

# Investigation of the Prevalence of *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Mycoplasma hominis* and *Ureaplasma urealyticum* in Genitouriner Tract of Patient with HPV

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## Abstract

**Objective:** In this study, investigation of the prevalence of *Chlamydia trachomatis* (*C.trachomatis*), *Neisseria gonorrhoeae* (*N.gonorrhoeae*), *Ureaplasma urealyticum* (*U.urealyticum*) and *Mycoplasma hominis* (*M.hominis*) pathogens in patients with Human Papilloma virus (HPV) and elimination of incorrect treatment choices are aimed.

**Material and Method:** Ninety-two women patients with vaginal discharge who admitted OMU faculty of medicine obstetrics and gynecology departments were included in the study. Of ninety-two women, forty-six were included in the HPV positive patient group and other forty-six were included in the HPV negative control group. *C.trachomatis* and *N.gonorrhoeae* were performed by real-time PCR and *U.urealyticum* and *M.hominis* were performed by Mycoplasma IST 2 kit.

**Results:** Growth was detected in eighty patients by Mycoplasma IST 2 kit. Also, both *U.urealyticum* and *M.hominis* were detected in five patients in the patient group. *M.hominis* was observed in five individuals and *U.urealyticum* was observed in eighty individuals. Totally, *U.urealyticum* growth of  $\geq 104$  cfu/ml was detected in eighty individuals and *M.hominis* growth of  $\geq 104$  cfu/ml was detected in five individuals. *U.urealyticum* was isolated in forty-three individuals in the patient group and in thirty-seven individuals in the control group. In the antibiotic susceptibilities testing of the microorganism from the patient group, the highest resistance rates were seen against erythromycin, tetracycline and clarithromycin. All of the *M.hominis* strains were found to be resistant to erythromycin and tetracycline. In one patient, resistance to all tested antibiotics was detected and *U.urealyticum* and *M.hominis* were isolated together in this patient. In thirty-seven *U.urealyticum* growth in the control group, the highest resistance rates were seen ofloxacin and erythromycin. PCR results test of two patients were found to be positive by Duplica Real Time Advanced *C.trachomatis* and Duplica Real Time Advanced *N.gonorrhoeae* kit. *N.gonorrhoeae* DNA was detected in no patients. The two patients with *C.trachomatis* DNA positive was in the patient group and *U.urealyticum* and *M.hominis* positivities were detected by Mycoplasma IST 2 kit in these patients.

**Conclusion:** As a conclusion, *U.urealyticum* was more prevalent than *M.hominis*, similar to other studies. Clinically a significant association between HPV positivity and the existence of *C.trachomatis*, *N.gonorrhoeae*, *U.urealyticum* and *M.hominis* wasn't detected. More comprehensive studies are needed to evaluate the relationship among these organisms

**Keywords:** *C.trachomatis*, *U.urealyticum*, *M.hominis*, Real-time PCR, HPV

## HPV Tanısı Konmuş Hastaların Genitoüriner Sisteminde *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Mycoplasma hominis* ve *Ureaplasma urealyticum* Sıklığının Araştırılması

### Özet

**Amaç:** Bu çalışmada cinsel yolla bulaşan *Neisseria gonorrhoeae* (*N.gonorrhoeae*), *Chlamydia trachomatis* (*C.trachomatis*), *Mycoplasma hominis* (*M.hominis*) ve *Ureaplasma urealyticum* (*U.urealyticum*) patojenlerinin klinik olarak Human Papilloma virus (HPV) tanısı konmuş hastalardaki sıklığının araştırılması ve yanlış tedavi seçeneklerinin ortadan kaldırılması amaçlanmıştır.

**Materyal ve Metot:** Çalışma kapsamına OMÜ Tıp Fakültesi Kadın Hastalıkları ve Doğum Anabilim Dalı polikliniğine başvuran vajinal akıntısı olan 92 kadın dahil edilmiştir. 92 kadının 46'sı klinik olarak HPV(+) tanısı almış hasta grubunu, 46'sı klinik olarak HPV(-) kontrol grubunu oluşturmuştur. *C.trachomatis* ve *N.gonorrhoeae* Real-time PCR yöntemi ile, *M.hominis* ve *U.urealyticum* Mycoplasma IST 2 kit yöntemi ile araştırılmıştır.

**Bulgular:** Mycoplasma IST 2 kiti ile çalışılan örneklerden kontrol ve hasta grubundaki toplam 92 kadından 80'inde ( $\geq 104$  CFU/ml) üreme saptanmıştır. Ayrıca hasta grubunda 5 kişide hem *M.hominis* ( $\geq 104$  CFU/ml) hem de *U.urealyticum* ( $\geq 104$  CFU/ml) tespit edilmiştir. Hasta grubundan 43 kişide, kontrol grubundan 37 kişide *U.urealyticum* izole edilmiştir. Yapılan Fisher ve düzeltilmiş Yates istatistiksel analizde hasta ve kontrol grupları arasında HPV(+)lığıyla anlamlı bir fark bulunmamıştır ( $p>0,05$ ). Hasta grubundan izole edilen mikroorganizmaların antibiyotik duyarlılıkları değerlendirildiğinde; en yüksek derecede direnç eritromisin, tetrasiklin, klaritromisine karşı görülmüştür. Tüm *M.hominis* suşları eritromisin ve tetrasikline dirençli bulunmuştur. Bir hastada test edilen bütün antibiyotiklere direnç saptanmıştır ve bu hastada *M.hominis* ve *U.urealyticum* birlikte izole edilmiştir. Kontrol grubunda üreyen 37 *U.urealyticum* da ise en yüksek derecede direnç ofloksasin ve eritromisine karşı görülmüştür. Duplica Real Time Advanced *C.trachomatis* ve Duplica Real Time Advanced *N.gonorrhoeae* kiti ile çalışılan örneklerden 2 kişide *C.trachomatis* PCR sonucu pozitif bulunmuştur. Hiçbir hastada *N.gonorrhoeae* DNA tespit edilememiştir. Pozitif bulunan 2 *C.trachomatis* DNA sonucu HPV (+) olan hasta grubuna dahil ve bu 2 hastada Mycoplasma IST 2 kiti ile yapılan çalışmada *M.hominis* ve *U.urealyticum* pozitifliği de tespit edilmiştir.

**Sonuç:** Sonuç olarak bizim çalışmamızda da diğer çalışmalarla benzer olarak *U.urealyticum*'a *M.hominis*'ten daha sık rastlanmıştır. İstatistiksel analizde klinik olarak HPV (+)lığının *C.trachomatis*, *U.urealyticum* ve *M.hominis* birlikteliğiyle anlamlı bir ilişkisinin olduğu saptanmamıştır ( $p>0,05$ ). *C.trachomatis*, *N.gonorrhoeae*, *M.hominis* ve *U.urealyticum*'un hakkında çalışmalar arttıkça daha doğru sonuçlar elde edilebilecektir.

**Anahtar kelimeler:** *C.trachomatis*, *U.urealyticum*, *M.hominis*, Real-time PCR, HPV

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## INTRODUCTION

Although the female genital tract provides a barrier against microorganisms to a certain extent due to the influence of estrogen, it can be exposed to various infectious agents. Therefore, one of the most common complaints in patients presenting to gynecology and obstetrics clinics is vaginal discharge. Mycoplasma hominis (M. hominis), Ureaplasma urealyticum (U. urealyticum), Gardnerella vaginalis, Neisseria gonorrhoeae (N. gonorrhoeae), Chlamydia trachomatis (C. trachomatis), Trichomonas vaginalis, yeasts, and various bacteria play an important role in the etiology of this discharge. The frequent coexistence of these microorganisms with Human Papilloma virus (HPV), facilitating the development of the other, is a clinically significant situation (1). C. trachomatis and N. gonorrhoeae infections in the urogenital system are often asymptomatic, are difficult to isolate in laboratory conditions, and optimal diagnostic methods have not yet been developed, making

them easy to spread and leading to complications such as infertility, ectopic pregnancy, and pelvic inflammatory disease, particularly in women (2). Similarly, genital mycoplasmas can cause numerous health problems, including cervicitis, salpingitis, pelvic abscess, nongonococcal urethritis, puerperal fever, chorioamnionitis, spontaneous abortions, and, rarely, infertility (3). However, simultaneously detecting all these pathogens in the clinic is often impossible due to both laboratory limitations and diagnostic inadequacies. Therefore, patients are often treated empirically, but this approach can lead to the emergence of recurrent and treatment-resistant infections. Only a small portion of sexually transmitted infections are accurately diagnosed and treated (4). Therefore, regular screening tests and the use of modern molecular diagnostic methods are of great importance (5). Insufficient knowledge of the prevalence of pathogens such as N. gonorrhoeae, C. trachomatis, M. hominis and U. urealyticum in our country can lead to inaccurate or inadequate treatment approaches. In this regard, the use of molecular methods, which allow for faster, more reliable, and more accurate identification of infections, is at the forefront (6). This study investigated the prevalence of sexually transmitted infections such as N.

gonorrhoeae, *C. trachomatis*, *M. hominis* and *U. urealyticum* and their relationship with HPV in married, sexually active women of childbearing age who presented to Samsun Ondokuz Mayıs University Faculty of Medicine with complaints of vaginal discharge.

## MATERIALS AND METHODS

### *Study Group*

This study included 92 women who presented to the Obstetrics and Gynecology Outpatient Clinic of Samsun Ondokuz Mayıs University Faculty of Medicine between June 2011 and January 2012 with complaints of vaginal discharge. Forty-six of the subjects were diagnosed with HPV (patient group) and 46 were HPV-negative (control group). All participants were sexually active, and informed consent was obtained before inclusion in the study.

### *Sample Collection and Storage*

Cervical swab samples were collected using sterile Dacron-tipped swabs during a routine gynecological examination. Samples were collected by inserting a speculum 1–2 cm into the cervix uteri and rotating the swab, without cleaning the vagina with antiseptic. One sample was transferred to the Mycoplasma IST 2 (BioMérieux®, USA) kit for *M. hominis* and *U. urealyticum*, and the other was transferred to Copan Universal Transport Medium for *C. trachomatis* and *N. gonorrhoeae*. Mycoplasma samples were stored at 2–8°C and processed within 48 hours, while *C. trachomatis* and *N.*

gonorrhoeae samples were stored at -70°C until analysis.

### *Sample Analysis*

Culture, typing, quantitative assessment, and antibiotic susceptibility testing for *M. hominis* and *U. urealyticum* were performed using the Mycoplasma IST 2 (BioMérieux®, USA) kit. The strip kit provided results based on color changes with specific substrates (e.g., arginine for *M. hominis*) and a pH indicator. Additionally, susceptibility to nine different antibiotics was evaluated simultaneously (doxycycline, josamycin, ofloxacin, erythromycin, tetracycline, ciprofloxacin, azithromycin, clarithromycin, and pristinamycin).

The EuroClone® Duplica Real Time Advanced Chlamydia trachomatis (EuroClone, Italy) kit was used for *C. trachomatis* and the EuroClone® Duplica Real Time Neisseria gonorrhoeae (EuroClone, Italy) kit was used for *N. gonorrhoeae*. DNA extraction for both tests was performed with the Qiagen EZ1 Virus Mini Kit v2.0. The obtained DNA products were amplified using real-time PCR and were processed according to the thermal cycling profiles specified by the manufacturer.

### *Statistical Analysis*

Adjusted Yates test and Fisher's exact test were used to compare the distribution of microorganisms in the patient and control groups. A p value of <0.05 was accepted as statistical significance.

**RESULTS**

This study included 92 sexually active women who presented to the Ondokuz Mayıs University Faculty of Medicine, Obstetrics and Gynecology Outpatient Clinic with complaints of vaginal discharge between June 2011 and January 2012. Forty-six of these cases were clinically HPV positive (patient group), and 46 were HPV negative (control group).

Assessment using the Mycoplasma IST2 method revealed growth in 80 of the 92 cases (86.9%). *U. urealyticum* was isolated in 80 (86.9%) cases and *M. hominis* in 5 (5.4%) cases. Growth was observed in 43 (93.4%) cases in the patient group and 37 (80.4%) cases in the control group. Thirty-eight of the HPV-positive patients showed growth of *U. urealyticum* alone, and five showed growth of *U. urealyticum* and *M. hominis* together. In all cases where growth was observed in the control group, only *U. urealyticum* was isolated (Table 1). Statistical analysis revealed no significant difference between the patient and control groups ( $p=1.00$  for *U. urealyticum*;  $p=0.055$  for *M. hominis*).

**Table 1.** Microorganism Distribution According to HPV-Positive Patients (n:46) and Control Groups (n:46)

Microorganism	HPV (+) n (%)	HPV (-) n (%)	Note
<i>U. urealyticum</i>	43 (93.47%)	37 (80.43%)	Most frequently
<i>M. hominis</i>	5 (10.86%)	0	All HPV (+) patients
<i>C. trachomatis</i>	2 (4.34%)	0	All HPV (+) patients
<i>N. gonorrhoeae</i>	0	0	None

When the antibiotic susceptibility profiles of all isolates were examined, the antibiotics to which *U. urealyticum* strains were most susceptible were doxycycline (96.3%), josamycin (96.3%), ciprofloxacin (95%), and azithromycin (95%). The highest resistance was observed against erythromycin (12.5%), ofloxacin (8.7%), and tetracycline (8.7%). All *M. hominis* strains were resistant to erythromycin and tetracycline. Furthermore, *M. hominis* and *U. urealyticum* were isolated together in one patient, and resistance to all tested antibiotics was detected (Table 2).

**Table 2.** Antibiotic sensitivities according to microorganisms for all samples.

	<i>U.urealyticum</i>		<i>M.hominis</i>	
	Sensitive	Resistance	Sensitive	Resistance
<b>Doxycycline</b>	77 (96.3%)	3	4 (80%)	1
<b>Josamycin</b>	77 (96.3%)	3	4 (80%)	1
<b>Ofloxacin</b>	73 (91.3%)	7	3 (60.0%)	2
<b>Erythromycin</b>	70 (87.5%)	10	0 (%0.0)	5
<b>Tetracycline</b>	73 (%91.3)	7	0 (%0)	5
<b>Ciprofloxacin</b>	76 (95.0%)	4	4 (80%)	1
<b>Azithromycin</b>	76 (95%)	4	4 (80%)	1
<b>Clarithromycin</b>	74 (92.5%)	6	4 (80%)	1
<b>Pristinamycin</b>	75 (93.8%)	5	3 (60%)	2

When the patient and control groups were evaluated separately, *U. urealyticum* isolates in the control group were found to be 100%

susceptible to doxycycline, tetracycline, and ciprofloxacin. In the HPV-positive patient group, the most significant resistance was observed against erythromycin (16.3%), tetracycline (16.3%), and clarithromycin (11.6%) (Table 3).

**Table 3.** Antibiotic susceptibility in *U. urealyticum*-producing organisms.

	Patient		Control	
	Sensitive	Resistance	Sensitive	Resistance
<b>Doxycycline</b>	41	2	37	0
<b>Josamycin</b>	41	2	36	1
<b>Ofloxacin</b>	39	4	34	3
<b>Erythromycin</b>	36	7	34	3
<b>Tetracycline</b>	36	7	37	0
<b>Ciprofloxacin</b>	39	4	37	0
<b>Azithromycin</b>	40	3	36	1
<b>Clarithromycin</b>	38	5	36	1
<b>Pristinamycin</b>	40	3	35	2

Real-time PCR analysis revealed *C. trachomatis* DNA positivity in 2 of 96 samples (2.1%). These two cases were in the HPV (+) patient group, and both cases had coinfection with *M. hominis* and *U. urealyticum*. *N. gonorrhoeae* DNA was not detected in any sample. Statistical analysis revealed no significant difference in *C. trachomatis* between the patient and control groups (p=0.49).

**DISCUSSION**

This study investigated the relationship between sexually transmitted microorganisms (*N. gonorrhoeae*, *C. trachomatis*, *M. hominis* and *U. urealyticum*) and HPV in women of childbearing age presenting with vaginal discharge. The

findings indicate that genital infections often develop from the coexistence of multiple microorganisms rather than a single pathogen, and this coexistence, particularly with viral agents such as HPV, leads to a more complex clinical picture.

*C. trachomatis* and *N. gonorrhoeae* infections are among the most common sexually transmitted bacterial diseases worldwide. According to World Health Organization (WHO) data, 128.5 million new cases of chlamydial infection were reported in 2020. The asymptomatic nature of the majority of infections creates serious obstacles to both diagnosis and treatment, contributing to the silent spread of the disease in the community. *N. gonorrhoeae* can cause complications such as pelvic inflammatory disease (PID), infertility, and ectopic pregnancy. Furthermore, increasing antibiotic resistance has become a significant problem in gonorrhea treatment (7).

Although *M. hominis* and *U. urealyticum* were long considered "opportunistic flora members," meta-analyses and cohort studies, particularly after 2020, support the association of these microorganisms with cervicitis, salpingitis, pelvic abscess, infertility, spontaneous abortion, and preterm birth. Recent multicenter studies and meta-analyses have shown that the prevalence of lower urogenital colonization by *Ureaplasma* spp. and *M. hominis* continues; the prevalence for *Ureaplasma* spp. is generally higher (20%-50%), while the rates reported for *M. hominis* are

more variable and generally lower (1%-15%). Furthermore, recent antibiotic resistance data indicate that, although regional variations exist, resistance to macrolides, tetracyclines, and fluoroquinolones is increasing. Therefore, clinical management should be based on local resistance patterns (8–11). The high frequency of isolation of these agents in our study demonstrates that their clinical importance should not be overlooked. In our study, *U. urealyticum* (86.9%) was detected much more frequently than *M. hominis*. The presence of vaginal discharge in all cases suggests that these microorganisms may be the causative agents. Furthermore, the colony density results of  $\geq 10^4$  cfu/ml obtained with the Mycoplasma IST 2 kit support the clinical significance of the isolations. The association between HPV positivity and *U. urealyticum* was also evaluated, but no significant association was found ( $p > 0.05$ ). When antimicrobial susceptibility results were examined, the highest resistance in our study was found to erythromycin and tetracycline for both *U. urealyticum* and *M. hominis*. The fact that all *M. hominis* isolates detected in our study were resistant to tetracycline supports this increasing trend. Therefore, considering that empirical treatments are often inadequate and lead to treatment-resistant cases, accurate identification of the pathogens and determination of antibiotic susceptibility are critical for treatment management.

HPV is the most common viral sexually transmitted infection and is considered the most important risk factor for the development of cervical cancer (12). The fact that *C. trachomatis* was detected in conjunction with HPV in our study is noteworthy. It has also been reported in the literature that *C. trachomatis* may increase the risk of developing cervical intraepithelial neoplasia (CIN) in cases of coinfection with HPV (13). This finding suggests that HPV and bacterial infections may interact synergistically. The immune-suppressive effect of HPV may increase the persistence of bacterial pathogens; similarly, chronic bacterial inflammation may predispose HPV to the development of persistent infection.

The prevalence of *C. trachomatis* infections is reported at highly variable rates in different populations, depending on patient groups and diagnostic methods used. A meta-analysis conducted by Huai et al. (2020) provided important conclusions by updating the prevalence of *C. trachomatis* worldwide. This study evaluated 29 studies covering a total of 89,886 individuals and found that the prevalence of *C. trachomatis* in the general population was 2.9%. Furthermore, regional differences were observed in subgroup analyses; for example, while the prevalence was 4.5% across the Americas, much lower rates (0.8%) were reported in Southeast Asia. These differences have been interpreted as being influenced by

social, cultural, economic, and health infrastructure factors (14). Verteramo et al. In their study of 857 women in Italy, they found a significant association between HPV and the presence of *C. trachomatis* and high concentrations of *U. urealyticum*, but they did not find any association with *N. gonorrhoeae* (15). Furthermore, a meta-analysis by Liang et al. reported a strong association between HPV infection and *C. trachomatis* and *U. urealyticum*. Furthermore, the coexistence of bacterial vaginosis and HPV increased the risk of developing cervical intraepithelial neoplasia (CIN) (16). In our study, only 2 (2.1%) of 96 patients with vaginal discharge were found to be positive for *C. trachomatis* by PCR. While it is noteworthy that these two cases were HPV positive, the statistical analysis did not reveal a significant association ( $p>0.05$ ). *N. gonorrhoeae* was not detected in any patient in our study. In the literature, chlamydial coinfection has been reported in 37.9%–40.8% of women infected with *N. gonorrhoeae*; such an association was not observed in our study (17). The lack of *N. gonorrhoeae* detection in our study may be related to the limited sample size, the fact that this patient population frequently received diagnosis and treatment in healthcare units before the University Hospital, and the geographical differences.

Given the limitations of conventional culture and serological tests, the importance of molecular

methods for the accurate diagnosis of sexually transmitted diseases is increasing. PCR and other nucleic acid amplification tests demonstrate high performance in terms of both sensitivity and specificity (18). The use of these methods in our study also enabled more accurate detection of pathogens. These results emphasize the need for routine use of molecular methods, especially in asymptomatic individuals.

The most important limitations of our study are the relatively limited sample size and the fact that the cases represent only a specific geographic region. Future studies should both determine population-wide prevalence with larger samples and examine resistance mechanisms. Furthermore, prospective and molecular studies to clarify the interaction between HPV and bacterial pathogens will further clarify the clinical significance of this association.

## CONCLUSION

In conclusion, this study demonstrates that the etiology of genital infections in women presenting with vaginal discharge is multifactorial, that bacterial and viral agents can frequently coexist, and that this can lead to serious clinical complications. The association of HPV with bacterial pathogens is particularly significant for the development of cervical cancer. Therefore, it is crucial that not only HPV but also bacterial pathogens be included in regular screening programs in public health

policies. It is crucial that molecular diagnostic methods be routinely implemented and that targeted therapies replace empirical treatments.

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**Ethics Committee Approval:** This study was approved by the Ondokuz Mayıs University Medical Research Ethics Committee with decision number 2011/230 dated 27.01.2011.

**Author Contributions:** Conception - Hacer Ozlem Kalayci, Murat Gunaydin; Supervision - Hacer Ozlem Kalayci; Data Collection and/or Processing - Hacer Ozlem Kalayci, Murat Gunaydin; Analysis and/or Interpretation - Hacer Ozlem Kalayci, Murat Gunaydin; Literature Search - Hacer Ozlem Kalayci, Murat Gunaydin; Writing - Hacer Ozlem Kalayci; Critical Review - Hacer Ozlem Kalayci, Murat Gunaydin

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## REFERENCES

1. Bi H, Zhang D, Xiao B. Association between human papillomavirus infection and common sexually transmitted infections, and the clinical significance of different *Mycoplasma* subtypes. *Frontiers in Cellular and Infection Microbiology*. 2023;13:1145215.
2. Darville T. Pelvic inflammatory disease due to *Neisseria gonorrhoeae* and *Chlamydia trachomatis*: immune evasion mechanisms and pathogenic disease pathways. *The Journal of infectious diseases*. 2021;224(Supplement\_2):S39-46.
3. Cheng C, Chen X, Song Y, Wang S, Pan Y, Niu S, et al. Genital mycoplasma infection: a systematic review and meta-analysis. *Reprod Health*. 2023;20(1):136.
4. Lillis R, Kuritzky L, Huynh Z, Arcenas R, Hansra A, Shah R, et al. Outpatient sexually transmitted infection testing and treatment patterns in the United States: a real-world database study. *BMC Infect Dis*. 2023;23(1):469.
5. Opota O, Greub G. Syndromic approaches for sexually transmitted infections: added value of molecular diagnosis. *Current Opinion in HIV and AIDS*. 2025;20(3):303-9.
6. Kirkoyun Uysal H, Koksall MO, Sarsar K, Ilktac M, Isik Z, Akgun Karapinar DB, et al. Prevalence of *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Mycoplasma genitalium* among Patients with Urogenital Symptoms in Istanbul. *MDPI Healthcare*. 2023; 11(7): 930.
7. Mahapure K, Singh A, Mahapure K. A review of recent advances in our understanding of *Neisseria gonorrhoeae*. *Cureus*. 2023;15(8): e43464.
8. Shao L, Wu X, Gao S, Liu L, Zhang Y, Zhao H. Epidemiological investigation and antimicrobial susceptibility analysis of *Ureaplasma* and *Mycoplasma hominis* in a

- teaching hospital in Shenyang, China. *Journal of Infection and Chemotherapy*. 2021;27(8):1212-6.
9. Song J, Wu X, Kong Y, Jin H, Yang T, Xie X, et al. Prevalence and antibiotics resistance of *Ureaplasma* species and *Mycoplasma hominis* in Hangzhou, China, from 2013 to 2019. *Frontiers in Microbiology*. 2022;13:982429.
  10. Wen X, Nobakht MS, Yang Y, Kouhsari E, Hajilari S, Shakourzadeh MZ, et al. Tetracyclines resistance in *Mycoplasma* and *Ureaplasma* urogenital isolates derived from human: a systematic review and meta-analysis. *Ann Clin Microbiol Antimicrob*. 2023;22(1):83.
  11. Wu Y, Majidzadeh N, Li Y, Shakourzadeh MZ, Hajilari S, Kouhsari E, et al. Trends of fluoroquinolones resistance in *Mycoplasma* and *Ureaplasma* urogenital isolates: systematic review and meta-analysis. *Journal of Global Antimicrobial Resistance*. 2024;36:13-25.
  12. Milano G, Guarducci G, Nante N, Montomoli E, Manini I. Human papillomavirus epidemiology and prevention: is there still a gender gap? *Vaccines*. 2023;11(6):1060.
  13. Pillai AB, Wong CM, Abidin NDIZ, Nor SFS, Hanan MFM, Abd Ghani SR, et al. Chlamydia infection as a risk factor for cervical cancer: A systematic review and meta-analysis. *Iranian journal of public health*. 2022;51(3):508.
  14. Huai P, Li F, Chu T, Liu D, Liu J, Zhang F. Prevalence of genital *Chlamydia trachomatis* infection in the general population: a meta-analysis. *BMC Infect Dis*. 2020;20(1):589.
  15. Verteramo R, Pierangeli A, Mancini E, Calzolari E, Bucci M, Osborn J, et al. Human Papillomaviruses and genital co-infections in gynaecological outpatients. *BMC Infect Dis*. 2009;9(1):16.
  16. Liang Y, Chen M, Qin L, Wan B, Wang H. A meta-analysis of the relationship between vaginal microecology, human papillomavirus infection and cervical intraepithelial neoplasia. *Infect Agents Cancer*. 2019;14(1):29.
  17. Yamaguchi N, Noda T, Nishioka Y, Myojin T, Kasahara K, Imamura T. The proportion of coinfections among sexually transmitted infections in Japan: a nation-wide claims database study. *Open Forum Infectious Diseases* 2025;12(7): ofaf393.
  18. Bachmann LH, Johnson RE, Cheng H, Markowitz L, Papp JR, Palella FJ, et al. Nucleic Acid Amplification Tests for Diagnosis of *Neisseria gonorrhoeae* and *Chlamydia trachomatis* Rectal Infections. *J Clin Microbiol*. 2010;48(5):1827-32.