Annual report of the Australian Meningococcal Surveillance Programme, 2000

The Australian Meningococcal Surveillance Programme

Abstract

The National Neisseria Network has undertaken meningococcal isolate surveillance by means of a collaborative laboratory based initiative since 1994. The phenotype (serogroup, serotype and serosubtype) and antibiotic susceptibility of 388 isolates of *Neisseria meningitidis* from invasive cases of meningococcal disease were determined in 2000. More than 90 per cent of the invasive isolates were either serogroup B or C. There was however, considerable diversity in the phenotypes circulating in the different States and Territories. Serogroup B strains predominated in all jurisdictions except Victoria and were isolated from sporadic cases of invasive disease. Serogroup B phenotypes were generally disparate although phenotypes B:15:P1.7 and B:4:P1.4 were widely distributed. The latter remained especially prominent in New South Wales. The number and proportion of serogroup C isolates again increased in Victoria compared with previous years. Infections with a novel phenotype that was first noted in 1999, C:2a:P1.4(7), were common in Victoria, especially in adolescents and adults, but rarely seen elsewhere in Australia. Phenotype C:2a:P1.2, was also noted in the preceding year and continued to be seen in Victoria in 2000 but was infrequently encountered in other jurisdictions. Serogroup C infections remained common in New South Wales where phenotype C:2a:P1.5 was regularly isolated. About two thirds of all isolates showed decreased susceptibility to the penicillin group of antibiotics (MIC 0.06 to 0.5 mg/L). All isolates tested were susceptible to third generation cephalosporins and to the prophylactic agents rifampicin and ciprofloxacin. Data relating to 147 laboratory-confirmed but culture-negative cases, supplemented information on culture-confirmed cases in this report. Some differences in the patterns of disease were revealed when culture-based and non-culture-based data were compared. *Commun Dis Intell* 2001;25:113-121.

Keywords: surveillance, Neisseria meningitidis*, meningococcal disease, antibiotics, penicillin*

Introduction

There is perennial interest in invasive meningococcal disease (IMD) from a public health and general community perspective. The common clinical manifestations of IMD are septicaemia and/or meningitis. Single organ disease such as arthritis occurs less frequently. Presentations may range from the mild and subclinical to the rapidly progressive and fatal. While the host response affects the ultimate outcome in individual cases, both this result and the patterns of the infection within a community may be altered by certain features of the infecting organism.[1,2]

The characteristics of the meningococci prevalent in a population and responsible for infections in individuals also influence the public health response to IMD. These features may be used to confirm or exclude the presence of an outbreak or cluster of cases suspected on clinical grounds, and to influence the public health measures used to control such an outbreak. For example, the presence of different subtypes of meningococci excludes case clustering if this is suspected epidemiologically. Currently, polysaccharide vaccines are available for some serogroups of meningococci but not for others. The imminent availability of a conjugate serogroup C vaccine will mean that decisions on its application will be affected by the pattern of IMD in Australia and the subtypes causing disease.

The Australian Meningococcal Surveillance Programme, for the examination of isolates of *Neisseria meningitidis* from cases of IMD, was commenced in 1994 through the collaboration of reference laboratories in each State and Territory. This laboratory-based activity is designed to supplement data from existing clinical notification schemes by adding information on the phenotype (the serogroup, the serotype and subserotype), on occasion the genotype, and the antibiotic susceptibility of invasive isolates to clinical data. Annual reports summarising data gathered since the inception of the Programme have been published in *Communicable Diseases Intelligence*.[3-8] The following report analyses the characteristics of meningococci isolated in the calendar year 2000. Non-culture-based laboratory testing, based on nucleic acid based amplification assays and serology, is increasingly used to confirm IMD.[9,10] This report includes data from IMD confirmed by these means.

Methods

The National Neisseria Network (NNN) is a collaborative program for the laboratory surveillance of the pathogenic Neisseria *N. meningitidis* and *N. gonorrhoeae*.[3-9] A network of reference laboratories in each State and Territory (see acknowledgments) undertakes meningococcal isolate surveillance.

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Isolate based surveillance

Each case was based upon isolation of a meningococcus from a normally sterile site. 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 surveillance subset of the Programme categorises cases on the basis of site of isolation of the organism. Where an isolate is grown from both blood and CSF cultures in the same patient, the case is classified as one of meningitis. It is recognised that the total number of cases was under-estimated. This particularly applies to the number of cases of meningitis, where there was no lumbar puncture or else where lumbar puncture was delayed and the culture sterile. , The above approach however, has been used since the beginning of this program and is continued for comparative purposes.

Phenotyping of invasive isolates of meningococci by serotyping and serosubtyping was based on the detection of outer membrane protein antigens using a standard set of monoclonal antibodies obtained from the National Institute for Public Health (RIVM), the Netherlands.

Antibiotic susceptibility was assessed by determining the minimal inhibitory concentration (MIC) to antibiotics used for therapeutic and prophylactic purposes. This program uses the following parameters to define the various levels of penicillin susceptibility/resistance when determined by a standardised agar plate dilution technique.[9]

- sensitive, MIC 0.03 mg/l;
- less sensitive, MIC 0.06 - 0.5 mg/l;
- relatively resistant MIC 1 mg/l.

Strains with MICs which 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.

Non-culture-based laboratory-confirmed cases

Additional laboratory confirmation of suspected cases of IMD is increasingly available by means of non-culture-based methods such as nucleic acid based amplification assays (NAA) and serological techniques. NAA testing is essentially by polymerase chain reaction (PCR) techniques.[10] Data from the results of these investigations were included for the first time in the 1999 report and are again reported here. The serological results are based on results of tests performed using the methods and test criteria of the Manchester Public Health Laboratory Service (PHLS) reference laboratory, UK and assessed for Australian conditions.[11] Age, sex and outcome data for patients with non-culture-based diagnoses are recorded when available. The site of a sample of a positive PCR test is used to define the clinical syndrome. This separation is not possible for cases diagnosed serologically.

Results

Numbers of isolates from culture-confirmed cases

A total of 388 invasive isolates of meningococci were examined in 2000. There were 141 isolates from patients whose infections were acquired in New South Wales (36% of all isolates), 108 (28%) from Victoria, 50 (13%) from Western Australia, 43 (11%) from Queensland, 20 (5%) from South Australia, 14 (3%) from Tasmania, 7 (2%) from the Northern Territory and 5 (1%) from the Australian Capital Territory (Table 1).

Seasonality

Seventy-one (19%) infections were identified between 1 January and 31 March 2000, 96 (25%) between 1 April and 30 June, 125 (33%) between 1 July and 30 September and 94 (25%) between 1 October and 31 December. A winter peak of meningococcal disease is usual.

Age group

The age distribution of patients infected with invasive isolates in each State and Territory is shown in Table 2. As in previous years the national peak incidence of meningococcal disease occurred in those 4 years and under. Of the 388 total cases, 47 (12%) were aged less than one year, and 73 (19%) were in the 1-4 year age group. A secondary peak was identified in adolescents and young adults. Of the 388 cases 79 (20%) were identified in the 15-19 year age group, and a further 47 cases (12%) occurred in those aged 20-24. Overall, there were 127 (32%) cases in the 15-24 year age

Table 1. *Neisseria meningitidis* isolates, 2000, by State or Territory and serogroup

State/ Territory	Serogroup												
	B		C		A	Y		W135		NG*		Total	
	n	%	n	%		n	%	n	%	n	%	n	%
ACT	5	100.0	0	0.0	0	0	0.0	0	0.0	0	0.0	5	1.3
NSW	74	52.5	55	39.0	0	7	5.0	3	2.1	2	1.4	141	36.3
NT	6	85.7	1	14.3	0	0	0.0	0	0.0	0	0.0	7	1.8
Qld	31	72.1	10	23.3	0	0	0.0	1	2.3	1	2.3	43	11.1
SA	12	60.0	5	25.0	0	1	5.0	1	5.0	1	5.0	20	5.2
Tas	9	64.0	4	28.0	0	0	0.0	0	0.0	1	8.0	14	3.6
Vic	40	37.0	58	53.7	0	5	4.6	4	3.7	1	1.0	108	27.8
WA	40	80.0	10	20.0	0	0	0.0	0	0.0	0	0.0	50	12.9
Total	217	56.0	143	37.0	0	13	3.2	9	2.3	6	1.5	388	100

*NG = not viable for serogrouping or not serogroupable

Table 2. *Neisseria meningitidis* isolates, 2000, by State or Territory and age

	Age group (years)										
	<1	1-4	5-9	10-14	15-19	20-24	25-44	45-64	65+	NS	All
ACT	0	2	0	1	1	0	1	0	0	0	5
NSW	13	24	13	7	39	14	13	14	3	1	141
NT	2	1	0	0	0	2	1	0	0	1	7
Qld	7	8	3	4	8	7	4	1	1		43
SA	4	5	1	1	5	1	0	2	1	0	20
Tas	4	2	0	0	1	1	1	1	0	4	14
Vic	9	18	5	7	18	17	17	12	5	0	108
WA	8	13	5	2	7	5	2	4	4	0	50
Total (n)	47	73	27	22	79	47	39	34	14	6	388
%	12.1	18.8	7.0	5.7	20.3	12.1	10.0	8.8	3.6	1.6	100

NS. Age not specified

group which was unusually high compared to previous years. This peak in the distribution was particularly noticeable in Victoria and New South Wales.

Serogroup, serotype and serosubtype (phenotype) distribution

The distribution of the isolates by serogroup is shown in Table 1. Nationally, 217 serogroup B isolates represented 56 per cent of all strains, a lower proportion than in the previous 3 years. The 143 serogroup C strains (37%) represented a further increase on the number (128) and proportion (33%) detected in 1999. The number (13) and proportion (3.2%) of serogroup Y strains did not change significantly. Nine serogroup W135 meningococci were identified. No serogroup A isolates were encountered.

Some important differences in the distribution of serogroups were evident when data were disaggregated by region. Serogroup B predominated in national data (56%) and in all jurisdictions except Victoria. When examined regionally, Western Australia (80% of isolates), the Australian Capital Territory (100%), South Australia (70%), the Northern Territory (85%), Queensland (72%) and Tasmania (64%) had high proportions of serogroup B strains. In New South Wales the 74 group B strains accounted for 52 per cent of isolates. In Victoria however, serogroup B isolates represented 37 per cent of the total. Group B disease comprised unlinked and apparently sporadic cases.

Figure 1b. Distribution (%) by age of serogroup B and C infections, Victoria, 2000

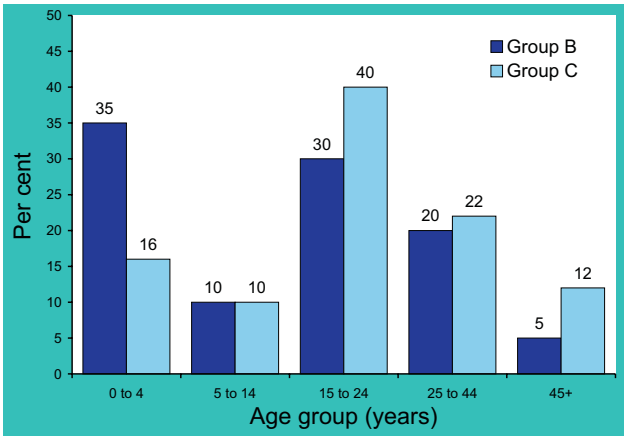


Figure 1a. Distribution (%) by age of serogroup B and C infections, centres other than Victoria and New South Wales, 2000

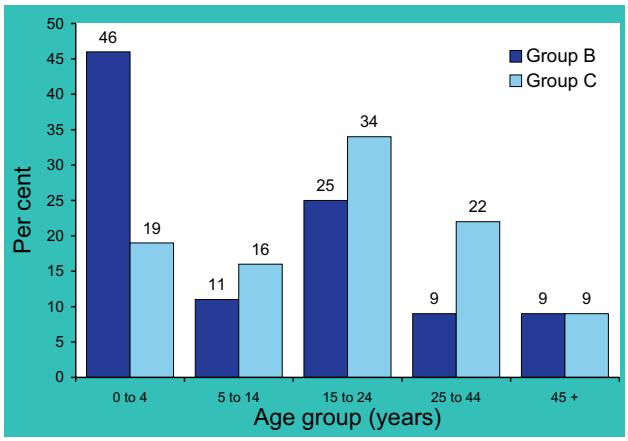
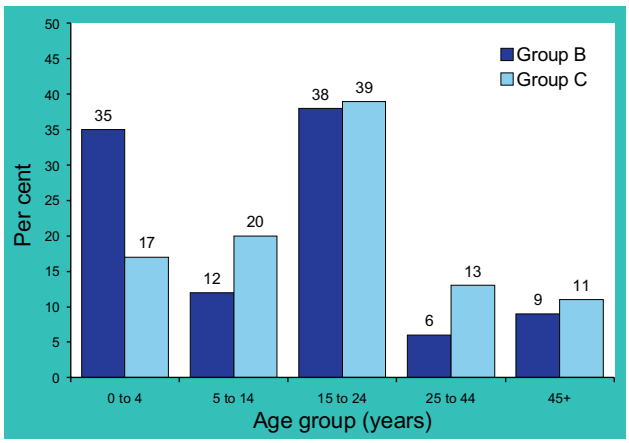


Figure 1c. Distribution (%) by age of serogroup B and C infections, New South Wales, 2000



A further increase in serogroup C infections in 2000, occurred in Victoria where 53 per cent of invasive isolates were serogroup C. The number of group C isolates increased from 42 (45% of the total) to 58 in 2000. In 1998 there were only 7 (17.5%) serogroup C strains identified in Victoria. Serogroup C isolates were also common in New South Wales in 2000 and the 55 isolates represented 39 per cent of the total, a similar proportion to that identified in 1999 (37%). One hundred and thirteen group C meningococci (79 per cent of all serogroup C strains isolated in Australia) were from cases residing in New South Wales and Victoria. The proportion of total strains identified as group C strains was lower in other States and Territories. There were 10 group C isolates (23%) in Queensland, 5 (20%) in South Australia, 10 (20%) in Western Australia and 4 (28%) in Tasmania but none in the Australian Capital Territory.

Table 3. Commonly isolated serotypes and serosubtypes and phenotypes of *N. meningitidis* of interest, 2000, by State and Territory

	Serogroup B				Serogroup C			
	Serotype	N	Serosubtype	N	Serotype	N	Serosubtype	N
ACT	4	3	1.4	1				
	15	1	1.7	1				
NSW	4	32	1.4	20	2a	46	1.5	22
			1.7	3			1.5,2	10
			1.14	4			1.2	3
			1.5	1			nst	11
			nst*	1			1.16	1
	15	9	1.7	9	2b	3	1.2	1
	14	8	1.4	2			nst	2
			nst	6	NT	5	1.5	1
	NT*	20	1.4	4			1.5,2	3
			1.15	3			1.15	1
			nst	8				
NT	15	1	1.7	1	2a	1	1.5	1
	NT	1	nst	1				
	14	3	nst	3				
Qld	15	8	1.7	4	2a	5	1.5	3
	4	1	nst	1			1.7	1
	NT	20	1.4	9	2b	1		
			nst	5	NT	3		
SA	4	2	1.4	1	2a	4	1.4	2
	1	1	nst	1			1.5	1
	14	1	nst	1			nst	1
	NT	8	15	2	NT		1.5,2	
Vic	15	8	1.7(16)	3	2a	55	1.4	24
			nst	5			1.2	10
	4	4	1.4	4			1.5,2	5
	2a	2	nst	2			1.5	2
	2b	3					nst	14
	NT	22	1.4	8	2b	2		
			1.7	2	15	1	12,13	1
			nst	6				
WA	15	10	1.7 (16)	6	2a	7	1.5	2
	4	2	nst	2			nst	3
	NT	25	1.4	7	2b	1	1.2	1
			1.15	2	NT	2	nst	2
			nst	13				

NT Not typed
nst No serosubtype

Serogroup distribution has been typically age-associated, but jurisdictional differences were evident in 2000 (Figures 1 a-c). In jurisdictions other than New South Wales and Victoria, serogroup B strains predominated in all age groups. In all jurisdictions serogroup B predominated in those aged 4 years or less. In Victoria group C strains were more frequently isolated in all other age groups. In New South Wales group C meningococci were also frequently isolated, but serogroup B was seen more often in those aged between 15 and 24 years.

There was again considerable phenotypic heterogeneity amongst invasive isolates as determined by serotyping and serosubtyping. The predominant serotypes/serosubtypes in each State and Territory are shown in Table 3. Serogroup B meningococci are more difficult to characterise by sero-logical methods and a number could not be phenotyped. B:4:P1.4(7) strains predominated in New South Wales and were also present in Queensland, South Australia and Victoria. B:15:P1.7 strains were present in New South Wales, Queensland, Victoria, and Western Australia.

There was less heterogeneity amongst serogroup C meningococci. Isolates were usually either serotype 2a or 2b. Phenotype C:2a:P1.4(7), which appeared in Victoria in 1999, requires special comment. There were 10 such strains in Victoria in 1999 and 24 in 2000, but they were rarely encountered elsewhere in Australia. Phenotype C:2a:P1.2 was also frequently isolated in Victoria in 2000 (10 isolates) but also rarely identified in other centres. New South Wales was the only other State with a higher proportion of serogroup C strains. Phenotypes C:2a:P1.5 and C:2a: P1.5,2 accounted for 70 per cent of serogroup C strains in that State. The C:2a:P1.5 phenotype was present in most jurisdictions. Serotype 2b strains were encountered in low numbers.

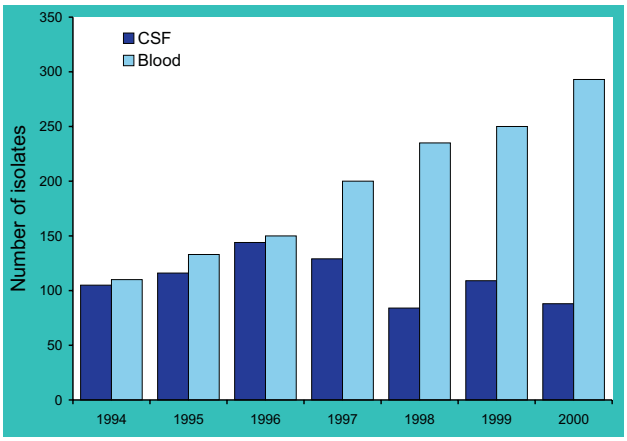
Site of isolation

There were 88 isolates from cerebral spinal fluid (CSF) either alone or with a blood culture isolate and 293 from blood cultures alone. Five isolates were identified from synovial fluid and one from skin. There has been an increase in the proportion of isolates identified from blood cultures over time (Figure 2). In 2000, the ratio of CSF isolates to blood culture isolates was 0.3:1, a substantial decrease from that recorded in 1999 (0.44:1).

Outcome data for cases with sterile site isolates

Outcome data (survived or died) were available for 278 patients (71%). Twenty-five deaths were recorded (9%) (Table 4). Outcomes were available in 70 per cent of serogroup B infections and 75 per cent of serogroup C infections. There were 9 (5.9%) deaths in serogroup B infections and 13 (12%) in serogroup C infections. Where outcomes were known, there were 4 deaths in 57 patients (7%) with meningitis. Two of these patients were infected with serogroup B, and 1 each with a serogroup C and serogroup Y strain. Twenty-one deaths were recorded in 218 bacteraemic patients (9.6%). There were 113 cases of serogroup B meningococcal bacteraemia with 7 deaths and another 90 cases were caused by serogroup C strains among whom 13 fatalities were recorded. Single fatalities were recorded with serogroup Y and W135 bacteraemias.

Figure 2. Number of meningococcal isolates from CSF and blood culture, 1994 to 2000



Antibiotic susceptibility surveillance of invasive meningococcal isolates

Penicillin

Three hundred and sixty-nine isolates of the 388 strains were tested for their susceptibility to penicillin. Using defined criteria, 118 strains (31.9%) were fully sensitive to penicillin and 251 (68.1%) less sensitive (MIC 0.06 to 0.5 mg/l). These

Table 4. Outcome of meningitic and septicaemic cases of meningococcal infection, Australia, 2000, by serogroup and culture positive cases

Disease Type	Outcome	Serogroup					
		B	C	Y	W135	NG	Total
Meningitis	Survived	38	14	0	0	1	53
	Died	2	1	1	0	0	4
	Total	40	15	1	0	1	57
Septicaemia	Survived	106	78	6	7	0	197
	Died	7	12	1	1	0	21
	Total	113	90	7	8	0	218
All cases*	Total	153	108	8	8	1	278
	Died	9	13	2	1	0	25

* Includes 3 serogroup C strains from joint aspirates from patients who survived.

proportions differ only slightly from those recorded for recent years. The highest MIC recorded was 0.5mg/L which was identified in 3 isolates.

Other antibiotics

All isolates were susceptible to ceftriaxone (and by extrapolation to other third generation cephalosporins) and to the prophylactic antibiotics rifampicin and ciprofloxacin.

Numbers and sources of non-culture diagnoses of IMD

There were 147 diagnoses of invasive meningococcal disease in 2000 diagnosed by PCR and/or serology in the absence of positive cultures (Table 5). Both tests were positive in 7 instances where both serology and PCR testing were performed. It was more usual however, to have available samples suitable for testing by only one of the above techniques. Ninety-one cases were diagnosed by PCR testing, and a further 49 cases diagnosed by serology.

For the cases diagnosed by PCR testing, it was also possible to categorise the disease type by source of specimen (Table 5). Of the 98 cases diagnosed by PCR, 43 were from CSF or CSF and blood, 53 from blood only and 2 from blood and joint fluid. This is a different distribution from that obtained with culture-based diagnosis. Culture-based diagnosis of blood yielded 2.5 times the number of cultures derived from CSF. With PCR based diagnosis the ratio of blood to CSF positive was 1.2:1. Changes in the number and sources of non-culture-based diagnoses of invasive meningococcal disease are shown in Table 5.

Serogroup and age distribution of non-culture-based IMD

Infections diagnosed by PCR can also be serogrouped. At present this is not available for serogroups other than B or C and cannot be performed by all centres. Of the 98 cases where a PCR-based diagnosis was made, the serogroup was also determined as B or C in 64 cases (Table 6).

Table 5. Source of non-culture based diagnosis of invasive meningococcal disease, 1999 to 2000

	1999	2000
All non culture based diagnoses	92	147
PCR and serology positive	13	7
PCR positive alone	41	91
CSF PCR positive*	*36*	*35*
CSF and Blood PCR both positive*	*18*	*9*
Blood PCR positive*		*52*
Blood/Joint positive		2
Serology positive alone	38	49

* including those with positive serology

Table 6. Serogroup and age distribution of IMD diagnosed by PCR, 2000

	Age groups									
Serogroup	<1	1 - 4	5 - 9	10-14	15-19	20-24	25-44	45-64	64+	U	Total
B	5	7	0	2	7	4	5	3	0	2	35
C	2	5	6	1	8	3	4	0	0	0	29
U*	4	10	4	1	8	6	1	0	0	0	34
All	11	22	10	4	23	13	10	3	0	2	98

U* undetermined

Table 7. Age distribution of serologically diagnosed cases of IMD, 2000

<1	1-4	5-9	10-14	15- 19	20-24	25-44	45-64	>65	Total
0	4	2	7	6	9	15	6	0	49

Table 8. Outcome data for cases of IMD diagnosed by PCR, 2000, by serogroup

	CSF			Blood			
Serogroup	S	D	U†	S	D	U†	Total
B	19	2	3	8	2	1	35
C	4	0	1	17	1	4	29*
Unknown	8	0	6	18	0	2	34
Total	31	2	10	43	3	7	98

* Includes 2 positive samples from blood/joints

† Not known

For those cases diagnosed by serology alone, age distribution was different, with most diagnoses (43 of 49) in those aged 10 years or more. This reflects in part the difficulty in obtaining serum samples from young children. The categorisation of IMD by site of organism capture cannot be determined with serology. Additionally, serogroup determination is not possible.

Clinical outcome for IMD based on non-culture-based diagnosis

For IMD diagnosed by PCR based tests, the clinical outcome was known in 82 instances. There were 3 deaths where PCR testing of blood alone was positive (2 of serogroup B and one serogroup C). Of a further 43 patients with a PCR CSF sample, 31 survived (19 group B, 4 group C, 9 undetermined serogroup) and 2 died (both serogroup B). Two cases who were diagnosed with serogroup C by PCR testing of blood or joint fluid, survived. Forty-seven of 49 cases diagnosed serologically survived and the outcome was unknown in the remaining cases.

Discussion

The total of 388 isolates examined by NNN laboratories in the Australian Meningococcal Surveillance Programme in 2000 was the highest since the inception of the Programme in 1994. The numbers of isolates examined between 1997 and 1999 represent small aggregate changes only. When data are disaggregated by jurisdiction however, differences become more apparent. The number of isolates available in Victoria increased from 41 in 1998 to 94 in 1999 and further to 108 in 2000. In contrast, the number of isolates from Queensland decreased from 81 to 66 to 43 over the same period. Isolate numbers in New South Wales and Western Australia increased slightly in 2000 but varied little from 1999 totals in other centres.

The number of isolates available for examination will always be less than the number of clinically notified cases because clinical surveillance case definitions include culture negative cases. The increasing capacity for laboratory confirmation of clinically suspected IMD by non-culture-based diagnosis however, has narrowed this differential. In 2000, 147 clinical cases were confirmed only by non-culture based laboratory examinations, an increase from the 86 diagnoses made by this means in 1999. These procedures include NAA assays using PCR and/or serological examination. Data on these cases were included separately in this report. Some of the PCR techniques in use can provide additional data on the serogroup of the isolate. It is likely that the use of these techniques will increase and that with further refinements in their application, additional subtyping data will also be available. Serological diagnosis of less florid cases has also increased. NNN laboratories may be contacted for advice regarding these tests.

The ratio of cases of meningitis to bacteraemia in culture-confirmed cases declined further in 2000, continuing a trend first noted in 1997. This trend was the subject of comment in the preceding report.[8] It was also noted in that report that there was a distinct difference in the source of PCR-based diagnostic material, with more diagnoses from CSF compared to blood. There is a possibility of bias in the PCR diagnostic data for 1999 as PCR was initially performed on CSF samples only. In addition, the sensitivity of PCR techniques in blood samples is less than for CSF. In the 2000 data, there was an increase in PCR based diagnoses from blood and a corresponding 'correction' in the proportions of diagnoses from CSF and blood by this technique.

The predominant disease pattern throughout the country continued to be sporadic infection with serogroup B meningococci. The proportion of serogroup C cases in aggregated data again increased in 2000. Analysis of serogroup distribution by State or Territory however, reveals considerable differences. About 80 per cent of serogroup C strains are found in the 2 larger States and Victoria is the only jurisdiction where the majority of strains are serogroup C. Cases of serogroup C increased from 7 in 1998 to 42 in 1999 and in 2000 the total reached 58. Serogroup C infections have been prominent in New South Wales for a number of years, although serogroup B strains have always been the majority. Serogroup C cases were also sporadic in 2000 and no serogroup A meningococci were isolated. The proportion of serogroup Y and W135 strains remained unchanged.

Children aged 4 years or less are traditionally the age group most frequently infected and a secondary incidence peak in young adults and adolescents is also usual. This pattern changed in 2000 with those in the 15-24 age range having more infections than those aged 4 years or less in aggregated data. Again this pattern varied by region with Victoria having the highest proportion of young adult cases. In New South Wales the case numbers in the two age groups were similar but elsewhere the usual infant case predominance prevailed. Serogroup B infections were the most frequently seen in the infant age group. Serogroup C disease occurred more often in the young adult age group and was responsible for the peak in adult cases in Victoria. In contrast, the high secondary peak in young adults in New South Wales involved more serogroup B cases.

Phenotyping data obtained on the basis of serotyping and serosubtyping emphasise the considerable differences that exist in meningococcal subtypes causing IMD in different jurisdictions. The heterogeneity of serogroup B isolates present in Australia was once more evident in 2000. Of interest amongst the group B strains were phenotypes B:4:P1.4(7) and B:15:P1.7 associated with hyperendemic disease in New Zealand and Europe respectively. B:4:P1.4(7) strains were prominent in New South Wales with this phenotype representing about 15 per cent of all isolates. Phenotype B:15:P:1.7 was widely distributed.

Of particular interest in 1999 was the emergence in Victoria of a phenotype C:2a:P1.4(7) and this phenotype persisted in 2000, accounting for about 22 per cent of all isolates in that State. C:2a:P1.5 was present in most jurisdictions and was the most frequently isolated phenotype in New South Wales. In Victoria, C:2a:P1.2 was relatively common (about 10 per cent of isolates) but infrequently encountered elsewhere. These variations illustrate the temporal and geographic variation in meningococcal subtypes that occurs in Australia and the volatility in predominant phenotypes that may occur. Meningococci have a well-recognised capacity for recombination through horizontal gene transfer and this may be expressed in phenotypic heterogeneity.

The overall mortality recorded in 278 assessable culture-positive cases remained at about 9 per cent and a higher mortality rate was again observed with serogroup C cases. Although serogroup C strains have been associated with increased mortality overseas, other factors, such as

age, and time from onset to presentation and treatment, may also explain this difference. No data were available on this however.

No strains resistant to penicillin were detected in 2000. The highest MIC recorded was 0.5 mg/L in 3 isolates and the proportion of 'less susceptible' strains remained essentially unchanged. All isolates were susceptible to the prophylactic agents rifampicin and ciprofloxacin and to the third generation cephalosporins.

The NNN is a continuing, long-term collaborative study that has examined a total of about 2200 strains from all States and Territories since 1994. It has assisted in clarifying and expanding information on invasive meningococcal isolates in Australia to augment data collected separately by clinically-based surveillance systems. The nature and high public recognition of meningococcal disease together with the proposed release of new vaccine types, suggests that the efforts of this Programme should continue. For further details please contact the relevant NNN member (see acknowledgments for contact numbers).

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