Demographic and geographical risk factors for gonorrhoea and chlamydia in greater Western Sydney, 2003–2013

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Abstract

Introduction: Notification rates of sexually transmitted infections (STIs) have increased in New South Wales as elsewhere in Australia. Understanding trends in chlamydia and gonorrhoea notifications at smaller geographical areas may assist public health efforts to deliver targeted STI interventions.

Methods: Routinely collected disease notification data from 2 local health districts within the greater Western Sydney area were analysed. De-identified notifications of gonorrhoea and chlamydia were extracted for people aged over 15 years during the period 1 January 2003 to 31 December 2013. Sex-specific and age-specific population notification rates for each infection were calculated. Incidence rate ratios were also calculated with age group, sex, year and local government area (LGA) of residence as explanatory variables.

Results: Rates of gonorrhoea and chlamydia increased among males and females over the period. Males had a 4-fold increased risk of gonorrhoea ($P<0.0001$). Compared with the 30–44 years age group, young people aged 15–29 years had a 70% increased risk of gonorrhoea and a 4-fold increased risk of chlamydia (P values <0.0001). Chlamydia notifications demonstrated smaller and more uniform annual increases across LGAs compared with gonorrhoea notifications, which appeared more highly clustered.

Conclusion: Analysis of notification rates of chlamydia and gonorrhoea in the greater Western Sydney area suggest that young people aged 15–29 years and residents of particular LGAs are at greater risk of infection. A limitation was the unknown effect of patterns of testing. Nevertheless, these results can support the planning of local sexual health clinical services as well as the design of targeted health promotion interventions. *Commun Dis Intell* 2017;41(2):E134–E141.

Keywords: gonorrhoea; *Neisseria gonorrhoeae, Chlamydia trachomatis;* Sydney; sexual health

Introduction

Australia has experienced a sharply increasing trend in detected cases of gonorrhoea (*Neisseria gonorrhoeae)*, particularly in men, since 2009.[1] Since chlamydia (*Chlamydia trachomatis*) became notifiable in Australia in 1999, overall rates have also increased each year until 2013, when a slight decrease was observed for the first time.[1] The increase in notification of these 2 infections over time are most likely due to multiple factors including increased screening, use of more sensitive tests to screen and diagnose as well as higher-risk sexual behaviours among subpopulations.[2]

In Australia, men who have sex with men (MSM) are a population particularly at risk of sexually transmitted infections (STIs) such as gonorrhoea, chlamydia, syphilis and HIV.[3] Since 2004, rates of unprotected anal intercourse with casual male partners have increased among MSM.[4] High rates of gonorrhoea observed in areas with large MSM populations, such as inner Sydney, support the theory that unprotected sex among MSM may be a significant driver of increased notifications.[5] A national study on gonorrhoea epidemiology demonstrated that a dual epidemic in Australia among Aboriginal people in remote areas, and non-Aboriginal men in metropolitan areas contributed substantially to the overall increase.[2] The rise in gonorrhoea notifications is especially concerning as it coincides with increasing drug resistance to currently used antimicrobials in Australia.[3]

The greater Western Sydney area is an outer metropolitan region with a population of over 2 million people, more ethnic and linguistic diversity compared with inner Sydney, and suburbs that are among the most socially disadvantaged in urban New South Wales.[6] It is unknown how cultural and behavioural factors might impact on the effectiveness of sexual health-related initiatives, especially for MSM for whom fewer specific services exist in this region compared with inner Sydney. Providing locally adapted clinical services and health promotion interventions pose unique challenges in this context.

Understanding local patterns of STI transmission can assist public health efforts to deliver targeted

interventions. An analysis was undertaken of routinely collected disease notification data from 2 local health districts within the greater Western Sydney area, Western Sydney Local Health District (WSLHD) and Nepean Blue Mountains Local Health District (NBMLHD).

WSLHD has a population of approximately 885,000 persons and covers the local government areas (LGAs) of Auburn, Blacktown, Holroyd, The Hills Shire and Parramatta. Around 43% of the WSLHD population were born overseas and 1.7% were Aboriginal or Torres Strait Islander people.[7] NBMLHD has a population of around 356,000 people and covers the LGAs of Penrith, Blue Mountains, Hawkesbury and Lithgow. Around 22% of the NBMLHD population were born overseas and 3.3% were Aboriginal or Torres Strait Islander people.[8,9]

The purpose of this study was to gain a better understanding of the population groups at greatest risk of STIs and to inform more targeted health promotion and clinical service delivery strategies. As gonorrhoea and chlamydia occur more commonly than other STIs such as syphilis and HIV, the study focussed on these 2 infections to allow meaningful analysis of trends and risk factors at the level of small geographical areas.

Methods

The Notifiable Conditions Information Management System (NCIMS) is an Internet based system used by New South Wales public health units and Health Protection NSW to register communicable disease notifications including gonorrhoea and chlamydia.[10] De-identified notifications of gonorrhoea or chlamydia were extracted from NCIMS for people aged over 15 years residing within boundaries of WSLHD or NBMLHD.

Notifications received during the 11-year period 1 January 2003 to 31 December 2013 were extracted for analysis in August 2014. Fields from the dataset included date of first notification, age, sex, Aboriginal and Torres Strait Islander status, Local Health District (LHD) of residence, LGA of residence, site of infection and laboratory testing method. If sex or age was recorded as missing the notification was excluded from further analysis. Data on sexual exposure were not routinely collected in the New South Wales database between 2003 and 2013.

Annual counts of all notifications of gonorrhoea and chlamydia were assembled separately and used to calculate sex specific population notification rates for each STI over the 11-year period of analysis. Age specific notification rates were also calculated by age group (15–29, 30–44, 45–59 and 60 years or over). Mid-calendar year resident population estimates were used in rate calculations and were obtained from the Australian Bureau of Statistics (ABS).[11]

In the absence of data on sexual exposure in the NCIMS database, annual counts of any oropharyngeal or anorectal infection of gonorrhoea or chlamydia in males were calculated and used to calculate notification rates among all males over 15 years. This was done to provide an approximate indicator of the trend in notifications specific to MSM.

The incidence rate ratio of gonorrhoea was estimated to allow comparisons by variables of interest. A Poisson regression model was fitted to gonorrhoea notification data with age group, gender, year and LGA of residence as explanatory variables. An interaction term between year and LGA was also included to account for differing trends within LGAs.

Similarly, the incidence rate ratio of chlamydia was estimated by fitting a negative binomial regression model to chlamydia notification data. A Poisson model was not suitable because of over-dispersion of the data. As with the model for gonorrhoea, age group (as above), gender, year, LGA and an interaction term of year and LGA were included as explanatory variables. Population was included as an offset. Confidence intervals (95%) were calculated for each relative risk. Indicators of goodness of fit were assessed.

Non-identified data, as defined by the Australian National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research were used for this study and ethics approval was not required. Analysis was conducted using SAS version 9.3 through SAS Enterprise Guide version 5.1.

Results

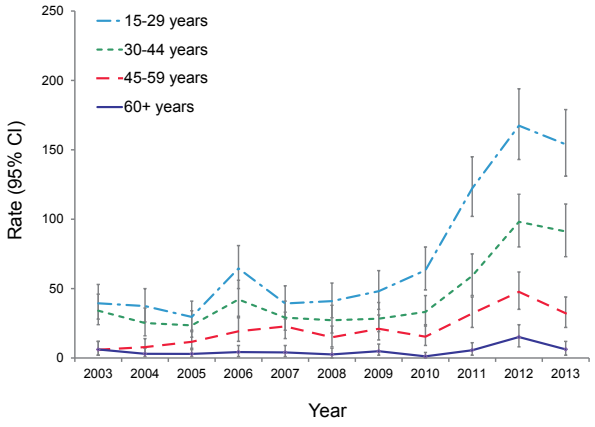
Descriptive analysis

A total of 2,513 notifications of gonorrhoea and 19,626 notifications of chlamydia were recorded among residents of WSLHD and NBMLHD between 1 January 2003 and 31 December 2013. Age or sex information was missing from 9 gonorrhoea notifications and 85 chlamydia notifications (0.4% of all notifications). These notifications were excluded from further analyses leaving a final number of 2,504 gonorrhoea notifications (80% male) and 19,541 chlamydia notifications (42% male) in the analysis.

The completeness of data on Aboriginal and Torres Strait Islander status was poor, with 56% of gonorrhoea notifications and 99% of chlamydia notifications recorded as 'unknown' or 'missing'. Data on Aboriginal and Torres Strait Islander status were therefore not included in further analysis. The greater completeness of gonorrhoea notifications can be explained by focused efforts by public health units to confirm Aboriginal and Torres Strait Islander status given the known disproportionate burden of gonorrhoea among Aboriginal and Torres Strait Islander peoples.

The rate of gonorrhoea in males showed a dramatic rise, particularly in 2011 and 2012. A steep upward trend was particularly marked in young men aged 15–29 years (Figure 1) who had a peak annual rate in 2012 of 167 per 100,000 population. There was a similar trend in females although of a lesser magnitude (Figure 2). While genitourinary infections in males accounted for the majority of notifications, there was an increasing trend in notifications of any anorectal or oropharyngeal gonorrhoea in men from 2010 (Figure 3) suggesting that transmission between MSM may account in part for the overall rise in notifications.

Figure 1: Notification rate of gonorrhoea in males, Western Sydney and Nepean Blue Mountains Local Health Districts, 2003 to 2013, by age group



Chlamydia rates steadily increased in both males and females throughout the study period although a steeper trend was evident from 2010. The highest rate and most marked increase was in females aged 15–29 years (Figure 4) followed by males aged 15–29 years (Figure 5). Anorectal or oropharyngeal chlamydia in males showed a rise from 2011 that peaked in 2012 and then slightly declined in 2013 (Figure 6).

Figure 2: Notification rate of gonorrhoea in females, Western Sydney and Nepean Blue Mountains Local Health Districts, 2003 to 2013, by age group

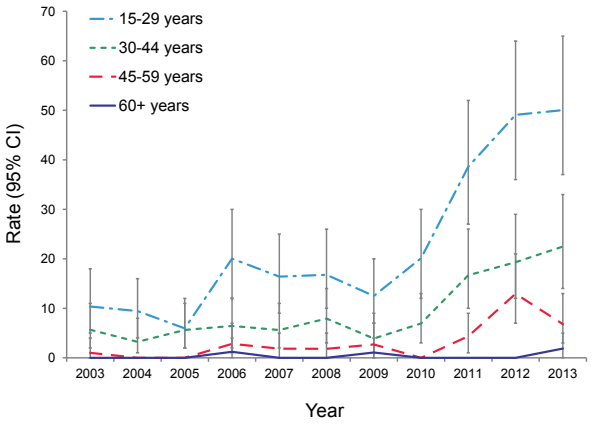


Figure 3: Notification rate of any anal, rectal oropharyngeal gonorrhoea in males, Western Sydney and Nepean Blue Mountains Local Health Districts, 2003 to 2013, by age group

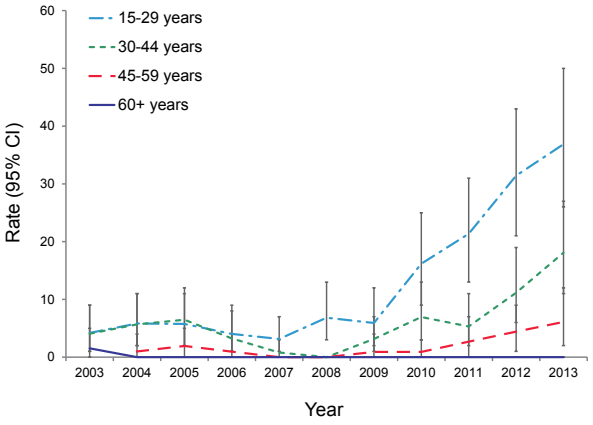


Figure 4: Notification rate of chlamydia in females, Western Sydney and Nepean Blue Mountains Local Health Districts, 2003 to 2013, by age group

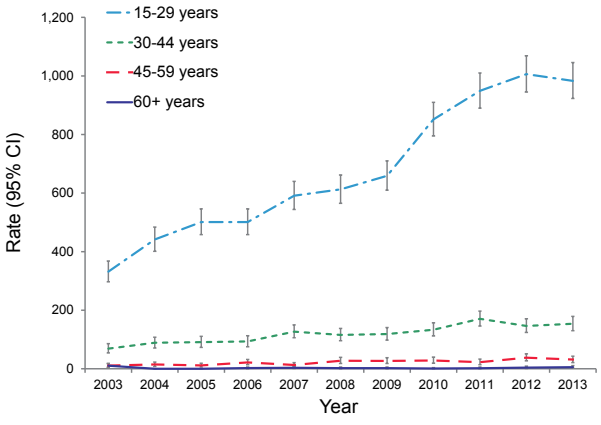


Figure 5: Notification rate of chlamydia in males, Western Sydney and Nepean Blue Mountains Local Health Districts, 2003 to 2013, by age group

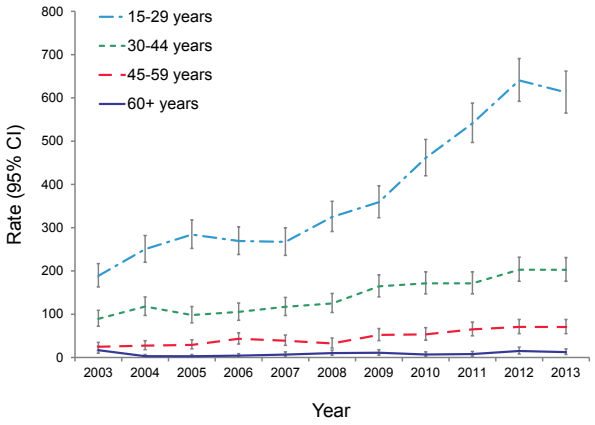
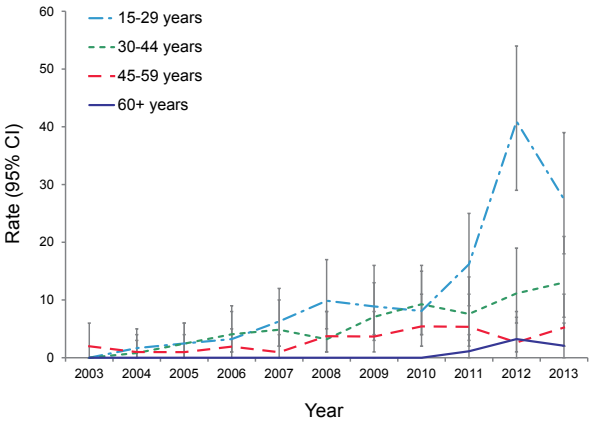


Figure 6: Notification rate of any anal, rectal oropharyngeal chlamydia in males, Western Sydney and Nepean Blue Mountains Local Health Districts, 2003 to 2013, by age group



Regression analysis

Tests for goodness of fit confirmed that the models were satisfactory for both the gonorrhoea data (scaled deviance/degrees of freedom = 1.21) and the chlamydia data (scaled deviance/degrees of freedom =1.14) (Table 1).

Controlling for age, LGA and year, males had a 4-fold increased risk of gonorrhoea ($P<0.0001$) but a reduced risk of chlamydia compared with females (IRR 0.93; $P=0.038$). Compared with those aged 30–44 years, young people aged 15–29 years had a 70% increased risk of gonorrhoea and a 4-fold increased risk of chlamydia when controlling for sex, LGA and year (P values < 0.0001).

Controlling for age and sex, the trend of gonorrhoea and chlamydia notifications by geographical area differed over the study period. Gonorrhoea notifications demonstrated a greater annual rate increase, particularly in Auburn LGA (25% per year, 95%CI 19% to 32% increase), Hawkesbury LGA (24% per year, 95%CI 16% to 33% increase), Penrith LGA (23% per year, 95%CI 19% to 27% increase) and Blacktown LGA (22% per year, 95%CI 19% to 24% increase). Chlamydia notifications demonstrated smaller and more uniform annual increases across LGAs (Table 2).

Discussion

A critical part of the public health response to STIs is to 'know the local epidemic'. This study illustrates the benefits and limitations of routinely collected data to support this aim.

The analysis demonstrates that gonorrhoea and chlamydia notification rates have increased overall and by LGA within the greater Western Sydney area. Young people aged 15–29 years and people residing in specific geographical areas appear to be at higher risk than other population groups. In addition, an analysis of data on site of infection, as a proxy measure for sexual exposure, suggests an increase in transmission between MSM. Importantly, our analysis could not provide further insight on key population groups especially Aboriginal people and Culturally and Linguistically Diverse communities, or on the influence of testing.

Table 1: Likelihood ratio statistics from regression models

Variable	Gonorrhoea			Chlamydia		
	Degrees of freedom	Chi-squared test statistic	*P*-value	Degrees of freedom	Chi-squared test statistic	*P*-value
Age	3	1495.76	<0.0001	3	1888.77	<0.0001
Sex	1	1164.5	<0.0001	1	4.12	0.0423
Local Government Area	8	108.67	<0.0001	8	130.7	<0.0001
Year	1	360.71	<0.0001	1	76.2	<0.0001
Year and Local Government Area interaction	8	51.13	<0.0001	8	57.43	<0.0001

Table 2: Association between demographic factors and gonorrhoea and chlamydia notifications

Variable	Gonorrhoea			Chlamydia		
	Rate ratio estimate	95% CI	*P* value	Rate ratio estimate	95% CI	*P* value
Sex						
Female	ref	ref	ref	ref	ref	ref
Male	3.98	3.63,4.36	<0.0001	0.93	0.87,0.99	0.038
Age						
15–29	1.71	1.59,1.84	<0.0001	3.92	3.65,4.2	<0.0001
30–44	ref	ref	ref	ref	ref	ref
45–59	0.47	0.41,0.52	<0.0001	0.27	0.25,0.3	<0.0001
60+	0.11	0.08,0.14	<0.0001	0.043	0.04,0.05	<0.0001
Local Government Area trend (per year)						
Blacktown	1.22	1.19,1.24	<0.0001	1.11	1.09,1.14	<0.0001
Auburn	1.25	1.19,1.32	<0.0001	1.12	1.08,1.15	<0.0001
Baulkham Hills	1.18	1.13,1.22	<0.0001	1.11	1.08,1.14	<0.0001
Blue Mountains	1.16	1.07,1.25	<0.0001	1.07	1.03,1.10	<0.0001
Hawkesbury	1.24	1.16,1.33	<0.0001	1.14	1.10,1.18	<0.0001
Holroyd	1.14	1.10,1.19	<0.0001	1.12	1.09,1.16	<0.0001
Lithgow	0.86	0.73,1.02	0.08	1.16	1.11,1.22	<0.0001
Parramatta	1.13	1.11,1.16	<0.0001	1.02	0.99,1.05	0.09
Penrith	1.23	1.19,1.27	<0.0001	1.15	1.11,1.18	<0.0001

Ref. = Reference group for negative binomial regression analysis

Previous studies exploring the spatial epidemiology of STIs identified gonorrhoea as the most highly clustered infection.[12,13] It has been suggested that the phase of the STI epidemic (growth, hyperendemic, decline or endemic) in conjunction with the density of the sexual network is associated with the geographical distribution of disease.[14] Incorporating geographical surveillance into routine STI surveillance has been proposed as an important tool in being able to implement geography-specific and phase-specific STI control strategies.[13] Our results support previous studies that identify gonorrhoea as having a more highly clustered geographical transmission pattern than chlamydia, and revealed particular LGAs in the greater Western Sydney area where the annual rate increase in gonorrhoea notifications was particularly high among residents (Auburn, Hawkesbury, Penrith and Blacktown). Further investigation is required to understand the higher rates of increase observed in these LGAs.

This study, using routinely collected administrative data, was limited by the lack of detailed data on characteristics to identify specific population groups of interest. Chlamydia and gonorrhoea notifications in New South Wales are notifiable by laboratories only and therefore demographic and risk factor information such as Aboriginal and Torres Strait Islander status, country of birth or sexual exposure is not routinely collected. We found poor recording of Aboriginal and Torres Strait Islander status in the data, which is an area that should be targeted for improvement given the known higher risk of both infections among Aboriginal and Torres Strait Islander peoples.

Given the particular concern around increasing STI rates among MSM, we analysed trends in notifications of any anorectal or oropharyngeal infections of gonorrhoea or chlamydia in males as a proxy measure for notifications among MSM. A steep rise, beginning in 2010 for gonorrhoea notifications and 2011 for chlamydia notifications, suggest that transmission between MSM may account in part for the overall rise in notifications.

Increasing notification rates of chlamydia or gonorrhoea could be explained by a true increase in incidence or by improved detection of cases through higher testing rates. Social marketing campaigns promoting testing may have contributed to increased testing and an associated increase in notifications although no campaign evaluation outcomes are available to assess if this occurred. In 2009, the New South Wales campaign 'Get tested, play safe' was launched and subsequently repeated in 2011. The campaign had a particular

focus on encouraging young people to test.[15] The Commonwealth government also had national campaigns in 2009 and 2010 encouraging people to get tested.[16]

Improved access to sexual health services in the greater Western Sydney area may have also resulted in increased notifications. However, there is no indication of significant local changes over the study period such as the opening of new sexual health clinics, improved general practitioner awareness or markedly changed STI testing guidelines that could explain the steep rise.

Notifications of chlamydia are particularly influenced by testing rates as infections are often asymptomatic. A study that analysed testing-adjusted chlamydia notification rates between 2000 and 2010 found that increased testing drove the increase in notifications in New South Wales over the period and that there was no evidence of a true increase in the prevalence of chlamydia.[17] In contrast, other analyses of Australian data have suggested that chlamydia prevalence modestly increased over a similar period among at-risk populations tested in sentinel clinics.[18,19] While the importance of interpreting notifications in the context of testing data including positivity rates is well recognised, data have not always been available to allow this to occur.

In New South Wales, the routine reporting of laboratory testing data commenced in January 2012 for selected notifiable conditions including chlamydia and gonorrhea.[20] This was an important step towards understanding state-wide notification trends. As a next step, more detailed testing data that would allow analysis of patterns of testing in subpopulations and geographical areas would be of value to enable STI transmission dynamics to be better understood.

Over the study period, nucleic acid amplification tests (NAAT) for gonorrhoea became more widely used to detect infections in non-genitourinary sites.[21–24] NAAT has greater sensitivity than culture,[25,26] and its increasing use may therefore have partly contributed to the overall increase in notifications. Furthermore, as NAAT for gonorrhea and chlamydia is a combined test, incidental findings of 1 infection when testing for the other may also have a role in the overall increase in notifications. However the extent to which this may affect notification rates is unclear.[27]

Finally, it is possible that over the study period there was a change in the profile of the population such that high-risk groups made up a greater proportion of the overall population in the Western Sydney area. However, similar trends across other regions of New South Wales suggest that these results are not explained by a shift in population demographics.[4]

This study suggests that within the greater Western Sydney area there are population groups at greater risk of STIs based on age, sex and place of residence. The apparent clustering of gonorrhoea notifications among residents of particular LGAs requires further investigation. Poor health literacy in relation to STI prevention and treatment among particular community groups, poor health seeking behaviour or inadequate training of local general practitioners may be contributing factors to be explored and addressed.

Surveillance systems should continue to be enhanced to combine testing data with more detailed geographic, demographic and sexual exposure data to obtain a clearer picture of local transmission dynamics. Improved recording of Aboriginal and Torres Strait Islander status is particularly important. This can inform timely health promotion strategies aimed at specific population groups and also support clinical services through targeted outreach programs and engagement with general practitioners.

Improving access to testing is important to diagnose and treat STIs early, especially for MSM of whom less than half currently receive comprehensive testing as recommended by guidelines.[28] In addition to traditional clinic-based services, novel approaches such as outreach initiatives show encouraging results in reaching high-risk populations.[29] Clinic-based and outreach services should continue to explore ways to improve their accessibility and acceptability, particularly by the culturally diverse community groups living in greater Western Sydney.

In conclusion, a better understanding of local STI epidemiology, including testing rates, is an important tool in the planning of clinical sexual health services and in the design of local health promotion interventions adapted to populations at greatest risk.

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