Impact of Bordetella pertussis exposures on a Massachusetts tertiary care medical system

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Comments
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Impact of *Bordetella pertussis* Exposures on a Massachusetts Tertiary Care Medical System

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**Objective.** To assess the impact of outbreaks of *Bordetella pertussis* infection on a tertiary care medical system.

**Design.** Retrospective study.

**Setting.** Academic tertiary care medical center and affiliated ambulatory care settings.

**Subjects.** All patients and healthcare workers (HCWs) who were in close contact with patients with laboratory-confirmed cases of *B. pertussis* infection from October 1, 2003, through September 30, 2004.

**Intervention.** Direct and indirect medical center costs were determined, including low and high estimates of time expended in the evaluation and management of exposed patients and HCWs during outbreak investigations of laboratory-confirmed cases of *B. pertussis* infection.

**Results.** During this period, 20 primary and 3 secondary laboratory-confirmed cases of *B. pertussis* infection occurred, with 2 primary pertussis cases and 1 secondary case occurring in HCWs. Outbreak investigations prompted screening of 353 medical center employees. Probable or definitive exposure was identified for 296 HCWs, and 287 subsequently received treatment or prophylaxis for *B. pertussis* infection. Direct medical center costs for treatment and prophylaxis were $13,416 and costs for personnel time were $19,500-$31,190. Indirect medical center costs for time lost from work were $51,300-$52,300. The total cost of these investigations was estimated to be $85,066-$98,456.

**Conclusions.** Frequent *B. pertussis* exposures had a major impact on our facility. Given the impact of exposures on healthcare institutions, routine vaccination for HCWs may be beneficial.

Despite effective childhood immunization, pertussis remains endemic in the United States. The incidence of pertussis has remained high in children 1-5 years old; however, evidence is increasing that *Bordetella pertussis* is also an important pathogen among adolescent and adult populations. Furthermore, it is apparent that adolescents and adults with pertussis represent a significant source for transmission of *B. pertussis* to infants younger than 4 months, resulting in increasing morbidity and mortality in this age group.

Pertussis is a remarkably contagious disease, transmitted by aerosolized droplets, with secondary attack rates of 50%-100% in close contacts, depending on the nature of the exposure. It thus represents a major challenge in healthcare settings, and during the last decade, numerous nosocomial outbreaks of pertussis have been reported. Unfortunately, these outbreaks not only represent a medical risk for patients but also can significantly strain healthcare institution resources. In this retrospective study, we sought to determine the impact of *B. pertussis* outbreaks on our healthcare system during 1 fiscal year, at a time when there was a notable increase in pertussis cases in our state.

**Methods**

**Study Design and Period**

A pertussis investigation was initiated at the University of Massachusetts Memorial Medical Center (UMMMC) whenever a laboratory-confirmed case of pertussis was recognized. For this report, all data from the UMMMC infection control and employee health departments were retrospectively reviewed to identify the number of screened, exposed, and treated patients and healthcare workers (HCWs) who un-
Pertussis cases were defined based on the criteria of the Massachusetts Department of Public Health. A clinical case of pertussis was considered to be infectious from 1 week before until 3 weeks after the onset of typical paroxysmal cough. Exposed screened HCWs were the subset of screened HCWs who reported a history of exposure to a patient or other HCW with confirmed pertussis. Unexposed screened HCWs were the subset of screened HCWs without exposure to an index case of pertussis.

The time needed for screening and exposure evaluation was assessed retrospectively by interviewing all personnel assigned to screening- and exposure-related activities. Because there was variation in the estimates of the time taken for these investigations, high and low time estimates for each of the aspects of the outbreak investigation were developed, as follows. For the infection control department, the time for the initial diagnostic workup was 2 hours plus 0.05 hour (low estimate) or 0.1 hour (high estimate) per screened HCW, and for the unit manager, the time for the initial diagnostic workup was 2 hours plus 0.25 hour or 0.5 hour per screened HCW. For the employee health department, the time spent was 2 hours plus 0.25 hour or 0.5 hour per screened unexposed HCW and was 2 hours plus 0.5 or 0.75 hour per screened exposed HCW. For screened HCWs, the time lost from work was 0.1 hour or 0.25 hour per screened unexposed HCW and was 0.5 hour or 0.75 hour per screened exposed HCW. All screened symptomatic HCWs who had been exposed to a patient with a confirmed case of B. pertussis were considered to be infectious from 1 week before until 3 weeks after the onset of typical paroxysmal cough. Exposed screened HCWs were the subset of screened HCWs who reported a history of exposure to a patient or other HCW with confirmed pertussis. Unexposed screened HCWs were the subset of screened HCWs without exposure to an index case of pertussis. Exposed screened HCWs were the subset of screened HCWs who reported a history of exposure to a patient or other HCW with pertussis. Unexposed screened HCWs were the subset of screened HCWs without exposure to an index case of pertussis.

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Note. All estimates are expressed as ranges; see Methods. HCW, healthcare worker.

a HCWs other than the case patient, if the case patient was an HCW.

b Associated with 3 secondary cases.
of pertussis in the United States has been rising, although vaccine efficacy has appeared to be good.\(^1\)\(^,\)\(^{10}\)\(^,\)\(^{20}\) Of note, numerous states reported particularly high levels of pertussis during calendar year 2004.

The transmissibility of pertussis is highest at the catarrhal stage before the onset of paroxysmal cough, and it gradually decreases until it is negligible approximately 3 weeks after the onset of symptoms. The symptoms of pertussis may vary in severity from a mild upper respiratory tract infection to the full-blown syndrome, and rapid diagnostic testing is not readily available. Also, many cases of pertussis occur in previously vaccinated persons because of waning immunity. All of these factors contribute to the difficulty of managing pertussis in healthcare settings, locations where infection control measures need to be especially rigorous to protect individuals at high risk of complications.

In our institution, all persons with suspected cases of pertussis were promptly isolated and placed under droplet precautions until they had completed 5 days of an appropriate course of antibiotic therapy. Prompt epidemiologic investigations were initiated to identify exposed HCWs and patients, and as appropriate, were performed in coordination with the Massachusetts Department of Public Health. All symptomatic HCWs exposed to individuals with confirmed cases of \textit{B. pertussis} infection during the period of communicability (21 days or less after the onset of cough) were tested and excluded from work until they had completed 5 days of an appropriate course of antibiotic therapy; if they were not treated, they were excluded from work for 3 weeks after cough onset. All asymptomatic exposed HCWs who did not receive antibiotic prophylaxis were excluded from work for 21 days after their last exposure or, if the time of exposure was unknown, for 21 days after the onset of the last confirmed case of pertussis in the facility.\(^{21}\)

Our approach of investigating all cases of pertussis for potential transmission within the institution may be considered relatively aggressive. However, during the past several years, an increasing number of pertussis outbreaks have occurred in healthcare facilities,\(^{14-16}\) and the approach that was undertaken was in accordance with guidelines from the Massachusetts Department of Public Health.\(^{19}\)

In this study, we found that implementing these guidelines for the evaluation of \textit{B. pertussis} exposures had a major impact on our facility. The impact on the infection control, employee health, and unit management staff was particularly significant, functionally representing 3-6 weeks of full-time effort for 1 infection control staff member, 1 employee health staff member, and 1 unit manager.

The direct medical center costs were estimated to be $64,716-$65,716, which does not include the indirect medical center cost of time lost from work because of screening and evaluation of exposed HCWs. Having HCWs placed on medical leave also represented a significant expense.

The retrospective nature of this study may have led to overestimation or underestimation of the time and expense involved in screening and exposure evaluation. We tried to overcome this limitation by developing high and low time estimates for each aspect of the outbreak investigations. Additionally, only partial data were available on patient exposures, because several of the exposures took place in waiting areas and it was not possible to identify all of the exposed individuals. However, a minimum of 200 patients were determined to have been exposed, and they each received a letter about potential exposure.

Given the increasing number of pertussis cases being seen nationally and the impact of pertussis exposures on healthcare institutions, routine vaccination for HCWs may be beneficial in decreasing the number of HCWs who develop the disease.\(^{22}\) However, as highlighted in this study, many of the exposures in healthcare settings are linked to illness in patients. Because the institutional expense for the work involved in outbreak investigations is significant, a key area for future study is determining whether immunizing HCWs can obviate the need for antibiotic prophylaxis or exclusion from work in this population.

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