Annual reports

Annual report of the Australian Meningococcal Surveillance Programme, 2007 – Amended

The Australian Meningococcal Surveillance Programme

Abstract

In 2007 there were 281 laboratory-confirmed cases of invasive meningococcal disease analysed by the National Neisseria Network, a nationwide network of reference laboratories. The phenotypes (serogroup, serotype and serosubtype) and antibiotic susceptibility of 154 isolates of *Neisseria meningitidis* from invasive cases of meningococcal disease were determined and an additional 127 cases were confirmed by non-culture based methods. Nationally, 223 (85%) confirmed cases where a serogroup was determined were infected with serogroup B and 17 (6.5%) with serogroup C meningococci. The total number of confirmed cases was 10 more than the 271 cases identified in 2006. Queensland and New South Wales recorded slight increases in case numbers and Victoria recorded a decline. Typical primary and secondary disease peaks were observed in those aged 4 years or less and in adolescents and young adults respectively. Serogroup B cases predominated in all age groups and jurisdictions. The common phenotypes circulating in Australia were B:15:P1.7, B:4:P1.4 and C:2a:P1.5. No evidence of meningococcal capsular 'switching' was detected. About three-quarters of all isolates showed decreased susceptibility to the penicillin group of antibiotics (MIC 0.06–0.5 mg/L). All isolates remained susceptible to rifampicin. A single serogroup B isolate had decreased susceptibility to ciprofloxacin (MIC 0.06 mg/L). This was the first local isolate of this type since the original report of this phenomenon in Australia in 2000. *Commun Dis Intell* 2009;33:1–9 (replacement for *Commun Dis Intell* 2008;32:299–307).

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

Introduction

There has been a significant reduction in the number of cases of invasive meningococcal disease (IMD) following the completion, in 2004, of a publicly-funded program of selective vaccination with conjugate serogroup C meningococcal vaccine. However, IMD remains an issue of public health concern in Australia, including the continuing need for analysis of the subtypes of *Neisseria meningitidis* responsible for current cases.

A national laboratory-based program for the examination of *N. meningitidis* from cases of IMD, the National Neisseria Network (NNN), has operated since 1994 through the collaboration of reference laboratories in each jurisdiction. The NNN supplies information on the phenotype and/or the genotype of invasive meningococci, and their antibiotic susceptibility and these data supplement those from clinical notification schemes. The characteristics of the meningococci responsible for IMD are important both for individual patient management and to tailor the public health response. Annual reports summarising data gathered since the inception of the program were published in *Communicable Diseases Intelligence*.[1,2] The following is an amended version of the report analysing the characteristics of meningococci isolated in the calendar year 2007 published earlier.[3] This report includes additional data from 1 jurisdiction.

Methods

The NNN continues as a long-term collaborative program for the laboratory surveillance of the pathogenic Neisseria, *N. meningitidis* and *N. gonorrhoeae*. A network of reference laboratories in each state and territory performs and gathers laboratory data on cases of IMD throughout Australia. A list of reference laboratories is contained in the acknowledgements.

Isolate based invasive meningococcal disease cases

Each case confirmation was based upon isolation of a meningococcus from a normally sterile site 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 e.g. where there was no lumbar puncture or else where lumbar puncture was delayed and the culture sterile, is underestimated. However the above approach has been used since the beginning of this program[1] 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 (porin) antigens using a standard set of monoclonal antibodies obtained from the National Institute for Public Health, The Netherlands. Increasingly, sequencing of products derived from amplification of the porin genes *porA* and *porB* has been used to supplement and supplant serotyping analyses based on the use of monoclonal antibodies. For the purposes of continuity and comparability, the typing data from both approaches has been unified in the accompanying tables by converting sequence data to the more familiar serotyping/serosubtyping nomenclature.

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 standardized 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 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. However, precise 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 including nucleic acid agglutination testing (NAAT) and serological techniques. NAAT testing is essentially by polymerase chain reaction (PCR) techniques[6] and has been progressively introduced in the different jurisdictions. Data from the results of these investigations were included for the first time in the 1999 report.[1] The serological results are based on results of tests performed using the methods and test criteria of the Manchester Public Health Laboratory Service reference laboratory, United Kingdom 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. This separation is not possible for cases diagnosed serologically.

Results

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

Number of laboratory confirmed cases

There were 281 laboratory confirmed cases of IMD in 2007 (Table 1) compared with 271 in 2006, 345 in 2005 and 361 in 2004. In 154 cases (54.8%), a positive culture was obtained with or without a positive non-culture based test and 127 cases were confirmed by a non-culture based method alone. The total number of all laboratory confirmed cases increased in New

Table 1. Number of laboratory confirmed cases of invasive meningococcal disease, Australia, 2007, by state or territory and serogroup

State or territory	Serogroup						NG	Total
	B	C	A	X	Y	W135		
ACT	4	0				1		5
NSW	78	6			5	1	11	101
NT	1	1						2
Qld	61	7		1	2	3	1	75
SA	11	1			1	0	1	14
Tas	3	0			1	1		5
Vic	46	2			4	3	4	59
WA	19	0					1	20
Australia	223	17	0	1	13	9	18	281

NG Not serogrouped.

South Wales where numbers detected rose to 101 from 84 after a decrease in 2006 and in Queensland from 68 in 2006 to 75. Small or no numerical differences were noted in other jurisdictions with the exception of Victoria where numbers decreased from 75 to 59.

Seasonality

Forty cases occurred between 1 January and 31 March 2007, 53 between 1 April and 30 June, 108 between 1 July and 30 September and 80 between 1 October and 31 December. A winter peak of meningococcal disease is more usual.

Age distribution

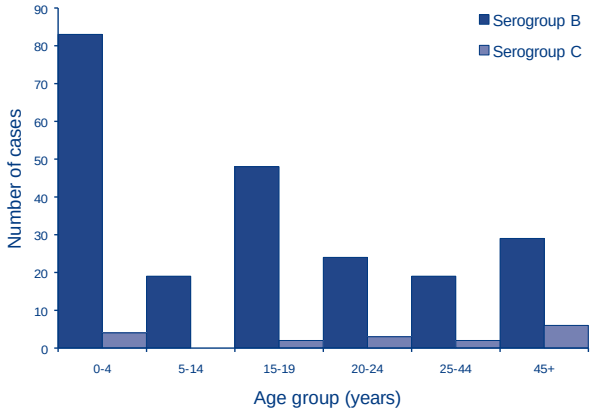
Nationally, the peak incidence of meningococcal disease was again in those aged 4 years or under (Table 2, Figure). Those aged less than 1 year or in the 1–4 year age group together accounted for 100 cases (35.5% of the total) in 2007. There were also 100 cases confirmed in these age groups (37%) in 2006. A secondary disease peak is also usual in the adolescent/young adult age group. The total of 56 cases (19.9% of all confirmed cases) in those aged 15–19 years was a little more than the 49 cases (18%) in this age group in 2006 (49, 18%). Those aged 15–24 years accounted for 87 cases (31%) in 2007 and 79 cases (29%) in 2006.

Table 2. All laboratory confirmed serogroup B and C cases of invasive meningococcal disease by age, Australia, 2007, by state or territory

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	2						1			4
	C											0
	Total	2	2						1			5
NSW	B	10	21	3	4	7	9	12	8	4	0	78
	C	1	1	0	0	0	1	0	3	0		6
	Total	15	24	3	6	8	10	15	12	8	0	101
NT	B						1					1
	C					1						1
	Total					1	1					2
Qld	B	10	14	4	2	15	4	5	5	2		61
	C		2			1	2	1		1		7
	Total	10	19	5	4	16	7	6	5	3		75
SA	B	2	3	1		4				1		11
	C								1			1
	Total	2	3	1		5	1		1	1		14
Tas	B		1		1						1	3
	C											0
	Total		1		1	1				1	1	5
Vic	B	8	6	1	3	17	7	0	3	1		46
	C							1	1			2
	Total	9	8	2	3	20	9	3	4	1		59
WA	B	2	2			5	3	2	4		1	19
	C											0
	Total	2	3			5	3	2	4		1	20
Australia	B	33	49	9	10	48	24	19	21	8	2	223
	C	1	3	0	0	2	3	2	5	1	0	17
	Total B+C	34	52	9	10	50	27	21	26	9	2	240
	other	6	8	2	4	6	4	5	1	5	0	41
	Total	40	60	11	14	56	31	26	27	14	2	281
	% of all	14.2	21.4	3.9	5	19.9	11	9.3	9.6	5	0.7	

NS Not stated. [Totals include cases due to other serogroups (23) and cases where the serogroup was not determined (18).]

Figure. Number of serogroup B and C cases of invasive meningococcal disease confirmed by all methods, Australia, 2007, by age



Serogroup data

The serogroup of the meningococci causing disease was determined in 264 of the 281 laboratory confirmed cases of IMD. Of these 264 cases where a serogroup was determined, 223 (85%) were serogroup B and 17 (6.5%) were serogroup C. In 2006, 217 (83.8%) cases were serogroup B and 26 (10%) were serogroup C. In 2007, an additional 9 cases (3.4%) were of W135 and 13 (4.9%) of serogroup Y. A serogroup X meningococcus was detected in Queensland. With the continuing decline in numbers of serogroup C infections, serogroup B meningococci predominated in all age groups and jurisdictional differences in serogroup distribution were not evident. Eight of the 17 cases of serogroup C disease in 2007 were in those aged 25 years or more, 2 cases were recorded in those aged 15–19 years and a further three in those aged 20–24 years. Seven serogroup C cases were identified in those aged 15–24 years in 2006. Queensland and New South Wales each accounted for 7 serogroup C cases.

Table 3 shows a comparison of the number and proportion of serogroup B and C cases by age from 2004 to 2007. In those aged 14 years or less, there was a decrease in total case numbers and in serogroup B cases in 2007. Serogroup C case numbers were always low in these age groups. In those aged 15–19 years and 20–24 years, the number of serogroup B cases has remained relatively unaltered, but the proportion of serogroup B cases increased as serogroup C cases declined. In older (25 years or more) age groups there was an increase in serogroup B cases in 2007 but a continuing decrease in serogroup C cases, so that again the proportion of serogroup B IMD increased over time.

Phenotypes of invasive meningococcal isolates

The typical heterogeneity of serogroup B meningococci was again seen in 2007 when the phenotypes of invasive isolates, based on a determination of their serogroup, serotype and serosubtype were analysed. The predominant serotypes/serosubtypes in each state and territory are shown in Table 4. Serogroup B meningococci are in general also more difficult to characterise by serological methods and a number could not be phenotyped. A total of 27 isolates were of serotype 4. Twelve of these were

Table 3. A comparison of the number and proportion of serogroup B and serogroup C laboratory-confirmed cases, 2004 to 2007, by age

Year	Serogroup	Age									
		< 4 years		5–14 years		15–19 years		20–24 years		25+ years	
		n	%	n	%	n	%	n	%	n	%
2007	B	83	90	19	83	48	91	24	80	49	75
	C	4	4	0		2 4		3	10	8	12
	All*	92		23		53		30		65	
2006	B	93	93	21	84	40	82	21	70	38	61.3
	C	2	2	3	12	4	8.2	7	23	10	16.1
	All	100		25		49		30		62	
2005	B	99	90	38	75	39	81	22	67	51	50
	C	6	5.5	5	10	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	

* All cases where a serogroup was determined.

Table 4. Common serotypes and serosubtypes of isolates from culture positive cases of Neisseria meningitidis infection, 2007, by state or territory

State or territory	Serogroup B				Serogroup C			
	Serotype	n	Serosubtype	n	Serotype	n	Serosubtype	n
ACT	4	1	1.4	1				
NSW	4	20	1.4	8	2a	4	1.5	2
			1.15	4			1.2	1
			1.7	2			1.4	1
			1.14	2				
			1.5	1				
			1.5,2	1				
			1.22,14	1				
			nst	1				
	15	5	1.5	5				
	1	3	1.4	1				
			nst	2				
	nt	14	1.9	3				
			1.14	1				
			1.15	1				
			1.16	1				
			1.4	1				
			nst	7				
NT					2a	1	1.5	1
Qld	1	7	1.14	4	2a	5	1.5	3
			1.4	2			nst	2
	15	4	1.7	3				
	nt	21	1.14	5				
			1.15	1				
			nst	12				
Tas	nt	1	1.17	1				
Vic	4	6	1.4	3	2a	2	1.16	2
			1.15	2				
			nst	1				
	15	6	1.7,16	4				
			1.4	1				
			1.5,10	1				
	nt	9	1.5,2	3				
			1.14	3				
			1.5,15	1				
			1..15	2				
			1..16	1				
			nst	2				
WA	14	1	1.5	1				
	15	1	nst	1				
	1	1	1.14	1				
	nt	6	diverse					

nt Not serotypable.

nst Not serosubtypable.

of serosubtype P1.4: eight from New South Wales, three from Victoria and one from the Australian Capital Territory. Fourteen serogroup B strains with this subtype/serosubtype were seen in 2006. This phenotype has been circulating in New Zealand at high rates for many years. Another 16 serogroup B isolates were of serotype 15 and included 5 of serosubtypes 1.5 and 10 of serosubtype 1.7. The latter phenotype has been circulating in Australia for many years.

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 is of particular interest. This phenotype has figured prominently in Victorian data in former years. Nationally, there were 29 cases of serogroup C isolates of this serotype/serosubtype detected in 2003; 21 in 2004, and eight in 2005. Only a single isolate with this phenotype was seen in 2007 (in New South Wales). All of the serotypeable serogroup C isolates were of serotype 2a.

Outcome data for invasive meningococcal disease for laboratory confirmed cases

Outcome data (survived or died) were available for 100 (35%) of the 281 laboratory confirmed cases (Table 5). Four deaths were recorded in this group (4%). Outcomes were available for 73 of 223 of serogroup B infections and five of 17 serogroup C infections. There was a single death from each of serogroup B and serogroup Y infections and two attributable to serogroup C. There were 2 deaths among 39 patients with meningitis, one due to a serogroup B and the other to a serogroup C meningococcus. Two deaths were recorded among 56 bacteraemic patients, one each due to serogroup C and serogroup Y infection. There were 39 cases of serogroup B meningococcal bacteraemia with no deaths. The single fatality with serogroup Y disease was in a group of 6 bacteraemic cases where outcomes were recorded. The septicaemic fatality due to serogroup C meningococci was recorded in 4 instances of bacteraemia with this serogroup.

Anatomical source of samples for laboratory confirmed cases

Table 6 shows the source of clinical samples by which laboratory confirmation of IMD was obtained. Those diagnoses shown as culture positive may have had positive PCR and/or serology, those shown as PCR positive were culture negative with or without positive serology and those shown as serologically positive were culture and PCR negative. There were 38 isolates from CSF either alone or with a blood culture isolate and 111 from blood cultures alone. There were 4 other isolates from synovial fluid and one, most unusually from the peritoneal fluid of a patient undergoing peritoneal dialysis.

Antibiotic susceptibility surveillance of invasive meningococcal isolates

Penicillin

One hundred and fifty-three isolates were available for determination of their susceptibility to penicillin and other antibiotics. Using defined criteria, 121 isolates (79%) were less sensitive to penicillin in the MIC range 0.06–0.5 mg/L and the remainder (21%) fully sensitive (MIC 0.03 mg/L or less). The proportion of less sensitive strains is higher than that reported in recent years (67% in 2006). Seven iso-

Table 5. Outcome data (survived, died) for laboratory confirmed cases of invasive meningococcal disease, 2007, by syndrome and serogroup

Disease type	Outcome	Serogroup					Total
		B	C	Y	W135	NG	
Meningitis	Survived	32	0	2	2	1	37
	Died	1	1	0	0	0	2
	Total	33	1	2	2	1	39
Septicaemia	Survived	39	3	5	2	5	54
	Died	0	1	1	0	0	2
	Total	39	4	6	2	5	56
All cases*	Survived	72	3	7	5	8	96
	Died	1	2	1	0	0	4
	Total	73	5	8	5	8	100

* Includes 3 cases of joint infection, one each of serogroup B and W135 and 1 non-sero-groupable and 1 case of septicaemia serogroup X, all of whom survived.

NG Not groupable.

Table 6. Anatomical source of samples positive for a laboratory confirmed case of invasive meningococcal disease, Australia, 2007

Specimen type	Isolate of MC	PCR positive*	Total
Blood	111	64	175
CSF +/– blood	38	57	95
Other†	5	1	6
Serology alone‡			5
Total	154	122	281

* Polymerase chain reaction (PCR) positive in the absence of a positive culture.

† Joint and fluid samples (4 isolates from joints and 1 by PCR of joint fluid; 1 culture from peritoneal fluid).

‡ Serology positive in the absence of positive culture or PCR.

lates had MICs of 0.5 mg/L. Six of these were found in New South Wales. Four were of serogroup B and three of serogroup Y.

Other antibiotics

All isolates were fully susceptible to ceftriaxone (and by extrapolation to other third generation cephalosporins). A single serogroup B strain from Queensland had a slightly elevated MIC for rifampicin of 1 mg/L. Another serogroup B isolate from New South Wales had reduced susceptibility to ciprofloxacin at an MIC of 0.06 mg/L.

Discussion

Overall, the number of cases has stabilised in 2007 with a small rise to 281 following the fall to 271 cases in 2006 after recording 345 cases in 2005. Much of the interpretation of these surveillance data needs to be in the context of the recently completed program of vaccination of children and adolescents with the serogroup C conjugate vaccine. The only jurisdictions to show small rises in the number of laboratory confirmed cases were Queensland and New South Wales. Cultures were obtained from sterile sites in 154 cases, the lowest number of isolates detected over the duration of the program that commenced in 1994 and a further decline from the 166 cases from whom isolates were obtained in 2006. Non-culture based diagnoses were used to confirm a further 127 (45%) of cases as IMD.

Only 17 serogroup C infections were identified nationally in 2007, 13 of these in Queensland and New South Wales combined, so that serogroup B disease accounted for 85% of all infections where a serogroup was determined. Only small numbers of infections due to serogroups Y and W135 were encountered, and this is usual for Australia. A serogroup X case was identified in Queensland. The NNN has not identified serogroup X cases previously, but prior to its inception serogroup X infection has been identified in Australia. A primary peak in IMD infection rates was again evident in younger age groups with a secondary peak in adolescents and young adults. In contrast to data from the earlier years of this program, serogroup C disease was infrequently encountered in the latter age group in 2007. Also of interest is the continuing decline in numbers of IMD in those aged 25 years or more (Table 3). A decrease in serogroup C cases in essentially unvaccinated age groups has been noted elsewhere. It is attributed to the secondary benefit of herd immunity accruing to the wider community following vaccination of those age groups where disease was formerly highly concentrated.[11]

The continuing absence of any substantial number of meningococci showing evidence of genetic recombination in phenotyping and genotyping data is reassuring and also consistent with data from the United Kingdom.[11] 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 low proportion of cases and must be interpreted with caution. The NNN does not attempt collection of morbidity data associated with IMD.

NNN trend data show an upward shift in penicillin MICs insofar as the proportion of invasive isolates with reduced susceptibility to penicillins increased from 67% to 79% in 2007. However penicillins remain a suitable treatment for IMD in Australia. All isolates were susceptible to the third generation cephalosporins and to the 'clearance' antibiotic rifampicin. Of particular interest was a serogroup B isolate from New South Wales with reduced susceptibility to ciprofloxacin (0.06 mg/L). The first ever reported case of an invasive *N. meningitidis* with reduced susceptibility to fluoroquinolones and where the molecular basis of the resistance mechanism involved was also described arose from surveillance conducted by this program.[12] Subsequently, other sporadic cases of meningococci

with reduced quinolone susceptibility have been reported in several countries, and more recently, clusters of quinolone less-susceptible meningococci have also been described in India[13] and the United States of America.[14] Serogroups A, B, C and Y have all exhibited this decreased quinolone susceptibility and a number of different resistance mechanisms are now known to be involved. Invasive meningococci possess the potential to develop full resistance to quinolones (similar to MIC levels now seen in quinolone-resistant *Neisseria gonorrhoeae*)[15] so that antimicrobial resistance surveillance remains an important component of Australian Meningococcal Surveillance Programme activities.

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Australian Meningococcal Surveillance Programme members in 2007 are: John Bates, Denise Murphy, Helen Smith, Public Health Microbiology, Queensland Health Scientific Services, Coopers Plains, Queensland, Athena Limnios, Sanghamitra Ray, Nhu Lan Nguyen and John Tapsall, Department of Microbiology, The Prince of Wales Hospital, Randwick, New South Wales; Jo Mercer and Robert Porrit, Department of Microbiology and Infectious Diseases, SWAPS, Liverpool, New South Wales; Geoff Hogg, Julia Griffith and Angelo Zaia, The Microbiological Diagnostic Unit (PHL, Department of Microbiology and Immunology, University of Melbourne, Parkville, Victoria); Andrew Lawrence, Microbiology Department, Women's and Children's Hospital, North Adelaide SA, South Australia; Peter Campbell and Tony Keil, Department of Microbiology, Princess Margaret Hospital for Children, Subiaco, Western Australia; Mark Gardam and Belinda Chamley, (Department of Microbiology and Infectious Diseases, Royal Hobart Hospital, Hobart, Tasmania); Gary Lum and Microbiology Staff, (Microbiology Laboratory, Royal Darwin Hospital, Casuarina, Northern Territory;) Susan Bradbury and Peter Collignon, (Microbiology Department, Canberra Hospital, Garran, Australian Capital Territory).

Participants in the 2007 Australian Meningococcal Surveillance Programme (to whom isolates and samples should be referred and enquiries directed) are listed below.

Australian Capital Territory

Dr P Collignon/Ms S Bradbury
Microbiology Department
The Canberra Hospital
PO Box 11
Garran ACT 2606
Telephone: +61 6 244 2425
Email: peter.collignon@act.gov.au

New South Wales

J Tapsall/A Limnios/TR Shultz
Microbiology Department
SEALS
The Prince of Wales Hospital
Randwick NSW 2031
Telephone: +61 2 9382 9079
Facsimile: +61 2 9398 4275
Email: j.tapsall@unsw.edu.au

J Mercer/R Porritt
Department of Microbiology and Infectious Diseases
SWAPS
Locked Mail Bag 90
Liverpool NSW 2179
Telephone: +61 2 9828 5128
Facsimile: +61 2 9828 5129
Email: Joanne.Mercer@swsahs.nsw.gov.au or Robert.Porritt@swsahs.nsw.gov.au

Northern Territory

Paul Southwell and staff
Microbiology Laboratory, NTGPS
Royal Darwin Hospital Campus
Tiwi NT 0810
Telephone: +61 8 8922 8034
Facsimile: +61 8 8980 0714
Email: paul.southwell@nt.gov.au

Queensland

John Bates/Denise Murphy/Helen Smith
Public Health Microbiology
Queensland Health Scientific Services
39 Kessels Road
Coopers Plains QLD 4108
Telephone: +61 7 3274 9101
Facsimile : +61 073274 9175
Email: john_bates@health.qld.gov.au

Tasmania

Dr A McGregor/Mr Mark Gardam/
Mrs Belinda Chamley
Department of Microbiology and Infectious Diseases
Royal Hobart Hospital
GPO Box 1061L
Hobart TAS 7001
Telephone: +61 36222 8656
Email: mark.gardam@dhhs.tas.gov.au

South Australia

Mr A Lawrence
Microbiology Department
Women's and Children's Hospital
72 King William Road
North Adelaide SA 5006
Telephone: +61 8 8161 6376
Facsimile: +61 8 8161 6051
Email: andrew.lawrence@cywhs.sa.gov.au

Victoria

Geoff Hogg/Julia Griffith/Angelo Zaia
Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL)
Department of Microbiology and Immunology
The University of Melbourne
Parkville VIC 3052
Telephone: +61 3 8344 5701
Facsimile: +61 3 8344 7833
Email: g.hogg@mdu.unimelb.edu.au

Western Australia

Mr P Campbell/Dr AD Keil
Department of Microbiology
Princess Margaret Hospital for Children
1 Thomas Street
Subiaco WA 6008
Telephone: +61 8 9340 8273
Facsimile: +61 8 9380 4474
Email: tony.keil@health.wa.gov.au; peter.campbell@health.wa.gov.au

Author details

Correspondence: Associate Professor John Tapsall, Department of Microbiology, SEALS, The Prince of Wales Hospital, High Street, RANDWICK, NSW 2031.

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