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Factors Associated With the Occurrence of Endocervical Bacteria Among Women With Genital Discharge in Kinondoni Municipal, Dar es Salaam, Tanzania: A Cross-Sectional Study

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ABSTRACT

Background: Endocervical bacterial infections may contribute to genital discharge and adverse reproductive health outcomes. In Tanzania, limited access to microbiological diagnostic services and reliance on syndromic management may result in inadequate identification of bacterial causes. This study assessed the occurrence of endocervical bacteria and factors associated with bacterial culture positivity among women presenting with genital discharge in Kinondoni Municipal, Dar es Salaam, Tanzania.

Methodology: A cross-sectional study was conducted in March and April 2022 at Mwananyamala Regional Referral Hospital, Magomeni Health Centre, and Tandale Health Centre. Women aged 15 to 49 years presenting with genital discharge were consecutively enrolled. Endocervical specimens were collected using standard procedures and processed by bacterial culture, Gram staining, and biochemical identification. Data were analysed using STATA version 15.5. Chi-square tests and logistic regression were used to assess associations between endocervical bacterial positivity and selected sociodemographic, behavioural, reproductive, and clinical factors. Statistical significance was set at $P<.05$.

Results: A total of 219 women were enrolled, with a median age of 37 years. Endocervical bacteria were isolated from 137 (62.5%) participants, yielding 138 isolates; one participant had two bacterial species. The predominant isolates were *Escherichia coli* (42, 30.4%), *Corynebacterium spp*. (18, 13.0%), *Staphylococcus aureus* (17, 12.3%), and *Klebsiella pneumoniae* (11, 8.0%). *Neisseria gonorrhoeae* was isolated from one participant (0.7%). Bacterial positivity was significantly higher among intrauterine device (IUD) users than non-users (80.7% vs. 59.6%, $P=.025$). In multivariable logistic regression, IUD use remained significantly associated with positive endocervical culture (adjusted odds ratio [aOR] 2.76; 95% CI, 1.06 to 7.16; $P=.036$). No statistically significant associations were observed with age, marital status, education, parity, history of miscarriage, history of sexually transmitted infection or the use of protection during sexual intercourse.

Conclusion: Endocervical bacterial positivity was common among women presenting with genital discharge, with E. coli being the predominant isolate. IUD use was significantly associated with positive endocervical culture. Strengthening laboratory-based evaluation of genital discharge may improve identification of bacterial organisms and support appropriate clinical management. Further prospective studies using molecular diagnostic methods are warranted to clarify the clinical significance of endocervical bacterial colonisation and its relationship with IUD use.

BACKGROUND

The endocervix connects the vagina and uterus and may serve as a passage for microorganisms from the vagina to the uterus, fallopian tubes, and ovaries. Under normal circumstances, mucus production and shedding of the outermost layer prevent pathogens from invading the upper genital tract from the lower genital tract.[1] Despite the defensive mechanism, pathogenic bacteria can colonize or invade the endocervix and cause disease. The disease can be symptomatic or asymptomatic, and for symptomatic cases, the most common symptoms are the presence of genital discharge and lower abdominal pain. The treatment of genital discharge is mainly based on the syndromic model, whereby clinicians prescribe medication based on the patient's explanation. The effect of untreated genital discharge can cause pelvic inflammatory disease (PID), increase infertility in severe cases and can increase the transmission of Human Immunodeficiency Virus (HIV).[2]

Bacterial endocervical infections and sexually transmitted infections affect the reproductive tract and are known to cause morbidity among women of reproductive age. The World Health Organization

(WHO) estimated that almost one million new cases of STIs occur daily worldwide, and 372 million people acquired at least one of chlamydia, gonorrhoea, syphilis, and trichomoniasis in 2020 worldwide.[3] The African region is the most affected among WHO regions, particularly among individuals aged 15 to 49.[5] The burden is further exacerbated in many African countries by limited access to diagnostic facilities, inadequate screening programs, and reliance on syndromic management, which may fail to detect asymptomatic infections and contribute to persistent transmission.[6] Therefore, reproductive tract infections are still a significant public health concern in sub-Saharan Africa, as they increase healthcare costs, cause adverse reproductive outcomes, and finally can contribute to high morbidity; for instance, studies from South Africa have demonstrated a substantial burden of reproductive tract infections and their associated complication, and STIs reported to accounted for more than 26% of all deaths and over 5 million DALYs in 2000 and over 98% of this burden was due to HIV/AIDS.[7]

Despite progress in Tanzania's health sector, access to diagnostic services remains limited, including laboratories capable of performing microbiological tests such as culture and sensitivity. This challenge is addressed by the country's treatment guidelines, which describe step-by-step the syndromic treatment, although the data on what type of bacteria is still scarce. A few studies have assessed the prevalence of genital infection in Tanzania, based on self-reported symptoms, and it was found to be 19.9% in 2013.[8] Another study which investigated endocervical bacteria in 2017 and 2018 at Muhimbili National Hospital, revealed *E.coli* 68 (61.8%) and *Klebsiella spp*. 22 (20.0%) from endocervical swabs.[9] Since mismanagement of female reproductive system disease can cause severe complications such as infertility[10], the current study assessed the endocervical bacterial profile and associated factors in women with genital discharge at Kinondoni Municipal Council, Dar es Salaam, Tanzania.

MATERIAL AND METHOD

Study Design, Setting, and Population

A cross-sectional study was conducted in March and April 2022 at three health facilities: Mwananyamala Regional Referral Hospital, Magomeni Health Centre, and Tandale Health Centre (one regional referral hospital and two health centres) in Kinondoni Municipal, Dar es Salaam, Tanzania. The study enrolled females aged between 15-49 years according to WHO age classification.[11]

Sample Size and Sampling Technique

The sample size was calculated based on Cochran's formula for sample size estimation, $n = (z_{\alpha/2})^2 \times P(1-P)/E^2$, considering the proportion of culture-positive results from the study of endocervical swabs among patients attending Muhimbili National Hospital in Tanzania, which was 86% [12], a 95% confidence interval, and 3% precision. Therefore, the minimum sample size was estimated to be 186. A purposive sampling technique was employed after identifying patients who met the enrollment criteria; research assistants (attending clinicians) explained the study's purpose and provided consent forms only to those willing to participate. Participants were consecutively enrolled at the outpatient clinics after signing written consent.

Data Collection Instrument

Using a structured questionnaire which had both Swahili and English versions and was pre-tested, we collected demographic, clinical, and behavioural information. The variables included age, marital status, number of sexual partners, use of protection during sexual intercourse, parity, history of STIs, and intrauterine device use.

Inclusion and Exclusion Criteria

This study included women of reproductive age and excluded pregnant women because the physiological changes occurs during pregnancy can alter the vaginal microbiota and genital discharge. It also excluded women who, at the time of data collection, were using antibiotics or had used antibiotics in the period of two weeks before sample collection.

Variables

The dependent variable was the status of the endocervical swab culture, categorised as either positive or negative. Independent variables include demographic factors (age, marital status, education level, parity, history of miscarriage, use of intrauterine device), sexual behaviour (number of sexual partners, use of protection during sexual intercourse), and clinical characteristics (history of STI).

Specimen Collection

Before specimen collection, the research assistants were oriented on sample collection, handling, and storage. A well-trained clinician or nurse collected endocervical swab specimens following the standard procedure. The swab was placed in Amie's with charcoal transport medium and then transported on the same day to Muhimbili University Microbiology Laboratory for processing within 1-2 hours.

Bacterial Isolation and Identification

An endocervical swab was inoculated on a Modified Thayer Martin Medium (MTM) (HiMedia, Mumbai, India), Chocolate Agar (CA) (Diagnostic Liofilchem, Italy), Blood Agar (BA) (Diagnostic Liofilchem, Italy), and MacConkey Agar (MCA) (Diagnostic Liofilchem, Italy). MTM and CA were incubated in 5% to 10% carbon dioxide for 24 to 48 hours, while BA and MCA were incubated aerobically for 18 to 24 hours. After inoculation, Gram staining was performed to assess the presence of clue cells, helping determine whether the observed growth was due to infection or merely colonization by the microorganism.

The growth on culture media was identified by colonial morphology, Gram staining, and biochemical tests (Oxidase, catalase, coagulase, Sulfide Indole Motility, Urease, Citrate utilization, and Triple Sugar Iron Agar). For Gram-positive cocci, the Catalase test and Coagulase test were used. Isolates suspected of being *Neisseria gonorrheae* were confirmed by a triple sugar fermentation test: fermenting glucose but not Maltose or sucrose.

Quality Control

Quality control of the prepared media was conducted through sterility checks and performance tests. Control organisms used for media control included *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923), and *Neisseria gonorrhoeae* (ATCC 47226). Additionally,

calibrated instruments such as the incubator and autoclave were monitored for temperature and underwent daily maintenance.

Data Management and Analysis

We analysed the data using STATA version 15.5 developed by Stata Corp LLC, Texas, United States. The study population's characteristics were summarised using frequencies, percentages, means, and medians. The differences in categorical variables were evaluated using the Chi-square test. The association between the presence of endocervical bacteria and independent variables was assessed using logistic regression. Variables with *P* values less than or equal to .2 were included in the multivariable logistic regression. A *P* value less than .05, within a 95% confidence interval, was considered statistically significant.

Ethical Consideration

We obtained ethical clearance from the Muhimbili University of Health and Allied Sciences Research and Publication Committee with Institutional Review Board (IRB) number MUHAS-REC-02-2022-959. Permission to collect data at Magomeni and Tandale health centres was obtained from the Kinondoni Municipal Council. For Mwananyamala Regional Referral Hospital, we obtained permission from the hospital management. Participant who were willing to participate in the study were given informed consent and informed of their right to decline participation or withdraw from the study at any time without any consequences or effect on the healthcare services they received.

RESULT

Characteristics of Study Participants

This study recruited 219 women with genital discharge with age ranging from 15 years to 50 years, and a median of 37 years. The distribution of marital status among participants was 91(41.6%), 94 (42.9%), and 34(15.5%) of single, married and widowed or divorced, respectively. Among participants, 5(3.2%) had no formal education, 178(81.3%) had a primary level of education and 53 (16.0%) had a secondary or college level of education. In sexual behaviour characteristics, only 30(13.7%) had zero parity, while 73(33.2%) had two parities, and 76 (34.7%) had three or more parities. The study also assessed the history of miscarriage; among women who participated, 34(15.5%) had a history of miscarriage once or more during their lifetime. Another characteristic was the use of an intrauterine device (IUD), whereby 14.2% admitted to being users and 188(85.8%) were non-users. The participants were also asked if they had ever been diagnosed with a sexually transmitted infection in their lifetime and 47 (21.5%) said yes while 172(78.5%) said no. Regarding the use of protection during sexual intercourse, 31 (14.2%) admitted to using protection, while 188(85.8%) admitted not to use protection. For the number of sexual partners, 126 (57%) had one partner, while 93 (42.5%) admitted to having more than one sexual partner. (Table1)

Profile of Endocervical Bacteria

A total of 138 bacteria were isolated from 137(62.5%) participants; the difference was attributable to a single participant from whom two distinct bacterial species were isolated, indicating a polymicrobial colonization. The most isolated bacteria was *Escherichia coli*, 42(30.43%), followed *Corynebacterium* spp 18(13.04%), *Staphylococcus aureus* 17(12.32%), and *Klebsiella pneumoniae* 11(7.97%). *Neisseria gonorrhoeae* was isolated from one participant, accounting for 1 (0.72%) of the isolated bacteria (Table 2).

TABLE 1: Demographic Characteristics of the Study Participants

Variable	Frequency (n)	Percentage (%)
Age (years)		
Median (IQR)	37 (21-50)	
15-24	11	5
25-34	75	34.3
35-44	88	40.2
45+	45	20.5
Marital status		
Single	91	41.6
Married	94	42.9
Divorced/widow	34	15.5
Education level		
No formal education	5	2.3
Primary school	178	81.3
Secondary school and college	54	16.0
Parity		
Mean (SD)	2.0 (1.32)	
0	30	13.7
1	40	18.3
2	73	33.3
3+	76	34.7
History of miscarriage		
Yes	34	15.5
No	185	84.5
Intrauterine device		
Yes	31	14.2
No	188	85.8
STI history		
Yes	47	21.5
No	172	78.5
Use of Condom		
Yes	31	14.2
No	188	85.8
Current sexual partner		
0 -1	126	57.5
> 1	93	42.5

Proportion of Isolated Endocervical Bacteria in Women with Genital Discharge

The proportion of endocervical bacteria was higher among participants with intrauterine devices (80.7%) than among those without (59.6%) (*P*=.025). There was no statistically significant difference in the proportion of endocervical bacteria by age group, marital status, education level, clinical symptoms, history of sexually transmitted infection, use of protection during sexual intercourse, or history of miscarriage (Table 3).

Factors Associated with Endocervical Bacteria

Logistic regression was used to assess the relationship between positive endocervical culture results and

sociodemographic, behavioural, and reproductive factors. In bivariate logistic regression, participants aged less than or equal to 37 years had lower odds of a positive culture compared with those aged more than 37 years (cOR, 0.86; 95% CI, 0.50 to 1.50; *P*=.613), although this association was not statistically significant.

Another socio-demographic factor, marital status, showed that single participants (cOR = 1.04, 95% CI, 0.46 to 2.33, *P*=.0.929) and married participants (cOR 1.04; 95% CI, 0.47 to 2.34, *P*=.918) had equal chances of having a presence of endocervical bacteria as widows and divorced participants, although this was not statistically significant. In the category of education level, it showed that both primary (cOR 0.38; 95% CI, 0.04 to 3.44; *P*=.387), secondary and college levels of education (cOR 0.65; 95% CI, 0.06 to 6.55; *P*=.715) had a lower odds of positive culture than those with no formal education, although the difference was not statistical significant. Participants with parity of less than two children had lower odds of having endocervical bacteria compared to women with more than two children, although this is not statistically significant.

A history of miscarriage was associated with an increased likelihood of a positive endocervical, although the association was not statistically significant (cOR 2.17; 95% CI, 0.93 to 5.05, *P*=.073). Similarly, participants with a history of STI had a higher likelihood of positivity compared to those without an STI history (cOR 1.36; 95% CI, 0.69 to 2.70; *P*=.378), but this association was also not statistically significant. Intrauterine Device (IUD) use was significantly associated with a positive endocervical swab culture. Participants who admitted to having an IUD had approximately three times higher odds of having a positive endocervical swab culture than the others (cOR 2.80; 95% CI, 1.10 to 7.21; *P*=.030). After adjustment for potential confounders, IUD use remained significantly associated with a positive endocervical swab culture (aOR 2.76; 95% CI, 1.06 to 7.16; *P*=.036). Thus, IUD users had approximately 2.8 times higher odds of having a positive endocervical swab culture than non-users (Table 4).

TABLE 2: Frequency and Percentage Distribution of Bacteria Isolated in Women With Genital Discharge (N=138)

Bacteria Isolated	Frequency (n)	Percentage (%)
Escherichia coli	42	30.43
Corynebacterium spp	18	13.04
Staphylococcus aureus	17	12.32
Klebsiella pneumoniae	11	7.97
Streptococcus agaractiae	9	6.52
Coagulase-negative *staphylococci*	8	5.80
Enterococcus fecalis	7	5.07
Pseudomonas aeruginosa	7	5.07
Enterobacter spp	5	3.62
Citrobacter spp	3	2.17
Proteus vulgaris	3	2.17
Gram-positive rod	2	1.45
Moragnella morganii	2	1.45
Acinetobacter spp	1	0.72
Aeromonas spp	1	0.72
Neisseria gonorrhoea	1	0.72
Providencia spp	1	0.72
Total	138	100.00

TABLE 3: Proportion of Isolated Endocervical Bacteria in Women With Genital Discharge (N=219)

Variable	Positive (n) %	Negative (n)%	*P Value*
Age group(years)			
≤37	67(60.9)	43(39.1)	.613
>37	70(64.2)	39(35.8)	
Marital status			
Single	21(61.8)	13(38.2)	.994
Married	59(62.7)	35(37.2)	
Divorced/widow	57(62.6)	34(37.4)	
Education level			
No formal education	4(80.0)	1(20.0)	.281
Primary school	107(60.1)	71(39.9)	
Secondary school and college	26(7.2)	10(27.8)	
Parity			
≤2	88(61.5)	55(38.5)	.669

Continue

TABLE 3: Continued

Variable	Positive (n) %	Negative (n)%	*P Value*
>2	49(64.5)	27(35.5)	
History of miscarriage			
Yes	26(76.5)	8(23.5)	.068
No	111(60.0)	74(40.0)	
Intrauterine device			
Yes	25(80.7)	6(19.4)	.025
No	112(59.6)	76(40.4)	
STI history			
Yes	32(68.1)	15(31.9)	.377
No	105(61.1)	67(38.9)	
Use of Condom			
Yes	20(64.5)	11(35.5)	.808
No	117(62.2)	71(37.8)	
Foul smell			
Yes	16(76.2)	5(23.8)	.175
No	121(61.1)	77(38.9)	
Genital ulcer			
Yes	8(50.0)	8(50.0)	.281
No	129(63.5)	74(36.5)	
Swelling lymph node			
Yes	6(66.7)	3(33.3)	.795
No	131(62.4)	79(37.6)	
Itching			
Yes	36(67.9)	17(32.1)	.354
No	101(60.8)	65(67.9)	
Genital burn			
Yes	6(66.7)	3(33.3)	.795
No	131(62.2)	79(37.6)	

TABLE 4: Bivariate and Multivariable Analysis of Factors Associated With a Positive Culture of Endocervical Bacteria (N=219)

Variable	Bivariate analysis cOR	95%CI	*P Value*	Multivariate analysis aOR	95%CI	*P Value*
Age (years) ≤37 ref. >37)	0.86	0.50-1.50	.613			
Marital status						
Single	1.04	0.46-2.33	.929			
Married	1.04	0.47-2.34	.918			
Widow and Divorced	1					
Education level						
Primary	0.38	0.04-3.44	.387			
Secondary school and college	0.65	0.06-6.55	.715			
No formal education	1					
Parity ≤2 ref.>2)	0.88	0.49-1.57	.669			
Miscarriage Yes ref. No	2.17	0.93-5.05	.073	1.9	0.82-4.61	.129
Intrauterine device Yes ref. No	2.8	1.10-7.21	.030	2.76	1.06-7.16	.036
STI history Yes ref. No)	1.36	0.69-2.70	.378			
Awareness of STI Yes ref. No	0.62	0.21-1.80	.380			
Use of Condom Yes ref. No	0.90	0.41-2.00	.080	0.90	0.40-2.04	.810
Number of sexual partners > 1 ref. 0-1	1.25	0.71-2.20	.426			
Foul smell Yes ref. No	2.04	0.71-5.78	.182	2.25	0.78-6.45	.133

Continue

TABLE 4: Continued

Variable	Bivariate analysis cOR	95%CI	*P Value*	Multivariate analysis aOR	95%CI	*P Value*
Genital ulcer Yes ref. No	0.57	0.21-1.59	.286			
Lymph node swelling Yes ref. No	1.21	0.29-4.95	.795			
Genital itching Yes Ref. No	1.36	0.17-2.62	.355			
Genital burn Yes Ref. No	1.20	0.29-4.96	.795			

DISCUSSION

This study aimed to assess the occurrence of endocervical bacterial isolates and factors associated with genital discharge in women. Gram positive and Gram negative bacteria endocervical bacteria were isolated from 137 (62.5%) out of 219 women. They including *Escherichia coli*, *Corynebacterium* spp., *Staphylococcus aureus*, and *Klebsiella pneumoniae*. Although several sociodemographic, behavioural, and reproductive characteristics were studied, intrauterine device (IUD) use was the only factor that remained significantly associated with a positive endocervical culture.

The high proportion of women with positive endocervical cultures observed in this study suggests that bacterial colonisation or infection may be common among women presenting with genital discharge. The predominance of *E. coli* is of concern because the organism is part of the normal intestinal microbiota but can colonise the female genital tract as opportunistic infections.[13] This colonization may reflect the close anatomical proximity of the gastrointestinal and female genital tracts, facilitating perineal colonization and ascending transmission.[14] The finding also suggests that genital discharge in this population may not be attributable exclusively to classical sexually transmitted pathogens and that bacterial organisms that are not traditionally classified as sexually transmitted pathogens may contribute to genital tract symptoms.[15]

The isolation of *Corynebacterium* spp. and *S. aureus* further demonstrates the diversity of bacteria recovered from the endocervical specimens. Some Corynebacterium species and staphylococci may represent normal or transient genital tract flora rather than clinically significant infection.[16,17,18] Therefore, their isolation should be interpreted alongside clinical findings and laboratory characteristics rather than as definitive evidence of pathogenic infection. Nevertheless, the presence of potentially pathogenic organisms in women with genital discharge emphasises the importance of appropriate microbiological evaluation when clinically indicated.

Gram-negative bacteria isolated included *K. pneumoniae* and other others, which indicate the association with the female the anatomical structure.[19] Bacteria can be transferred from the urinary tract to the vaginal opening and ascend to the cervix.[20] The relatively low frequency of *Neisseria gonorrhoeae* in this study, with only one isolate detected, may indicate that gonococcal infection was uncommon among the participants sampled. However, low culture positivity should be interpreted with caution because the sensitivity of culture for *N. gonorrhoeae* can be affected by specimen collection, transport conditions, prior antimicrobial exposure, and the diagnostic method used.[21] Molecular methods such as nucleic acid amplification tests may provide greater sensitivity for detecting gonococcal infection.

An important finding of this study was the significant association between IUD use and positive endocervical bacterial culture. Participants using an IUD had significantly higher odds of a positive culture in both bivariate analysis (cOR 2.80; 95% CI, 1.10 to 7.21; *P*=.030) and multivariable analysis (aOR 2.76; 95% CI, 1.06 to 7.16; *P*=.036). This finding is consistent with the regression analysis and provides additional evidence that IUD use may be an important factor associated with endocervical bacterial positivity in this population. This result is similar to the study conducted in Iraq[22], in which the positivity of endocervical culture results was 44.44%, and the predominant bacteria were *E.coli* (17.28%), *S.aureus* (7.41%), and *Klebsiella spp* (6.79%) among IUD users. Also, in Uganda, the study revealed an association between PID and IUD use, whereby *S.aureus* was predominant among the bacteria isolated.[23] In Tanzania, the assessment on IUD use showed a high prevalence of STIs among women who opted for IUCD use in the city of Mwanza.[24] Insertion of an IUD involves the introduction of a foreign device through the cervix, and insertion may facilitate the introduction or redistribution of microorganisms within the upper genital tract. In addition, the presence of a foreign body may influence the local genital tract environment and facilitate bacterial adherence or persistence.

Other factors assessed, such as a history of miscarriage, showed a potentially increased likelihood of positive endocervical culture, although the association did not reach statistical significance (cOR 2.17; 95% CI, 0.93 to 5.05; *P*=.073). Similarly, participants with a history of sexually transmitted infection had higher odds of positive culture than those without such a history, but the association was not statistically significant (cOR = 1.36, 95% CI: 0.69–2.70, *P* = 0.378). This finding may indicate that previous STI exposure could be related to bacterial colonization or infection, but the evidence from this study is insufficient to establish such an association. No statistically significant association was observed between positive endocervical culture and age, marital status, education level, or the other assessed characteristics. The absence of significant associations should, however,

not be interpreted as evidence that these factors have no relationship with genital tract bacterial infections. Differences in sexual behaviour, healthcare-seeking practices, hygiene, previous antimicrobial exposure, and other unmeasured factors may influence bacterial colonization and could not necessarily be fully captured by the variables assessed in this study.

The finding of polymicrobial infection in one participant is also noteworthy. A total of 138 bacterial isolates were recovered from 137 participants, indicating that one participant had two distinct bacterial species. This demonstrates that more than one bacterial organism can occur concurrently in the endocervical tract. In the analysis, participants rather than individual isolates were used as the unit of analysis for culture positivity, which avoids counting one participant more than once when estimating the proportion of women with bacterial positivity.

CONCLUSION

Conclusively, findings of this study reveal the burden of endocervical bacteria isolated among the women, which is attributed to the use of IUDs. The diversity of bacteria isolated suggests that the microbiological causes of genital discharge may be heterogeneous. Where laboratory capacity is available, microbiological investigation can complement clinical investigation and help distinguish bacterial colonization from clinically relevant infection. Particular attention should also be given to women using IUDs who present with persistent or recurrent genital discharge, while avoiding unnecessary removal of an IUD solely based on bacterial culture positivity without appropriate clinical assessment. Despite these limitations, the study provides important evidence on the bacterial profile of endocervical specimens among women presenting with genital discharge and identifies IUD use as a significant factor associated with bacterial culture positivity. The findings support the importance of strengthening laboratory-based evaluation of genital discharge and further investigating the relationship between contraceptive-device use and endocervical bacterial colonization or infection. Prospective studies incorporating molecular detection methods, detailed information on IUD characteristics and duration of use, antimicrobial exposure, and clinical follow-up would provide a better understanding of the clinical significance and causal pathways underlying the observed association.

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