CASE REPORT

Outbreak of *Bordetella pertussis* among oncology nurse specialists

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Abstract

We describe an outbreak of pertussis with transmission between health care workers (HCWs) in a hospital oncology department and a patient identified as a possible source. Three of the four HCWs testing positive for pertussis had received primary immunization as children, consistent with waning immunity into adulthood. The fourth health care worker was unimmunized. No evidence of onward nosocomial acquisition within the patient group was found; however, transmission within the household of one health care worker was identified. Countries differ in their approach to protecting health care staff and patients from occupational and nosocomial pertussis infection with immunization recommended for some HCWs in some countries. Surveillance for pertussis in the UK and response to suspected or confirmed cases requires further development.

Key words Biological hazards; epidemiological surveillance; immunization; occupational disease; occupational epidemiology.

Introduction

*Bordetella pertussis* (whooping cough) persists within the UK population as a highly infectious, though vaccine-preventable disease. Symptoms can last up to 3 months, commencing with a catarrhal stage, preceded by a persistent (spasmodic) cough and followed by the classic ‘whoop’. Both vomiting and apnoeic episodes are also associated with the infection with symptoms most severe in young infants. The infection is transmitted by airborne droplets, with cases being most infectious during the first 2–3 weeks. The pertussis immunization was introduced into the UK in the 1950s and today consists of three doses of vaccine in infants under a year together with a preschool booster.

Clusters and outbreaks of pertussis among adults within occupational settings have been documented among health care workers (HCWs), soldiers, office workers, inmates and students [1–6]. The risk and consequences of such transmission within the health care setting is of concern, particularly when exposed patients fall within vulnerable groups [7]. The USA, Australia, Germany and France currently recommend pertussis immunization for HCWs. The USA and Australia offer pertussis immunization to HCWs working in either paediatrics or infectious disease [8–11]. National UK policy recommends four doses of pertussis vaccination for children preschool [12]. There is no policy on HCW immunization.

In this report, we describe an outbreak of pertussis displaying significant transmission between HCWs in a hospital oncology department, with a former patient considered to be a possible source. No evidence of onward nosocomial acquisition within the patient group was found.

Case report

Investigation by the local health protection unit (HPU) began following a HCW (specializing in oncology) testing positive for pertussis on the 23 January 2009. This HCW had been symptomatic with a persistent cough, together with an inspiratory whoop, post-tussive vomiting and apnoeic attacks since early/mid-December 2008. She presented to her general practitioner (GP) 2 weeks following the onset of symptoms and had blood taken for serological testing on the 31 December 2009. The HCW’s GP had no record of her having ever been immunized for pertussis. The result caused concern among the HCW’s colleagues with similar symptoms. They contacted the HPU informing them of four other symptomatic colleagues within the workplace. The index case shared an office with two of these symptomatic HCWs, which
was often also used by two additional and also symptomatic HCWs. All five HCWs predominantly worked within an oncology outpatient department with limited contact with the oncology inpatient unit.

Of these additional four symptomatic colleagues, three had previously presented with persistent coughs to primary care and were each commenced on a 7 day course of the macrolide, clarithromycin within 14 days of onset of symptoms (one was unable to complete the course due to abdominal discomfort, a recognized side-effect of this antibiotic). Notification to the local HPU for testing was not undertaken. Upon serological testing (recommended by the HPU), all three colleagues (aged between 39 and 52 years) treated by their GPs with a macrolide were found to be positive for pertussis, consistent with recent infection. Secondary spread to a household contact of one of the cases was also confirmed, see Figure 1 below.

Serological testing for pertussis is undertaken within England by the Respiratory and Systemic Infection Laboratory at the Health Protection Agency. Enzyme units (eU) of IgG anti-\textit{B pertussis} toxin antibody within blood are tested for. In the absence of recent vaccination, levels $>100$ eU/ml are considered indicative of recent pertussis infection. Each of the four nurses and the household contact of the fourth cases had levels of IgG anti-\textit{B pertussis} ranging from 157 to 915 eU/ml, consistent with recent infection. Specificity for this serology test is 100%.

The fifth symptomatic health care worker (who inconsistently used this main office) did not seek medical advice during the course of her illness and did not commence antibiotic therapy. She tested serologically negative for pertussis.

Following the identification of this outbreak, passive surveillance was undertaken by the HPU to identify transmission to patients. This was largely due to the time that had lapsed from exposure (early to mid December 2008) to notification of the outbreak (late January 2009), thus too late for chemoprophylaxis to be effective ($>21$ days). Additionally, a report of a similar pertussis outbreak among staff in a haematology–oncology unit was identified and used to inform response. This described a cluster of 10 pertussis cases out of a total of 117 employees [2]. Reassuringly, active case finding through patient screening in this study found no secondary transmission to patients.

A manual search through pertussis notifications was undertaken within the public health office to identify any increase in local cases, together with any identified cases that had past medical histories indicating the patient would have received treatment within this unit. No such cases were identified to suggest ongoing transmission; however, a possible source was identified (a patient with confirmed pertussis who received regular treatment within this oncology department). This possible source, a 71-year-old unimmunized female, tested positive for

<table>
<thead>
<tr>
<th>Case 1.</th>
<th>46 yr old</th>
<th>Member of public</th>
<th>Primary immunisations complete</th>
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<tr>
<td>(Oct 2008)</td>
<td></td>
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<tr>
<td>Case 2.</td>
<td>71 yr old</td>
<td>Patient</td>
<td>Social contact of Case 1.</td>
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<td>(Nov 2008)</td>
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<td>Case 3.</td>
<td>43 yr old</td>
<td>Nurse</td>
<td>Unimmunised</td>
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<td>(Early Dec 2008)</td>
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<td>Case 4.</td>
<td>50 yr old</td>
<td>Nurse</td>
<td>Primary immunisations complete</td>
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<tr>
<td>(Early/mid Dec 2008)</td>
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<tr>
<td>Case 5</td>
<td>16 yr old</td>
<td>Household contact of Case 4</td>
<td>Early/mid Dec 2008</td>
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<td>Primary immunisations &amp; pre-school booster</td>
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<td>Case 6.</td>
<td>19 yr old</td>
<td>Nurse</td>
<td>Primary immunisations complete</td>
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<td>(Dec 2008)</td>
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<td>Case 7.</td>
<td>43 yr old</td>
<td>Nurse</td>
<td>Primary immunisations complete</td>
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<td>(Mid/late Dec 2008)</td>
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Figure 1. Transmission of pertussis from community to HCWs.
pertussis in late November 2008 following a reported cough of many weeks. She is likely to have acquired the infection from a social contact, a 46-year-old (fully immunized) female who was confirmed on serology to have pertussis in mid-October 2008, following a cough lasting >3 weeks. This primary case was notified direct from the laboratory, 6 weeks after the onset of symptoms. Additionally, this case was inadequately treated for the infection, commencing a 3 day course of azithromycin 23 days after the onset of the cough.

Additional colleagues outside of the immediate team of the confirmed HCWs were approached verbally to assess if they had experienced similar symptoms. No evidence of this was found. The hospital infection control team were made aware of the situation, and discussion was undertaken with occupational health with the request to notify public health if they were to identify additional cases. Again, no further cases were identified.

Evidence of secondary transmission within the household setting was identified. The 16-year-old daughter (fully immunized, including preschool booster) of one of the HCWs developed symptoms following that of her mother and tested positive for the infection.

**Discussion**

We have presented an outbreak of pertussis showing transmission among adults in an occupational setting. Outbreaks of pertussis are well documented and reflect an increase in the incidence of pertussis within the adult population [13–15].

The shared office (as a transmission setting) had an attack rate reflective of the household setting of up to an estimated 90% [16]. HCWs are a group recognized to be at a greater risk of acquiring pertussis than the general adult population (odds ratio = 1.7 [17]). HCWs with pertussis have the potential to act as a significant pool of infection, as was seen in an outbreak within a French general hospital. In this instance, infection was thought to have originated in a HCW, which was transmitted to colleagues (n = 15) and subsequently to patients (n = 2) [18]. The infection spread throughout the hospital affecting HCWs and patients on seven different wards. The two patients found to be positive for pertussis were both immunocompromised (a teenager with HIV and an adult on chemotherapy). Both this report and others from the USA and France confirm the capacity of the hospital workplace to allow transmission of pertussis [2, 18].

The health care setting for such outbreaks is of importance given the potential complications for the vulnerable patient and risk of spread (many are densely populated environments). Infants are known to suffer more severe complications of pertussis than any other group. It is estimated that between 1994 and 1999, there were nine deaths from pertussis each year in the UK, 88% of which were in infants under 4 months of age [19]. Serious illness is less common in adults and adolescents, although they often act as reservoirs for the infection, passing this onto susceptible infants [20]. In light of these complications, national occupational health policies recommend HCWs in Australia (Australian Government Department of Health and Ageing), Germany (Robert Koch Institute) and the USA (American College of Occupational and Environmental Medicine and the Advisory Committee on Immunization Practices) have been adapted to recommend immunization for HCWs [11, 21–23].

Given the grossly under-reported numbers of pertussis cases, a lower threshold to consider pertussis when staff report to occupational health departments with persistent coughs is required. Referral to primary care for assessment, testing, treatment and exclusion from work should be considered as is reasonable. Again, notification to and discussion with local HPUs are important where one or more case is suspected. There are no national policies for responding to cases or outbreaks of pertussis among HCWs in the UK. In the absence of such, guidance for cases within the community should be used in regard to testing, treating and exclusion [24].

Pertussis is a notifiable infection within the UK and many other countries internationally. Diagnosing physicians are legally obliged to notify their local HPU on suspicion of infection, rather than awaiting laboratory confirmation, and are requested to document the patient’s occupation and any known or likely source of infection. Such practice increases the ability of HPUs to detect outbreaks of infection.

Gross under-reporting of pertussis infection has been highlighted in a British study which found an incidence of infection at 330/100 000 when serologically testing persons with acute tracheitis or spasmodic cough lasting >3 weeks compared with the statutory notifications at 4/100 000 [25]. Adults and persons who were previously infected or immunized and go on to develop pertussis infection have been found to experience milder illness. This decreases the likelihood of patients presenting to primary care for treatment or testing. Additionally, of those presenting to primary care, only a small minority of suspected cases are then notified to local HPUs. If GPs do not notify upon suspicion, but test for infection by serology, then, if positive, the HPU are informed directly by the laboratory with the absence of information regarding occupation and possible source.

This UK outbreak highlights previous calls to re-evaluate occupational health policy for HCW immunization, improve awareness of the infection and to consider standardizing public health follow-up for pertussis infection in a HCW. Figure 1 displays the immunization status of these seven persons with confirmed infection; of whom three were documented to have been fully immunized for pertussis. This demonstrates the knowledge that immunity offered from childhood vaccination had diminished.
over time, no longer providing protection from the infection. However, duration of immunity offered by the acellular pertussis vaccine (currently used in the UK) compared with the previously used whole-cell vaccine is unknown. Ongoing surveillance following the introduction of acellular vaccine is needed to clarify this. Awareness among adults and in particular HCWs of this waning immunity from pertussis vaccination is therefore important. The introduction of a booster dose of pertussis immunization to HCWs should be considered, particularly for those working with vulnerable groups, as countries such as Australia have recommended. Prevention of infection through offering an immunization booster to HCWs may be favoured by occupational health departments, as opposed to working solely reactively in responding to cases or outbreaks of the infection itself [15]. It has been suggested that a universal adult booster dose of pertussis vaccination could be implemented nationally or specifically for HCWs (initially targeting those within paediatrics [7]) to reduce the risk of nosocomial and community spread [15].

A change in national policies would require consideration of cost-benefits, risk, expected uptake of vaccination and vaccine efficacy. The current poor uptake of the annual influenza immunization by the UK acute hospital occupational health departments for HCWs (found to be 13% in 2007/2008 [26]) highlights the challenge of implementing optional vaccination programmes within this country. However, one French author suggests that pertussis awareness has increased with the many nosocomial outbreaks over recent years that may well act to improve uptake of a vaccine were it to be offered (in France this is a recommended, not mandatory vaccination for HCWs) [27].

The efficacy of introducing a universal booster vaccination for adults (not solely HCWs) has been modelled in the USA based upon findings from both an infant pertussis case–control study and an adult pertussis randomized control trial [28]. A compartmental age-structured mathematical model suggests that a universal adult pertussis vaccination (with a booster dose every 10 years), at a coverage from 40%, could play a significant role in controlling the infection. This would be in preference to introducing an adolescent immunization (which others suggest), which is thought likely to offer only an immediate but not long-term effect. This study also evaluates the targeted (cocoon) strategy as seen in Australia. Results from this modelling study also suggest that to be effective, the cocoon strategy would require at least 65% coverage [27].

In conclusion, this paper highlights the often unrecognized burden of infection with pertussis within the adult population and presents an outbreak that demonstrates significant transmission among HCWs. We feel there is need for improved surveillance for pertussis generally and also specifically for HCWs. The lack of a national occupational policy for HCWs in the UK highlights pertussis as a significant issue requiring further review.

Key points

- The paper highlights a UK outbreak of pertussis among health care workers, demonstrating significant transmission among colleagues, but no detected onward transmission to patients.
- Countries differ in their approach to protecting health care staff and patients from occupational and nosocomial pertussis infection with immunization recommended for some health care workers in some countries.
- The paper calls for a re-evaluation of occupational health policy for health care worker immunization, together with improved surveillance and development of a national occupational policy for health care workers.

Conflicts of interest

None declared.

References


