Annual report of the Australian Meningococcal Surveillance Programme, 2011

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Abstract

In 2011, there were 241 laboratory-confirmed cases of invasive meningococcal disease (IMD) analysed by the National Neisseria Network, which represented 100% of cases notified to the National Notifiable Diseases Surveillance System. One hundred and twenty-five isolates of *Neisseria meningitidis* from invasive cases of meningococcal disease were available for which the phenotypes (serogroup, serotype and serosubtype) and/or genotype and antibiotic susceptibility were determined. An additional 116 cases were confirmed by non-culture based methods (95 by nucleic acid amplification testing (NAAT) and 21 by serology), and where possible, serotyping was determined. Nationally, 179 (83.6%) laboratory-confirmed cases, where a serogroup was determined, were infected with serogroup B; 9 (4.2%) with serogroup C; 11 (5.2%) with serogroup W135 and 15 (7%) with serogroup Y meningococci. In 2011 there was a modest increase in the number of cases of IMD notified from that reported in 2010 (214). However, with the exception of 2010, this was the lowest number of laboratory confirmed IMD cases since surveillance data were recorded. Primary and secondary disease peaks were observed in those aged 4 years or less and in adolescents (15–19 years) and young adults respectively (20–24 years). There was also a disease peak observed in those aged 45–64 years. Serogroup B cases predominated in all age groups and jurisdictions. In 2011, the most common phenotype circulating in Australia was B:4:P1.7, corresponding to the *porA* genotype P1.7,2-4. Serogroup C cases were again numerically low, as were serogroups W135 and Y, however there was an increase in incidence of serogroup Y cases (7 in 2010, 15 in 2011). The proportion of isolates with decreased susceptibility to the penicillin group of antibiotics minimal inhibitory concentration (MIC) (0.06 to 0.5 mg/L) was 84.6% and 1 isolate exhibited relative resistance to penicillin (MIC = 1.0 mg/L). All isolates remained susceptible to ceftriaxone and ciprofloxacin. One isolate had reduced susceptibility to rifampicin (MIC = 0.5 mg/L). *Commun Dis Intell* 2012;36(3):E251–E262.

Keywords: antibiotic resistance; disease surveillance; meningococcal disease; *Neisseria meningitidis*

Introduction

The National Neisseria Network (NNN) is a long-term collaborative program for the laboratory surveillance of the pathogenic *Neisseria* species: *Neisseria meningitidis* and *Neisseria gonorrhoeae*. Since 1994 the NNN has operated through a network of reference laboratories in each state and territory to provide a national laboratory-based program for the examination of *N. meningitidis* from cases of invasive meningococcal disease (IMD).[1] The NNN supplies data on the phenotype and/or the genotype of invasive meningococci, and their antibiotic susceptibility, supplementing clinical notification data from the National Notifiable Diseases Surveillance System (NNDSS). The NNN receives samples for analysis from about 90% (range 85%–100% 2004–2011) of IMD cases notified to NNDSS.[2] The NNN annual reports are published in *Communicable Diseases Intelligence*.[3]

The characteristics of the meningococci responsible for IMD are important both for individual patient management and to tailor the public health response for outbreaks or case clusters locally and nationally. The introduction of publicly funded conjugate serogroup C meningococcal vaccine to the National Immunisation Program in 2003 (with a catch-up program for those aged 1–19 years that ran until May 2007) has seen a significant and sustained reduction in the number of cases of IMD evident after 2004.[2] However, IMD remains an issue of public health concern in Australia. The success of any further vaccine initiatives in Australia is dependent upon detailed analysis of the *N. meningitidis* isolates circulating locally. This report provides relevant details of cases of IMD confirmed by laboratory testing in Australia in 2011.

Methods

Isolate based invasive meningococcal disease cases

Case confirmation

Case confirmation was based upon isolation of, or positive nucleic acid amplification testing (NAAT) for, *N. meningitidis* from a normally sterile site; or by positive serology, and defined as IMD according to Public Health Laboratory Network criteria.[4]

Information on the site of infection, the age and sex of the patient and the outcome (survived/died) of the infection was sought. The isolate-based subset of the program categorised cases on the basis of site of isolation of the organism. Where an isolate was grown from both blood and cerebrospinal fluid (CSF) cultures in the same patient, the case was classified as one of meningitis. It is recognised that the total number of cases, and particularly the number of cases of meningitis, is underestimated because no lumbar puncture was performed, or was delayed and the culture was sterile. However; the above approach has been used since the beginning of this program[1] and is continued for comparative purposes.

Phenotyping and genotyping

Phenotyping of invasive isolates of meningococci by serotyping and serosubtyping was based on the detection of outer membrane protein (porin) antigens using a standard set of monoclonal antibodies obtained from The Netherlands National Institute for Public Health. Increasingly, sequencing of products derived from amplification of the porin genes *porA, porB* and *FetA* (genotyping) is used to supplement and supplant meningococcal serotyping analyses based on the use of monoclonal antibodies.

Antibiotic susceptibility

Antibiotic susceptibility was assessed by determining the MIC to antibiotics used for therapeutic and prophylactic purposes. This program uses the following parameters to define the various levels of penicillin susceptibility or resistance when determined by a standardised agar plate dilution technique:[5]

Sensitive: MIC ≤ 0.03 mg/L

Less sensitive: MIC 0.06–0.5 mg/L

Relatively resistant: MIC ≥ 1 mg/L

Strains with MIC values that place them in the category of sensitive or less sensitive would be considered to be amenable to penicillin therapy when used in currently recommended doses. However precise the MIC, outcome correlations are difficult to obtain because of the nature of IMD.

Non-culture based laboratory-confirmed cases

Additional laboratory confirmation of suspected cases of IMD was obtained by means of non-culture based methods (NAAT and serology). NAAT testing is essentially by polymerase chain reaction (PCR) techniques[6] that demonstrate the presence of meningococcal-specific nucleic acid in appropriate samples and has been progressively introduced and updated in the different jurisdictions. Data from the results of these investigations were included for the first time in the 1999 report. The serological results are based on the demonstration of IgM antibody by enzyme immunoassay to *N. meningitidis* outer membrane protein using the methods and test criteria of the Health Protection Agency UK as assessed for Australian conditions.[7–10] Where age, sex and outcome data for patients with non-culture based diagnoses are available these were also recorded. The site of a sample of a positive NAAT is also used to define the clinical syndrome.

Results

Aggregated data on cases confirmed by culture and non-culture based methods

Number of laboratory confirmed cases

There were 241 laboratory confirmed cases of IMD in Australia in 2011 compared with 214 in 2010 and an average of 252 over the past 5 years (Table 1). In 2011, the number of laboratory confirmed cases of IMD was the same as the number of IMD notifi-

Table 1: Number of laboratory confirmed cases of invasive meningococcal disease, Australia, 2011, by serogroup and state or territory

State or territory	Serogroup						Total
	B	C	Y	W135	NG	ND	
ACT	5	0	0	0	0	0	5
NSW	35	2	7	4	5	14	67
NT	1	0	0	0	0	0	1
Qld	50	3	3	1	0	4	61
SA	17	2	0	2	0	1	22
Tas	6	1	0	3	0	0	10
Vic	45	1	3	1	0	3	53
WA	20	0	2	0	0	0	22
Australia	179	9	15	11	5	22	241

NG Non-groupable

ND Non-determined, samples were examined by nucleic acid amplification test and serological methods.

cations to NNDSS.[2] In 125 cases (52%), a positive culture was obtained with or without a positive non-culture based test and 116 (48%) cases were confirmed by a non-culture based method alone.

The highest number of laboratory confirmed cases was from New South Wales (67 cases), which decreased from 77 cases in 2010. The number of laboratory confirmed cases in Queensland in 2011 increased to 61, from 47 in 2010. Victoria showed an increase to 53 cases from 38 cases in 2010. There were very slight increases from 2010 in Western Australia, South Australia and the Australian Capital Territory.

Seasonality

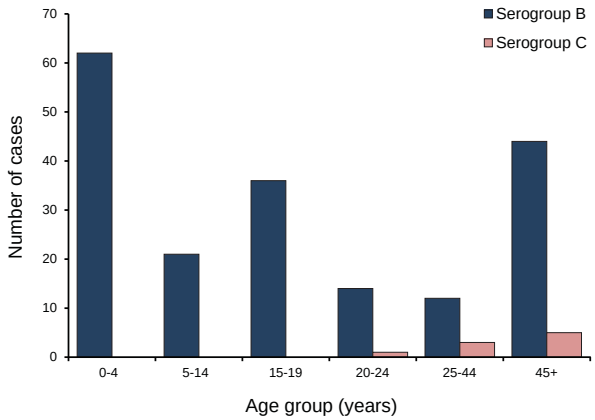
Fifty-seven cases occurred between 1 January and 31 March 2011, 56 between 1 April and 30 June, 73 between 1 July and 30 September and 55 between 1 October and 31 December. A winter peak of meningococcal disease is usual and the above pattern was also observed in 2007, 2008, 2009 and 2010.

Age distribution

Nationally, the peak incidence of meningococcal disease was in children aged less than 5 years, similar to previous years (Figure 1 and Table 2). Children aged less than 5 years accounted for 68 cases (28% of the total) in 2011, down from 33%–36% in 2007–2010.

A secondary disease peak was observed in previous years amongst adolescents and young adults aged 15–24 years. The 41 confirmed cases (17% of all cases) in those aged 15–19 years in 2011 was more than the number reported for 2010, but is similar to the range reported in this age group in the years 2007–2009 (19%–20%). There were 23 cases (9.5% of the total) 20–24 year age group, a marked decrease compared with the 22%–31% reported in this age group in the years 2007–2010.

Figure 1: Number of serogroup B and C cases of invasive meningococcal disease confirmed by all methods, Australia, 2011, by age group



Serogroup data

The serogroup was determined in 219 of the 241 laboratory confirmed cases of IMD in 2011 (Table 1). Of these, 179 (84%) were serogroup B and 9 (4.2%) were serogroup C. The proportion of cases that were serogroup B was little changed from the proportion reported between 2006 and 2010 (85%–88%). There is a continuing decrease in the number of cases of serogroup C. In 2011 there were 11 cases (5.2%) of serogroup W135, which was little changed from 2010 (4.5%). There were 15 cases of serogroup Y (7%), which represented an increase from 2009–2010 (3.5%–4%). With the continuing low numbers of serogroup C infections, serogroup B meningococci predominated in all age groups and jurisdictional differences in serogroup distribution were not evident.

In 2011, total case numbers, and the number of cases due to serogroup B in those aged 14 years or less was similar to 2010, but was lower than the years 2004–2009 (Table 3), and there were no serogroup C cases. In people aged 15–19 years, the proportion of serogroup B cases decreased to 88% in 2011 from 94% in 2010. In people aged 20–24 years, the number of serogroup B cases (14) was similar to the period 2008–2010 (14–15) but there was a marked decrease in the proportion of serogroup B cases, from 80%–88% between 2007 and 2010 to 61% in 2011. There was an increase in the number of serogroup Y and W135 cases in this age group. In people aged 25 years or more, there was an increase in the number of serogroup B cases compared with 2010, but a continuing decline in the proportion of serogroup B cases. This may be in part be explained by an increase, in this age category for 2011, in the number of serological IMD diagnoses (and thus serogroup not determined). The reasons for this are unclear, however ease of blood collection at the point of care may have played a role. The proportion of serogroup C cases in this age group remained similar to the period 2006–2010.

Phenotypes of invasive meningococcal isolates

Serogroup B meningococci are typically of heterogeneous phenotypes. In 2011, the phenotypes of invasive isolates, based on a determination of their serogroup, serotype and serosubtype, were analysed for New South Wales, the Australian Capital Territory and Tasmania (Table 4). Serogroup B meningococci are in general more difficult to characterise by serological methods and a number could not be phenotyped. A total of 43 were serotyped. Twenty-nine of these were serogroup B, of which six were serotype 15 and four of these were serosubtype P1.7, which has been circulating in Australia for many years; seven were serotype 4, five (all from New South Wales) of which were serosubtype P1.7. Eight serogroup B were non-typeable.

Table 2: All laboratory confirmed cases of invasive meningococcal disease, Australia, 2011, by age, state or territory and serogroup

State or territory	Serogroup	Age group										Total
		<1	1–4	5–9	10–14	15–19	20–24	25–44	45–64	65+	NS	
ACT	B	1	1	1	0	0	0	0	2	0	0	5
	C	0	0	0	0	0	0	0	0	0	0	0
	Total	1	1	1	0	0	0	0	2	0	0	5
NSW	B	4	7	2	1	6	6	2	3	4	0	35
	C	0	0	0	0	0	0	1	0	1	0	2
	Total	5	12	2	3	9	11	11	8	6	0	67
NT	B	1	0	0	0	0	0	0	0	0	0	1
	C	0	0	0	0	0	0	0	0	0	0	0
	Total	1	0	0	0	0	0	0	0	0	0	1
Qld	B	6	10	3	6	14	2	1	6	2	0	50
	C	0	0	0	0	0	1	2	0	0	0	3
	Total	6	10	3	6	17	4	4	6	5	0	61
SA	B	3	2	1	0	3	1	3	2	2	0	17
	C	0	0	0	0	0	0	0	2	0	0	2
	Total	3	2	1	0	3	1	3	6	3	0	22
Tas	B	1	0	0	0	1	1	1	0	2	0	6
	C	0	0	0	0	0	0	0	0	1	0	1
	Total	1	0	0	0	1	3	1	1	3	0	10
Vic	B	14	8	2	1	8	3	3	5	1	0	45
	C	0	0	0	0	0	0	0	1	0	0	1
	Total	14	8	2	1	9	3	6	8	1	0	53
WA	B	2	2	2	2	4	1	2	4	1	0	20
	C	0	0	0	0	0	0	0	0	0	0	0
	Total	2	2	2	2	4	1	2	4	3	0	22
Australia	B	32	30	11	10	36	14	12	22	12	0	179
	C	0	0	0	0	0	1	3	3	2	0	9
	Total	33	35	11	13	41	23	27	35	21	0	241
	% B of within age group	97	85.7	100	76.9	87.8	60.9	44.4	62.9	57.1	0	83.6

Other: cases diagnosed by serology; or by nucleic acid amplification test where the serogroup was not determined.

Three serogroup C strains were phenotyped and two (both from New South Wales) were serotype 2a. This phenotype has predominated in serogroup C meningococci in Australia for many years. Of these two, one was phenotyped C:2a:P1.5, one C:2a strain was non-subtypeable. One serogroup C strain was non-typeable and non-subtypeable. There is continuing interest in the presence of any serogroup B or serogroup C meningococci of serotypes that indicate the possibility of genetic recombination events. Among serogroup C strains, phenotype C: 2a:P1.4 had been of particular interest where it figured prominently in Victorian data in previous years. For example, in 2003 there were 29 serogroup C isolates of this serotype/serosubtype detected nationally with 21 detected in 2004 and 8 detected in 2005. However, other than the two C:2a:P1.4 meningococcal isolates reported in New South Wales in 2010, no isolates with this phenotype or its equivalent genotype were seen in other jurisdictions in 2009 or 2011.

Genotyping data of invasive meningococcal samples (culture or nucleic acid amplification test products)

Sequencing products derived from amplification of the variable region *porA, porB* and *FetA* genes is used in an increasing number of jurisdictions in place of

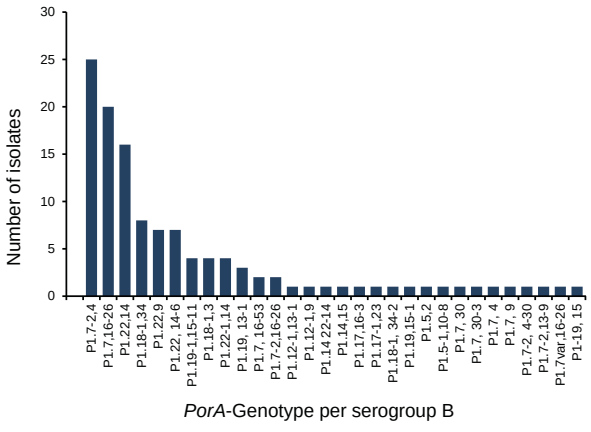
Table 3: A comparison of the number and proportion of serogroup B and serogroup C laboratory-confirmed cases, 2004 to 2011, by known cases

		Age group									
		< 5		5–14		15 –19		20–24		25+	
Year	Serogroup	n	%	n	%	n	%	n	%	n	%
2011	B	62	91	21	88	36	88	14	61	46	55
	C	0	0	0	0	0	0	1	4	8	10
	All*	68		24		41		23		83	
2010	B	61	85	19	76	29	94	15	88	39	60
	C	2	3	3	12	1	3	0	0	10	15
	All*	72		25		31		17		65	
2009	B	72	94	21	75	38	83	14	88	41	76
	C	2	2.6	3	11	1	2.2	1	6.3	4	7
	All*	77		28		46		16		55	
2008	B	82	89	23	96	42	91.3	15	83	57	85
	C	4	4.4	0	0	1	2.2	2	11.1	8	11
	All*	92		24		46		18		67	
2007	B	83	90	19	83	48	91	24	80	49	75
	C	4	4	0	0	2	4	3	10	8	12
	All	92		23		53		30		65	
2006	B	93	93	21	84	40	82	21	70	38	61
	C	2	2	3	12	4	8.2	7	23	10	16
	All	100		25		49		30		62	
2005	B	99	90	38	75	39	81	22	67	51	50
	C	6	5.5	510		4	8	8	24	27	27
	All	110		51		48		33		101	
2004	B	97	88	27	77	40	65	20	57	59	50
	C	6	5.5	5	14	17	28	11	31	32	27
	All	110		35		61		35		117	

* Cases where a serogroup was determined and patient's age was supplied.

serotyping using monoclonal antibodies. Since 2009, jurisdictions have moved to the use of genotyping. In 2011, genotyping data were available from all states and territories for 144/241 (60%) IMD cases. There was heterogeneity of typing data across jurisdictions with predominance of a few phenotypes or genotypes (Table 4). Figure 2 shows the collation of the national genotyping data of *porA* genotypes by number for all serogroup B confirmed cases of invasive meningococcal disease for 2011. The predominant *porA* genotypes include P1.7-2,4 (25 cases), P1.7,16-26 (20 cases), and P1.22,14-6 (16 cases). Figure 3 shows the collation of the national genotyping data of *porA* genotypes by number for serogroup C, Y and W135 in confirmed cases of invasive meningococcal disease for 2011.

Figure 2: Number of *porA*-genotypes* for serogroup B cases of invasive meningococcal disease, Australia, 2011



* Where genotype data were available

Table 4: Phenotypes (serotype, sero-subtype) and genotypes: *porB* variable region type, *porA* variable region, and *FetA* type of isolates or DNA extracts from cases of invasive meningococcal disease, 2011, by state or territory

		Phenotype				Genotype					
State or territory	Sero-group	Serotype	n	Sero-subtype	n	*porA*	n	*porB*	n	*FetA*	n
ACT	B	NT	1	NST	1	P1.7, 30	1				
		NT	1	P1.14, 22-14	1	P1.14 22-14	1				
		1	1	P1.6	1						
NSW	B	1	5	P1.14	2						
				P1.17	1	P1.17-1,23	1				
				P1.4	2						
		4	7	P1.15	1						
				P1.7	2						
				P1.7-2	3	P1.7-2,4	3				
				NT	1						
		15	6	P1.14	1						
				P1.7	4						
				NT	1						
		NT	5	P1.14	1	P1.22-1,14	1				
				P1.4	1						
				P1.9	2	P1.22,9	1	B,C,7,14b	1	F5-12	
				NT	1						
	C	2a	2	P1.5	1						
				NT	1						
	Y	14	2	P1.5	1						
				NT	1	P1.5-2,10-1	1				
		NT	4	P1.5,2	1						
				P1.6,3	1	P1.18-1,3	1				
				NT	2	P1.5-2,10-1	1				
	W135	1	1	P1.18	1	P1.18-1,16	1				
		NT	2	P1.4	1						
				P1.6,3	1						
NT											
Qld	B					P1-18-1,3	1			F1-5	1
						P1-19, 15	1			F5-2	1
						P1-19, 15-39	1			F5-1	1
						P1.12-1,13-1	1			F5-7	1
						P1.14,15	1			F1-64	1
						P1.18-1,34	3			F1-5	3
						P1.18-1, 34-2	1			F1-5	1
						P1.19, 13-1	3			F5-1	2
										ND	1
						P1.22,9	1			F1-55	1
						P1.22, 14	4			F4-7	1
										F5-9	3
						P1.22, 14-6	4			F1-5	1
										F5-5	1
										F5-88	1
										ND	1
						P1.7, 4	1			F1-5	1
						P1.7, 9	1			F3-20	1

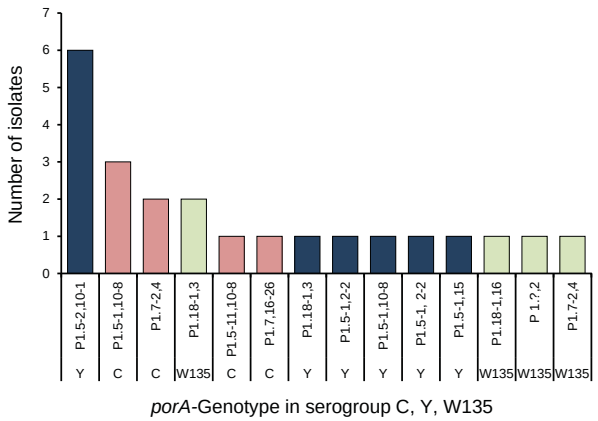
Table 4 *continued*: Phenotypes (serotype, sero-subtype) and genotypes: *porB* variable region type, *porA* variable region, and *FetA* type of isolates or DNA extracts from cases of invasive meningococcal disease, 2011, by state or territory

State or territory	Sero-group	Phenotype				Genotype					
		Serotype	n	Sero-subtype	n	*porA*	n	*porB*	n	*FetA*	n
Qld, *cont'd*						P1.7, 16-26	7			F2-9	1
										F3-3	5
										F5-19	1
						P1.7, 16-53	2			F3-3	2
						P1.7, 30-3	1			F1-2	1
						P1.7-2,4	11			F1-5	9
										F1-55	1
										F3-3	1
						P1.7-2, 4-30	1			F1-5	1
						P1.7-2,16-26	2			F3-3	2
	C					P1.5-1,10-8	2			F3-6	2
						P1.5-11,10-8	1			F3-6	1
	Y					P1.5-1, 2-2	1			F5-8	1
						P1.5-1,15	1			F5-1	1
						P1.5-2,10-1	1			F4-1	1
	W135					P1.18-1,3	1			F4-1	1
SA	B			P1.7-2,4	5	P1.7-2,4	5			F1-5	4
										F5-2	1
				P1.7,16-26	1	P1.7,16-26	1			F3-3	1
				P1.18-1,3	1	P1.18-1,3	1			F1-5	1
				P1.18-1,34	1	P1.18-1,34	1			F1-5	1
				P1.22,14	1	P1.22,14	1			F5-5	1
				P1.22,14-6	2	P1.22,14-6	2			F1-5	1
										F3-9	1
	C			P1.7-2,4	2	P1.7-2,4	2			F1-5	1
										F5-2	1
	W135			P 1.?,2	1	P 1.?,2	1			F1-1	1
Tas	B	A,A,A,Ba	1	P1.7var,16-26	1	P1.7var,16-26	1	A,A,A,Ba	1	F3-3	1
		19,Db,7c,14	1	P1.22,14	1	P1.22,14	1	19,Db,7c,14	1	F3-6	1
		NT	1	P1.22,14	1	P1.22,14	1	ND	1	NT	1
	C	4,B,7,14a	1	P1.7,16-26	1	P1.7,16-26	1	4,B,7,14a	1	F3-3	1
	W135	ND	1	P1.18-1,3	1	P1.18-1,3	1	ND	1	F3-6	1
Vic	B					P1.7-2,4	4	4,D,7,14a	1	F1-5	1
								19,Dvar,7b,14	1	F5-9	1
								ND	2	ND	2
						P1.7-2,16	1	New,Dvar,&b,Bvar	1	F3-3	1
						P1.7,16-26	8	A,A,A,Ba	5	F3-3	3
								ND	3	F3-3	3
						P1.7-2,13-9	1	ND	1	F1-5	1
						P1.12-1,9	1	4,D,7,14a	1	F1-5	1
						P1.17,16-3	1	19,Ab,7var,Aa	1	F5-5	1
						P1.18-1,3	2	ND	1	F3-9	1
								ND	1	ND	1
						P1.18-1,34	4	19,Ac,7a,1	2	F1-5	2

Table 4 *continued*: Phenotypes (serotype, sero-subtype) and genotypes: *porB* variable region type, *porA* variable region, and *FetA* type of isolates or DNA extracts from cases of invasive meningococcal disease, 2011, by state or territory

State or territory	Phenotype				Genotype					
	Sero-group	Serotype	n	Sero-subtype	n	*porA*	n	*porB*	n	*FetA*	n
Vic *cont'd*								4,D,7,14a(var)	1	F1-5	1
								ND	1	ND	1
						P1.19-1,15-11	4	B,C,7,14b	2	F5-1	2
								ND	2	F5-1	2
						P1.22,14	8	19,Ac,7a,1	3	F5-5	3
								ND	5	ND	5
						P1.22,9	5	B,C,7,14b	1	F1-55	1
								B,C,7,14b	1	F5-12	1
								new,Dvar,7b,Bvar	3	F5-12	3
						P1.22-1,14	1	4,B,7,14a	1	F3-9	1
						P1.5-1,10-8	1	4,D,7,14a	1	F1-5	1
	C					P1.5-1,10-8	1	ND	1	ND	1
	Y					P1.5-1,10-8	1	19,Db,7c,14	1	F1-3	1
						P1.5-2,10-1	2	19,Db,7c,14	1	F4-1	1
								ND	1	ND	1
	W135					P1.7-2,4	1	ND	1	F5-2	1
WA	B					P1.7,16-26	3			F3-3	2
										F3-6	1
						P1.7-2,4	2			F1-5	2
						P1.5,2	1			F1-7	1
						P1.19,15-1	1			F1-5	1
						P1.22-1,14	2			F4-1	1
										F5-2	1
						P1.22,14	1			F3-9	1
						P1.22,14-6	1			F3-9	1
	Y					P1.5-1,2-2	1			F5-8	1
						P1.5-2,10-1	1			F4-1	1

Figure 3: Number of *porA*-genotypes* for serogroup C, Y, W135 in cases of invasive meningococcal disease, Australia, 2011



* Where genotype data were available

Outcome data for invasive meningococcal disease for laboratory confirmed cases

Outcome data (survived or died) were available for only 25 (10%) of the 241 laboratory confirmed cases (Table 5). Five deaths were recorded in the 25 cases with outcome data available, all attributable to septicaemia. Four of these deaths were due to serogroup B infections and one to W135 infection. Outcome data were available for 18 of 179 cases with serogroup B infection and one of the 11 serogroup W135 infections, one of the 9 serogroup C infections and one of the 15 serogroup Y infections.

Anatomical source of samples for laboratory confirmed cases

There were 85 diagnoses of meningitis based on cultures or NAAT examination of CSF either alone

or with a positive blood sample; and 151 from blood samples (cultures or NAAT) alone (Table 6). Twenty-one cases were serologically positive where culture and NAAT were negative. Diagnoses made from sites other than blood, CSF or serum were brain tissue (2), lung tissue (1), pelvic fluid (1) and synovial fluid (1). Those diagnoses shown as culture positive may also have had positive NAAT and/or serology; however those shown as NAAT positive were culture negative with or without positive serology.

Antibiotic susceptibility surveillance of invasive meningococcal isolates

Penicillins

Susceptibility to penicillin and other antibiotics was determined for one hundred and twenty-five meningococcal isolates of the 241 cases (52%). Using defined criteria, 108 isolates (86.4%) were less sensitive to penicillin in the MIC range 0.06–0.5 mg/L and (12.8%) fully sensitive (MIC 0.03 mg/L or less). One isolate (0.8%) was relatively resistant (MIC = 1.0 mg/L). The proportion of less sensitive strains (86.4%) is higher than that reported in 2007–2010 (range 67%–80%)

Other antibiotics

All isolates were fully susceptible to ceftriaxone and by extrapolation to other third generation cephalosporins. All isolates were fully susceptible to ciprofloxacin and there was 1 isolate with altered susceptibility to rifampicin (MIC = 0.5 mg/L).

Discussion

In 2011 there were 241 IMD cases laboratory confirmed by the NNN, representing 100% of notifications to the NNDSS.[2] There was a steady decrease in the number of notifications of IMD in Australia between 2003 and 2010, with numbers in 2010 less than half those in 2003 (558 and 214 cases respectively), but in 2011 there was a slight increase. The number of cases in 2011 was lower than the number of notified cases reported in any year from

Table 5: Outcome data for laboratory confirmed cases of invasive meningococcal disease, Australia, 2011, by syndrome and serogroup

		Serogroup					
Disease type	Outcome	B	C	Y	W135	NG	Total
Meningitis	Survived	4	0	0	1	0	5
	Died	0	0	0	0	0	0
	Unknown	70	3	3	2	4	82
	Total	74	3	3	3	4	87
Septicaemia	Survived	10	1	1	3	0	15
	Died	4	0	0	1	0	5
	Unknown	91	5	11	4	23	134
	Total	105	6	12	8	23	154
All cases	Survived	14	1	1	4	0	20
	Died	4	0	0	1	0	5
	Unknown	161	8	14	6	27	212
	Total	179	9	15	11	27	241

NG Serogroup not groupable or not determined.

Table 6: Anatomical source of samples positive for a laboratory confirmed case of invasive meningococcal disease, Australia, 2011

Specimen	Bacterial isolate	NAAT*	Serology†	Total
Blood	92	38	21	151
CSF +/– blood	31	54	0	85
Other‡	2	3	0	5
Total	125	95	21	241

* Nucleic acid amplification test (NAAT) positive in the absence of a positive culture.

† Serology positive in the absence of positive culture or NAAT.

‡ Joint, tissue and fluid samples (pelvic fluid (1), lung (1), brain tissue (2), joint fluid (1))

1991 to 2009 (range 259–687).[2] The proportion of IMD notifications with laboratory confirmation has increased from 88% to 100% since 2004.

The distribution of serogroup B IMD cases is essentially the same as that reported for 2006 to 2010. The proportion of serogroup C cases continues to decline as a result of the introduction of the serogroup C vaccine in 2003. There was an increase in the number of serogroup Y cases compared with the period 2006 to 2010. This will need to be monitored to determine if this is the beginning of an increasing trend.

There was a decrease in the number of culture confirmed cases from previous years with a corresponding increase in the number of NAAT confirmed cases. This may reflect the increasing availability of NAAT assays for diagnosis of IMD. Attention is drawn to earlier AMSP reports that explain the differences between the number of clinically notified cases and laboratory confirmed cases,[11] however in 2011, for the first time, there was a corresponding number of laboratory confirmed cases from the Australian Meningococcal Surveillance Programme data and NNDSS notifications. It should also be noted that surveillance systems rarely capture all cases in any given period so that small differences in the number of cases should be expected.

Only 9 serogroup C infections were identified nationally in 2011. Serogroup B disease accounted for 84% of all infections where a serogroup was determined. Low numbers of infections to serogroups Y and W135 is usual for Australia, however there was a proportional increase in serogroup Y disease in 2011 from 2010, which will continue to be monitored by the NNN surveillance program.

A primary peak in IMD infection rates was evident in younger age groups, as reported in previous years, with a secondary peak in adolescents and young adults. In people aged 25 years or more, there was a continuing decline in the proportion of serogroup B cases in 2011. This may be explained in part by an increase in the number of serological IMD diagnoses (where the serogroup is not able to be determined for serogroups B, Y and W135), therefore this must be interpreted with some caution.

The distribution of serogroup C disease was low across all age groups in 2010, with no reported cases in those aged less than 20 years. As in previous years, there were only a small number of serogroup C cases in those aged 25 years or more, which may reflect the secondary benefit of herd immunity accruing to the wider community following vaccination of those age groups where disease was formerly highly concentrated.[12]

As in previous years, phenotypic and genotypic data found no evidence of substantial numbers of cases of IMD caused by *N. meningitidis* that have undergone genetic recombination, although sporadic instances of this have been detected in Australia. There were some concerns expressed that the documented capacity for genetic reconfiguration within meningococci may lead to the emergence of new and invasive subtypes following extensive vaccine use.[12] Analysis of meningococcal subtypes and any evidence for the expansion of 'new' subtypes will continue as part of the NNN program. Mortality data were assessable in only a small proportion of cases (10%) and must be interpreted with caution. Four of the 5 fatal cases of IMD were associated with serogroup B infection, and one with serogroup W135. The NNN does not attempt collection of morbidity data associated with IMD.

The distribution of penicillin MICs in invasive isolates in 2011 showed that the proportion that were in the less sensitive category for penicillins was 86%. This was higher than the proportion reported in previous years. It should be emphasised that this shift from fully sensitive to less sensitive category does not affect clinical outcomes and penicillins remain a suitable treatment for IMD in Australia. All isolates were susceptible to the third generation cephalosporins and to the 'clearance' antibiotics rifampicin and ciprofloxacin with the exception of 1 isolate with decreased susceptibility to rifampicin from Queensland. Strains with decreased susceptibility to quinolone antibiotics have been the subject of on-going international interest following their first description from the Australian Meningococcal Surveillance Programme group in 2000.[13–16] There were no isolates with decreased susceptibility to quinolone antibiotics detected in 2011, compared with one in 2010, four in 2009; two in 2008; and one in 2007.

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