# Nosocomial pertussis infection of infants: still a risk in 2009

Jennifer M Paterson, Vicky Sheppeard


## Abstract

The Sydney West Centre for Population Health investigated a confirmed pertussis infection in a health care worker on a maternity ward and identified pertussis infection in 4 neonates cared for by this case. This report describes the public health intervention to identify and prevent further cases. Of the 4 neonates, three were laboratory-confirmed cases and one was diagnosed on clinical grounds alone. All were cared for by the infected worker during only one shift and developed symptoms six to 16 days afterwards. No other possible source of infection was identified. This investigation highlights the need to maintain awareness, particularly amongst staff working with neonates, that pertussis infection can arise despite complete vaccination. Thus it is important to investigate new coughing illnesses and exclude symptomatic staff from contact with neonates until pertussis infection is excluded or effectively treated. The burden on the health system arising from a pertussis infection in a health care worker in a high-risk setting is also described with the hospitalisation of 4 infants, and prophylactic antibiotics given to 73 new mothers, infants and health care workers. *Commun Dis Intell* 2010;34(4):440–443.


Keywords: pertussis transmission, neonates, infants, health care worker, outbreak

**Issues raised by this paper**

Vaccinated health care workers can contract pertussis infection and their symptoms are likely to be modified compared to classic pertussis; nevertheless they can be responsible for transmission to others, especially vulnerable infant contacts.

Reinforces the recommendation for all exposed HCW (irrespective of immunisation status) to receive chemoprophylaxis if in contact with vulnerable patient populations.

Implications for how frequently re-vaccination is required, and the need for a monovalent acellular pertussis vaccine.

## Introduction

A pertussis outbreak commenced in New South Wales in February 2008 and peaked in December of that year.[1] The peak number of notifications greatly exceeded that seen in other outbreaks during the past decade (Figure). About 54% of the cases were children under 15 years of age, with 21% of cases notified in children under 5 years.

Pertussis containing vaccine is free for Australian children at 2, 4 and 6 months of age, with a booster at 4 years and during adolescence.[2] All doses are acellular pertussis vaccine combined with diphtheria and tetanus antigens. This outbreak occurred in the context of good childhood vaccination coverage (93% at 12 months and 90% at 4 years).[3]

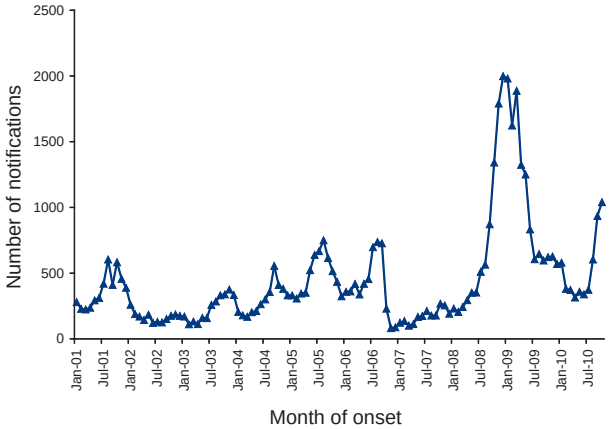
Pertussis infection is of most concern during the first year of life, particularly prior to receiving the first 2 doses of vaccine. In addition to increased susceptibility of acquiring infection, infants are also most at risk of developing severe complications, including death, from pertussis infection.[4]

This report describes the investigation of a pertussis infected health care worker (HCW), the probable transmission to 4 neonates in a maternity ward, and the public health intervention to prevent further cases.

## Methods

Pertussis is a notifiable condition in New South Wales and must be notified to the local public health unit by doctors and laboratories. Pertussis infection is confirmed by isolation of *Bordetella pertussis* by culture or by detection with nucleic acid testing. Cases with clinical evidence of pertussis (a coughing illness lasting more than 2 weeks or history of paroxysmal cough, inspiratory whoops or post-tussive vomiting) are also considered confirmed cases if

**Figure: Pertussis notifications, New South Wales, January 2000 to October 2010**



they have a positive serological test or if they have an epidemiological link to a case with laboratory evidence of pertussis.

In this outbreak all upper pharyngeal specimens were tested by nucleic acid methods using polymerase chain reaction (PCR) testing.[5]

Public health follow up of notifications was undertaken according to New South Wales and Australian guidelines.[6] The guidelines include provision of prophylactic antibiotics to all neonates and parents directly cared for by an infectious case, if they can be commenced within 21 days of the last contact, and all health care workers who have been exposed to the infected staff member who are to care for neonates in the next 3 weeks, regardless of vaccination status.

Exposed patients and staff were identified by the maternity unit nurse manager through a review of staff rosters. Public health unit staff contacted all identified patients by phone using a standard interview format. Neonates reporting cough or apnoeas were requested to attend a paediatric emergency department for assessment. All other neonates and mothers were requested to attend a public health clinic held in the maternity unit if within 21 days of last exposure, or were provided with information about the exposure and potential risk if more than 21 days had elapsed.

Exposed HCWs were contacted by managers and assessed against the guidelines. Any symptomatic staff members had a throat swab taken for pertussis PCR testing.

## Results

### Index case

On 15 July 2009 the Public Health Unit was notified of a positive pertussis PCR test in a 54-year-old HCW. The HCW reported an influenza-like illness from 26 to 29 June and a coughing illness from 7 July. The HCW presented to a general practitioner on 26 June and again on 10 July when a swab was taken for pertussis testing and erythromycin treatment commenced. The HCW had received an acellular pertussis vaccine in 2006.

The HCW had worked as a registered nurse on a maternity ward on 28 and 30 June and 7 and 9 July and provided direct care to 39 mothers and newborns during those shifts. Twenty HCWs were also identified as being exposed to the index case while infectious.

### Secondary cases

Four infant contacts of the HCW were confirmed cases of pertussis, three by laboratory test and one with a cyanotic episode, mild cough and epidemiological link (Table). No other potential source of infection could be identified for these cases using the standard pertussis investigation questionnaire.[7] The incubation period ranged from 6–16 days. All 4 secondary cases had short hospital stays but none required intensive care.

Two other infants who had a cough reported but negative pertussis PCR tests, received prophylactic antibiotics and information about pertussis according to the same guidelines as followed for asymptomatic infants. Their mothers also received prophylactic antibiotics.

A HCW contact who reported a spasmodic cough also tested negative for pertussis by PCR and returned to work after commencing antibiotic prophylaxis.

No secondary cases were confirmed amongst adult patients or HCWs.

### Other public health interventions

Antibiotic prophylaxis was provided to another 25 infants and 26 mothers. Azithromycin was administered according to Australian Therapeutic Guidelines to all contacts except those with macrolide allergy, where trimpethoprim-sulfamethoxazole was substituted.[8] Contacts were also advised of the potential risk of developing pertussis and to seek medical review if symptoms developed.

Eight mother and infant pairs were contacted more than 21 days after exposure so were only provided with information about the exposure and potential risk.

HCW records were reviewed and all had received vaccination with acellular pertussis vaccine within

**Table: Details of neonatal pertussis cases**

| Age at onset | Exposure date | Onset date | Symptoms | Laboratory test and date |
|---|---|---|---|---|
| 10 days | 7 July | 15 July | Mild cough | PCR + 16 July |
| 8 days | 9 July | 15 July | Mild cough, cyanotic episode | Not tested |
| 16 days | 30 June | 16 July | Apnoeas and vomiting (rhinorrhoea noted 13 July) | PCR + 17 July |
| 21 days | 30 June | 14 July | Cough | PCR + 21 July |

the past 3 years. Eighteen HCW who were rostered to work on the maternity ward within 21 days of last exposure to the infectious case were administered azithromycin daily for 5 days, or trimethoprim-sulfamethoxazole twice daily for 7 days

Maternity ward managers were requested to maintain a high awareness for the symptoms of pertussis amongst their staff, and to exclude any HCW with a coughing illness until they tested negative for pertussis. Managers and HCW were also reminded that pertussis can develop despite recent vaccination or past infection.

## Discussion

This incident highlights the highly transmissible nature of pertussis infection with 1 epidemiologically-linked and 3 laboratory-confirmed cases of pertussis in neonates cared for by an infected HCW. Each neonate was exposed during only 1 shift and developed symptoms six to 16 days after exposure. Fortunately none of the infants developed severe disease and to our knowledge no other cases of pertussis developed amongst the 27 neonates provided with prophylaxis or the 8 neonates who were identified too late for antibiotics.

As culture isolates were not obtained it could not be conclusively proven that the neonatal infections were acquired from the HCW. However no other possible source of infection amongst the neonates' other contacts could be identified. Transmission from HCWs to neonates is well documented, albeit, not recently in Australia.[9–13] Thorough investigations of infected HCWs in maternity wards have not always yielded clear evidence of infection transmission.[14,15]

The index case's history of symptoms was not completely typical of pertussis infection, with an initial period of fever and nasal congestion that was reported to resolve completely, followed 1 week later by the more typical coughing illness of pertussis.[16] This resulted in some uncertainty in defining the infectious period. However 2 laboratory-confirmed cases were identified as related to the earlier phase of illness, more than 7 days before the index case could recall any cough.

This outbreak also underlines the cost to the health system of a pertussis infection in a HCW in a high-risk setting such as a maternity unit. In addition to the hospitalisation of 4 infants, 73 courses of prophylactic antibiotics were administered. Providing this intervention as soon as possible after recognition of the exposure drew considerably on public health and maternity unit resources. The serious adverse health and economic burden of pertussis outbreak control in hospitals has been previously described.[17–19] Ward et al note that where infants are exposed to pertussis the costs are higher due to the higher expected hospitalisation rates.[19] Some authors have attempted to model the effectiveness of HCW vaccination compared to outbreak control measures and suggest that there is a health and economic benefit from HCW vaccination.[20,21]

In 2006 Edwards et al reviewed the challenges of controlling pertussis outbreaks in hospitals and noted the promise of adult pertussis booster vaccines to markedly reduce or eliminate this risk.[10] It is disappointing that this outbreak occurred despite the mandatory NSW Health policy for all HCWs to have received the full primary course of pertussis vaccination, and an adult booster dose.[21] Staff in maternity and paediatric units have been prioritised to achieve compliance with this policy. All the staff in this unit, including the index case, had evidence of complete pertussis vaccination.

Thus despite adoption of a mandatory HCW vaccination policy a risk to infants for nosocomial infection with pertussis continues. Several factors unique to pertussis infection and highlighted by previous authors play a part in this ongoing risk: immunity wanes over time and multiple life-time infections can occur; vaccination provides protection to only around 80% of those vaccinated; cases with prior vaccination or infection tend to have mild/atypical symptoms.[10,22] These factors lead to delay in recognition, diagnosis and treatment, potentially resulting in ongoing exposure during the most infectious period of the disease.

Hospital infection control practitioners and maternity HCW must maintain awareness that pertussis infection can arise despite complete vaccination and investigate new coughing illnesses. HCWs must be excluded from contact with neonates until pertussis infection is ruled out or effectively treated. As the early stages of pertussis can mimic many other upper respiratory conditions, access to rapid diagnostic testing is essential to protect neonates from infection while minimising disruption to staff rosters. Vigilance is particularly required during pertussis epidemics, when the likelihood of community-acquired pertussis infection in HCW increases. A flexible human resources policy that allows redeployment of maternity unit staff with cough to lower risk duties (and their replacement with suitably trained staff from other units) while awaiting test results could help reduce the risk of such incidents in the future.

Earlier development of immunity to pertussis would also assist in reducing the risk of infection during the neonatal period. Strategies such as maternal immunisation during pregnancy (to provide passive infant immunity) and a birth dose of pertussis vaccine are under investigation to determine if earlier protection can be provided safely and effectively to

neonates.[23] Of these options, only passive immunity could provide protection for neonates exposed to infected HCWs in the immediate post-natal period.

Finally, public health units have a role in ongoing raising of awareness and education of HCWs in high risk settings of the current pertussis transmission risk in the local community; effectiveness of vaccination; recognition of early symptoms; and the latest treatment and exclusion policies.

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## Author details

Mrs Jennifer M Paterson, Infectious Diseases Surveillance Officer
Dr Vicky Sheppeard, Manager Communicable Diseases and Immunisation

Sydney West Centre for Population Health, Parramatta, New South Wales

Corresponding author: Mrs Jennifer Paterson, Sydney West Centre for Population Health, Locked Bag 7118, PARRAMATTA BC 2150. Telephone: +61 2 9840 3603. Facsimile: +61 2 9840 3608. Email: Jen_M_Paterson@wsahs.nsw.gov.au

## References

1. NSW Department of Health. Year in Review: communicable disease surveillance, NSW, 2008. *N S W Public Health Bull* 2009;20(9–10):141–151.
2. Australian Government Department of Health and Ageing, Immunise Australia Program. National Immunisation Program Schedule. Available from: http://www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/nips2 Accessed August 2009.
3. Australian Government, Medicare Australia.. Australian Childhood Immunisation Register coverage report 31 March 2009. Available from: http://www.medicareaustralia.gov.au/provider/patients/acir/statistics.jsp Accessed August 2009.
4. Wood N, Quinn HE, McIntyre P, Elliot E. Pertussis in infants: Preventing deaths and hospitalisations in the very young. *J Paediatr Child Health* 2008;44(4):161–165.
5. Australian Government Departmetn of Health and Ageing, Public Health Laboratory Network. Pertussis laboratory case definition.Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-phlncd-pertussis.htm
6. NSW Department of Health. Pertussis guidelines. Available from: http://www.health.nsw.gov.au/factsheets/guideline/pertusis.html
7. NSW Department of Health. Pertussis investigation form. Available from: http://www.health.nsw.gov.au/resources/publichealth/infectious/diseases/pdf/pertussis_form.pdf
8. Therapeutic Guidelines: *Antibiotic*. Version 13. Melbourne: Therapeutic Guidelines Limited; 2006.
9. Centers for Disease Control and Prevention. Outbreaks of pertussis associated with hospitals—Kentucky, Pennsylvania, and Oregon, 2003. *MMWR Morb Mortal Wkly Rep* 2005;54(3):67–71.
10. Edwards KM, Talbot TR. The challenges of pertussis outbreaks in healthcare facilities: is there a light at the end of the tunnel? *Infect Control Hosp Epidemiol* 2006;27(6):537–540.
11. Bryant KA, Humbaugh K, Brothers K, Wright J, Pascual FB, Moran J, et al. Measures to control an outbreak of pertussis in a neonatal intermediate care nursery after exposure to a healthcare worker. *Infect Control Hosp Epidemiol* 2006;27(6):541–545.
12. Wright EP, Joce R, Whincup G. Management of pertussis in a nurse at a special care baby unit. *Commun Dis Public Health* 2004;7(2):128–131.
13. Spearing NM, Horvath RL, McCormack JG. Pertussis: adults as a source in healthcare settings. *Med J Aust* 2002;177(10):568–569.
14. Friedman DS, Curtis R, Schauer SL, et al. Surveillance for transmission and antibiotic adverse events among neonates and adults exposed to a healthcare worker with pertussis. *Infect Control Hosp Epidemiol* 2004;25(11):967–973.
15. McCall BJ, Tilse M, Burt B, Watt P, Barnett M, McCormack JG. Infection control and public health aspects of a case of pertussis infection in a maternity health care worker. *Commun Dis Intell* 2002;26(4):584–586.
16. Broder KR, Cortese MM, Iskander JK, Kretsinger K, Slade BA, Brown KH, et al. Preventing tetanus, diphtheria, and pertussis among adolescents: use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccines: recommendations of the Advisory Committee on Immunization Practices. *MMWR Recomm Rep* 2006;55(RR–3):1–34.
17. Baggett HC, Duchin JS, Shelton W, Zerr DM, Heath J, Ortega-Sanchez IR, et al. Two nosocomial pertussis outbreaks and their associated costs—King County, Washington, 2004. *Infect Control Hosp Epidemiol* 2007;28(5):537–543.
18. Calugar A, Ortega-Sánchez IR, Tiwari T, Oakes L, Jahre JA, Murphy TV. Nosocomial pertussis: costs of an outbreak and benefits of vaccinating health care workers. *Clin Infect Dis* 2006;42(7):981–988.
19. Ward A, Caro J, Bassinet L, Housset B, O'Brien JA, Guiso N. Health and economic consequences of an outbreak of pertussis among healthcare Workers in a hospital in France. *Infect Control Hosp Epidemiol* 2005;26(3):288–292.
20. Greer AL, Fisman DN. Keeping vulnerable children safe from pertussis: Preventing nosocomial pertussis transmission in the neonatal intensive care unit. *Infect Control Hosp Epidemiol* 2009;30(11):1084–1089.
21. NSW Department of Health. *Occupational Assessment, Screening & Vaccination Against Specified Infectious Diseases*. PD2007_006 2007: p16–18, 27.
22. Murphy TV, Slade BA, Broder KR, Kretsinger K, Tiwari T, Joyce PM, et al. Advisory Committee on Immunization Practices. Centers for Disease Control and Prevention. Prevention of pertussis, tetanus, and diphtheria among pregnant and postpartum women and their infants: recommendations of the Advisory Committee on Immunization Practices.[erratum in *MWR Morb Mortal Wkly Rep* 2008;57(26):723.] *MMWR Recomm Rep* 2008;57(RR–4):1–51.
23. McIntyre P, Wood N. Pertussis in early infancy: disease burden and preventive strategies. *Curr Opin Infect Dis* 2009;22(3):215–223.