Epidemiology

Pertussis is an illness caused by infection with the bacterium *Bordetella pertussis*. New Zealand continues to experience epidemics of pertussis every 4 to 5 years despite improved immunisation rates. A substantial proportion of children are not immunised on time.

Based upon several measures of diseases incidence (notification rates, hospitalisation rates and laboratory isolation rates) the incidence rate of pertussis in New Zealand is about 3 times higher than the United States or Australia.

Clinical Spectrum

The spectrum of pertussis disease is broad, and with the disease now being vaccine-modified in many age groups the clinical presentation can sometimes be very difficult to differentiate from other respiratory infections. Infants are at greatest risk of severe disease. The mortality rate from pertussis in the developed world fell during the first half of the 20th century and then declined more rapidly after the introduction of immunisation. The mortality rate from pertussis in infants appears to have increased in developed countries over the past decade with a number of deaths reported in recent epidemics in Australia, the United Kingdom and the United States.

The vast majority of children who present to hospital with pertussis are less than 1 year of age. The disease is more difficult to diagnose in infants than in preschool or school aged children partly because the presentation is less typical, and partly because of other illnesses such as bronchiolitis, have considerable symptom and sign overlap with pertussis.

Approximately 60% of infants who get pertussis will require hospital admission. Among those infants hospitalised, 30% are in hospital for more than 1 week, over half have episodes of cyanosis, and 1 in 10 are admitted to the Paediatric Intensive Care Unit. Of those admitted to PICU one in six will either die or be left with brain or airway/lung damage.

Diagnosis

As laboratory confirmation can be difficult, clinical case definitions are used to help define a larger proportion of those who have the illness (in addition to those who are laboratory confirmed).

The clinical case definition used in New Zealand is:

- cough for 14 days or more PLUS
- one or more of:
  - whoop
  - cyanosis
  - post-tussive vomiting or
  - apnoea for which there is no other cause.
The obvious limitation of the clinical case definition is that you cannot satisfy it until you have been coughing for 2 weeks. Less than half of children hospitalised with pertussis have coughing for 2 weeks at the time that they are admitted. The presence of any of these symptoms should make you suspicious of pertussis irrespective of the duration of cough, particularly if the infant is afebrile and/or there are no clinical signs of respiratory distress (such as tachypnoea, wheeze or crackles).

Other aspects of the history are important. The disease epidemic peaks are in February/March rather than July/August (as for bronchiolitis). Coughing illness in other family members usually precedes that of the infant (by weeks) rather than being concurrent or within days of the infants. The coughing is also described to be worse at night.

Confirmation of infection is by one of these methods:

- Culture of *B. pertussis* from a nasopharyngeal swab
- Identification of *B. pertussis* specific DNA from a nasopharyngeal swab or aspirate using PCR
- Paired serology.

Only one quarter of children hospitalised with pertussis in Auckland are culture positive for *B. pertussis*. PCR is considerably more sensitive and can be performed on the same nasopharyngeal aspirate as is collected for respiratory viral immunofluorescence. Paired serology is impractical in terms of making a diagnosis in a clinically relevant period of time. A lymphocytosis increases the likelihood of the diagnosis but it is only present in approximately 30% of those hospitalised with pertussis, and is only seen in those not yet immunised.

**Management**

Pertussis is a notifiable disease. Suspected cases must be notified to the Medical Officer of Health.

Macrolides such as erythromycin and azithromycin have been shown to reduce the duration of time that a person with pertussis is culture positive (infectivity) but are not been shown to significantly alter the course of the illness. However the quality of information on the effect of erythromycin on the course of the disease is relatively poor.

Azithromycin is funded for infants and children for treatment of pertussis and prophylaxis and recommended as first line for infants.
Table 1: Recommended antimicrobial therapy and post-exposure prophylaxis for pertussis in infants, children, adolescents and adults

<table>
<thead>
<tr>
<th>Age</th>
<th>Recommended</th>
<th>Alternative</th>
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<tr>
<td></td>
<td>Azithromycin&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Erythromycin</td>
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<tr>
<td>Younger than 4 weeks</td>
<td>Day 1: 10 mg/kg/day in a single daily dose (max 500 mg on day 1); Days 2–5: 5 mg/kg/day in a single daily dose (maximum 250 mg per day)</td>
<td>40 mg/kg/day in 4 divided doses for 14 days</td>
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<tr>
<td>1–5 months</td>
<td>Day 1: 10 mg/kg/day in a single daily dose (max 500 mg on Day 1); Days 2–5: 5 mg/kg/day in a single daily dose (maximum 250 mg per day)</td>
<td>40 mg/kg/day in 4 divided doses for 14 days</td>
</tr>
<tr>
<td>6 months or older and children</td>
<td>Day 1: 10 mg/kg/day in a single daily dose (max 500 mg on day 1); Days 2–5: 5 mg/kg/day in a single daily dose (maximum 250 mg per day)</td>
<td>40 mg/kg/day in 4 divided doses for 14 days (max 2 g/day)</td>
</tr>
<tr>
<td>Adolescents and adults</td>
<td>Day 1: 500 mg as a single dose Days 2–5: 250 mg once daily</td>
<td>2 g/day in 4 divided doses for 14 days</td>
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<sup>a</sup> Preferred macrolide during pregnancy, lactation and in infants < 1 month old because of risk of idiopathic hypertrophic pyloric stenosis associated with erythromycin.

<sup>b</sup> Not funded for treatment or post-exposure prophylaxis in New Zealand.

<sup>c</sup> TMP = trimethoprim; SMX = sulfamethoxazole.


**Prophylaxis**

Public health can advise on prophylaxis of contacts but generally, to minimise risk of contacts developing pertussis or passing it onto to someone vulnerable, prophylactic antibiotics are recommended to the following groups:

- Aged less than 1 year; or
- Is partially or un-immunised & less than 5 years of age; or
- Has chronic disease or is immunocompromised; or
- In the last trimester of pregnancy; or
- Has daily contact with a high priority contact (i.e. an infant <12 months old, a pregnant women, an immunocompromised person) and poses a transmission risk.
Any coughing family members should be advised to see a doctor and have treatment to lessen infectivity, particularly if they are accompanying an inpatient in the hospital.

When an infant is in PICU it is difficult for families to access their own treatment therefore other measures below may be need:

- Referring hospitals to arrange antibiotics for families prior to transfer, wherever possible / if time permits
- Clinical team to contact family GP requesting scripts for prophylaxis for family members
- For infants from out of town, the Infection Control nurse or duty manager should be informed promptly to liaise with Ronald McDonald House staff as family with contacts who are potentially infectious will need to be housed at alternative accommodation

Family members are deemed to be non-infectious once (reference ARPHS)

- coughing >3 weeks
- if all family members have completed 5 days macrolide antibiotic (azithro or erythro)

**Discharge Planning**

It is difficult to know when a child with pertussis is ready to be discharged home from hospital. The clinical course is less predictable than it is for bronchiolitis. Twenty percent of children hospitalised with pertussis are readmitted within 1 month of their presenting illness. The illness often does not peak in severity until the cough has been present for 3 weeks. Particularly in infants less than 6 months of age, you need to be confident that their illness has peaked and is waning before you send them home. A rule of thumb is that for the 48 hours prior to hospital discharge the infant should have no cyanosis with coughing paroxysms and should have paroxysms that are less than 30 seconds long and resolve spontaneously.

The risk of readmission with pertussis is increased in children who have:

- ≥1 cyanotic episode per day,
- cyanosis on ≥50% of in hospital days
- ≥2 coughing paroxysms on the last hospital day; or
- any cyanotic episodes on the last day.

Pertussis is an exhausting illness for families that can affect different family members over a number of months resulting in prolonged periods of disturbed sleep in the household. As the coughing is worse at night it is particularly difficult for families to manage at home. Bear this in mind when planning a discharge date.

**References**