Original article

Epidemiology of sexually transmissible infections in New South Wales: are case notifications enough?

Teresa M Wozniak, Helen A Moore, C Raina MacIntyre

Abstract

Background: Surveillance of sexually transmissible infections (STI)s is important to assess the disease burden in the population and to monitor and evaluate changes in trends over time. Routinely collected surveillance data in New South Wales are reliant on case reporting, which for many infections is an inadequate mechanism for capturing incidence and prevalence. Increasing rates of chlamydia over the past decade have sparked intense debate as to whether the current notification system is optimal and whether the true burden of infection are being measured. This study describes the current surveillance for STIs in New South Wales.

Methods: New South Wales-specific data for the years 2000–2009 were analysed. Notification data were used to examine the rate of the 4 STIs that are notifiable in New South Wales; chlamydia, gonorrhoea, infectious syphilis and HIV notifications. Hospital admissions and chlamydia-associated pelvic inflammatory disease were analysed using admitted patient data.

Results: Chlamydia was the most frequently reported of the notifiable STIs in New South Wales. Despite the higher rates of notification compared with other STIs, chlamydia-related hospitalisations contribute less than a 5th of all STI-related hospital admissions. Infectious syphilis contributed to the highest proportion of all STI-related hospitalisations in New South Wales and rates increased from 2000 to 2009. For other STIs such as anogenital herpes and gonorrhoea, hospital admissions remained stable for the same period.

Conclusions: Notifications data for STIs should be complemented with hospital admission and other data sources to better describe STI morbidity. A synthesis of these data sources is needed to improve current surveillance and allow for better comparisons and trend analysis of STIs in New South Wales. *Commun Dis Intell* 2013;37(4):E407–E414.

Keywords: sexually transmissible infections, surveillance, hospitalisation, notifications, New South Wales

Introduction

Sexually transmissible infections (STI)s can be transferred from one person to another through sexual contact. STIs are a significant cause of preventable morbidity worldwide, mainly attributed to syphilis, gonorrhoea and chlamydia. Despite the greatest burden of infection being in developing countries,[1] either social, demographic or migratory trends have resulted in infection spreading to other countries. In Australia over the past decade, chlamydia was the most frequently notified STI followed by gonorrhoea, HIV and syphilis. Non-notifiable conditions such as genital warts have declined in Australia.[2]

Currently in Australia, surveillance for STIs is a combination of routine case notification, surveillance for antimicrobial resistant isolates, enhanced surveillance systems and a collection of special interest studies. Notifications capture incident and / or prevalent cases of chlamydia, gonorrhoea, syphilis and HIV in the population and are reported through the National Notifiable Diseases Surveillance System. Enhanced surveillance systems include the continuous randomised study of national general practice termed 'Bettering the Evaluation And Care of Health' (BEACH), the Australian Collaboration for Chlamydia Enhanced Sentinel Surveillance (ACCESS) and the Australian Gonococcal Surveillance Programme These systems serve to enrich notifications data by collecting additional information such as general practitioner (GP) encounters and frequency of testing for STIs. Special-interest studies serve to monitor a representative sample of the population, and in Australia, a number of such studies exist.[3,4] Smaller studies may focus on gaining an understanding of gay health issues, and these include the Gay Community Periodic Survey[5] and the Health in Men cohort study of HIV antibody negative men who have sex with men (MSM), in Sydney.[6] Hospital admissions may inform disease trends and measure the additional health care costs associated with severe disease, but limited published data are available in Australia.[7–9]

The aim of this study was to examine the current surveillance systems for STIs and to describe the epidemiology of STIs in New South Wales using notifications and hospital admissions data.

Methods

In New South Wales, notifiable diseases are reported to the NSW Notifiable Conditions Information Management System (NCIMS). Under the authority of the *NSW Public Health Act 2010,* the NSW Ministry of Health receives notifications of communicable disease through public health units from GPs, hospitals, and pathology laboratories.

The following notifiable conditions were analysed from NCIMS for the years 2000 to 2009:

Communicable disease group	Condition
Chlamydia trachomatis	*Chlamydia trachomatis* (non-lymphogranuloma venereum), congenital *Chlamydia trachomatis*
Gonorrhoea	Gonorrhoea; including site of infection: of the eye, pharynx, genitourinary system, anus/rectum and other or unspecified sites
Syphilis	Infectious syphilis (less than 2 years duration)
HIV	HIV

New South Wales Admitted Patient Data Collection (APDC) was utilised to extract records for hospital separations for the following ICD10-AM codes:

Early congenital syphilis, symptomatic	A50.0
Early congenital syphilis, latent	A50.1
Early congenital syphilis, unspecified	A50.2
Late congenital syphilitic oculopathy	A50.3–A50.7
Congenital syphilis, unspecified	A50.9
Primary genital syphilis	A51.0
Primary anal syphilis	A51.1
Primary syphilis of other sites	A51.2
Secondary syphilis of skin and mucous membranes	A51.3
Other secondary syphilis	A51.4
Early syphilis, latent	A51.5
Infectious syphilis	A51.9
Cardiovascular syphilis (I98.0*)	A52.0
Symptomatic neurosyphilis	A52.1
Asymptomatic neurosyphilis	A52.2
Neurosyphilis, unspecified	A52.3
Other symptomatic late syphilis	A52.7
Late syphilis, latent	A52.8
Late syphilis, unspecified	A52.9
Latent syphilis, unspecified as early or late	A53.0
Syphilis, unspecified	A53.9
Gonococcal infection of lower genitourinary tract without periurethral or accessory gland abscess	A54.0
Gonococcal infection of lower genitourinary tract with periurethral and accessory gland abscess	A54.1
Gonococcal pelviperitonitis and other gonococcal genitourinary infections	A54.2
Gonococcal infection of eye	A54.3
Gonococcal infection of musculoskeletal system	A54.4
Gonococcal pharyngitis	A54.5
Gonococcal infection of anus and rectum	A54.6
Other gonococcal infections	A54.8
Gonococcal infection, unspecified	A54.9
Chlamydial lymphogranuloma (venereum)	A55
Chlamydial infection of lower genitourinary tract	A56.0
Chlamydial infection of pelviperitoneum and other genitourinary organs	A56.1
Chlamydial infection of genitourinary tract, unspecified	A56.2
Chlamydial infection of pharynx	A56.4
Sexually transmitted chlamydial infection of other sites	A56.8
Chancroid	A57
Granuloma inguinale	A58
Urogenital trichomoniasis	A59.0
Herpesviral infection of genitalia and urogenital tract	A60.0
Herpesviral infection of perianal skin and rectum	A60.1
Anogenital herpesviral infection, unspecified	A60.9
Anogenital (venereal) warts	A63.0
Other specified predominantly sexually transmitted diseases	A63.8
Unspecified sexually transmitted disease	A64

The APDC was used to extract records for hospital separations for pelvic inflammatory disease (PID) ICD10-AM codes: N70.0, N70.1, N70.9, N71.0, N71.1, N71.9, N73.0–N73.2, N73.8, N73.9, N74.4.

Rates of hospital admission measures separations, not individuals, and one person may have multiple separations within a reporting period. The principal cause of the hospitalisation was defined as the diagnosis that caused the patient's episode of care in hospital. A hospitalisation rate is an estimate of the proportion of a population that was hospitalised during a specified period and is the number of hospitalisations per 100,000 population per year.

Notifications are a measure of incident cases: that is, the number of new cases in a specified period. A

notification rate is an estimate of the proportion of the population who have been diagnosed with the condition per 100,000 population per year.

All rates were age-standardised to adjust for differences in the age structure between populations using the direct method to compare between study groups. The Australian Bureau of Statistics estimated residential population as at 30 June 2001 was used as the standard population. All analyses were conducted using SAS software (SAS Institute, Inc., Cary, North Carolina).

The study was conducted by the NSW Ministry of Health and used de-identified aggregated data for which ethics committee approval was not required.

Results

Notifications in New South Wales

In New South Wales in 2009, chlamydia was the most commonly notified STI, with rates notably higher when compared with infectious syphilis, HIV or gonorrhoea (Figure 1). The largest increases in rates from 2000 to 2009 were for chlamydia (53.7–215.4 per 100,000) and infectious syphilis (1.2–7.4 per 100,000) whilst the rate of gonorrhoea and HIV notification remained stable over this period. In the study period, gonorrhoea and chlamydia notifications were most common amongst persons aged 15–34 years (Table 1). Rates of chlamydia notification among women in this age group were double that of males (Table 1).

Notification rates for infectious syphilis (range 7.8–26.8 per 100,000), HIV (range 13.2–28.1 per 100,000) and gonorrhoea (range 82.5–102.6 per 100,000) were 5 to 10 times higher amongst males aged 20–39 years compared with females. More specifically, between 2000 and 2009 there was

Figure 1: Age-standardised rate for notifiable sexually transmissible infections, New South Wales, 2000 to 2009, by year

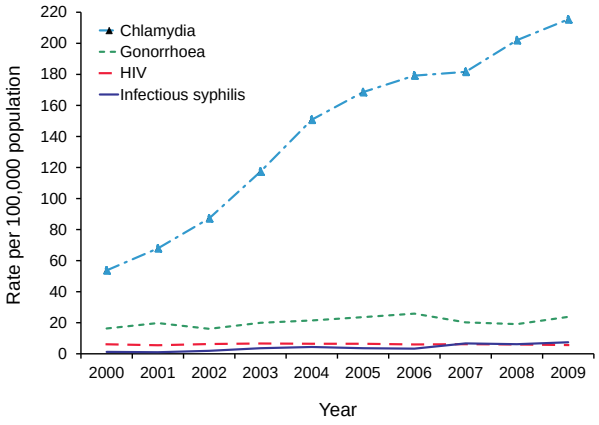
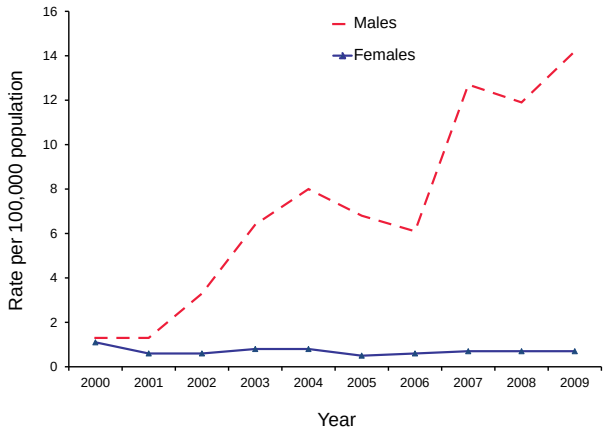


Table 1: Age-specific rate for notifiable sexually transmissible infections, New South Wales, 2000 to 2009, by age and sex

	Chlamydia		Gonorrhoea		HIV		Infectious syphilis	
Age group	Females	Males	Females	Males	Females	Males	Females	Males
0–4	9.4	8.5	0.3	0.1	0.3	0.1	0.0	0.0
5–9	0.3	0.0	0.2	0.0	0.1	0.1	0.0	0.0
10–14	28.0	2.4	1.4	0.0	0.2	0.0	0.0	0.0
15–19	880.6	237.6	18.1	27.6	0.7	0.9	0.6	1.4
20–24	1,093.8	661.6	22.8	92.7	3.6	13.2	1.6	7.8
25–29	489.7	471.6	15.5	102.6	3.8	23.5	2.0	15.7
30–34	213.2	273.4	10.3	90.4	3.5	25.6	1.7	20.0
35–39	103.8	177.1	6.7	82.5	1.8	28.1	0.6	26.8
40–44	54.1	119.1	4.4	56.1	1.8	22.5	1.0	22.5
45–49	28.5	73.6	3.1	33.3	1.0	14.8	0.7	13.9
50–54	17.3	48.3	1.6	22.6	1.1	8.8	0.4	9.0
55–59	6.4	26.9	1.3	12.1	0.6	5.5	0.4	4.7
60–64	3.0	15.5	1.0	8.1	0.5	4.1	0.1	3.6
65–69	1.9	8.2	0.3	4.2	0.5	1.1	0.2	1.9
70–74	1.2	4.4	0.4	1.3	0.4	0.6	0.4	1.0
75–79	0.6	2.3	0.2	1.2	0	0.9	0.0	1.6
80–84	0.2	1.0	0.2	0.0	0.2	0.7	0.2	0.4
85+	1.1	2.2	0.3	0.0	0.0	0.0	0.0	0.0

an 11-fold increase in infectious syphilis notifications amongst males. The rate increased from 1.3 per 100,000 in 2000 to 14.2 per 100,000 in 2009 (Figure 2).

Figure 2: Age-standardised rates of infectious syphilis, New South Wales, 2000 to 2009, by sex



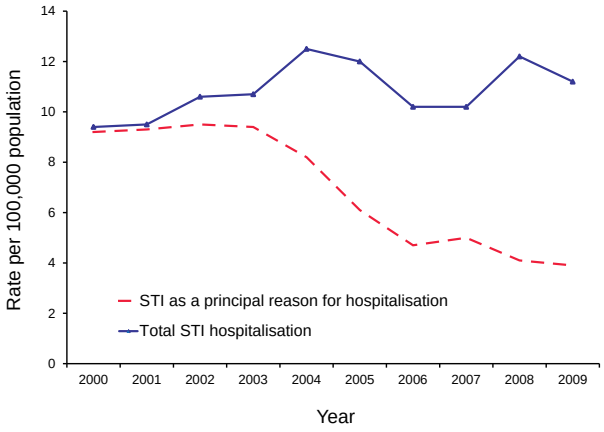
Gonorrhoea most commonly caused infection of the genitourinary system in all ages except in the 0–14 years age range (n=6) where infection of the eye or 'other' were more common (Table 2). Anogenital (genitourinary combined with infection of the anus or rectum) infection accounted for approximately 72% (n=10,239) of the gonococcal notifications of people aged 15 years or over. Amongst those younger than 15 years, there were 16 cases of anogenital gonorrhoea. Pharyngeal infection due to gonorrhoea was highest in the 30–34 years age group where it contributed to 11% (n=285) of total gonorrhoea infections (Table 2).

Hospital admissions in New South Wales

The rate of hospital separations in which an STI was recorded as the principal diagnosis or co-morbid condition can provide a measure of the burden of more serious STI complications. In New South Wales, the total rate of STI admissions has gradually increased from a rate of 9.4 per 100,000 in 2000 to 11.2 per 100,000 in 2009 (Figure 3). Females were more likely to be hospitalised for an STI than males at a ratio of 1.3:1 (data not shown). Over the same period, there was a greater than 2-fold decrease in hospital admissions with an STI as the principal cause of the hospitalisation (Figure 3).

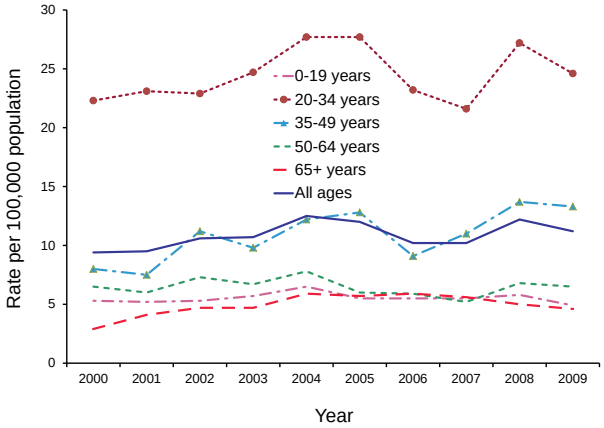
Syphilis, anogenital herpes and chlamydia represented the greatest proportion of total STI-related hospital admissions (Table 3). An analysis of changes over time shows that hospitalisations for chlamydia and syphilis increased between 2000 and 2009, while hospitalisations for conditions related to anogenital herpes and gonorrhoea remained stable.

Figure 3: Age-standardised rate of sexually transmissible infection hospitalisations, New South Wales 2000 to 2009, by year



Young adults experienced the highest rate of STI-related hospital admissions, with the number of STI-related admissions amongst those aged 20–34 years being approximately double that for those aged 35–49 years and approximately 5 times that of people in the other age groups (0–19, 50–64, and 65+) (Figure 4).

Figure 4: Rate for sexually transmissible infection hospitalisation,* New South Wales, 2000 to 2009, by age group and year



* Primary and secondary diagnoses

Table 2: Site of gonorrhoea infection, New South Wales, 2000 to 2009, by age group

	<15		15–19		20–24		25–29		30–34		35–39		40–44		45–49		50–54		55–59		>60	
Site of infection	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Eye	6	15	5	1	5	0	2	0	3	0	2	0	3	1	1	0	0	0	0	0	0	0
Genitourinary	16	39	584	59	1,472	59	1,609	58	1,399	56	1,275	58	830	58	521	65	314	63	166	69	147	65
Anus and rectum	0	0	50	5	317	13	379	14	392	16	360	16	235	16	101	13	55	11	16	7	1	7
Pharynx	0	0	42	4	198	8	293	10	285	11	213	10	117	8	62	8	24	5	11	5	11	5
Other	19	46	302	31	509	20	495	18	433	17	356	16	246	17	118	14	103	21	48	19	52	23

Total number of notifications for site of infections in the eye n=27; in genitourinary site n=8,334; anus/ rectum site n=1,922; pharynx site n=1,256; and other n=2,681. Total number of notifications n=14,220.

Table 3: Sexually transmissible infection-related hospitalisations * where a sexually transmissible infection was the primary cause of hospitalisation, New South Wales, 2000 to 2009

	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Syphilis	48	35	42	29	42	29	41	30	60	34	46	28	36	28	46	29	57	36	66	40
Gonorrhoea	12	9	19	13	31	22	18	13	14	18	17	10	16	12	19	12	14	9	21	13
Chlamydia	15	11	26	18	25	17	21	16	37	21	46	28	32	25	36	23	37	23	31	19
Anogenital herpes	48	35	44	30	36	25	33	24	45	26	45	27	40	31	51	32	46	29	45	28
Other†	15	11	15	10	9	6	22	16	20	11	11	7	6	5	8	8	5	3	0	0

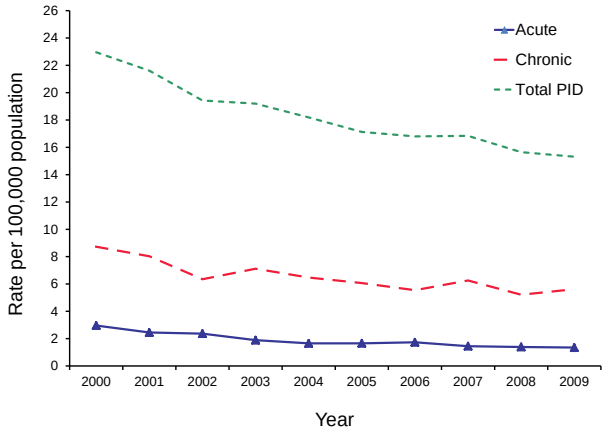
The total hospitalisations where a sexually transmissible infection was the primary diagnosis for the period 2000 to 2009 was 1,515.

* does not include co-morbid conditions (n=2,359) and conditions coded as 'other predominantly sexually transmissible infections not elsewhere specified' (n=3,092).

† 'Other' refers to hospitalisations for chancroid, granuloma inguinale and urogenital trichomoniasis.

Rates of total PID due to chlamydia infection declined over the past decade from 22 per 100,000 population in 2000 to 15 per 100,000 population in 2009 (Figure 5). Of these, the largest decline since 2000 was for chronic PID hospitalisation, whereas acute PID hospitalisations were stable.

Figure 5: Age-standardised rate of chlamydia-associated pelvic inflammatory disease diagnosis,* New South Wales, 2000 to 2009



* Coded as a principal diagnosis. Pelvic inflammatory disease of unspecified duration, n=6663.

Discussion

STIs remain a significant public health burden in New South Wales. Much of what informs STI disease trends in New South Wales is generated from the case notification system. Chlamydia is the most highly reported notifiable STI in New South Wales, followed by gonorrhoea, with infectious syphilis and HIV remaining stable and low for the period 2003–2009. However, these notification data do not establish the detail essential to understanding the true burden of disease, such as the rates of undiagnosed infections and the severity of disease. Much of the current focus has been on the increase in chlamydia notification rates in young people and in particular amongst young females. However, there needs to be a more wide reaching discussion as to how suitable the current notification based surveillance system is at measuring rates of STIs in New South Wales, in the absence of an evaluation of the NSW Notifiable Conditions Information Management System. Clearly, notifications are important for ascertaining the overall number of identified cases, but as is the case for chlamydia, infectious syphilis and gonorrhoea notifications, they do not provide a measure of incidence and overall burden of disease. Other data sources are required to complement notifications data and to more appropriately reflect changes in rates of infection and associated disease complications. These include data generated by surveys,[3] sentinel surveillance systems,[11] testing data[10,12] and inpatient hospital statistics. Currently, hospitalisation data are under utilised but can provide valuable information on the more severe consequences of undiagnosed or untreated infection.

Chlamydia notification rates in New South Wales increased rapidly between 2000 and 2009, with the highest proportion increase amongst young women aged 15–24 years. These apparent trends in increased notification rates may be a result of increasing transmission rates or an increase in targeted testing activity,[10,11,12] which is detecting and treating previously asymptomatic persons, or a combination of both. Currently, there is no systematic reporting of chlamydia testing patterns. However, studies have shown that the testing rates for chlamydia and other STIs have increased 10-fold since 1998 and testing is undertaken most frequently amongst the 15–24 years age group.[10] Similarly, increased rates of chlamydia testing were also evident in rural New South Wales, though the proportion of people tested in this region remained low (below 2% per GP visit).[12] Measures of chlamydia testing rates in priority populations are needed, more specifically, the number of young people tested for chlamydia in the past 12 months. These data could be collected through Medicare reports or alternatively by establishing an enhanced surveillance system for the regular collection and reporting of these data. The Australian Government Department of Health is in negotiations with Medicare for the routine release of testing data.[13]

While chlamydia notification rates were the highest of all STIs in New South Wales, chlamydia-associated PID rates have been declining, and chlamydia was not the leading primary diagnosis for STI-related hospitalisations. Similar discordances between chlamydia notifications and PID rates have been previously reported.[9,14] The discordance may reflect early detection and treatment of chlamydia, preventing the subsequent complications. Although difficulties with the diagnosis of PID may lead to differences in the rate of diagnosis between clinicians,[15,16] few studies have examined these differences. Without a co-ordinated approach and a clear understanding of the complexity of chlamydia and its associated disease development, notifications alone cannot provide evidence for appropriate public health actions.

Over the past decade there has been an 11-fold increase in infectious syphilis notification rates amongst males and this may in part explain the large proportion of STI-related hospitalisations that are due to syphilis. In New South Wales, infectious

syphilis occurs predominantly amongst MSM, approximately half of whom are HIV co-infected.[17] The increase in the number of male cases of syphilis may be a consequence of factors other than an increase in prevalence, such as increasing testing,[18] which disproportionately affects some populations. Notifications data and published studies support a predominance of syphilis transmission amongst males and amongst those co-infected with HIV. However, more detailed socio-demographic and behavioural predictors are needed to draw appropriate conclusions about disease trends. In the future, information pertaining to 'gender of partner' and or 'HIV status' would be necessary to complement notifications in understanding the priority populations most affected by infection.[13] Furthermore, hospitalisation data would improve the understanding of the impact of infection in the more severe cases of untreated infectious syphilis.

Despite an increase in antimicrobial resistance amongst gonococci isolates in New South Wales, which might be expected to lead to a higher number of infections,[19] gonorrhoea notifications remained stable from 2003 until 2009. The anogenital region accounted for the majority of gonorrhoea notifications, followed by infection of the pharynx. Pharyngeal gonorrhoea is most common amongst MSM,[20] and can be transmitted to other sites.[21] Currently, there are limited data on the transmissibility of gonorrhoea, particularly by anatomical sites. Reporting the site of gonorrhoea infection is important for determining appropriate diagnosis and treatment and in some populations. It may also reflect changes in sexual behaviour.

With changes in STI epidemiology, it is important to examine whether notifications alone are reliable enough to monitor trends in a population. In many instances, case notifications measure the rate of infection in those individuals who present with symptoms, those who have been tested opportunistically or have requested to be tested. It does not however, provide a measure of population-level rates of STIs and can only approximate trends over time as it is highly dependent on who presents with symptoms and who is tested. To better understand the timing and duration of infection, data relating to testing and positivity rates are needed. As GPs are the first point of contact with approximately 80% of the Australian population,[22] surveillance data from GPs could estimate population-level testing patterns. Information relating to GP practices can be found in the BEACH program or by requesting data from Medicare. The BEACH data show that the rate of GP management for all STI-related problems increased by two-thirds between 1998 and 2007.[10] Other than GPs, STIs can also be investigated in sexual health clinics, and data from this setting suggests chlamydia rates to be at least a third of that currently notified, when adjusted for testing patterns.[11] No similar studies have been conducted for other STIs but comparable trends may be evident when testing data becomes more readily available.

There are several limitations to the data presented. Persons with asymptomatic disease or with mild symptoms of the infection are less likely to seek health care than those with symptoms. Site of infection for gonorrhoea notifications does not take into account multiple sites infected but rather the site where the organism was first isolated. Persons may have several hospital admissions, which may overestimate rates of hospitalisation. This may occur for infections such as chlamydia in particular where repeat infections are common, or syphilis, where positive serology may have been from previously treated individuals.

Despite the substantial heterogeneity in diagnosis, treatment and surveillance systems, available data suggest that STIs are on the rise. Changes in the epidemiology of STIs presents challenges to surveillance both in understanding the true burden of disease and for service provision. Understanding the true burden of disease needs to comprise of morbidity measures to effectively monitor the spread of disease and establish true patterns of progression. Morbidity is currently routinely reported using case notification, whilst other data measuring rates of STI-related hospitalisations are under utilised. Both data sources are important and should not be used in isolation but rather combined, and complemented with data on testing patterns, diagnosis, treatment, and aspects of sexual behaviour. A synthesis of these systems is needed to improve current surveillance which in turn would allow for better comparisons and trend analysis of STIs in New South Wales.

Author details

Dr Teresa M Wozniak[1,2]
Mrs Helen A Moore[3]
Professor C Raina MacIntyre[2]

1. New South Wales Public Health Officer Training Program, NSW Ministry of Health, Sydney, New South Wales
2. School of Public Health and Community Medicine, University of New South Wales, Sydney, New South Wales
3. Centre for Epidemiology and Evidence, NSW Ministry of Health, Sydney, New South Wales

Corresponding author: Dr Teresa Wozniak. Email: twozn@doh.health.nsw.gov.au

References

1. World Health Organization. Estimation of the incidence and prevalence of sexually transmitted infections. Report of a WHO consultation 2002. Geneva; World Health Organization: 2002.
2. Donovan B, Franklin N, Guy R, Grulich AE, Regan DG, Ali H, et al. Quadrivalent human papillomavirus vaccination and trends in genital warts in Australia: analysis of national sentinel surveillance data. *Lancet Infect Dis* 2011;11(1):39–44.
3. Kang M, Rochford A, Skinner SR, Mindel A, Webb M, Peat J, et al. Sexual behaviour, sexually transmitted infections and attitudes to chlamydia testing among a unique national sample of young Australians: baseline data from a randomised controlled trial. *BMC Public Health* 2014;8(14):12.
4. Cunningham AL, Taylor R, Taylor J, Marks C, Shaw J, Mindel A. Prevalence of infection with herpes simplex virus types 1 and 2 in Australia: a nationwide population based survey. *Sex Transm Infect* 2006;82(2):164–168.
5. Lee E, Holt M, Mao L, McKenzie T, Batrouney C, Kennedy M, et al. Gay Community Periodic Survey: Melbourne 2011. Sydney: National Centre in HIV Social Research, The University of New South Wales; 2011. Available from: http://nchsr.arts.unsw.edu.au/publications/
6. Jin F, Prestage GP, Mao L, Kippax SC, Pell CM, Donovan B, et al. Transmission of herpes simplex virus types 1 and 2 in a prospective cohort of HIV-negative gay men: the health in men study. *J Infect Dis* 2006;194(5):561–570.
7. Pirotta M, Stein AN, Conway EL, Harrison C, Britt H, Garland S. Genital warts incidence and healthcare resource utilisation in Australia. *Sex Transm Infect* 2010;86(3):181–186.
8. Brotherton JM, Heywood A, Heley S, The incidence of genital warts in Australian women prior to the national vaccination program. *Sex Health* 2009;6(3):178–184.
9. Chen MY, Fairley CK, Donovan B. Discordance between trends in chlamydia notifications and hospital admission rates for chlamydia related diseases in New South Wales, Australia. *Sex Transm Infect* 2005;81(4):318–322.
10. Britt H, Miller GC, Charles J, Valenti L, Fahridin S, Pan Y, et al. General practice in Australia, health priorities and policies, 1998 to 2008. Canberra: Australian Institute of Health and Welfare. Available from: http://www.aihw.gov.au/publication-detail/?id=6442468257
11. Ali H, Guy RJ, Fairley CK, Wand H, Chen MY, Dickson B, et al. Understanding trends in genital *Chlamydia trachomatis* can benefit from enhanced surveillance: findings from Australia. *Sex Transm Infect* 2012;88(7):552–557.
12. Reynolds R, Oakman T. Genital chlamydia in southern New South Wales: an ecological analysis of testing and notification patterns 2004–2008. *Aust J Rural Health* 2010;18(4):159–165.
13. Communicable Diseases Network Australia. *National Blood-borne Virus and Sexually Transmissible Infections Surveillance and Monitoring Plan: 2010–2013*. Accessed November 2011. Available from: http://www.health.gov.au/internet/publications/publishing.nsf/Content/ohp-bbvs-plan10-13-l~ohp-bbvs-plan10-13-l-1
14. Liu B, Donovan B, Parker J, Guy R, Hocking J, Kaldor JM, et al. Increasing chlamydia diagnoses but little change in hospitalisations for ectopic pregnancy and infertility among women in New South Wales from 2001 to 2008. *Sexual Health* 2012;9(4):355–359.
15. Doxanakis A, Hayes RD, Chen MY, Gurrin LC, Hocking J, Bradshaw CS, et al. Missing pelvic inflammatory disease? Substantial differences in the rate at which doctors diagnose PID. *Sex Transm Infect* 2008;84(7):518–523.
16. Ness RB, Smith KJ, Chang CC, Schisterman EF, Bass DC, et al. Prediction of pelvic inflammatory disease among young single sexually active women. *Sex Transm Dis* 2006;33:137–142.
17. Jin F, Prestage GP, Kippax SC, Pell CM, Donovan BJ, Kaldor JM, et al. Epidemic syphilis among homosexually active men in Sydney. *Med J Aust* 2005;183(4):179–183.
18. Guy R, Wand H, Holt M, Mao L, Wilson DP, Bourne C, et al. High annual syphilis testing rates among gay men in Australia, but insufficient retesting. *Sex Transm Dis* 2012;39(4):268–275.
19. Australian Gonococcal Surveillance Programme. Annual report of the Australian Gonococcal Surveillance Programme 2009. *Commun Dis Intell* 2010.34(2): 89–95.
20. Janier M, Lassau F, Casin I, Morel P. Pharyngeal gonorrhoea: the forgotten reservoir. *Sex Transm Infect* 2003;79(4):345.
21. McMillan A, Young H, Moyes A. Rectal gonorrhoea in homosexual men: source of infection. *Int J STD AIDS* 2000;11(5):284–287.
22. Britt HC, Miller GC. The BEACH study of general practice. *Med J Aust* 2000 17;173(2):63–64.