Incidence of *Chlamydia trachomatis* detected by PCR in women’s endocervical samples in Lages, Santa Catarina, Brazil

*Incidência de Chlamydia trachomatis detectada por PCR em amostras endocervicais de mulheres em Lages, Santa Catarina, Brasil*

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**ABSTRACT**

**Introduction:** *Chlamydia trachomatis* is one of the major causative agents of sexually transmitted infections (STI) in men and women, but the greatest impact of infection occurs in the reproductive system of women, causing, among other problems, infertility. **Objective:** To estimate the incidence of *C. trachomatis* detected by the polymerase chain reaction (PCR) technique in endocervical samples from women in Lages, Santa Catarina, Brazil. **Methods:** A descriptive, quantitative, cross-sectional study was conducted from May to November 2017. Endocervical cell samples were collected from 126 women that receive medical assistance at three primary healthcare units and one gynecology clinic in the city. The samples of endocervical material were evaluated for the diagnosis of *C. trachomatis* by the PCR technique. Prior to sample collection, a Cancer Information System (SISCAN) standard questionnaire was answered by the participants. Fisher’s exact test and chi-square test were used to evaluate the association between infection and the variables of the questionnaire. **Results:** From the 126 endocervical samples analyzed, 39.7% were positive for *C. trachomatis*. The average age of the participants was 31.7 years old. From the 118 women who did not show changes in the cervix, 43 were positive for *C. trachomatis*, which reinforces the asymptomatic character of the infection. There was no significant association between endocervical infection by *C. trachomatis* and age, use of contraceptive pill, time of last pap test and signs of STI. **Conclusion:** The incidence of *C. trachomatis* infection in the endocervical samples from these women can be considered high, which emphasizes the importance of measures designed to clarify and prevent this important STI.

**Key words:** *Chlamydia trachomatis*; diagnosis; polymerase chain reaction; sexually transmitted diseases; public health.

**RESUMO**

**Introdução:** Chlamydia trachomatis é um dos principais agentes causadores de infeções sexualmente transmissíveis (IST) em homens e mulheres, porém, o maior impacto da infecção ocorre no sistema reprodutivo das mulheres, ocasionando, entre outros problemas, infertilidade. **Objetivo:** Estimar a incidência de *C. trachomatis* detectada pela técnica da reação em cadeia da polimerase (PCR) em amostras endocervicais de mulheres em Lages, Santa Catarina, Brasil. **Métodos:** Estudo transversal descritivo quantitativo, realizado entre maio e novembro de 2017, com coleta de material endocervical de 126 mulheres atendidas em três unidades básicas de saúde e em um consultório médico ginecológico. As amostras de material endocervical foram avaliadas para diagnóstico de *C. trachomatis* pela técnica da PCR. Todas as participantes responderam a um questionário padrão do Sistema de Informação do Câncer (SISCAN) antes da coleta das amostras. Teste exato de Fischer e qui-quadrado foram utilizados para avaliar a associação entre a infecção e as variáveis do questionário. **Resultados:** Das 126 amostras endocervicais, 39,7% foram positivas para *C. trachomatis*. As participantes tinham idade média de 31,7 anos. Das 118 mulheres que não apresentaram alterações no colo do útero, 43 foram positivas para *C. trachomatis*, o que reforça o caráter assintomático da infecção. Não houve associação significativa entre a infecção endocervical por *C. trachomatis* e a idade, o uso de anticoncepcional, o tempo do último exame preventivo e os
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**Introducción:** *Chlamydia trachomatis* es uno de los principales agentes causantes de infecciones de transmisión sexual (ITS) en hombres y mujeres, pero el mayor impacto de la infección se produce en el aparato reproductor de las mujeres, causando, entre otros problemas, la infertilidad. **Objetivo:** Calcular la incidencia de *C. trachomatis* detectada por la técnica de reacción en cadena de la polimerasa (PCR) en muestras endocervicales de mujeres en Lages, Santa Catarina, Brasil. **Métodos:** Estudio descriptivo, transversal, cuantitativo, realizado entre mayo y noviembre de 2017, con recolección de material endocervical de 126 mujeres atendidas en tres unidades básicas de salud y en un consultorio ginecológico. Se evaluaron las muestras de material endocervical para diagnóstico de *C. trachomatis* mediante la técnica de PCR. Todas las participantes respondieron a un cuestionario estándar del Sistema de Información del Cáncer (SISCAN) antes de la recolección de las muestras. Las pruebas exacta de Fisher y de ji cuadrado fueron utilizadas para evaluar la asociación entre la infección y las variables del cuestionario. **Resultados:** De las 126 muestras endocervicales, el 39,7% fueron positivas para *C. trachomatis*. Las participantes tenían edad media de 31,7 años. De las 118 mujeres que no presentaron alteraciones en el cuello uterino, 43 fueron positivas para *C. trachomatis*, lo que refuerza el carácter asintomático de la infección. No hubo asociación significativa entre la infección endocervical por *C. trachomatis* y edad, uso de anticonceptivo, fecha del último Papanicolaou y señales de ITS. **Conclusión:** La incidencia de infección por *C. trachomatis* en el material endocervical de esas mujeres puede ser considerada alta. Eso muestra la importancia de medidas de aclaración y prevención de esa importante ITS.

**Resumen**

**Introducción:** *Chlamydia trachomatis* es uno de los principales agentes causantes de infecciones de transmisión sexual (ITS) en hombres y mujeres, pero el mayor impacto de la infección se produce en el aparato reproductor de las mujeres, causando, entre otros problemas, la infertilidad. **Objetivo:** Calcular la incidencia de *C. trachomatis* detectada por la técnica de reacción en cadena de la polimerasa (PCR) en muestras endocervicales de mujeres en Lages, Santa Catarina, Brasil. **Métodos:** Estudio descriptivo, transversal, cuantitativo, realizado entre mayo y noviembre de 2017, con recolección de material endocervical de 126 mujeres atendidas en tres unidades básicas de salud y en un consultorio ginecológico. Se evaluaron las muestras de material endocervical para diagnóstico de *C. trachomatis* mediante la técnica de PCR. Todas las participantes respondieron a un cuestionario estándar del Sistema de Información del Cáncer (SISCAN) antes de la recolección de las muestras. Las pruebas exacta de Fisher y de ji cuadrado fueron utilizadas para evaluar la asociación entre la infección y las variables del cuestionario. **Resultados:** De las 126 muestras endocervicales, el 39,7% fueron positivas para *C. trachomatis*. Las participantes tenían edad media de 31,7 años. De las 118 mujeres que no presentaron alteraciones en el cuello uterino, 43 fueron positivas para *C. trachomatis*, lo que refuerza el carácter asintomático de la infección. No hubo asociación significativa entre la infección endocervical por *C. trachomatis* y edad, uso de anticonceptivo, fecha del último Papanicolaou y señales de ITS. **Conclusión:** La incidencia de infección por *C. trachomatis* en el material endocervical de esas mujeres puede ser considerada alta. Eso muestra la importancia de medidas de aclaración y prevención de esa importante ITS.

**Palabras clave:** *Chlamydia trachomatis*, diagnóstico, reacción en cadena de la polimerasa, enfermedades sexualmente transmisibles, salud pública.

**INTRODUCTION**

*Chlamydia trachomatis* is one of the most prevalent bacteria that cause sexually transmitted infections (STI) in men and women.[6] Infection risk factors include being young or adolescent, the number of sexual partners, using contraceptive pill, recordings of sexual infection and low educational and socioeconomic levels.[2] In general, the infection is asymptomatic in women and less commonly observed in men, but the infection may serve as a bacterium transmission reservoir to sexual partners.[5]

*Chlamydia trachomatis* can infect various types of cells and tissues in the human body. A considerable infection are found in the urogenital tract, where this agent mainly infects the columnar epithelium cells of the genital mucosa, the cervix is the most commonly infected site in women.[6] This bacterium may cause infectious cervicitis and urethritis in women as well as pelvic inflammatory disease (PID) that, consequently, may cause complications in the woman’s reproductive system, such as chronic pelvic pain, ectopic pregnancy, and infertility.[5]

Regarding the prevalence of STI by *C. trachomatis*, according to the World Health Organization (WHO), the number of cases reached 105.7 million worldwide in 2008.[8] In Europe and the US, this infection requires mandatory notification, and only in the US, two to five million new cases are reported every year.[7] For this reason, it is considered the main bacterial STI, and is called silent epidemics because it is asymptomatic in more than 80% of the cases.[6] In Europe, 345,000 cases of infections by *C. trachomatis* were diagnosed in 2010.[9] In England, 200,000 people were diagnosed with STI caused by this bacterium in 2016, representing almost half of all STIs recorded in the year, with an incidence more usually found in young people aged 15 to 24 years.[6]

In Latin America, infections caused by *C. trachomatis* are not notifiable, and the estimates are based on local studies. As an example, the prevalence of this infection in sexually active women was 26.4% in the northeastern region of Argentina,[8] and 5% in female sex workers in Peru.[10]

In Brazil, there are no consolidated data of infections caused by *C. trachomatis* because it is not a notifiable disease.[12] The prevalence of this infection in Brazil, according to clinical...
studies with women who received medical care in gynecological ambulatories and in gynecologist’s offices ranged from 4.3% to 31% (13). But this prevalence may vary according to the region, method of diagnosis and the participants’ characteristics. In a study conducted in Manaus, for example, 52.8% of the women who had infertility problems were infected by *C. trachomatis* (14). In São Miguel do Oeste, Santa Catarina (SC), Brazil, the *C. trachomatis* infection prevalence in endocervical samples was 11% (15); another study carried out with women from Santa Catarina e São Paulo showed a prevalence of 56.4% (16). The tests used for the diagnosis of *C. trachomatis* can be a limiting factor for the determination of its prevalence in certain studies. Conventional methodologies, such as cell culture, require viable microorganisms, invasive collection, and its lack of sensitivity makes the bacterium identification difficult (17). In recent years, techniques for amplification of nucleic acids based on the polymerase chain reaction (PCR) offered improvements in the sensitivity of *C. trachomatis* infection diagnosis, and when it is possible, screening of the bacterium is recommended (18, 19).

Therefore, due to the lack of studies on genital infection caused by *C. trachomatis* in Santa Catarina, the aim of this study was to estimate the incidence of *C. trachomatis* detected by the PCR technique in endocervical samples from women in Lages-SC, Brazil.

**METHODS**

**Participants and study design**

A quantitative, descriptive, cross-sectional study was carried out for the detection of *C. trachomatis* in endocervical cells of women in the period from May to November 2017. This study was approved by the Research Ethics Committee of the Universidade do Planalto Catarinense (Process no. 2.028.254). An Informed Consent Form was signed by all the participants.

Endocervical cells collection tests for *C. trachomatis* were carried out at three Primary Healthcare Units (PHU) located in Tributo, Santa Mônica and Coral neighborhoods, and in a gynecologist’s office in the city of Lages-SC. These sites were selected by convenience, due to the researcher’s facility to obtain samples and access to the records of the women’s monthly visits for routine screening tests.

The study included women aged 18 years and older, non-pregnant, non-postmenopausal, no hysterectomy, no prior report of human immunodeficiency (HIV) seroconversion, no vaginal bleeding, no urinary loss, no use of antibiotics or vaginal cream in the preceding 30 days, abstinence from sexual intercourse in the 72 hours prior to the exam, with pap smear appointments scheduled in the above mentioned healthcare units. Women who did not fit the eligibility criteria or the ones who refused to participate were excluded.

The women who met the eligibility criteria were referred to a nurse who explained the objectives and importance of participating in the research. As a result, 126 women participated in the study and all of them answered a standard questionnaire provided by the Cancer Information System [Sistema de Informação do Câncer (SISCAN)], routinely used at the PHUs and gynecology clinics/offices before the collection of the sample for the pap test. The following information was obtained from the questionnaire: age, the reason for the test, if she had ever done a pap test, date of last pap test, if she had been using an intrauterine device, if she had been using birth control pills and if she had experienced bleeding after intercourse. After the pap test, information about the cervix (normal or abnormal) was collected and if there was a signal of STIs.

**Sample collection**

After the patient’s consent, she was taken to the collection room where the nurse first collected the sample for the appointed pap smear exam, and then performed the endocervical cell collection, for the *C. trachomatis* test. For this second collection the nurse used an endocervical brush (Cytobrush), rotating it 360° in the endocervix to collect squamous cells. Each sample was stored in 400 microliters of TE solution [tris-HCl pH 8.0 10 mM/ ethylenediamine tetraacetic acid (EDTA) pH 8.0 1 M] and kept at -20°C until the time of analysis.

**PCR diagnostic**

For the tests, each sample was treated with 400 μl of TPK solution (TE 20%, 10 mg/ml of protein K) followed by incubation at 60°C during 90 minutes, and then boiled for 10 minutes, and deoxyribonucleic acid (DNA) was extracted by the phenol/chloroform method.

The plasmid primers (20) 1KL10 (5’TCCGGAGGCGAGTTACGAAGA3’), KL20 (3’AATCAATGCCCGGGATTGGT5’) were used to amplify a 241-base pairs fragment of plasmid DNA from *C. trachomatis* using PCR. PCR consisted of 5 μl DNA, and 5 μl of 10× PCR buffer, 2 μl of MgSO₄ 50 mM, 1 μl of dNTP 10 mM, 5 μl of each primer (5 pmol/μl), and 0.2 μl of 5 U/μl Taq DNA polymerase, and 26.8 μl of water to complete 50 μl of volume.
The amplification was performed on a thermocycler using a 30-cycle amplification program, pre-denaturation at 94°C for 60 seconds, denaturation at 94°C for 30 seconds, annealing at 57°C during 60 seconds and extension/elongation at 72°C during 2 minutes, followed by a final extension at 72°C during 8 minutes. Amplions analysis was carried out by electrophoresis in agarose gel (1.5%) stained with ethidium bromide.

To confirm the amplicon identity, all positive samples for *C. trachomatis* were sequenced. To prepare the samples for the amplicon sequencing, a microcentrifuge tube was used, which was filled with 240 ng of DNA and completed with milli-Q water to a final volume of 6 µl. Then it was dried in a SpeedVac at 35°C for 30 minutes and sent for sequencing, which was carried out on an ABI-Prism 3500 Genetic Analyzer (Applied Biosystems) by ACTGene Company.

In the analysis, a positive control (PC) and a negative control (NC) for *C. trachomatis* were used, in which DNA was not present where there is an amplification of the 241-bp fragment of *C. trachomatis* DNA in endocervical samples subjected to PCR (Figure).

### RESULTS

The average age of the participants was 31.7 years old (18 to 53 years old) and the incidence of *C. trachomatis* was 39.7% (*n* = 50) out of 126 women that participated in the study. Regarding the incidence of *C. trachomatis* at the studied healthcare units, one woman out of three from the Coral PHU was positive for the bacterium; in Santa Mônica PHU, seven out of 18 women were positive; in Tributo PHU, 15 out of 35 were positive, and at the gynecologist’s office, 28 out of 70 women were positive. The incidence of *C. trachomatis* in endocervical samples and the information collected from SISCAN questionnaire are presented in Table.

| Variable                  | Total | *Chlamydia* positive |
|---------------------------|-------|----------------------|
|                           | *n*   | %                    |
| Reason for doing the test |       |                      |
| Screening                 | 116   | 92                   | 47 | 40.5 |
| Follow-up                 | 10    | 8                    | 4  | 40   |
| Have you ever done a Pap test? |       |                      |
| Yes                       | 119   | 94.4                 | 49 | 41.2 |
| No                        | 7     | 5.6                  | 7  | 100  |
| Last Pap test             |       |                      |
| One year ago              | 6     | 4.8                  | 2  | 33.3 |
| Two or more years ago     | 120   | 95.2                 | 48 | 40   |
| Use of contraceptive pill |       |                      |
| Yes                       | 46    | 36.5                 | 22 | 47.8 |
| No                        | 80    | 63.5                 | 28 | 35   |
| Bleeding after intercourse|       |                      |
| Yes                       | 20    | 15.9                 | 8  | 40   |
| No/don’t known/don’t remember | 106  | 84.1                 | 43 | 40.5 |
| Cervix inspection         |       |                      |
| Normal                    | 118   | 93.6                 | 43 | 36.4 |
| Abnormal                  | 8     | 6.3                  | 6  | 75   |
| Signs of STI              |       |                      |
| Yes                       | 16    | 13                   | 9  | 56.2 |
| No                        | 110   | 87                   | 42 | 38.2 |

There was no significant association between endocervical infection by *C. trachomatis* and age, use of birth control pill, time of last pap test (one year ago or two or more years ago) and STI signals (*p > 0.05*).

### DISCUSSION

The incidence of 39.7% *C. trachomatis* infection, found in the endocervical cell samples from the women of this study,
is considered high when compared to other regional studies conducted in Brazil, where the incidence of infection with this bacterium, analyzed by PCR, was on average 11% (13, 20, 21). In recent studies conducted in Santa Catarina, the incidence of this infection varied. In self-collected endocervical samples from university students in Florianópolis, also tested by PCR, the incidence was 3% (22). In another study conducted in Palhoça-SC with endocervical samples from HIV patients, the incidence for C. trachomatis detected by PCR was 1.8% (22). This research warns about the importance of screening for the incidence of this bacterium in endocervical samples during women’s routine visits at the PHUs and gynecologist’s offices, even in those patients with no complaints and no signs or symptoms, because it is known that this infection, in most cases, is asymptomatic (8).

According to the Brazilian Ministry of Health, from 2007 to 2017, 8,527 HIV cases were notified in Santa Catarina, especially in 2016, with 1,880 reports; and between 2010 and 2017, 16,200 HIV cases were notified in Santa Catarina, especially this infection, in most cases, is asymptomatic (8).

The number of women who exhibited signs of STI was 16, nine of them were infected by C. trachomatis, and 42 out of 110 women who did not have STI signs were positive for the bacterium. This underlines the importance of the pap smear test, which provides important clinical data for the diagnosis of STIs and also for the need to investigate the incidence of C. trachomatis because many women are asymptomatic for this infection.

Regarding that, preventive actions should be adopted, since most people are unaware of the infection caused by C. trachomatis and its consequences, even though it is considered one of the bacterial STIs that can be easily treated and cured. Unfortunately, in Brazil, C. trachomatis is not investigated and notified such as other STIs (HIV, syphilis, hepatitis), and its diagnosis may have a positive impact on the quality of life of women, considering that it may reduce the risk for cervicitis and urethritis, and the risk for developing pelvic inflammatory disease (PID), which may cause complications on the female reproductive system such as chronic pelvic pain, ectopic pregnancy, and infertility (30). Moreover, screening of sexually active individuals can decrease the burden of disease, leads to treatment, and prevents severe health implications to women and men (24).

This was the first study about C. trachomatis in Lages-SC and the results emphasize the importance of developing health measures for awareness and prevention of this critical STI in this city. The women who participated in this research benefited from the result of the tests, which were delivered to the PHUs and the gynecologist’s office for further treatment and clarifications about the consequences of C. trachomatis infection.

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This study has some limitations. First, because our findings came from four different places of collection in Lages-SC and it
is unclear how they can be extended to other areas of the city, although the proportion of infection detection was similar between the sites. Secondly was the impossibility of assessing risk factors associated with *C. trachomatis* infection in Lages-SC, because we could only use the standard SISCAN questionnaire used in the PHU routine services and in the doctor’s offices, where data were collected. Thus, more studies are necessary for a better understanding of its epidemiology and associated factors to *C. trachomatis* infection in this municipality.

**CONCLUSION**

The incidence of infection by *C. trachomatis* in endocervical samples was 39.7% that is considered high when compared to other regional studies conducted in Brazil. This was the first study carried out on the incidence of *C. trachomatis* infection in Lages-SC and since accurate diagnosis and timely treatment are critical to the control of STIs, we suggest the use of PCR methodology in screening tests for this bacterium.

**REFERENCES**

1. Travassos AG, Xavier-Souza E, Neto E, et al. Anogenital infection by Chlamydia trachomatis and Neisseria gonorrhoeae in HIV-infected men and women in Salvador, Brazil. Braz J Infect Dis. 2016; 20(6): 569-575. doi: 10.1016/j.bjid.2016.09.004.
2. Afrasiabi S, Moniri R, Samimi M, Khorshidi A, Mousavi, SG. The prevalence of endocervical Chlamydia trachomatis infection among young females in Kashan, Iran. Jundishapur J Nat Pharm Prod. 2015; 8: 1-4. doi: 10.5812/jrpm.844(2015).15576.
3. Jauvéry F, Charlot P, Vessières A, Picard B. Prevalence of Chlamydia trachomatis and Neisseria gonorrhoeae infections detected by real-time PCR among individuals reporting sexual assaults in the Paris, France. Arab J Sci Eng. 2016; 16: 1-14. doi: 10.1016/j.j rescient.2016.04.031.
4. Versteeg B, Bruijsten SM, Heijman T, et al. Monitoring therapy success of urogenital Chlamydia trachomatis infections in women: a prospective observational cohort study. PLoS One. 2017; 12(9). doi: 10.1371/journal.pone.0185295.
5. Tadesse E, Teshome A, Arosalu A, Shimelis T. Genital Chlamydia trachomatis infection among women of reproductive age attending the gynecology clinic of hawassa University referral hospital, Southern Ethiopia. PLoS One. 2016; 12: 1-11. doi.org/10.1371/journal.pone.0168580.
6. World Health Organization. Global incidence and prevalence of selected curable sexually transmitted infections. [Internet]. Genebra: Instituição; updated 2008; quoted in: Apr, 2019. Available at: http://apps.who.int/iris/bitstream/10665/75181/1/9789241503839_eng.pdf.
7. Vega NC, Mofrin-Otero R, García S, et al. Frequency and genotypes of Chlamydia trachomatis in patients attending the obstetrics and gynecology clinics in Jalisco, Mexico and correlation with sociodemographic, behavioral, and biological factors. Womens Midlife Health. 2017; 17: 1-9. doi: 10.1186/s12905-017-0428-5.
8. Buckner LR, Amedee AM, Albritton HL, et al. Chlamydia trachomatis infection of endocervical epithelial cells enhances early HIV transmission events. PLoS One. 2016; 10: 1-20. doi: 10.1371/journal.pone.0146663.
9. Harding-Esch EM, Cousins EC, Chow SC, et al. A 30-min nucleic acid amplification point-of-care test for genital Chlamydia trachomatis infection in women: a prospective, multi-centre study of diagnostic accuracy. Ebiomedicine. 2017; 17: 1-27. doi:10.1016/j.ebiom.2017.12.029.
10. Deluca GD, Basiletti J, Schlover E, et al. Chlamydia trachomatis as a probable cofactor in human papillomavirus infection in aboriginal women from northeastern Argentina. Braz J Infect Dis. 2011; 15(6): 567-72. doi.org/10.1590/S1413-86702011000600011.
11. Carcamo CP, Campos PE, García PJ, et al. Prevalences of sexually transmitted infections in young adults and female sex workers in Peru: a national population-based survey. Lancet Infec Dis. 2012; 12(10): 765-73. doi: 10.1016/S1473-3099(12)70144-5.
12. Brasilense DN, Borges BN, Ferreira WS. Genotyping and prevalence of Chlamydia trachomatis infection among women in Belém, Pará, northern Brazil. J Infect Dev Ctries. 2016; 10(2): 134-7. doi: 10.3855/jidc.6474.
13. Santos MS, Ulian WL, Trindade JQ, et al. Prevalência da infecção endocervical de Chlamydia trachomatis em universitárias do estado do Pará, Região Amazônica, Brasil. Rev Panamericana Saude. 2017; 8(3): 27-33. doi.org/10.5123/S2176-62232017000300004.
14. Freitas NSL, Borborema-Santos CM, Barroso Serrão Das Neves D, et al. High prevalence detection of Chlamydia trachomatis by polymerase chain reaction in endocervical samples of infertile women attending University Hospital in Manaus-Amazonas, Brazil. Gynecol Obstet Invest. 2011; 72(4): 220-6. doi: 10.1159/000324798.
15. Golletto L. Detecção do HPV e da Chlamydia trachomatis em amostras de córveia uterina de mulheres da cidade de São Miguel do Oeste [dissertation]. Florianópolis: Universidade Federal de Santa Catarina; 2014. Available at: https://repositorio.ufsc.br/xmlui/handle/123456789/123189.
16. Herkenhoff ME, Gaulke R, Vieira LL, et al. Prevalência de Chlamydia trachomatis no córion de placenta e da uretra de mulheres em São Paulo e Santa Catarina pela PCR. J Bras Patol Med Lab. 2012; 48(5): 323-7. doi.org/10.1590/S1413-86702012000500004.
17. Fernandez G, Martinó E, González V, et al. Usefulness of a novel multiplex real-time PCR assay for the diagnosis of sexually-transmitted infections. Enferm Infecc Microbiol Clin. 2016; 1-6. doi: 10.1016/j.eimc.2015.10.014.
18. Rastamni MN, Hossein Rashidi B, Aghsaghloo F, Nazari R. Comparison of clinical performance of antigen based-enzyme Immunoassay (EIA) and major outer membrane protein (MOMP)-PCR for detection of genital Chlamydia trachomatis infection. Int J Reprod Biomed (Yazd). 2016; 14(6): 411-20. doi: 10.29252/ijrm.14.6.411.
19. Seadi CF, Oravec R, Poser BV, Cantarelli VV, Rossetti ML. Diagnóstico laboratorial da infecção pela Chlamydia trachomatis: vantagens e desvantagens das técnicas. J Bras Patol Med Lab. 2002; 38(2): 125-33.
20. Alfaia APB, Freitas NS, Astolfi Filho S, Borborema-Santos CM. Chlamydia trachomatis infection in a sample of northern Brazilian pregnant women: prevalence and prenatal importance. Braz J Infect Dis. 2013; 17(5): 545-50. doi: 10.1016/j.bjid.2013.01.014.

21. Garçês AX, de Martinez AMB, Gonçalves CV, et al. Prevalência de Chlamydia trachomatis e fatores de risco associados à infecção detectada em amostra endocervical. Rev Bras Ginecol Obstet. 2013; 35(8): 379-83. doi.org/10.1590/S0100-72032013000800008.

22. Vieira Mlv, Bazzo ML. Detecção de Chlamydia trachomatis em mulheres assintomáticas de 18 a 30 anos utilizando a autocoleta como obtenção da amostra [dissertation]. Florianópolis: Universidade Federal de Santa Catarina; 2016. Available at: https://repositorio.ufsc.br/xmlui/handle/123456789/167958.

23. Sales WB, Caveião C, Visentin A, et al. Comportamento sexual de risco e conhecimento sobre IST/SIDA em universitários da saúde. Rev Enf Ref. 2016; 9(10): 19-27. doi.org/10.12707/RIV16019.

24. Fyle-Thorpe O. Chlamydia and gonorrhea: an update. J Nurse Practioeners. 2019; in press. Available at: https://doi.org/10.1016/j.nurpra.2018.12.027.

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