Preliminary results of a screening programme for Chlamydia in an asymptomatic young population

CURRENT STATUS: UNDER REVIEW

BMC Infectious Diseases  ▶ BMC Series

Oriol Yuguero  oriol.yuguero@gmail.com
Institut de Recerca Biomedica de Lleida
Corresponding Author
ORCiD: 0000-0002-3433-8005

Jose Manuel Fernández-Armenteros
Institut de Recerca Biomedica de Lleida

Álvaro Vilela
Institut de Recerca Biomedica de Lleida

Jesus Aramburu
Institut de Recerca Biomedica

Raquel Lain
Institut de Recerca Biomedica de Lleida

Pere Godoy
Institut de Recerca Biomedica de Lleida

DOI: 10.21203/rs.2.18488/v1

SUBJECT AREAS  Infectious Diseases  Sexual & Reproductive Medicine

KEYWORDS  Sexually Transmitted Diseases, Screening, Chlamydia, Emergencies, Prevention
Abstract

Introduction Chlamydia trachomatis infection has increased in recent years, reaching 127 million cases in 2016. Possible complications, especially among women, require intervention for early detection. The objective of our study was to determine the prevalence of Chlamydia infection in a young, sexually active, asymptomatic population.

Methods A cross-sectional study was conducted among young patients aged 18 to 25 years attending the emergency room for any reason. The presence of Chlamydia trachomatis and other STIs in urine was determined.

Results Twenty-two patients enrolled in the screening (7.4%) were diagnosed with Chlamydia. A further nine patients among the partners of those affected were detected. Young people with two or more sexual partners in the last month and those suffering from infection by ureaplasma were at greater risk of infection by Chlamydia. Up to 50% of participants do not use barrier methods.

Conclusion The prevalence of infection by Chlamydia in the asymptomatic young population is higher than expected. The scarce use of barrier methods among this population may be one of the causes of this increase and one of the targets to work on in order to reduce the prevalence of the infection.

Introduction

The natural history of Chlamydia infection is unknown. The period of communicability can reach several months in subjects who are not treated. In 70% of women and 50% of men the infection can be asymptomatic. If left untreated, the infection can persist for months and can produce important long-term sequelae.
Genital infection in women can result in pelvic inflammatory disease (PID), which carries a risk of infertility or ectopic pregnancy, notwithstanding complications in pregnancy and postpartum. It can also cause infertility in the male population. Infection by *Chlamydia trachomatis* has become an emerging sexually transmitted disease globally. According to estimates by the WHO in 2016, 127 million people worldwide had been infected with chlamydia. In countries with higher gross domestic product, Chlamydia infection is the most common among young heterosexuals. In 2017, Unemo M et al. stated that Chlamydia infection was the most common bacterial STI and that it causes reproductive complications, especially in women. The same review recommends the performance of opportunistic screening in asymptomatic patients or in patients with risk factors for infection. However, the study by Hocking et al. did not reveal the expected results in a population screening programme.

Due to the lack of scientific evidence on what are the best initiatives to control Chlamydia infection, the WHO strategy in STI 2016–2021 recommended investigating the cost effectiveness of screening projects. Some countries such as Australia, the United States and Canada have conducted screening programmes. However, none of these cases establish the recommendation to screen based on a specific prevalence of the infection. Projects in Europe have increased in recent years.

Other screening programmes have been conducted in asymptomatic patients such as the one carried out in Bangkok in a homosexual population, and in Paris in patients attending a specific STI centre, where the prevalence was 5.7%.

In Spain, surveillance is carried out via the Microbiological Information System. In Catalonia, however, it is reported individually to the surveillance system. And it is
precisely in Catalonia that, according to data from the CEEISAT, there has been an increase from the 300 plus cases a year in 2008 to more than 900 cases per year in 2014. Between November 2012 and April 2013 in the STI Unit of the Arnau de Vilanova University Hospital a pilot study was conducted in patients attending for a sexually transmitted infection (STI) yielding a prevalence of infection by Chlamydia of 10%, which was higher than expected.

The involvement of the Emergency Services in the control of Chlamydia infection has been discussed in other initiatives. Currently in our country, rapid detection tests for Chlamydia such as those described by Gaydos are not used. In 2018, Adamson et al. presented the results of the screening programme for Chlamydia infection in Australia where emergency services were involved. We believe that carrying out the screening program in an emergency department allows us to access a healthy young pollution group that is difficult to get in touch with the public health system.

The aim of our study was to detect the prevalence of Chlamydia infection in asymptomatic, sexually active young patients attending the emergency room for reasons unrelated to an STI.

Methodology

An epidemiological cross-sectional study was conducted on the prevalence of Chlamydia infection detected in a screening programme for patients who attended the emergency room between 1 December 2017 and 31 December 2018. The Emergency Department of the Arnau de Vilanova University Hospital is the reference centre for about 300,000 patients in our health region. Of these, about 7,000 patients are between 18 and 25 years old.
Variables

All patients who agreed to participate in the study were informed of the study protocol and were interviewed with questions based on the CEEISCAT epidemiological survey. Subjects’ sociodemographic (age, sex, country of origin, level of education and employment status) and epidemiological variables (sexual orientation, number of sexual partners in the last month and year, use of barrier methods and practice of prostitution), and medical history (previous diagnosis of STIs in the last year and pregnancy) were evaluated. In addition to the detection of Chlamydia infection, the same sample was used to detect Ureaplasma urealyticum, Ureaplasma parvum, Mycoplasma genitalium, Mycoplasma hominis, Trichomonas vaginalis and Neisseria gonorrhoeae.

The method applied for the diagnosis of Chlamydia infection was the Nucleic Acid Amplification Test (NAAT) Allplex™ STI Essential Assay, Seegne® in urine for men and women, with 88–95% sensitivity and 95–98% specificity.

Patients with Chlamydia were summoned to the STI Unit at the Arnau de Vilanova University Hospital, where they were administered treatment for the detected infection, the contact study was carried out and the opportunity to perform serology to detect other sexually transmitted diseases (HIV, Hepatitis B and C and Syphilis) was offered.

Inclusion criteria

Sexually active patients between 18 and 25 years of age attending the Emergency room between the dates set out above for reasons not related to a sexually transmitted infection were included. We considered a sexually active person, the one who had had sex in the last 6 months.
Exclusion criteria

Patients who did not agree to participate or who had symptoms that could be caused by Chlamydia were excluded.

Statistical analysis

Qualitative variables were described by absolute frequencies and percentages. For quantitative variables, the median and 25% and 75% percentiles were obtained. The prevalence of Chlamydia infection and other STI were estimated and the 95% confidence interval (CI) was calculated. Possible differences in the population were evaluated according to whether Chlamydia was detected or not. Whenever application assumptions were held, the Pearson’s Chi-square test was used to compare the qualitative variables, and the Mann-Whitney test was used for the quantitative variables. The crude odds ratios (OR) calculated by the Wald method and their 95% CI calculated using normal approximation were also obtained.

A logistic regression model was developed to determine the variables associated with Chlamydia infection. Forward selection approach based on the likelihood ratio test was followed to determine the independent variables of the multivariable analysis. Age and sex were included as adjustment variables. Calibration was evaluated using the Hosmer-Lemeshow test, and discrimination with the area under the ROC curve. The adjusted OR are presented, along with the 95% CI. In all analyses an alpha error of 5% was assumed and the R statistical program was used.

Results

During the study period, 7267 patients between 18 and 25 years old went to the emergency room. Of these, 3775 (51.9%) attended a clinic that could be caused by an infection by Chlamydia (abdominal pain, dysuria or genital secretion). 2182
patients denied being sexually active (30%). Of the 1310 patients who were likely to participate in the study, 300 (22.9%) agreed to participate. We studied 300 patients, but two were excluded as they were under 18 years of age, 54.4% were women and the median age was 22 years. The sociodemographic variables are presented in Table 1. Ninety-three percent of participants declared themselves as being heterosexual, 4.4% bisexual, and the remaining 2.3% homosexual. Just over one-tenth (10.4%) had two or more partners in the last month, 49.3% had not used a condom in their last sexual intercourse, and 4.4% reported a previous STI. (Table 2).

In the screening study, 22 Chlamydia-infected patients were detected (7.4%, 95% CI = 4.8–11.1%), and a further nine were detected in the study of their contacts. The total number of patients infected with Chlamydia was 31. An STI was diagnosed in 34 patients (11.4%). In addition to the 22 infected with *Chlamydia trachomatis*, 11 were infected with *Ureaplasma urealyticum* (3.7%), 2 with *Mycoplasma genitalium* (0.6%), 1 with *Trichomonas vaginalis* (0.3%), and 1 with *Neisseria gonorrhoeae* (0.3%). Three patients were co-infected with Chlamydia and Ureaplasma. Only in three patients was serologic screening carried out for hepatitis B, C, syphilis and HIV. HIV was detected in one of these cases.

Chlamydia infection showed no association with age or gender, but manual workers (17.4%), service workers (17.4%) and the unemployed (13.3%) had a higher prevalence of infection than students (3.9%). Patients with secondary school studies also had a higher prevalence of Chlamydia than the other groups (Table 3). All subjects in whom Chlamydia infection was detected were heterosexual, and 60% had a stable partner. Patients with Chlamydia had a greater number of sexual partners. Approximately 40% of the study participants did not use barrier methods routinely (Table 4).
Twenty-one patients with Chlamydia received treatment (95.5%). Focusing on the other STIs, only four patients were treated for Ureaplasma and one for Neisseria. Twelve of the patients with Chlamydia identified their contact (54.5%) and nine of them were diagnosed and treated for Chlamydia.

Logistic regression analysis showed that patients who had two or more partners in the last month (OR, 3.8; 95% CI (1.2–12.1) and were infected with Ureaplasma (OR 6.8; 95% CI (1.6–29.2) had a higher risk of Chlamydia infection (Table 5).

Discussion

The prevalence of *Chlamydia trachomatis* infection in young asymptomatic patients is 7.4% in the screening patients, and 10% if we add the patients that were detected in the study of contacts. This figure is higher than that previously described in our environment, since prevalence had been estimated at 5%. In 2010 a similar study was conducted in our country that showed a prevalence of 4%.

This is the first screening study for infection by *Chlamydia trachomatis* in young asymptomatic subjects in Catalonia. The study results are preliminary, although we have considered that they are relevant enough to be communicated. At the moment the screening program is still underway in our Emergency Department, and we believe that if the high prevalence is confirmed, we can consider carrying out this screening program in other UR services in our region. We believe that the population attending out-of-hours healthcare services was a good choice since it is difficult to contact young patients since they tend to visit the emergency room for acute problems or accidents. Previous studies to screen for the infection have been conducted, but in risk groups or subjects who attend STI units.

The mean age of our sample is 22 years and there is a predominance of women
(54.5%). However, there is no association with gender, age, sexual orientation or country of origin. However the low number of patients classified as homosexual and/or bisexual could account for the absence of a significant relationship.

There is an association with the number of sexual partners in the last month: the greater the number of sexual partners in the last month, the higher the risk of Chlamydia infection. This was already described by Lopez-de-Munain in a recent study\textsuperscript{26} which also revealed a higher risk of infection in a cohort of patients who attended an STI unit and reported two or more sexual partners in the last month.

The study allowed us to detect 31 cases of Chlamydia in asymptomatic patients, thus preventing the spread of the disease and the subsequent complications that may arise from asymptomatic infection. Also, in the subsequent study, we detected one case of HIV in an asymptomatic patient. Probably, if serology had been performed in a larger number of patients, we would have detected more cases. It was disappointing that many patients have not undergone serological tests despite their positive results for other STIs. Patients are probably not aware of the high likelihood of being infected by other sexually transmitted infections, in addition to Chlamydia.

The co-infection of Chlamydia with \textit{Ureaplasma parvum} is notable. This association is also described in other studies. (Kim SI) (Berçot) and (Yamazaki) suggest that the presence of Ureaplasma has a significant effect on the presence of \textit{C. trachomatis} in the genital tract (Yamazaki\textsuperscript{25}). Berçot \textit{et al.} go further and relate this co-infection with the establishment of chronic \textit{C. trachomatis} infection. We believe the possibility of using tests that detect various infections in screening programmes may be in order to achieve greater patient information, although there is a need to
perform cost-benefit studies and discard overdiagnosis and overtreatment before recommending their use.

One study (Miranda) showed that even in asymptomatic women there is a high incidence of STIs whether they belong to a high-risk group or not, as our results confirm. This article also suggests that both asymptomatic and symptomatic patients should be screened for STIs.

We also believe it is relevant that approximately 50% of participants do not use barrier methods regularly and did not use a condom at their last sexual intercourse. This is remarkable given the multitude of awareness campaigns that exist and the little impact they have on young people. Strategies to promote condom use and improve its impact on young people should be reviewed.

To date, screening programmes had been conducted in patients with risk factors to make them more cost effective. Through an opportunistic case finding strategy, the project took advantage of visits by young sexually active patients to an emergency room to reach one of the main risk groups which, being asymptomatic, is very unlikely to attend the physician’s office.

We believe that having detected 7.4% of infected young people highlights the significant increase in the prevalence of Chlamydia infection since 2010 (16) and justifies the planning of strategies to detect infection in young patients. The benefit of receiving treatment and avoiding complications and sequelae is sufficiently important to consider implementing a nationwide strategy.

The main limitation of our study is the current sample size. We have achieved a response of 23% of the participants so that the size of our sample is small. However, the screening program continues. Moreover, another limitation is that in the emergency room younger patients are sometimes accompanied by relatives and
in their presence, these patients do not admit the practice of sexual relations.

Furthermore, many patients refused the chance to expand the serological study. Information on some significant variables such as sexual orientation, condom use and number of partners may be subject to some errors due to the stigma attached to STIs. Also, the out-of-hours healthcare services user population may not be representative of all young people.

Our study provides evidence of the importance of a screening programme, but also the importance of campaigns to raise awareness in the use of barrier methods, since the number of sexual partners is still the main factor conditioning Chlamydia infection.

Declarations

Ethical approval: The study (CEIC-1844) was approved by the Ethics Committee of the Lleida Biomedical Research Institute. All patients signed a form of informed consent for their inclusion in the study and patient data were processed according to Organic Law 3/2018 on Data Protection.

Competing interests: The authors declare no conflict of interest.

Funding. The study was supported by the Health Department of the Diputació de Lleida.

Author’s contributions: OY and PG contribute to the conception and design of the work. JMF, RL and AV participated in the acquisition and interpretation of data. JA drafted the work and revised it critically. All the authors gave the final approval of the versión to be published.

Acknowledgements: We want to thank to Dr. César Pardos, Dra. Violant Pujol, Ms. Noemí Espies, Ms. Núria Garcia and Mr. Àlvar Sole to their contribution in the data collection.

Tables

Table 1 Sample sociodemographic variables
|                | N (%) |
|----------------|-------|
|                | 298 (100%) |

| Sex           |       |
|---------------|-------|
| Male          | 136 (45.6%) |
| Female        | 162 (54.4%) |

| Mean Age (P25-P75) | 22 [20-23.08] |

| Employment                      |       |
|---------------------------------|-------|
| Craftspeople and skilled workers in the manufacturing and construction industries (except operators of plant and machinery) | 23 (7.72%) |
| Accounting, administrative and other office employees | 12 (4.03%) |
| Student                          | 154 (51.7%) |
| Elementary occupations           | 8 (2.68%) |
| Other technical, scientific and intellectual professionals | 7 (2.35%) |
| Unemployed                       | 30 (10.1%) |
| Technical, scientific and intellectual professionals | 16 (5.37%) |
| Qualified agricultural, livestock, forestry and fisheries employees | 25 (8.39%) |
| Workers in catering, personal, security and sales services | 23 (7.72%) |

| Country of Origin            |       |
|------------------------------|-------|
| Spain                        | 214 (71.8%) |
| Rest of Europe               | 27 (9.06%) |
| Africa                       | 25 (8.39%) |
| Asia                         | 2 (0.67%)  |
| South America                | 30 (10.1%) |

| Education Level               |       |
|-------------------------------|-------|
| No Education                   | 6 (2.01%)  |
| Primary                       | 19 (6.38%)  |
| Vocational Training           | 76 (25.5%)  |
| Secondary                     | 82 (27.5%)  |
| University                    | 115 (38.6%) |

Description of the sample included in the study.
| Table 2 |
|---------|
| Sample clinical and epidemiological variables |
|                                      | N (%)          |
|--------------------------------------|----------------|
| **Sexual Orientation**               |                |
| Heterosexual                         | 277 (93.0%)    |
| Homosexual                           | 7 (2.35%)      |
| Bisexual                             | 13 (4.36%)     |
| Unknown                              | 1 (0.34%)      |
| **Stable Partner**                   |                |
| No                                   | 117 (39.3%)    |
| Yes                                  | 181 (60.7%)    |
| **Number of partners in the last month** |          |
| 0-1                                  | 267 (89.6%)    |
| 2+                                   | 31 (10.4%)     |
| **Number of partners in the last year** |            |
| 1                                    | 188 (63.1%)    |
| 2-5                                  | 84 (28.2%)     |
| 6+                                   | 26 (8.72%)     |
| **Exercising Prostitution**          |                |
| No                                   | 295 (99.0%)    |
| Yes                                  | 3 (1.01%)      |
| **Routine Use of Barrier Methods**   |                |
| No                                   | 124 (41.6%)    |
| Yes                                  | 174 (58.4%)    |
| **Condom use at last intercourse**   |                |
| No                                   | 147 (49.3%)    |
| Yes                                  | 151 (50.7%)    |
| **Pregnancy**                        |                |
| No                                   | 291 (97.7%)    |
| Yes                                  | 7 (2.35%)      |
| **Previous STI diagnosis?**          |                |
| No                                   | 285 (95.6%)    |
| Yes                                  | 13 (4.36%)     |
| **Within the last year**             |                |
| No                                   | 297 (99.7%)    |
| Yes                                  | 1 (0.34%)      |
Clinical and epidemiological characteristics of the patients participating in the study.

Table 3. Patient demographic variables according to Chlamydia infection
|                  | Yes (N=22) | No (N=276) | P Value |
|------------------|------------|------------|---------|
| **Sex**          |            |            | 0.81    |
| Male             | 9 (40.9%)  | 127 (46.0%)|         |
| Female           | 13 (59.1%) | 149 (54.0%)|         |
| **Age**          |            |            | 0.752   |
|                  | 22.0 [21.0;23.0] | 22.0 [20.0;24.0] | |
| **Employment**   |            |            |         |
| Craftspeople and skilled workers in the manufacturing and construction industries (except operators of plant and machinery) | 4 (18.2%) | 19 (6.88%) |  |
| Accounting, administrative and other office employees | 1 (4.55%) | 11 (3.99%) | |
| Student          | 6 (27.3%)  | 148 (53.6%)|         |
| Elementary occupations | 0 (0.00%) | 8 (2.90%) | |
| Other technical, scientific and intellectual professionals | 1 (4.55%) | 6 (2.17%) | |
| Unemployed       | 4 (18.2%)  | 26 (9.42%) |         |
| Technical, scientific and intellectual professionals | 2 (9.09%) | 14 (5.07%) | |
| Qualified agricultural, livestock, forestry and fisheries employees | 0 (0.00%) | 25 (9.06%) | |
| Workers in catering, personal, security and sales services | 4 (18.2%) | 19 (6.88%) | |
| Country of Origin |            |            |         |
| Spain            | 17 (77.3%) | 197 (71.4%)|         |
| Europe           | 0 (0.00%)  | 27 (9.78%) |         |
| Africa           | 2 (9.09%)  | 23 (8.33%) |         |
| Asia             | 1 (4.55%)  | 1 (0.36%)  |         |
| South America    | 2 (9.09%)  | 28 (10.1%) |         |
| Education Level  |            |            |         |
| No Education     | 1 (4.55%)  | 5 (1.81%)  | 0.28    |
| Primary          | 1 (4.55%)  | 18 (6.52%) |         |
| Vocational Training | 7 (31.8%) | 69 (25.0%) |          |
| Secondary        | 8 (36.4%)  | 74 (26.8%) |         |
| University       | 5 (22.7%)  | 110 (39.9%)|         |

Chi square test for sex, and Mann-Whitney test for age. OR obtained univariate logistic regression

|                  |            |            |         |
|------------------|------------|------------|---------|
| **Table 4. Epidemiological and clinical variables of patients infected by Chlamydia** |            |            |         |
| Sexual Orientation          | Yes (N=22) | No (N=276) | P Value | OR (95% CI) |
|----------------------------|------------|------------|---------|-------------|
| Heterosexual               | 22 (100%)  | 255 (92.4%)| -       | -           |
| Homosexual                  | 0 (0.00%)  | 7 (2.54%)  | -       | -           |
| Bisexual                   | 0 (0.00%)  | 13 (4.71%) | -       | -           |
| Unknown                    | 0 (0.00%)  | 1 (0.36%)  | -       | -           |
| Stable Partner             | >0.99      | 9          | -       | 0.93 [0.38-3.25] |
| No                         | 9 (40.9%)  | 108 (39.1%)| Ref     | -           |
| Yes                        | 13 (59.1%) | 168 (60.9%)| 0.064   | 2.83 [0.96-8.29] |
| Number of partners in the last month |            |            |         |             |
| 0-1                        | 17 (77.3%) | 250 (90.6%)| Ref     | -           |
| 2+                         | 5 (22.7%)  | 26 (9.42%) | 0.326   | 1.69 [0.66;4.38] |
| Number of partners in the last year |          |            |         | 2.10 [0.54;8.08] |
| 1                          | 11 (50.0%) | 177 (64.1%)| Ref     | -           |
| 2-5                        | 8 (36.4%)  | 76 (27.5%) | 0.465   | -           |
| 6+                         | 3 (13.6%)  | 23 (8.33%) | 0.831   | -           |
| Exercising Prostitution    | -          |            |         |             |
| No                         | 22 (100%)  | 273 (98.9%)| >0.99   | 9           |
| Yes                        | 0 (0.00%)  | 3 (1.09%)  | 0.65    | [0.27-1.58] |
| Routine Use of Barrier Methods |          |            |         |             |
| No                         | 9 (40.9%)  | 115 (41.7%)| Ref     | -           |
| Yes                        | 13 (59.1%) | 161 (58.3%)| 1.03    | [0.43-2.49] |
| Condom use at last intercourse |          |            |         |             |
| No                         | 13 (59.1%) | 134 (48.6%)| Ref     | -           |
| Yes                        | 9 (40.9%)  | 142 (51.4%)| 0.65    | [0.27-1.58] |
| Pregnancy                  | -          |            |         |             |
| No                         | 21 (95.5%) | 270 (97.8%)|         |             |
| Yes                        | 1 (4.55%)  | 6 (2.17%)  |         |             |
| Previous STI diagnosis?    | -          |            |         |             |
| No                         | 20 (90.9%) | 265 (96.0%)|         |             |
| Yes                        | 2 (9.09%)  | 11 (3.99%) |         |             |
| Within the last year       | -          |            |         |             |
| No                         | 22 (100%)  | 275 (99.6%)|         |             |
| Yes                        | 0 (0.00%)  | 1 (0.36%)  |         |             |

P values correspond to the chi-square test.
OR obtained univariate logistic regression

Table 5. Multivariate logistic regression analysis for Chlamydia infection.

|                            | OR     | (95% CI)  | P-value |
|-----------------------------|--------|-----------|---------|
| Number of partners in the last month (2+ vs <2) | 3.84   | 1.22-12.1 | 0.021   |
| Ureaplasma Infection       | 6.81   | 1.59-29.2 | 0.010   |
| Age                        | 1.02   | 0.83-1.26 | 0.831   |
| Sex = Female               | 1.62   | 0.62-4.20 | 0.324   |

Analysis adjusted for sex and age.
References

1. Horner P, Boag F. Clinical Effectiveness Group. 2006 UK National guideline for the management of genital tract infection with Chlamydia trachomatis. London: British Association for Sexual Health and HIV (BASHH), 2006.

2. “Chlamydial Infections” A: Canadian Guidelines on Sexually Transmitted Infections. Ottawa: Public Health Agency of Canada. [rev. January 2019]. Available at: http://www.phac-aspc.gc.ca/std-mts/sti_2006/sti_intro2006-eng.php

3. Management of genital Chlamydia trachomatis infection: A national clinical guideline. Edinburgh: Scottish Intercollegiate Guidelines Network (SIGN), 2000 (review 2005). (SIGN; 42).

4. Rowley J, Vander Hoorn S, Korenromp E, Low N, Unemo M, Abu-Raddad LJ, et al. Global and Regional Estimates of the Prevalence and Incidence of Four Curable Sexually Transmitted Infections in 2016. WHO Bulletin. June 2019. Available at: https://www.who.int/bulletin/online_first/BLT.18.228486.pdf

5. Newman L, Rowley J, Vander Hoorn S, Wijesooriya NS, Unemo M, Low N, et al. Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systematic review and global reporting. PLoS One 2015; 10: e0143304.

6. Redmond SM, Alexander-Kisslig K, Woodhall SC, van den Broek IV, van Bergen J, Ward H et al. Genital chlamydia prevalence in Europe and non-European high income countries: systematic review and meta-analysis. PLoS One 2015; 10: e0115753.
7. Unemo M, Bradshaw CS, Hocking JS, de Vries HJC, Francis SC, Mabey D, et al. Sexually transmitted infections: challenges ahead. Lancet Infect Dis. 2017;17(8):e235-e279.

8. Haggerty CL, Gottlieb SL, Taylor BD, Low N, Xu F, Ness RB. Risk of sequelae after Chlamydia trachomatis genital infection in women. J Infect Dis 2010; 201 (suppl 2): S134–55.

9. Hocking JS. Screening for chlamydia: does it work, results from ACCEPt. Sex Transm Infect 2015; 91: PL03.2 (abstr)

10. World Health Organization. Global Health Strategy on Sexually Transmitted Infections 2016-2021. Geneva 2016. Available at: https://apps.who.int/iris/bitstream/handle/10665/246296/WHO-RHR-16.09-eng.pdf?sequence=1

11. ECDC. Guidance on chlamydia control in Europe—2015. Stockholm: European Centre for Disease Prevention and Control, 2016

12. Hocking JS, Temple-Smith M, Guy R, Donovan B, Braat S, Law M, Population effectiveness of opportunistic chlamydia testing in primary care in Australia: a cluster-randomised controlled trial. Lancet. 2018;392(10156):1413-1422.

13. Van den Broek IV, Sfetcu O, van der Sande MA, Andersen B, Herrmann B, Ward Het al. Changes in chlamydia control activities in Europe between 2007 and 2012: a cross-national survey. Eur J Public Health 2016; 26: 382-88

14. ECDC. Chlamydia control in Europe: literature review. Stockholm: European Centre for Disease Prevention and Control, 2014.

15. Pattanasin S, Dunne EF, Wasinrapee P, Tongtoyai J, Chonwattana W, Sriporn A et al. Screening for Chlamydia trachomatis and Neisseria gonorrhoeae infection among asymptomatic men who have sex with men in Bangkok, Thailand. Int J
16. Rondeau P, Valin N, Decré D, Girard PM, Lacombe K, Surgers L. Chlamydia trachomatis screening in urine among asymptomatic men attending an STI clinic in Paris: a cross-sectional study. BMC Infect Dis. 2019;19(1):31.

17. CEEISCAT. Vigilància epidemiològica de les infeccions de transmissió sexual a Catalunya. 2017 Annual Report. Available at: http://canalsalut.gencat.cat/web/.content/_A-Z/S/sida/enllasos/anual_ITS.pdf

18. Yuguero O, Casanova JM, Manonelles A, Godoy P. Detection of Chlamydia trachomatis infection in patients seen at a sexually transmitted infection clinic. Actas Dermosifiliogr. 2015;106(3):235-8.

19. Gaydos CA, Ako MC, Lewis M, Hsieh YH, Rothman RE, Dugas AF. Use of a Rapid Diagnostic for Chlamydia trachomatis and Neisseria gonorrhoeae for Women in the Emergency Department Can Improve Clinical Management: Report of a Randomized Clinical Trial. Ann Emerg Med. 2019;74(1):36-44.

20. Adamson PC, Klausner JD. No benefit of chlamydia screening in primary care? Lancet. 2018;392(10156):1381-1383.

21. CEEISCAT. Enquesta epidemiològica individualitzada de les infeccions de transmissió sexual. Available at: https://www.aspb.cat/wp-content/uploads/2018/06/ENQUESTA_ITS_Decret2015.pdf

22. Centers for Disease Control and Prevention. Recommendations for the laboratory-based detection of Chlamydia trachomatis and Neisseria gonorrhoeae--2014. MMWR Recomm Rep. 2014;63(RR-02):1-19.

23. E. López-Corbeto, V. González, E. Bascunyana, V. Humet, J. Casabona et al. Trend and determinants of porChlamydia trachomatis genital infection in children under 25 years. Cataluña 2007-2014 Enferm Infecc Microbiol Clin.
24. Fernández-Benítez C, Mejuto-López P, Otero-Guerra L, Margolles-Martins MJ, Suárez-Leiva P, Vazquez F. Prevalence of genital Chlamydia trachomatis infection among young men and women in Spain. BMC Infect Dis. 2013;13:388.

25. Aranaz J, Martínez R, Gea T, Rodrigo V, Antón P, Gómez F. Why do patients use hospital emergency services on their own initiative? Gac Sanit. 2006;20(4):311-5

26. López-de-Munain J, Cámara-Pérez MD, Imaz-Pérez M, Pereda-Berroeta J, López-Azcarreta I, Muñoz-Sánchez J. Chlamydia trachomatis re-infection in Spain: A STI clinic-based cohort study. Enferm Infecc Microbiol Clin. 2017;35(3):165-173.

27. Kim SI, Yoon JH, Park DC, Lee DS, Lee SJ, Choe HS et al. Co-infection Of Ureaplasma urealyticum And Human Papilloma Virus In Asymptomatic Sexually Active Individuals. Int J Med Sci. 2018;15(9):915-920

28. Ndeikoundam Ngangro N, Viriot D, Fournet N, Pioche C, De Barbeyrac B, Goubard A et al. Bacterial sexually transmitted infections in France: recent trends and patients’ characteristics in 2016. Euro Surveill. 2019;24(5).

29. Yamazaki T, Matsuo J, Nakamura S, Oguri S, Yamaguchi H. Effect of Ureaplasma parvum co-incubation on Chlamydia trachomatis maturation in human epithelial HeLa cells treated with interferon-γ. J Infect Chemother. 2014;20(8):460-4.

30. Miranda AE, Gadelha AM, Szwarcwald CL. Behavior patterns related to sexual practices and drug use among female adolescents in Vitória, Espírito Santo, Brazil, 2002]. Cad Saude Publica. 2005;21(1):207-16.

Supplementary Files
This is a list of supplementary files associated with the primary manuscript. Click to download.

TITLE PAGE.docx