THE NEW ZEALAND MEDICAL JOURNAL
Vol 118 No 1211 ISSN 1175 8716

Sexually transmitted infections in New Zealand in 2003

Alisha Johnston, Dinusha Fernando, Graham MacBride-Stewart

Abstract

Aims To describe the current burden and trends of sexually transmitted infections (STIs) in New Zealand (NZ) since 1999, as reported by current surveillance methods.

Methods Clinic rates were calculated by dividing the number of diagnoses by the total number of clinic visits. Laboratory rates were calculated using the NZ Census 2001 population data for the Auckland, Waikato, and Bay of Plenty regions.

Results In 2003, chlamydia was the most commonly diagnosed STI in sexual health (SHCs) and family planning clinics (FPCs), followed by genital warts. Laboratory surveillance reported a chlamydia rate of 653.0 per 100,000 population and a gonorrhoea rate of 90.2 per 100,000 population. The highest rates of chlamydia and gonorrhoea were in the 15 to 19 years age group. From 2002 to 2003, both chlamydia and gonorrhoea cases have increased by 14.0% in SHCs. In FPCs, chlamydia increased by 25.9% and gonorrhoea increased by 11.4%. Since 2002, numbers of chlamydia and gonorrhoea cases have increased by 14.0% in SHCs and by 25.9% and 11.4%, respectively, in FPCs. Maori and Pacific Peoples continue to be disproportionately affected by STIs.

Conclusions Current national surveillance methods are unrepresentative of the NZ population and do not provide accurate estimates of the population burden of STIs. Expansion of laboratory surveillance (to accurately reflect all areas of NZ) is needed and is currently under active consideration.

Sexually transmitted infections (STIs) are a major global cause of morbidity and infertility with significant sequelae. In New Zealand, rates of STIs, in particular genital chlamydia (*Chlamydia trachomatis*) and gonorrhoea (*Neisseria gonorrhoeae*) are steadily increasing.[1,2]

In New Zealand, STIs (with the exception of AIDS) are non-notifiable diseases. Surveillance of STIs has been based on voluntary data from specialist sexual health clinics. Since mid-1998, surveillance has progressively expanded to include family planning clinics, student and youth health clinics, and several laboratories in the Waikato, Bay of Plenty, and Auckland regions of New Zealand's North Island.

This paper adds to previously published STI data[3,4] by reporting surveillance data on STIs from both clinic and laboratory sources in 2003 and examining trends from 1999. This data provides an indication of the current burden and populations at risk of STIs in New Zealand and highlights some limitations of the current surveillance system.

Methods

Data sources

Clinic data—The case definitions of STIs under surveillance are as previously described.[3] All participating sexual health clinics (SHCs), family planning clinics (FPCs), and student and youth health clinics (SYHCs) report the total number of clinics attendances and anonymised data on the age, sex, and ethnicity of cases. Clinics send data to the Institute of Environmental Science and Research Ltd. (ESR) each month—either directly, or via a regional co-ordinator. In 2003, STI data was received from 25 SHCs, 42 FPCs, and 15 SYHCs. SYHC data is not presented here, as the data collected is not representative of all SYHCs; also of the SYHCs that do report, many provide incomplete data. The location of participating clinics is illustrated in Figure 1.

Laboratory data—Ten laboratories in the Waikato, Bay of Plenty, Lakes, Counties Manukau, and Auckland District Health Boards (DHBs) provide data to ESR. This includes approximately two-thirds of the microbiology laboratories in these DHBs. The DHBs where laboratories participate in STI surveillance is illustrated in Figure 2. Gonorrhoea diagnoses were by culture and nucleic acid amplification test (NAAT), [one laboratory used strand displacement amplification (SDA)]. Chlamydia diagnoses were by NAATs [eight laboratories used polymerase chain reaction (PCR), one laboratory used both PCR and enzyme linked immunoassay (EIA), and one laboratory used SDA]. Laboratories report anonymised age and sex data for chlamydia and gonorrhoea cases. As patient identifiable information is not collected, it is not possible to differentiate an infection isolated from two different sites in one patient or from one patient diagnosed in two clinical settings—e.g. if the same patient presents at a GP and is then referred to a SHC. These factors may result in duplicate reporting and so the calculated infection rates may be higher than the true rate.

Data analysis

Clinic rates—Rates based on clinic data use the total number of clinic visits, whether for STIs or other conditions, as the denominator. It is not possible to use the number of patients tested for STIs as the denominator because this is not reported.

Laboratory positivity and rates—The total number of specimens tested for chlamydia was used to calculate the chlamydia positivity rate. It is not possible to calculate the positivity by sex or age because only the total number of specimens tested is reported. The total number of specimens tested for gonorrhoea in 2003 was not available. Estimated population rates were calculated by dividing the number of cases by the total 'usually resident' population data from the New Zealand Census 2001 for the relevant DHBs. For chlamydia rates this also included the population in the Waitemata DHB as the chlamydia data submitted by one laboratory in the Auckland DHB includes specimens from Waitemata DHB. Because all data were recorded with an anonymous identifier it was not possible to link data on clinic attendees with laboratory results. For categorical variables, multiway contingency table analyses were used to calculate the proportions. A robust method of constructing 95% confidence intervals[5] and Chi-squared statistics were used to determine statistically significant difference across age, sex, and ethnicity strata. Univariate analyses were performed to test for significance in trends. Analyses were completed using Statistical Analysis Software (SAS) version 8.2.

Results

In 2003, there were 81,356 SHC visits (59.5% female) and 191,651 FPC visits (96.1% female). The majority of attendees were aged less than 25 years (51.7% in SHCs; 64.7% in FPCs) and of European ethnicity (69.5% in SHCs; 66.0% in FPCs).

Chlamydia was the most commonly diagnosed STI in both clinical settings, accounting for 39.2% and 66.3% of all confirmed STI diagnoses in SHCs and FPCs, respectively. This was followed by genital warts (35.9% of STI cases in SHCs; 19.3% in FPCs). Table 1 shows the number of cases and rates of chlamydia, gonorrhoea, genital warts, and genital herpes diagnosed in SHCs and FPCs. In 2003, there were 1062 non-specific urethritis (NSU) cases in SHCs, and 9 cases in FPCs. SHCs also

reported 30 cases of infectious syphilis in 2003. Clinic infection rates were higher in males than females for all age groups (Table 1).

In 2003, participating laboratories reported 11,525 chlamydia cases (positivity 7.2%, rate 653.0 per 100,000) and 1204 gonorrhoea cases (rate 90.2 per 100,000). Females accounted for 72.1% of chlamydia cases and 40.3% of gonorrhoea cases. The majority of cases were in people less than 25 years old (67.4% of chlamydia and 60.0% of gonorrhoea cases) (Table 2). Laboratory surveillance rates of gonorrhoea were highest in males whereas the highest rates of chlamydia were in females. In 2003, the highest rates of chlamydia and gonorrhoea were found in the 15 to 19 years age group, in both clinic and laboratory surveillance (Table 1 and 2). Laboratory surveillance rates of chlamydia and gonorrhoea in this age group were four times higher than the overall rate. In 2003, there were 51 cases of neonatal chlamydia infection and 2 cases of neonatal gonorrhoea infection. (This has decreased since 2002, when 96 cases of neonatal chlamydia and 4 cases of neonatal gonorrhoea infection were reported.) In SHCs, the highest rates of genital warts were in the 20 to 24 year age group; the highest rates of genital herpes in the greater than 29 years age group and the highest rate of NSU in males in the 25 to 29 years age group. In FPCs, the highest rate of genital warts was in the 15 to 19 years age group.

Infection rates in the clinical settings varied by ethnicity (Table 3). Rates of chlamydia were significantly higher in Maori and Pacific Peoples than in those of European ethnicity. In SHCs, gonorrhoea rates were also significantly higher in these groups compared to those of European ethnicity, while rates of genital herpes were significantly higher in the European group. There was no significant difference in the rates of genital warts by ethnicity.

Since 1999, the number of chlamydia and gonorrhoea cases diagnosed at SHCs has significantly increased (Figure 3). This trend may, in part, be due to the increasing the number of clinic attendances (54,992 in 1999, 81,356 in 2003). Increasing numbers of STIs are also seen at FPCs (Figure 4); however between 1999 and 2000, the number of participating FPCs increased 10-fold causing the number of reported attendances to increase from 6931 in 1999 to 191,651 in 2003.

Since 2001, there have been no major changes to clinical surveillance. Between 2002 and 2003, the number of clinic attendances changed only slightly in SHCs (<0.1% increase) and decreased by 3.6% in FPCs. Over the same period, the number of chlamydia cases reported by SHCs and FPCs increased significantly (by 14.0% and 25.9% respectively, $p<0.0001$). The number of gonorrhoea cases also increased (14.0% in SHCs and 11.4% in FPCs), but only the change at the SHCs was of statistical significance ($p<0.05$). Between 2002 and 2003, the number of genital warts cases decreased in SHCs (by <0.1%) and FPCs (by 7.9%), but this change was not statistically significant. In SHCs the number of NSU and infectious syphilis cases also decreased (by 5.6% and 36.2% respectively (not significant)) in 2003 compared to 2002. Since 1999, laboratory surveillance has reported increases in chlamydia ($p<0.05$) and gonorrhoea ($p>0.05$) rates in the Auckland, Waikato, and Bay of Plenty regions (Figure 5). However between 1999 and 2000, the number of laboratories reporting gonorrhoea results increased from 9 to 10. Between 2000 and 2001, the number of laboratories reporting chlamydia increased from 7 to 10. From 2001, there have been no major changes in the participating laboratories; between 2002 and 2003 chlamydia and gonorrhoea rates increased by 12.1% and 21.4% respectively ($p<0.05$).

Figure 1. District Health Boards (DHBs) in New Zealand where sexual health clinics and family planning clinics participate in the surveillance of sexually transmitted infections (2003)

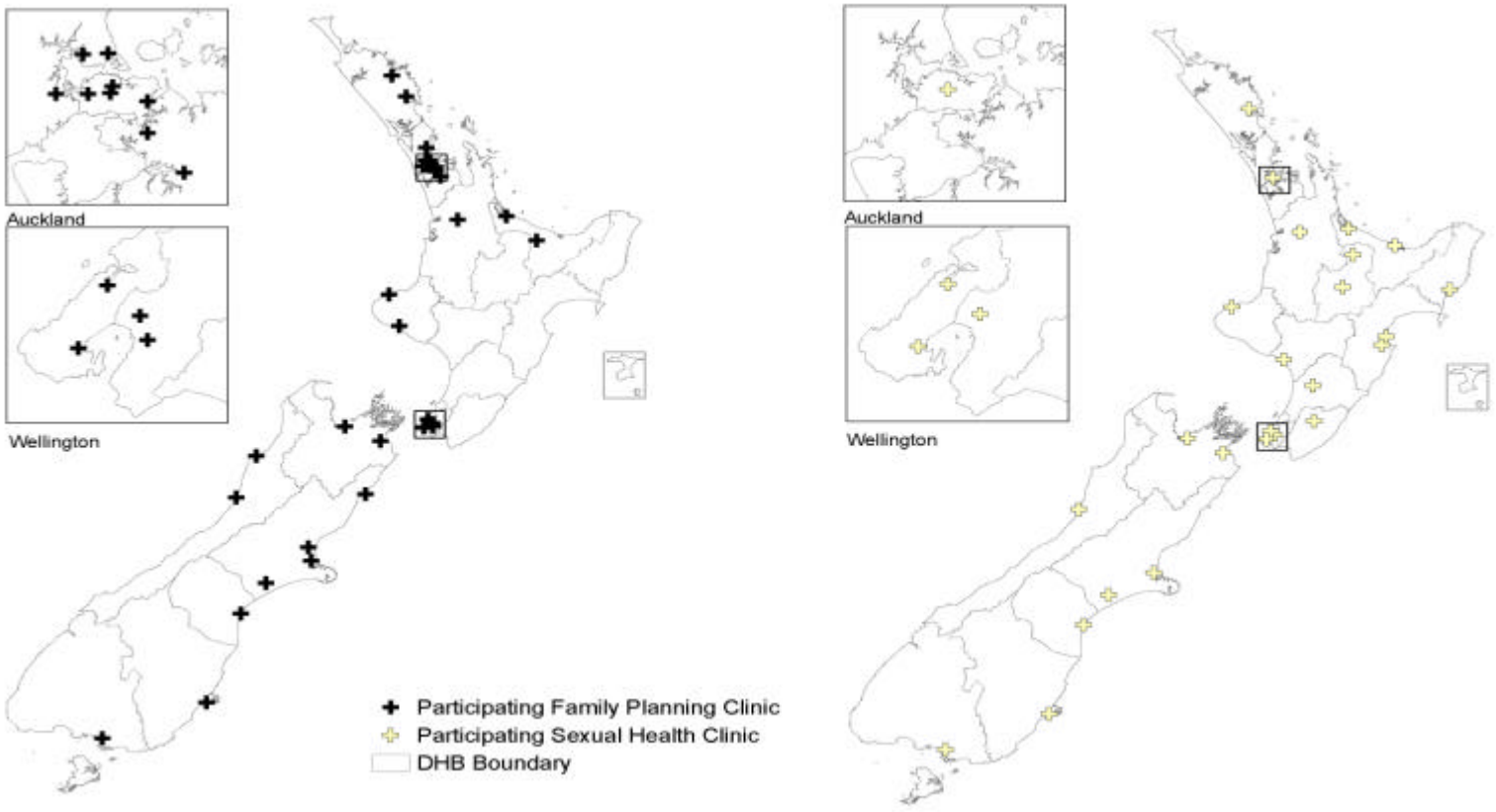

Figure 2. District Health Boards (DHBs) in New Zealand where laboratories participate in the surveillance of sexually transmitted infections (2003).

Figure 3. Number of confirmed sexually transmitted infections diagnosed in sexual health clinics in New Zealand: 1999–2003

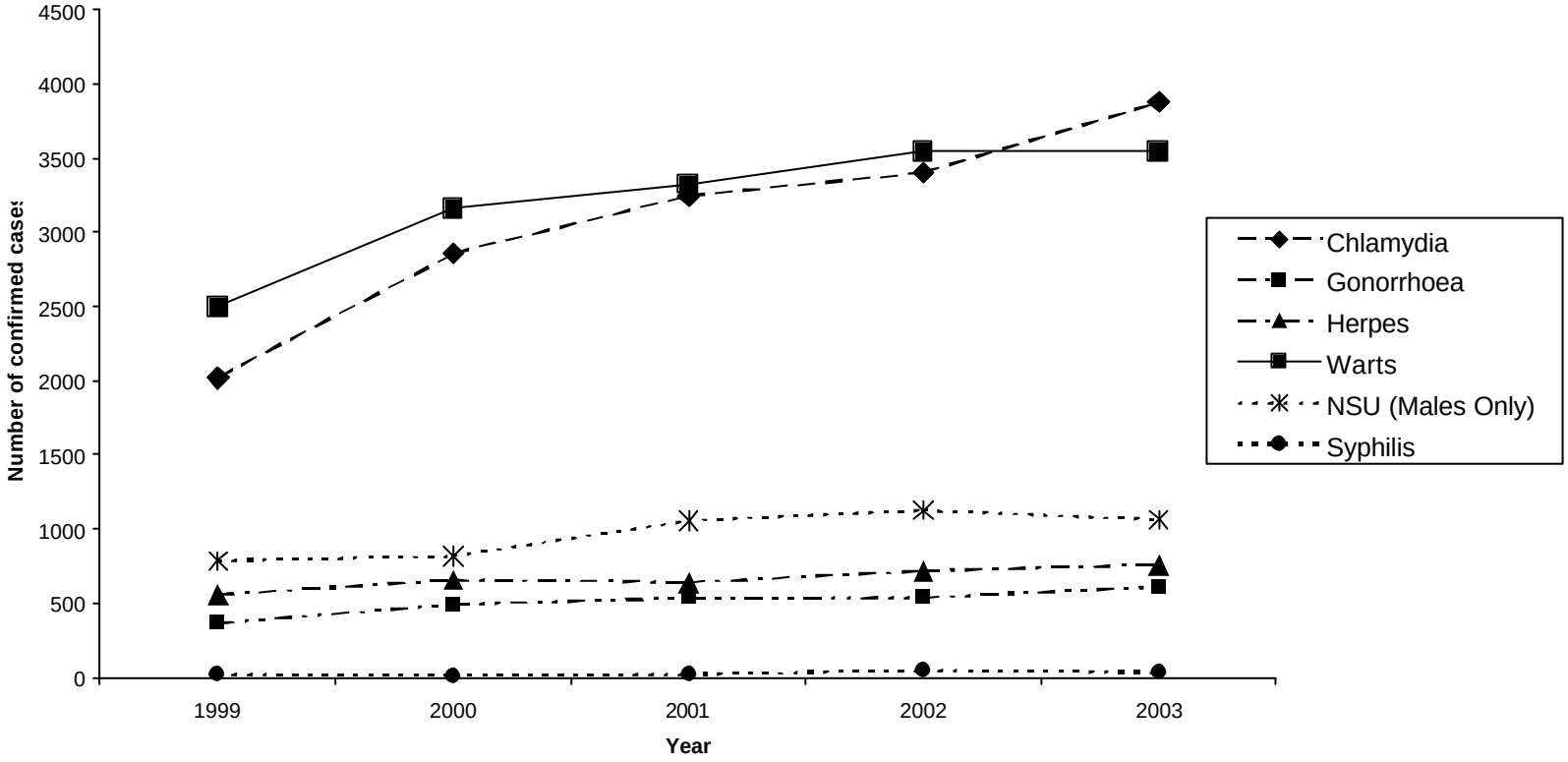

Figure 4. Number of confirmed sexually transmitted infections diagnosed in family planning clinics in New Zealand: 1999–2003

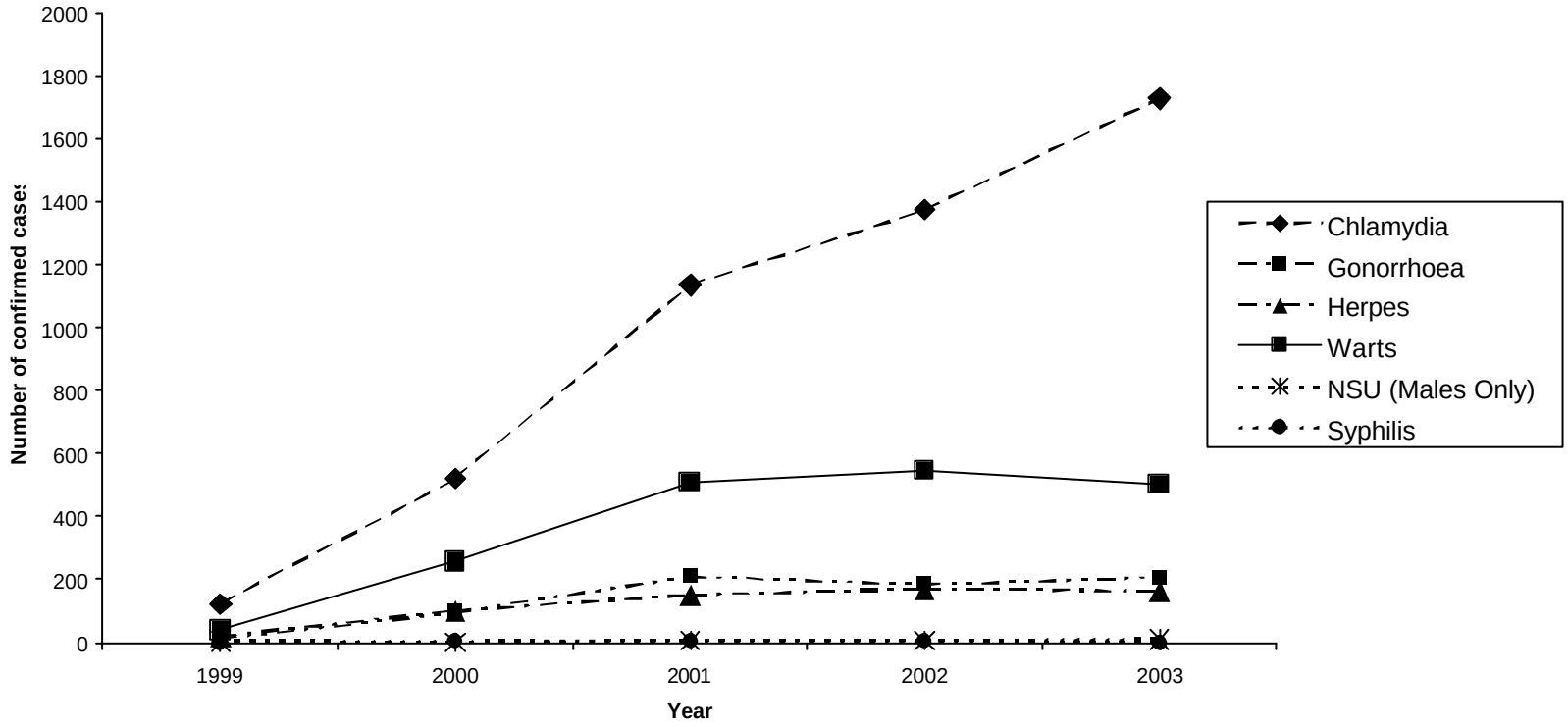

Figure 5. Rates of chlamydia and gonorrhoea reported through laboratory surveillance in the Auckland, Waikato, and Bay of Plenty regions: 1999–2003

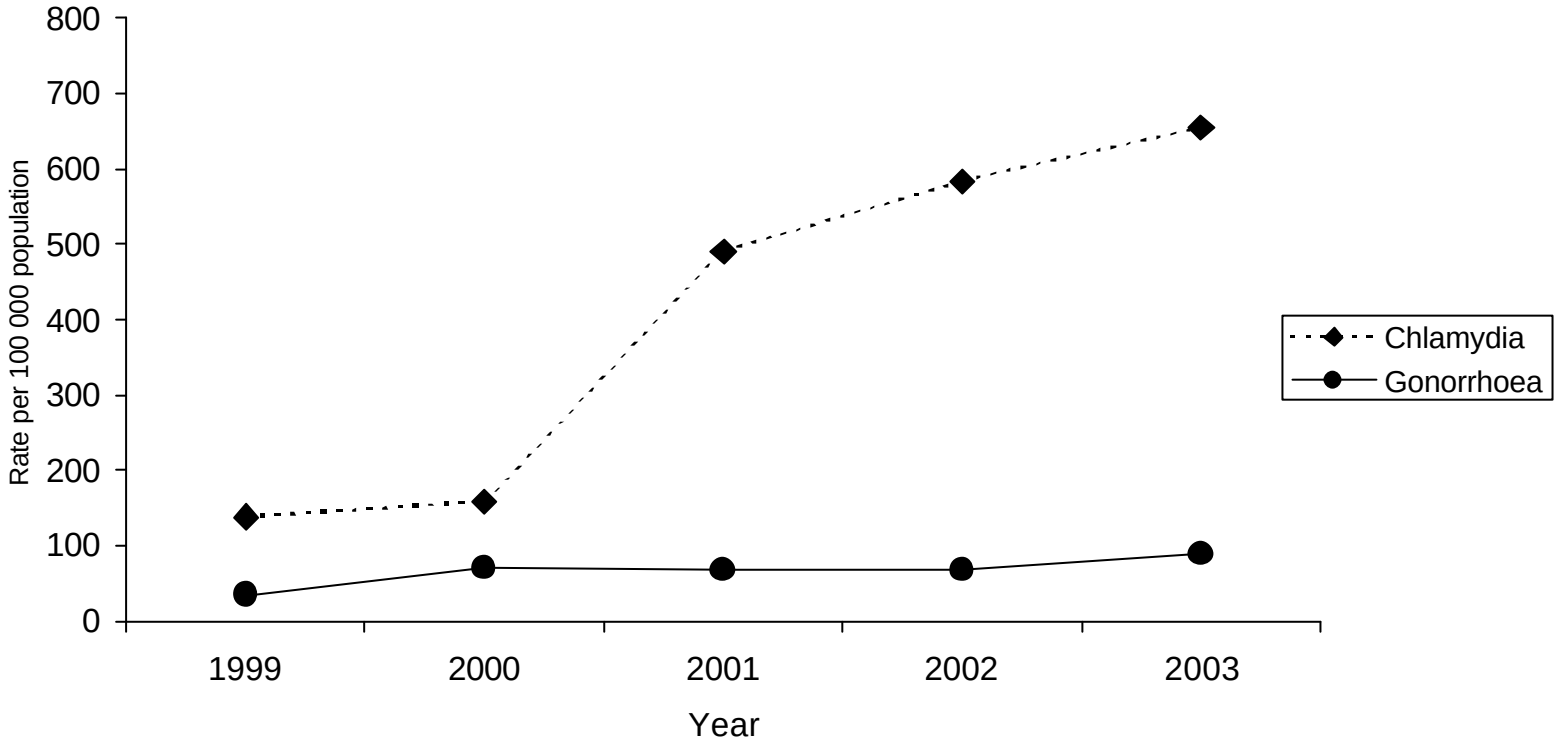

Table 1. Number and clinic rates of confirmed chlamydia, gonorrhoea, genital herpes and genital warts diagnoses in sexual health and family planning clinics, by age group and sex: 2003

		Sexual Health Clinics								Family Planning Clinics							
		Chlamydia		**Gonorrhoea**		**Herpes**[†]		**Warts**[†]		**Chlamydia**		**Gonorrhoea**		**Herpes**[†]		**Warts**[†]	
Age group (years)	Sex	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)
10-14	Male	2	2.0	0	0.0	1	1.0	1	1.0	1	0.6	0	0.0	0	0.0	0	0.0
	Female	66	6.8	6	0.6	4	0.4	16	1.7	31	0.9	1	0.0	0	0.0	5	0.1
	Total	68	6.4	6	0.6	5	0.5	17	1.6	32	0.9	1	0.0	0	0.0	5	0.1
15-19	Male	368	11.5	66	2.1	21	0.7	219	6.9	77	3.2	5	0.2	7	0.3	34	1.4
	Female	988	6.4	106	0.7	96	0.6	737	4.8	783	1.3	94	0.2	49	0.1	202	0.3
	Total	1356	7.3	172	0.9	117	0.6	956	5.2	860	1.3	99	0.2	56	0.1	236	0.4
20-24	Male	716	7.9	109	1.2	74	0.8	634	7.0	130	6.6	16	0.8	12	0.6	43	2.2
	Female	668	5.0	61	0.5	107	0.8	650	4.8	467	0.9	60	0.1	45	0.1	139	0.3
	Total	1384	6.1	170	0.8	181	0.8	1284	5.7	597	1.1	76	0.1	57	0.1	182	0.3
25-29	Male	356	5.5	74	1.1	71	1.1	377	5.8	23	3.1	3	0.4	8	1.1	12	1.6
	Female	237	3.2	30	0.4	62	0.8	232	3.1	114	0.5	15	0.1	11	0.0	33	0.1
	Total	593	4.3	104	0.8	133	1.0	609	4.4	137	0.6	18	0.1	19	0.1	45	0.2
30+	Male	319	2.3	128	0.9	173	1.2	467	3.3	22	1.0	2	0.1	4	0.2	7	0.3
	Female	156	1.4	28	0.3	148	1.3	208	1.9	79	0.2	9	0.0	27	0.1	28	0.1
	Total	475	1.9	156	0.6	321	1.3	675	2.7	101	0.2	11	0.0	31	0.1	35	0.1
All[‡]	Male	1761	5.3	378	1.1	340	1.0	1698	5.2	253	3.3	26	0.3	31	0.4	96	1.3
	Female	2116	4.4	231	0.5	417	0.9	1844	3.8	1475	0.8	179	0.1	132	0.1	407	0.2
	Total	3876	4.8	608	0.7	757	0.9	3541	4.4	1727	0.9	205	0.1	163	0.1	503	0.3

†First diagnosis; ‡Includes cases of all and unknown age.

Table 2. Number and rates of chlamydia and gonorrhoea reported by participating laboratories in the Auckland, Waikato, and Bay of Plenty regions, by age and sex: 2002–2003

		Chlamydia					Gonorrhoea				
		2002		2003			2002		2003		
Age group (years)	Sex	No.	Rate[†]	No.	Rate[†]	Sig[‡]	No.	Rate[†]	No.	Rate[†]	Sig[‡]
10-14	Male	7	9.9	15	21.2	N	6	8.5	3	8.0	N
	Female	134	196.4	175	256.4	Y	9	13.2	18	26.4	N
	Total	141	101.4	190	136.6	Y	15	10.8	21	15.1	N
15-19	Male	583	1194.1	740	1515.7	Y	105	215.1	158	323.6	Y
	Female	2653	5615.5	3184	6739.5	Y	142	300.6	223	472.0	Y
	Total	3236	3368.5	3924	4084.7	Y	247	257.1	381	396.6	Y
20-24	Male	919	2073.0	1040	2346.0	Y	164	369.9	192	433.1	N
	Female	2301	4984.7	2618	5671.5	Y	100	216.6	128	277.3	N
	Total	3220	3558.3	3658	4042.3	Y	264	291.7	320	353.6	Y
25-29	Male	530	1190.1	582	1306.8	N	94	211.1	128	287.4	Y
	Female	1121	2283.7	1187	2418.2	N	38	77.4	56	114.1	N
	Total	1651	1763.5	1769	1889.5	Y	132	141.0	184	196.5	Y
30+	Male	743	211.7	801	228.2	N	217	61.8	236	67.2	N
	Female	1173	302.7	1094	282.3	N	39	10.1	56	14.5	N
	Total	1916	259.4	1895	256.6	N	256	34.7	292	39.5	N
All *	Male	2833	329.5	3219	374.4	Y	587	90.2	719	110.5	Y
	Female	7445	822.5	8305	917.5	Y	331	48.4	485	70.9	Y
	Total[¶]	10284	582.7	11525	653.0	Y	992	74.3	1204	90.2	Y

[†]Rate per 100 000 population; [‡]Significance testing comparing 2003 to 2002 data. Y=result is significant, p<0.05; *Includes cases of unknown age; [¶]Includes cases of unknown sex.

Table 3. Number and clinic rates of chlamydia, gonorrhoea, genital herpes and genital warts diagnosed in sexual health and family planning clinics, by ethnicity: 2003

	Sexual Health Clinics								Family Planning Clinics							
	Chlamydia		Gonorrhoea		Herpes†		Warts†		Chlamydia		Gonorrhoea		Herpes†		Warts†	
Ethnicity	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)
European	2060	3.6	213	0.4	575	**1.0**	2576	**4.6**	924	0.7	79	0.1	121	0.1	353	**0.3**
Maori	1365	9.1	260	1.7	106	0.7	619	4.1	271	**2.0**	33	0.2	10	0.1	41	**0.3**
Pacific	256	**10.0**	83	**3.2**	13	0.5	110	4.3	107	1.8	17	**0.3**	6	0.1	15	0.2
Other	173	2.8	46	0.7	55	0.9	202	3.2	264	1.1	41	0.2	17	0.1	46	0.2
Unknown	23	2.1	7	0.6	8	0.7	37	3.3	162	0.7	35	0.2	9	0.0	48	0.2

†First diagnosis

Discussion

Both SHCs and FPCs play a vital role in the provision of sexual health services, however the total burden of STIs in New Zealand is likely to be substantially higher than that presented here, as a large proportion of the population attend other healthcare settings (such as general practice) for their sexual health.[6,7] In those regions where both laboratory and clinical based surveillance are in place, the number of chlamydia and gonorrhoea cases is 50% higher in laboratories compared to clinics.[4] This suggests a significant proportion of cases are diagnosed in healthcare settings not currently under clinic surveillance (e.g. primary care).

Another factor influencing clinic rates may be the use of total clinic visits as the denominator in rate calculations. Participating clinics do not report the number of patients tested for STIs, therefore the number of clinic visits is the only denominator available to calculate rates. However, as no distinction is made between the reasons for clinic visits, the denominator may result in an underestimation of the true STI rate.

Laboratory surveillance is currently only in place in the Auckland, Waikato, and Bay of Plenty regions, an area covering 47.2% of the New Zealand population. In 2003, laboratory surveillance estimated a chlamydia rate of 653.0 per 100,000 population in these regions—an increase of 12.1% from 2002. Cross-sectional studies in New Zealand report similar high rates of chlamydia—e.g. 4.8% in pregnant women,[8] 11.7% (11.1% males and 12.6% females) in SHC attendees,[9] and 4.0% in male army recruits.[10]

The rate of chlamydia in these regions is now more than four times higher than the most recent figures available (2002 data) for Australia[11] and the United Kingdom (UK)[12] (excluding Scotland). The rate of gonorrhoea is now 90.2 per 100,000 population in these regions, more than double that in Australia[11] and the UK[12] (excluding Scotland). However, it is important to note there are differences in surveillance methods between countries; for example in the UK, STI reporting is mandatory and surveillance is based on a network of genitourinary medicine clinics, whereas in Australia STIs are notifiable diseases and surveillance is based on a combination of both clinic and laboratory data.

In New Zealand, STIs are not notifiable diseases and current surveillance coverage is incomplete. Although laboratory surveillance can provide us with a better estimate of the burden of STIs in the population, it encompasses only 75% of laboratories in the Auckland, Waikato, and Bay of Plenty regions and is not representative of the whole country. Furthermore, as a large percentage of chlamydia and gonorrhoea cases are asymptomatic,[13,14] patients may remain undiagnosed resulting in underestimation of the true population infection rates.

Since 1999, the numbers of chlamydia and gonorrhoea cases diagnosed at SHCs have increased by 92.0% and 68.2%, respectively. Over the same period, the number of attendances at SHCs increased by 47.9%. For FPCs, comparisons with years prior to 2001 are difficult, due to a 10-fold increase in the number of participating FPCs between 1999 and 2000. Since 2001, the number of chlamydia diagnoses at FPCs has increased, but there has been little change in the number of gonorrhoea cases.

Increasing rates of STIs are of significant public health concern, not only because untreated STIs can lead to the development of serious sequalae[13] but also because of

their ability to facilitate the transmission of HIV.[15,16] The prevalence of ciprofloxacin-resistant gonorrhoea has also reached a level surpassing that acceptable as first-line treatment,[17] which may have important consequences for the treatment and management. In the 1990s, increases in STI incidence in New Zealand were attributed to a number of factors including a greater professional awareness,[18] changes to service provision and attendance patterns, and the introduction of more sensitive and specific diagnostic techniques. Whereas from 2000, increases may be more indicative of changes in sexual behaviour.[19]

In the United Kingdom, where the incidence of STIs is also increasing,[12] the *National Survey of Sexual Attitudes and Lifestyles* indicated increasing trends towards risky sexual behaviour.[20] Such behaviour included an increased number of partners, increased frequency of partner change, and reduced condom use. National studies reporting high-risk sexual behaviour have also been completed in Australia[21,22]and the United States.[23]

The highest rates of STIs in clinic surveillance are in males. This may merely reflect that males are more likely to have symptomatic infections and so are more likely to seek treatment. High rates in male FPC attendees may also be due to the low percentage of men attending FPCs. In addition, the majority of males attending FPCs are targeted through partner notification, and more likely to have a positive diagnosis. Laboratory surveillance reports higher rates of chlamydia in females than males; this may be a result of females attending other healthcare settings (e.g. for routine cervical screening), thus providing the opportunity to screen for asymptomatic infections.

In New Zealand, as reported in other industrialised countries,[11,12] surveillance data indicates the highest burden of STIs are in young people and non-European ethnic groups. Young people have more sexual partners, change partners more frequently,[19,24,25] and are at greater risk of re-infection.[26] Furthermore, a significant proportion of young people do not always practice safe sex,[27] putting them at risk of acquiring an STI. A school-based survey in Christchurch, New Zealand reported 4.1% of female and 0.4% of male sexually-active students had a previous STI diagnosis, and 56% reported that they did not always use a condom.[28] Targeted intervention and education strategies directed at reducing high-risk sexual behaviour and programmes to improve young peoples skills and confidence to implement behavioural changes are few. The frequency of such programmes needs to be increased with adequate funding and training.

STI surveillance data and other studies[8,9,29] continue to report that the Maori and Pacific People populations are disproportionately effected by poor sexual health. Difficulties in accessing services have been identified for Maori and others,[30] and it has been shown that Maori are significantly less likely to attend a GP at least once in a year.[31] In other countries where rates of STIs are higher amongst certain ethnic groups, factors in addition to access to healthcare have been implicated. These include differences in sexual behaviour and sexual networks.[32,33]

Current surveillance provides valuable information on the trends of STIs and the populations at risk, but difficulties are met when trying to establish national baselines and applying the data to the general population. This, along with the lack of a suitable denominator for rate calculations, means it cannot provide useful estimates of the true population burden of STIs. There is an urgent need for robust and reliable information

to inform and monitor control and prevention initiatives. One way is by expanding laboratory surveillance to all areas of New Zealand. (ESR and the Ministry of Health are currently in discussions with laboratories and Public Health Units about this.)

Many STIs are easy to diagnose and treat effectively with antibiotics, yet STI rates continue to increase. Sustained high rates of STIs among young people and Maori and Pacific Peoples indicate there is the need for more innovative approaches to the development of effective sexual health campaigns. The Ministry of Health's '*Sexual and Reproductive Health, A resource book for New Zealand health care organisations*'[34] is a step in the right direction, but now is the time to implement the suggested strategies and to move from planning to unified action. For example, in New Zealand the high rate of chlamydia, including infections in neonates,[8] reinforces the need for appropriately resourced chlamydia screening guidelines for healthcare professionals. Indeed, in other industrialised countries, this approach accompanied by opportunistic testing for chlamydia, has been shown to reduce chlamydia prevalence.[35–38]

Author information: Alisha R Johnston, Epidemiologist, Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, England (formerly of the Institute of Environmental Science & Research Ltd, Kenepuru Science Centre, Porirua); Dinusha Fernando, Biostatistician; Graham MacBride-Stewart, Senior Advisor, Population and Environmental Health Programme, Institute of Environmental Science & Research Ltd, Kenepuru Science Centre, Porirua

Acknowledgements: This paper could not have been generated without the continuing support of staff at sexual health and family planning clinic as well as the participating laboratories that provided data throughout New Zealand. We also thank Dr Min Lo (Wellington Sexual Health Clinic), Mike Brokenshire (Lab Plus, Auckland), Dr Jane MacDonald and Dr David Philips (ESR, Kenepuru Science Centre, Porirua) for their critique of the paper. The Ministry of Health and ESR provided funding for this project. (The opinions expressed here are those of the authors and do not reflect official policies of the Ministry of Health or ESR.)

Correspondence: Dinusha Fernando, Institute of Environmental Science & Research Ltd., Mt Albert Science Centre, Private Bag 92-021, Auckland. Fax: (09) 849 6046; email: dinusha.fernando@esr.cri.nz

References:

1. Institute of Environmental Science and Research Ltd. Sexually Transmitted Infections in New Zealand, Annual Surveillance Report, 2003. Wellington: Institute of Environmental Science and Research Ltd, 2004. Available online. URL: http://www.surv.esr.cri.nz/PDF_surveillance/STISurvRpt/2003/STIAnnualReport2003.pdf Accessed March 2005.
2. McIlraith J. Chlamydia - the young adults epidemic. N Z Fam Physician. 2003;30:416–9.
3. McNicholas A, Bennett S, Turley M, Garrett N. Surveillance of sexually transmitted infections in New Zealand, 1998. N Z Med J. 2001;114:279-83.
4. McNicholas AM, Turley ML, Bennett SN. *C. trachomatis* and *N. gonorrhoeae* surveillance in New Zealand: comparison of laboratory and clinic data. Aust N Z J Public Health. 2001;25:368–70.

5. Newcombe RG, Altman DG. Proportions and their differences. In: Altman DG, Machin D, Bryant TN, Gardner MJ, editors. Statistics with Confidence. 2nd ed. Bristol: BMJ Books; 2000. p45–56.

6. Dickson N, Paul C, Herbison P, et al. The lifetime occurrence of sexually transmitted diseases among a cohort aged 21. N Z Med J 1996;109:308–12.

7. Dickson N, Paul C, Herbison P. Where young people with multiple sexual partners seek medical care: implications for screening for chlamydial infection. Sex Transm Infect. 1998;74:445–7.

8. Lawton B, Rose S, Bromhead C, et al. Rates of Chlamydia trachomatis testing and chlamydial infection in pregnant women. N Z Med J. 2004;117(1194). URL: http://www.nzma.org.nz/journal/117-1194

9. Connor J, Paul C, Sharples K, Dickson N. Patterns of disease and HIV testing at sexually transmitted disease clinics. N Z Med J. 1997;110:452–5.

10. Cole K, Mitchell DL, Leighton J, et al. Determination of Chlamydia trachomatis prevalence in asymptomatic male military personnel in New Zealand: Comparing performances of COBAS amplicor and Abbott LCx Chlamydia detection systems for urine specimens. N Z Med J. 2001;55:71–74.

11. Australian Government, Department of Health and Ageing, Australia's notifiable diseases status, 2002. Communicable Diseases Intelligence; 2004;28. Available online. URL: http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/cda-pubs-cdi-2004-cdi2801-pdf-cdi2801b-cnt.htm/$FILE/cdi2801b.pdf Accessed March 2005.

12. Health Protection Agency, SCIEH, ISD, National Public Health Service for Wales, CDSC Northern Ireland and the UASSG. Renewing the focus. HIV and other Sexually Transmitted Infections in the United Kingdom in 2002. London: Health Protection Agency; 2003.

13. Cates W, Wasserheit JN. Genital chlamydial infections: epidemiology and reproductive sequelae. Am J Obstet Gynaecol. 1991;164:1771–81.

14. Farley TA, Cohen DA, Elkins W. Asymptomatic sexually transmitted diseases: The case for screening. Prev Med. 2003;36:502.

15. Flemming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sex Transm Infect. 1999;75:3–17.

16. Centers for Disease Control and Prevention. HIV prevention through early detection and treatment of other sexually transmitted diseases: United States. MMWR Morb Mortal Wkly Rep. 1998;47:RR-12.

17. Heffernan H, Brokenshire M, Woodhouse R, et al. Antimicrobial susceptibility among *Neisseria gonorrhoeae* in New Zealand in 2002. N Z Med J 2004;117:(1191). URL: http://www.nzma.org.nz/journal/117-1191

18. Siiri B, McNicholas A, Garrett N. Screening and diagnostic practices for Chlamydia infections in New Zealand. N Z Med J 2001;114:349–52.

19. Paul C, Dickson NP, Davis DP, et al. Heterosexual behaviour and HIV risk in New Zealand. Aust J Public Health. 1995;19:13–18.

20. Johnson A, Mercer C, Erens B, et al. Sexual behaviour in Britain: partnerships, practices and HIV risk behaviour. Lancet. 2001;358:9835–42.

21. Rissel CE, Richters J, Grulich AE, et al. Sex in Australia: experiences of commercial sex in a representative sample of Adults. Aust N Z J Public Health. 2003;27:191–7.

22. de Visser RO, Smith AM, Rissel CE, et al. Sex in Australia: safer sex and condom use among a representative sample of adults. Aust N Z J Public Health. 2003;27:223–9.

23. Laumann E, Gayon J, Michael R, Michaels S. The social organisation of sexuality: Sexual practices in the United States. Chicago: University of Chicago Press; 1994.

24. Humblet O, Paul C, Dickson N. Core group evolution over time: high-risk sexual behaviour in a birth cohort between sexual debut and age 26. Sex Transm Dis. 2003;30:818–24.

25. de Visser RO, Rissel CE, Richters J, Grulich AE. Sex in Australia: Safer sex and condom use among a representative sample of adults. Aust N Z J Public Health. 2003;27:223–9.

26. Orr PO, Johnston K, Brezendine E, et al. Subsequent sexually transmitted infections in urban adolescents and young adults. Arch Pediatr Adolesc Med. 2001;155:947–53.

27. Dickson N, Paul C, Herbison P, et al. The lifetime occurrence of sexually transmitted diseases among a cohort aged 21. N Z Med J. 1996;109:308–12.

28. Corwin P, Abel G, Wells EJ, et al. *Chlamydia trachomatis* prevalence and sexual behaviour in Christchurch high school students. N Z Med J. 2002;115:(1158). URL: http://www.nzma.org.nz/journal/115-1158

29. Lo M, Reid M, Brokenshire M. Epidemiological features of women with trichomoniasis in Auckland sexual health clinics: 1998-99. N Z Med J. 2002;115(1159). URL: http://www.nzma.org.nz/journal/115-1159

30. Ministry of Health, New Zealand. Reducing inequalities in health. Wellington: Ministry of Health; 2002. Available online. URL: http://www.moh.govt.nz/moh.nsf/0/523077dddeed012dcc256c550003938b?OpenDocument Accessed March 2005.

31. Scott KM, Marwick JC, Crampton PR. Utilization of general practioner services in New Zealand and it's relationship with income, ethnicity and government subsidy. Health Serv Manage Res. 2003;16:45–55.

32. Elam G, Fenton K, Johnson A, et al. Exploring ethnicity and sexual health. London: Social Community Planning Research;1999, p1–116.

33. Johnson EH, Jackson LA, Hinkle Y, et al. What is the significance of black-white differences in risky sexual behaviour? J Natl Med Assoc. 1994;86:745–59.

34. Ministry of Health, New Zealand. Sexual and Reproductive Health. A resource book for New Zealand health care organisations. Wellington: Ministry of Health; 2003. Available online. URL: http://www.moh.govt.nz/moh.nsf/0/cffe42ce625d5a37cc256dec000dc097?OpenDocument Accessed March 2005.

35. Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2002 Supplement, Chlamydia Prevalence Monitoring Project. Atlanta, GA. Department of Health and Human Services, Centers for Disease Control and Prevention; 2003.

36. Herrmann B, Egger M. Genital Chlamydia trachomatis infections in Uppsala County, Sweden, 1985-1993: declining rates for how much longer? Sex Transm Dis 1995;22:253–60.

37. Mertz KJ, Levine WC, Mosure DJ et al. Trends in the prevalence of chlamydia infections. The impact of community-wide testing. Sex Transm Dis 1997;24:169-175.

38. Townsend JRP, Turner HS. Analysing the effectiveness of chlamydia screening. J Oper Res Soc 2000;51:812–24.

