

Draft Chlamydia Management Guidelines

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Executive Summary

Chlamydia trachomatis is the most common treatable sexually transmissible infection acquired in New Zealand. Between 2002 and 2006 ESR reports from clinic surveillance data showed increases in chlamydia case numbers of 27.7% for sexual health clinics and 146.7% for Family Planning clinics. Laboratory surveillance data also showed an increase in the rate of chlamydia diagnosis of 43.3%.

Case numbers and rates are generally highest for females aged 15–19 years and for males aged 20–24 years, with over 70% of diagnosed cases occurring in females. The rate of chlamydial infection for Māori is 2.2–2.7 times higher, and for Pacific peoples 1.4–2.5 times higher, than the European rate.

Genital chlamydial infection is highly infectious and can cause both short- and long-term morbidity, with potential sequelae in women including endometritis, pelvic inflammatory disease, ectopic pregnancy and tubal infertility. In men, possible sequelae include epididymo-orchitis, reactive arthritis and infertility.

Fortunately, infection with *C. trachomatis* can be easily identified using modern tests that are highly sensitive and specific. These tests can be performed on clinical specimens that are self-collected and do not require an invasive clinical examination. Uncomplicated infection is readily treated by antibiotics: either a single dose of azithromycin or a seven-day course of a tetracycline such as doxycycline.

An effective chlamydia management programme requires increased testing of those with known risk factors, along with prompt identification and treatment of their sexual contacts, with the aim of reducing both the duration of infection and the rates of re-infection in affected populations. Enhanced and effective partner notification by health practitioners is an essential component of such a programme.

How to have your say

You can make your submission on the content of the draft guidelines in writing either as a letter or by email.

Please send mail submissions to: -

Draft Chlamydia Management Guidelines consultation
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Communicable Disease and Environmental Health Team
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PO Box 5013
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Email: Ingrid_Hamilton@moh.govt.nz (please include 'Chlamydia consultation' in the subject line)

The closing date for submissions is 21st February 2008.

Recommendations

The Sexual Health Advisory Group makes the following recommendations to the Ministry of Health.

1. Current chlamydia surveillance could be improved by introducing comprehensive national data collection and laboratory reporting of positive test results.
2. The NAAT (nucleic acid amplification test) method of testing for *Chlamydia trachomatis* should be used.
3. Asymptomatic women should be sampled with a low vaginal swab, and asymptomatic men with a first catch of urine.
4. A risk assessment for chlamydial infection should be done at least annually whenever sexually active females aged under 25 years present to health services, and testing offered if they conform with the proposed criteria.
5. Opportunistic testing for chlamydia should be considered for all sexually active males aged under 25 years if they conform with the proposed criteria.
6. Training should be given to health providers to help them normalise taking sexual health history (eventually becoming part of the undergraduate medical training programme).
7. Health practitioners with the skills and training to carry out partner notification need to be available and accessible on site wherever testing for chlamydial infection is performed.
8. Cost should not be a barrier to sexual health testing and treatment. It is recommended that these services are at no or low cost to young people, especially in the 15–19 years age group, so as to remove barriers to implementing this strategy.

Introduction

Concern at the burden of disease from sexually transmissible infections (STIs) was identified as a priority by the Government in the *Sexual and Reproductive Health Strategy – Phase one* (Ministry of Health 2001). This report stated that New Zealand faces a chlamydia epidemic and proposed that action plans be developed to address this and other concerns. The report seeks ‘Good sexual and reproductive health for all New Zealanders’. If such a vision is to be achieved, the incidence and prevalence of chlamydia in the community must be reduced.

An effective *Chlamydia trachomatis* management programme requires increased testing of those with known risk factors, along with prompt identification and treatment of their sexual contacts, with the aim of reducing both the duration of infection and the rates of re-infection in affected populations. Enhanced and effective partner notification by health practitioners is an essential component of such a programme.

An effective programme would be expected, with time, to result in a reduction in the complication rates of *C. trachomatis* infections as well as a reduction in the prevalence of infection in the community. Similar management programmes are currently being implemented in the United States (CDC 2006), Canada (Public Health Agency of Canada 2006), the United Kingdom (Department of Health 2007) and Australia (Victorian Government Department of Human Services 2001).

This management guideline proposes utilising a risk assessment to better identify which young women are more likely to have chlamydia infection in order to improve the cost-effectiveness of testing. There is currently a lack of evidence for what constitutes the best testing strategy to reduce the population prevalence of chlamydia, particularly with respect to what emphasis should be placed on testing men.

Although this guideline is for the management of chlamydia, the Sexual Health Advisory Group acknowledges that other STIs need to be recognised and emphasises that the chlamydia work programme is just one part of the wider response to STIs.

Epidemiology in New Zealand

Because *C. trachomatis* is asymptomatic in 70–90% of women (Stamm 1993) and up to 73% of men (Greene and Stafford 2007; LaMontagne et al 2003), the actual prevalence of infection in New Zealand is unknown. Planned changes to public health legislation introducing direct laboratory reporting of unnamed positive results to the medical officer of health and ESR (Environmental Science and Research) are aimed at improving and facilitating data collection to obtain more accurate information.

Surveillance data on STIs in New Zealand is collated and reported by ESR. However, this surveillance, which relies on voluntary participation, does not provide comprehensive country-wide data because not all laboratories participate, and the clinic-based surveillance does not cover STIs diagnosed in other settings (general practice in particular).

Based on data of the number of cases of diagnosed chlamydia infection at sexual health clinics, which is the clinic type considered to provide the most reliable time series data, infection rates appear to be increasing in New Zealand, having risen by 27.7% from 3363 diagnosed cases in 2002 to 4295 in 2006. The rate of chlamydia diagnosed through laboratories in Auckland, Waikato and Bay of Plenty over the same time period has increased by 43.3%, from 528 to 757 per 100,000 population (ESR 2007). To what extent these increased rates reflect an increased frequency of testing using more sensitive molecular diagnostic techniques is unclear. However, it is unlikely that all of the increase can be explained by the move away from less sensitive culture-based testing methods.

Across both the clinic- and laboratory-based surveillance data, rates are generally highest for females aged 15–19 years and for males aged 20–24 years, with over 70% of diagnosed cases occurring in females (ESR 2007). The burden of disease by ethnicity is only available from the clinic-based surveillance data, which shows that the rate of chlamydia for Māori is 2.2–2.7 times higher, and for Pacific Island people is 1.4–2.5 times higher, than the European rate (ESR 2007).

Geographic variation in chlamydia is also evident in the surveillance data. According to laboratory data from Auckland, Waikato and the Bay of Plenty for 2004–2006, Bay of Plenty has consistently had a higher chlamydia rate: 991 per 100,000 population in 2006, compared with 772 for Auckland and 691 for Waikato (ESR 2007).

Applying 2006 District Health Board (DHB) Census data to the sexual health clinic data also indicates wide geographic variation in chlamydia diagnosis rates by region. However, these rates should be interpreted with caution because access to sexual health clinics versus other primary care providers for STI diagnosis and management is likely to differ between DHBs. Nonetheless, using this methodology, in 2006 the DHBs with the highest sexual health clinic chlamydia diagnosis rates per 100,000 population were Tairāwhiti with 416, Bay of Plenty with 306 and Taranaki with 256, compared with

the lowest rates of 16 per 100,000 in the Hutt Valley, 46¹ in the Auckland region and 65 in Nelson Marlborough.²

Increasing rates of neonatal infections, causing conjunctivitis or pneumonitis, are being reported via laboratory surveillance, with 63 cases of chlamydial infection in infants less than one year of age recorded in 2004, 94 cases in 2005 and 111 cases in 2006 in Auckland, Bay of Plenty and Waikato (ESR 2005; 2006; 2007).

Infection rates in New Zealand appear to be high by international standards. Data from laboratory surveillance in Auckland, Waikato and Bay of Plenty indicates that the reported rate in these regions is six times higher than in Australia, and four times higher than has been reported in the UK (excluding Scotland) (Perkins 2004). However, these reported rates do not take into account differences in testing rates, which may account for the apparent discrepancies. Table 1 shows data from New South Wales where, for a population of six million people, the number of chlamydia specimens tested and the number of chlamydia positive specimens was similar to that of the Waikato and Bay of Plenty regions alone in New Zealand with a population of approximately 500,000 (Table 1).

Table 1: Data comparison of Bay of Plenty and Waikato with New South Wales

	Bay of Plenty and Waikato (2003)	NSW (2001)
Laboratory reports/notifications: number of cases	4371	4418
Approximate population	0.5 million	6.6 million
Chlamydia infection rates reported: cases/100,000	739	< 90
Chlamydia tests	42,916	52,790
Approximate chlamydia testing rates: tests/100,000	8583	800
Yield of positive tests	10.1%	8.5%

Sources: New Zealand data: ESR 2005; information for NSW is from Professor Basil Donovan, Sydney Sexual Health Service, personal communication, 2005.

Prevalence studies of chlamydia infection in New Zealand have covered selected populations only, limiting both their generalisability and their utility for determining those population groups that would most benefit from testing. Point prevalence studies have focused on teenagers and young adults, with point prevalence estimates in females ranging from 2.3% in sexually active Christchurch high school students aged 16 and over (Corwin et al 2002) to 8.0% in Wellington Family Planning Clinic attendees aged under 25 years.³ Point prevalences in males have tended to be lower, ranging from 1.8% in the same high school study as for the females (Corwin et al 2002) to 4.0% of 200 asymptomatic army personnel and recruits aged 17 to 35 years (Cole et al 2001).

¹ Data is incomplete for 2006.

² Unpublished ESR data.

³ Note: this prevalence is based on 2462 attendees, of whom 97 (4%) were male (Sparrow et al 2007).

New Zealand studies have found chlamydia point prevalence to be higher in non-Europeans (Baker et al 2005; Rose et al 2005; Sparrow et al 2007); those aged under 25 years (Rose et al 2005); individuals not in a committed relationship (Rose et al 2005); and those with a history of recent partner change or multiple partners (Sparrow et al 2007), previous STIs (Baker et al 2005), or irregular condom use (Baker et al 2005). In addition, a Wellington study of chlamydia test positivity among antenatal patients found higher test positivity in those going on to have a termination, in those aged less than 25 years, and in Māori and Pacific women. In this study, the highest test positivity was found for Māori women who went on to complete their pregnancy, with 15.2% of chlamydia tests submitted antenatally for women in this group being positive (Lawton et al 2004).

Although none of these studies are representative of the general population, they do suggest that New Zealand prevalence rates are probably somewhere between 2 and 15% for young women and 2 and 4% for young men. This data further suggests that the greatest health benefit from a chlamydia management plan would be achieved by increased identification of infection in young women, with particular emphasis on the under 25 years age group and targeting young Māori and Pacific females.

A summary of New Zealand chlamydia studies published since 2000 is provided in the Appendix.

Recommendation 1: Current chlamydia surveillance could be improved by introducing comprehensive national data collection and laboratory reporting of positive test results.

Biology and Pathology

C. trachomatis are intracellular obligate bacteria, with several species causing human disease. *C. trachomatis* serotypes D–K are implicated in urogenital chlamydial infection, with humans as the reservoir and sexual intercourse the mode of transmission. Chlamydia is highly infectious, with up to 70% of the partners of infected people becoming infected (Lin et al 1998; Quinn et al 1996; Viscidi et al 1993). Worldwide, chlamydia is the most common bacterial STI.

Females

Although 70–90% of infected women are asymptomatic (Stamm 1993), chlamydial infection can cause increased vaginal discharge, post-coital and/or intermenstrual bleeding, lower abdominal pain and dysuria. Signs of chlamydial infection include a mucopurulent cervical discharge, cervical friability, and adnexal tenderness on vaginal examination (suggestive of pelvic inflammation). Complications of repeated chlamydial infection include pelvic inflammatory disease (PID), ectopic pregnancy, tubal infertility and signs or symptoms of proctitis. Recurrent chlamydial infection increases the risk of hospitalisation for ectopic pregnancy and PID (Hillis et al 1997) (see Table 2).

Table 2: Risk of hospitalisation for ectopic pregnancy and PID in women with a prior history of chlamydia infection

Previous chlamydia infection	Odds ratio of hospitalisation	
	Ectopic pregnancy	PID
2 episodes	2.1	4
3 or more episodes	4.5	6.4

There is a lack of reliable data on the risk of developing PID and other complications from chlamydia infection, and overall the probability of sequelae from untreated chlamydial infection is unclear. However, it is significantly less than the figure of 20–40% frequently quoted, which dates back to the 1970s and is based on chlamydia culture testing performed on symptomatic women (Barlow et al 2001). More recent studies using more sensitive molecular testing methods report a lower frequency of complications (Marrazzo et al 1997). In a recently published long-term study (carried out between 1985 and 1989, with follow up to 1999) on 43,715 women aged 15–24 years, the cumulative incidences of hospital-diagnosed PID, ectopic pregnancy and infertility by age 35 years were 2–4% overall and 3–7% in those with a diagnosed history of chlamydia (Low et al 2006b). In data reported from Amsterdam (van Valkengoed et al 2004), the probabilities of sequelae from chlamydia infection were estimated as:

- PID 0.43%
- ectopic pregnancy 0.07%
- tubal factor infertility 0.02%.

Males

Although up to 73% of males are asymptomatic (Greene and Stafford 2007; LaMontagne et al 2003), symptoms of chlamydial infection include urethral discharge and/or dysuria. Signs include a mucoid or mucopurulent urethral discharge, which on microscopy reveals numerous polymorphonuclear white blood cells. Complications of untreated infection include epididymo-orchitis and reactive arthritis in around 1% of infected men (reactive arthritis is less common in women), prostatitis, possible infertility, and signs or symptoms of proctitis.

Transmission and clearance

For an infected person, the frequency of transmission to a sexual partner has been estimated to be 45–68% (Lin et al 1998; Quinn et al 1996; Viscidi et al 1993). Infected people clear chlamydia slowly: most untreated infections remain culture positive for more than 60 days (Golden et al 2000), with some small series showing infection persisting for years. Two studies have demonstrated clearance of untreated chlamydia (by molecular diagnostic methods) of around 50% at one year (Molano et al 2005; Morre et al 2002).

Laboratory Testing for *C. trachomatis*

Diagnostic tests currently available for *C. trachomatis* include:

- cell culture
- nucleic acid amplification tests (NAATs):
 - polymerase chain reaction (PCR)
 - transcription-mediated amplification (TMA)
 - strand displacement amplification (SDA)
- antigen detection tests:
 - enzyme immunoassay (EIA)
 - immunofluorescent methods.

A comprehensive review of the tests available for detecting *C. trachomatis* is provided by Cook et al (2005). The results of this review are summarised in Table 3.

Table 3: Summary of diagnostic tests available for *C. trachomatis*

Technique	Approved specimens	Detection	Sensitivity %	Specificity %
Cell culture*	Urethral, endocervical or eye swab	Growth of <i>C. trachomatis</i> in cell monolayers	60–80	100
Antigen assays: direct immunofluorescence (DFA) (Microtrak)	Urethral, endocervical or eye swab	Species-specific major outer membrane protein antigens (MOMP)	75–100	> 95
Enzyme immunoassay (EIA) (Chlamydiazyme)	Urethral, endocervical	Genus-specific lipopolysaccharide antigen	60–97	96–99
NAAT: PCR	Urethral, endocervical or urine (first voided)	Chlamydial cryptic plasmid DNA	89.7–90.3	98.4–99.4
NAAT: Real-time PCR, Cobas Taqman, Abbott M1000	Urethral, endocervical or urine (first voided)	Chlamydial cryptic plasmid DNA	95–100	> 99

* For these assays it is important to collect cellular material rather than exudate or pus.

Tests and performance

The performance of a laboratory test is assessed by determining its sensitivity and specificity.⁴ In general, NAATs have a sensitivity of 90–95%, with the majority of studies indicating that as the number of sites sampled increases, or the number of different NAAT tests used increases, the greater the detection of *C. trachomatis* in any given population.

Although there is widespread agreement that NAATs have superior sensitivity when compared with conventional antigen detection tests, NAATs are susceptible to false negative results (due to an inadequate specimen, or genetic mutants of chlamydia, or technical issues such as inhibition that affects laboratory testing) and false positive results (due to laboratory contamination). Therefore, NAAT results should be interpreted with appropriate caution and considered alongside patient history and examination findings.

In the laboratory, an inhibitory control should be used for each specimen, but particularly for urine (Skidmore et al 2006), because substances may be present in biological fluids that can inhibit NAATs. Failure to use an inhibitory control with each specimen may lead to false negative results.

Recommendation 2: The NAAT method of testing for *C. trachomatis* should be used.

Sites to be sampled

Asymptomatic women

- *Vaginal swab:* a low vaginal swab is recommended for asymptomatic women. It has a sensitivity of 90–95% and can *either* be collected by a health care worker *or* self-collected by the patient (Rose et al 2007; Schachter et al 2003). The sensitivity of a low vaginal swab is similar to – or even better than – a cervical swab for NAATs (Garrow et al 2002; Schachter et al 2003). Flocked swabs increase cell collection and test sensitivity.
- *Cervical swab:* if the woman is undergoing a vaginal speculum examination (eg, for STI screening prior to termination of pregnancy or intra-uterine device insertion), a cervical swab is recommended. After the cervix is cleaned, a swab is inserted in the cervical canal and fully rotated twice against the endocervix to obtain a good yield of cervical columnar cells.

⁴ Sensitivity is the ability of the test to correctly detect (as positive) samples that contain *C. trachomatis*. Specificity is the ability of the test to correctly identify (as negative) samples that do not contain *C. trachomatis*.

- *Urine*: urine specimens can be used provided care is taken in collecting the sample. To achieve an adequate urine specimen, the urine must be the 'first catch' of urine (FCU, the first 10–20 ml of urine that is voided), and the patient must not have passed urine during the previous 1–2 hours. The sensitivity of urine (92%) is slightly lower than for vulvo-vaginal swabs or endocervical swabs (97%) (Skidmore et al 2006), but is more convenient to obtain and less intrusive to the patient.

Asymptomatic men

Use of the first 10–20 ml of voided urine (FCU), where the person has not passed urine during the preceding 1–2 hours, yields results as good as a urethral swab (Sugunendran et al 2001), and is quick, convenient and does not cause discomfort. Use of a urethral swab in men is not recommended.

Recommendation 3: Asymptomatic women should be sampled with a low vaginal swab, and asymptomatic men with an FCU.

Rectal, pharyngeal and conjunctival specimens

Currently none of the Food and Drug Administration-approved NAATs have been approved for these sites, although they are frequently used in clinical practice. Culture or direct fluorescent antibody (DFA) are the approved recommended tests, so these are more often used for non-genital sites even though they have lower sensitivity than NAATs. However, in the absence of culture or DFA testing, NAATs can be used (Lister et al 2004).

Rectal specimens

Rectal swabs should ideally be obtained via anoscopy, which allows direct visualisation of the rectal mucosa (British Association for Sexual Health and HIV 2006). Rectal specimens should be taken from men who have sex with men (MSM) and who are practising receptive anal intercourse. This should be part of routine STI tests at least annually, depending on sexual history (Royal Australasian College of Physicians 2005). Several studies have shown that both clinician-collected or self-collected blind anal swabs are acceptable to patients (Jin et al 2007). The swab needs to be inserted 3 cm into the anal canal, rotated and then withdrawn and replaced in the swab container. Rectal swabs should not be submitted to the laboratory when there is obvious faecal contamination.

All MSM presenting with anorectal symptoms should undergo anoscopic examination and a full STI check, and have their management discussed with either a sexual health physician or infectious disease physician. This is recommended due to the recent emergence of *Lymphogranuloma venereum* (LGV) infection both overseas (French et al 2005) and in New Zealand (unpublished data). LGV is due to infection with a variant of *C. trachomatis* that is more common overseas in MSM and which may cause severe complications if not diagnosed and treated appropriately. The current recommended

method of detecting rectal LGV infection is to perform a rectal NAAT, which, if positive, may be sent for confirmation to a referral laboratory.

Pharyngeal specimens

Routine testing for pharyngeal infection with chlamydia is not recommended due to low prevalence and uncertain clinical significance.

Conjunctival specimens

An NAAT should be used when testing is appropriate.

Medico-legal cases

Refer to the specific protocols (eg, DSAC – Doctors for Sexual Abuse Care, www.dsac.org.nz).

When to Test for Genital Chlamydial Infection

It is important that whenever a test for genital chlamydial infection is performed, the individual is aware of the reason for performing the test, the implications of a positive test, and how the results of the test are to be obtained. At the same time, the opportunity to promote safer sex should be utilised, including ensuring there is access to condoms to prevent acquisition of infection. Chlamydia testing should only be undertaken in circumstances where there are robust systems in place to ensure that patients with positive results will be followed up and recalled for treatment.

Testing for chlamydial infection is indicated:

- if there are signs or symptoms suggestive of chlamydia or other STIs
- in clinical scenarios where there is increased risk of complications from chlamydial infection
- for patients who have a history compatible with exposure to chlamydial infection.

Symptomatic individuals

Testing for *C. trachomatis* should be performed in women and men with symptoms and signs that may be attributable to chlamydial infection. Failing to diagnose, or a delay in the diagnosis of, chlamydial infection is potentially harmful. In symptomatic people, rapid spread can cause ascending infection (endometritis, PID or epididymo-orchitis). Delay in diagnosis or failure to diagnose also reduces the opportunity for contact tracing to reduce the risk of community spread of infection.

If there is a high index of suspicion of chlamydial infection (eg, mucopurulent cervicitis in a known contact of chlamydia infection, or urethral discharge), treatment should be given for presumed chlamydial infection while awaiting the outcome of the laboratory tests.

Symptoms suggestive of chlamydial infection are:

- **Women**
 - vaginal discharge
 - post-coital and/or intermenstrual bleeding
 - inflamed/friable cervix (bleeding on contact)
 - urethritis (dysuria)
 - lower abdominal pain
 - reactive arthritis.
- **Men**
 - urethral discharge
 - dysuria
 - epididymo-orchitis (testicular pain or mass)
 - reactive arthritis.

Testing to prevent sequelae of untreated chlamydial infection

Testing for chlamydia should also be routinely performed in situations where there are greater risks of adverse sequelae from untreated infection, as follows.

- *Termination of pregnancy*: failure to treat chlamydial infection carries an approximate 25% risk of post-abortion salpingitis (Møller et al 1982; Osser 1989; Qvigstad et al 1982).
- *IUD insertion*: no studies have specifically demonstrated the benefit of testing prior to IUD insertion, but two studies showed that giving an antimicrobial agent effective against chlamydial infection at the time of IUD insertion reduced the rate of salpingitis (Farley et al 1992; Sprague et al 1990).
- *Pregnancy*: there is a 20–50% risk of neonatal transmission in women who have untreated chlamydial infection at delivery (see risk assessment). Possible neonatal complications include conjunctivitis and pneumonitis.
- *Semen and egg donation*: semen and egg donors should be tested for chlamydial infection to reduce the risk of transmission of infection to the recipient (Tjiam et al 1987).

Individuals with an increased likelihood of chlamydial infection

The following individuals should routinely be offered testing:

- sexual partners of chlamydia-positive people*
- sexual partners of people with conditions for which chlamydia is often a recognised cause, such as PID or epididymo-orchitis*
- people with a recent history (within the last six months) of chlamydia infection (as re-infection is common)
- mothers of infants with chlamydial conjunctivitis or pneumonitis.*

(* These people should be treated even if testing is declined.)

Summary

The following individuals should routinely be offered testing for chlamydial infection:

- patients with symptoms suggestive of chlamydia or another STI
- sexual partners of patients with suspected or confirmed chlamydial infection
- patients requesting a sexual health check
- patients diagnosed with another STI
- sexual partners of patients with PID or epididymo-orchitis
- people with a recent history (within the last six months) of chlamydia infection
- pregnant women with risk factors for chlamydial infection
- women undergoing termination of pregnancy
- mothers of infants with chlamydial conjunctivitis or pneumonitis
- pre-menopausal women undergoing uterine instrumentation, including IUD insertion

- semen and egg donors
- men who have sex with men (offer test annually).

Opportunistic testing of asymptomatic persons

Opportunistic testing refers to offering a test to people attending a health service for another reason. There is currently a lack of evidence to support both the efficacy and cost-effectiveness of population-based screening programmes to reduce the prevalence of chlamydia (Low 2007). However, a selective testing strategy could improve the cost-effectiveness of opportunistic testing by increasing the pre-test probability of a positive result.

Selective testing and chlamydia risk factors

Females

Risk factors for acquiring chlamydia infection in women have been derived from studies in the UK, USA and Sweden. The results of these studies have consistently identified age and sexual behaviour as the main indicators.

A study in London found that a selective testing strategy based on testing those aged under 25 who had two or more partners in the past year detected 87% of infections while testing only 49% of the study population (Grun et al 1997).

ESR data consistently shows that the highest prevalence of chlamydia in New Zealand is in sexually active women:

- aged 15–24 years
- who have had two or more sexual partners in the last year and/or a recent partner change
- who have not consistently used condoms.

An opportunistic selective testing strategy could be applied whenever a female aged under 25 years has contact with any health service (eg, attending an acute medical or accident service, family planning, primary health care). Testing should be offered to all sexually active females under 25 years of age if they have never been tested. Receptionists and/or nurses could play a key role in identifying these women, who could then be offered a chlamydia test.

Offer of testing should be repeated *annually* to all sexually active females under 25 years of age if they conform with the risk criteria:

- had two or more partners in the last 12 months, or
- had a recent partner change, or
- inconsistently used condoms.

Recommendation 4: A risk assessment for chlamydial infection should be done at least annually whenever sexually active females aged under 25 years present to health services, and testing offered if they conform with the proposed criteria.

Males

Because men have been less studied, there is insufficient evidence to recommend *routine* testing for chlamydia in asymptomatic sexually active young men. More research needs to be done in this area. However, young males who conform to the following risk profile should be evaluated and offered testing because they have a higher probability of infection:

- aged under 25 years, and
- two or more sexual partners in the last year or recent partner change, or
- inconsistent use of condoms, or
- co-infection with another STI.

Recommendation 5: Opportunistic testing for chlamydia should be considered for all sexually active males aged under 25 years if they conform with the proposed criteria.

Promoting risk profile

The risk profiles should be actively promoted to young people (male or female) in schools, at youth groups, and at meetings and other activities by anyone involved in the care or education of young people, including educators, leaders and health promoters. The chlamydia risk factors should be readily evident (eg, on posters, pamphlets) wherever young people have contact with health services.

Whenever the risk assessment is applied, clinical staff should use the opportunity to promote safer sex behaviour and ensure the person has access to condoms. Failure to do so represents a lost opportunity to reduce the overall prevalence of STIs.

For this approach to be effective, and to reduce the prevalence of chlamydia infection (and other STIs), it must be:

- broad-based with multisectoral engagement ('whole of health')
- multi-faceted, and closely combined with the promotion of safer sex and the provision of condoms
- accompanied by improved education of health practitioners, educators and young people as to the importance of chlamydia as a preventable STI.

Recommendation 6: Training should be given to health providers to help them normalise taking sexual health history (eventually becoming part of the undergraduate medical training programme and continuing medical education activities).

Timing of chlamydia tests

There is no data on how soon after sexual exposure an NAAT test may become positive. The following guidelines are recommended (Public Health Agency of Canada 2006).

- If the patient is asymptomatic, advise a test two to three weeks after unprotected sexual intercourse.
- If the patient is symptomatic, do an STI screen (culture for gonorrhoea and blood tests for syphilis and HIV) and treat if chlamydial infection is clinically suspected.
- Sexual contacts of chlamydia should be tested and treated at initial presentation (see the section 'Partner management', below).

In cases where the patient is unlikely to re-present for follow-up, it is better to treat him or her opportunistically at the time.

Treatment of *Chlamydia trachomatis* Infection

There are no randomised trials for the treatment of genital chlamydial infection with agent(s) compared to placebo because original trials for the treatment of non-gonococcal urethritis (40–50% of which are attributable to chlamydia) established the efficacy of tetracyclines and macrolides (erythromycin). Newer agents (such as azithromycin) have been compared to older drugs such as tetracycline or erythromycin in proven *C. trachomatis* infection and found to be comparable.

Newer tetracyclines (minocycline or doxycycline) are as effective as older tetracyclines or erythromycin. Doxycycline is better tolerated than minocycline, and is the recommended tetracycline of choice. Azithromycin 1 g stat is equivalent to doxycycline 100 mg given twice daily for seven days, or alternatively minocycline 100 mg daily given for nine days, with a microbial cure rate of 97% and 98% respectively in a recent meta-analysis of 12 randomised clinical trials (Lau 2002).

Treatment of uncomplicated infection

Males and non-pregnant females

The standard recommended treatment regimens for uncomplicated infection are:

- azithromycin, 1 g stat, or
- doxycycline, 100 mg, twice daily for seven days.

For uncomplicated infection the recommended treatment is azithromycin, 1 g stat, because it is the simplest regimen to administer and can act as a 'directly observed' form of therapy. To maximise compliance, medications for chlamydial infections should be dispensed *on site* wherever possible. Primary care practitioners can order azithromycin on Medical Practitioner Supply Order (MPSO) to facilitate treatment on site.

Alternative regimens are:

- erythromycin stearate, 500 mg orally, four times a day for seven days, or
- erythromycin ethylsuccinate, 800 mg orally, four times a day for seven days.

Note that either regimen can cause gastro-intestinal upset in up to 20–25% of cases (Linnemann et al 1987).

To minimise transmission, those treated for chlamydia should be instructed to abstain from sexual intercourse for seven days after single-dose (azithromycin) therapy or until completion of the seven-day course of treatment of doxycycline, if prescribed.

Pregnant females

Recommended regimens are:

- azithromycin, 1 g stat, or
- amoxicillin, 500 mg, three times a day for seven days, or
- erythromycin stearate, 500 mg, four times a day for seven days or twice daily for 14 days.

Erythromycin estolate should not be used in pregnancy because of liver toxicity.

Note that azithromycin is not currently approved for use in pregnancy in New Zealand. However, it has been proven to be safe and effective in overseas studies. Azithromycin causes fewer gastrointestinal side-effects and has greater microbiological cure rates when compared with erythromycin (Adair et al 1998; Wehbeh et al 1998). Azithromycin should be used preferentially if adherence is in doubt or the patient is close to delivery (recommended as first-line treatment in pregnancy by the CDC, and recommended in WHO guidelines and UK guidelines).

Both a meta-analysis and a randomised controlled trial have demonstrated that amoxicillin is more efficacious than erythromycin in pregnancy, and with fewer side-effects, so it should be used in preference to erythromycin (Alary et al 1994; Brocklehurst and Rooney 2000; Turrentine 1995). However, *in vitro*, amoxicillin has been shown to induce latency, and re-emergence of infection at a later date remains a theoretical concern, which is why most guidelines recommend azithromycin as the first choice for treatment in pregnancy.

Due to higher rates of repeat positive chlamydia tests following treatment in pregnancy (attributed to either a less efficacious treatment regimen, non-compliance or re-infection), it is recommended that all pregnant women be re-tested no sooner than five to six weeks after completing therapy, and preferably at least one month before the expected date of delivery, to prevent neonatal transmission. A first-catch urine (FCU) specimen or self-collected low vaginal swab can be done to avoid the woman having to undergo another speculum examination.

Men who have sex with men

The recommended treatment for symptomatic rectal chlamydial infection in MSM is doxycycline, 100 mg bd, for 21 days, in case infection is due to a *Lymphogranuloma venereum* (LGV) serovar of chlamydia.

Infants

Initial *C. trachomatis* perinatal infection involves the mucous membranes of the eyes, oropharynx, urogenital tract and rectum, and is often asymptomatic. Neonatal *C. trachomatis* infection often manifests itself as conjunctivitis developing five to twelve days after birth, or later on as a sub-acute pneumonitis between one to three months of age. Recommended treatment is with erythromycin base or ethylsuccinate 50 mg/kg/day, orally divided into four doses daily for 14 days. The mother and her sexual partner(s) need to be tested and treated for chlamydia infection.

Treatment of complicated chlamydia infection

Upper genital tract infection in women (tubo-ovarian abscess, salpingitis, PID)

PID may be asymptomatic or present with symptoms including lower abdominal pain, dyspareunia, abnormal vaginal discharge, abnormal vaginal bleeding or fever. Signs and symptoms are non-specific, but given that complications are potentially serious there should be a low threshold for treatment. The possibility of ectopic pregnancy should be considered in any woman presenting with lower abdominal pain.

The majority of studies on the treatment of PID use clinical rather than microbial end points for assessing efficacy. *C. trachomatis* and *N. gonorrhoeae* are important pathogens in PID, and treatment regimes should cover these bacteria. PID has a polymicrobial aetiology and should be treated as a mixed (facultative and anaerobic) infection.

The recommended treatment regimen is:

- ceftriaxone, 250 to 500 mg IM stat, plus
- doxycycline, 100 mg bd, for 14 days.

Metronidazole, 400 mg bd, for 14 days can be added if symptoms are moderately severe and extra anaerobe cover is required.

An alternative regimen (if there is low risk of gonococcal infection) is:

- ciprofloxacin, 500 mg po stat, plus
- doxycycline, 100 mg bd, for 14 days.

Metronidazole, 400 mg bd, for 14 days can be added if symptoms are moderately severe and extra anaerobe cover is required.

Anaerobes are of relatively greater importance in patients with severe PID, and metronidazole may be discontinued in those patients with mild or moderate PID who are unable to tolerate it (British Association for Sexual Health and HIV 2006).

Patients should be reviewed within a few days to check for response to therapy. Sexual contacts should be tested and treated for chlamydia (see the 'Partner management' section below).

Epididymo-orchitis in men

This usually presents with unilateral scrotal pain and swelling similar to torsion of the testicle. There may also be urethral discharge and dysuria. A urology opinion should be sought if there is any doubt as to the diagnosis. In sexually active young men, *C. trachomatis* is the most commonly implicated pathogen but antibiotic cover should also be given against gonococcal infection.

The recommended regimen is:

- doxycycline, 100 mg, twice daily for 14 days, plus either
- ceftriaxone, 250 mg, 500 mg IM stat, or ciprofloxacin, 500 mg stat (depending on local gonococcal antibiotic resistance profiles).

All patients should be reviewed within a few days to check for response to therapy. Sexual contacts should be tested and treated for chlamydia (see the 'Partner management' section below).

Note that people testing positive for chlamydia infection may have other co-existing STIs. Testing for other STIs – including gonorrhoea, syphilis and HIV – should be offered depending on the individual's sexual behaviour.

Test of cure

A test of cure for chlamydial infection is not required because the recommended first-line treatment regimens of azithromycin or doxycycline are more than 95% effective (CDC 2006).

Exceptions to this recommendation are:

- if a non-standard antibiotic regimen has been used, or
- if the patient is pregnant.

In these circumstances, because treatment failure is more likely, a repeat test should be done no sooner than five weeks after completion of antibiotic therapy. This testing interval is recommended because NAATs are very sensitive, and if performed too early may detect remnants of nucleic acids from non-viable organisms (CDC 2006).

Repeat testing

Having been diagnosed in the past with an STI is recognised as a predictor of increased likelihood of acquiring a further STI (Rietmeijer et al 2002). In various studies 13–18% of patients with a prior history of chlamydia infection were found to be re-infected at follow-up visits (Burstein et al 1998; Cook et al 1999; Whittington et al 2001). Consequently, whenever a chlamydia infection is identified and treated, it is recommended that a repeat assessment be performed at three to six months. Safer sex education and provision of condoms should be addressed on each occasion.

Testing when an unexpected positive result is found

If a positive test occurs in an unlikely situation and could result in adverse medical, social or psychological impacts for the patient, a repeat test using a freshly collected specimen should be obtained before the diagnosis is considered secure. Confirmatory testing using the same specimen can result in discrepant results, especially if the burden of infecting organisms is low. Obtaining a fresh specimen overcomes this problem.

Partner Management

The identification of a person infected with *C. trachomatis* provides a unique opportunity to interrupt the chain of infection in the community by the appropriate management of sexual contacts. Appropriate partner management often helps to identify asymptomatic infected individuals and reduce the risk of harmful sequelae. The *treatment* of sexual contacts prior to resumption of sexual intercourse is the strongest predictor for preventing re-infection (Arya et al 1980).

All patients identified with a chlamydial infection should have partner management discussed with them at the time of treatment by a trained health care professional. Research has shown that up to 70% of female partners of men infected with chlamydia have asymptomatic infection (Thelin and Mårdh 1982).

If the index patient is symptomatic, a look-back period with a cut-off of 60 days is used to identify those partners at greatest risk. If the index person is asymptomatic, an arbitrary look-back cut-off of six months, or until the last previous partner (whichever is the longer time), is recommended. Common sense needs to be used in assessing which sex partner(s) may have been at risk in these situations. All sexual contacts in the specified time frame need to be informed and offered testing for other STIs (including gonorrhoea, syphilis and HIV) (British Association for Sexual Health and HIV 2006). Treatment for chlamydia should be given even if tests are negative or testing is declined.

Partner notification

The following terms and definitions are used in this discussion (Australasian Society for HIV Medicine 2006).

- **Index case:** the original person identified with an infection. The index case may or may not have infected other people but represents a starting point for the process of partner notification.
- **Contact:** a person who has had sex or some other relevant exposure to the index case. The exposure may have been 'safe' or 'unsafe'.
- **Partner notification:** this is a secondary prevention process through which sexual partners and other contacts exposed to an STI are identified, located, assessed, counselled, tested and treated.
- **Referral of the partner:** this can be either:
 - patient referral, where the index patient has the responsibility for informing sex partners of their exposure to an STI
 - provider referral, where health service personnel are responsible for tracing and notifying sex partners of index patients with STIs.

The means of contacting the partner – preferably by patient referral – should be agreed between the parties at the time of the initial interview. If a contact is tested and found positive, they are then redefined as an index case and a further partner management plan formulated.

Barriers to partner notification

Actual or feared physical or emotional abuse that may result from partner notification can prevent effective partner notification. Ensuring the safety of the index case should take precedence over the notification process. Issues that may need to be addressed include:

- fear of losing a partner due to an STI diagnosis (blame, guilt, stigma)
- fear of loss of confidentiality, which cannot be guaranteed in monogamous relationships
- anonymous (casual) partnering, which can be a significant barrier to partner notification.

Although partner notification has many positive potential benefits for the individual and their sexual contacts, the negative psychological effects of a diagnosis of an STI need to be taken into careful consideration when undertaking this intervention.

Key messages to patients

The following are suggested for use by clinical staff discussing testing and treatment options with people who may be infected with a chlamydial infection.

- Most people in New Zealand with chlamydia don't know they have it.
- Chlamydia is the most common bacterial STI in New Zealand.
- Chlamydia is curable with a single dose of antibiotic.
- Chlamydia is asymptomatic in the majority of patients and can remain undiagnosed for long periods of time (months to years).
- There is a high risk of transmission per sexual act (30–50%).
- The likelihood of a long-term partner becoming infected is high (approximately 70%).
- Chlamydia may be diagnosed within a stable relationship.
- Re-infection is likely if you have unprotected sex with infected partner.
- Chlamydia can result in serious complications if not treated (for example, PID, infertility and ectopic pregnancy).
- Chlamydia is sexually transmitted, so it is important that partners are notified and treated and that you avoid sex with the partner until you have both been treated.
- Using condoms helps protect against all STIs.

Role of primary care practitioners in effective partner management

Although primary care practitioners are frequently aware of the importance of partner notification, they may not perceive it to be their role or may lack the skills and training to adequately perform it. A survey of Australian general practitioners (GPs) (Keogh et al 1998) found that 55% of GPs did not consider contact tracing (partner notification) to be their responsibility, which contrasted with a 5% request rate from GPs for specialist contact tracing for patients with chlamydia. Although a large proportion of GPs always inform a patient presenting with an STI to advise their contacts to seek medical treatment, only 22% always check with the patient to see whether they have followed up their contact.

The provision of effective partner management within primary care need not be costly. A study in the UK addressing the effectiveness of practice-based partner notification by trained practice nurses with telephone follow-up was shown to be at least as effective as referral to a specialist health advisor based in a genito-urinary medicine clinic, at a similar cost level (Low et al 2006a). Sixty-five percent of participants receiving practice nurse-led partner notification had at least one partner treated, compared with 53% of those referred to a specialist clinic-based contact tracer.

The Sexual Health Advisory Group concludes that contact management is best handled by an appropriately trained and supported health care professional working at the initial place of patient contact with the health care system.

Recommendation 7: Health practitioners with the skills and training to carry out partner notification need to be available and accessible on site wherever testing for chlamydial infection is performed.

Improving partner management practice

Following are some suggestions for improving partner management practice.

- As part of public health services, DHBs could employ a contact tracer/information officer who is responsible for training, supporting and sustaining effective community-based management of STIs by raising awareness of chlamydia, improving the education of health care personnel in sexual history taking and risk assessment, and ensuring that effective contact-tracing measures are undertaken in the DHB. This person could also be responsible for overseeing effective implementation of the chlamydia management strategy.
- Primary health organisations (PHOs) or a practice group could identify a health care worker who has the responsibility in that PHO or practice group for performing partner notification. This would include:
 - identifying the need for contact management with the index case, and the method of partner referral to be employed
 - discussing how to overcome perceived barriers to implementing partner management
 - providing counselling on safer sex and ensuring there is access to condoms

- providing follow-up (eg, by phone) to ensure partners have been contacted
- ensuring the index case understands the recommendation for repeat testing in six months by providing either a follow-up appointment or a referral.

Single or isolated practitioners should be able to refer contacts to the DHB-based contact tracer if they are unable to provide their own contact-tracing resource.

Future initiatives for consideration

Novel partner notification practices (Trelle et al 2007)

With changing trends in STI rates and transmission, research is being conducted to look at the feasibility of alternative methods of partner notification. One such method is the use of expedited patient-delivered treatment of sex partners (PDPT, or patient-delivered partner treatment). The index case is given medication, together with safety information and a list of contraindications to give to partners for presumptive treatment without clinical assessment. The aim is to reduce gonorrhoea or chlamydia re-infections and increase the proportion of partners treated. Limited studies have demonstrated a trend towards a decrease in rates of persistent or recurrent chlamydia with this approach compared with standard partner referral. Although still controversial, this method may be beneficial in high-risk and hard-to-reach populations.

Other useful strategies for partner notification include:

- simple referral plus providing index patients with written information for partners and a treatment guideline, which was shown to be more effective at reducing persistent infection, or re-infection rates, for chlamydia and gonorrhoea among index patients than simple partner referral alone
- providing index patients who have chlamydia with home sampling kits and patient-delivered partner treatment, which has been shown to improve testing rates in sexual contacts, although participation rates were low (Trelle et al 2007).

Novel approaches/education

Testing for STIs usually takes place in traditional clinic-based settings (general practice, STD clinics, Family Planning clinics). Now that urine-based tests or self-collected vaginal swabs are available, testing can be performed from non-clinic-based sites (such as correctional facilities, outreach settings and community-based settings). Young people most at risk (15–20 year olds) may not seek clinic-based care, but utilising self-collection kits that enable tests to be collected at home and posted in to the laboratory for testing creates new possibilities to access hard-to-reach groups.

Contacting such people with positive tests can be facilitated by the use of mobile phone technology (eg, texting a ‘time to call in for results’ message) or the use of email messages. Trials of such methods have yielded promising results (Cook et al 2007).

Using an Internet-based self-selective testing approach along with home sampling has also been investigated. Widespread publication of an Internet-based chlamydia education tool that included a module to assess personal risk and at the same time request a home sampling kit has been found to be successful in accessing some hard-to-reach people (Richardus and Götz 2007).

Education/training requirements

If we want to improve the control of chlamydial infection by reducing the sequelae of infection and the community prevalence of infection, both the medical/nursing professions and the community (with an emphasis on young people in particular) will need appropriate education. Non-dedicated sexual health professionals see major barriers to instituting opportunistic chlamydia testing in their practice. Educating health professionals will need to address these perceived barriers, in particular addressing:

- the public health importance of chlamydia along with other STIs
- difficulties in obtaining a sexual history, especially if a third party (eg, parent) is present
- issues such as lack of time, fear of intrusion, concerns over inadequacy or being seen as judgmental
- using different methods of testing (clinic-based, home-based)
- partner management.

Most of these issues can be mitigated by training staff, utilising handout materials and promoting Internet-based information. Existing primary practice computer software could be easily adapted to provide automatic prompts for chlamydia testing when patients within a particular demographic present themselves. Assessment forms and simple treatment guidelines could also be embedded within software to facilitate patient management.

Appropriately trained registered nurses can be a significant resource for increasing opportunistic testing and the treatment of chlamydia in a variety of community settings. Where a nurse is the first point of contact in the target group, management can be expedited by training and providing standing orders for treatment.

Conclusion

It is unlikely that chlamydia will be controlled by any one or two interventions, and goals will not be achieved by the health sector working alone. In particular, health promotion requires co-ordinated action by all concerned: governments, health and other social and economic sectors, non-governmental and voluntary organisations, local authorities, industry and the media. People in all walks of life are involved as individuals, families and communities. Professional and social groups and health personnel have a major responsibility to mediate between differing interests in society for the pursuit of health (WHO 1986).

Different approaches at the community level will need to be explored to access marginalised young people. There is some concern that improving access to sexuality education may increase sexual activity among young persons, thereby producing a negative outcome. This topic was reviewed by Kirby et al (2007), who report that 'the evidence is strong that programs do not hasten or increase sexual behaviour but, instead, some programmes delay or decrease sexual behaviours or increase condom or contraceptive use'. Community opposition on grounds such as this will pose difficulties for the effective implementation of any strategy to reduce STIs.

Improving awareness of chlamydia (and other STIs) requires the engagement of community leaders, group peers and the media, as well as widespread community-based promotion sites (eg, supermarkets, sports clubs and events, educational and vocational training sites). Programmes should seek to engage young people via the Internet, and the use of cellphone technologies must be sharply focused and well presented to engage the target audience of, in particular, 15–20 year old youths (Ministry of Health 2005).

Programmes must promote safer sex at all times, with an emphasis on the ways and means to access condoms (where, how, cost, etc).

Appropriately trained nurses could be enabled to test and treat hard-to-reach young people by utilising standing orders for treatment and practitioner's supply order (PSO) of azithromycin (under control of the medical officer of health or the sexual health service of the DHB).

Appropriately trained reception staff have an important role in promoting the risk assessment and selective testing strategy to all sexually active people aged 15–24 years seeking any consultation with health services, and facilitating any appointment that may be required with the practice nurse or their appropriate clinical staff.

Education about chlamydial infection should be integrated with other sexual health promotion activities and should routinely be part of safer sex messages and condom promotion initiatives.

Recommendation 8: Cost should not be a barrier to sexual health testing and treatment. It is preferable that these services are at no or low cost to young people, especially in the 15–19 years age group, so as to remove barriers to implementing this strategy.

Assessment of the Programme

How the programme will be monitored and evaluated is still under discussion. Some possible measures are listed below.

1. Improved quality of epidemiological data will help the planning of further strategies. Under provisions in the Epidemic Preparedness Act 2006, the possibility for direct laboratory reporting of notifiable disease information to a medical officer of health has been made possible. Chlamydia is not currently a notifiable disease, but it is a proposed addition to the schedule of notifiable diseases in 2008. Systems for reporting are being developed. It is recommended that laboratories report the following data on positive chlamydia tests to the medical officer of health:
 - National Health Index (NHI) number
 - age
 - sex
 - provider type (eg, primary care, sexual health clinic)
 - specimen site
 - type of test.

Ethnicity and domicile will need to be obtained from the NHI database or the GP. It is also recommended that laboratories provide information on the total number of chlamydia tests performed by the laboratory, broken down into age, sex and ethnicity.

2. PHOs and publicly funded clinics could provide information to the medical officer of health on the number of people who tested positive for *C. trachomatis*, and the percentage treated within a four-week timeframe in order to monitor the efficiency of treatment delivery over time.
3. Contact management data could be provided to the medical officer of health and monitored from PHOs and publicly funded clinics. Data provided should indicate the:
 - number of index cases that provide numbers and details of partners
 - number and percentage of partners who are contacted
 - number and percentage of partners who are treated and/or tested.

Although it is expected that such data will be incomplete, at least 50% of identified contacts should be treated.

4. There could be long-term monitoring, from PHOs and publicly funded hospitals and clinics, of the number of:
 - diagnosed/treated cases of PID
 - diagnosed/treated cases of ectopic pregnancy
 - diagnosed/treated cases of neonatal (< one year age) infections
 - prescriptions for stat doses of azithromycin 1 gram, by region.

Appendix: Summary of New Zealand Chlamydia Studies Published Since 2000

Table A1: Test positivity for chlamydia

Author	Study population	Test positivity	Notes
ESR 2007	Lab surveillance: Auckland, Bay of Plenty, Waikato, other labs combined	2006: Auckland 7.3%, Waikato 9.6%, Bay of Plenty 11.8%, other labs 10.7%	
Morris and McCarthy 2006	Auckland community lab, October–December 2005, females, aged 15–25	13.2% (833/19,970)	
Lawton et al 2004	Community lab Wellington; all specimens submitted for CT testing 1999–2003	All specimens: annual positivity 4.9–6.6%. Antenatal specimens only (terminations and completed pregnancy): annual positivity 5.3–7.6%. Completed pregnancy: (a) 4.8% 1999–2002 (318/6614) (b) < 25 y 12.2% vs 25+y 2.3% (c) Māori 15.2%, Pacific 12.5% vs Europeans 2.0%	Non-calendar years. Last year only 10 months. Completed pregnancy: < 25 y more likely to have antenatal testing, as were Māori and Pacific women.
Coughlan and Young 2006	4918 samples submitted for CT testing, Christchurch sexual health clinic attendees, February–November 2003	7.1% overall for any site	Subset 297 (mostly MSM) 2.0% (6) positive

Table A2: Point prevalence studies of chlamydia

Author	Study population	Point prevalence	Notes
Sparrow et al 2007	< 25 y, Wellington Family Planning clinics, November 2004–May 2005	8%	Māori vs European: OR 2.32 (95% CI 1.66–3.24) Pacific vs European: OR 2.76 (95% CI 1.71–4.45) Change of partner last three months: OR 2.2 (95% CI 1.65–2.99) > 2 partners previous 12 months: OR 2.58 (95% CI 1.88–3.55) 54% of eligible gave valid urine. Study pop: 95% > 16 y, 68% European, 17% Māori, 6% Pacific, 4% Asian, 5% other
Baker et al 2005	Female, Victoria University of Wellington students, March–October 2003, sexually active	2.7% (95% CI: 1.7–4.2)	Multivariate analysis: only significant = previous CT infection OR 4.89 (95% CI 1.54–15.48). Univariate: elevated OR for previous + STI, previous + CT, non-European, irregular condom use. Exclusion criteria: not sexually active, CT in previous three months, language barriers, 60% participation of eligible population, predominantly 18–21 y, (68.4%) and European (82.6%).
Rose et al 2005	1001 terminations patients from February 2003 500 fee-paying clinic, 501 free clinic.	7.7% (77/1001)	Significantly higher if < 25 y, Māori, Pacific, neither married, nor <i>de facto</i> , free clinic attendee. Fee-paying clinic has high proportion of Asian and non-New Zealand residents.
Corwin et al 2002	17 Christchurch schools, 2001, year 12 and 13 (age 16+)	Sexually active males 1.8%; sexually active females 2.3%	72% participation rate (1136/1583). More than half schools were socially advantaged, 49% sexually active, of whom 84% provided urine.
Cole et al 2001	200 asymptomatic male army personnel and recruits aged 17–35	4.0% (8 males)	Year of study not explicit. Selection/inclusion criteria not included. Participation rate not specified. Symptomatic excluded. 49% aged < 20 y.

Table A3: Self-reported cumulative incidence of chlamydia

Author	Study population	Self-reported cumulative incidence of CT	Notes
Baker et al 2005	Female, Victoria University of Wellington students, March–October 2003, sexually active	5.6% (40/718)	Exclusion criteria: not sexually active, CT in previous three months, language barriers. 60% participation of eligible population, predominantly 18–21 y (68.4%) and European (82.6%)
Corwin et al 2002	17 Christchurch high schools, 2001, year 12 and 13 (age 16+)	Males: 1.8% Females: 2.4%	72% participation rate (1136/1583). More than half of schools were socially advantaged. 49% sexually active.

Key to Tables A1–A3: CT= *Chlamydia trachomatis* infection, y = years, STI = sexually transmissible infection, MSM= men who have sex with men, OR = odds ratio, CI = confidence interval.

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