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LESSONS FROM SURVEILLANCE: SOLVING THE PERTUSSIS PUZZLE

GUEST EDITORIAL

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This issue of the *NSW Public Health Bulletin* is the second in a series of two to focus on vaccine-preventable diseases (VPDs). In particular, the theme of this issue is the surveillance of VPDs, including the application of routine surveillance data to VPDs targeted by well established programs (for example, pertussis), enhanced surveillance of diseases more recently targeted by vaccines (for example, pneumococcal disease), and the use of new methods of surveillance in the Australian context (for example, serosurveillance). As pertussis is the most problematic disease for surveillance in NSW and Australia, I will focus this editorial on the problems associated with the interpretation of surveillance data for pertussis, and the insights offered by the articles in this issue for the control of pertussis by vaccines.

SURVEILLANCE DATA FOR PERTUSSIS

There are several factors that must be taken into consideration when interpreting surveillance data for pertussis, which have made the analysis of trends of this disease over the past decade difficult. First, in NSW, in common with all jurisdictions except South Australia, routine notification of pertussis lapsed between the late 1950s and the late 1970s.[1] This lapse followed a dramatic fall in notifications that occurred after a pertussis vaccine first became available in 1942, and with the later introduction of the combined diphtheria–tetanus–whole cell pertussis (DTPw) vaccine in the routine infant vaccine schedule in 1953.[2] Second, although pertussis in adults was recognised in the pre-vaccine era,[3] it was thought to be rare and was poorly diagnosed by physicians. A Sydney study of patients with prolonged cough referred to a respiratory physician in the 1980s played an important role in changing this perception. The study was one of the first to document adult pertussis using serology, which is based on IgA antibody response to a whole-cell pertussis antigen.[4]

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The use of serological testing to confirm the diagnosis of pertussis rapidly increased in NSW in the 1990s following the release of a commercially-produced kit. By 1993, notification by laboratories accounted for more than 70 per cent of all notifications. Third, medical practitioners are notoriously poor notifiers of communicable diseases,[5,6] so the introduction of mandatory notification by laboratories in the *Public Health Act* of 1991, together with the increased use of serology, had a significant impact on the number of pertussis notifications in the 1990s.

There has been concern that these laboratory-notified cases may overestimate the true incidence of pertussis. Reassurance on this point comes from two sources. First, whole-cell pertussis serology has the desirable characteristic, from a surveillance point of view, of high specificity and low sensitivity (although at the clinical level this characteristic adds to uncertainty as a negative test does not rule out a diagnosis of pertussis).[7] Second, a high proportion of notified cases in adults are associated with typical symptoms.[8] So, if we can be confident that the increase in notified cases, especially in older people, represents real or indeed underestimated case numbers, does it constitute a true increase in the incidence of pertussis over time or simply increased testing and reporting?

The pattern of age-specific hospitalisation data analysed by Menzies, Wang, and McIntyre presented in this issue provide probably the best evidence available to date that there has indeed been a real increase in pertussis in NSW that is not accounted for by diagnostic or notification practices. As opposed to notification rates, which showed a general increase, hospitalisation rates increased significantly in only one age group—adults. It is interesting that this increase was demonstrable despite the relatively small proportion of adults with pertussis who are hospitalised. At the other end of the age spectrum, the data presented by Torvaldsen show that the gap between hospitalisation and notification rates in infants is narrowing, consistent with improved reporting; however, there are real differences in both hospitalisation rates and reporting by notifiers between regions of NSW. The highest infant hospitalisation rates were seen in rural health areas, but of note is that all but one rural area recorded static or declining hospitalisations in the most recent epidemic, whereas four metropolitan health areas saw substantial increases. Are there any lessons for the control of pertussis from these data, particularly control by vaccines?

EFFECT OF VACCINES ON PERTUSSIS

The articles by Brotherton and McAnulty, and Menzies, Wang and McIntyre, give useful insights into the effect of vaccines on the presentation of pertussis in two age groups —school-aged children and infants. Important background information to both articles is the fact that Australia has a relatively poorly immunised cohort: those born in the late 1970s to the early 1990s (currently aged between 13 and 25 years).[9] This period was associated with an excessive concern about the side-effects of and contraindications to whole-cell pertussis vaccine, which led to many infants having only one or two doses of DTPw, with subsequent doses given as diphtheria–tetanus vaccine (CDT) only.[10] The tail-end of this cohort, those born after 1990, were eligible for a fifth dose of pertussis-containing vaccine at 4–5 years of age, though uptake is likely to have been sub-optimal until this dose became exclusively acellular vaccine after 1998. Brotherton and McAnulty demonstrate that the fifth dose has had a significant impact on pertussis notifications in the eligible cohort in successive epidemics. However, the largest group of under-immunised persons—those born in the 1980s—continue to have high rates of pertussis notification. A similar cohort effect has also been reported in Canada, but there the affected cohort had high coverage with a sub-optimal vaccine, rather than sub-optimal coverage.[11] In infants, Menzies, Wang, and McIntyre show that a significant fall in pertussis hospitalisations coincided with improved coverage in the first half of the 1990s, but benefit was only evident among age groups eligible for two or more doses of vaccine. This fall commenced while DTPw was still in general use, consistent with estimates of the Australian whole-cell vaccine's effectiveness in NSW in the 1990s using the screening method.[12]

In 2003, the challenge remains of death and hospitalisations among infants too young to receive two doses of diphtheria–tetanus–acellular pertussis (DTPa) vaccine. These cases are largely related to the continued high incidence of pertussis in their adult contacts—in particular, their parents.[13] Current recommendations to reduce this are summarised in the paper by Brotherton and McAnulty. First, implementation of the recommendation to replace the current scheduled dose of adult diphtheria–tetanus (ADT) vaccine at 15–17 years with an adult-formulated acellular pertussis (dTpa) vaccine, would reduce pertussis cases in one part of the under-immunised cohort. Second, wider use of dTpa instead of ADT in adults, especially those in contact with infants, such as new or prospective parents and health care workers, should reduce the exposure of infants to pertussis. In the recently-released NSW guidelines for immunisation of health care workers, dTpa vaccine is recommended unless ADT has been received in the previous five years.[14] Active promotion of dTpa vaccine to new and prospective parents by healthcare workers, including general practitioners, obstetricians, midwives, and infant welfare nurses, could significantly enhance the benefits from awareness of cough exposure for newborns, already provided by the sticker in their personal health record (or 'blue book'), by adding protection from pertussis to awareness of its dangers.

The final articles in this issue of the Bulletin concentrate on other aspects of the surveillance of VPD. McIntyre, Gilmour, and Watson describe the work of the Metropolitan NSW Pneumococcal Study Group in using enhanced surveillance to describe the age-specific incidence, serotype distribution, and antimicrobial resistance patterns of invasive pneumococcal disease. Gidding describes population serosurveillance and Australia's national serosurveillance program, in particular, how it is used to estimate levels of immunity to vaccine-preventable diseases. The issue concludes with two short reports of recent publications by the National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases (NCIRS), *Vaccine-Preventable Diseases and Vaccination Coverage in Australia, 1999–2000* and *Immunisation Coverage: Australia 2001*.

REFERENCES

1. Hall R. Notifiable diseases surveillance, 1917 to 1991. *Commun Dis Intell* 1993;17:226-36.
2. McIntyre P, Amin J, Gidding H, et al. Vaccine preventable diseases and vaccination coverage in Australia, 1993–1998. *Commun Dis Intell* 2000;24 (Suppl):S1–S83.
3. Orenstein WA. Pertussis in adults: epidemiology, signs, symptoms, and implications for vaccination. *Clin Infect Dis* 1999;28 (Suppl):S147–S150.
4. Robertson PW, Goldberg H, Jarvie BH, Smith DD, Whybin LR. Bordetella pertussis infection: a cause of persistent cough in adults. *Med J Aust* 1987;146(10):522–5.
5. Blogg S, Trent M. Doctor's notifications of pertussis. *N S W Public Health Bull* 1998;9:53–4
6. Allen CJ, Ferson MJ. Notification of infectious diseases by general practitioners: a quantitative and qualitative study. *Med J Aust* 2000;172:325–8.
7. Poynten M, Hanlon M, Irwig L, Gilbert GL. Serological diagnosis of pertussis: evaluation of IgA against whole cell and specific *Bordetella pertussis* antigens as markers of recent infection. *Epidemiol Infect* 2002;128:161–7.
8. Thomas PF, McIntyre PB, Jalaludin BB. Survey of pertussis morbidity in adults in western Sydney. *Med J Aust* 2000;173:74–6.
9. Sullivan EA, Chey T, Nossar V. A population-based survey of immunisation coverage in children aged 2 years and younger in New South Wales. *J Paediatr Child Health* 1998;34:342–5.
10. MacIntyre CR, Nolan T. Attitudes of Victorian vaccine providers to pertussis vaccine. *Med J Aust* 1994;161:295–9.
11. Ntezayabo B, De Serres G, Duval B. Pertussis resurgence in Canada largely caused by a cohort effect. *Paediatr Infect Diseases J* 2003;22:22–7.
12. Torvaldsen S, Simpson JM, McIntyre PB. Effectiveness of pertussis vaccination in New South Wales, Australia, 1996–1998. *Eur J Epidemiol* 2003;18:63–9.
13. McIntyre P, Elliot E, Morris A, Ridley G et al. Hospitalised pertussis in infancy. *Australian Paediatric Surveillance Unit. 9th Annual Report.* Elliot E, Ridley G, Rose D, Morris A, Redmond D, Fowler J (editors). Sydney:APSU, 2002.
14. NSW HCW immunisation web address: www.health.nsw.gov.au/fcsd/rmc/cib/circulars/2001/cir2001-91.pdf

HAS PERTUSSIS INCREASED IN NSW OVER THE PAST DECADE? AN EVALUATION USING HOSPITALISATION AND MORTALITY DATA VERSUS NOTIFICATIONS 1988–2002

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Pertussis, or whooping cough, notifications, and deaths declined dramatically after the introduction of mass vaccination in the 1950s, to the extent that many states stopped collecting notifications.[1] However, since 1990, notification rates have increased noticeably from the record low levels seen in the 1970s and 1980s in all Australian states and territories, including NSW.[1] A number of factors, other than a true increase in the underlying incidence of pertussis, may account for this.[2,3] These factors include: improved surveillance, the introduction of direct notification of cases by laboratories, and the introduction of additional means of laboratory diagnosis such as serology and nucleic acid testing.[2] In contrast to notifications, criteria for coding hospital separations or deaths due to pertussis are less likely to have been influenced by these changes,[3–7] thus providing a data source that is more consistent over time to evaluate for evidence of a resurgence in pertussis. This article compares age-specific hospital separations, notifications, and deaths due to pertussis in NSW, prior to and including the period of changes to the notification procedure that followed introduction of the *NSW Public Health Act 1991*.

METHODS

Data sources

NSW hospital separations with a primary diagnosis code of pertussis (ICD-9, 033; ICD–10, A37) were available from 1988–1989 to 2000–2001 from the NSW Inpatients Statistics Collection (ISC) through the Health Outcomes Information Statistical Toolkit (HOIST), and the yearly total for 2001–2002 from the NSW Health Information Exchange. Notifications were available from 1992– 2002 from the Notifiable Disease Database, via HOIST.

Deaths reported with a principal or underlying cause of pertussis (ICD-7, 056; ICD-8, 033; ICD-9, 033; ICD-10, A37) were obtained from the Australian Bureau of Statistics via HOIST. Death data were available from 1964–2000. Deaths that occurred in 2001 were ascertained by a