EPIREVIEW

MENINGOCOCCAL DISEASE IN NEW SOUTH WALES, 1991–2002

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BACKGROUND

Meningococcal disease is caused by invasive infection with the bacteria *Neisseria meningitidis*. Humans are the only natural reservoir for *N. meningitidis*, 5–10 per cent of whom have naso-pharangeal colonisation of the bacteria at any given time.[1] The bacteria are transmitted between people by secretions from the naso-pharynx. Disease occurs in rare instances when a virulent strain of the bacteria invades through the naso-pharynx. Disease can present in a variety of syndromes, usually meningitis and/or septicaemia, and more uncommonly pneumonia, otitis media, septic arthritis, urethritis, and purulent pericarditis.[1]

N. meningitidis can be classified into serogroups, with serogroups B and C the most commonly reported in developed countries.[1,2,3] Risk factors for developing meningococcal disease include: close contact with a case; age, in particular early childhood or early adulthood; the seasons of winter and early spring; exposure to tobacco smoke; overcrowding; the immunosuppressive effect of preceding viral infections; and exposure to environmental dust.[1,4,5]

In NSW, laboratories and hospitals are required by law to notify cases of meningococcal infection to public health units (PHUs). The staff of PHUs investigate cases to identify close contacts and provide advice and prophylaxis according to national guidelines.[2] PHU staff enter data about cases into a statewide database for notifiable diseases, which is maintained by the NSW Department of Health. The Australian Meningococcal Surveillance Programme collates data from the notifications from all states and territories, and reports their findings annually.[14]

Meningococcal C vaccines have been licensed for use in Australia since early 2002. In October 2002, the Commonwealth Department of Health and Ageing announced funding over a four-year period for a national Meningococcal C Vaccination Program, commencing in early 2003, for all people 1–19 years of age.[6] In September 2003, the National Health and Medical Research Council recommended the introduction of routine meningococcal C vaccination of all children at 12 months of age.[7]

In 1999, the United Kingdom was the first country to introduce a large-scale national immunisation program for serogroup C meningococcal disease. At the time, concerns were raised regarding the potential effects of decreasing the incidence of serogroup C, and the potential for 'serogroup switching' by the bacteria, thereby causing an increase in serogroup B infections. However, subsequent studies have not shown a significant increase in 'serogroup switching', in the United Kingdom or elsewhere.[8,9]

Establishing the endemic incidence of meningococcal disease in NSW, prior to the introduction of the national vaccination program, will allow future analysis of changes in meningococcal epidemiology, and to detect potential trends in the incidence of various serogroups. The epidemiology of meningococcal disease notifications in NSW between 1991 and 1999 has previously been reviewed.[10] This article presents previously unpublished findings for that period, as well as a comparison with meningococcal disease notifications for the years 2000–2002.

METHODS

In NSW, a case of meningococcal disease is defined according to national guidelines.[2] Case definitions changed in the late 1990s, with the acceptance of nucleic acid test methods and serology as evidence of infection. We analysed data for cases of meningococcal disease from the statewide database for the years 1991 to 2002.[11] The characteristics of cases notified for the years 2000, 2001, and 2002 were compared with cases notified for the period between 1991–1999.

Cases were analysed by year of onset, place of residence, gender, age group, indigenous status, disease syndrome (meningitis–septicaemia), serogroup, disease outcome, and diagnostic method. The analysis for the age of cases reflected the anticipated distribution of the disease in the population. Consequently, cases aged less than five years were analysed by year of age, cases aged between 5–24 years in 5-year age bands, cases aged between 25–64 in 20-year age bands, and the remainder of the population 65 years and over were included in one age group. Place of residence was categorised by the 'Greater Sydney' area health services and the 'Rural NSW' area health services. The Greater Sydney category covered all the major urban areas in NSW and included the Sydney and Central Coast Area Health Services, and the Hunter and Illawarra Area Health Services. Factors associated with the death of cases were examined, but this examination was restricted to notifications between 1997 and 2002 because the data was not complete for preceding years.

Descriptive analysis was performed using the statistical programs SAS and Microsoft Excel 2000 Version 9. The relative risk of death was calculated for the period 1997

TABLE 1

CHARACTERISTICS OF CASES NOTIFIED WITH MENINGOCOCCAL DISEASE, NSW, FOR THE YEARS 2000, 2001, AND 2002, COMPARED WITH 1991–1999

Case characteristics	1991–1999 Cases	% total	Rate per 100,000	Deaths	Case Fatality Rate	2000 Cases	% total	Rate per 100,000	Deaths	Case Fatality Rate	2001 Cases	% total	Rate per 100,000	Deaths	Case Fatality Rate	2002 Cases	% total	Rate per 100,000	Deaths	Case Fatality Rate	Total (1991–2002) Cases	% total	Rate per 100,000	Deaths	Case Fatality Rate
Residence																									
Greater Sydney Area*	754	(52.5)	3.5	51	(6.8)	146	(58.9)	3.8	8	(5.5)	129	(56.1)	3.3	3	(2.3)	126	(58.6)	3.2	10	(7.9)	1155	(54.2)	3.2	72	(6.2)
Rural NSW	664	(46.2)	3.2	37	(5.6)	101	(40.7)	3.8	6	(5.9)	101	(43.9)	3.8	4	(4.0)	87	(40.5)	3.2	9	(10.3)	953	(44.7)	3.2	56	(5.9)
Unknown	19	(1.3)	.	1	(5.2)	1	(0.4)	.	0.0	0.0	.					2	(0.9)	.	0.0		22	(1)	1	1	(4.5)
Sex																									
Male	773	(53.8)	2.5	54	(7.0)	138	(55.6)	4.3	3	(2.2)	111	(48.3)	3.4	5	(4.5)	123	(57.2)	3.8	12	(9.8)	1145	(53.8)	3.1	82	(7.2)
Female	663	(46.0)	2.1	35	(5.3)	110	(44.3)	3.4	11	(10.0)	119	(51.7)	3.6	2	(1.7)	91	(42.3)	2.7	7	(7.7)	983	(46.2)	2.6	47	(4.8)
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	(0.5)	0.0	0.0	2	(0.1)	0.0	0.0								
Aboriginal or Torres Strait Islander																									
Indigenous	76	(5.3)	7.0	5	(6.6)	8	(3.2)	6.7	0.0		9	(3.9)	7.5	0.0		15	(7.0)	12.5	0.0		108	(5.1)	7.5	5	(4.6)
Non-indigenous	1361	(94.7)	2.3	84	(6.2)	240	(96.8)	3.7	14	(5.8)	221	(96.1)	3.4	7	(3.2)	200	(93.0)	3.1	19	(9.5)	2022	(95.0)	2.6	124	(6.1)
Age group (years)																									
<1	253	(17.6)	29.1	17	(6.7)	28	(11.3)	32.8	1	(3.6)	37	(16.1)	43.4	2	(5.4)	23	(10.7)	27.0	2	(8.7)	341	(16)	39.2	22	(6.5)
1	186	(12.9)	21.3	8	(4.3)	16	(6.5)	18.8	1	(6.25)	15	(6.5)	17.6	0.0		12	(5.6)	14.1	1	(8.3)	229	(10.8)	26.3	10	(4.4)
2	89	(6.2)	10.2	4	(4.5)	12	(4.8)	14.1	1	(8.3)	8	(3.5)	9.4	0.0		11	(5.1)	12.9	0.0		120	(5.6)	13.7	5	(4.2)
3	56	(3.9)	6.4	3	(5.3)	10	(4.0)	11.5	1	(10)	4	(1.7)	4.6	0.0		9	(4.2)	10.3	0.0		79	(3.7)	9.0	4	(5.1)
4	55	(3.8)	6.3	2	(3.6)	7	(2.8)	8.0	0.0		7	(3.0)	8.0	0.0		2	(0.9)	2.3	0.0		71	(3.3)	8.1	2	(2.8)
Total <5	639	(44.5)	14.6	34	(5.3)	73	(29.4)	16.9	4	(5.5)	71	(30.9)	16.8	2	(2.8)	57	(26.5)	13.6	0.0		840	(39.4)	16.1	43	(5.1)
5–9	103	(7.2)	2.4	8	(7.8)	23	(9.3)	5.2	1	(4.3)	17	(7.4)	3.8	1	(5.9)	23	(10.7)	5.2	2	(8.7)	166	(7.8)	3.2	12	(7.2)
10–14	87	(6.1)	2.1	14	(16.1)	17	(6.9)	3.8	0.0		16	(7.0)	3.6	0.0		21	(9.8)	4.7	1	(4.8)	141	(6.6)	2.7	1	(0.7)
15–19	224	(15.6)	5.2	4	(1.8)	53	(21.4)	11.9	3	(5.7)	26	(11.3)	5.8	1	(3.8)	41	(19.1)	9.2	2	(4.9)	344	(16.2)	6.6	20	(5.8)
20–24	105	(7.3)	2.3	11	(10.5)	26	(10.5)	5.8	1	(3.8)	21	(9.1)	4.7	1	(4.8)	20	(9.3)	4.4	2	(10)	172	(8.1)	3.1	8	(4.7)
25–44	135	(9.4)	0.7	10	(7.4)	33	(13.3)	1.7	3	(9.1)	51	(22.2)	2.6	1	(2)	27	(12.6)	1.4	4	(14.8)	246	(11.5)	1.1	19	(7.7)
45–64	77	(5.4)	0.6	10	(13.0)	19	(7.7)	1.3	2	(10.5)	19	(8.3)	1.2	0.0		17	(7.9)	1.1	4	(23.5)	132	(6.2)	0.8	16	(12.1)
65+	67	(4.7)	0.9	8	(12.0)	4	(1.6)	0.5	0.0		9	(3.9)	1.1	1	(11.1)	9	(4.2)	1.1	1	(11.1)	89	(4.2)	0.9	10	(11.2)
Syndrome																									
Meningitis	771	(53.7)	1.2	27	(3.5)	108	(43.5)	1.7	4	(3.7)	82	(35.7)	1.3	0.0		71	(33.0)	1.1	3	(4.2)	1032	(48.5)	1.4	34	(3.3)
Septicaemia	403	(28.0)	0.7	50	(12.4)	56	(22.6)	0.9	9	(16.1)	77	(33.5)	1.2	5	(6.5)	117	(54.4)	1.8	15	(12.8)	681	(32)	0.9	79	(11.6)
Unspecified	263	(18.3)	0.4	12	(4.6)	84	(33.9)	1.3	1	(1.2)	71	(30.9)	1.1	2	(2.8)	27	(12.6)	0.4	1	(3.7)	417	(19.6)	0.6	16	(3.8)
Serogroup																									
Serogroup B	279	(19.4)	0.5	18	(6.5)	93	(37.5)	1.4	6	(6.5)	91	(39.6)	1.4	2	(2.2)	104	(48.4)	1.6	8	(7.7)	567	(26.6)	0.8	34	(6.0)
Serogroup C	231	(16.1)	0.4	20	(8.7)	64	(25.8)	1.0	4	(6.3)	38	(16.5)	0.6	5	(13.2)	53	(24.7)	0.8	10	(18.9)	386	(18.1)	0.5	39	(10.1)
Serogroup W135	11	(0.8)	0.0	1	(9.1)	4	(1.6)	0.1	0.0		1	(0.4)	0.0	0.0		1	(0.5)	0.0	0.0		17	(0.8)	0.0	1	(5.9)
Serogroup Y	11	(0.8)	0.0	1	(9.1)	7	(2.8)	0.1	1	(14.3)	2	(0.9)	0.0	0.0		2	(0.9)	0.0	0.0		22	(1.0)	0.0	2	(9.1)
Serogroup Unknown	905	(63.0)	1.5	49	(5.4)	80	(32.3)	1.2	3	(3.8)	98	(42.6)	1.5	0.0		55	(25.6)	0.8	1	(1.8)	1138	(53.4)	1.5	53	(4.7)
Method of Detection																									
Clinically	67	(4.7)	0.1	4	(6.0)	17	(6.9)	0.3	1	(5.9)	32	(13.9)	0.5	0.0		21	(9.8)	0.3	1	(4.8)	137	(6.4)	0.2	6	(4.4)
Culture	638	(44.4)	1.2	47	(7.4)	98	(39.5)	1.5	7	(7.1)	84	(36.5)	1.3	6	(7.1)	97	(45.1)	1.5	11	(11.3)	918	(43.1)	1.2	71	(7.7)
Microscopy	79	(5.5)	0.1	3	(3.8)	15	(6.0)	0.2	0.0		9	(3.9)	0.1	1	(11.1)	14	(6.5)	0.2	1	(7.1)	117	(5.5)	0.2	4	(3.4)
PCR	35	(2.4)	0.0	2	(5.7)	38	(15.3)	0.6	2	(5.6)	30	(13.0)	0.5	0.0		43	(20.0)	0.7	5	(11.6)	146	(6.9)	0.2	9	(6.2)
Serology	106	(7.4)	0.2	10	(9.4)	48	(19.4)	0.7	2	(4.2)	67	(29.1)	1.0	0.0		31	(14.4)	0.5	1	(3.2)	251	(11.8)	0.3	13	(5.2)
Unknown	489	(34.0)	0.9	22	(4.5)	24	(9.7)	0.4	2	(8.3)	6	(2.6)	0.1	0.0		7	(3.6)	0.1	0.0		526	(24.7)	0.7	25	(4.8)
Antigen detected	22	(1.5)	0.0	1	(4.5)	7	(2.8)	0.1	0.0		2	(0.9)	0.0	0.0		2	(0.9)	0.0	0.0		33	(1.5)	0.0	1	(3.0)
Total	**1437**		**2.6**	**89**	**(6.2)**	**248**		**3.8**	**14**	**(5.6)**	**230**		**3.5**	**7**	**(3.0)**	**215**		**3.3**	**19**	**(8.8)**	**2130**		**2.8**	**129**	**(6.1)**

Notes: * For purposes of this analysis Greater Sydney includes the Sydney and Central Coast Area Health Services and the Illawarra and Hunter Area Health Services.

Source: Communicable Diseases Branch, NSW Notifiable Diseases Database (HOIST). Centre for Epidemiology and Research, NSW Department of Health.

to 2002 using the epidemiological software Epi Info version 6.04d. We used the Health Outcomes Information Statistical Toolkit (HOIST), maintained by the Centre for Epidemiology and Research of the NSW Department of Health, to calculate crude incidence rates using Australian Bureau of Statistics year-specific mid-year population data for NSW,[11] and rates for Aboriginal and Torres Strait Islander people using Australian Bureau of Statistics population estimates for 2001.[12] For cases aged less than five years, crude incidence rates for 2001 and 2002 were calculated using mid-year population estimates for the year 2000.[11]

RESULTS

Incidence

From 2000 to 2002, 693 cases of meningococcal disease were notified, which represents an average of 231 cases per year and a crude incidence rate of 3.5 per 100,000 people. This incidence is considerably higher than for the previous study period (1991 to 1999), when an average of 160 cases (2.6 per 100,000) were notified each year (Tables 1 and 2). Annual peaks of notifications occurred consistently during winter and spring (Figure 1).

Serogroup

From 2000 to 2002 serogroup B notifications were almost twice as common as serogroup C; the incidence of serogroup B was 1.5 cases per 100,000 population (*n*=288) and for serogroup C incidence was 0.8 per 100,000 (*n*=155). These rates are higher than for the previous study period 1991–1999 (Table 1). The proportion of meningococcal disease notifications due to an unknown serogroup was substantially lower in 2000–2002 (34 per cent of cases) than for 1991–1999 (63 per cent of cases).

TABLE 2

NOTIFICATIONS OF MENINGOCOCCAL DISEASE, NSW, BY YEAR 1991–2002, ANNUAL AVERAGE RATE, AND CASE FATALITY RATE

Year	Cases	% total	Average annual rate per 100,000	Deaths	Case fatality rate
1991	128	6.0	2.2	3	2.3
1992	122	5.7	2.0	8	6.6
1993	153	7.2	2.5	11	7.2
1994	142	6.7	2.3	15	10.6
1995	113	5.3	1.8	7	6.2
1996	161	7.6	2.6	7	4.3
1997	219	10.3	3.5	7	3.2
1998	184	8.6	2.9	17	9.2
1999	215	10.1	3.4	14	6.5
2000	248	11.6	3.8	14	5.6
2001	230	10.8	3.5	7	3.0
2002	215	10.1	3.3	19	8.8
Total	**2130**		**2.8**	**129**	**6.1**

Source: Communicable Diseases Branch, NSW Notifiable Diseases Database (HOIST). Centre for Epidemiology and Research, NSW Department of Health.

Age and Serogroup

From 2000 to 2002, the highest notification rates occurred in children aged less than one year (34.4 per 100,000). In the same period, children aged 1–4 years had an annual average rate of 11.0 per 100,000 people and adolescents 15–19 years had an annual average rate of 9.0 per 100,000. From 1991 to 1999 the age distribution of cases was similar.

Between 2000–2002, the highest notification rates of serogroup B meningococcal disease were in children less than one year of age (16.4 per 100,000 people), children 1–4 years of age (6.4 per 100,000), adolescents 15–19 years of age (3.2 per 100,000), and young adults 20–24 years of age (2.1 per 100,000). Serogroup C notification rates during the same period were highest in children less than one year of age (4.7 per 100,000), adolescents 15–19 years of age (3.5 per 100,000), children 1–4 years of age (2.3 per 100,000) and young adults 20–24 years of age (1.0 per 100,000). Between 1991–1999, notification rates for both serogroup B and C were highest in children less than one year of age (7.1 and 1.7 per 100,000 respectively).

Sex

In 2000–2002, 54 per cent of notifications were male, this was similar to the previous study period (1991–1999).[10]

Place of residence

In rural NSW, for 2000–2002, the rate of meningococcal disease notifications (3.4 per 100,000 people) was similar to that for Greater Sydney (3.5 per 100,000 people). In rural NSW between 1991–1999, the notification rate was slightly higher (2.9 per 100,000) than in Greater Sydney (2.3 per 100,000).

Aboriginal and Torres Strait Islanders

The annual average rate of meningococcal disease notifications among Aboriginal and Torres Strait Islander people was 8.9 per 100,000 in 2000–2002, compared with 7.0 per 100,000 in 1991–1999. Almost half of the notifications in 2000–2002 were serogroup B (*n*=15), 25 per cent were serogroup C (*n*=8), and the remaining cases were due to an unspecified serotype.

Diagnostic method

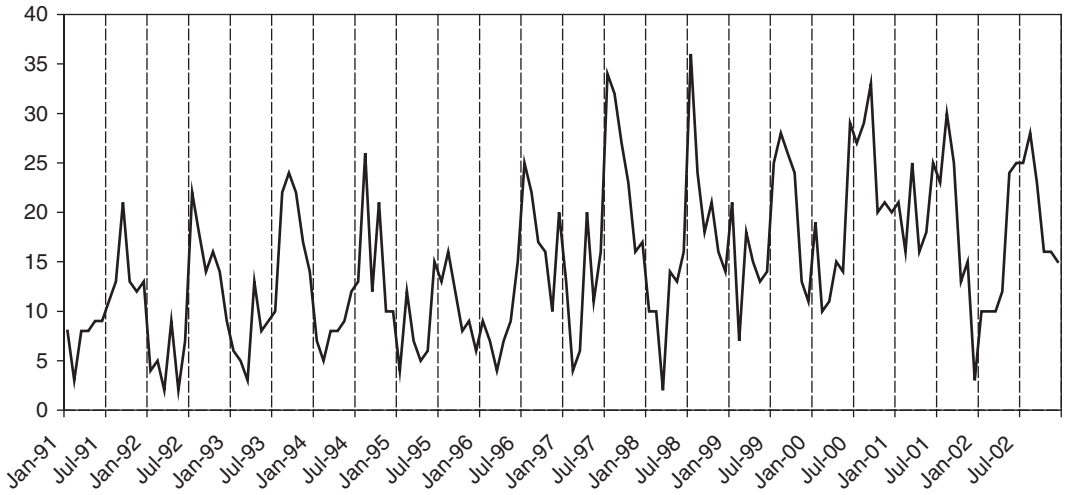
Laboratory confirmed cases comprised 84 per cent (*n*=585) of all notifications between 2000–2002, and 61 per cent (*n*=880) in 1991–1999. Bacterial culture remains the most common laboratory method used to diagnose the disease, with the use of serological and nucleic acid (for example, polymerase chain reaction or PCR) techniques steadily increasing in recent years (Table 1).

Syndrome

In 2000–2002, 38 per cent of cases (*n*=262) were reported to have meningitis, 40 per cent septicaemia (*n*=280) and for 22 per cent (*n*=151) the nature of their presentation was not specified. Overall, septicaemia was the most

FIGURE 1

NUMBER OF NOTIFICATIONS OF MENINGOCOCCAL DISEASE BY MONTH OF ONSET, NSW, 1991–2002



Source: Communicable Diseases Branch, NSW Notifiable Diseases Database (HOIST). Centre for Epidemiology and Research, NSW Department of Health.

Notes: For purposes of this analysis Greater Sydney includes the Sydney and Central Coast Area Health Services and the Illawarra and Hunter Areas Health Services.

common presentation for cases less than 15 years of age (46 per cent), above 65 years of age (55 per cent), and in males (43 per cent). Meningitis was the most common syndrome for cases between 15 and 64 years of age (42 per cent). The incidence of meningitis and septicaemia in serogroup B disease was similar. Septicaemia was the most common presentation in serogroup C disease, occurring in 48 per cent (*n*=75) of reported cases, compared to 32 per cent (*n*=49) with meningitis.

DEATHS

Incidence

Between 2000–2002, 40 deaths due to meningococcal disease were reported, which represents 5.8 per cent of all cases for this period. There were no deaths reported of indigenous cases. The proportion of cases that died was generally higher in: males; older adults; those from rural NSW; cases with serogroup C infections; and cases with septicaemia (Table 1).

Between 1997–2002, there were no significant associations between the death of cases, and their sex or place of residence. However, death was significantly associated with septicaemia (RR: 2.8; CI: 1.7–4.7), serogroup C meningococcal infection (RR: 2.7; CI: 1.6–4.4), and increasing age. Cases aged between 45–64 years were more than twice as likely to die than cases in other age groups (RR: 2.3; CI: 1.3–4.1).

DISCUSSION

In NSW between 2000–2002, meningococcal disease remained uncommon, occurring most frequently in young children and adolescents. Meningococcal disease due to serogroup B infection was twice as common as serogroup C infection. The age-distributions for cases with serogroups B and C infections were largely similar, although serogroup B was the most common strain causing disease in very young children. Approximately six per cent of the cases die from their illness, and the case fatality rate tends to be higher in males, cases presenting with septicaemia, older adults, and cases of serogroup C infection.

The overall number of notifications of meningococcal disease in NSW has increased from 1991 to 2002. The reasons for the increase in incidence have not been established, however it is likely that factors such as increased case ascertainment and reporting by clinicians, and increasingly sensitive laboratory tests, may have played a role.

The completeness of notification data contained in the statewide database for notifiable diseases has increased substantially in recent years. The increase in the notification rate for Aboriginal and Torres Strait Islander people may also be, in part, due to the increasing completeness of data describing the indigenous status of cases.

Notification data for meningococcal disease are limited in their scope. Information describing the various risk factors associated with developing disease is not collected. A close correlation between notification and hospitalisation data suggests that notifications are a good estimate of incidence since the degree of underreporting of cases is very low.[10]

The epidemiology of meningococcal disease in Australia has been described previously,[13] and the national surveillance program reports annually.[14] Perhaps the most notable difference between NSW and several other Australian states is that meningococcal B disease is the most common presentation in NSW.[14]

Exposure to tobacco smoke has been identified as a risk factor for developing meningococcal disease, and may play a role in a third of cases.[4] While reducing exposure to tobacco smoke is an effective public health strategy to control the incidence of meningococcal disease, vaccination is likely to have a more immediate affect. The ongoing identification and reporting of the serogroups responsible for meningococcal disease cases by the surveillance system is of particular importance following the introduction of meningococcal C immunisations. Ongoing monitoring of the epidemiology of the disease is essential to measure the effectiveness of the vaccination program, and to detect any trends in capsular switching that may be promoted, which may increase the incidence of serogroup B notifications.

NSW has begun an enhanced surveillance program for meningococcal disease. This program seeks to improve the completeness and quality of the case data, and collect data on a wider range of risk factors and outcomes than previously gathered.

Early diagnosis and treatment is thought to reduce the risk of death. However, the data available for this analysis are limited, and likely to represent the experience of the severe end of the disease spectrum. More detailed investigations would assist the interpretation of these findings, such as enhanced surveillance to determine the influence of known risk factors and the spectrum of disease severity. Describing the long-term sequelae of meningococcal disease for patients may increase our understanding of the affect of this disease on the NSW population.

CONCLUSION

This study used surveillance data to describe the epidemiology of meningococcal disease in NSW, and to identify groups at increased risk of infection and mortality. Surveillance data can be used to compare the epidemiology of meningococcal disease before and after the introduction of the meningococcal C vaccination program.

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