



## Rates of *Chlamydia trachomatis* testing and chlamydial infection in pregnant women

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### Abstract

**Aims** To determine the rate of *Chlamydia trachomatis* testing and chlamydial infection in pregnancy (by auditing a community medical laboratory database).

**Methods** Data for women registered with a maternity care provider between 1999 and 2002 were matched with a community medical laboratory database for patients who met one of three criteria: tested for *C. trachomatis*, or had a first or second antenatal blood screen at that laboratory. The rate of *C. trachomatis* testing and of chlamydial infection was then calculated in this sample.

**Results** The overall rate of *C. trachomatis* testing for 6614 matched deliveries was 37.5%, with 4.8% of those tests positive for chlamydial infection. The rate of testing differed significantly between age-bands ( $p < 0.0001$ ), and by ethnicity ( $p < 0.0001$ ). The rate of infection showed a significant effect of age ( $p < 0.0001$ ) and ethnicity ( $p < 0.0001$ ). Maori and Pacific women, and those under the age of 25 years, had the highest rates—both of testing and of *C. trachomatis* infection.

**Conclusions** There is a high rate of maternal *C. trachomatis* in under 25-year-olds, and in Maori and Pacific women, together with incomplete testing for the infection in pregnancy. This highlights the need to instigate routine testing for *C. trachomatis* in pregnancy—to reduce the significant, yet preventable, morbidity associated with chlamydia in both the mother and the neonate.

*Chlamydia trachomatis* (*C. trachomatis*) is the most common bacterial sexually transmitted infection (STI) in New Zealand.<sup>1</sup> *C. trachomatis* has a high rate of asymptomatic infection—approximately 80% of cases in females, and 45% in males, are estimated to be asymptomatic.<sup>2</sup>

The exact prevalence of *C. trachomatis* in New Zealand is unknown, although rates are typically higher in females, in under 25-year-olds, and in Maori and Pacific people.<sup>2,3</sup> In 2000, a survey of laboratory and STI clinic data in the Waikato and Bay of Plenty regions revealed an incidence rate of 4162 per 100,000 for females aged 15–19.<sup>4</sup>

More recently, year 2002 laboratory data from Waikato and Bay of Plenty reported increasing rates of *C. trachomatis*—with up to 6998 cases per 100,000 for 15–19 year old females.<sup>2</sup> The overall rate of *C. trachomatis* was reportedly five times higher than that found in Australia (similarly calculated from laboratory surveillance data).<sup>2</sup> Dunedin laboratory figures have also shown that the incidence of *C. trachomatis* increased by 37% in females and 10% in males between March 2002 and March 2003.<sup>5</sup>

The prevalence of *C. trachomatis* in females who were sexually active and provided a urine sample for a New Zealand school-based study in Christchurch was 2.3%.<sup>6</sup> Despite the apparent increasing prevalence of *C. trachomatis* in New Zealand, it is not a notifiable STI, there is no national data collection, and there are no screening or treatment guidelines.<sup>1</sup>

There are currently no New Zealand prevalence data for *C. trachomatis* in pregnancy. Infection rates reported in pregnant women in the USA and Canada have varied from 5% to 20%.<sup>7</sup> The sequelae of untreated (which includes undetected or asymptomatic) chlamydial infections can be severe—both for the pregnant woman and for the neonate. Prenatal implications of chlamydial infection for the mother and newborn include associations with ectopic pregnancy, spontaneous abortions, preterm labour, amnionitis, premature rupture of membranes, low birth weight, prematurity, still birth, and neonatal deaths.<sup>7-9</sup> Women with chlamydia during pregnancy are also more likely to develop intrapartum fever and or late onset postpartum endometritis after vaginal delivery.

It has been estimated that 20%–40% of infected untreated women will progress to pelvic inflammatory disease (PID)<sup>9</sup>—and these women will subsequently be exposed to complications of infertility, chronic pelvic pain, ectopic pregnancies, and death from ectopic pregnancy. For the newborn of untreated mothers, inclusion conjunctivitis occurs in 11%–44% of cases, and pneumonia occurs in 11–20% of cases.<sup>7</sup> Furthermore, *C. trachomatis* in infancy has also been associated with otitis media, bronchiolitis, pharyngitis, rhinitis and gastroenteritis.<sup>8</sup>

Vertical transmission of *C. trachomatis* to the neonate occurs in approximately 50% of cases.<sup>8,10,11</sup> During 2002, up to 96 babies under the age of 12 months had *C. trachomatis* diagnosed at Auckland and Waikato/Bay of Plenty laboratories, which was an increase of almost 70% when compared to 2001.<sup>2</sup> By eliminating transmission of chlamydial infection from mother to child, it has been shown there are more favourable outcomes for both the mother and the newborn—including significant reductions in premature labour, low birth weight, and increased survival.<sup>9</sup>

Although screening for *C. trachomatis* in pregnancy is considered best practice internationally,<sup>12,13</sup> there are currently no guidelines in New Zealand advocating routine testing in pregnant women. Testing for *C. trachomatis* is desirable—for detecting and subsequently treating the chlamydial infection in pregnant women, and for reducing the associated morbidity, which is significant.

This audit process was carried out in a community medical laboratory to determine the prevalence of *C. trachomatis* testing and chlamydial infection in pregnant women who delivered between 1999 and 2002.

## Methods

Ethics approval to carry out this audit was granted by the Wellington Ethics Committee and consultation took place with the Maori Health Directorate (Ministry of Health).

**Crude rates.** Rates of chlamydial infection were ascertained in all specimens (male and female) tested at Wellington Medical Laboratory in 1999, 2000, 2001, 2002 (September to September), and 2003 (September to June). Rates of chlamydial infection in pregnancy (that may include both completed and terminated pregnancies) were determined by matching all first antenatal bloods with *C. trachomatis* tests in the same laboratory in 1999–2003. The rate of *C. trachomatis* in infants (1-year-old or younger) was determined by retrieving results from all paediatric eye swabs tested during 2001, 2002, and 2003 (before 2001, data were not available for this type of test). This laboratory uses the polymerase chain

reaction (PCR) test (Amplicor CT/NG, Roche Diagnostics) to routinely detect *C. trachomatis* in both urine and swab samples.

**Maternity care provider data matched to laboratory tests.** To determine the prevalence of *C. trachomatis* testing in ongoing pregnancies, details of completed pregnancies that were registered with a maternity care provider were matched to laboratory data. For the years 1999–2002, name, date of birth, ethnicity and year of delivery were identified for all women with completed pregnancies who were registered with a maternity care provider.

Ethnicity was determined by self-identification using the 2001 census form completed by patients at an antenatal hospital booking. These data were forwarded to Wellington Medical Laboratory and matched with patients who met one of three criteria: had a *C. trachomatis* test; had a first antenatal blood screen, or had a second antenatal blood screen at that laboratory between 1998 and 2002. Data matching at the laboratory went back as far as 1998 to capture pregnancies that began in 1998 and delivered in early 1999.

The laboratory assigned a study number to each patient, and the anonymised data were returned to the research team for analysis. Data included—study number; year of delivery; age at testing (under 25 years, 25 years and older); mean, median, and age-range of the sample; ethnicity; whether tested for *C. trachomatis*; and the outcome of that test (whether positive or negative for *C. trachomatis*).

## Results

**Crude rates.** The (crude) rates of chlamydial infection in all male and female specimens (ie, from antenatal specimens and in paediatric eye swabs tested at the laboratory) are presented in Table 1.

**Table 1. Prevalence rates of chlamydial infection in all laboratory samples (male and female) tested between 1999 and 2003**

	Year of testing and percent positive for <i>C. trachomatis</i>				
	1999 (%)	2000 (%)	2001 (%)	2002 (%)	2003 (%)
All specimens	4.9	6	5.5	5.4	6.6
Antenatal specimens*	6.2	7.6	5.3	5.6	7.6
Paediatric eye swabs	Not available	Not available	20.0 <sup>†</sup>	20.0 <sup>‡</sup>	4.25 <sup>§</sup>

\*Includes both completed and terminated pregnancies; <sup>†</sup>n=5; <sup>‡</sup>n=10; <sup>§</sup>n=47.

**Maternity care provider matched to laboratory tests.** The maternity care provider supplied the laboratory with data for 7913 deliveries. Of those, 6614 matches were obtained for women who had had an antenatal blood test through the laboratory—so we could include them in the study sample. The 1299 women for whom no data was available at the laboratory were excluded due to the possibility that they may have been tested at another laboratory. The age range of the study sample was 14 to 52 years with a mean age of 30.6 years, and a median age of 31 years.

Tests for *C. trachomatis* had been performed for 37.5% of the 6614 deliveries between 1999 and 2002. Of those tested, 4.8% were positive for *C. trachomatis*, while 95.2% were negative. Invalid results were obtained for two tests (Table 2).

When analysed by age when tested (under 25 years, 25 years and older), the rate of testing for women 25 years and older (33.3%) was significantly lower than for women under 25 years (61.7%) ( $p<0.0001$ ). Of those women tested, a significantly higher proportion of women under 25 years tested positive for *C. trachomatis* (12.2%) than those 25 years and older (2.3%), ( $p<0.0001$ ).

**Table 2. Rates of testing for *C. trachomatis* in pregnant women (who delivered between 1999 and 2002) and rates of chlamydial infection in those tested**

	Total	Tested for chlamydia			Chlamydia positive*		
	n	n	%	p value	n	%	p value
<b>Age-band</b>							
Younger than 25 years	985	608	61.7	chi <sup>2</sup> =287.89	74	12.2	chi <sup>2</sup> =212.93
25 years and older	5629	1874	33.3	p<0.0001	44	2.3	p<0.0001
<b>Ethnicity (all ages)</b>							
NZ European	4015	1306	32.5	chi <sup>2</sup> =227.86	26	2.0	chi <sup>2</sup> =273.63
Maori†	505	277	54.9	p<0.0001	42	15.2	p<0.0001
Pacific	581	343	59.0		43	12.5	
Asian	495	202	40.8		1	0.5	
Not stated	479	170	35.5		5	2.9	
Other	539	184	34.1		1	0.5	
<b>Total</b>	<b>6614</b>	<b>2482‡</b>	<b>37.5</b>		<b>118</b>	<b>4.8</b>	

\* Includes six 'equivocal' results, percentages calculated using denominator of all those tested;

† Includes 'sole' and 'mixed' Maori; ‡ Includes all tests, including two 'invalid' results.

The rate of testing for *C. trachomatis* during pregnancy differed significantly across ethnic groups (p<0.0001), with testing in 59% of Pacific women, 54.9% of Maori women, and 32.5% of New Zealand European women. Of those tests that were carried out, the percentage of those who tested positive for *C. trachomatis* also differed significantly by ethnic group (p<0.0001); 15.2% of Maori women, 12.5% of Pacific women, 2% of New Zealand European women, and 0.5% of Asian women tested positive for *C. trachomatis*.

Table 3 presents a model of estimated national rates of *C. trachomatis* that have been scaled up using the rates of testing and infection presented in Table 1. Figures were calculated using the ethnicity-specific rates of testing and rates of chlamydial infection for Maori, Pacific, and New Zealand European women, as well as 2001 national birth statistics for these ethnic groups.<sup>14</sup>

**Table 3. Model estimating national rates of *C. trachomatis* in pregnancy, as well as rates of undetected chlamydia in mothers and consequent infection in neonates (based on the rates of testing and infection found in the present audit)**

Ethnicity*	Number of births	Estimated cases of chlamydia in mother†	Estimated cases of undetected chlamydia in mother‡	Estimated cases of chlamydia in neonates§
NZ European	38,307	766.1	517.1	258.6
Maori	12,689	1928.7	869.9	435.0
Pacific	6,321	790.1	323.9	162.0
<b>Total</b>	<b>57,307</b>	<b>3484.9</b>	<b>1710.9</b>	<b>855.6</b>

\* Ethnicity of the mother giving birth; † Maximum number of cases modelled using the number of births in 2001 and the ethnicity (all ages) specific rates of chlamydia in Table 2; ‡ Calculated by subtracting the number of cases of detected chlamydia (calculated using ethnicity specific rates of testing in Table 2) from the total estimated number of cases; § Calculation based on 50% transmission rate from estimated cases of undetected chlamydia.

The estimated infection in the neonate was modelled from the number of cases that would go undetected in pregnancy in the absence of testing, half of which would be transmitted to the neonate.<sup>8,10,11</sup>

## Discussion

Less than half of all pregnant women in this audit population were tested for *C. trachomatis* between 1999 and 2002. These results along with increased detection of chlamydial infection in New Zealand neonates<sup>2</sup> suggest that *C. trachomatis* testing is not routinely carried out in pregnancy in New Zealand.

The rate of *C. trachomatis* in untested women is unknown, but the overseas evidence suggests that the overall rate is likely to be similar to the rate in those tested.<sup>7</sup> The rate of chlamydial infection in pregnant women (included in this audit) was high for Maori and Pacific women, and for women under the age of 25 years. This finding was consistent with previous New Zealand studies that have found a higher rate of infection in these groups.<sup>2,3</sup> However, there are limitations to the interpretation of this data as other risk factors such as socioeconomic status, previous STI, and educational level are not able to be taken into account. Women in the present audit could all be considered 'at-risk' due to the fact that they had unprotected intercourse.

The increasing incidence of chlamydial infection in the community has been well documented, along with an increase in cases of neonatal chlamydia.<sup>2,5</sup> Table 3 attempts to quantify the rate of possible undetected infection in New Zealand, as well as the subsequent rates of infection in neonates using the rates obtained in this audit. Furthermore, Table 3 shows an estimated 3485 women who gave birth in New Zealand who might have been positive for *C. trachomatis*. Indeed, based on ethnicity-specific testing rates, as many as 1711 cases might have gone undetected, and with a 50% rate of vertical transmission, up to 856 babies would have been infected with *C. trachomatis*.

We recognise that estimating the burden of chlamydial infection in this way has a number of weaknesses. The model does not take into account variation in rates of testing, age at delivery, or the ethnicity-specific variation in the age-structure of the population. Furthermore, this model presumes the same rates of testing nationally, and assumes that there will be an equal incidence of *C. trachomatis* in those women who were not tested. The median age of the mother at delivery in this sample (31 years) was higher than the national average.<sup>14</sup> Therefore, given the higher rate of *C. trachomatis* in younger women, the rates reported here may underestimate national rates of infection.

Diagnosis of maternal chlamydial infection requires either a cervical or urethral swab, or first pass urine specimen. Recent recommendations for the optimal diagnosis of *C. trachomatis* infection include adding a urine sample to conventional swab(s) for assessment, rather than replacing a swab with a urine sample.<sup>15</sup>

While inhibition is a recognised problem with non-invasive urine samples; when used in combination with swab(s), an increase in the chlamydial detection rate of 9% has been reported.<sup>15</sup> It is recommended that high-risk women are re-tested in the third trimester of their pregnancy to check for re-infection.<sup>12</sup> The recommended treatment for pregnant women is erythromycin 500 mg by mouth (4 times per day, for 7 days).<sup>7</sup>

However, a major drawback of this treatment is the high rate of gastrointestinal side effects and the length of treatment. Amoxicillin 500 mg by mouth for 7 days is shown to be equal in efficacy to erythromycin, with fewer side effects.<sup>16</sup> Azithromycin 1 g is an effective single dose treatment of *C. trachomatis*, is listed as an alternative regimen when compliance is an issue, and is being increasingly prescribed in pregnancy in New Zealand and overseas.<sup>13,17</sup> Contact tracing and treatment of partners are also essential to prevent re-infection.

## Conclusions

There is a high rate of maternal *C. trachomatis* and incomplete testing for the infection in pregnant women. These findings highlight the need to instigate routine testing for *C. trachomatis* in pregnancy—to reduce the significant, yet preventable morbidity associated with chlamydial infection in both the mother and the neonate.

Routine screening for *C. trachomatis* in pregnancy is currently recommended in evidence-based international guidelines,<sup>7,13</sup> and has been advocated by other researchers in New Zealand.<sup>1,2,5</sup> Pregnant women are an easily reached population for testing and the beneficial health and economic consequences of detecting and treating *C. trachomatis* are significant.<sup>9</sup> The unacceptable rate of chlamydial infection in pregnancy, and the avoidable burden of disease in pregnant women and neonates must be highlighted to maternity caregivers.

Lastly, we recommend that testing for *C. trachomatis* should be added to best-practice screening that is already carried out in pregnancy.

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