

The Bacteriological Spectrum of Endocervical Swabs in Patients with Preterm

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Abstract

Background: Preterm labor (PTL) is the onset of uterine contractions with cervical changes before 37 weeks of gestation and remains a major cause of neonatal morbidity and mortality worldwide. Genital tract infections are strongly implicated in its pathogenesis, yet data from Iraq remain scarce.

Aim of the Study: To identify the bacteriological spectrum of genital tract infections among women presenting with active preterm labor, to guide preventive and therapeutic strategies.

Methods: A cross-sectional study was conducted at Al-Mawani Teaching Hospital for Maternity and Children in Basra, Iraq, over nine months (October 2024–July 2025). A total of 111 pregnant women (28–36 weeks) with clinically diagnosed active PTL were enrolled. Data on demographics, obstetric history, and clinical presentation were collected using a structured questionnaire. Endocervical swabs were obtained aseptically, cultured on standard media, and analyzed using Gram staining and biochemical tests.

Results: Culture positivity was 78.4%, with *Staphylococcus* spp. (48.6%) as the predominant isolate, followed by *Streptococcus* spp. (13.5%), *E. coli* (8.1%), and *Candida* spp. (5.4%). Mixed *Candida* + *Staphylococcus* infections (2.7%) were strongly associated with neonatal mortality ($p < 0.001$). Significant predictors of positive cultures included younger maternal age (<20 years, 100%; $p < 0.001$), low parity ($p < 0.001$), vaginal discharge ($p = 0.024$), vaginal itching ($p = 0.045$), and prolonged symptom duration ($p = 0.008$). Neonatal outcomes included 55.9% NICU admissions and 10.8% mortality.

Conclusions: Genital tract infections, particularly mixed infections, represent a preventable and clinically significant determinant of PTL and adverse neonatal outcomes. Routine microbiological screening of high-risk women is recommended to improve maternal and neonatal health.

Keywords: Preterm labor, Genital tract infection, Endocervical swab, Staphylococcus, Neonatal outcomes

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Introduction

Preterm labor (PTL) is defined as the onset of regular uterine contractions with cervical changes before the completion of 37 weeks of gestation [1]. It occurs between 20 weeks and 36 weeks + 6 days and represents a major obstetric complication, contributing substantially to neonatal morbidity and mortality. The World Health Organization (WHO) classifies preterm birth into extremely preterm (<28 weeks), very preterm (28–32 weeks), and moderate to late preterm (32–37 weeks). The causes are multifactorial, with infections, uteroplacental

insufficiency, and maternal stress being prominent triggers. Ascending genital tract infections are particularly important, as they activate inflammatory pathways that precipitate labor. Early detection and management are therefore essential to improve neonatal outcomes [2].

Globally, preterm birth affects about 11.1% of live births, accounting for 75–80% of neonatal complications [3]. A 2014 review estimated a prevalence of 10.6%, with Asia and Sub-Saharan Africa contributing over 80% of cases [4]. In high-income settings, the burden remains significant; for

example, the United States reported a rate of 10.2% in 2019, with racial and socioeconomic disparities evident [5]. Indonesia recorded 8.8%, with premature rupture of membranes and poor antenatal care as major risk factors. In the Arab world and MENA region, data are limited, but North Africa reported a prevalence of 13.4% [4]. In Iraq, research is scarce, underscoring the need for local studies to identify prevalence and risk factors [6].

Infections are implicated in 25–40% of PTL cases. Intrauterine infections such as chorioamnionitis promote uterine contractions, cervical remodeling, and membrane rupture [7]. Genitourinary tract infections, particularly those caused by *Escherichia coli* and *Gardnerella vaginalis*, are strongly associated, with UTIs accounting for 40% of cases and *E. coli* isolated in two-thirds [8]. Chronic deciduitis has been linked to 28% of idiopathic PTL, while systemic conditions such as periodontal disease also contribute through inflammatory pathways. Biomarkers like fetal fibronectin and maternal ferritin have shown potential for prediction [9]. Preventive strategies include antibiotic prophylaxis for UTIs and periodontal screening, though implementation remains challenging in low-resource settings [10].

Risk factors for PTL extend beyond infections. Maternal age extremes (<20 and ≥ 35 years) increase risk, with the lowest rates seen in women aged 30–34. Both primiparity and high parity (≥ 5) are associated with PTL, due to uterine immaturity or overdistension [11]. A history of preterm birth is a strong predictor of recurrence, particularly with concurrent short cervical length. Cervical surgery also increases risk, and prophylactic cerclage or cervical length monitoring may be required [12].

Sexually transmitted infections (Chlamydia, Gonorrhea, Trichomonas, HSV) and bacterial vaginosis [13] significantly increase PTL risk through inflammation and disruption of cervical barriers. Preventive interventions such as routine prenatal screening, appropriate antibiotic treatment, and lifestyle modifications can reduce infection-related PTL. Despite this, gaps in resources and access to care continue to hinder implementation in many settings.

Patients and methods

This cross-sectional study was conducted at Al-Mawani Teaching Hospital for Maternity and Children, Basra, Iraq, a tertiary referral center, over nine months (October 1, 2024 – July 1, 2025). The study aimed to identify the bacteriological spectrum of genital tract infections among women with active preterm labor.

The study population comprised pregnant women between 28 and 36 completed weeks with a clinical diagnosis of active preterm labor, confirmed by regular uterine contractions associated with progressive cervical changes assessed by vaginal examination performed by an obstetrician. Women with incomplete records, ruptured membranes, chorioamnionitis, placenta previa, abruption placentae, recent antibiotic use, or significant bleeding were excluded. A total of 111 women who were presenting with active preterm labour during the study period were recruited.

Data were collected using a structured, supervisor-modified questionnaire adapted from Satyavathi et al. [14], including demographic details, obstetric history, clinical presentation, and examination findings. Endocervical swabs were obtained aseptically during speculum examination and transported promptly for laboratory analysis.

In the microbiology laboratory, swabs were cultured on Blood Agar, Chocolate Agar, MacConkey Agar, and Thayer-Martin medium, incubated at 37°C, and examined after 24–48 hours. Identification was performed using Gram staining and biochemical tests according to standard microbiological protocols.

Statistical analysis was carried out using SPSS version 26. Descriptive statistics summarized baseline characteristics, while Chi-square, independent t-tests, and ANOVA were applied to assess associations. A p-value <0.05 was considered statistically significant.

Ethical approval was obtained from the University of Basrah, College of Medicine. Oral informed consent was secured from all participants, confidentiality was maintained, and withdrawal rights were respected.

Results

A total of 111 women with active preterm labor (PTL) were included. The mean maternal age was 25.25 ± 5.68 years, with most aged 20–29 years (55.9%). The majority were housewives (88.3%) and urban residents (79.3%), with nearly half having only primary or no education. The mean BMI was 26.6 ± 3.71 kg/m². Only 36.0% reported adequate antenatal care, while 23.4% had no visits. A history of previous PTL was documented in 33.3% and miscarriage in 38.7%, whereas 19.8% had undergone cervical surgery. Infections were the most frequent complication during pregnancy (63.1%), followed by hypertension (17.1%) and diabetes mellitus (11.7%) (Table 1).

The most frequent symptoms were abdominal pain (60.4%) and vaginal discharge (49.5%). Vaginal itching occurred in 27.9% and bleeding in 5.4%. Recent antibiotic use was reported in 41.4%, mainly ceftriaxone (18.0%). Vaginal discharge color was whitish in 36.0%, yellowish in 21.6%, bloody in 10.8%, greenish in 2.7%, and absent in 28.8% (Table 2).

Most women delivered vaginally (68.5%), while 31.5% underwent cesarean section. Endocervical cultures were positive in 78.4%, predominantly *Staphylococcus* spp. (48.6%), followed by *Streptococcus* spp. (13.5%), *E. coli* (8.1%), and *Candida* spp. (5.4%). Mixed *Candida* + *Staphylococcus* infections occurred in 2.7% (Table 3).

Neonatal outcomes (Figure 1) included NICU admission in 55.9%, survival without NICU in 33.3%, and neonatal death in 10.8%.

Significant predictors of positive cultures included young maternal age (<20 years, 100%; $p < 0.001$), lower parity ($p < 0.001$), vaginal discharge ($p = 0.024$), vaginal itching ($p = 0.045$), prolonged symptom duration ($p = 0.008$), and discharge color ($p < 0.001$). These associations are summarized in Table 4.

Neonatal outcomes were influenced by maternal age, education, occupation, and residency (all $p < 0.01$). ANC frequency, prior PTL, cervical surgery, gestational age, and complications such as bleeding and placenta previa were also significant ($p \leq 0.038$). Cesarean delivery was associated with higher neonatal mortality (17.1% vs 7.9%; $p = 0.001$). Clinical symptoms linked with poor neonatal

outcomes included abdominal pain ($p = 0.007$), tender scar ($p = 0.005$), and vaginal bleeding ($p = 0.004$). These findings are summarized in Table 5

Finally, pathogen-specific analysis (Table 6) revealed that mixed *Candida* + *Staphylococcus* infection was strongly associated with neonatal death (3/3 deaths; $p < 0.001$), while other organisms showed no significant association.

Discussion:

The current study aimed to investigate the sociodemographic, obstetric, clinical, microbiological, and neonatal characteristics of patients presenting with active preterm labor at a tertiary care center in Iraq. By analyzing parameters such as maternal age, prenatal care utilization, obstetric history, endocervical swab culture results, clinical symptoms, and pregnancy complications, as well as their association with mode of delivery and neonatal outcomes.

In this tertiary-centre study from Basra, most women with active PTL were young (55.9% aged 20–29 years) with predominantly urban residence and lower educational attainment. This mirrors the age distribution reported by Kayiga et al. [15]. The education gradient and the socioeconomic patterns described by Bylykbashi et al. [16] underscore social determinants in PTL risk. Unlike Kuslimawati et al. [17], occupation was not associated with infection or outcomes in our study, likely reflecting differences in job type and physical workload across settings.

Culture positivity in the present study was high (78.4%), dominated by *Staphylococcus* spp. (48.6%), with *Streptococcus* spp., *E. coli*, and *Candida* spp. also prevalent. This elevated rate likely reflects the selective inclusion of women presenting with clinically active preterm labor, a group known to have a higher burden of ascending genital tract infection compared with unselected pregnant populations. These yields are comparable to Uma et al. [18], while the regional series (Gehlot & Meena [19]) showed higher *Candida/E. coli*, suggesting local microbiology and laboratory practice differences. Younger age, lower parity, vaginal discharge/itching, longer symptom duration, and discharge color were associated with culture positivity, echoing age–infection links in

inflammatory/microbial invasion signals in Cobo et al. [20]. Notably, a sizeable subset lacked discharge despite positive cultures, consistent with asymptomatic infection reported by Shrestha et al. [21] and supporting microbiologic screening beyond symptom-based detection. Neonatal morbidity was substantial: 55.9% NICU admission and 10.8% mortality. Adverse outcomes clustered among younger mothers, rural residence, and lower education, concordant with Fernandes et al. [22], Bylykbashi et al. [16], and Abdallah et al. [23]. Gestational age at delivery was the dominant survival predictor, paralleling week-by-week gains in Patil et al. [24]. Antepartum bleeding/placenta previa carried uniformly fatal outcomes, in line with Kayiga et al. [15]. Cesarean delivery correlated with higher mortality than NVD; consistent with Kayiga et al. [15], this likely reflects confounding by indication (emergency C/S in compromised fetuses), not a causal harm.

Clinically, abdominal pain and increased discharge were common, aligning with Khan et al. [25]. Prolonged symptoms (≥ 5 days/week) tracked with culture positivity, supporting time–risk relationships from Nikoloska [26] and physiologic markers in Yeni et al. [27]. Prior antibiotics (41.4%) did not reduce culture positivity or improve outcomes, paralleling Patil et al. [24] and resistance concerns from Bunyan et al. [28], emphasizing culture-guided rather than empirical regimens.

Maternal anthropometry averaged in the overweight range (BMI 26.6 kg/m²) yet did not differ by culture status or neonatal outcome, broadly consistent with Bhowmik et al. [29]. Pathogen–outcome analyses showed no single organism significantly predicted outcome, though *E. coli* trended adverse; critically, mixed *Candida* + *Staphylococcus* infection was identified in three cases, all of which resulted in neonatal death ($p < 0.001$), consonant with Gehlot & Meena [19], and Satyavathi et al. [14]. These data argue for early detection of polymicrobial infection and tailored, culture-directed therapy in PTL.

Limitation

This is a single-centre study, and a small sample size limits generalizability to the wider pregnant population. Small subgroups constrained power for organism-specific effects and adjusted analyses; follow-up was limited to short-term neonatal outcomes. These constraints may have attenuated

detection of modest associations and should inform interpretation and future study design.

Conclusions

Genital tract infection emerged as a key contributor to preterm labor, with *Staphylococcus* spp. as the predominant isolate. Younger age, low parity, abnormal vaginal discharge, and prolonged symptoms were significantly linked to positive cultures, while mixed infections, especially *Candida* with *Staphylococcus*, carried the highest risk of neonatal mortality. These findings highlight the value of routine bacteriological screening in high-risk women, emphasizing infection as a preventable and clinically significant determinant of adverse maternal and neonatal outcomes.

Recommendations

Based on the study findings, routine screening for genital tract infections should be considered in women at high risk of preterm labor, particularly those presenting with abnormal vaginal discharge, younger maternal age, or prolonged symptoms. Integration of microbiological assessment into antenatal care protocols may facilitate early identification and timely management of infections. Future research should include multicenter prospective cohort studies with larger sample sizes, incorporation of antimicrobial susceptibility testing, and extended neonatal follow-up to better elucidate causal relationships and inform evidence-based preventive strategies.

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Table 1. Baseline sociodemographic, anthropometric, and obstetric characteristics of the study patients with active preterm labor (n = 111).

Variable	n (%)	
Age (years)	<20	24 (21.6%)
	20–29	62 (55.9%)
	≥30	25 (22.5%)
	Mean ± SD	25.25 ± 5.68
Occupation	Housewife	98 (88.3%)
	Worker	13 (11.7%)
Residency	Urban	88 (79.3%)
	Rural	23 (20.7%)
Education	Illiterate	20 (18.0%)
	Primary	41 (36.9%)
	Secondary	40 (36.0%)
	Higher	10 (9.0%)
Anthropometry	Weight	79.41 ± 6.93 kg
	Height	166.9 ± 7.15 cm
	BMI	26.6 ± 3.71 kg/m ²
ANC Visits	Adequate	40 (36.0%)
	Inadequate	45 (40.5%)
	None	26 (23.4%)
Parity	Mean ± SD	2.2 ± 1.9 (Median: 2.0)
History of Miscarriage	None	68 (61.3%)
	Once	22 (19.8%)
	Twice	21 (18.9%)
Cervical Surgery	Yes	22 (19.8%)
Current Complications	Infection	70 (63.1%)
	Hypertension	19 (17.1%)
	Diabetes	13 (11.7%)
	Bleeding	3 (2.7%)
	Placenta previa	3 (2.7%)
Gestational Age (weeks)	Mean ± SD	32.33 ± 2.06 (Median 33.0)

Table 2. Clinical symptoms and recent antibiotic use among patients with active preterm labor (n = 111).

Symptom		n (%)
Abdominal pain		67 (60.4%)
Vaginal discharge		55 (49.5%)
Vaginal bleeding		6 (5.4%)
Vaginal itching		31 (27.9%)
Tender scar		12 (10.8%)
Symptom duration	Few hours	34 (30.6%)
	Few days	71 (64.0%)
	≥5 days/week	6 (5.4%)
Antibiotic use (past month)	None	65 (58.6%)
	Amoxicillin	16 (14.4%)
	Ceftriaxone	20 (18.0%)
	Cefixime	10 (9.0%)

Table 3. Mode of delivery and microbial culture results (n = 111).

Variable		n (%)
Mode of Delivery	NVD	76 (68.5%)
	C/S	35 (31.5%)
Culture Results	Positive	87 (78.4%)
	Negative	24 (21.6%)
Pathogens Identified	<i>Staphylococcus</i> spp.	54 (48.6%)
	<i>Streptococcus</i> spp.	15 (13.5%)
	<i>E. coli</i>	9 (8.1%)
	<i>Candida</i> spp.	6 (5.4%)
	Mixed	3 (2.7%)

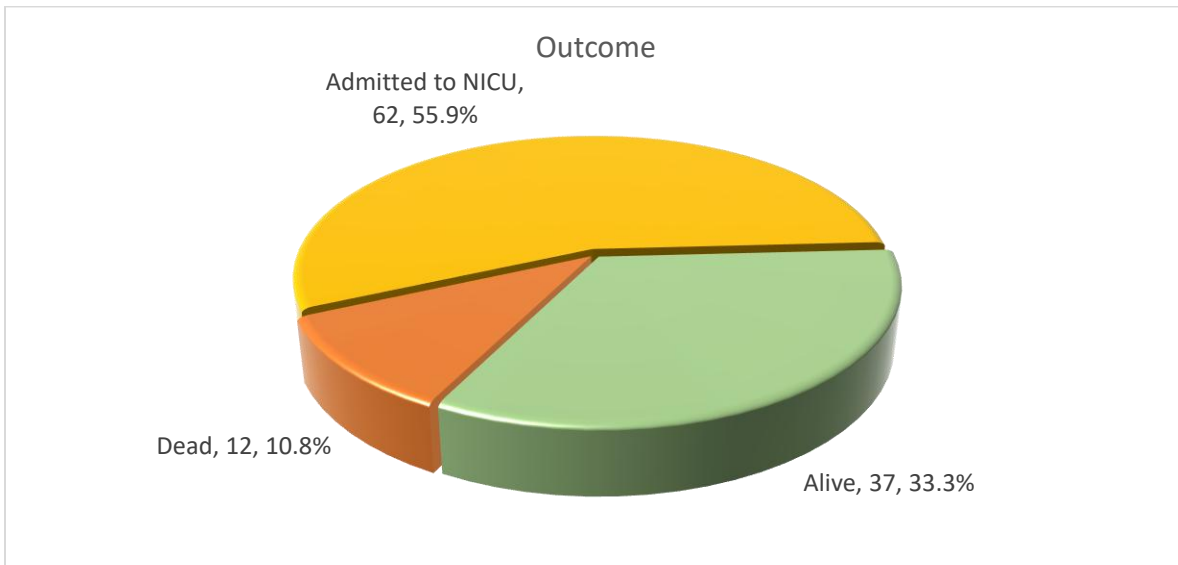


Figure 1. Neonatal outcomes among patients with active preterm labor (n = 111).

Table 4. Associations between maternal and clinical characteristics and endocervical culture results.

Variables		Endocervical swab findings				P value
		No growth		Growth		
		No=24	%	No=87	%	
Age	< 20 Y	0	0.0%	24	100.0%	<0.001
	20-29 Y	12	19.4%	50	80.6%	
	≥ 30 Y	12	48.0%	13	52.0%	
	Mean ±SD	29.67±3.795		24.03±5.518		
Residency	Rural	3	13.0%	20	87.0%	0.262
	Urban	21	23.9%	67	76.1%	
Frequency of ANC	Adequate	9	22.5%	31	77.5%	0.324
	Inadequate	12	26.7%	33	73.3%	
	Nil	3	11.5%	23	88.5%	
Parity	Mean ±SD	3.75±0.676		1.77±1.915		0.001
History of previous preterm labor	No	13	17.6%	61	82.4%	0.142
	Yes	11	29.7%	26	70.3%	
History of miscarriage	No	13	19.1%	55	80.9%	0.420
	Yes	11	25.6%	32	74.4%	
History of cervical surgery	No	21	23.6%	68	76.4%	0.310
	Yes	3	13.6%	19	86.4%	
Gestational age (Weeks)	Mean ±SD	32.88±2.525		32.18±1.902		0.146
Tender Scar	No	16	16.2%	83	83.8%	0.001
	Yes	8	66.7%	4	33.3%	
Vaginal Discharge	No	17	30.4%	39	69.6%	0.024
	Yes	7	12.7%	48	87.3%	
Vaginal Itching	No	21	26.3%	59	73.8%	0.045
	Yes	3	9.7%	28	90.3%	
	Few Hours	14	41.2%	20	58.8%	0.008

Duration of symptoms	Few days	10	14.1%	61	85.9%
	Several days	0	0.0%	3	100.0%
	Few Weeks	0	0.0%	3	100.0%

Table 5. Maternal, obstetric, and clinical predictors of neonatal outcomes.

Variables	Outcome						P value	
	Dead		Admitted to NICU		Alive			
	No=12	%	No=62	%	No=37	%		
Age	< 20 Y	0	0.0%	15	62.5%	9	37.5%	<0.001
	20-29 Y	12	19.4%	38	61.3%	12	19.4%	
	≥ 30 Y	0	0.0%	9	36.0%	16	64.0%	
	Mean ±SD	23.50±2.153		24.37±5.305		27.30±6.540		0.023
Residency	Rural	6	26.1%	6	26.1%	11	47.8%	0.002
	Urban	6	6.8%	56	63.6%	26	29.5%	
Educational level	Illiterate	6	30.0%	3	15.0%	11	55.0%	<0.001
	Primary	6	14.6%	22	53.7%	13	31.7%	
	Secondary	0	0.0%	33	82.5%	7	17.5%	
	Higher	0	0.0%	4	40.0%	6	60.0%	
Frequency of prenatal care visits	Adequate	3	7.5%	28	70.0%	9	22.5%	0.038
	Inadequate	3	6.7%	22	48.9%	20	44.4%	
	Null	6	23.1%	12	46.2%	8	30.8%	
preterm labor	No	9	12.2%	34	45.9%	31	41.9%	0.010
	Yes	3	8.1%	28	75.7%	6	16.2%	
cervical surgery	No	6	6.7%	49	55.1%	34	38.2%	0.006
	Yes	6	27.3%	13	59.1%	3	13.6%	
	Yes	9	12.9%	39	55.7%	22	31.4%	
Bleeding	No	9	8.3%	62	57.4%	37	34.3%	<0.001
	Yes	3	100.0%	0	0.0%	0	0.0%	

Placenta previa	No	9	8.3%	62	57.4%	37	34.3%	<0.001
	Yes	3	100.0%	0	0.0%	0	0.0%	
Gestational age (Weeks)	mean±SD	29.75±1.357		32.00±1.756		33.73±1.661		<0.001
Abdominal Pain	No	9	20.5%	18	40.9%	17	38.6%	0.007
	Yes	3	4.5%	44	65.7%	20	29.9%	
Tender Scar	No	12	12.1%	50	50.5%	37	37.4%	0.005
	Yes	0	0.0%	12	100.0%	0	0.0%	
Vaginal Discharge	No	9	16.1%	27	48.2%	20	35.7%	0.118
	Yes	3	5.5%	35	63.6%	17	30.9%	
Vaginal Bleeding	No	9	8.6%	59	56.2%	37	35.2%	0.004
	Yes	3	50.0%	3	50.0%	0	0.0%	
Vaginal discharge colour	No Discharge	0	0.0%	15	46.9%	17	53.1%	0.001
	Greenish	0	0.0%	0	0.0%	3	100.0%	
	Bloody	3	25.0%	9	75.0%	0	0.0%	
	Yellowish	3	12.5%	18	75.0%	3	12.5%	
	Whitish	6	15.0%	20	50.0%	14	35.0%	
Mode of delivery	C/S	6	17.1%	26	74.3%	3	8.6%	0.001
	NVD	6	7.9%	36	47.4%	34	44.7%	

Table 6. Association between specific endocervical swab pathogens and neonatal outcomes

Endocervical swab pathogens		Outcome						P value
		Dead		Admitted to NICU		Alive		
		No=12	%	No=62	%	No=37	%	
Staphylococcus	No	6	10.5%	29	50.9%	22	38.6%	0.472
	Yes	6	11.1%	33	61.1%	15	27.8%	
Streptococcus	No	12	12.5%	53	55.2%	31	32.3%	0.340
	Yes	0	0.0%	9	60.0%	6	40.0%	
E. coli	No	9	8.8%	59	57.8%	34	33.3%	0.064
	Yes	3	33.3%	3	33.3%	3	33.3%	
Candida	No	12	11.4%	56	53.3%	37	35.2%	0.082
	Yes	0	0.0%	6	100.0%	0	0.0%	
Mix candida and staphylococcus	No	9	8.3%	62	57.4%	37	34.3%	<0.001
	Yes	3	100.0%	0	0.0%	0	0.0%	