Invasive Pneumococcal Disease in Children Aged Under Five Years in Queensland, in 2002

Communicable Diseases Unit
Public Health Services

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Executive Summary

In 2002, 166 children aged under five years in Queensland were notified as having Invasive Pneumococcal disease (IPD), representing an incidence of 66.6/100,000 in this age group. This age group accounted for 38% of the total number of cases of IPD notified in Queensland, which is similar to previous years. There were no deaths amongst children aged under five years in 2002. Seventy-one percent of the cases aged under five years were aged under two years. Twelve children were identified as Indigenous which is not an over-representation of this group.

Seventy-three percent of the cases had bacteraemia as the primary diagnosis. Bacteraemia was more common in Non-Indigenous (76%) than in Indigenous children (33%), in whom pneumonia was a more common presentation (67%). Forty-six cases (28%) had one or more medical risk factors for IPD. There was a reduction in rates of IPD for children in the north of the State in 2002 compared with 2001 although this did not reach statistical significance. The reduction of rates in the north are likely to be due to the vaccination program for Indigenous children aged under two years but further monitoring is required to monitor the coverage and impact of this program.

The most common serotype amongst the pneumococcal isolates in 2002 (31.9%) was serotype 14, which is included in the 7-valent pneumococcal conjugate vaccine (7vPCV). Of all IPD in non-Indigenous children aged under five years in 2002, 88% was due to serotypes that are included in the 7vPCV. Of all IPD in Indigenous children aged under five years in 2002, 45% was due to serotypes that are included in the 7vPCV. Among all cases of IPD in children aged under five years, 21 (13%) were potentially avoidable as they occurred in children eligible for vaccination but not vaccinated, and the serotypes were included in the 7vPCV. There were no vaccine failures in 2002. There was reduced susceptibility to penicillin for 14.7% of isolates.

A universal vaccination program would decrease the amount of IPD for all young children, particularly in non-Indigenous children, although this report does not include a cost-benefit analysis of such a program. A universal vaccination program would be less complicated to administer than the existing program, which requires service providers to identify and vaccinate eligible children. Continued monitoring is needed to observe changes patterns of this disease to further monitor the impact of the current vaccine program strategies, control and management of this disease.

1. Introduction

Invasive Pneumococcal Disease (IPD) is an uncommon disease, which usually manifests as bacteraemia, pneumonia or meningitis.

IPD has been a notifiable disease in Queensland since 1996. The data are maintained on the Notifiable Conditions database (NOCS). Enhanced surveillance of cases aged under five years, conducted by communicable diseases staff of the Public Health Units, began state-wide in July 2001[1]. . The epidemiology of all cases of IPD is described in the Queensland Health 1997-2001 Notifiable Diseases Report[2] and in the report of Notifiable Diseases in 2002 (in preparation)..

The purposes of this report are:

- To describe the epidemiology of IPD in Queensland in 2002 in children under five years.
- To describe trends of the disease since 1997 overall but focussing principally on trends in children aged under five years.

2. Methods

Cases of IPD are detected by:

Isolation of *Streptococcus pneumoniae* from a normally sterile site

Public health units seek information on each notified case from the attending medical staff and from the case or next of kin. A standardised case reporting form is used. Analysis was performed in Excel, and Epi-Info 6. Chi-square tests were used where appropriate.

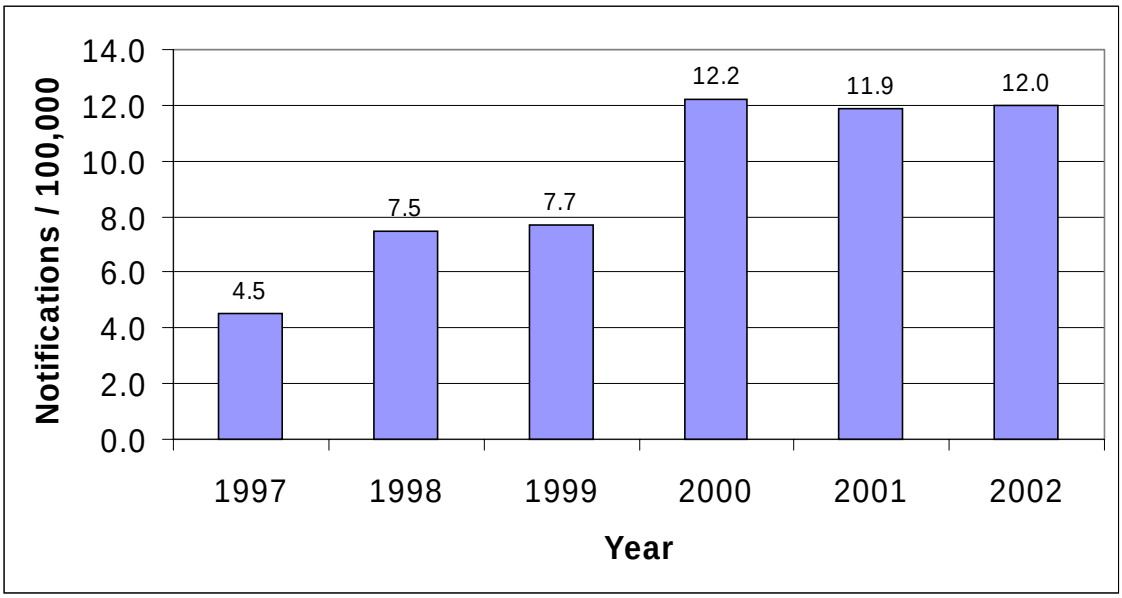
[1] IPD surveillance began in Far North Queensland in 1992 with comprehensive enhanced surveillance data collection on all cases since 1999.
Hills, S.L., Hanna, J.N., Murphy, D. 2002. Invasive pneumococcal disease in North Queensland, 2001. Commun Dis Intell; 26: 520-524.
Hanna, J.N., Young, D.M., Brookes, D.L. 2001. The initial coverage and impact of the pneumococcal and influenza vaccination program for at- risk indigenous adults in Far North Queensland. Aust. N.Z.J. Public Health; 25: 543-546.

[2] Queensland Health 1997-2001 Notifiable Diseases Report. 2002. Queensland Health. http://www.health.qld.gov.au/phs/Documents/cdu/15896.pdf

3. Results

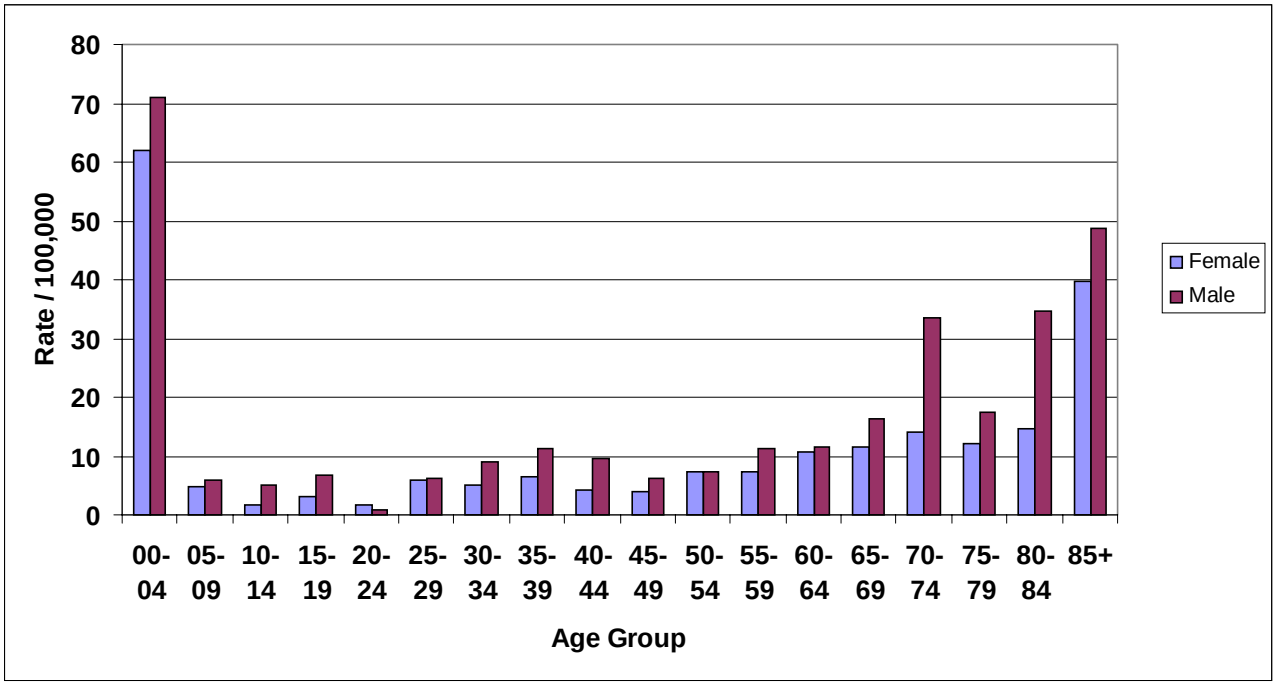
There were 437 notifications of IPD in Queensland in 2002. This is an incidence of 12.0/ 100,000, which is similar to the previous two years (Figure 1). Of these notifications, 166 (38%) were in children aged under five years. This age group had the highest age specific rate of 66.6/100,000 (Figure 2); this rate is similar to that in previous years [1]. There were four deaths in 2002, all occurring in adults, representing an overall case fatality rate of 0.9%.

Figure 1. Annual incidence per 100,000 of invasive pneumococcal disease, Queensland 1997 – 2002



*Rates calculated using the estimated resident population (erp) for each year except for 2002 which were not available; the 2001 erp were used for 2002 data.

Figure 2. Notifications of IPD per 100,000 by age groups in 2002



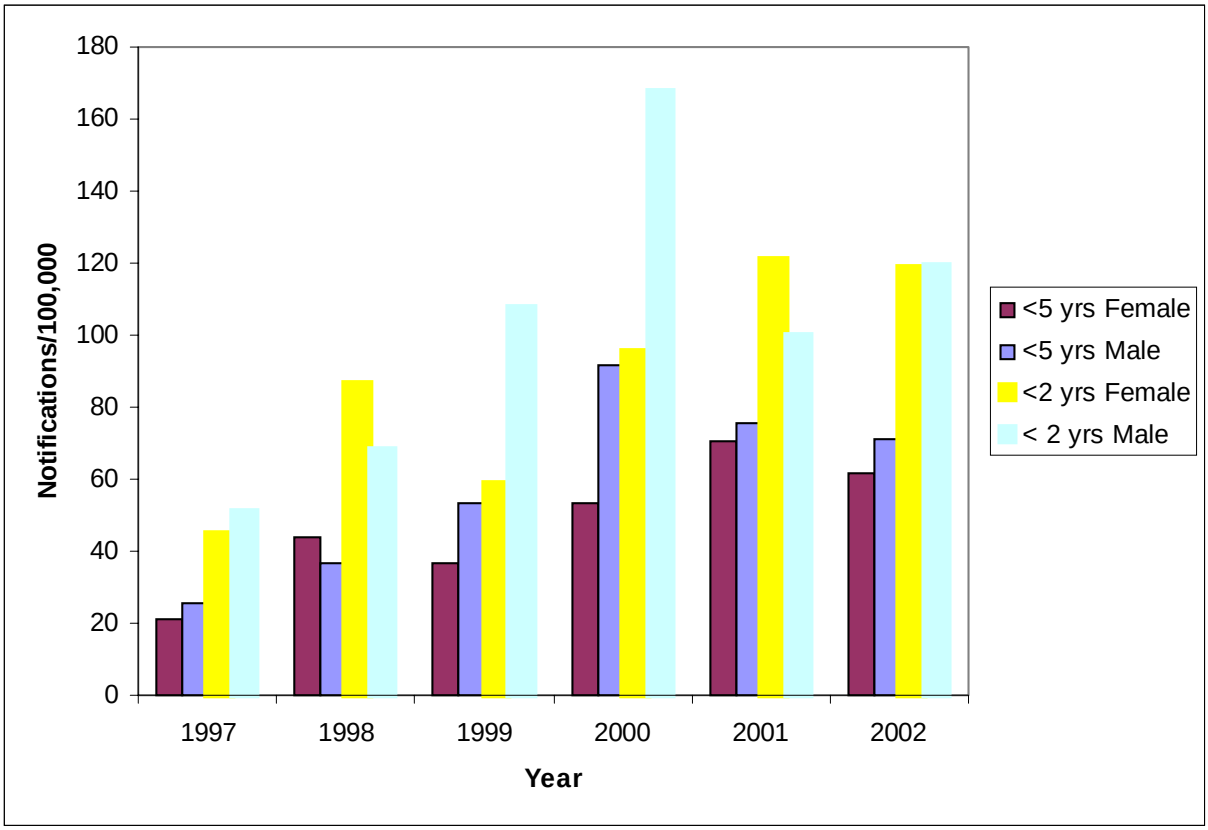
*Rates calculated using 2001 erp.

The following results refer to notifications in children aged under five years only.

3.1 Age and gender distribution

The highest rates of notifications of IPD in 2002 were in children aged under two years (Figure 3). During 2002 in Queensland, there were 118 notifications of IPD in children aged under two years; 52% male, 48% female. This represents 71% of notifications in children aged under five years. In all children aged under five years, 91 (55%) were males and 75 (45%) were females. Males have been slightly over-represented in notifications of IPD in children aged under five years for the previous three years. Rates in 2002 were not significantly different for either males and females in the <2 or <5 year old age groups compared with the same gender and age specific rates in 2001 (p= or >0.4).

Figure 3. Notifications of IPD per 100,000 for 0-4 year olds and 0-1 year olds, 1997-2002



*Rates calculated using the erp for each year except for 2002 which were not available; the 2001 erp were used for 2002 data.

3.2 Indigenous status

Indigenous status was not identified for 28 (17%) of the notifications of IPD in children aged under five years. Of the 138 cases with Indigenous status identified, twelve (9%) were recorded as Indigenous. This is not significantly different from the proportion of Indigenous children in this age group in Queensland, where 6.2% are estimated to be Indigenous (p= 0.2).

3.3 Seasonal Variation

Table 1 shows notifications by month of onset in 2002. As in previous years, the incidence of disease peaked during late winter or early spring [2].

Table 1. Notifications of IPD in children aged under five years by month of onset in Queensland, 2002

Month	Number of notifications	Percent
Jan	5	3.0%
Feb	2	1.2%
Mar	7	4.2%
Apr	7	4.2%
May	15	9.0%
Jun	22	13.3%
Jul	20	12.0%
Aug	29	17.5%
Sep	23	13.9%
Oct	18	10.8%
Nov	8	4.8%
Dec	10	6.0%
Total	**166**	**100.0%**

3.4 Primary diagnoses

Table 2. Primary diagnoses of notified cases of IPD in children aged under five years, Queensland 2002.

Clinical Presentation	Number of notifications	Percent
Meningitis	6	3.6
Pneumonia	39	23.5
Bacteraemia	108	65.1
Osteomyelitis	1	0.6
Eye disease	1	0.6
Not stated	11	6.6
Total	**166**	**100**

Bacteraemia was the most common primary diagnosis in this age group (Table 2).

There were significant differences in the primary diagnoses in Indigenous and non-Indigenous children ($p \leq 0.02$). Of nine Indigenous children with their diagnoses recorded, 33% had bacteraemia while of 115 Non-Indigenous children with their diagnoses recorded, 76% had bacteraemia alone. Pneumonia was the most common primary diagnosis in Indigenous children (67%) compared with 22% in non-Indigenous children.

3.5 Geographic distribution

Table 3 shows the distribution of notified cases of IPD in children aged under five years by statistical division (SD); Brisbane SD has the highest rate of notifications (94.0/100,000). This is a similar rate to the previous year (88.5/100,000) in Brisbane SD. Rates in the north of the state have fallen since 2001 (Table 3). These changes failed to reach statistical significance due to small numbers (p= 0.09, 1.0 and 0.1 for Far North, North west and Northern SDs respectively). Numbers are small in these northern areas particularly in the North West so they are prone to random fluctuation but overall rates were consistently high in these areas in the years 1997-2001 due to the high rates in the zero to four age group [2].

Table 3. Notifications of IPD in children aged under five years, by Statistical Division, Queensland, with rates in 2002 compared with 2001.

Statistical Division	Number of notifications In 2002	Rate per 100,000 in 2002	Rate per 100,000 in 2001
Brisbane	103	94.0	88.5
Central West		0.0	0.0
Darling Downs	7	45.6	39.1
Far North	7	41.3	88.4
Fitzroy	3	21.7	43.5
Mackay	2	21.2	31.7
Moreton	27	57.9	55.7
North West	2	55.3	82.9
Northern	6	40.4	87.6
South West	1	43.0	43.0
Wide Bay-Burnett	8	51.2	38.4
Total	**166**	**66.2**	**70.6**

*Rates calculated using 2001 erp.

3.6 Predisposing factors

Missing data constrains reporting on predisposing conditions. Details about passive smoking was missing for 36% of cases, details about congenital or chromosomal abnormality was missing for 30% of cases, and details on prematurity was missing for 86% of cases. Concerns were identified regarding interpretation of the question about prematurity.

Of all children aged under five years notified with IPD in 2002, fifty children (30%) were in recognised at risk groups. This included12 Indigenous children and 46 children with one or more medical risk factors. Eight of the 12 Indigenous children were included in the 46 children with medical risk factors for IPD. Two cases were identified as having immunocompromising conditions, seven were reported as having congenital or chromosomal abnormalities, and nine were reported to have chronic or other predisposing conditions. Eighteen children were reported to be born premature. Three of the cases with the above-mentioned predisposing factors and a further 13 were reported to have a smoker in the house.

3.7 Laboratory diagnosis

The majority of notifications of IPD in children aged under five years (97%) were diagnosed by blood culture (Table 4).

Table 4. Laboratory specimen tested for cases of IPD in children aged under five years, Queensland 2002.

Specimen	Number of cases
Blood	161
Cerebrospinal fluid	4
Pleural aspirate	1
Total	**166**

3.8 Serotypes and and vaccination status

Serotypes were obtained for 161 of the 166 isolates. The most common serotype was serotype 14, which is included in the 7-valent pneumococcal conjugate vaccine, (7vPCV, Prevenar®). This serotype was identified as the cause of 33% of notified cases in non-Indigenous children aged under five years and 33% of notified cases in Indigenous children aged under five years (Table 5). The serotypes 33F and eight were isolated only from Indigenous children but numbers are small and this may be a random finding.

Overall, 86% of the 161 serotypes are included in the 7vPCV. Of all IPD in non-Indigenous children aged under five years in 2002, 88% was due to serotypes included in the 7vPCV, compared to 45% in the isolates from Indigenous children ($p<0.001$).

Among all cases of IPD in children aged under five years, 21 (13%) were potentially avoidable as they occurred in children eligible for vaccination but not vaccinated, and the serotypes were included in the 7vPCV[3]. This included three Indigenous children, and 18 Non-Indigenous children with recognised medical risk factors (Table 6).

There were no IPD infections in fully vaccinated children i.e. there were no known vaccine failures identified in children aged under five years in 2002. Twenty-four of 166 (14.5%) children with notified IPD in 2002 had received at least one dose of 7vPCV. However, 20 of these children had received only one dose of 7vPCV at the time of infection and none had received a full primary course.

Of the 24 children who received any dose of 7vPCV, 10 were not eligible for funded vaccine. The other 14 were eligible to receive funded vaccine; six of the 12 Indigenous children and eight of the 37 non-Indigenous children with recognised risk factors had received at least one dose of 7vPCV. Two Indigenous children notified with IPD in 2002 had been fully vaccinated for their age but were infected with serotypes not present in the 7vPCV (33F and 8).

[3] Roche, P, Vicki Krause et al. 2002. Invasive pneumococcal disease in Australia, 2001. CDI; 26: 505-519.

Table 5. Serotypes of invasive pneumococcal isolates in children aged under five years, Queensland 2002.

Serotype	Number of cases	% of cases
14*	53	31.9%
6B*	26	15.7%
18C*	19	11.4%
19F*	17	10.2%
4*	12	7.2%
6A	7	4.2%
19A	5	3.0%
23F*	5	3.0%
9V*	5	3.0%
33F	3	1.8%
11A	1	0.6%
15B	1	0.6%
19B	1	0.6%
22A	1	0.6%
22F	1	0.6%
3	1	0.6%
38	1	0.6%
7F	1	0.6%
8	1	0.6%
NON-TYPEABLE	1	0.6%
NON-VIABLE	2	1.2%
Not known	2	1.2%
Total	166	100.0%

* Serotypes present in 7vPCV

Table 6. Serotypes of invasive pneumococcal isolates in unvaccinated children aged under five years, Queensland 2002

Serotype	Indigenous	Non-Indigenous (cases with predisposing factors)
11A		1
14*	2	31 (5)
15B		1
18C*		15 (3)
19A		3
19B		1
19F*		13 (1)
22A		
22F		1
23F*		2
3		
33F	1	
38		1
4*		10 (3)
6A		4
6B*	1	18 (5)
7F		1
9V*		2 (1)
NON-TYPEABLE		1
Not known	1	
Total	**5**	**105**

* Serotypes present in 7vPCV

3.9 Antibiotic sensitivities

Penicillin resistance was found in five of 163 (3.1%) isolates tested and a further 19 (11.6%) isolated yielded an intermediate sensitivity so that there was an overall reduced susceptibility to penicillin for 14.7% of the isolates.

Eleven of 163 (7%) isolates available for antibiotic testing were resistant to three or more groups of antibiotics (chloramphenicol, co-trimoxazole, erythromycin, penicillin and /or tetracycline) ie. considered to be multi-resistant. They were all sensitive to vancomycin and rifampicin. Multi-resistance was identified for two serotypes (6B and 19F), both of which are included in the 7vPCV.

3.10 Outcome

There were no deaths among the notified cases of IPD in 2002 in children aged under five years.

4. Discussion

This report comments on notified cases of IPD in Queensland.

The incidence of IPD as determined by notified cases in children aged under five years was 66.2/100,000 in 2002. This is similar to the rate in 2001. This age group accounted for 38% of notified cases of IPD in Queensland in 2002. This is similar to previous years, and to reports from other jurisdictions in Australia, although there may be variations due to differences in clinical practice or the ability to capture all cases [3]. Rates of IPD in children aged under five years in Queensland increased each year from 1997 to 2000 and here has been little change since then apart from a peak in rates amongst males aged under two years in 2000. Under-ascertainment and under-notification of cases hinders the interpretation of the trends. Efforts have been made to ensure all laboratory confirmed cases are notified to enable analysis of trends and evaluation of the 7vPCV program for children at high risk of IPD, which commenced in July 2001 [3].

The completeness of the enhanced surveillance information provided by Public Health Units should be improved, particularly with respect to recording of Indigenous status and details about predisposing factors and primary diagnoses. Gaps in data are more likely if the child has been discharged from hospital by the time the public health unit receives the notification. Improvements in data completeness may be improved by enhancing timeliness of notification. The Pneumococcal Reference Laboratory (Queensland Health Scientific Services) was able to type 97% of the invasive isolates and perform antibiotic sensitivity tests on 98%.

The epidemiology of the disease was generally consistent with that seen in other years. The peak season was late winter and early spring, there were more males than females, and the peak incidence occurred in children aged under two years. This is similar to that reported by other jurisdictions in Australia [3]. There are some variations to note in Queensland in 2002. The rate of IPD in children aged under five years residing in the north of the state appears to be falling although this decline has not yet reached statistical significance. This suggests that the vaccination program for Indigenous children aged under two years is reducing the incidence of the disease in the Northern Zone which has a higher proportion of children who are Indigenous compared with other areas of the State, (15.2% in the Northern zone compared with 4.2% in Central and 3.8% in Southern Zone) but further monitoring is required to confirm this. However, the rate in the SE has not changed. This may reflect both disease in non-Indigenous children without any known predisposing factors, and incomplete vaccination of children with predisposing factors.

Slightly over one quarter of the cases had predisposing risk factors for IPD. This may be an under-estimate, as there were some missing data. If universal vaccination was implemented for all children aged under five years, 86% of the cases may have been prevented. However even if all children had been vaccinated, vaccination may have a lesser impact in Indigenous children as only 45% of IPD in Indigenous children was due to serotypes included in the 7vPCV. Continued monitoring of this is required, especially in Indigenous communities, as it may reflect selection of serotypes not included in the vaccine. Concerns about selective pressure on the circulation of vaccine serotypes have been noted nationally [3].

The primary diagnosis in Non-Indigenous children aged under five years with IPD was significantly different from that reported elsewhere in Australia [3]. Seventy-six percent of 115 Queensland Non-Indigenous children presented with bacteraemia without localised signs compared with 58% of 255 Australian Non-Indigenous children (p=0.001). This may be due to differences in clinical reporting practice. There was no significant difference in the presentation of Indigenous children in Queensland compared with Indigenous children elsewhere in Australia ($p \geq 0.7$).

Thirteen percent of notified cases of IPD in children aged under two years in 2002 were potentially avoidable, as they occurred in children eligible to receive funded vaccine. There were no vaccine failures but some children had a reduced opportunity to develop immunity, as they had not received the recommended number of doses that they required for their age. The full impact of the vaccination program on IPD among Indigenous children is yet to be seen, as vaccination coverage rates remain lower than desired. Estimates of 7vPCV coverage rates in Queensland in the year following the implementation of the program for Indigenous children under the age of one year were 69% in north Queensland and 36% in the rest of Queensland[4]. Coverage rates for Indigenous children varied according to the vaccine provider; ranging from 76% for children seen by aboriginal health services to 32% seen by general practitioners [4]. Barriers to delivering vaccination need to be identified and overcome to improve coverage rates for Indigenous children and children with identified medical risk factors for IPD. A universal vaccination program may improve coverage rates in these high risk groups and would be less complicated for service providers to administer.

There was reduced susceptibility to penicillin for 14.7% of the invasive isolates, similar to; that reported nationally[3]. Infections with antibiotic resistant *S.pneumoniae* have been increasing worldwide [5] and have been shown to increase the cost of treatment and the duration of the infection[6]. Antibiotic sensitivities should continue to be monitored in Queensland and this information can be used to guide treatment regimes and use of antibiotics. This report supports national findings which showed that the reduced antibiotic susceptibilities occurred in the vaccine serotypes so that vaccination is expected to be important in controlling the spread of drug resistant pneumococcal disease [3].

Continued monitoring is needed to observe changes patterns of this disease to guide vaccine strategies, control and management of this disease.

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[4] Pugh, RE. 2003 invasive pneumococcal disease: trends in Queensland 1997-2002: fact or artefact? In Appendix: Abstracts of presentations form states and territories on invasive pneumococcal disease in 2002. Commun Dis Intell. 27: 85-86.

[5] Turnidge, JD et al. 2000. Rapidly emerging antimicrobial resistances in *Streptococcus pneumoniae* in Australia. Med. J. Aust. 170: 152-155.

[6] Rowland, KE & Turnidge, JD. 2000. The impact of penicillin resistance on the outcome of invasive *Streptococcus pneumoniae* infection in children. 30: 441-449.

5. Acknowledgments

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