Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i5.6086

TREATMENT EVALUATION OF GENITAL CHLAMYDIA TRACHOMATIS INFECTION DURING PREGNANCY

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ABSTRACT

Background: *Chlamydia trachomatis* is an intracellular pathogenic bacterium whose solitary natural host is human. *Ct* is a sexually transmitted disease normally detected during pregnancy and thus has been associated with adverse pregnancy outcomes and also mother-to-child transmission can occur at the time of birth and may result in premature rupture of membranes, preterm birth, low birth weight, conjunctivitis, and pneumonia in infants if left untreated.

Aims and Objectives: The main objective of this review is to evaluate existing literature to determine potential benefits of antenatal treatment evaluation for treating genital chlamydia trachomatis infection during pregnancy to prevent adverse outcomes that leads to either neonatal or mother morbidity. The literature will also analyze the most efficacious antibiotic regimen to treat *Chlamydia trachomatis* infections in pregnancy, side effects of the treatment regimen and resistance.

Methodology: I have searched data from PubMed, Cochrane Library and Scopus till the end of February 2024. Only Randomized control trials that meet the inclusion criteria of antibiotics consider safe to consume during pregnancy for genital chlamydia trachomatis are Macrolides (Azithromycin, Erythromycin), Clindamycin and Amoxicillin compared with either placebo or no treatment or any alternative antibiotic treatment were included.

Results: Clindamycin proved somewhat the most successful treatment in eradicating Chlamydia trachomatis among pregnant women (95%) which significantly related to least treatment failure (5.2%) as compared to azithromycin, erythromycin and Amoxicillin. Among all of the Comparisons of Erythromycin with other antibiotic treatment like Amoxicillin, Clindamycin, Azithromycin the rate of GIT side effects associated to Erythromycin are significantly higher than others (27%).

Conclusion: In conclusion, the best antibiotic for treating C. trachomatis infections during pregnancy is Clindamycin. Clindamycin's characteristic pharmacokinetic profile enabled a high degree of patient compliance and a high success rate in eliminating the active infection with less gastrointestinal side effects.

Keywords: Chlamydia trachomatis, Pregnant women, Clindamycin, Erythromycin, Azithromycin, Amoxicillin, Sexually transmitted infections, Infertility.

INTRODUCTION

Sexually transmitted infections are most commonly caused by the intracellular Gram-negative bacteria Chlamydia trachomatis *(Ghasemian et al., 2023)*. Studies conducted in the UK have revealed that between 2% to 26% of expecting mothers test positive for chlamydia trachomatis during their pregnancies *(Dian, 2022)*. Chlamydia trachomatis infections in the genital region are becoming more widely acknowledged as a concern in obstetric *(Omer et al., 2023)*. Incidence differs among populations, however reports of chlamydial trachomatis infection throughout pregnancy range as high around 50% *(Land et al., 2009)*. Pregnant women with untreated genital chlamydia trachomatis infection have a considerably higher risk of premature birth, early membrane rupture, and neonatal and mother mortality *(Daskalakis et al., 2023)*. However, in females, the chlamydial infection may manifest clinically as endometritis, urinary tract infections, or mucopurulent cervicitis *(Usta, 2023)*. With connections to an ectopic pregnancy causing early miscarriages, chlamydia is thought to be the main reason of Inflammatory Disease of pelvic region and infertility globally *(Ramnarain et al., 2023)*. Pregnant women who contract C. trachomatis infections typically show no symptoms. On the other hand, if treatment is not given, it may lead to early infant birth, preterm delivery and unexpected miscarriage in the very first trimester *(Mussa et al., 2023)*. Untreated chlamydia trachomatis infections enhance the neonate's risk of contracting chlamydial infection after birth, which usually appears as lung infection or ophthalmic neonatorum *(Moore et al., 2022)*. The World Health Organization report on the global incidence of Ct infections states that, when comparing the data obtained from 2012 to 2016 *(Niu, Huang and Liu, 2024)*, the prevalence of Chlamydia trachomatis infections decreased globally. However, WHO estimated that around 129 million new cases of Chlamydia trachomatis have estimated in the year 2020 *(Wang et al., 2023)*. Consequently, testing asymptomatic adults through the use of Chlamydia Screening Programs may be one of the most effective ways to end this illness. In 2020, the worldwide incidence among individuals aged 15 to 49 years is estimated to be 2.5% for males and 4.0% for females *(Wang et al., 2023).*

According to some protocols pregnant women should avoid doxycycline, ofloxacin and erythromycin, while early evidence suggests azithromycin is safe and effective *(Emily R. BA, 2020)*. The non-pregnant patients diagnosed with chlamydial infection can be treated with tetracycline and doxycycline *(Emily R. BA, 2020)*. The azalide Azithromycin is a derivative of the more broad-spectrum macrolide Erythromycin with the recommended dose of 1g single dose orally is the 1st line treatment of chlamydial infection *(Rodrigues, Sousa and Vale, 2022)*. Azithromycin's MOA does not directly harm chlamydial elementary bodies, but it does limit bacterial protein synthesis in chlamydia-infected cells. Its inhibition is often effectively rapid, requiring only a brief exposure to produce its effects. Studies indicate that Azithromycin has a higher failure rate than Doxycycline *(Rodrigues et al., 2022).*

Erythromycin is a more broad-spectrum macrolide antibiotic with the recommended dose of 500mg ×4 times a day for 7 days *(Rodrigues et al., 2022).* It has bacteriostatic effects on infections. According to studies, there may be a higher chance of pyloric stenosis causing the particular gastrointestinal problems linked to the antibiotic erythromycin *(Rodrigues et al., 2022).*

Clindamycin, a lincosamide antibiotic, is effective against Chlamydial trachomatis infections at a dose of 600mg ×3 per day for 10 days. It also has a bacteriostatic effect and has a long-lasting effect (Rodrigues et al., 2022). Clindamycin is less commonly used to treat Chlamydial infections; however, it is regarded a beneficial medicine for patients who have antibiotic allergies or intolerances (Erythromycin) *(Rodrigues et al., 2022)*. It is expected to be successful in blocking C. trachomatis infections, although compliance concerns could compromise the overall outcome of treatment *(Rodrigues et al., 2022).*

Another antibiotic, a penicillin derivative, slows the proliferation of reticulate bodies as well as their differentiation into infectious elementary bodies, but does not always kill the organism. Amoxicillin's MOA shows that it is a relatively weak drug against C. trachomatis bacteria. The recommended dose

of amoxicillin is 500mg × 3 per day for 7 days *(Rodrigues et al., 2022).* Amoxicillin is also linked to an increased requirement for routine monitoring, which raises medical costs and time. However, significant severe side effects are not attributable to Amoxicillin administration, and the success of the therapy *(Rodrigues et al., 2022).*

This study aims to identify an antibiotic with low side effects for both mother and neonate while effectively inhibiting Chlamydial infections during pregnancy. Macrolides (Azithromycin, erythromycin), clindamycin and amoxicillin (ß-lactam Penicillin) are the antibiotics prescribed as per the protocols since they are commonly used for Chlamydial trachomatis infections.

Study Objectives

The research aims to investigate the treatment evaluation of genital chlamydia trachomatis infections in pregnant women.

- The research aims to investigate the most efficacious and the most tolerated therapy for the treatment of genital chlamydia trachomatis infections in pregnant women to prevent maternal and neonatal adverse clinical outcomes due to Chlamydia trachomatis.
- The research aims to determine which antibiotic has the least side effects on both maternal and the neonatal health.
- To help decide the most principal medication to provide to a woman who is pregnant with a *C. trachomatis* infection, the adverse effects experienced by both mother and baby for all chosen antibiotics were assessed.

PICO Framework

Table 1: PICO (Population, Intervention, Comparison, Outcome) Framework

PICO Study Model			
Population	**Intervention**	**Comparison**	**Outcome**
• **Age category 13-64 years** • **Pregnant Women** • **Chlamydia Trachomatis Infection**	Antibacterials for Systemic Use	• Antibiotic Regimen for systematic Use • Placebo	• Chlamydia test negative/ Microbial cure • Least Side effect • Most effective Treatment

METHODOLOGY

Study design

This systematic literature review is about the treatment evaluation of genital Chlamydia trachomatis infection among pregnant women. The technique use to evaluate the primary (treatment success and microbiological cure) and secondary outcomes (side effects and intolerance) to understand Chlamydia trachomatis treatment and health outcomes of both maternal and neonatal. The qualitative investigation method is used i.e. PICO model (population, Intervention, Comparison and Outcome) to gather and synthesize research data on treatment of pregnant women infected with genital infections due to chlamydia trachomatis.

Search Strategy and Information Sources

A comprehensive web search found information on treatment evaluation health outcomes of genital chlamydial trachomatis infection among pregnant women. The primary search has done to extract the studies by using electronic database PubMed, Cochrane Library and Scopus till February 2024. This searching of articles was strictly related to studies conducted on humans. Using database specific keywords and restricted vocabulary phrases, the search focused on the bacterial pathogen (“Chlamydia trachomatis”), health related diseases (“genital infections”, “STI”, “Pregnancy complications”, “neonatal complications”, “neonatal mortality”, “neonatal infection” “prematurity” and “adverse outcomes”) and the targeted population (not specific to any region). The search

eliminated all of the comments, editorials and also non peer reviewed works. Results were filtered by publication date, language (English), and also research study type before searching databases. After the preliminary search, EndNote helps in removing duplicates of searched data. A systematic review software "Rayyan" filtered publications with respect to software criteria. Comprehensive review method conveys trustworthy and beneficial results.

Study Criteria

Inclusion Criteria:

The Literature review includes all of the studies consisting of several feature:

- All of the studies are Randomized controlled trials (RCT) highlighted the use of any antibiotics or placebo used by pregnant women to treat genital chlamydia trachomatis were included.
- All of the studies must include pregnant women with genital chlamydia trachomatis infection.
- Pregnant women RCTs who tested positive for Chlamydia during any of the trimester of pregnancy.
- Any co morbidities related to STIs along with Chlamydia trachomatis infection also included
- Only English language reported articles were included.

Exclusion criteria

The Literature review exclude all of the studies that consist of several feature:

- The study which was not a RCT
- Pregnant women with multiple genital tract infections which is not only associated with Chlamydia trachomatis.
- A cohort study that includes both positive and negative chlamydia trachomatis test.
- Observational, retrospective, prospective studies.

Quality assessment and Data Collection

Studies that matched the criteria for inclusion were chosen by taking into account an adequate number of participants, clearly defined research objectives, suitability of approach selection, data collection, evaluation, and reporting of study results. Open Access full text of the eligible research articles evaluated in terms of the inclusion requirements. Using Technical software "Rayyan" for data management and EndNote for reference management, a database that could handle the data collected was established.

Outcome of Interest

Primary outcome: It was focused on the comparison of the most effective antibiotic to completely cure of Chlamydia trachomatis which means Chlamydia test should be negative after at least three weeks of maternal treatment.

Secondary Outcome: It was focused on comparing the antibiotic regimen therapeutic index with respect to its safety and side effects of treatment among pregnant women.

Statistical Analysis

SPSS model 22.0 was used to enter and analyze the data from all of the selected RCTs. The relationship of antibiotics with regard to their effectiveness and side effects among different antibiotic groups were compared using the Chi square test, and numerical data such as total numbers and (%) percentages were reported. All of the data was determined by using a 95% CI. If the P-value was higher than 0.05, it was regarded as significant.

Study Selection

After thorough evaluation of exclusion and inclusion criteria, seventeen eligible randomized clinical trials were selected for the evaluation of clinical outcomes.

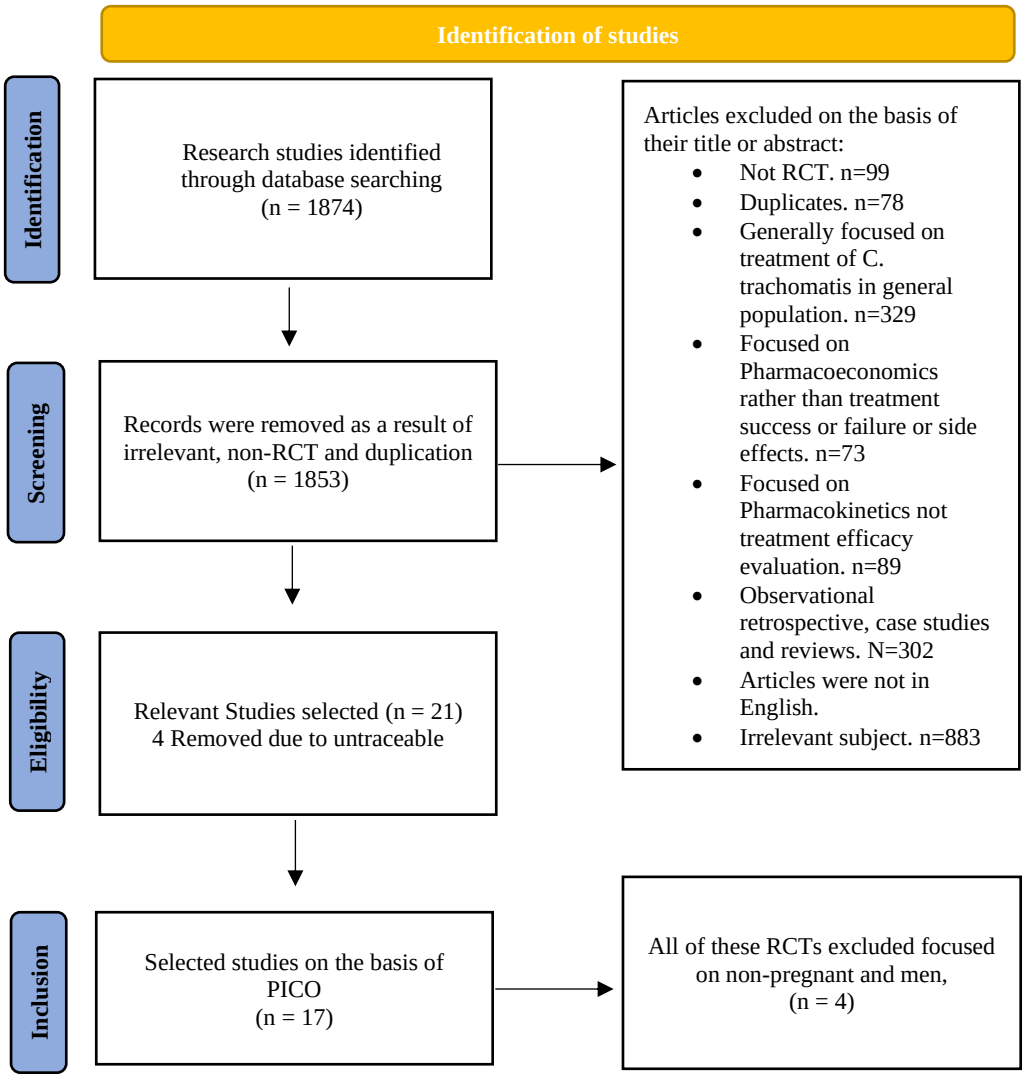

Figure 1: Flow Diagram

RESULTS

Selected Study

Figure 1, presented the flow diagram describing the selection process applied to identify RCT included to evaluate the most effective treatment regimen along with the treatment adverse effects concerning drug safety and compliance along microbial test of cure. Initially one thousand eight hundred and seventy-four articles were identified by using relevant search terms on the basis of inclusion criteria. After screening, records were removed as a result of irrelevant, non RCT and duplication, 1857 articles were excluded for the reason mentioned in figure.1. Finally 17 *RCT's (Adair, 1998), (Bell, 1982), (Gilbert, 1992), (Gunter, 1996), (Alary et al., 1994), (Alger and Lovchik, 1991), (Bush and Rosa, 1994), (Edwards et al., 1996), (Jacobson et al., 2001), (Kacmar et al., 2001), (Magat et al., 1993), (Martín et al., 1997), (Okunola et al., 2016), (Rosenn, Macones and Silverman, 1995), (Silverman et al., 1994), (Turrentine, Troyer and Gonik, 1995)* and *(Wehbeh et al., 1998)* were included in this comprehensive literature review. All of the studies included in this review were undertaken in USA (14 study), Canada (1 study) and Nigeria (1 study).

Study Characteristics

Table 1, describes the characteristics of all of the 17 seventeen RCTs. All of the patients enrolled are pregnant women with confirmed genital chlamydia trachomatis with no difference in demographic characteristics between the different studies. All of the participants who were tested positive for

chlamydia trachomatis were advised to receive proper treatment and to use protection while doing sexual intercourse.

Interventions and Comparisons

Table.1, showed that from the 17 selected RCTs, One of the RCT compared amoxicillin with placebo *(Bell, 1982)*. Two of the RCT compared erythromycin with placebo *(Alger and Lovchik, 1991)* and *(Martín et al., 1997).* Two of the RCT compared clindamycin with placebo *(Gilbert, 1992*), *(Alger and Lovchik, 1991)*. Two of the RCT compared amoxicillin with azithromycin *(Kacmar et al., 2001)* and *(Jacobson et al., 2001)*. Five of the RCT compared amoxicillin versus erythromycin *(Alary et al., 1994), (Turrentine, Troyer and Gonik, 1995), (Magat et al., 1993), (Silverman et al., 1994)* and *(Okunola et al., 2016)*. Six of the RCT compared erythromycin and azithromycin *(Wehbeh et al., 1998), (Bush and Rosa, 1994), (Edwards et al., 1996), (Adair, 1998), (Rosenn, Macones and Silverman, 1995), (Gunter, 1996).* Three of the RCT compared clindamycin and erythromycin *(Turrentine, Troyer and Gonik, 1995), (Alger and Lovchik, 1991), (Gilbert, 1992).* One of the RCT compared amoxicillin with clindamycin *(Turrentine, Troyer and Gonik, 1995).*

In one RCT, subjects received as a single 1g dosage of azithromycin dissolved into 60ml of water. Whereas in others it was given as 1g of tablet dosage. 13 of the RCTs receiving the dosage of erythromycin as per the guidelines i.e. 500mg QID for 14days, except 1 RCT in which the dose of erythromycin is 333mg QID for 14 days. Amoxicillin was given in a standard dose of 500mg PO, TID for 7 days. Different doses and treatment durations of clindamycin were observed in this study. For example, in one RCT, a 600 mg dose was given TID for 10 days, while in another, a 450 mg dose was given QID for 14 days.

Table 2: Study Characteristics

S. No	Reference and year of publication	Treatment regimen	Dosage and treatment periods	Number of enrolled patients	Number of clinically evaluated patients	Percentage success of treatment	Percentage failure of treatment
1.	(Alary et al., 1994)	Amoxicillin	500mg ×3 a day, 7 days	105	100	99/100 99.00%	1/100 1%
		Erythromycin	500mg ×4 a day, 7 days	105	99	87/99 87.90%	12/99 12.10%
2.	(Edwards et al., 1996)	Azithromycin	1g single dose	65	62	58/62 93.50%	4/62 6.50%
		Erythromycin	500mg ×4 a day, 7 days	65	64	46/64 71.90%	8/64 12.50%
3.	(Rosenn, Macones and Silverman, 1995)	Azithromycin	1 single dose	24	23	21/23 91.30%	2/23 8.70%
		Erythromycin	500mg ×4 a day, 7 days	24	22	17/22 77.30%	5/22 22.72%
4.	(Turrentine, Troyer and Gonik, 1995)	Amoxicillin	500mg ×3 a day, 7 days	57	55	52/55 94.00%	3/55 5.50%
		Erythromycin	500mg ×4 a day, 7 days	56	53	51/53 96.00%	2/53 3.80%
		Clindamycin	600mg ×3 a day, 10 days	55	52	51/52 98.00%	1/52 1.92%
5.	(Jacobson et al., 2001)	Azithromycin	1g single dose	63	55	35/55 63.60%	20/55 36.40%
		Amoxicillin	500mg ×3 a day, 7 days	66	55	32/55 58.20%	23/55 41.80%
6.	(Adair, 1998)	Azithromycin	1g dissolved in 60ml of water, single dose	53	42	37/42 88.10%	5/42 11.90%
		Erythromycin	500mg ×4 a day, 7 days	53	43	40/43 93.00%	3/43 7.00%
7.	(Gilbert, 1992)	Clindamycin	450mg ×4 a day, 14 days	42	42	39/42 93.00%	3/42 7.14%
		Erythromycin	333mg ×4 a day, 14 days	42	42	35/42 84.00%	7/42 16.70%

		Placebo	N/A	42	42	0/42 0.00%	42/42 100%
8.	(Alger and Lovchik, 1991)	Clindamycin	450mg ×4 a day, 14 days	42	41	38/41 92.6%	3/41 7.3%
		Erythromycin	333mg ×4 a day, 14 days	40	37	31/37 83.7%	6/37 16.2%
9.	(Martín et al., 1997)	Erythromycin	333mg ×4 a day, 14 days	205	205	164/205 80%	41/205 20%
		placebo	N/A	209	209	77/209 37%	132/209 63%
10.	(Bell, 1982)	Amoxicillin	500mg ×3 a day, 7 days	11	9	6/9 66.6%	3/9 33.3%
		Placebo	N/A	10	6	2/6 33.3%	4/6 66.6%
11.	(Kacmar et al., 2001)	Azithromycin	1g single dose	20	20	19/20 95%%	1/20 5%
		Amoxicillin	500mg ×3 a day, 7 days	19	19	12/19 63%	7/19 37%
12.	(Magat et al., 1993)	Amoxicillin	500mg ×3 a day, 7 days	72	64	55/64 86%	9/64 14%
		Erythromycin	500mg ×4 a day, 7 days	71	50	47/50 94%	3/50 6%
13.	(Bush and Rosa, 1994)	Erythromycin	500mg ×4 a day, 7 days	15	15	14/15 93.3%	1/15 6.6%
		Azithromycin	1g single dose	15	15	15/15 100%	0/15 0%
14.	(Gunter, 1996)	Erythromycin	500mg ×4 a day, 7 days	18	11	5/11 45.0%	6/11 54.5%
		Azithromycin	1g single dose	22	15	15/15 100%	0/15 0.00%
15.	(Silverman et al., 1994)	Amoxicillin	500mg ×3 a day, 7 days	39	39	33/39 85.0%	6/39 15.4%
		Erythromycin	500mg ×4 a day, 7 days	38	38	32/38 84.2%	6/38 16%
16.	(Wehbeh et al., 1998)	Erythromycin	500mg ×4 a day, 7 days	21	21	17/21 81.0%	4/21 19.0%
		Azithromycin	1g single dose	27	27	26/27 96.3%	1/27 4%
17.	(Okunola et al., 2016)	Erythromycin	500mg ×4 a day, 7 days	110	101	98/101 97%	3/101 3%
		Amoxicillin	500mg ×3 a day, 7 days	110	103	96/103 93%	7/103 6.7%

Comparative Treatment Outcomes for treating genital *Chlamydia trachomatis*.

Comparison of Amoxicillin v/s Placebo.

It is unclear from the data whether amoxicillin (n= 6) or a placebo (n= 2) enhances microbiological cure.

Comparison of Amoxicillin with Placebo, Outcome: Chlamydia trachomatis Cure			
Study	**Amoxicillin**	**Placebo**	**P-value**
(Bell, 1982)	6	2	NA
Total	6	2	

Comparison of Erythromycin v/s Placebo.

After comparison of Erythromycin with placebo, erythromycin (n= 195) appears significantly (p= 0.05) more efficacious in microbial cure than placebo (n=87).

Comparison of Erythromycin with Placebo, Outcome: Chlamydia trachomatis Cure			
Study	**Erythromycin**	**Placebo**	**P-value**
(Gilbert, 1992)	31	10	0.05
(Martín et al., 1997)	164	77	
Total	195	87	

Comparison of Clindamycin v/s Placebo.

After comparison of clindamycin with placebo, clindamycin (n= 38) appears more efficacious in microbial cure than placebo (n=10).

Comparison of Clindamycin with Placebo, Outcome: Chlamydia trachomatis Cure			
Study	**Clindamycin**	**Placebo**	**P-value**
(Gilbert, 1992)	39	10	0.08
Total	39	10	

Comparison of Amoxicillin v/s Azithromycin.

As compare to Azithromycin (n= 53) it is unclear that if amoxicillin (n=44) enhances or decreases microbial cure.

Comparison of Amoxicillin with Azithromycin, Outcome: Chlamydia trachomatis Cure			
Study	**Amoxicillin**	**Azithromycin**	**P-value**
(Jacobson et al., 2001)	32	35	0.67
(Kacmar et al., 2001)	12	18	
Total	44	53	

Comparison of Amoxicillin v/s Erythromycin.

As compared to erythromycin (n= 206), amoxicillin (n= 231) has a negligible impact on microbiological cure.

Comparison of Amoxicillin with Erythromycin, Outcome: Chlamydia trachomatis Cure			
Study	**Amoxicillin**	**Erythromycin**	**P-value**
(Alary et al., 1994)	98	87	0.36
(Magat et al., 1993)	55	47	
(Silverman et al., 1994)	28	27	
(Turrentine, Troyer and Gonik, 1995)	50	45	
(Okunola et al., 2016)	96	98	
Total	231	206	

Comparison of Erythromycin v/s Azithromycin.

As compare to Erythromycin (n=151), azithromycin (n= 179) seems to possibly enhance microbiological cure.

Comparison of Azithromycin with Erythromycin, Outcome: Chlamydia trachomatis Cure			
Study	**Azithromycin**	**Erythromycin**	**P-value**
(Adair, 1998)	37	40	0.06
(Bush and Rosa, 1994)	15	14	
(Edwards et al., 1996)	58	46	
(Gunter, 1996)	22	17	
(Rosenn, Macones and Silverman, 1995)	21	17	
(Wehbeh et al., 1998)	26	17	
Total	179	151	

Comparison of Clindamycin v/s Erythromycin.

As compared to Erythromycin (n=111), clindamycin (n= 124) has a negligible impact on microbiological cure.

Comparison of Clindamycin with Erythromycin, Outcome: Chlamydia trachomatis Cure			
Study	**Clindamycin**	**Erythromycin**	**P-value**
(Alger and Lovchik, 1991)	38	31	0.3
(Turrentine, Troyer and Gonik, 1995)	47	45	
(Gilbert, 1992)	39	35	
Total	124	111	

Comparison of Amoxicillin v/s Clindamycin.

As compared to clindamycin (n= 47), amoxicillin (n=50) has a negligible impact on microbiological cure.

Comparison of Amoxicillin with Clindamycin, Outcome: Chlamydia trachomatis Cure			
Study	**Amoxicillin**	**Clindamycin**	**P-value**
(Turrentine, Troyer and Gonik, 1995)	50	47	NA
Total	50	47	

Comparative Treatment Evaluation of Success and Failure Outcomes for treating genital *Chlamydia trachomatis*.

Table showed that in eight RCTs associated with Azithromycin the success rate is around 87.2% whereas 12.7% failed to response positive possibly due to antibiotic resistance. In 14 RCTs associated to erythromycin, the success rate is around 85.3% where as 14.6% failed to response positively, this might be due to antibiotic resistance. In 3 RCTs associated to Clindamycin the success rate is around 94.8% whereas 5% failed to response positively due to antibiotic resistance. In 8 RCTs associated to Amoxicillin *(Alary et al., 1994)*, the success rate is around 86.7% where as 13.2% failed to response positively possibly due to antibiotic resistance. Overall Clindamycin showed the increase success rates among all of the treatment 95% success rate along with least number of failure rates among all 5.2%

Antibiotics (treatment regimen)	Reference and year of publication	Treatment success rate	Treatment Failure rate	Total percentage of treatment success and failure
Azithromycin	(Edwards et al., 1996)	58/62 93.50%	4/62 6.50%	**Success Rate** 226/259 87.2% **Failure Rate** 33/259 12.7%
	(Rosenn, Macones and Silverman, 1995)	21/23 91.30%	2/23 8.70%	
	(Jacobson et al., 2001)	35/55 63.60%	20/55 36.40%	
	(Adair, 1998)	37/42 88.10%	5/42 11.90%	
	(Kacmar et al., 2001)	19/20 95%%	1/20 5%	
	(Bush and Rosa, 1994)	15/15 100%	0/15 0%	
	(Gunter, 1996)	15/15 100%	0/15 0.00%	
	(Wehbeh et al., 1998)	26/27 96.3%	1/27 4%	
Erythromycin	(Alary et al., 1994)	87/99 87.90%	12/99 12.10%	**Success Rate** 684/801 85.3% **Failure Rate** 117/801 14.6%
	(Edwards et al., 1996)	46/64 71.90%	8/64 12.50%	
	(Rosenn, Macones and Silverman, 1995)	17/22 77.30%	5/22 22.72%	
	(Turrentine, Troyer and Gonik, 1995)	51/53 96.00%	2/53 3.80%	
	(Adair, 1998)	40/43 93.00%	3/43 7.00%	
	(Gilbert, 1992)	35/42 84.00%	7/42 16.70%	
	(Alger and Lovchik, 1991)	31/37 83.7%	6/37 16.2%	
	(Martín et al., 1997)	164/205 80%	41/205 20%	
	(Magat et al., 1993)	47/50 94%	3/50 6%	
	(Bush and Rosa, 1994)	14/15 93.3%	1/15 6.6%	
	(Gunter, 1996)	5/11 45.0%	6/11 54.5%	

	(Silverman et al., 1994)	32/38 84.2%	6/38 16%	
	(Wehbeh et al., 1998)	17/21 81.0%	4/21 19.0%	
	(Okunola et al., 2016)	98/101 97%	3/101 3%	
Clindamycin	(Turrentine, Troyer and Gonik, 1995)	51/52 98.00%	1/52 1.92%	**Success Rate** 128/135 95% **Failure Rate** 7/135 5.2%
	(Gilbert, 1992)	39/42 93.00%	3/42 7.14%	
	(Alger and Lovchik, 1991)	38/41 92.6%	3/41 7.3%	
Amoxicillin	(Alary et al., 1994)	99/100 99.00%	1/100 1%	**Success Rate** 385/444 87% **Failure Rate** 59/444 13.2%
	(Turrentine, Troyer and Gonik, 1995)	52/55 94.00%	3/55 5.50%	
	(Jacobson et al., 2001)	32/55 58.20%	23/55 41.80%	
	(Bell, 1982)	6/9 66.6%	3/9 33.3%	
	(Kacmar et al., 2001)	12/19 63%	7/19 37%	
	(Magat et al., 1993)	55/64 86%	9/64 14%	
	(Silverman et al., 1994)	33/39 85.0%	6/39 15.4%	
	(Okunola et al., 2016)	96/103 93%	7/103 6.7%	

Comparative Treatment Side Effects Outcomes for treating genital *Chlamydia trachomatis*.

Table 2 shows that in eight RCTs with azithromycin, a total of 45/275 (16%) of the patients had gastrointestinal problems (such as nausea, diarrhea, stomach discomfort, and rash) and showed signs of intolerance to the medication. In the fourteen RCTs on erythromycin, 215/795 (27%) of the Pregnant women had rash and gastrointestinal problems. In the three randomized controlled trials with Clindamycin, 20/133 (15%) of the patients had medication intolerance. In the eight randomized controlled trials with amoxicillin, 33 out of 438 pregnant women (7.5%) showed signs of gastrointestinal problems.

Antibiotics (treatment regimen)	Reference and year of publication	Percentage of reported gastrointestinal issues	Total percentage of side effects
Azithromycin	(Edwards et al., 1996)	12/62 17.7%	45/275 16.3%
	(Rosenn, Macones and Silverman, 1995)	4/22 18.2%	
	(Jacobson et al., 2001)	6/55 10.9%	
	(Adair, 1998)	6/53 11.3%	
	(Kacmar et al., 2001)	10/19 40%	
	(Bush and Rosa, 1994)	0/15 0%	
	(Gunter, 1996)	3/22 14%	
	(Wehbeh et al., 1998)	4/27 14.8%	
Erythromycin	(Alary et al., 1994)	32/99 31.3%	215/795 27%
	(Edwards et al., 1996)	42/46 65.6%	

	(Rosenn, Macones and Silverman, 1995)	10/22 45.5%	
	(Turrentine, Troyer and Gonik, 1995)	14/53 24.5%	
	(Adair, 1998)	31/53 58.50%	
	(Gilbert, 1992)	10/42 23.8%	
	(Alger and Lovchik, 1991)	7/42 17%	
	(Martín et al., 1997)	9/114 8%	
	(Magat et al., 1993)	4/65 6.1%	
	(Bush and Rosa, 1994)	15/15 100%	
	(Gunter, 1996)	11/88 13%	
	(Silverman et al., 1994)	5/34 15%	
	(Wehbeh et al., 1998)	12/21 57.1%	
	(Okunola et al., 2016)	13/101 13%	
Clindamycin	(Turrentine, Troyer and Gonik, 1995)	7/52 9.6%	20/133 15%
	(Gilbert, 1992)	4/42 9.5%	
	(Alger and Lovchik, 1991)	9/39 23.1%	
Amoxicillin	(Alary et al., 1994)	6/100 6.0%	33/438 7.5%
	(Turrentine, Troyer and Gonik, 1995)	3/55 5.4%	
	(Jacobson et al., 2001)	3/55 5.5%	
	(Bell, 1982)	0/9 0%	
	(Kacmar et al., 2001)	5/17 29.4%	
	(Magat et al., 1993)	4/65 6.1%	
	(Silverman et al., 1994)	5/34 15%	
	(Okunola et al., 2016)	9/103 9%	

Comparison of Erythromycin with placebo considering treatment side effects.

Two RCTs showed Erythromycin (n= 123) causes significantly (p = 0.03**) more adverse effects associated to GIT than a placebo (n= 90) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Erythromycin with Placebo, Outcome: Side Effects of treatment			
Study	**Erythromycin**	**Placebo**	**P-value**
(Gilbert, 1992)	10	0	0.03**
(Martín et al., 1997)	113	90	
Total	123	90	

Comparison of Clindamycin with placebo considering treatment side effects.
One RCT showed Clindamycin (n=4) probably causing more side effects associated to GIT than a placebo (n=1) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Clindamycin with Placebo, Outcome: Side Effects of Treatment			
Study	**Clindamycin**	**Placebo**	**P-value**
(Gilbert, 1992)	4	1	NA
Total	4	1	

Comparison of Amoxicillin with Azithromycin considering treatment side effects.
Two RCT showed Azithromycin (n=16) causes significantly (p= 0.03*) more side effects associated to GIT than Amoxicillin (n=8) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Amoxicillin with Azithromycin, Outcome: Side Effects of treatment			
Study	**Amoxicillin**	**Azithromycin**	**P-value**
(Jacobson et al., 2001)	3	6	0.03**
(Kacmar et al., 2001)	5	10	
Total	8	16	

Comparison of Amoxicillin with Erythromycin considering treatment side effects.
Five RCT (Alary et al., 1994), showed Erythromycin (n= 102) causes significantly (p = 0.03**) more side effects associated to GIT than Amoxicillin (n= 37) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Amoxicillin with Erythromycin, Outcome: Side Effects of treatment			
Study	**Amoxicillin**	**Erythromycin**	**P-value**
(Alary et al., 1994)	15	34	0.03**
(Magat et al., 1993)	5	30	
(Silverman et al., 1994)	5	12	
(Turrentine, Troyer and Gonik, 1995)	3	13	
(Okunola et al., 2016)	9	13	
Total	37	102	

Comparison of Azithromycin with Erythromycin considering treatment side effects.
Six RCT showed Erythromycin (n= 115) causes significantly (p= 0.04*) more side effects associated to GIT than Azithromycin (n= 28) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Azithromycin with Erythromycin, Outcome: Side effects of treatment			
Study	**Azithromycin**	**Erythromycin**	**P-value**
(Adair, 1998)	5	25	0.04*
(Bush and Rosa, 1994)	0	15	
(Edwards et al., 1996)	12	42	
(Gunter, 1996)	3	11	
(Rosenn, Macones and Silverman, 1995)	4	10	
(Wehbeh et al., 1998)	4	12	
Total	28	115	

Comparison of Clindamycin with Erythromycin considering treatment side effects.
Three RCT showed Erythromycin (n= 32) causes significantly (p= 0.04*) more side effects associated to GIT than Clindamycin (n=14) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Clindamycin with Erythromycin, Outcome: Side Effects of Treatment			
Study	**Clindamycin**	**Erythromycin**	**P-value**
(Alger and Lovchik, 1991)	5	9	0.04*
(Turrentine, Troyer and Gonik, 1995)	5	13	
(Gilbert, 1992)	4	10	
Total	14	32	

Comparison of Amoxicillin with Clindamycin considering treatment side effects.

Only one RCT showed clindamycin causes more side effects (n=5) associated to GIT than Amoxicillin (n= 3) in terms of occurrence. GIT side effects associated are nausea, abdominal pain, vomiting and diarrhea.

Comparison of Amoxicillin with Clindamycin, Outcome: Side effects of treatment			
Study	**Amoxicillin**	**Clindamycin**	**P-value**
(Turrentine, Troyer and Gonik, 1995)	3	5	NA
Total	3	5	

DISCUSSION

The 17 RCTs enrolling 1639 total pregnant women, total data extracted from the studies for the evaluation of treatment success of eradicating Chlamydia Trachomatis infections in pregnancy.

The overall data indicated that the least successful antibiotic regimen examined in this investigation was erythromycin therapy (n=684/801, 85.3%) *(Turrentine, Troyer and Gonik, 1995)*. In addition to the expected unfavorable gastrointestinal side effects of erythromycin (n= 215/795, 27%) *(Turrentine, Troyer and Gonik, 1995*), there were understandably high rates of incompliance patients in RCTs, which was strongly associated with failure of therapy. Strong digestive and pyloric contractions brought on by the treatment interaction with motilin receptors are assumed to be the underlying cause of the gastrointestinal adverse effects associated with erythromycin, which are thus specific to macrolides. It makes sense that the number of patients participating in RCTs decreased due to erythromycin's associations with pyloric stenosis and ensuing gastrointestinal problems.

Clindamycin (n= 128/135, 95%) *(Turrentine, Troyer and Gonik, 1995)*, proved somewhat the most successful treatment in eradicating Chlamydia trachomatis among pregnant women which significantly related to least treatment failure as compared to azithromycin, erythromycin and Amoxicillin.

Amoxicillin (n= 33/438, 7.5%) *(Kacmar et al., 2001), (Jacobson et al., 2001), (Alary et al., 1994), (Turrentine, Troyer and Gonik, 1995), (Magat et al., 1993), (Silverman et al., 1994)* and *(Okunola et al., 2016)* proved somewhat the most effective in terms of providing the least GIT side effects among all of the medications used in this Study.

In Comparison of Erythromycin with Azithromycin *(Wehbeh et al., 1998), (Bush and Rosa, 1994), (Edwards et al., 1996), (Adair, 1998), (Rosenn, Macones and Silverman, 1995), (Gunter, 1996)*, Azithromycin, the azalide derivative of Erythromycin, had a marginally higher efficacy in eradicating the Chlamydial infection. Only 6 RCTs that met the inclusion criteria could be compared, and 5 of them showed that azithromycin was more effective than erythromycin at curing Chlamydia trachomatis. Only 1 showed decreased efficacy due to drug reconstitution of powdered dosage form of azithromycin in 60 ml of water, this reduced the efficacy of azithromycin. When compared to Erythromycin (n= 151), azithromycin (n=179) generally had a higher success rate in curing a C. trachomatis infection in pregnancy. Significantly greater rates of gastrointestinal side effects were also linked to a higher probability of Erythromycin treatment failure. One possible explanation for the lower rate of treatment success in the trials involved in the comparison of these two macrolides is patient noncompliance because of adverse effects in the RCTs of each medication.

Among all of the Comparisons of Erythromycin (27%) with other treatments like Amoxicillin (7.5%), Clindamycin (15%), Azithromycin (16.3%) the rate of GIT side effects associated to Erythromycin are significantly higher than others.

As Compared to Erythromycin *(Turrentine, Troyer and Gonik, 1995)*, Clindamycin had a somewhat greater success rate in curing C. trachomatis infections in pregnant women. Once again, this was probably related to the decreased compliance that patients receiving erythromycin and having negative gastrointestinal side effects experienced in RCTs. Clindamycin is more probable to prevent recurrent infections because of its mechanism of action, which involves attaching to chlamydia ribosomal subunits and enabling a post-antibiotic consequence. In addition, there weren't many negative side effects connected with this antibiotic. Still, additional randomized controlled trials would be necessary to enhance the validity of these results.

Limitations of the study

While the literature evaluation indicated that Clindamycin was the most successful treatment with greater success rates and fewer side effects, there were very few trials on the use of Clindamycin to treat chlamydia trachomatis infections during pregnancy. There isn't many research that compare the treatments that patient received and assess the satisfactory results. The WHO should recommend more studies and randomized controlled trials (RCTs) on the use of antibiotics during pregnancy in order to improve this and obtain more meaningful results.

CONCLUSION

In conclusion, the best antibiotic for treating C. trachomatis infections during pregnancy is Clindamycin. Clindamycin's characteristic pharmacokinetic profile enabled a high degree of patient compliance and a high success rate in eliminating the active infection with little gastrointestinal side effects. This antibiotic makes it easier to eradicate C. trachomatis infections in pregnant women quickly and completely. The present research had access to more Clindamycin data than it did on Azithromycin data. Although azithromycin is also highly effective in treating C. trachomatis infections in pregnant women, but there isn't much evidence to back this claim. The effectiveness of azithromycin has to be investigated in future studies using further RCTs. Moreover, in allergic situations or when C. trachomatis exhibits widespread antibiotic resistance to the clindamycin, azithromycin may be used as a backup antibiotic to clindamycin.

FUNDING

This research received no external funding or financial support.

ACKNOWLEDGMENT

None to disclose.

REFERENCES

1. Adair, C. (1998). Chlamydia in Pregnancy: A Randomized Trial of Azithromycin and Erythromycin. *Obstetrics & Gynecology*, 91(2), pp.165–168. doi:https://doi.org/10.1016/s0029-7844(97)00586-3.
2. Alary, M., Joly, J.R., Moutquin, J.M., Mondor, M., Boucher, M., Fortier, A., Pinault, J.J., Paris, G., Carrier, S. and Chamberland, H. (1994). Randomised comparison of amoxycillin and erythromycin in treatment of genital chlamydial infection in pregnancy. *Lancet (London, England)*, [online] 344(8935), pp.1461–1465. doi:https://doi.org/10.1016/s0140-6736(94)90288-7.
3. Alger, L.S. and Lovchik, J.C. (1991). Comparative efficacy of clindamycin versus erythromycin in eradication of antenatal Chlamydia trachomatis. *American Journal of Obstetrics and Gynecology*, [online] 165(2), pp.375–381. doi:https://doi.org/10.1016/0002-9378(91)90097-b.
4. Bush, M.R. and Rosa, C. (1994). Azithromycin and erythromycin in the treatment of cervical chlamydial infection during pregnancy. *Obstetrics and Gynecology*, [online] 84(1), pp.61–63. Available at: https://pubmed.ncbi.nlm.nih.gov/8008325/ [Accessed 11 Mar. 2024].
5. Edwards, M.S., Newman, R.B., Carter, S.G., Leboeuf, F.W., Menard, M.K. and Rainwater, K.P. (1996). Randomized Clinical Trial of Azithromycin vs. Erythromycin for the Treatment of

Chlamydia Cervicitis in Pregnancy. *Infectious Diseases in Obstetrics and Gynecology*, [online] 4(6), pp.333–337. doi:https://doi.org/10.1155/S1064744996000671.
6. Jacobson, G.F., Autry, A.M., Kirby, R.S., Liverman, E.M. and Motley, R.U. (2001). A randomized controlled trial comparing amoxicillin and azithromycin for the treatment of Chlamydia trachomatis in pregnancy. *American Journal of Obstetrics and Gynecology*, 184(7), pp.1352–1356. doi:https://doi.org/10.1067/mob.2001.115050.
7. Kacmar, J., Cheh, E., Montagno, A. and Peipert, J.F. (2001). A Randomized Trial of Azithromycin Versus Amoxicillin for the Treatment of Chlamydia trachomatis in pregnancy. *Infectious Diseases in Obstetrics and Gynecology*, 9(4), pp.197–202. doi:https://doi.org/10.1155/s1064744901000321.
8. Magat, A.H., Alger, L.S., Nagey, D.A., Hatch, V. and Lovchik, J.C. (1993). Double-blind randomized study comparing amoxicillin and erythromycin for the treatment of Chlamydia trachomatis in pregnancy. *Obstetrics and Gynecology*, [online] 81(5 (Pt 1)), pp.745–749. Available at: https://pubmed.ncbi.nlm.nih.gov/8469466/ [Accessed 11 Mar. 2024].
9. Martín, D.H., Eschenbach, D.A., Mary Frances Cotch, Nugent, R.P., Rao, A.P., Klebanoff, M.A., Lou, Y., Rettig, P.J., Gibbs, R.S., Pastorek, J.G., Regan, J.A. and Kaslow, R.A. (1997). Double-Blind Placebo-Controlled Treatment Trial ofChlamydia trachomatisEndocervical Infections in Pregnant Women. *Infectious diseases in obstetrics and gynecology*, 5(1), pp.10–17. doi:https://doi.org/10.1155/s1064744997000057.
10. Okunola, T.O., Ajenifuja, K.O., Ogunniyi, S.O. and Aboderin, A.O. (2016). Erythromycin versus amoxicillin for the management of chlamydia infection in pregnant women: a randomized controlled trial. *International Journal of Medicine and Biomedical Research*, [online] 5(1), pp.35–42. doi:https://doi.org/10.14194/ijmbr.5.1.5.
11. Rosenn, M.F., Macones, G.A. and Silverman, N.S. (1995). Randomized trial of erythromycin and azithromycin for treatment of chlamydial infection in pregnancy. *Infectious Diseases in Obstetrics and Gynecology*, [online] 3(6), pp.241–244. doi:https://doi.org/10.1155/S1064744995000718.
12. Silverman, N.S., Sullivan, M., Hochman, M., Womack, M. and Jungkind, D.L. (1994). A randomized, prospective trial comparing amoxicillin and erythromycin for the treatment of Chlamydia trachomatis in pregnancy. *American Journal of Obstetrics and Gynecology*, 170(3), pp.829–832. doi:https://doi.org/10.1016/s0002-9378(94)70292-6.
13. Turrentine, M.A., Troyer, L. and Gonik, B. (1995). Randomized prospective study comparing erythromycin, amoxicillin, and clindamycin for the treatment of chlamydia trachomatis in pregnancy. *Infectious Diseases in Obstetrics and Gynecology*, [online] 2(5), pp.205–209. doi:https://doi.org/10.1155/S1064744995000020.
14. Wehbeh, H.A., Ruggeirio, R.M., Shahem, S., Lopez, G. and Ali, Y. (1998). Single-dose azithromycin for Chlamydia in pregnant women. *The Journal of reproductive medicine*, [online] 43(6), pp.509–514. Available at: https://europepmc.org/article/med/9653697 [Accessed 11 Mar. 2024].
15. Bell, T., Sandstrom, I., Eschenbach, D., Hummel, D., Kuo, C., Wang, S., et al. (1982). Treatment of Chlamydia trachomatis in pregnancy with amoxicillin. Fernstrom Foundation Series, 2, 221-224.
16. Gunter, M.E., Adair, C.D., Ernest, J.M., & McElroy, G. (1996). Azithromycin powder versus erythromycin in the treatment of chlamydial cervicitis in pregnancy. Infectious Diseases in Obstetrics and Gynecology, 4, 53.
17. Gilbert, E. (1992). Comparative efficacy of Clindamycin versus Erythromycin in eradication of antenatal Chlamydia trachomatis. Annals of Emergency Medicine, 21(1), 105.
18. Daskalakis, G., Alexandros Psarris, Koutras, A., Zacharias Fasoulakis, Ioannis Prokopakis, Varthaliti, A., Karasmani, C., Ntounis, T., Ekaterini Domali, Theodora, M., Panos Antsaklis, Pappa, K.I. and Angeliki Papapanagiotou (2023). Maternal Infection and Preterm Birth: From Molecular Basis to Clinical Implications. *Children*, 10(5), pp.907–907. doi:https://doi.org/10.3390/children10050907.
19. Dian, T. (2022). *March 2022 - Volume 75 - Issue : Annals of Medicine and Surgery*. [online]

journals.lww.com. Available at: https://journals.lww.com/annals-of-medicine-and-surgery/fulltext/2022/03000/female_urogenital_chlamydia__epidemiology [Accessed 9 Oct. 2023].
20. Emily R. BA, G. (2020). *April 2020 - Volume 135 - Issue 4 : Obstetrics & Gynecology*. [online] journals.lww.com. Available at: https://journals.lww.com/greenjournal/Abstract/2020/04000/Patterns_of_Screening.
21. Ghasemian, E., Harding-Esch, E., Mabey, D. and Holland, M.J. (2023). When Bacteria and Viruses Collide: A Tale of Chlamydia trachomatis and Sexually Transmitted Viruses. *Viruses*, [online] 15(9), p.1954. doi:https://doi.org/10.3390/v15091954.
22. Land, J.A., Van Bergen, J.E.A.M., Morre, S.A. and Postma, M.J. (2009). Epidemiology of Chlamydia trachomatis infection in women and the cost-effectiveness of screening. *Human Reproduction Update*, [online] 16(2), pp.189–204. doi:https://doi.org/10.1093/humupd/dmp035.
23. Moore, R.K., Mallett, P., Hull, S., Christie, S., Simpson, E., Bowen, J., Dinsmore, W.W., McCaughey, C. and Livingstone, A. (2022). *Chlamydia trachomatis*conjunctivitis in the pre-pubertal child. *Archives of Disease in Childhood-education and Practice Edition*, 108(2), pp.104–108. doi:https://doi.org/10.1136/archdischild-2022-323845.
24. Mussa, A., Wynn, A., Ryan, R., Babalola, C.M., Hansman, E., Simon, S., Bame, B., Tamuthiba, L., Ramontshonyana, K., Ndlovu, N., Moshashane, N., Masole, M., Klausner, J.D. and Morroni, C. (2023). Prevalence of Chlamydia trachomatis and Neisseria gonorrhoeae infection and associated factors among asymptomatic pregnant women in Botswana. *International journal of STD & AIDS*, [online] 34(7), pp.448–456. doi:https://doi.org/10.1177/09564624231163203.
25. Niu, S., Huang, S. and Liu, B. (2024). *Chapter 65 - Chlamydia trachomatis*. [online] ScienceDirect. Available at: https://www.sciencedirect.com/science/article/abs/pii/B9780128186190000496 [Accessed 11 Mar. 2024].
26. Omer, H.M.H., Khalid, K.E., Miskeen, E.I., Taha, M.Y., Saleh, E.Y., Ahmed, E.A., Abdelwahid, O.H., Hassan, M.A. and Abakar, A.D. (2023). *Cytological and molecular screening of Chlamydia trachomatis in infertile women attending a maternity teaching hospital in Gezira State, Sudan: a cross-sectional study*. [online] f1000research.com. Available at: https://f1000research.com/articles/9-589 [Accessed 11 Mar. 2024].
27. Ramnarain, C., Govender, R., N Mabaso and N Abbai (2023). The impact of Chlamydia trachomatis infection on pregnancy and neonatal outcomes. *The journal of medical laboratory science & technology of South Africa*, 5(1), pp.39–45. doi:https://doi.org/10.36303/jmlstsa.135.
28. Rodrigues, R., Marques, L., Vieira-Baptista, P., Sousa, C. and Vale, N. (2022). Therapeutic Options for Chlamydia trachomatis Infection: Present and Future. *Antibiotics*, 11(11), p.1634. doi:https://doi.org/10.3390/antibiotics11111634.
29. Rodrigues, R., Sousa, C. and Vale, N. (2022). Chlamydia trachomatis as a Current Health Problem: Challenges and Opportunities. *Diagnostics*, 12(8), p.1795. doi:https://doi.org/10.3390/diagnostics12081795.
30. Usta, S.S. (2023). *Chlamydia trachomatis Infection in Women*. [online] www.intechopen.com. Available at: https://www.intechopen.com/chapters/87139 [Accessed 11 Mar. 2024].
31. Wang, J., Zhao, P., Xu, W. and Wang, C. (2023). Changing trends in Chlamydia and gonorrhea infections among female sex workers in Southern China: a surveillance data analysis spanning 2019 to 2022. *Journal of Public Health*, [online] 46(1). doi:https://doi.org/10.1093/pubmed/fdad222.