Guidelines for the Public Health Management of Pertussis

Public Health Medicine Communicable Disease Group HSE

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1.0	August 2012	Pertussis Subgroup of Vaccine Preventable Disease Group	PHMCDG	
1.1	January 2013	Pertussis Subgroup of Vaccine Preventable Disease Group	PHMCDG	Page 22. Vulnerable "close" contacts defined
1.2	October 2013	Pertussis Subgroup of Vaccine Preventable Disease Group	PHMCDG	Pages 13-16. Updated vaccination recommendations

Guidelines for the Public Health Management of Pertussis

The Pertussis Guidelines Group of the Public Health Medicine Communicable Disease Group wishes to particularly acknowledge the Health Protection Agency, UK in relation to extracts from its 2011 publication entitled "HPA Guidelines for the Public Health Management of Pertussis".

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PART ONE: Background and rationale

1.1 Introduction

Pertussis or whooping cough is an acute bacterial infection caused by *Bordetella pertussis*, an exclusively human pathogen which can affect people of all ages. Whilst adolescents and adults tend to display mild symptoms, infants are the most vulnerable group with the highest rates of complications and mortality. Transmission of the organism occurs as a result of close direct contact with an infected person.[1] It is highly contagious, with up to 90% of susceptible household contacts developing the disease.[2]

The incubation period of pertussis is on average between 7–10 days (range 4–21 days). Patients with pertussis are most infectious in the initial catarrhal stage and during the first three weeks after the onset of cough.[3]

Effects of pertussis[4]

Pertussis is primarily a toxin-mediated disease. Bacteria attach to the respiratory cilia and produce toxins which paralyse the cilia. This, and inflammation, interferes with the clearing of secretions. Many factors determine disease severity, including age of the patient and time since vaccination or previous infection.

Classical pertussis symptoms occur mainly in children. The symptoms are less marked in those who had infection or vaccination within the previous 10-20 years. The initial catarrhal stage has an insidious onset and is the most infectious period. Cough is absent or mild in the early stages, the main symptom being rhinorrhoea. The cough gradually becomes paroxysmal (>90%), with a characteristic inspiratory whoop (80%) and/or vomiting (>50%). This paroxysmal stage usually occurs within 1-2 weeks, and often lasts for 2- 3 months. Complications include pneumonia, fits, encephalopathy, otitis media, dehydration, bladder incontinence, weight-loss, rib fractures, conjunctival haemorrhages, rectal prolapse and loss of consciousness. The case fatality rate ranges from 0.04-4%.

Pertussis in infants

In infants the typical whoop may never develop (30%) and coughing spasms may be followed by periods of apnoea and cyanosis. Complications including hospitalisation are significantly more frequent in infants (particularly in those <6 months of age) than in older children and adults.

Of those hospitalised:

- 50% have apnoea

- 20% have pneumonia
- 3% have seizures
- 1-4% will die
- 0.3% have encephalopathy (as a result of hypoxia from paroxysmal coughing or apnoeic episodes, or possibly due to a direct effect of toxin)

Among infants who die, refractory pulmonary hypertension is a common complication, and encephalopathy will have occurred in approximately 20%. The highest mortality rate is in preterm infants.

Pertussis in adults and adolescents

Up to 30% of adults and adolescents with a cough lasting longer than 2 weeks may have pertussis. The cough is paroxysmal in >80%, but a whoop and vomiting are absent in 50-70%. The cough lasts for at least 3 weeks in over 80%, and for up to 3 months in over 25% of cases. Diagnosis on clinical grounds can be difficult and cultures may be negative in previously vaccinated persons.

Vaccination provides the most effective strategy for preventing pertussis transmission in the population, although protection afforded by vaccination or from past infection is not lifelong.

1.2 Childhood immunisation programme for pertussis control

In Ireland, the whole cell pertussis vaccine (wP) was introduced in 1952/3 as part of the DTP vaccine (against diphtheria, tetanus & pertussis). The acellular pertussis vaccine (aP) was introduced in Ireland in 1996 as part of the DTaP vaccine. Children are vaccinated at 2, 4 and 6 months of age and are given a booster at 4-5 years. A further booster at 11-14 years is now recommended[4] and implementation commenced in 2011.

In the United States, the average incidence of pertussis dropped from 150/100,000 in the 1920s & 1930s, to 1/100,000 in 1980 following the introduction of the pertussis vaccine[5]

1.3 Surveillance of pertussis in Ireland

Epidemiological data on pertussis has been gathered in Ireland since 1948. Over this time period there has been an overall decline in incidence and the number of deaths associated with pertussis (Figure 1), although increases in notifications have been seen in recent years (Figure 3).

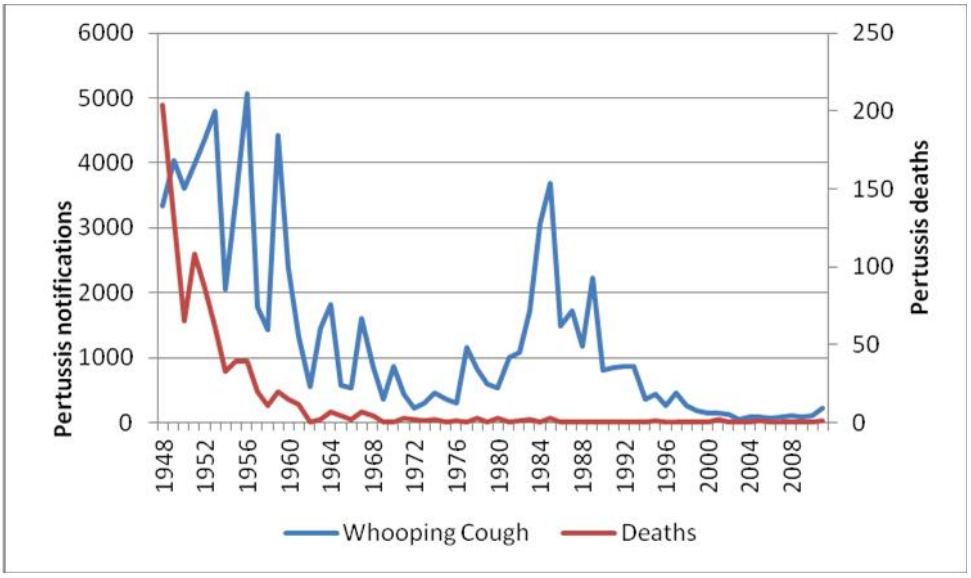


Figure 1. Number of pertussis cases and deaths notified 1948-2011*, Ireland
**2011 provisional data*

Please note: the axes for notifications and deaths in the above graph use different scales

A decline in pertussis incidence followed the introduction of the vaccine in the early 1950s. A resurgence of disease in the mid-1970s (following adverse media reports or alleged severe side effects of the pertussis vaccine) negatively impacted on vaccination uptake. This was then followed by an upsurge in incidence of disease in the latter half of the 1970s and 1980s. The disease incidence and temporal association with the vaccinations is seen in Figure 2.

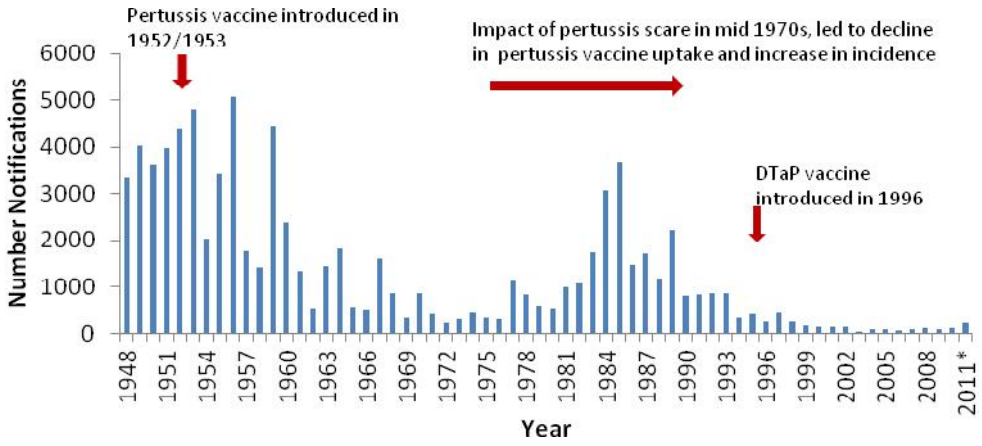


Figure 2. Number of pertussis cases and vaccination history in Ireland1948-2011, Ireland
**2011 provisional data*

Since the 1950s the composition and the combination of the pertussis vaccine with other vaccines has changed. In Ireland, an acellular vaccine replaced the whole cell vaccine in the 3-in-1 vaccine in 1996. Further changes took place in 2001 with the introduction of a combined vaccine, the 5-in-1 vaccine which included the DTaP, *Haemophilus influenzae* type b (Hib) vaccine and an inactivated polio vaccine. In 2008 a 6-in-1 vaccine (including hepatitis B vaccine in addition to the other vaccines in the 5- in-1 vaccine) was introduced (see figure 3).

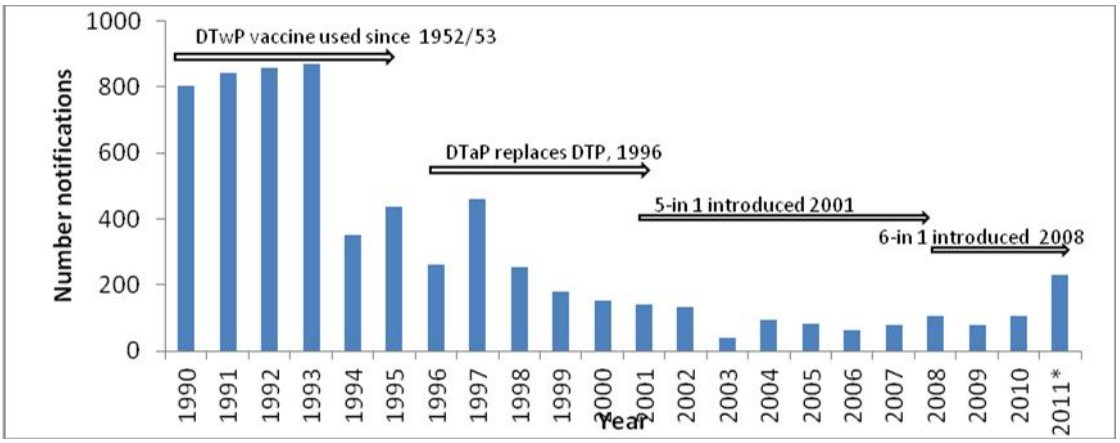


Figure 3. Pertussis notifications 1990-2011*, and vaccine changes
**2011 provisional data*

Since 1999 pertussis vaccination status at 24 months of age has been routinely available and reported to the HPSC. Between 1999- until Q3 2011 the uptake of three doses of a pertussis containing vaccine has increased from a low of 82% in 1999 to the current high of 94%. The relatively high incidence of pertussis in 2011 is occurring against a background of the highest pertussis vaccination coverage since routine reporting began, (Figure 4). Data on the booster dose recommended at 4-5 years of age is not available nationally.

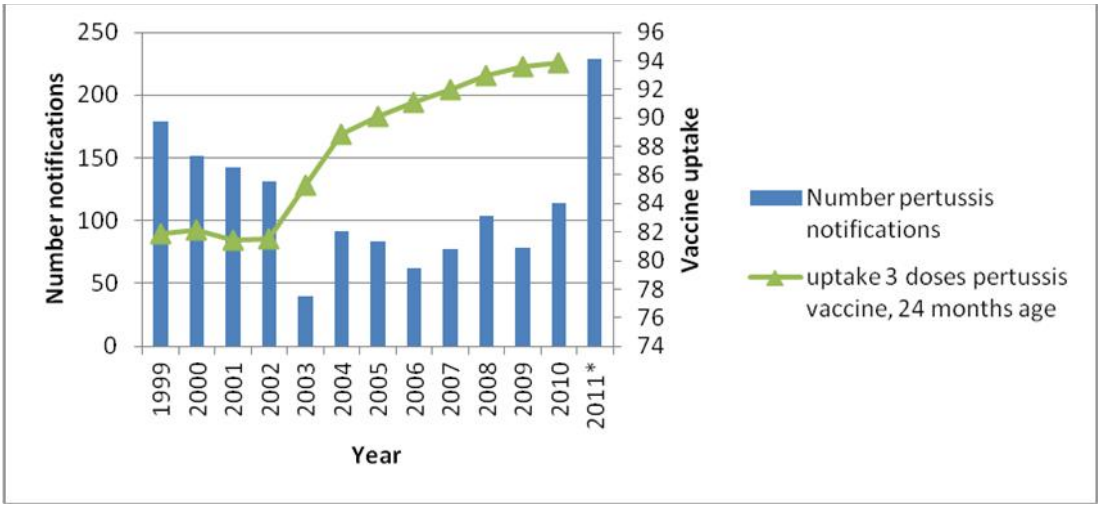


Figure 4. Annual number of pertussis notifications and Pertussis vaccination (3 doses) uptake at 24 months, 1999-2010
**2011 provisional data*

The recent increase in pertussis in paediatric age groups < 15 years of age is notable since 2010; an increase in the adolescents occurring in 2010 and an increase in younger age groups is clearly seen in 2011. Additionally in both 2010 and 2011 an increase in adults has been evident, in 2011 this was most marked in the 35-54 year age groups (Figure 5). The age

specific incidence (ASIR) in the 0-4 year age group was 40/100,000 in 2011, double that reported in 2010 (ASIR 20/100,000). (ASIR data not shown).

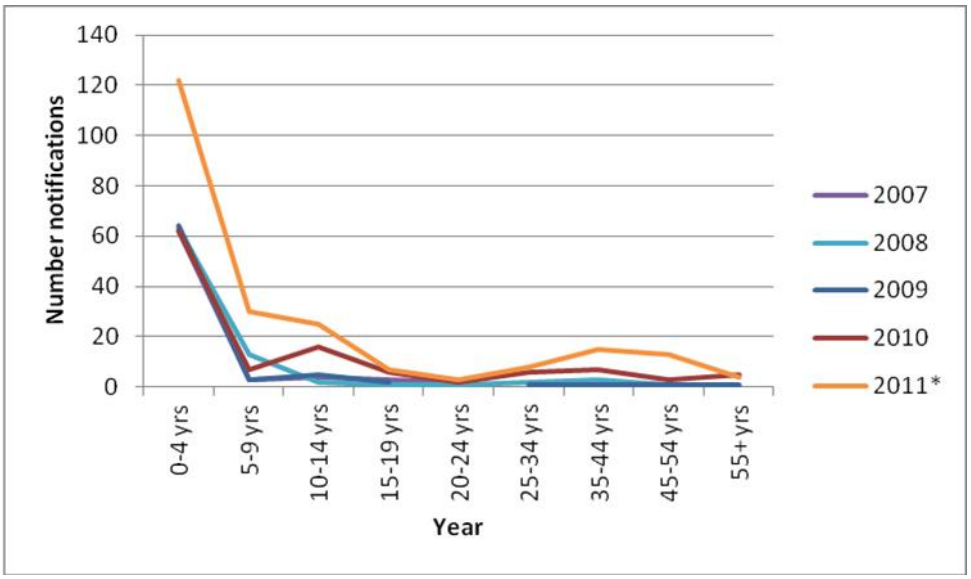


Figure 5. Pertussis notifications by age group, 2007-2011
**2011 provisional data*

Closer analysis of the 2011 notifications among children < 5 years of age, demonstrates that within this age group infants in the 0-5 month age group account for most (65% - 79/122) cases.

Laboratory confirmation of disease was most common in the children in the youngest age groups (figure 6). This reflects in part the fact that at this age most children will require hospitalisation for the severe disease and it is normal for samples to be obtained and sent to the laboratory for diagnostic testing. Increased availability of PCR testing in Ireland, notably in Our Lady's Hospital for Sick Children has contributed to better diagnosis and notifications in this age group. For older age groups, even when cases do present to the GP, the GP may not diagnose pertussis and would rarely send samples for diagnostic testing.

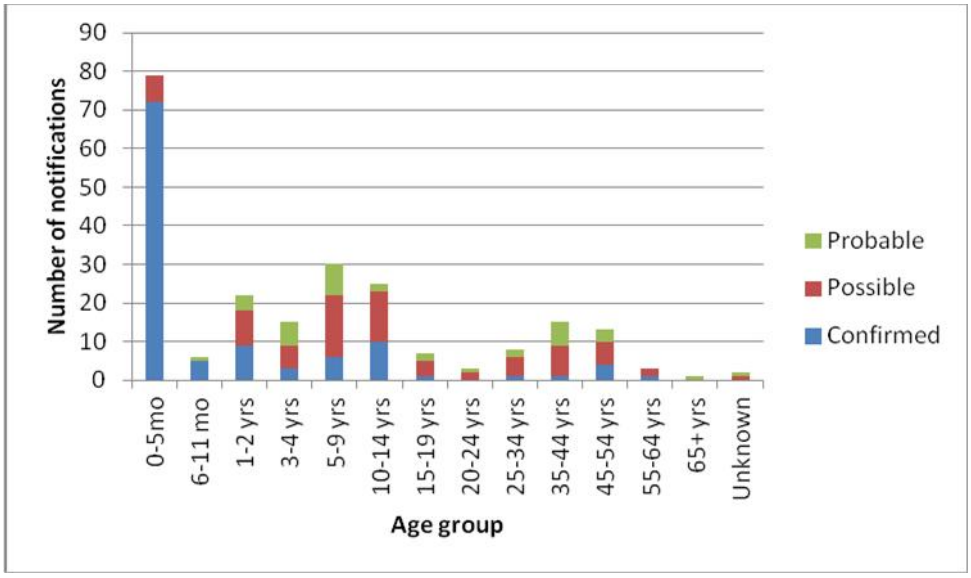


Figure 6. Pertussis notifications 2011 by age group and case classification (n=229)
**2011 provisional data*

Enhanced data on pertussis is not currently routinely collected. However, based on the data available it is evident that pertussis causes severe disease in infants, notably those < 6 months of age. In 2011, of the 229 cases reported, 65 cases were reported as hospital patients, of which 57 (87%) were infants < 6 months of age.

1.4 Laboratory confirmation of clinically suspected cases

1.4.1 Culture

Laboratory confirmation is conventionally performed by isolating the *B. pertussis* organism through culture from nasopharyngeal aspirates or pernasal swabs. Culture lacks sensitivity as the organism is delicate and can be affected by processing delays. The sensitivity of nasopharyngeal culture decreases with time after onset and is highly dependent on specimen quality. The culture of *B. pertussis* is most likely to be successful during the first three weeks of illness. Children, particularly the younger age groups, may yield positive cultures for a longer time span of 5 to 6 weeks.

It is also more difficult to culture the organism in vaccinated children compared with unvaccinated children. Given the limited 'window of opportunity' for positive culture, it is important to emphasise that a negative culture does not exclude pertussis. Despite the low yield, culture should always be attempted as isolation of the causative organism is definitive. Receipt of antibiotics effective against pertussis decreases but does not preclude the likelihood of isolating *B. pertussis* in culture.

In an investigation of a pertussis outbreak in the HSE-North West in 2010, 67 possible cases were identified[6]. Of 26 cases from whom samples were obtained only seven cases were laboratory confirmed; one (9%) of the eleven swabs taken grew pertussis on culture; six of 17 cases (35%) from whom serology was obtained were serologically confirmed.

The CDC website has information on specimen collection for pertussis culture at this link, http://www.cdc.gov/pertussis/clinical/diagnostic-testing/specimen-collection.html

Key points to consider when considering culture for diagnosis of pertussis

- In adults positive results more likely in first 3 weeks illness
- Younger children may have positive results for 5-6 weeks
- Result affected by vaccination status
- Result affected by administration of antibiotics.

1.4.2 Serology.

Detection of anti-pertussis toxin (PT) IgG antibody levels in serum is well-established and can be performed using an enzyme immuno-assay. The EU Pertstrain group reviewed serology tests in 2011. Their recommendation is that only purified non-detoxified Pertussis Toxin (PT) should be used in either enzyme linked immunosorbent assays (ELISA's) or immunoassays.

Serology may confirm the diagnosis of pertussis in patients who have been symptomatic for some weeks when culture and PCR are unlikely to yield positive results. Serology may stay positive for up to one year post infection. It is used predominantly in older children and adults. Serological diagnosis amongst infants has some limitations e.g. infants less than three months may not develop measurable antibodies. Antibody detection is not a suitable test for patients who have been vaccinated in the previous twelve months. Caution is required with interpretation of results for those vaccinated within the previous 24 months. Serology is not recommended for confirmation of vaccine status or antibody levels.

Interpretation of serology results may be made on a single or dual sample results. The result is expressed in International Units per millilitre (IU/ml). The best sensitivity is thought to exist with a cut-off value between 60-75 IU/ml. If an equivocal result is obtained, then a convalescent serum should be collected three weeks after the first sample. Serology tests are done in OLHSC in Crumlin and the turnaround time for results is 7 days.

Key points to consider when considering serology for diagnosis of pertussis

- Useful when patients symptomatic for prolonged period
- Useful in older children and adults
- **Not** useful if vaccinated within the previous year
- Interpretation of result may be based on single or dual sample.

1.4.3 PCR

This is a molecular technique where specific chosen DNA sequences are amplified or increased to provide millions of copies of the chosen target. The real advantage of this method is that, non-viable organism or their fragments can be detected. Consequently PCR remains positive, where cultures have become negative.

PCR is a more robust tool than culture for diagnosis. It is particularly useful as it remains positive for longer than culture, even if antibiotics have been administered. PCR is also invaluable in diagnosing pertussis in young infants in whom serology is difficult and the yield from culture may be low. This is a more sensitive test as the organism does not need to be viable. PCR tests are done in OLHSC in Crumlin and the turnaround time for results is 3 days.

Key points to consider when considering PCR testing for diagnosis of pertussis

- Useful as it is a more sensitive test than culture
- Useful as it remains positive for longer than culture
- Useful when antibiotics have been administered
- Useful in all age groups.

1.5 Rationale for public health action

Outbreaks of pertussis can occur in households, schools, healthcare settings and in the community. Cases amongst adolescents and adults are particularly relevant given that adults in the household are often the source of infection for cases occurring in very young infants, who are most at risk of severe complications. In a US study of infants with reported pertussis, over 70% had been infected by their mother or other family member, the majority of whom were aged 20 years or more.[7] In a study of infants admitted to a UK Paediatric Intensive Care Unit with respiratory complications, 20% had laboratory evidence of pertussis and half of these had acquired infection from an adult family member.[8]

If outbreaks are detected at an early stage, prompt action including chemoprophylaxis and vaccination can limit the spread.[9,10] Ideally specimens should be taken to permit laboratory confirmation of contacts. This facilitates curtailment of outbreaks and provides epidemiological data to inform future vaccination policies. Cases occurring in households where there are vulnerable contacts (See Table 2 for definition of vulnerable contacts) need to be identified so that prompt post-exposure prophylaxis may be offered to all household contacts.[1]

In addition to parents, other adults in close contact with young infants including healthcare workers can be responsible for transmission.[11] In healthcare settings, outbreaks can be prolonged involving groups of adults with waning immunity who have multiple opportunities for transmission. Exclusion of staff in hospital and school settings can be very disruptive and costly.[12]

1.5.1 Use of antibiotics in the treatment and prevention of pertussis

Erythromycin has long been recommended as the drug of choice for the prophylaxis and treatment of pertussis, except for infants below one month, although it is poorly tolerated, causing gastrointestinal side effects in up to 30% of patients[13,14] which may lead to non-compliance with therapy.[9] Treatment with erythromycin is primarily aimed at eradicating *B. pertussis* from cases and preventing secondary transmission. It has a limited effect in improving the clinical course of the illness especially if administered beyond 2–3 weeks after the onset of symptoms. A 1998 UK review of the use of erythromycin in the management of persons exposed to pertussis reported little effect in preventing secondary transmission, any benefit was limited to close prolonged household type contact.[9] Effects of erythromycin were modest, short term and associated with gastrointestinal side effects.[9] As a result, the use of chemoprophylaxis in the UK has been limited to households with vulnerable contacts where the risk of severe complications and/or ongoing transmission is high.[1] This contrasts with the US approach of recommending more widespread use of chemoprophylaxis to all household contacts and other close contacts regardless of age and immunisation status.[15]

Newer macrolides such as azithromycin and clarithromycin offer the advantages of improved absorption, a longer half-life, good *in vitro* activity against *B. pertussis* and a better side effect profile.[16] In addition, these agents involve less frequent dosing and shorter duration of therapy. A number of studies have established the safety and efficacy of newer macrolides for eradicating *B. pertussis*.[16,17] The improved side effect profile has also been shown to improve compliance with treatment.[18] Recent data suggest that there is no evidence of macrolide-resistant strains in the UK.[19] For those patients where a macrolide is contra-indicated or is not

tolerated, co-trimoxazole is effective in eradicating *B. pertussis* from the nasopharynx and can serve as an alternative agent, although it is unlicensed for chemoprophylaxis.[20-22]

In a 2007 Cochrane systematic review of antibiotics for pertussis, the authors concluded that although antibiotic therapy for cases was effective in eliminating *B. pertussis,* it did not alter the subsequent clinical course of the illness.[21] Short term use (azithromycin for 3–5 days; clarithromycin or erythromycin for seven days) was as effective as erythromycin for 10–14 days in eradicating *B. pertussis* from the nasopharynx (RR 1.02, 95% CI 0.98, 1.05) and had fewer side effects (RR 0.66, 95% CI 0.52, 0.83).

The review concluded that there was insufficient evidence to determine the benefit of prophylactic treatment of pertussis contacts.[21] In the two trials included in the review, which investigated the effectiveness of chemoprophylaxis with erythromycin, clinical symptoms in the treatment group were not statistically significantly different to the placebo group.[14;23] The number of contacts that became culture-positive were slightly less in the erythromycin group (3/142, 2.1%) compared to placebo (8/158, 5.1%) but the difference was not statistically significant (RR 0.42; 95% CI 0.11, 1.54).[14] Although there have been no specific studies of prevention of secondary transmission using azithromycin or clarithromycin, their biological effect is considered to be similar to erythromycin.

Post-exposure chemoprophylaxis for contacts over six months of age did not significantly improve clinical symptoms or the number of cases developing culture positive *B. pertussis*, although timing of prophylaxis was thought to be a critical factor. Whilst early administration may improve the efficacy of chemoprophylaxis in preventing secondary transmission, this requires clinical diagnosis, which is likely to be a challenge given that adolescents and adults who are often the source of infection, generally do not seek timely health advice.

1.5.2 Vaccination

The National Immunisation Advisory Committee (NIAC) published updated guidance for pertussis immunisation in September 2013.[4] The updated guidelines can be accessed on line at http://www.immunisation.ie/en/HealthcareProfessionals/ImmunisationGuidelines/#d.en.9412 The following is an extract from the NIAC guidelines regarding indications for pertussis vaccine.

Indications

1. Primary vaccination

The primary course consists of 3 doses given at 2, 4 and 6 months as 6 in 1 vaccine (DTaP/IPV/Hib/Hep B).

If the primary course is interrupted it should be resumed but not repeated, allowing appropriate intervals between the remaining doses (see catch up schedule in Chapter 2).

If pertussis vaccine is refused by parents for their children, the only available pertussis-free diphtheria and tetanus vaccines are Td and Td/IPV which contain low dose diphtheria toxoid which is insufficient for primary immunisation in children under 10 years of age. They are not intended for use as part of the primary schedule, may not give a sufficient immune response to diphtheria and tetanus if so used, and are not licensed for such use.

2. Booster vaccination

Routine

A first booster dose is recommended at 4-5 years of age as 4 in 1 vaccine (DTaP/IPV).

Children who have received four pertussis containing vaccines before their fourth birthday should receive a further 4 in 1 booster after their 4th birthday at least 6 months after the 4th dose.

A booster is recommended at 11-14 years as part of a Tdap vaccine which contains low dose acellular pertussis vaccine. No interval is required between this booster and any previous tetanus or diphtheria toxoid containing vaccine.

Health Care Workers

A booster dose of Tdap is recommended for Health Care Workers who are in contact with infants, pregnant women and the immunocompromised.
Boosters every 10 years may be considered.

Pregnant Women

Maternal antibodies from women immunised before pregnancy wane quickly and the concentration of pertussis antibodies is unlikely to be high enough to provide passive protection to their infants prior to primary vaccination.

Pregnant women should be offered Tdap during 27 -36 weeks gestation in each pregnancy, to protect themselves and their infant.

Tdap can be given at any time in pregnancy before 27 or after 36 weeks gestation although may be less effective in providing passive protection to the infant.

Post partum women
Tdap should be offered in the week after delivery to those women who were not vaccinated during their pregnancy.

Adults
Tdap may be considered for adult contacts who have not had a pertussis vaccine in the previous 10 years to decrease the risk of infection to themselves and infants.

3. Vaccination of cases
Unvaccinated or partially vaccinated cases should complete the age appropriate vaccination schedule during convalescence as infection may not confer long term immunity.

4. Vaccination of contacts
Unvaccinated or partially vaccinated contacts should complete the age appropriate vaccination schedule. Adult contacts, including HCWs, who have not had a pertussis containing vaccine within the previous 10 years should be given Tdap.

5. Cocooning
Preventing pertussis in infants by immunising their close contacts - parents, siblings, grandparents, child care providers, and health care workers is advised for infants born before 32 weeks gestation as they may not have received protection via maternal antibody transfer.

Tdap should be offered to all unvaccinated close adult contacts who have not had a pertussis vaccine in the previous 10 years. Ideally, the vaccine should be given at least 2 weeks before beginning close contact with the infant.

Cocooning of incompletely vaccinated infants should be considered in the event of community outbreaks.

Children under 10 years should receive full dose pertussis vaccine as DTaP/IPV/Hib/Hep B or DTaP/IPV.

All aged 10 years and over should receive low dose pertussis vaccine as Tdap or Tdap/IPV depending on other vaccine requirements.

If pertussis vaccine is indicated

for those aged <10 years

There should be an interval of at least 6 months between booster doses of DTaP and the completion of a primary course of DTaP containing vaccines. DTaP containing vaccines can be given at any interval following (an inappropriately administered) Td.

for those aged 10 years and older

Tdap or Tdap/IPV can be given at any interval following a Td containing vaccine."

PART TWO: Management and investigation of suspected cases of pertussis and their contacts

2.1 Surveillance information to be recorded when a case is reported

All notified cases should be entered on CIDR as possible, probable or confirmed. Enhanced surveillance should be undertaken on all confirmed cases and the enhanced surveillance form completed (Appendix 2). Consideration should be given to undertaking enhanced surveillance on other cases, such as probable cases, cases with clinical presentation highly suspicious of pertussis (e.g. infant with cough and apnoea) or clusters of cases.

2.2 Risk assessment for the index case

The positive predictive value of a clinical diagnosis of pertussis is not very high, particularly amongst adolescents and adults who may present with atypical features. (In the outbreak in the North West in 2010 only 35% of serology samples were positive and 12.5% of swabs were positive on culture.) Risk assessment should be based on a combination of clinical and epidemiological factors such as clinical presentation, vaccination history and epidemiological links. Management may need to proceed based on clinical suspicion without waiting for the results of laboratory testing.

2.3 Case definitions

Clinical criteria

Any person with a cough lasting at least two weeks
AND
at least one of the following three:
- Paroxysms of coughing
- Inspiratory “whooping”
- Post-tussive vomiting

OR
Any person diagnosed as pertussis by a physician
OR
Apnoeic episodes in infants

Laboratory criteria

At least one of the following three:
- Isolation of *Bordetella pertussis* from a clinical specimen
- Detection of *Bordetella pertussis* nucleic acid in a clinical specimen
- *Bordetella pertussis* specific antibody response

Epidemiological criteria

An epidemiological link by human to human transmission

Case classification
A. **Possible case**
Any person meeting the clinical criteria
B. **Probable case**
Any person meeting the clinical criteria and with an epidemiological link
C. **Confirmed case**
Any person meeting the clinical and the laboratory criteria

Case definition booklet 2012 may be downloaded from the HPSC website at
http://www.hpsc.ie/hpsc/NotifiableDiseases/CaseDefinitions/

2.4 Investigation of Suspected Cases.

Nasopharyngeal aspirates are the preferred sample, otherwise a pernasal swab is acceptable. The laboratory at OLHC offers a range of reference and referred tests to seek laboratory confirmation of clinically suspected cases of pertussis and the choice of test is largely based on factors such as age and date of testing in relation to onset of symptoms.

Recommendations for testing

INFANTS *(up to and including one year of age)*

A. Hospitalised Infants

Samples for **culture** and **PCR** testing should be taken at the time of admission or as soon as possible after admission.

PCR testing can only be done in laboratories offering reference facilities. In Ireland, Our Lady's Hospital for Sick Children Crumlin (OLHSCC) is accredited for this purpose.

B. Infants Not Requiring Hospitalisation

Laboratory investigation by **culture** or PCR is recommended for these infants as soon as possible post onset of disease. .

CHILDREN OVER 12 MONTHS AND ADULTS

A. Early (within two weeks of onset or 48 hours of antibiotics therapy)

Culture is recommended in the early stages of illness

B. Late (more than two weeks from onset of cough/more than 48 hours since commenced antibiotic therapy)

Serology is recommended for individuals whose onset of illness is greater than fourteen days **AND** who have not been immunised against pertussis in the previous year regardless of whether they have been on antibiotic treatment for more than 48 hours.

Serology testing can only be done in laboratories offering accredited reference facilities. In Ireland Our Lady's Children's Hospital Crumlin (OLCHC) is accreditation for this purpose.

Please contact OLCHC for details on how to send samples.

Urgent Diagnosis

If an urgent diagnosis is required (for example, where rapid protection of vulnerable contacts in a healthcare setting may be required) please contact the consultant microbiologist or the pertussis laboratory in OLCHC for advice – contact details below.

Dr. Niamh O'Sullivan,
Consultant Microbiologist
Our Lady's Children's Hospital, Crumlin
Dublin 12
Telephone: 409 6861
Email: niamh.osullivan@olchc.ie

2.5 Case management

2.5.1 Infection Control

The case or relevant care-giver should be advised about the nature of the infection and the mode of transmission. Standard and droplet precautions should be used to minimise the risk of further transmission. Emphasis should be placed on minimising exposure to susceptible persons, especially infants and vulnerable groups

2.5.2 Exclusion

Children with possible, probable or confirmed pertussis should be excluded from schools or nurseries until they have had five days of appropriate antibiotic treatment or for 21 days from onset of illness if no antibiotic treatment is given.

For adults working in educational, social and healthcare settings, contact with vulnerable groups should be avoided for five days from commencing antibiotic therapy or for 21 days from onset of illness if no antibiotic treatment.

2.5.3 Antibiotic therapy

For possible, probable or confirmed cases, recommended antibiotic regimens are summarised in Table 1. Antibiotics should be administered as soon as possible after onset of illness in order

to eradicate the organism and limit ongoing transmission. The effect of treatment on reducing symptoms, however, is limited or lacking especially when given late during the disease and therefore antibiotic treatment for the case is recommended within three weeks of onset of illness.

Erythromycin is associated with adverse effects, which may lead to non-compliance with therapy. Therefore, azithromycin and clarithromycin should be considered as suitable alternative agents. Azithromycin is the preferred agent for use in infants below one month of age. For individuals in whom macrolides are contra-indicated or not tolerated, co-trimoxazole may be used.

The doses for treatment and prophylaxis are the same

2.5.4 Immunisation

It is important that unvaccinated and partially immunised cases complete their course of primary immunisation and booster vaccine, once they have recovered from their acute illness. See Chapter 2 in Immunisation Guidelines for Ireland for recommendations on catch up schedules[4], (http://www.immunisation.ie/en/HealthcareProfessionals/ImmunisationGuidelines2008/#d.en.9412). There is no upper age limit for use of this vaccine.

Table 1: Recommended antibiotic treatment and post exposure prophylaxis for pertussis by age group[a]

Age group	Erythromycin	Clarithromycin	Azithromycin	Co-trimoxazole*
<1 month	Avoid due to association with hypertrophic pyloric stenosis 12.5mg/kg every 6 hours for 7 days	Not preferred in this age group	**Under 6 months:** 10mgs/kg once a day for 5 days	Not recommended for infants below 6 weeks (risk of kernicterus)
1-24 months	125mg every 6 hours for 7 days	Under 8kgs: 7.5mg/kg 12 hourly for 7 days 1-2 yrs: 62.5mg 12 hourly for 7 days	**Infants and children ≥ 6 months:** 10mg/kg (maximum 500mg) on day 1, followed by 5mg /kg (maximum 250mg) on days 2-5	6 weeks – 5 months: 120mg 12 hourly for 7 days
2-8 years	250 mg every 6 hours for 7 days	3-6 yrs: 125 mg 12 hourly for 7 days 7-9 yrs: 187.5mg 12 hourly for 7 days		6 months – 5 years: 240mg 12 hourly for 7 days
Children >8 years	250-500 mg every 6 hours for 7 days	≥10 yrs: 250 mg 12 hourly for 7 days		6-12 years: 480mg 12 hourly for 7 days
Adults	250 – 500 mg every 6 hours for 7 days	500mg 12 hourly for 7 days	500mg on day 1 followed by 250mg once daily on days 2-5	960mg 12 hourly for 7 days

*consider if macrolides contra-indicated or not tolerated

Please note that the doses for treatment and prophylaxis are the same.

[a] The above information has been taken from BNF 59, Children's BNF. Azithromycin doses based on SPC and CDC Guidelines[3].

2.*6. Contact management*

Management of contacts should proceed for all confirmed and probable cases. Risk assessment (based on a combination of clinical and epidemiological factors such as clinical presentation, vaccination history and epidemiological links) should be carried out on possible cases. Following risk assessment, contact management may need to proceed based on clinical suspicion without waiting for the results of laboratory testing.

Definition of close contacts

Family members or people living in the same household are considered close 'household contacts'. Contacts in institutional settings with overnight stays in the same room, e.g. healthcare settings, should also be considered close contact. Other types of contact, e.g. contact at work or school, would generally not be considered close contact although each situation would need to be assessed on an individual basis where vulnerable contacts are involved.

Definition of vulnerable close contacts

These include close contacts who are themselves at increased risk of complications from pertussis as well as those at risk of transmitting the infection to others at risk of severe disease.

Table 2. Definition of vulnerable close contacts

- Newborn infants born to mothers with suspected or confirmed pertussis, who are still infectious at delivery (i.e. within 21 days of onset or <5 days treatment)
- Infants under one year who have received less than three doses of a pertussis containing vaccine
- Children under ten years who are not age appropriately immunised
- Women in the last month of pregnancy
- Adults who work in a healthcare, social care* or childcare facility and have contact with vulnerable individuals
- Immunocompromised individuals (see Appendix 3 for definition)
- Presence of other chronic illnesses which may predispose to more severe pertussis infection

**Social care refers to residential care services for children, older people and people with disabilities*

2.6.1 Exclusion

Exclusion for asymptomatic contacts is ***NOT*** required.

2.6.2 Chemoprophylaxis

Given the limited benefit of chemoprophylaxis, antibiotic prophylaxis should only be offered to close contacts when both of the following conditions apply:

- Onset of disease in the index case is within the preceding twenty one days **AND**
- There is a vulnerable close contact present (as defined above).

Where both these conditions are met, ***ALL*** close contacts (regardless of age and previous immunisation history) should be offered chemoprophylaxis. The dose of antibiotics for use as chemoprophylaxis is the same as for the treatment of cases (see Table 1). **Chemoprophylaxis is *NOT* required where there are no vulnerable close contacts**.

For **pregnant women** with suspected or confirmed pertussis, who are still infectious at delivery (i.e. within twenty one days of onset or <5 days of treatment), the newborn infant should be offered chemoprophylaxis with azithromycin for five days.

2.6.3 Immunisation

Unvaccinated or partially vaccinated contacts should complete the age appropriate* vaccination schedule.

Health Care Worker contacts, who are in contact with infants, pregnant women and the immunocompromised, should have a booster dose of Tdap if they have not had a dose of pertussis-containing vaccine in the last 10 years.

A booster dose of Tdap is recommended for those contacts who have been offered chemoprophylaxis if they have not had a dose of pertussis-containing vaccine in the last 10 years.

2.7 Special situations

2.7.1 Outbreaks

Definitions of outbreaks in various situations can be found in Appendix 4.

In the event of a hospital or significant community outbreak, an outbreak control team may need to be convened. An appropriate outbreak control team is likely to include:

- Consultant in Public Health Medicine
- Senior Medical Officer Public Health
- Surveillance Scientist/Officer Public Health
- Hospital Microbiologist

In particular circumstances it may be appropriate to include:

- HPSC CPHM
- Hospital Infection Control Team representative (if hospital setting)
- Principal Medical Officer (if mass vaccination may be required)
- Occupational Health (if workplace or healthcare setting)
- Public Health Nursing
- Preschool Inspection Team (if childcare setting)

2.7.2 Healthcare settings

Healthcare workers can be an important source of pertussis transmission to patients, particularly young children and immunocompromised patients who are at risk of severe complications. It is important that cases in healthcare workers are notified immediately to public health.

When one or more suspected or confirmed cases are identified in a hospital setting, infection control procedures need to be implemented immediately and this will require close liaison with the consultant microbiologist, infection control team and occupational health department. Infection control measures are likely to include standard respiratory isolation of cases until they are no longer infectious, rapid investigation to confirm cases, chemoprophylaxis for close contacts staying overnight in the same bay as the case during the infectious period, and vaccination as appropriate.

Health Care Worker contacts, who are in contact with infants, pregnant women and the immunocompromised, should have a booster dose of Tdap if they have not had a dose of pertussis-containing vaccine in the last 10 years.

Other options to be considered by the hospital infection control team may include carrying out active surveillance amongst exposed patients and staff and rapidly investigating staff members and patients who present with a coughing illness.

2.7.3 Childcare and school settings

Children with possible, probable or confirmed pertussis should be excluded from schools or childcare until they have had five days of appropriate antibiotic treatment or for 21 days from onset of illness if no antibiotic treatment. Asymptomatic contacts do ***NOT*** need to be excluded.

If a single case occurs in a childcare or school setting consideration should be given to issuing an information letter to parents, see Appendix 5 for template letter. If two or more cases occur it is recommended that a letter would issue to parents.

In an outbreak situation, in a childcare setting, serious consideration should be given to recommending that unimmunised or incompletely immunised infants and children should be excluded from the facility during the outbreak.

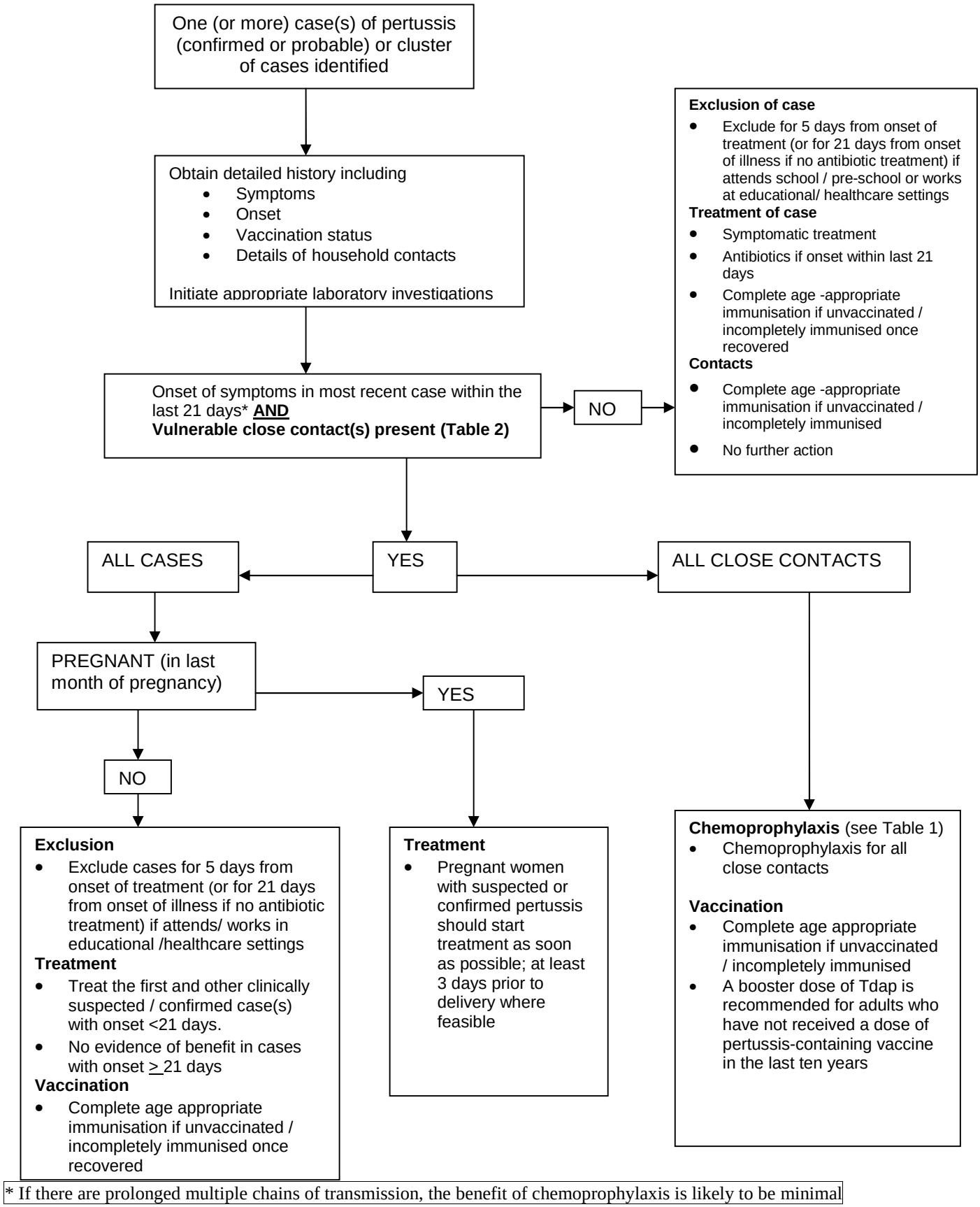
In exceptional circumstances, wider chemoprophylaxis for a school/nursery outbreak may be considered by the outbreak control team and may be informed by a number of factors including:

- Duration of the outbreak and thus the likely benefit of chemoprophylaxis.
- Presence of a clearly defined group who can be identified for chemoprophylaxis.
- Practicality and feasibility of widespread chemoprophylaxis.
- Acceptability and compliance with antibiotics.
- Residential setting e.g. boarding school, children's respite care homes.

2.7.4 Community Outbreak

Cocooning **(**preventing pertussis in infants by immunising their close contacts- parents, siblings, grandparents, child care providers, and health care personnel) should be considered in the event of community outbreaks. Ideally, these adolescents and adults should receive Tdap at least 2 weeks before beginning close contact with the infant.

Guidelines for the management of cases and close contacts of pertussis



* If there are prolonged multiple chains of transmission, the benefit of chemoprophylaxis is likely to be minimal

APPENDIX 1: Table of quality of evidence for recommendations

Strongly recommended on the basis of more than two consistent, well conceived, well executed studies with control groups or longitudinal measurements.

Recommended on the basis of more than one well conceived, well executed, controlled, or time series study; or more than three studies with more limited execution.

Indicated on the basis of previous scientific observations and theoretic rationale, but case controlled or prospective studies do not exist.

Recommendation	**Level of Evidence**
Children with suspected/ epidemiologically linked / confirmed pertussis should be excluded from school / nurseries for 5 days from commencing antibiotic therapy	Indicated
Suspected / epidemiologically linked / confirmed cases should be treated with antibiotics	Strongly recommended
Chemoprophylaxis should be offered to all close contacts when onset of illness in index case is within the preceding twenty one days AND there is a vulnerable close contact present	Recommended

Appendix 2 Enhanced surveillance form

The national pertussis enhanced surveillance form is currently under review. Please access the HPSC website at the link below for the most recent version.

http://www.hpsc.ie/hpsc/NotifiableDiseases/NotificationForms/

Appendix 3 Definitions of immunosuppressed patients

Immunosuppressed patient, e.g. HIV with CD4 count <200/mm^3, TNF alpha antagonist, high-dose systemic steroids, immunosuppressive chemotherapy, haematopoietic stem cell transplant recipients, other immunosuppressants such as azothioprine, cyclosporine, methotrexate, cyclophosphamide, leflunomide either alone or in combination with low doses of steroids, patients who received a solid organ transplant and are on immunosuppressive treatment currently, genetic conditions causing primary immunodeficiency, and as defined by attending consultant.

Source
Blood-Borne Viruses in Haemodialysis, CAPD and Renal Transplantation Settings, 2010
http://www.hpsc.ie/hpsc/A-Z/Hepatitis/BloodborneVirus/File,4374,en.pdf

Appendix 4 Definitions of outbreaks

Household outbreak: Two or more cases; the outbreak definition may be used to count cases if one case has been confirmed. Household contacts should be considered “epidemiologically linked”.

School or child care outbreak: Two or more cases clustered in time in a school or child care center; the outbreak case definition may be used to count cases if one case has been confirmed. Because pertussis tends to be a milder disease in older and/or vaccinated persons, it may not be recognised in a timely manner which allows the spread of disease to other students and adults in a school setting.

Community pertussis outbreak; when the number of reported cases is higher than expected on the basis of previous reports during a non-epidemic period for a given population in a defined time period.

Source
Centers for Disease Control and Prevention. Guidelines for the Control of Pertussis Outbreaks. Centers for Disease Control and Prevention: Atlanta, GA, 2000.

Appendix 5 Template letter for school or childcare

Health Service Executive
Department of Public Health
(address, phone)

Date:

Dear Parent or Guardian,

The Department of Public Health in HSE- has been informed of a possible case of whooping cough (Pertussis) in your child's school. It is possible that your child may become ill. Children who have not been vaccinated against whooping cough are most at risk.

Whooping cough is a lung infection that can be very serious in young infants and in children with lung or heart problems or other chronic illness. Possible complications include pneumonia, seizures and even brain damage.

It usually begins as a mild chesty cold which develops into a severe cough. There may be a whoop sound after a spasm of coughing but this is not always present. Spasms of coughing can cause vomiting. Infants and young children may have a runny nose and a pause in their breathing but little cough.

Children are vaccinated against whooping cough with their routine baby vaccinations at 2, 4 and 6 months with a booster in junior infants. **If you have any children who have not received the full series of vaccines for their age, or if you are unsure, please contact your family doctor.**

The illness usually develops 7 to 10 days after meeting the illness. **If your child develops a cough please consult your doctor and inform them that your child has been in contact with whooping cough. If whooping cough is diagnosed ask your doctor to notify public health.** Taking the correct antibiotic as soon as symptoms start can help stop the illness from spreading to other people.

Children with whooping cough should stay at home until they have taken the appropriate antibiotic for at least five days. If they have not taken antibiotics they should stay home for 21 days from the start of illness.

Yours sincerely

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