible effect to birth control. It is known for being safe, effective, easy to use contraceptive method, and it is inexpensive. Although IUD may have failure rate of about 0.5–0.8%. It's not dependent on patient compliance [2]. Around the world, about 22.8% of women seeking for birth control prefer using IUD, significantly varies with geographic, governmental policies, and the level of education among healthcare workers rather than medical qualifying requirements [3]. Copper (Cu) loaded IUD is locally acting as a contraception by enhancing sterile inflammation within the uterine endometrium making it hostile for implantation of the fertilized ovum, in addition to the spermicidal action of Cu-loaded in the device [2]. Levonorgestrel intrauterine system causes progressive atrophy of the endometrium for prevention of implantation, this will add further benefit in the treatment of heavy menstrual bleeding in addition to its contraceptive features [4]. As any contraception it's not out of complications like perforation, expulsion, disturbance of menstrual pattern and infection [5]. Infection of the female upper genital tract is called pelvic infection, that's common among women using IUCDs. Infection ascends from the vagina and endocervix can progress to endometritis, salpingitis, tubo-ovarian abscess, parametritis, oophoritis, and/or pelvic peritonitis [1]. The main implicated organisms are the sexually transmitted *Chlamydia trachomatis (C. trachomatis)* and *Neisseria gonorrhoeae (N. gonorrhoeae)* as well as microorganisms such as *Haemophilus influenzae*, *Gardnerella vaginalis,* and gram-negative rods in intestine, *Ureaplasma urealyticum* and *Streptococcus* [2]. There are different mycoplasmas that can live in the human genital tract. These include *Mycoplasma hominis*, which is also known as classical or big colony-forming mycoplasma, and *T. Mycoplasma* ("T" for tiny) because it grows in very small groups [5]. It has been shown that these organisms may invade the lower and upper female genital tract causing inflammation and altered vaginal discharges, abdominal pain, dyspareunia, abnormal vaginal bleeding with constitutional symptoms like fever, malaise [3]. On the other hand, these organisms are said to cause nongonococcal urethritis in adult men, they have also been linked to stillbirths, abortions, low birth weight, preterm birth and puerperal sepsis [5]. Pelvic infection has great implications effecting woman health since it happens so often and can cause infertility, ectopic pregnancy, pelvic adhesion, chronic pelvic pain, and pelvic abscesses [6]. The most susceptible women to pelvic infection are young, sexually active persons who have had no children, women who are using contraceptive devices, smoking and have lower income commonly develop pelvic infection as well [1, 7]. Diagnosis usually made by history and clinical examination, high vaginal and endocervical swab, nucleic acid amplification, test of the blood and ultrasound examination of pelvis to exclude other causes of abdominal pain [5]. Pelvic infections are treated with antibiotics that should affect both *C. trachomatis* and *N. gonorrhoeae* as well as other suspected anaerobic microorganisms for two weeks. Partner notification and treatment is vital to break the cycle of infection followed by test of cure for both partners [6].

The objective: to find out the prevalence of bacterial microorganism causative agents in women using IUCDs as a contraception, relaying on the endocervical swabs taken from them.

MATERIALS AND METHODS

Study design. This study designed as cross-sectional study conducted from 01.06.2022 to 01.06.2024. The study sample consisted of 162 women aged between 18 and 48 years. Purposive sampling was employed, with participants recruited from private gynecological clinics and Al-Zahrawi hospital in Mosul city, Iraq. Participants used IUD for contraceptive purposes, visited gynecology clinics for follow up and presented with various gynecological symptoms like altered vaginal discharges, lower abdominal pain, and constitutional symptoms. Their past gynecological history was negative for any other gynecological disease like fibroid, ovarian cyst and adenomyosis. Data collection was facilitated using a structured questionnaire.

Sample collection. All participant underwent a pelvic examination, and endocervical swabs were obtained by a sterile, unlubricated speculum inserted into the vagina. Samples from the endocervical area were collected using sterile cotton swabs. Care was taken to avoid contamination from gut flora and vulvar regions. Specimens were labelled, collected and transported using Amies transport media, with a maximum transport time of 30 minutes. For detection of deoxyribonucleic acid of *C. trachomatis* and *N. gonorrhoeae*, swab was sent using "Digene" in addition to Gram stain, culture in blood agar. Microbiological study was performed at the central Al-Mansour Laboratory of Microbiology.

Inclusion criteria: women in reproductive age (18–48 years) who have used either Cu or hormonal IUDs for contraceptive purpose for more than 30 days.

Exclusion criteria:

- Women using contraceptive methods other than IUD.
- Women who have taken antibiotics within the previous two weeks.
- Women presented with vaginal bleeding due to any cause.
- Women diagnosed with autoimmune diseases, chronic administration of immunosuppressive therapy, or undergoing cancer treating chemotherapy.

Ethical approval. This study, in compliance to the ethical principles outlined in the Helsinki Declaration, has obtained the ethical approval from the local ethics committee (document number 584, dated 18 October 2023). Verbal and written consent were granted by each participant prior to sample collection (Appendix).

Sample processing

Diagnosis of the isolates. Colonies, who have been grown on various media, were isolated, purified, and diagnosed. This involving the sub culturing isolated colonies onto fresh agar plates to ensure purity. Each colony was then subjected to gram staining and a series of biochemical tests. The bacteria isolated were diagnosed by the VITEK 2 system, general primers GP5/GP6 and the Hybrid Capture 2 (HC2) system.

Gram staining. A single overnight-grown colony was transferred using a sterile loop onto a clean slide and a drop of distilled water was added. The smear was heat-fixed, air-dried, and then stained with Crystal Violet stain for 1 minute, followed by iodine solution for 2 minutes. After washing with water and decolorizing with ethanol, the smear was counterstained with safranin, dried, and examined under a light microscope with an oil immersion lens to observe bacterial morphology and cell characteristics.

Biochemical tests. The biochemical profile of isolates was determined by testing their ability to ferment sugars, glycosides, and polyhydric alcohols, which is essential for differentiating Enterobacteriaceae and other medically important bacteria. The tests included pH changes in media and gas production. Rapid identification kits and automated systems were used in the laboratory for efficient processing and identification.

Confirmatory diagnosis using VITEK 2 compact system. Principle. The VITEK 2 system (an automated microbiology system) which relies on growth detection was available in three formats (VITEK 2 COMPACT, VITEK 2, and VITEK 2 XL), to automate the identification and the susceptibility testing of microorganisms collected. The system utilizes colorimetric reagent cards which are incubated and automatically interpreted, providing faster results and reducing manual operations. The system includes both a filler/sealer, an incubator/reader and a computer connected to the printer, with capacities ranging from 32 to 480 cards.

Statistical analysis. For the analyses of data, we have used IBM SPSS software version 23.1. The chi-square (χ^2) test was employed for comparison between groups. Significant difference was at the level $p < 0.05$.

Table 1

General parameters of women used IUDs as contraception (n = 162)

General properties of women used IUDs		n (%)
Age (years)	< 30	44 (27.16)
	> 40	20 (12.35)
	30–40	98 (60.49)
	Total	162 (100.00)
Type of IUD	Cu	128 (79.01)
	Hormonal	34 (20.99)
	Total	162 (100.00)
Duration, years	< 1	30 (18.52)
	> 6	13 (8.02)
	1–2	53 (32.72)
	3–4	31 (19.14)
	5–6	35 (21.60)
	Total	162 (100.00)
Residency	Rural	9 (5.56)
	Urban	153 (94.44)
	Total	162 (100.00)
Occupation	Employee	26 (16.05)
	Housewife	136 (83.95)
Diabetic	No	154 (95.06)
	Yes	8 (4.94)
Hypertension	No	153 (94.44)
	Yes	9 (5.56)
Weight	Normal	137 (84.57)
	Obesity	5 (3.08)
	Overweight	20 (12.35)

RESULTS AND DISCUSSION

Among 162 women included in this study, the majority of them were between 30 and 40 years, representing 98 (60.49%) of the sample (Table 1). Cu-IUDs were the most commonly used, chosen by 128 (79.01%) of the women. IUDs were being used for 1 to 2 years by 53 (32.72%) women. The vast majority of participants resided in urban areas 153 (94.44%). A large proportion were housewives (136 (83.95%)), and 154 (95.06%) of the women were non-diabetic, and 153 (94.44%) were free from hypertension. In terms of body weight, 137 (84.57%) had a normal weight.

Overall, a notable portion of women using IUDs reported discomfort, particularly in terms of dyspareunia – 105 (64.81%) participants, and vaginal discharge, followed by abnormal vaginal discharge – 66 (40.74%) women, and pelvic pain, noted by 61 (37.65%) women (Table 2). Vaginal itching affected 55 (33.95%) of the participants, while burning was reported by 56 (34.57%). Fever was the least common symptom, only 43 (26.54%) of the women experiencing it.

The bacteriological findings from the study indicate that, out of the 162 samples, 90 (55.56%) showed no bacterial growth, while 72 (44.44%) were culture-positive. Among the bacterial isolates, *Escherichia coli (E. coli)* was found to be the most common (28 women (17.28%)). This distribution highlights *E. coli* as the predominant bacterial isolate among the positive cultures, with a substantial portion of the samples showing no bacterial growth as in Table 3.

Table 2

Associated clinical features women used IUDs (n = 162)

Clinical features		n (%)
Burning	No	106 (65.43)
	Yes	56 (34.57)
Abnormal vaginal discharge	No	96 (59.26)
	Yes	66 (40.74)
Vaginal dyspareunia	No	57 (35.19)
	Yes	105 (64.81)
Fever	No	119 (73.46)
	Yes	43 (26.54)
Vaginal itching	No	107 (66.05)
	Yes	55 (33.95)
Pelvic pain	No	101 (62.35)
	Yes	61 (37.65)

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Table 3

The bacteriological findings of cervical culture of women used IUDs (n = 162)

Bacteriological finding		n (%)
Culture result	Negative	90 (55.56)
	Positive	72 (44.44)
	Total	162 (100.00)
Bacterial isolates	*E. coli*	28 (17.28)
	Klebsiella spp.	11 (6.79)
	Proteus mirabilis	6 (3.70)
	Enterococcus faecalis	6 (3.70)
	Staphylococcus aureus	12 (7.41)
	Staphylococcus epidermidis	5 (3.09)
	No growth	94 (58.02)

The analysis of factors which are associated with positive culture results in women using IUDs reveals notable associations with presence of clinical features had significantly higher rates of positive culture results, all with p-values below 0.05 (Table 4). The type of IUD (Cu vs hormonal) showed no significant difference in culture results ($p > 0.05$). Similarly, factors like residency, occupation, diabetes status, and hypertension status did not significantly impact the culture results. Interestingly, the duration of IUD use showed variability, with higher culture positivity among those who had used an IUD for less than 1 year (25.00%) or between 1 and 2 years (45.59%).

The overall antibiotic sensitivity results for women with positive cervical culture highlight that imipenem, meropenem, levofloxacin, and colistin demonstrated the highest efficacy, with 100% sensitivity (72 out of 72 women) and no resistance, while amikacin and ampicillin

Table 4

Factors associated with positive culture results in women using IUDs (n = 162)

Factors	Category	Subcategory	Negative, n (%)	Positive, n (%)	p-value
Clinical features	Burning	No	80 (85.11)	26 (38.24)	< 0.05
		Yes	14 (14.89)	42 (61.76)	
	Abnormal vaginal discharge	No	82 (87.23)	14 (20.59)	< 0.05
		Yes	12 (12.77)	54 (79.41)	
	Vaginal dyspareunia	No	46 (48.94)	11 (16.18)	< 0.05
		Yes	48 (51.06)	57 (83.82)	
	Fever	No	76 (80.85)	43 (63.24)	< 0.05
		Yes	18 (19.15)	25 (36.76)	
	Vaginal itching	No	90 (95.74)	17 (25.00)	< 0.05
		Yes	4 (4.26)	51 (75.00)	
	Pelvic pain	No	90 (95.74)	11 (16.18)	< 0.05
		Yes	4 (4.26)	57 (83.82)	
Type of IUD		Cu	74 (78.72)	54 (79.41)	> 0.05
		Hormonal	20 (21.28)	14 (20.59)	
Duration of IUDs using, years		< 1	13 (13.83)	17 (25.00)	< 0.05
		> 6	12 (12.77)	1 (1.47)	
		1–2	22 (23.40)	31 (45.59)	
		3–4	20 (21.28)	11 (16.18)	
		5–6	27 (28.72)	8 (11.76)	
Residency		Rural	2 (2.13)	7 (10.29)	> 0.05
		Urban	92 (97.87)	61 (89.71)	
Occupation		Employee	17 (18.09)	9 (13.24)	> 0.05
		Housewife	77 (81.91)	59 (86.76)	
Diabetic		No	89 (94.68)	65 (95.59)	> 0.05
		Yes	5 (5.32)	3 (4.41)	
Hypertension		No	87 (92.55)	66 (97.06)	> 0.05
		Yes	7 (7.45)	2 (2.94)	
Obesity		Normal	74 (78.72)	63 (92.65)	> 0.05
		Obesity	4 (4.26)	1 (1.47)	
		Overweight	16 (17.02)	4 (5.88)	

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exhibited the lowest sensitivity rates, with only 34.25% and 28.77% respectively, and higher resistance rates of 65.75% and 71.23% (Table 5).

Vaginal dyspareunia was the most prevalent IUD-related symptom, reported by 105 (64.81%) women. After then, 66 (40.74%) participants complained abnormal vaginal discharge and 61 (37.65%) had pelvic discomfort. 55 (33.95%) women felt vaginal itching, while 56 (34.57%) participants reported burning. Fever was the least prevalent symptom, affecting 43 (26.54%) women. Many women utilizing IUDs experienced pain, notably dyspareunia and vaginal discharge, underscoring the necessity for regular follow-up.

Of the 162 samples tested, 90 (55.56%) exhibited no bacterial growth and 72 (44.44%) were culture-positive. *E. coli* was the most prevalent bacterial isolate, reported in 28 (17.28%) samples. *Klebsiella* spp. was found in 11 (6.79%), followed by *Proteus mirabilis* and *Enterococcus faecalis* is in 6 (3.70%) women. *Staphylococcus aureus* was identified in 12 (7.41%) participants instances and *Staphylococcus epidermidis* in 5 (3.09%). This distribution shows *E. coli* as the most common bacterial isolate in positive cultures, with many samples exhibiting no growth (Table 2). Irrespective of the IUD type employed, this number aligns with the findings of B. P. Brown et al., which indicated that 34% of women with Cu-IUDs and an equivalent percentage of women with hormonal IUDs exhibited positive lateral vaginal wall swab cultures [1]. In a separate research conducted by B. C. Oranye et al., studies indicated that individuals with Cu-IUDs exhibited a greater risk (33.3%) of vaginal infections compared to the hormonal IUDs group (5.3%) [2]. The results can be elucidated by several prior studies that have investigated the changes the IUDs induce on the vaginal microbiota; one research even linked the tail and string of IUDs to the transfer of pathogenic bacteria and the subsequent involvement in ascending infections [2–4]. A second study was conducted to find out the underling relation between infection and the mechanism of action. This study has noticed that the IUD induces an inflammatory response disrupt fertilization. Concurrently, the IUD is regarded as a foreign device or catheter, thereby contributing to the development of infections associated with foreign bodies. In contrast to our findings, A. D. Saidu et al. reported divergent data, indicating that among women utilizing various contraceptive methods, 7 (20%) of those with Cu-IUDs and 3 (8.6%) women with hormonal IUDs were diagnosed with bacterial infections [6].

It was notably observed that Cu-IUDs were significantly linked to genital infections compared to hormonal IUDs. The discrepancies between the current study and that of A. D. Saidu et al. [6] may stem from several factors. These factors could be the variations in study populations (demographic characteristics, geographical location, and socioeconomic status). The differences in sample size, sampling techniques, and laboratory methods for bacterial detection could be also accounted for the variations in results shown. The contraceptive methods employed by study participants may differ between the two studies, with distinct methods potentially impacting the vaginal microbiota and susceptibility to bacterial infections. Factors such as sexual behavior, hygiene practices, and underlying health conditions are also believed to determine the prevalence of bacterial infections which contributes to discrepancies between the studies [8].

Table 5

Total antibiotics sensitivity of women with positive cervical culture results (n = 72)

Antibiotic	Sensitive, n (%)	Resistant, n (%)
Imipenem	72 (100.0)	0 (0.0)
Meropenem	72 (100.0)	0 (0.0)
Levofloxacin	72 (100.0)	0 (0.0)
Colistin	72 (100.0)	0 (0.0)
Ceftolozane	62 (86.11)	10 (13.89)
Gentamicin	62 (86.11)	10 (13.89)
Ciprofloxacin	61 (84.72)	11 (15.28)
Ceftriaxone	50 (69.44)	22 (30.56)
Amoxicillin	45 (62.50)	27 (37.50)
Ceftazidime	42 (58.33)	30 (41.67)
Cefotaxime	34 (47.22)	38 (52.78)
Trimethoprim/ Sulfamethoxazole	33 (45.83)	39 (54.17)
Amikacin	24 (33.33)	48 (66.67)
Ampicillin	21 (29.17)	51 (70.83)

The analysis of factors associated with positive culture results in women using IUDs reveals notable associations with several clinical features [9, 10]. Women who reported symptoms like burning (61.76% positive), abnormal vaginal discharge (79.41% positive), vaginal dyspareunia (83.82% positive), fever (36.76% positive), vaginal itching (75.00% positive), and pelvic pain (83.82% positive) had significantly higher rates of positive culture results, all with p-values below 0.05, indicating strong statistical associations. The type of IUD (Cu vs hormonal) showed no considerable difference in culture results ($p > 0.05$), suggesting that infection rate may not depend on the IUD type used. Similarly, factors like residency (rural vs urban), occupation, diabetes status, and hypertension status did not significantly impact the culture results.

Interestingly, the duration of IUD use showed variability, with higher culture positivity among those who had used an IUD for less than 1 year (25.00%) or between 1 and 2 years (45.59%), highlighting potential early-stage susceptibility. Overall, the findings underscore that specific symptoms are associated with an increased likelihood of positive cultures, while other demographic and health-related factors appear less influential.

The overall antibiotic sensitivity results for women with positive cervical culture highlight that imipenem, meropenem, levofloxacin, and colistin demonstrated the highest efficacy, with 100% sensitivity and no resistance. Ceftolozane and gentamicin also showed strong effectiveness, with sensitivity rates of 86.11% (62 women out of 72 persons) and low resistance at 13.89%. Ciprofloxacin had a high sensitivity rate of 84.72% but a slightly higher resistance rate at 15.28%. Sensitivity rates began to decrease notably with antibiotics like ceftriaxone (69.44% sensitivity), amoxi-

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cillin (62.50%), and ceftazidime (58.33%). Lower sensitivity was observed with cefotaxime at 47.22% and trimethoprim/sulfamethoxazole at 45.83%, both showing significant resistance. Amikacin and ampicillin exhibited the lowest sensitivity rates, with only 33.33% and 29.17% respectively, and higher resistance rates of 66.67% and 70.83%. These findings suggest that carbapenems (imipenem and meropenem) and other highly effective antibiotics like levofloxacin and colistin may be more suitable for treating infections in this population, while caution is advised with antibiotics showing lower sensitivity, like amikacin and ampicillin.

Consistent with current results, research done by Y. F. Kazi et al. has reported that the incidence of *E. coli* in high vaginal regions of a sample of Pakistanian women was 28% [11]. In contrast, another study has found that the isolation rate of *E. coli* from women with Cu-IUDs was 24.1%, which is less than the result of the current study. Few studies have explained the findings of isolation in these types of bacteria among the IUD users. They found that isolation of *E. coli* was more common among IUD users than those who use no intrauterine contraceptives specially during 1–7 days of menstrual cycle rather than in pre-menstrual. It was also higher in women with history of urinary tract infections [10, 12]. The predominant microorganism in the present study is *E. coli*, the same finding was detected by V. Pruthi et al. [13], while Z. Pal et al. [14] have found that *Enterobacter* was the most predominant microorganism followed by *E. coli*. The second causative microorganism in our study was *Staphylococcus aureus*. This discrepancy in findings could be due to different cultural setting. A. A. El-Sayed et al. study states that *E. coli* was found in 16% of women using Cu-IUDs, followed by *Staphylococcus aureus*, *Klebsiella pneumoniae* (12%), *Proteus mirabilis* (8%) and *Actinomycetes israelii* (6%) [5]. Concerning the IUD, although the association between its usage and bacterial vaginosis (BV) is unclear, it is accepted that the probable reason is the change in the vaginal flora favoring the growth of bacteria causing vaginosis. Controversially, a significant number of studies have reported no association [13, 15].

However, H. Chapa et al. [16] have found that tuboovarian abscesses may occur due to potential introduction of *Staphylococcus aureus* into the pelvic organ by the IUD placement. Other previous studies concerning vaginitis have recorded that microorganisms introduced into the uterus from the use of poorly sterilized instruments, mostly *E. coli, and Staphylococcus* were also concerned [1, 4]. J. Y. Lee and J. S. Yang revealed that the frequency of 1,589 positive culture, 49 (3.0%) had *Mycoplasma hominis* alone, 1,243 women (70.2%) had *Ureaplasma* species alone while 297 women (18.4%) had both *Mycoplasma hominis* and *Ureaplasma* species [18]. This variation might be due to difference in method of isolation and identification of swab taken. Moreover, environmental factors and difference on the actual study participants might also explain the above discrepancy. The exposure of the vagina to different levels of gynecological-obstetric risks lead to these different microbial strains' findings [16–18].

Hypoestrogenemia (directly mediated by estrogens decreases vaginal glycogen), elevates of vaginal pH and leads to easier adhesion to epithelial cell. The preceding sequence of events has been associated with the high microbial colonization of the vagina; the progestin releasing IUDs disrupts the periodic fluctuations in vaginal microbiota and suppresses *Lactobacillus* growth [16]. The study has involved women with positive cultures with reported symptoms agreed with the study of F. Shobeiri and M. Nazari, which reported perceived symptoms in 100 IUD users, including backache, abdominal pain, dysmenorrhea, and dyspareunia along with vaginal discharge [21]. Pelvic pain was also noted in a significant proportion in the current study subjects consistent with findings from other investigators who reported cervical erosion in women using IUDs in different populations [19–21]. Furthermore, S. D. Song et al. have reported that the most frequent symptom was the presence of abnormal vaginal discharge [20]. The symptoms reported in the current study among women with positive cultures can be attributed strongly to IUD usage. These symptoms were abnormal vaginal discharge, burning and/or itching sensation, fever, and pelvic pain due to local irritation or inflammation [22, 23]. Some women have also complained on discomfort or pain during sexual intercourse (dyspareunia) which is may be resulted from the device's placement or related factors. Furthermore, infections linked to IUD usage can exacerbate existing symptoms or lead to additional symptoms such as fever, indicating that there is a systemic response to infection. Lastly, cervical erosion was observed and in contribution with symptoms like abnormal vaginal discharge and bleeding [24].

The observation that Cu-IUD users had the highest percentage of vaginitis in the 1–2 years duration category. This suggests that the time frame may be a critical period concerning the development of vaginitis among them, and this finding aligns with previous research indicating that Cu-IUDs may impact vaginal flora and increase the risk of vaginal infections, including BV and yeast infections, particularly during the initial years [25, 26]. The release of Cu-ions by the device may disrupt the balance of vaginal microbiota, leading to alterations in pH and creating an environment conducive to the growth of pathogenic microorganisms [27]. These conclusions are best confirmed by studies who have revealed that BV risk were persistent up to 18 months of Cu-IUD use. Interestingly, BV risk has been reverted to its pre-initiation levels by discontinuation of Cu-IUD usage [21, 27].

In contrast, hormonal IUD infections within the 1–2 years duration category were the most common, similarly to Cu-IUD users but slightly higher proportion for the same timeframe, which are the same as finding recognized by other study [28], suggesting that hormonal IUDs also influence the vaginal environment, albeit to a lesser extent than Cu-IUDs. While hormonal IUDs primarily act locally on the uterus to prevent pregnancy, they still affect hormone levels and potentially impact vaginal flora, particularly during the early years of usage. Driving to the same end point of irritation and the normal vaginal flora alteration, BV is thought to be caused by the hormonal IUD strings [27, 29].

In the current study, regarding the sensitivity of various antibiotics in inhibiting bacterial growth align with existing literature, underscoring the importance of anti-

biotic susceptibility testing for guiding effective treatment strategies. Antibiotics demonstrating impeccable sensitivity were imipenem, meropenem, tigecycline, and colistin consistent with previous studies highlighting their efficacy against a broad spectrum of bacterial pathogens [30, 31]. These antibiotics are often reserved for severe infections or cases of multidrug-resistant organisms due to their potent antimicrobial activity and low resistance rates [32, 33]. Ceftolozane-tazobactam, gentamicin also have shown high sensitivity in the current study, in line with their recognized efficacy against certain gram-negative pathogens [34, 35]. Ceftazidime-avibactam have shown moderate sensitivity, consistent with its activity against multidrug-resistant gram-negative bacteria, although the probability to develop resistance still present [36]. In contrast, ampicillin-sulbactam and ciprofloxacin were less favored in the current study, since the antibiotic susceptibility test demonstrates a higher rate of bacteria resistance to them, corroborating findings from different samples included in other study [31, 37]. The prevalence of resistance to these antibiotics underscores the importance of antibiotic usage and consideration of local resistance patterns when selecting empirical therapy.

These findings advise tailoring antibiotic therapy based on local susceptibility patterns and individual patient characteristics to optimize treatment outcomes and minimize the development of antibiotic resistance. Furthermore, the robust sensitivity of certain antibiotics underscores their continued importance in combating bacterial infections, particularly in those who are infected by multidrug-resistant organisms [38, 39]. The significantly observed resistance rate of *E. coli* to ampicillin-sulbactam and ciprofloxacin underscore the need for judicious antibiotic prescribing practices and consideration of alternative treatment options in cases of vaginitis among IUD users, which is consistent with global conception about the uprising rates of antibiotic resistance among *E. coli* isolates, particularly in the context of recurrent or persistent infections [31, 37]. The emergence antibiotic resistance shown by *E. coli* isolated from women with vaginitis who use IUDs may be attributed to various factors, including previous antibiotic exposure, biofilm formation, and the selective pressure exerted by the local microbiota. Additionally, the presence of an IUD may contribute to alterations in the vaginal environment, potentially influencing bacterial colonization and antibiotic susceptibility patterns [40, 41].

CONCLUSIONS

Overall, the findings underscore that specific symptoms of pelvic region in women who use IUD are associated with an increased likelihood of positive vaginal cultures, while other demographic and health-related factors appear less influential. Suggesting that the infection rate may not depend on the IUD type used.

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REFERENCES

1. Brown BP, Feng C, Tanko RF, Jaumdally SZ, Bunjun R, Dabee S, et al. Copper intrauterine device increases vaginal concentrations of inflammatory anaerobes and depletes lactobacilli compared to hormonal options in a randomized trial. Nat Commun. 2023;14:499. doi: 10.1038/s41467-023-36002-4.
2. Oranye BC, Adekunle AO, Arowojolu AO, Makanjuola O, Tayo B. Comparative study of cervical-vaginal microbial flora changes in women using Cu-T380A contraceptive device and LNG-IUS in Ibadan: a two-centre clinical COHORT study. Int J Reprod Contracept Obstet Gynecol. 2021;10(10):3703-10. doi: 10.18203/2320-1770.ijrcog20213833.
3. Fedosiuk K, Pakharenko L, Chayka K, Basiuha I, Kurtash O. Abnormal uterine bleeding in women of reproductive age: PALM-COEIN causes. Bangladesh J Med Sci. 2023;22(4):809-14. doi: 10.3329/bjms.v22i4.67116.
4. Al-Kattan SA, Burhan DT, Burhan ST. Biofilm formation on intrauterine device and associated infections. Iraqi Postgrad Med J. 2013;12(4):562-7.
5. El-Sayed AA, Mohamad EE, Tawfiek AM, Belbasy RE. Bacterial infections and biofilm formation associated with intrauterine contraceptive device among females attending Al-Glaa Teaching Hospital in Cairo. Egypt J Hosp Med. 2018;70(5):882-90.
6. Saidu AD, Tunau KA, Panti AA, Nwobodo EI, Mohammed Y, Amin J, et al. Effect of hormonal and copper IUDs on genital microbial colonization and clinical outcomes in North-Western Nigeria. Int J Reprod Contracept Obstet Gynecol. 2017;6(6):2143-7. doi: 10.18203/2320-1770.ijrcog20172304.
7. Pakharenko LV, Basiuha IO, Zhurakivskyi VM, Lasytchuk OM, Kurtash NYa. The importance of the genital tract microflora in the endometriosis development. Reprod Health Woman. 2023;(2):21-5. doi: 10.30841/2708-8731.2.2023.278155.
8. Dereje N, Engida B, Holland RP. Factors associated with intrauterine contraceptive device use among women of reproductive age group in Addis Ababa, Ethiopia: A case control study. PLoS One. 2020;15(2):e0229071. doi: 10.1371/journal.pone.0229071.
9. Holdcroft AM, Ireland DJ, Payne MS. The vaginal microbiome in health and disease – what role do common intimate hygiene practices play? Microorganisms. 2023;11(2):298. doi: 10.3390/microorganisms11020298.
10. Taran OA, Bulavenko OV, Kukuruza IL, Tytarenko NV, Ovcharuk MV, Starovier AV, et al. Modern approaches to restoring vaginal microbiocenosis. Reprod Health Woman. 2024;(3):53-9. doi: 10.30841/2708-8731.3.2024.305500.
11. Kazi YF, Saleem S, Kazi N. Investigation of vaginal microbiota in sexually active women using hormonal contraceptives in Pakistan. BMC Urol. 2012;12:22. doi: 10.1186/1471-2490-12-22.
12. Ghazal S, Musmar M, Al-Tell MAI. Effect of IUD (intrauterine device) on reproductive tract infection (RTI) in the Northern West Bank. Middle East J Fam Med. 2004;5(5):1-12.
13. Pruthi V, Al-Janabi A, Pereira BMJ. Characterization of biofilm formed on intrauterine devices. Indian J Med Microbiol. 2003;21(3):161-5. doi: 10.1016/S0255-0857(21)03065-6.
14. Pal Z, Urban E, Dosa E, Pal A, Nagy E. Biofilm formation on intrauterine devices in relation to duration of use. J Med Microbiol. 2005;54(Pt12):1199-203. doi: 10.1099/jmm.0.46197-0.
15. Ahmad R. Cervico-vaginopathogenic Escherichia coli in Iran: serogroup distributions, virulence factors, and antimicrobial resistance properties. Microb Pathog. 2014;75:29-34. doi: 10.1016/j.micpath.2014.08.004.
16. Chapa H, Hagar C, Rueda Chavez E. Staphylococcus aureus as pelvic inflammatory disease and tubo-ovarian abscess pathogen. J Clin Gynecol Obstet. 2023;12(1):28-31.
17. Bobrytska V, Lakhno I, Chernyak O. Modern therapy of inflammatory diseases of the female genital sphere with a symptom complex of urethritis and vaginitis. Reprod Health Woman. 2023;(1):64-72.
18. Lee JY, Yang JS. Prevalence and antimicrobial susceptibility of mycoplasma hominis and ureaplasma species in nonpregnant female patients in South Korea indicate an increasing trend of pristinamycin-resistant isolates. Antimicrob Agents Chemother. 2020;64(10):e01065-20. doi: 10.1128/AAC.01065-20.
19. Mulu W, Yimer M, Zenebe Y, Abera B. Common causes of vaginal infections and antibiotic susceptibility of aerobic bacterial isolates in women of reproductive age attending at Felegehiwot Referral Hospital, Ethiopia: a cross sectional study. BMC Womens Health. 2015;15:42. doi: 10.1186/s12905-015-0197-y.

ISSN 2708-8723 (print)
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20. Song SD, Acharya KD, Zhu JE, Deveney CM, Walther-Antonio MRS, Tetel MJ, et al. Daily vaginal microbiota fluctuations associated with natural hormonal cycle, contraceptives, diet, and exercise. mSphere. 2020;5(4):e00593-20. doi: 10.1128/mSphere.00593-20.
21. Shobeiri F, Nazari M. Vaginitis in intrauterine contraceptive device users. Health. 2014;6(11):1154-9. doi: 10.4236/health.2014.611149.
22. Ferraz do Lago R, Simões JA, Bahamondes L. Follow-up of users of intrauterine device with and without bacterial vaginosis and other cervicovaginal infections. Contraception. 2023;68(2):105-9. doi: 10.1016/S0010-7824(03)00109-4.
23. Wright KO, Mohammed AS, Salisu-Olatunji O, Kuyinu YA. Cervical Ectropion and Intra-Uterine Contraceptive Device (IUCD): A five-year retrospective study of family planning clients of a tertiary health institution in Lagos Nigeria. BMC Res Notes. 2014;7:946. doi: 10.1186/1756-0500-7-946.
24. Soliman AS, Mohammed BE El Mohammady, Hasheesh MA, Abdelhady IH. Incidence of causative organisms of vaginitis in females with intrauterine device. Al-Azhar Int Med J. 2024;5(5):17. doi: 10.58675/2682-339X.2419.
25. Catlett T. Everything you need to know about IUD side effects [Internet]. Healthline. 2023. Available from: https://www.healthline.com/health/birth-control/iud-side-effects.
26. Yefet E, Bejerano A, Iskander R, Zilberman KT, Nachum Z. The association between gestational diabetes mellitus and infections in pregnancy-systematic review and meta-analysis. Microorganisms. 2023;11(8):1956. doi: 10.3390/microorganisms11081956.
27. Nagendra L, Boro H, Mannar V. Bacterial Infections in Diabetes [Internet]. In: Feingold KR, Ahmed SF, Anawalt B, et al., editors. Endotext South Dartmouth (MA): MDText.com, Inc.; 2000. Available from: https://www.ncbi.nlm.nih.gov/books/NBK579762/.
28. Cherney K. Complications of hypertension [Internet]. 2024. Available from: https://www.healthline.com/health/high-blood-pressure-hypertension/hypertension-complications.
29. Ray A, Bonorden MJL, Pandit R, Nkhata KJ, Bishayee A. Infections and immunity: associations with obesity and related metabolic disorders. J Pathol Transl Med. 2023;57(1):28-42. doi: 10.4132/jptm.2022.11.14.
30. Daubert E, Weber KM, French AL, Seidman D, Michel K, Gustafson D, et al. Obesity is associated with lower bacterial vaginosis prevalence in menopausal but not pre-menopausal women in a retrospective analysis of the Women's Interagency HIV Study. PLoS One. 2021;16(3):e0248136. doi: 10.1371/journal.pone.0248136.
31. Daniel AL, Auerbach S, Nazarenko D, Agbemenu K, Lorenz R. An integrative review of the relationship between intrauterine devices and bacterial vaginosis. Nurs Womens Health. 2023;27(2):141-51. doi: 10.1016/j.nwh.2023.01.007.
32. Donders GGG, Bellen G, Ruban K, Van Bulck B. Short- and long-term influence of the levonorgestrel-releasing intrauterine system (Mirena®) on vaginal microbiota and Candida. J Med Microbiol. 2018;67(3):308-13. doi: 10.1099/jmm.0.000657.
33. Shokouhi Mostafavi SK, Najar-Peerayeh S, Mohabbati MA, Kardoust PM. Detection of virulence factors, phylogroups, serogroups and biofilm formation among CTX-M-1 positive Escherichia coli isolated from patients with pyelonephritis. Biomed Res. 2018;29(8):1543-9. doi: 10.4066/biomedicalresearch.29-18-270.
34. Wang JL, Lai CC, Ko WC, Hsueh PR. Geographical patterns of in vitro susceptibilities to tigecycline and colistin among worldwide isolates of Acinetobacter baumannii, Escherichia coli and Klebsiella pneumoniae: Data from the Antimicrobial Testing Leadership and Surveillance (ATLAS) programme, 2016–2021. Int J Antimicrob Agents. 2023;62(3):106930. doi: 10.1016/j.ijantimicag.2023.106930.
35. Tuon FF, Cieslinski J, Rodrigues SDS, Serra FB, Paula MD. Evaluation of in vitro activity of ceftolozane-tazobactam against recent clinical bacterial isolates from Brazil – the EM200 study. Braz J Infect Dis. 2020;24(2):96-103. doi: 10.1016/j.bjid.2020.04.004.
36. Walker MM, Roberts JA, Rogers BA, Harris PNA, Sime FB. Current and emerging treatment options for multidrug resistant Escherichia coli urosepsis: a review. Antibiotics. 2022;11(12):1821. doi: 10.3390/antibiotics11121821.
37. Daham WM, Abid IM. Detection of antibiotic susceptibility and biofilm formation in clinical isolates of E. coli and Klebsiella spp. J Educ Pure Sci Univ Thi-Qar. 2023;13(4):8. doi: 10.32792/jeps.v13i4.379.
38. Raheem ZK, Said LA. Antibiotic susceptibility profile of bacteria causing aerobic vaginitis in women in Iraq. Arch Razi Inst. 2023;78(1):31-43. doi: 10.22092/ari.2022.358775.2307.
39. Papadimitriou-Olivgeris M, Bartzavali C, Nikolopoulou A, Kolonitsiou F, Mplani V, Spiliopoulou I, et al. Impact of Tigecycline's MIC in the Outcome of Critically Ill Patients with Carbapenemase-Producing Klebsiella pneumoniae Bacteraemia Treated with Tigecycline Monotherapy-Validation of 2019's EUCAST Proposed Breakpoint Changes. Antibiotics (Basel). 2020;9(11):828. doi: 10.3390/antibiotics9110828.
40. Al-Khaqani MM, Alwash MS, Al-Dahmoshi HO. Investigation of phylogroups and some virulence traits among cervico-vaginal Escherichia coli (CVEC) isolated from females in Hilla City, Iraq. Malays J Microbiol. 2017;(2):132-8. doi: 10.21161/MJM.92716.
41. Gorbunova O, Zarichanska K, Shcherbinska O, Netskar I, Iarova I. Biocenosis of the vagina and modern approaches to the correction of vaginal dysbiosis (Literature review). Reprod Health Woman. 2023;(5):69-81. doi: 10.30841/2708-8731.5.2023.286772.

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