Prevalence and Antibiotic Resistance Patterns of Escherichia coli and Pseudomonas aeruginosa Isolated from Vaginal Infections in Women in Samarra, Iraq

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Abstract— Abnormal vaginal microbiota, as seen in bacterial vaginosis (BV), is related to an increased dangerous of complications during childbirth. gynecological diseases, and sexually transmitted infections. In BV, anaerobic bacteria replace the natural vaginal flora, which is dominated by lactobacilli (LDB). Diagnosis of BV relies on clinical symptoms (foul-smelling vaginal discharge) and/or microscopic examination of vaginal swabs, methods that do not identify specific microorganisms. Vaginal infections are among the most common gynecological health problems. Infections of the female reproductive tract include sexually transmitted infections and bacterial vaginosis (BV).

Sixty clinical specimens were collected from women of varying ages in Salah al-Din Governorate. Pathogenic bacteria were collected and isolated using standard bacteriological methods, and antibiotic Susceptibility testing was conducted using tablet form. The results showed that 22 specimens (33.3%) were positive for bacterial growth, while 40 specimens (66.7%) were non-positive. E. coli was the most important bacterium (90%), followed by Pseudomonas aeruginosa (10%). High resistance to penicillin (100%) was observed, while ciprofloxacin showed moderate efficacy. The efficacy of azithromycin and Augmentin varied with age. This study, conducted from December 2025 to April 2026, aimed to Diagnosis of bacteria isolated from women with vaginal infections and perform antibiotic sensitivity testing.

Keywords: *Escherichia coli, Pseudomonas aeruginosa*, antibiotic resistance, female reproductive system

Introduction

Bacterial vaginosis was among the most important causes of vagina irritation [1,2]. The normal vaginal microbiota, characterized by lactobacilli, inhabits the healthy vaginal tract in women of

reproductive age, providing protection Towards some types of pathogenic bacteria [3]. Vaginal bacterial infections occur due to the invasion of bacteria from the urinary tract and anus into the vagina [4]. Bacterial vaginosis is a multi-microbial infection characterized by disruption of the balance of the normal vaginal microflora. [5]. It is characterized by an increased vaginal media pH (acidity), a decrease in lactobacilli, particularly hydrogen peroxide-producing species, and an increase in the quantity and/or type of facultative and anaerobic bacteria [6]. The vagina microbiota is a complex ecosystem that significantly impacts women's health by forming a mutually beneficial relationship with its host [7.8]. Lactobacilli species produce hydrogen peroxide, lactic acid, and bacteriocins to help it attack off infections. Lactic acid, a byproduct of glucose fermentation, maintains a vaginal pH between 3.8 - 4.5, which inhibition the growth of harmful microbes. *Lactobacilli* species produce hydrogen peroxide (H_2O_2) as a defense mechanism against pathogenic colonization. Bacteriocins are antimicrobial peptides produced by Lactobacillus species that are toxic to bacteria [8]. This study aimed to isolate and identify microorganisms causing vaginitis, such as *Escherichia coli* and *Pseudomonas aeruginosa*, and to analyze the factors causing vaginal bacterial imbalance and antibiotic sensitivity to bacterial infection prevalent in several age groups of women who frequent outpatient clinics and Samarra Hospital. This study aims to identify patterns of bacterial prevalence in the female reproductive tract and assess their antibiotic susceptibility in Samarra, Salah al-Din Governorate/Iraq.

Materials and Methods

1 . Research Design, Area, & Population

The Research was conducted from December 2025 to April 2026. Research was conducted on 60 women visiting private clinics in Samarra, Salah al-Din Governorate, for healthcare. The Research excluded women who were menstruating or pregnant, had taken antibacterial medications in the previous week, or had used a vaginal douche in the past 24 hours.[9]

2. The patient was positioned supine, and samples were collected from the vagina surface using sterile cotton swabs.

3 .Microscopic Examination

Gram staining of vaginal secretions was performed using standard methods. The swabs were fermentable, and microscopic examination was performed according to [10].

4- Culture Media

The culture media used in this study include:

o Brain Heart Infusion Broth. It is used for the growth of anaerobic bacteria that have a role in bacterial vaginosis (BV).

Nutrient agar medium

Cetrimide agar medium

Peptone water medium

o Mueller-Hinton agar medium

Kovacs Regent

Catalase reagent

Oxidase reagent.[11]

Ethical Statement

All vaginal sampling procedures were performed in accordance with internationally recognized standards and received approval from the Institutional Animal Ethics Committee at [Samarra University] (Approval No.: IAEC-2024-308, dated January 4, 2026).

Collection Samples

Microorganisms were isolated from samples taken directly in the laboratories of the Department of Biology, College of Education for Pure Sciences, Samarra University, using standard procedures.

Microorganisms were identified using procedures that This microscopic examination involved the growth of bacterial cell colonies in selected culture media.. [12, 13].

Anti-biotic disc

Antibiotic susceptibility testing using the Kirby-Bauer B method was performed for CLSI criteria, and included the following antibiotics:

* Penicillin
* Ciprofloxacin
* Azithromycin
* Augmentin
* Cephalexin

Results

Incidence of Vaginal Infections

Of 60 patients, (33.3%) tested positive for vaginal infections. Of the 60 women, the H (highest prevalence was observed in the Thirty-Forty years age group.

Table 1: Age: The Research Sample Distribution

Female<20year	20_30	30 _40	40 to 50	50 to60	60 to 70
3(1.5%)	5 (2.5%)	25 (12.5%)	14 (7.0%)	2 (1.0%)	1(0.5%)

Bacteriological profile of vaginal cotton swabs

The positive results were 18% of single infections, while mixed infections were 4%.

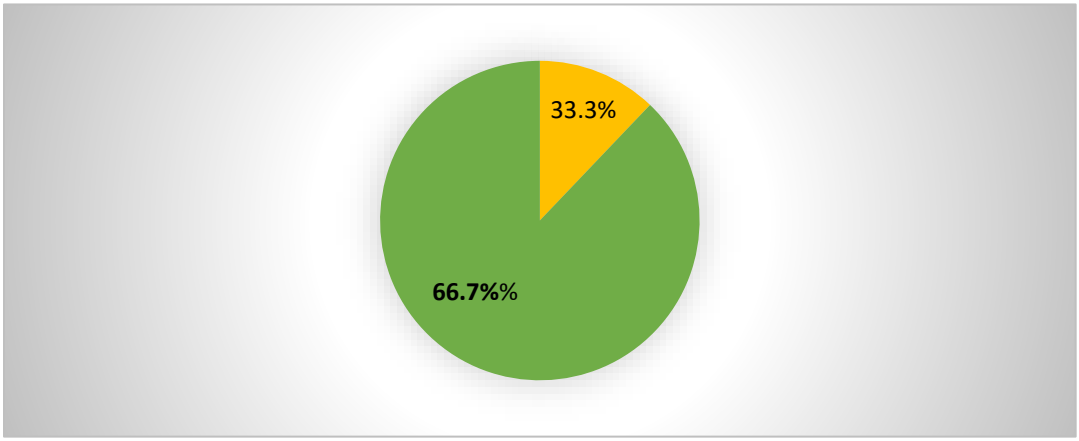


Fig 1: Percentage of vaginal swabs infected with bacteria.

The most important isolated bacteria from vaginal cotton swabs are *E. coli* (90%) and *P. aeruginosa* (10%). As shown in Table 2.

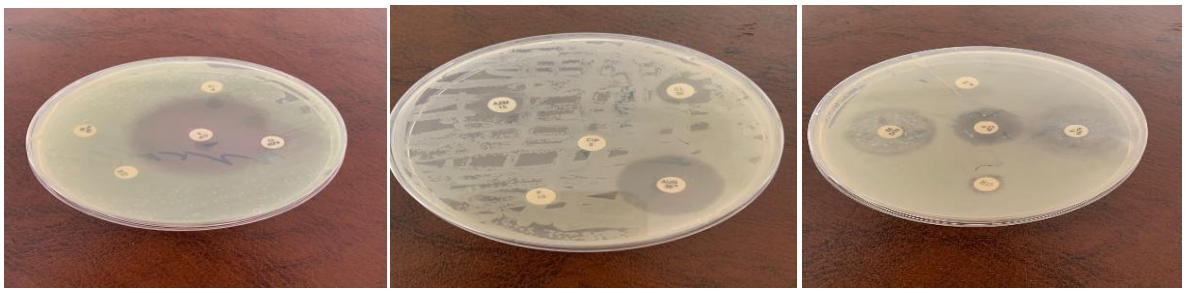
Pathogens	Number	Percentage
E. coli	**18**	**90%**
P. aeruginosa	**2**	**10%**
Total	**60**	**22%**

Antibiotic sensitivity test

Table of inhibition rates by age (40-20 years)

Age	Bacteria	Penicillin	Cipro-floxacin	Azithro-mycin	Augmentin	Cephalexin	Per
20	***P. aeruginosa***	R	S	R	R	R	20%
20	***Escherichia coli***	R	R	R	S	R	20%
25	***Escherichia coli***	R	S	S	S	R	60%
26	***Escherichia coli***	R	R	R	R	S	20%
30	***Escherichia coli***	R	R	S	S	S	60%

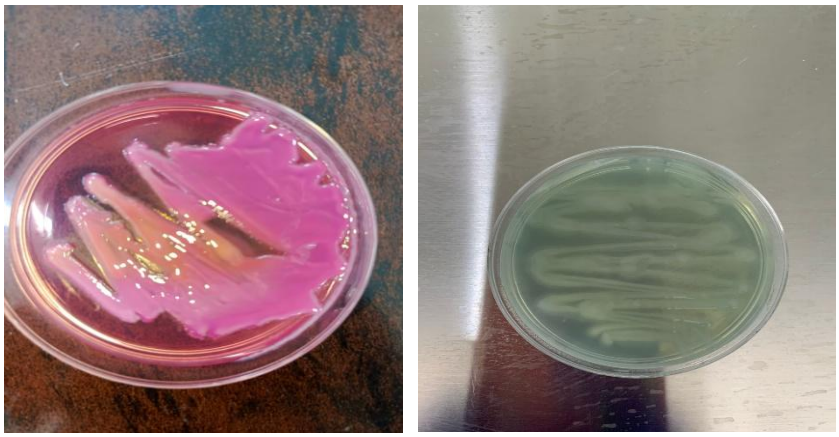
R (resistant) **S** (sensitive)



No	Samples	Total variable	Percentage (%)
1	38	Negative	66.7%
2	22	Positive	33.3%
3	40	-	100%

Bacterial distribution

No	Bacteria Samples	Total
1	***E. coli***	90
2	***P. aeruginosa***	10
	40	100



A- *E. coli* MacConkey agar

B- B- *P. aeruginosa* Stramide agar .

Discussion

This finding is consistent with past research confirming that Escherichia coli bacteria are a cause of the disease. of female genitourinary infections, indicating it as a leading cause of genitourinary tract infections in women .Complete penicillin resistance was also observed, reflecting the prevalence of beta-lactamase-producing strains, a finding corroborated by recent World Health Organization reports .Ciprofloxacin demonstrated moderate efficacy, but resistance to it has been increasing due to genetic mutations in the bacteria. Azithromycin and Augmentin showed mixed results, suggesting different resistance mechanisms among the isolates. The variation in susceptibility across age groups may be attributed to differences in bacterial strains or prior antibiotic exposure, rather than age itself. These findings suggest the need for susceptibility-tested treatment and the avoidance of indiscriminate antibiotic use.

The results of this research showed an increased prevalence of bacterial vaginosis, particularly among women aged 30 to 40. Studies have indicated a correlation between age and bacterial vaginosis. The increased prevalence of vaginitis in this age group can be attributed to the high level of sexual activity among women during this period, as well as increased hormonal activity during pregnancy [14]. 46% of the samples were cultured for bacterial identification, similar to the 64% of samples previously reported in Ouagadougou, Burkina Faso. Current research shows that single infections account for 18% compared to 4% for double infections, which differs from previous research conducted in Ouagadougou, Burkina Faso, which indicated a ratio of 48% to 16% for single infections [15]. Researchers and Bohbot, in their research on bacterial pathogen diversity in the vagina in France, found that 60.9% of infections were single and 8.9% were double.

This is attributed to factors leading to acidic environmental changes in the vagina at the pH level, specifically cell invasion [16]. Antibiotic treatment for sexually transmitted infections is often ineffective, and side effects persist due to antibiotic resistance and recurrence of infections. [17]. [18]. Laboratories determine changes in the vaginal environment at the pH level by microscopic examination and a cotton swab vaginal. The Nugent score involves staining vaginal smears with a Gram stain and has been proposed as a primary diagnostic criterion for bacterial vaginosis compared to the Amzel criteria, which rely solely on non-quantifiable and non-reproducible clinical symptoms. Bacterial vaginosis is diagnosed by quantifying Gram-stained microorganisms, classifying them according to their different vaginal phenotypes, and identifying indicator cells (part of the Amzel criteria). This can be a laborious process requiring skilled personnel [19] Amzelle criteria, which include saline microscopy, Symptoms improve over time thanks to increased immunity, with the appearance of thin, homogeneous, and watery vaginal discharge, an elevated vaginal pH (>4.5), the presence of 20% indicator cells (vaginal epithelial cells), and a peculiar fishy odor after adding 10% KOH to the vaginal discharge. (The odor test is used to diagnose bacterial vaginosis, with a moderate recurrence potential [20].

Conclusions

The current research results showed that bacterial vaginosis in women in outpatient clinics in Samarra was mainly associated with Escherichia coli, followed by *Pseudomonas aeruginosa*. The highest infection rate was in the age group of 30-40 years. Antibiotic susceptibility testing also showed complete resistance to penicillin, while both ciprofloxacin and Augmentin showed varying activity against bacterial isolates. These results indicate the need to perform bacterial culture and antibiotic susceptibility testing before prescribing treatment, rather than relying on empirical therapy. The study also confirms the necessity of continuous local monitoring of various antibiotic resistance patterns in vaginal infections to improve the quality of treatment decisions and limit the spread of resistant strains.

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