

# Pertussis in Young Infants: Clinical Presentation, Course and Prevention

## Abstract:

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## Abstract

Pertussis is a highly contagious disease caused by the Gram negative aerobic coccobacillus, *Bordetella pertussis*. It may present with severe symptoms and complications in infants and can pose a diagnostic challenge. This is a vaccine preventable illness covered by the Irish Childhood Immunisation Schedule. In 2011, a retrospective review was conducted of the records of infants, under six months, with a confirmed diagnosis of pertussis, presenting to Temple Street Children's University Hospital (TSCUH). A summary of notifications of pertussis nationally, from 2001 to 2012, was also examined as part of the study. This found that the rate of reported cases of pertussis has been increasing in Ireland. This national increase corresponds with a rising number of cases identified at TSCUH. Patients commonly presented severely ill with cyanosis and apnoea, on a background of prolonged cough. We found that pertussis was diagnosed rapidly in most cases however in all cases there was a delay to commencement of appropriate macrolide therapy.

## Introduction

There has been a recent increase in the number of reported cases of pertussis in Ireland. Pertussis is a vaccine-preventable, highly contagious disease caused by *Bordetella pertussis*. Pertussis in young infants is a severe illness, often requiring prolonged hospitalisation. Not only is there considerable economic expense but there are also costs in parental time, loss of earnings and stress on the extended family<sup>1-3</sup>. The Irish Childhood Immunisation Schedule vaccinates against pertussis (acellular pertussis vaccine) at 2, 4, and 6 months, 4-5 years and 11-14 years<sup>4</sup>. According to the Health Protection Surveillance Centre (HPSC) data for the first quarter of 2013 shows that 91% of infants in Ireland have received three doses of pertussis vaccine during the first year of life. The introduction of this vaccination in the United States, in the 1940s, reduced the incidence of pertussis by 80%. However there has been widely reported increasing incidence of pertussis in developed countries despite high vaccine uptake. While increased reporting, due to improved diagnostic tests, may account for some of the increase, there is strong evidence to suggest that waning immunity amongst older children and adults is a key factor<sup>5,8</sup>. New measures to control the spread of pertussis include vaccinating health care workers and vaccination boosters for pregnant women and adolescents. Reducing transmission from known infected patients still plays a vital role in controlling the spread of disease.

Given the increase in numbers of patients presenting with pertussis we reviewed admissions to Temple Street Children's University Hospital (TSCUH), in order to profile the presentations of pertussis in the infant population where diagnosis is often more challenging and complications are more severe. This review also addresses measures to control the spread of disease from known infected patients.

## Methods

A retrospective review was carried out of all infants under six months of age, admitted to TSCUH during 2011, with a confirmed diagnosis of pertussis. A confirmed diagnosis was a clinical diagnosis of pertussis in addition to laboratory detection of *B. pertussis* by either culture or polymerase chain reaction (PCR). Demographic data on all children admitted with pertussis was reviewed, including: age, number of siblings, sick contacts, duration and nature of symptoms, indicators of severity of illness (length of stay in hospital and whether high dependency or intensive care were required), and factors which affected potential transmission (institution of isolation precautions and time to commencement of macrolide antibiotic therapy). Pertussis is a statutory notifiable disease in Ireland. Data on the annual number of cases notified in Ireland was obtained from the national Computerised Infectious Disease Reporting (CIDR) system, maintained at the HPSC. Data on hospital costs was obtained from the Department of Health, and data on hospital-acquired cases and institution of isolation precautions was obtained from the TSCUH Infection Prevention and Control Department.

## Results

The number of cases of pertussis notified in Ireland decreased in the early 2000s. Between 2003 and 2008, 40 to 104<sup>10</sup> cases of pertussis were notified annually, with infants suffering the highest incidence of morbidity and mortality. The HPSC have recorded a marked increase in the number of confirmed pertussis cases, notified year on year, since 2010 (Figure 1). Figures doubled from 2010 to 2011 and doubled again from 2011 to 2012. There were eighteen laboratory confirmed cases of pertussis diagnosed at TSCUH in 2011. Fifteen of these were under 6 months of age and therefore were included in this study. A complete data set was available on all patients, with the exception of two patients transferred with a pre-existing diagnosis of pertussis and one other patient who was not admitted to hospital. All patients acquired pertussis in the community and there was no recorded case of infection acquired in hospital.

The infants with pertussis had a median age of 44 days (range 36 to 96 days). Ten patients had siblings living in the home. In only one case the siblings were reported to be unvaccinated. Ten patients had documented exposure to a sick contact in the home. This was most commonly the child's mother or older siblings with similar respiratory symptoms, often with prolonged cough. All patients had a history of cough (median 14 days of symptoms prior to presentation, range 3 to 17 days). There was a history of concurrent vomiting in four of the cases. One patient was reported to have apnoeic episodes for a number of days before presentation. Patients presented to the hospital as a result of increased severity of symptoms - for example with the development of apnoea and cyanosis (Table 1).

One infant was discharged home directly from the Emergency Department (ED). Two were transferred from another hospital directly to the Paediatric Intensive Care Unit (PICU). All others were admitted through the ED to the wards. Of those admitted to the wards, one required admission to the PICU, making a total of three PICU admissions. Another child was admitted from a ward to the High Dependence Unit (HDU). PICU admissions had a median length of stay of 4 days (range 3 to 8 days). The overall median duration of hospital admission was 7 days (range 4 to 13 days). Calculating for a cost of 800 for a night on a general ward and 1600 for a night in intensive care the total cost of admissions to the hospital was in excess of 90,000, with an average cost of 6,450 per patient.

As per hospital policy all patients under investigation for pertussis were isolated with droplet precautions. Isolation facilities were not available in the ED and so patients were isolated upon entry<sup>11</sup> to the ward. For pertussis nasopharyngeal aspirates are the preferred sample, otherwise a pernasal swab is acceptable. Of the admitted patients, four did not have a record of when pertussis swabs were taken, and two had swabs taken after leaving the ED. All other patients were under investigation at time of entry to the ward and were therefore isolated from this time. The two patients swabbed after leaving the ED were isolated 7-9 hours after entry to the ward. In all admitted cases, appropriate antibiotics were prescribed but there was a lag between presentation and initiation of first line macrolide antibiotics. Specific antimicrobial therapy was not initiated in the ED, despite a high clinical suspicion of pertussis. Macrolide antibiotics were commenced between 4.5 hours and 24 hours after presentation, with a median time to commencement of 15 hours.

## Discussion

Despite a high uptake of the acellular pertussis vaccine, pertussis has been increasing both internationally and in Ireland. This increase has been reflected in the rising number of cases identified at TSCUH. The increasing incidence has a particular impact on infants under the age of 6 months, where symptoms may be subtle but complications can be life threatening. Prior to the onset of more severe symptoms, the patients in this study had symptoms similar to those of a viral upper respiratory tract infection. The diagnosis of early pertussis is difficult and requires a high index of suspicion amongst parents and primary health care providers to identify infants before the onset of complications. A prolonged duration of cough was the most common symptom prior to presentation. Many infants presented to TSCUH with dramatic symptoms - three quarters experiencing apnoea, cyanosis or both. The significance of pertussis in infants is reflected in the prolonged duration of stay and the high number of admissions to PICU and HDU care among the study sample. This protracted hospital course with challenging complications requires substantial resources. The resurgence in pertussis has resulted in considerable impact, on hospital finances and parental resources.

A laboratory diagnosis requires the timely collection of samples and results may not be available for a number of days after samples are sent. Until rapid detection testing such as PCR become more widely available and with shortened turnaround time the diagnosis remains a clinical one. Macrolide antibiotic therapy is associated with reduced duration and severity of symptoms only if started in the catarrhal stage of the illness. However, once the paroxysmal phase has begun, prompt use of antibiotics and isolation reduces the time during which the patient is contagious. While many cases are correctly identified and appropriately treated, this opportunity to reduce infectivity by the introduction of early antibiotic therapy is often overlooked. Addressing the lag in commencing therapy is likely to yield a decrease in transmission rates. High levels of vaccination have not eliminated the spread of pertussis. Awareness amongst parents and physicians will aid early detection but to see the true benefit of this early isolation and commencement of macrolide therapy are essential.

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