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Pertussis notifications in Australia, 1991 to 1997

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Abstract

Although pertussis is a vaccine-preventable disease, it has been epidemic in Australia since 1993 and recently claimed the lives of four children under three months of age. We reviewed national notifications of pertussis from 1991 to 1997 and found notification rates ranged from 2.0 per 100,000 population in 1991 to a peak of 30.5 per 100,000 population in 1994 despite pertussis vaccination coverage approaching 90% for the three-dose primary course. We found that notification rates were highest in infants (<1 year of age) and school aged children (5 - 14 years of age). Although there was a resurgence of pertussis in 1996, age-specific notification rates decreased for children aged 1 - 7 years and it appears that the diphtheria-tetanus-pertussis (DTP) booster introduced as a fifth dose at 4 - 5 years may be having an effect. We raise the possibility that the current whole cell pertussis vaccine may be providing only short-term immunity and that our results may reflect low or inadequate vaccine coverage among both the population at large and the individual cases. We identify gaps in the national surveillance system which require attention including under-reporting and the need for information on vaccination status of notified cases; method of diagnosis; and date of birth or age in months to identify the proportion of infants in the highest risk group, that is under six months of age. *Comm Dis Intell* 1997;21:145 - 148.

Introduction

Children under one year, and particularly those under six months of age, are at greatest risk of death from pertussis (whooping cough)[1,2]. Although pertussis is a vaccine-preventable disease, it has been epidemic in Australia since 1993 and has claimed the lives of four children under three months of age since October 1996[3]. While these children were too young to be adequately immunised in accordance with the recommended schedule[4], their risk of exposure would have been diminished if there was less pertussis in the community.

Parents and older siblings are considered to be an important source of pertussis[1,2]. Since 1993, national notification data have shown attack rates were highest among children under 15 years of age and that there was a smaller secondary peak among adults 30 - 49 years of age[3]. In an attempt to reduce transmission among school aged children and therefore reduce the potential for transmission to infants, a fifth dose of pertussis at 4 - 5 years (in the form of diphtheria-tetanus-pertussis (DTP) vaccine) was added to the recommended childhood

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vaccination schedule in August 1994[4]. This replaced the previous recommendation of combined diphtheria-tetanus (CDT) vaccine at school entry.

Our aim was to review national notifications of pertussis, describe the epidemic, assess any impact from the introduction of the DTP booster for 4 - 5 year old children and highlight gaps in the national data collection.

Methods

Pertussis is a notifiable disease under the public health legislation of each State and Territory. All States and Territories require medical practitioners to notify pertussis and all except Western Australia also require laboratories to do so. Nationally, notifications of pertussis have only been routinely collected since the establishment of the National Notifiable Diseases Surveillance System (NNDSS) in 1990.

The NNDSS receives de-identified notification data from each State and Territory, including age in years, date of onset and date of notification to the relevant public health authority[5]. Pertussis can be identified on clinical grounds, through laboratory diagnosis or by being epidemiologically linked to a laboratory confirmed case. Most States and Territories use the National Health and Medical Research Council (NHMRC) case definition[6]. That is:

- Isolation of *Bordetella pertussis* from a clinical specimen; or
- Elevated *Bordetella pertussis*-specific IgA in serum or *Bordetella pertussis* antigen in a nasopharyngeal specimen using immunofluorescence with a history of clinically compatible illness; or
- An illness lasting 2 weeks or more with one of the following:
  - paroxysms of coughing,
  - inspiratory 'whoop' without other apparent causes,
  - post-tussive vomiting; or
- An illness characterised by a cough lasting at least 2 weeks in a patient who is epidemiologically related to a laboratory confirmed case.

We reviewed notifications of pertussis received by the NNDSS up until 1 April 1997 and analysed those with a date of onset from 1 January 1991 to 28 February 1997. It should be noted that some of the 1996 and 1997 data may be subject to revision.

We calculated crude and age-specific notification rates using the Australian Bureau of Statistics estimates of the mid-year populations as our denominator.

Results

There were 19,815 notifications of pertussis to the NNDSS with onset from 1 January 1991 to 31 December 1996 and a further 1,447 with onset in the first two months of 1997. There was a clear seasonal pattern, with 64% of the notifications occurring over the spring and summer months from August to January (Figure 1). Notifications increased dramatically from 1993, with over 4,000 cases of pertussis occurring each year (4,453 in 1993; 5,443 in 1994; 4,168 in 1995 and 4,604 in 1996). A peak in late 1996 marked a resurgence in the epidemic, with 2,270 notifications having onset between November 1996 and January 1997. The majority of these cases resided in Victoria (30%), South Australia (25%) and New South Wales (25%). Overall, there were more females than males notified in every age group (male:female ratio 1:1.3) (Figure 2). More than 60% of notifications were for persons 10 years of age or older.

The crude notification rate per 100,000 population increased from 2.0 and 4.6 in 1991 and 1992 respectively to 25.2 in 1993. The crude rate remained high into 1996 (30.5 in 1994, 23.1 in 1995 and 25.2 in 1996). Notification rates were highest among infants under one year of age (Figure 3). However, since the NNDSS only receives age in years, it was not possible to determine what proportion of these were in the highest risk group, that is under six months of age. During the epidemic years, 1993 to 1996, pre-school aged children (1 - 4 years) had lower age-specific notification rates than school aged children (5 - 14 years).

Despite the resurgence of pertussis in 1996, the age-specific notification rates decreased for children aged 1 - 4 years and 5 - 9 years. Among the 5 - 9 year age group the rates actually increased for eight and nine year old children and were the highest recorded over the period (85.5 and 86.2 respectively per 100,000 population). Although declining, the rates for seven year old children were similar to those of eight and nine year

Figure 1. Pertussis notifications by month of onset, 1991 to February 1997

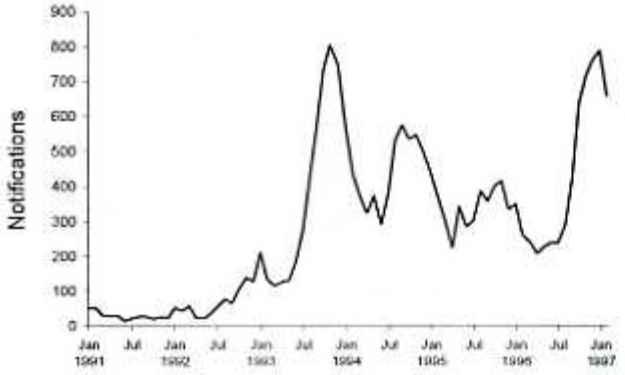
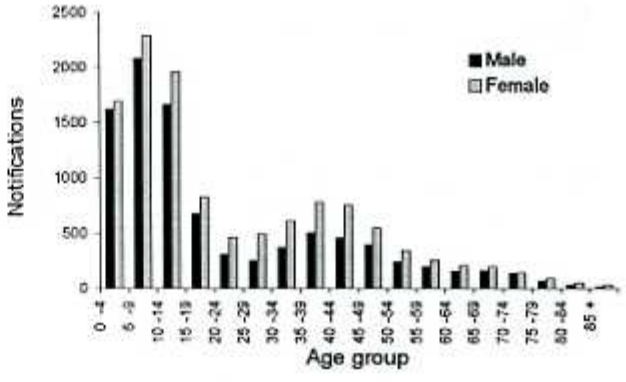


Figure 2. Pertussis notifications by age group and sex, 1991 to February 1997



NNDSS = National Notifiable Disease Surveillance System

old children (84.7 per 100,000 population). In contrast, five and six year old children (for whom the DTP booster had been available) had markedly lower rates (45.4 and 55.6 per 100,000 population respectively), even though they were probably exposed to the older children at school. There was no evidence of a decrease in the age-specific notification rates for infants aged less than one year.

Discussion

Pertussis epidemic

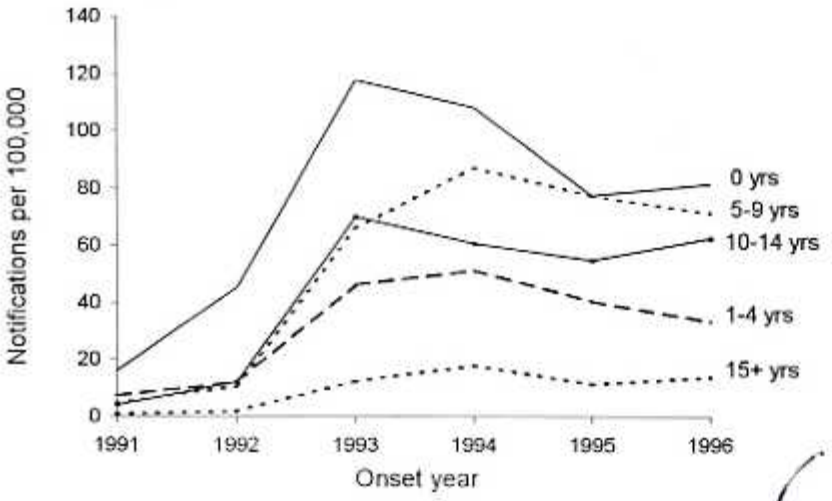
Peaks in pertussis incidence have been reported to occur every three to four years in Australia and overseas[7-12]. Rather than the expected cyclical peaks, the NNDSS data show sustained activity at the national level over the last four years, with a peak of 30.5 per 100,000 population in 1994. This may in part be due to increased awareness of pertussis and the requirement for notification on the part of medical practitioners and/or increased testing. For example, the media coverage of infant deaths due to pertussis in late 1996 and early 1997 may have resulted in some increased diagnosis and reporting. However, we believe this is unlikely to fully explain the apparent sustained epidemic of pertussis in Australia from 1993 which is continuing into 1997.

International comparisons

Comparisons between countries need to be balanced against variations in case definitions, methods of diagnosis and case ascertainment. At a crude level, pertussis notification rates in Australia are 10 times higher than those of the United States of America and three times those of England and Wales. The United States of America have a five-dose vaccination schedule similar to the current Australian schedule and have reported vaccination coverage for the three-dose primary course approaching 90%[13]. England and Wales have a three-dose vaccination schedule with vaccine coverage reported to be 93%[11]. The crude notification rates for pertussis in Australia are similar to those reported in Italy when the estimated pertussis vaccine coverage in that country was 38% for children under five years of age[10]. The 1995 Australian Bureau of Statistics immunisation survey estimated pertussis vaccine coverage for the primary course to be at similar levels to those in the United States of America, England and Wales (86% for one year old children)[14].

In contrast to the United States of America and Italy, Australian data show rates for school aged children above those for pre-school aged children[9,10,15]. Although this may reflect variations in case ascertainment between the countries, it could also suggest that either pertussis vaccine coverage in Australia is not as high as reported for the primary course, or that the current whole cell pertussis vaccine is at best only providing short-term immunity. Importantly, the effectiveness of Australia's current whole cell pertussis vaccine has not been tested[8].

Figure 3. Pertussis age-specific notification rate by year of onset, 1991 to 1996



Age specific notification rates

We suspect there are four factors contributing to the differences between notification rates for pre-school and school aged children in Australia:

- some of the school aged children are unvaccinated or inadequately vaccinated;
- others, although vaccinated, have waning or inadequate immunity;
- there is increased transmission at school entry due to exposure to children with pertussis; and
- there is better detection of cases among school aged children because case follow up tends to be more intensive in this age group than the pre-school age group where contacts may not be so clearly defined.

We cannot confirm the influence of these factors because the NNDSS data do not include vaccination status or method of diagnosis, and the effectiveness of the current whole cell pertussis vaccine remains uncertain.

DTP booster at 4 - 5 years

In England and Wales, there has been an upward shift in the age distribution of cases to school aged children as vaccination coverage has improved[16]. In the absence of accurate information on vaccine coverage (both for the general population and the individual case), two factors suggest the introduction of the DTP booster for 4 - 5 year old children in August 1994 may be having an effect. Firstly, there was a reduction in notification rates for 5 - 9 year old children in 1996 despite the resurgence of pertussis leading to an overall increase in rates. Secondly, in 1996, those aged five and six years (for whom the DTP booster was available) had markedly lower rates than the seven, eight and nine year old children (for whom the DTP booster was not routinely available). If the variation in the rates is due to the introduction of the DTP booster at 4 - 5 years, this may be a further indicator of short-term immunity provided by the vaccine or it may reflect low or inadequate vaccination coverage with the first four doses.

The surveillance system

Surveillance data need to be interpreted cautiously. Documented limitations of pertussis surveillance in the United States of America include

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under-reporting, disproportionate representation of classic and severe cases, lack of uniform reporting criteria among states and undue reliance on laboratory diagnosis of pertussis by some states[9].

We believe there has been under-reporting of pertussis in Australia, however the degree of under-reporting is not known. While it is also likely that we have a disproportionate representation of classic and severe cases, it is possible that a proportion of the notified cases, particularly adults, are not true pertussis cases. If some of these cases were identified on the basis of serology alone, then, in the absence of clinical symptoms, they may not be recent infections and would therefore not be true pertussis cases. The NNDSS does not receive information on method of diagnosis, that is whether cases were: (a) diagnosed clinically, and if so on what basis; (b) laboratory confirmed, and if so by what method; or (c) epidemiologically linked to a laboratory confirmed case. Such information would enable a sensitivity analysis of the surveillance system and a review of the data using varying case definitions. States and Territories should adopt uniform case definitions and procedures for case ascertainment. If the variations continue, adequate information should be provided to describe the variations at the national level.

The focus of pertussis immunisation is to reduce the risk of disease in those at greatest risk. The very young are the group at highest risk of morbidity and mortality from pertussis. However the NNDSS only receives age in years so it is not possible to determine what proportion of infants are in the highest risk group, that is under six months of age. The NNDSS data should include date of birth or at least age in months if less than two years of age. Aboriginal and Torres Strait Islander people are another population group at increased risk of communicable diseases. Although the NNDSS collects information on indigenous status, this field is rarely completed and the impact of pertussis among Aboriginal and Torres Strait Islander peoples cannot be assessed.

Finally, the NNDSS does not receive information on the vaccination status of cases and this is clearly essential. With the introduction of acellular pertussis vaccines, the information will need to include not only whether a case has been vaccinated but also the particular brand of vaccine used.

Even allowing for the limitations of surveillance data, the evidence is clear that pertussis is a serious problem in Australia and that children are dying unnecessarily from this vaccine-preventable disease.

Acknowledgements

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How do they know if the data on cases/deaths isn't analysed also side vax status?

Yet they STILL don't collect it as of 1999!! If it is essential WHY NOT do it!