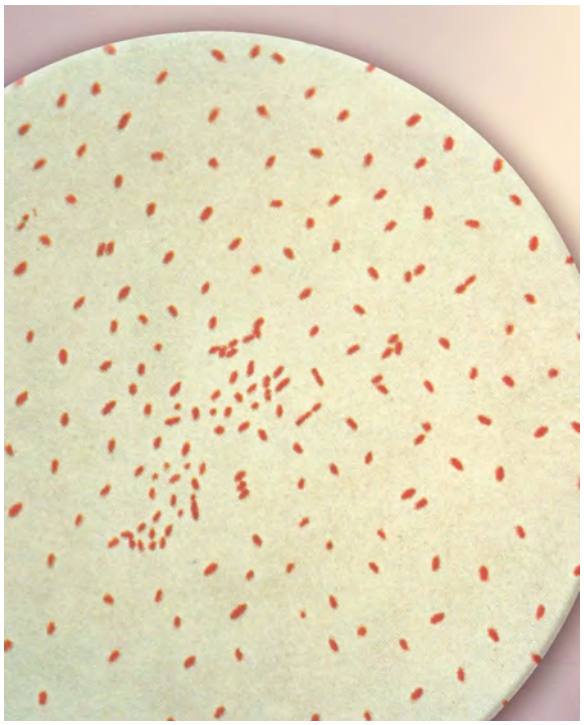
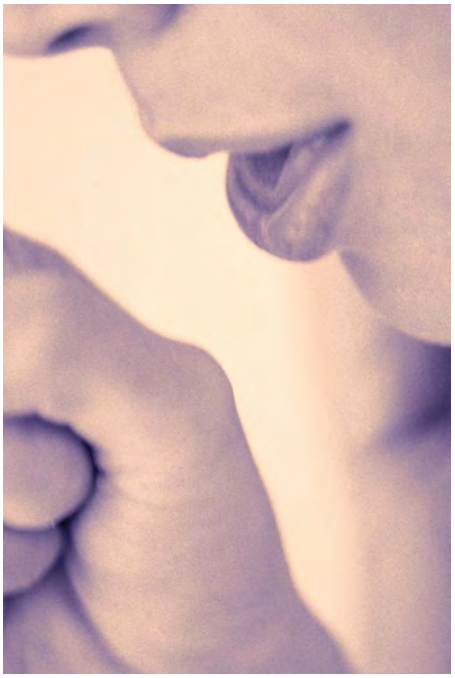
Health Protection Agency

HPA Guidelines for the Public Health Management of Pertussis

(Updated October 2012)





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Pertussis Guidelines Group

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Guidelines for the Public Health Management of Pertussis

Summary of Changes

These guidelines, which update the 2011 HPA Guidelines for the public health management of pertussis [1], are based on a recent review of all currently available scientific evidence and consultation with experts where required. The revised guidelines have been circulated within the HPA for comment and signed off by the HPA Vaccine Programme Board.

The key changes in the October 2012 guidance include:

- Updated epidemiology of pertussis in England and Wales
- Revised definitions of the priority groups for public health action which include individuals at risk of severe or complicated pertussis ('vulnerable') and those at risk of transmitting to these 'vulnerable' individuals
- Revised recommendations for the use of newer macrolides in the treatment and prevention of pertussis
- Updated recommendations for the use of pertussis containing vaccine in household contacts aged 10 years or over (including pregnant women >32 weeks gestation) where there is a clinically suspected or confirmed case of pertussis and chemoprophylaxis is indicated due to the presence of one or more individuals in a priority group.

The information presented by this guidance is intended to supplement, not substitute for, the expertise and judgement of healthcare professionals.

Please note, from the 1st October 2012, the Respiratory and Systemic Infection Laboratory (RSIL), MS-Colindale has become the Respiratory and Vaccine Preventable Bacteria Reference Unit (RVPBRU), within which the National Bordetella Reference Laboratory sits.

CONTENTS

PART ONE: Background and rationale

1.1 Introduction

Pertussis (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, young unimmunised infants are the most vulnerable group with the highest rates of complications and death. Transmission of the organism occurs as a result of close direct contact with an infected person [2]. It is highly contagious, with up to 90% of household contacts developing the disease [3].

The incubation period of pertussis is on average between 7–10 days (range 5–21 days). The usual clinical presentation is an initial catarrhal stage with a cough that becomes paroxysmal. Paroxysms of cough usually increase in frequency and severity as the illness progresses and persist for 2–6 weeks. These paroxysms may end in vomiting, cyanosis and/or a characteristic inspiratory whoop. Patients with pertussis are most infectious in the initial catarrhal stage and during the first three weeks after the onset of cough [4]. Symptoms slowly improve in the convalescent phase, which generally lasts 2–6 weeks but can persist for months. Serious complications include pneumonia, seizures and encephalitis. 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 UK strategy for pertussis control

Whole-cell pertussis vaccination was introduced into the UK routine childhood immunisation schedule in the 1950s. In order to optimise pertussis control, the current accelerated primary schedule consisting of three primary doses at two, three and four months replaced the previous three, five and ten month schedule in 1990. In October 2001, an acellular pertussis booster was introduced at three years four months to five years of age, subsequently simplified to between three years four months and three years six months [5]. In October 2004, the

diphtheria/tetanus/acelluar pertussis/inactivated polio/*Haemophilus influenzae* type b (DTaP/IPV/Hib) vaccine Pediacel™ replaced whole-cell pertussis vaccine in the routine primary schedule. This combination includes a five-component acellular pertussis vaccine which is less reactogenic than the previous whole cell pertussis component [6-8] and an inactivated polio virus component which removes the risk of vaccine-associated paralytic poliomyelitis associated with live oral polio vaccine [9].

1.3 Vaccine coverage and disease burden

There was a fall in pertussis vaccine coverage in the 1970s linked to high profile scares about the safety of the vaccine, followed by a period of recovery in the 1980s. Since 1991, coverage by second birthday has remained above 90% in England and has exceeded 95% since 2009/10 [10]. During this period, there has been a marked reduction in notifications of pertussis in England and Wales, although the typical 3–4 yearly cyclical pattern continues to occur with 2007/08 and 2011/12 reported as the most recent peak years.

In England and Wales, the burden of disease in children under one year has fallen since the introduction of the accelerated schedule and concomitant period of sustained high coverage. The highest rates of disease, however, occur in infants less than three months (laboratory confirmed pertussis: 103 per 100,000 population in 2011) who account for the highest proportion of all hospitalised cases [11]. Rates of pertussis in older children and adolescents have also increased with a marked rise since 2006 for 10–14 year olds and since 2004 for those 15 years and over.

A national increase in laboratory confirmed cases of pertussis was observed after the second quarter of 2011 predominantly in adolescents and adults. Whilst improved ascertainment of cases through the introduction of serology testing is thought to account for most of the rise prior to 2011, waning of vaccine induced immunity is an important contributory factor to the increase observed in older age groups during 2011/2012. To date in 2011/2012, the reported incidence is above the levels seen over the previous two decades and the situation was declared a national outbreak in April 2012 [12]. In response to the national outbreak, on the 28th September 2012,

the Department of Health announced the introduction of a temporary immunisation programme for pregnant women between 28-38 weeks of pregnancy. The primary purpose of this programme is to boost antibodies by vaccinating women in late pregnancy so that higher levels of pertussis antibodies are passed from mother to baby. This is thought to be the most effective way to provide protection to newborn infants before the age of routine immunisation. Further details are available on the HPA website [13].

1.4 Surveillance of pertussis

Pertussis remains a notifiable disease under the Health Protection Legislation (England) Guidance 2010 and suspected cases should be notified to the proper officer of the local authority and to the Health Protection Agency (HPA). Notification to the local Health Protection Unit (HPU) (and after April 2013, to the Public Health England (PHE) Centre) would fulfil the responsibility to notify the local authority proper officer. This should be done by telephone as soon as practical and in writing within three days. In addition, from October 2010, all diagnostic laboratories are required to report all confirmed cases of *B. pertussis* infection to their local HPU [14]. Written notification must be provided within 7 days of the agent being identified, or oral notification as soon as is practicably reasonable if the case is considered to be urgent [14]. HPUs are encouraged to report all pertussis related deaths and clusters in institutional settings via regional colleagues to the national weekly 'Health Protection Update meeting'.

Staff at the Immunisation, Hepatitis and Blood Safety department (IHBSD), HPS-Colindale follow-up all cases of pertussis confirmed by the reference laboratory and all confirmed cases reported from diagnostic laboratories to obtain further epidemiological and clinical information as well as vaccination status. The HPA's IHBSD is responsible for reporting annual case based information on confirmed cases to the European Centre for Disease Prevention and Control (ECDC) and also to the World Health Organization (WHO) European region.

1.5 Laboratory confirmation of clinically suspected cases

The availability of laboratory testing for pertussis is likely to vary across the country. It is important to ascertain what services are available locally.

The Bordetella Reference Laboratory at the Respiratory and Vaccine Preventable Bacteria Reference Unit (RVPBRU) currently offers:

(i) *B. pertussis* PCR for acutely ill infants (aged twelve months or under) admitted to a paediatric intensive care unit (PICU) or paediatric ward with respiratory illness compatible with pertussis, and

(ii) Estimation of anti-pertussis toxin (PT) IgG antibody for the serological confirmation of pertussis infection on a single serum sample taken more than two weeks after onset of cough for older children and adults with a history of prolonged cough. The serological service is a referred (charged for) test; (see HPA website for full details.)

For the investigation of suspected clusters or outbreaks of pertussis, please contact the Bordetella Reference Laboratory at RVPBRU to discuss the most appropriate test. Once laboratory confirmation of pertussis infection has been demonstrated in a cluster (e.g. school) it is not usually necessary to perform extensive additional testing.

Laboratory confirmation of clinically suspected cases can be made by culture and isolation of the causative organism *B. pertussis*, detection of its DNA (typically from nasopharyngeal swabs/ pernasal swabs or nasopharyngeal aspirates) or serological tests (which usually only provide a late or retrospective diagnosis). The pros and cons of each of the options for laboratory confirmation of cases are discussed below.

1.5.1 Culture

Laboratory confirmation is conventionally performed by isolating the *B. pertussis* organism through culture from nasopharyngeal aspirates or nasopharyngeal swabs/ pernasal swabs.

However, culture can lack sensitivity as the organism is delicate and can be affected by processing delays. The sensitivity of nasopharyngeal culture is affected by patient age (decreasing with increasing age), vaccination status and length of illness. The sensitivity decreases with time after onset and is highly dependent on specimen quality. Timing of specimen collection is also important: sensitivity decreases substantially (55% to <10%) from week 1 to week 4. [15, 16]. Cultures are unlikely to be positive more than two weeks from the onset of symptoms. Based on HPA enhanced surveillance data [17], less than one third of all culture positive cases in 2009 (where onset date was recorded) were confirmed more than two weeks post onset of symptoms. It is also more difficult to culture the organism in vaccinated compared with unvaccinated children [18]. 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 be attempted where local laboratory facilities are available, as isolation of the causative organism is definitive. Pure cultures of any putative isolates of *B. pertussis* obtained should then be referred to RVPBRU for confirmation and serotyping which allows further genotypic and phenotypic analyses. Isolates are processed on receipt and under normal circumstances turnaround times range from 4-10 calendar days.

1.5.2 Serology

Detection of anti-pertussis toxin (PT) IgG antibody levels in serum is well-established and can be performed using an enzyme linked immunosorbent-assay (ELISA). This referred (charged for) service is offered by RVPBRU for older children and adults where the sample has been taken at least fourteen days after the onset of cough. 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.

A serologically confirmed case is defined as an anti-pertussis toxin IgG concentration >70 International Units per millilitre (IU/ml)[19] in the absence of recent vaccination

(within the past year). Serological confirmation amongst infants has some limitations e.g. infants less than three months of age may not develop measurable antibodies and recent pertussis vaccination (primary or booster vaccination) can confound the test results. Preliminary data suggest that this confounding period may be around 10 months after the primary vaccination and up to three years or more post-vaccination with the preschool booster [20]. Until further data are available however, serological testing should only be undertaken where there is a minimum of one year from a primary or booster dose of pertussis containing vaccine and any results should be interpreted accordingly.

1.5.3 Genome detection by real-time PCR

PCR is invaluable in pertussis confirmation in young infants and has been shown to have improved sensitivity over culture. Since April 2002, PCR was offered by RVPBRU to investigate suspected cases in infants up to six months of age from nasopharyngeal swabs/pernasal swabs or nasopharyngeal aspirates. From April 2007, this was extended to all children 12 months and under who are acutely unwell and admitted to hospital with a respiratory illness compatible with pertussis.

Two PCR assays are undertaken on each sample: one, targeting the pertussis toxin S1 promoter (*ptxA*-pr), which includes an internal process control to test for sample inhibition and reagent performance; the other targeting the insertion element IS*481* which is present in multiple copies in *B. pertussis,* but is also present in some other Bordetella species [21]. PCR is usually more sensitive than culture as the organism does not need to be viable. A same-day service is provided by the Bordetella Reference Laboratory in RVPBRU for samples meeting the criteria defined above received by 10am. However, please note this service is not available outside of regular working hours (0900- 1730 Monday to Friday).

1.5.4 Oral fluid testing

An enhanced surveillance test for the follow-up of notified cases of pertussis, which had not already been confirmed by other laboratory methods (PCR, culture or

serology), in England and Wales was offered from 2007 to September 2009. The purpose was to determine the number of notifications which could be confirmed by laboratory testing for pertussis toxin IgG antibodies in oral fluids (OF). The OF test remains available to HPUs for investigation and management of pertussis outbreaks where sera cannot be obtained, but only after discussion with the Bordetella Reference Laboratory. It should be noted that the OF assay is less sensitive than the serological assay and is also potentially confounded by recent vaccination (as described above). As with serological specimens, OF specimens should be taken at least 2 weeks post-onset of cough to allow sufficient time for seroconversion.

1.6 Rationale for public health action

Outbreaks of pertussis can occur in households, schools, healthcare settings and in the community. If outbreaks are detected at an early stage, prompt action including chemoprophylaxis and vaccination can limit the spread [22, 23]. Chemoprophylaxis and vaccination of close contacts may also be of benefit in reducing transmission to those who are most at risk of severe or complicated infection and is therefore recommended in settings where there is a vulnerable person or an individual who may facilitate ongoing transmission to vulnerable groups. As such, a list of priority groups for public health action has been defined. This has been updated from earlier guidance following a recent literature review and is based upon identifying groups who are either:

Group 1. At increased risk of severe or complicated pertussis ('Vulnerable')
Group 2. At increased risk of transmitting infection to individuals in Group 1.

Group 1: Groups at increased risk of severe or complicated pertussis ('vulnerable')

It is widely accepted that young infants (particularly those under three months of age [24]) are at greatest risk of severe complications, hospitalisation and death following *B. pertussis* infection. Although most cases of severe illness occur amongst those too young to have received any immunisations, partially immunised infants also remain at increased risk. In a study of 201 infants (< 6 months of age) hospitalised with pertussis infection, the median duration of hospitalisation was

significantly shorter (4 vs. 11 days; p=0.03) for those who had received at least one dose of vaccine, when compared with those that were unimmunised [25].

Whilst complicated illness may occur in older individuals [26] and can also on occasion be severe (including pneumonia, syncope and rib fracture [27]), there is little evidence to suggest that specific clinical groups are at increased risk of pertussis or its complications [28]. Pregnant women are not considered at increased risk of severe disease compared with non-pregnant adults. The relative immunosuppression of pregnant women to viral disease in the third trimester does not appear to be replicated with bacterial infections such as *B. pertussis* [29], although symptoms in late pregnancy may be more intense due to constraints on pulmonary function.

Pertussis is not generally considered an opportunistic infection amongst immunocompromised individuals [30]. Those with underlying immunosuppression may be less likely to mount a sufficient immune response to vaccination [31] but there is little evidence of increased severity of illness (single case reports only) [32-34]. A number of case studies have also described prolonged illness in patients with HIV infection [35-37] but pertussis infection amongst HIV infected individuals is again not thought to be particularly common [38]. It might be expected that some underlying chronic conditions, such as asthma, congestive heart failure or chronic obstructive pulmonary disease would exacerbate illness following pertussis infection, but there is little evidence to support this [39-41].

Given the lack of evidence to support an increased risk of severe pertussis infection amongst individuals with chronic disease or those who are immunosuppressed, the list of individuals at increased risk of severe or complicated disease has been updated. Infants under one year of age, who are either unimmunised or partially immunised (i.e. who have received less than three doses of DTaP/IPV/Hib) are considered to be particularly 'vulnerable' and hence a priority group for public health action.

Group 2: Groups at increased risk of transmitting pertussis to those at risk of severe or complicated infection

a. Pregnant women

Parents and particularly mothers are found to be a frequent and important source of pertussis infection amongst young infants [42-46]. In a US study of infants with reported pertussis, over 70% had been infected by their mother or another family member, the majority of whom were aged 20 years or more [47]. A further study of infants admitted to a UK Paediatric Intensive Care unit with respiratory complications, demonstrated that 20% had laboratory evidence of pertussis and half of these were infected from an adult family member [48]. Women in the later stages of pregnancy may be at particular risk of transmitting pertussis to newborn infants. Although pertussis in pregnant women is not thought to be more severe than in other adults, and no obstetric or foetal adverse outcomes have been described [38], mother to infant transmission at the time of, or shortly after, birth has been described [49, 50] and is often associated with severe neonatal illness [51-53]. A Dutch study of 201 infants hospitalised with pertussis demonstrated that 24% of the index cases within households were mothers, compared with 29% which were siblings and 11% which were fathers [25]. Of the mothers, 22% (14/46) had onset of symptoms in pregnancy [25].

Given the increased risk of ongoing transmission to newborn infants, women in the later stages of pregnancy are considered to be a priority group for public health action and post-exposure prophylaxis. Previous guidance recommended post exposure prophylaxis to any woman exposed in the last month of pregnancy. However, in order to take into account of preterm deliveries and the delay between exposure and outcome, this has been revised to include any pregnant woman exposed > 32 weeks gestation [54].

b. Healthcare workers

In addition to parents, other adults in close contact with vulnerable young infants including healthcare workers may be responsible for transmission [55]. Serological

studies suggest that infection in healthcare workers can be frequent, but often unrecognised [56] and outbreaks in healthcare settings may be prolonged involving groups of adults with waning immunity who have multiple opportunities for transmission. As such, specific guidance for the public health management of pertussis incidents in healthcare settings is also available [57]. Likely transmission from healthcare worker to patient and vice versa has frequently been described [58-61] although the greatest risk of nosocomial transmission is likely to be from a healthcare worker to a patient or other member of staff. A five year analysis of clusters of pertussis infection in France revealed that the most frequent reports of healthcare associated clusters were from paediatric, maternity and neonatal units [62].

Due to the risk of ongoing transmission to individuals vulnerable to severe or complicated pertussis, healthcare staff working with infants or pregnant women are therefore considered a priority group for public health action in these guidelines. Other individuals who have close, regular contact with young, unimmunised infants have also been identified as a priority group.

1.6.1 Use of antibiotics in the treatment and prevention of pertussis

UK guidelines published in 2002 recommend chemoprophylaxis with erythromycin in households with vulnerable contacts within twenty one days from the onset of disease [2]. Prior to the widespread use of newer macrolides, erythromycin was recommended as the drug of choice for the prophylaxis and treatment of pertussis, except for infants below one month. 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. Erythromycin is poorly tolerated, causing gastrointestinal side effects in up to 30% of patients [63, 64] which may lead to non-compliance with therapy [22]. A 1998 UK review of the use of erythromycin in the management of persons exposed to pertussis reported little effect in preventing secondary transmission, which was limited to close

prolonged household type contact [22]. Effects of erythromycin were modest, short term and associated with gastrointestinal side effects [22].

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 [2]. This compares 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 [65].

Newer macrolides such as azithromycin and clarithromycin are now the preferred choice for the treatment and prophylaxis of pertussis, with clarithromycin being the preferred antibiotic for use in neonates. Both antibiotics offer the advantages of improved absorption, a longer half-life, good in vitro activity against *B. pertussis* and a better side effect profile [66]. 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* [66, 67]. The improved side effect profile has also been shown to improve compliance with treatment [68]. Prior to 1994, erythromycin resistance in *B. pertussis* was not observed, however since then resistance has been reported in the USA and Taiwan and recently in France [69]. From 2001 to 2009, UK *B. pertussis* isolates were tested against three agents, erythromycin, clarithromycin and azithromycin and all isolates (n = 583) were found to be fully susceptible to all three agents tested [70].

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 [71-73].

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 [72]. Short term antibiotics (azithromycin for 3–5 days; clarithromycin or erythromycin for 7 days) were as effective as long term (erythromycin for 10–14 days) in eradicating *B.*

pertussis from the nasopharynx (RR 1.02, 95% CI 0.98, 1.05) but had fewer side effects (RR 0.66, 95% CI 0.52, 0.83).

The Cochrane review also concluded that there was insufficient evidence to determine the benefit of prophylactic treatment of pertussis contacts [72]. In the two trials included in the review, which investigated the effectiveness of chemoprophylaxis with erythromycin, clinical symptoms in the treatment group were slightly less (not statistically significant) than the placebo group [64, 74]. 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) [64]. Although there have been no specific studies of prevention of secondary transmission using these newer macrolides, 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 a 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.

In summary, newer macrolides (e.g. azithromycin and clarithromycin) are the preferred choice for the treatment and prophylaxis of pertussis (except in pregnant women – see below), with clarithromycin being the preferred antibiotic for use in neonates.

Use of Antibiotics in Pregnant Women

The primary purpose for treating cases with antibiotics is to eradicate *B. pertussis* from the nasopharynx and prevent secondary transmission. Antibiotics are unlikely to have any clinical benefit unless administered in the early stages of the illness.

Although there is no evidence of harm, avoidance of all drugs in the first trimester of pregnancy is generally advised [75]. Erythromycin may be offered to treat women early in pregnancy but this is only likely to be of any clinical benefit if it can be administered in the early stages of the illness. For a woman diagnosed with pertussis in the last month of pregnancy, erythromycin is recommended to prevent transmission to her infant. Potential concerns regarding an association between maternal erythromycin therapy (in late pregnancy) and infant hypertrophic pyloric stenosis have largely been refuted [76-78]. Therefore, whilst these guidelines recommend the use of erythromycin to treat cases in the last month of pregnancy, its use in earlier stages of pregnancy should be a clinical decision based on the likely clinical benefit for the woman and the presence of any vulnerable close contacts.

Antibiotics are also recommended for women exposed during pregnancy. In these circumstances, chemoprophylaxis is only recommended for women exposed after 32 weeks of pregnancy, who have not received a pertussis containing vaccine more than 1 week and less than 5 years ago (see section 1.6.2). Given that it takes at least one week to develop an antibody response from a pertussis booster dose in adults, pregnant contacts who have received a pertussis containing vaccine within the past one week will still require chemoprophylaxis.

1.6.2 Post-exposure vaccination

In the UK, use of pertussis-containing vaccines at the time of exposure has been recommended for unvaccinated or partially immunised contacts up to ten years of age to provide long term protection [79]. More recently, a number of studies have demonstrated the safety and immunogenicity of a combined tetanus/low dose diphtheria vaccine/low dose acellular pertussis (Tdap) vaccine in adolescents and adults. [80] [81, 82] The introduction of a TdaP-IPV[a] vaccine (Repevax®) for use as a pre-school booster currently provides the only licensed low dose acellular pertussis-containing vaccine suitable for adolescents and adults in the UK.

[a] Studies using Tdap referred to in this guidance have equivalent pertussis antigen content to Repevax. Repevax is referred to as pertussis containing vaccine in this guidance.

Although duration of immunity following acellular pertussis vaccination has not been clearly established, a recent review based on limited studies suggested duration of protection for 5–6 years [83]. Persistence of immunity for 6–9 years after a booster administered in the second year of life was reported for children receiving a three-component acellular pertussis vaccine [84].

In October 2001, a booster dose of a three-component acellular pertussis-containing vaccine was introduced into the UK routine schedule for children aged between three years four months and five years. Children born before November 1996 would have been eligible for only three primary doses of (whole cell) pertussis-containing vaccine during infancy. In these individuals in particular, protection is likely to have waned [85]. Therefore, in the event of exposure, contacts over ten years (many of whom would only have been eligible to receive a three-dose primary course), whether they be unvaccinated, partially or fully immunised, are likely to benefit from a dose of pertussis-containing vaccine, especially given their role in transmission.

To determine the potential value of vaccination as part of an outbreak control strategy in adults, the immediate immune response to vaccination in adult healthcare workers at the time of exposure has been investigated [23]. Of the 106 healthcare staff immunised during a 2006 US outbreak, Tdap antibody responses were noticeable at one week following vaccination with more than 50% of subjects showing a response to filamentous haemagglutinin, pertactin and fimbriae and 46% showing a booster response to pertussis toxoid [23]. By two weeks between 88–94% showed a booster response, depending on the specific pertussis antigen. Vaccine effectiveness could not be determined in this study because there was no unvaccinated control population [86]. However, the data suggests early Tdap vaccination may be valuable in preventing illness and transmission among adults in outbreak settings, reducing susceptibility of the population within 1–2 weeks.

One key concern regarding the use of pertussis-containing vaccines in children over ten years is increased rates of severe local reactions, including Arthus-type reactions if pertussis containing vaccine is administered too soon after a previous Td-IPV vaccine in older children and adults, either as part of the school leaver booster

(which is offered to all 13–18 year olds in the UK), as a booster prior to travel or as part of the post exposure management for diphtheria or tetanus [87]. In pre-licensure clinical trials of Tdap in adolescents, those who had received doses of a diphtheria or tetanus toxoid-containing vaccine during the preceding five or ten years were excluded [88]. However, a Canadian study, which investigated the safety of administering a dose of Tdap at intervals less than five years after paediatric DTaP or Td concluded that Tdap can be safely administered at intervals of more than 18 months since a previous Td vaccine [89]. Two smaller Canadian post-licensure safety studies in adolescents have also shown acceptable safety when Tdap is administered at intervals less than five years [90, 91]. Based on these findings, Canada's National Advisory Committee on Immunization (NACI) concluded that there is no evidence of increased risk of severe adverse events for Canadian adolescents after receiving diphtheria and tetanus toxoid-containing vaccines at intervals of less than five years [91]. In 2006, the US Advisory Committee on Immunization Practices (ACIP) recommended that adolescents who had received Td booster vaccine should receive Tdap for added protection, preferably with a five-year interval to reduce the risk of local and systemic reactions, although an interval of less than five years may be used [88].

More recently, the authors of a randomised, double-blind study in France, which assessed the safety of Tdap-IPV administered one month after vaccination with Td-IPV in 500 healthy adults, concluded that Tdap-IPV may be administered to adults as little as one month after Td-IPV without significantly increasing the frequency or severity of side effects relative to considerably longer vaccination intervals [92].

Based on the currently available evidence, these HPA guidelines recommend extending the offer of post-exposure vaccination with Pertussis containing vaccine beyond unimmunised or partially immunised contacts below ten years of age. In households where there is a clinically suspected or confirmed case of pertussis and a close contact in a priority group (as defined in section 1.6) pertussis containing vaccine should also be offered to all household contacts over 10 years of age, who have not received a dose of pertussis containing vaccine in the last five years and no Td-IPV vaccine in the preceding month (see section 2.6.3).

The duration of immunity following immunisation with pertussis-containing vaccines is not fully established [83, 84], but the relatively high incidence of laboratory-confirmed pertussis in the 10-14 year age group during re-emergence of the disease in 2012 suggests protection from the booster lasts less than ten years [93]. As such, the period for which previous doses of pertussis containing vaccine should be considered has been revised from ten years to five years. No upper limit of age for adult vaccination is specified in the SPC for Repevax [94] and the limit of 64 years for booster vaccination referred to in the previous pertussis guidance [1] has also been removed.

Pregnant Women

Post-exposure vaccination is recommended for women exposed to pertussis after 32 weeks pregnancy who have not received a pertussis containing vaccine in the preceding 5 years. Although many pregnant women in the UK may not have been eligible for the pre-school booster, some may have received adult or adolescent booster doses overseas. In addition, the recent introduction of a temporary programme to offer pertussis containing vaccine to all pregnant women in the UK [95] means that women who have been vaccinated routinely after 28 weeks will not require post-exposure vaccination (or chemoprophylaxis) if exposed later in pregnancy (provided at least one week has elapsed since vaccination).

In addition to the temporary programme to vaccinate pregnant women in the UK [95], updated recommendations in the USA, published by the ACIP in 2011 [96] recommend that pregnant women who have not been vaccinated against pertussis receive the Tdap vaccine after their 20th week of pregnancy. Ireland and some parts of New Zealand now also recommend the use of pertussis-containing vaccine during pregnancy [97, 98]. Although pregnant women themselves are not thought to be at any greater risk of severe or complicated infection, [65] the rationale for vaccination during pregnancy is to provide indirect protection to vulnerable newborn infants. Vaccination of women exposed towards the end of pregnancy provides direct protection for the mother, reducing the risk of transmission to infants at or around the time of birth, but more importantly provides indirect protection to the neonate through transplacental transfer of antibody. Studies of antibody response suggest

that a maximum response to pertussis containing vaccines is not achieved until 14 days after vaccination, and as such, post-partum vaccination may not provide timely protection for newborn infants during the most vulnerable period [99].

All subclasses of IgG are transferred from mother to infant across the placenta, primarily during the third trimester of pregnancy [100]. Data from the pre-vaccine era suggest that maternal antibodies may provide at least short-term protection for newborn infants, the proportion of deaths being lower in children less than one month of age when compared with those aged 1-3 months [101]. Transplacental transfer of pertussis IgG antibody has been demonstrated with concentrations in the newborn [102, 103] or cord serum samples [103-105] reflective of those in the mother. Indeed, higher concentrations of pertussis antibodies have been demonstrated in cord blood for newborn infants of vaccinated when compared with non-vaccinated mothers.[29, 106] These are said to have a half-life of approximately 6 weeks and so if boosted to sufficiently high levels are likely to provide time-limited, passive protection for newborn infants prior to administration of the first childhood immunisation at age 2 months [102, 107].

The rationale for offering post exposure vaccination to pregnant women is different to the rationale for offering vaccination routinely to all pregnant women. In the post-exposure situation the vaccine is given to reduce the risk of the infant (prior to pertussis immunisation) getting exposed to maternal pertussis infection. For this reason vaccination is given to those late enough in pregnancy (> 32 weeks) to reduce the risk of the mother being infectious in the immediate post-partum period. In the current temporary programme to vaccinate all pregnant women (between 28-38 weeks) the objective is to boost the immunity in the mother to provide sufficiently high enough levels of maternal antibody that can be transferred to the infant passively and therefore provide protection in the first months of life before routine immunisation. This programme is recommended when there is widespread transmission and therefore there is an increased risk of exposure from contacts other than the mother. Whilst the temporary programme is in place, most pregnant women should have been vaccinated by 32 weeks and therefore would not require post-exposure prophylaxis.

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

2.1 Minimum details to be recorded when a case is reported

Caller details

- Name, address, designation and contact number

Demographic details

- Name, date of birth, sex, ethnicity, NHS number
- Address including postcode
- Contact details including phone number
- Occupation (if applicable)
- Place of work / education (if applicable)
- GP name and contact details (including address and phone number)

Clinical /Epidemiological details

- Clinical information – onset dates, cough (including duration), presence of inspiratory whoop / apnoea / post-tussive vomiting, complications, treatment
- Need for admission to hospital (including dates where relevant)
- Pertussis immunisation history* (including dates)
- Pregnancy status
- Contact with confirmed or suspected case
- Any close contacts within a priority group (including healthcare workers in high risk settings, newborn infants, incompletely immunised infants under one year and pregnant women >32 weeks)
- Context: household, school, healthcare setting (including name of setting, where relevant)

*including pertussis vaccines administered to the mother during pregnancy for an infant case

2.2 Risk assessment for the index case

The positive predictive value (PPV) of a clinical diagnosis of pertussis is not very high, particularly amongst adolescents and adults who may present with atypical features. However, the PPV will increase during periods of heightened pertussis activity and will vary with age. Between January and August 2012, 65% of serology samples taken from 11-14 year olds were positive compared with 16% in those aged 1-4 years. Risk assessment should be based on a combination of clinical and epidemiological factors such as clinical presentation, vaccination history and epidemiological links. Management should proceed based on this risk assessment without waiting for the results of laboratory testing.

2.3 Case definitions

Suspected case of pertussis

- Any person in whom a clinician suspects pertussis infection **or**
- Any person with an acute cough lasting for 14 days or more, without an apparent cause plus one or more of the following:-
    - Paroxysms of coughing
    - Post-tussive vomiting
    - Inspiratory whoop

AND

- Absence of laboratory confirmation
- No epidemiologic link to a laboratory confirmed case.

Confirmed case of pertussis

Any person with signs and symptoms consistent with pertussis with:

- *B. pertussis* isolated from a respiratory sample (typically a nasopharyngeal aspirate or nasopharyngeal swab / pernasal swab **or**
- Anti- Pertussis toxin IgG titre >70 IU/ml [19] (in the absence of vaccination within the past year[b]) **or**
- Confirmed *B. pertussis* PCR positive in a respiratory clinical specimen.

[b] This is currently under review and will be modified as more data are available

Epidemiologically linked case of pertussis

- A suspected case with signs and symptoms consistent with pertussis, but no laboratory confirmation, who was in contact with a laboratory confirmed case of pertussis in the 21 days before the onset of symptoms.

2.4 Laboratory Confirmation and Public Health action

Appropriate Public Health action should not wait for laboratory results as negative results cannot be used to exclude pertussis infection. At the request of the Health Protection Unit, the Bordetella Reference Laboratory will prioritise testing for evidence of B. pertussis infection in support of outbreaks or incident investigations as appropriate. However, please note these services are not available outside of regular working hours. Please contact RVPBRU on 0208 327 7327 and discuss with senior staff prior to sending specimens.

Recommendations for testing (summarised in Table 1 below)

- ***INFANTS*** *(up to and including 12 months of age)*

A. Hospitalised Infants

PCR testing, which is offered by the Bordetella Reference Laboratory at RVPBRU, is recommended for these infants as soon as possible post-onset. **Culture** can be undertaken in these infants as soon as possible post-onset.

Note: RVPBRU does not perform primary culture for Bordetella pertussis. HPUs must ascertain whether this is offered by their local hospital laboratory. Please ask the local laboratory for any putative B. pertussis isolates to be sent to RVPBRU for confirmation.

B. Infants Not Requiring Hospitalisation

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

Laboratory investigation by **culture** is recommended for these infants as soon as possible post-onset.

Table 1: Appropriate laboratory tests for sporadic cases of pertussis

Age	Clinical symptoms	
	≤ 2 weeks cough	**> 2 weeks cough***
≤ 1 yr Hospitalised	NPA/NPS/PNS for PCR (RVPBRU) **or** NPS/PNS for culture (local laboratory)[1]	NPA/NPS/PNS for PCR (RVPBRU) **or** NPS/PNS for culture (local laboratory)[1]
≤ 1 yr[2] Community	NPS/PNS for culture (local laboratory) [1]	Serum for serology (RVPBRU)
> 1 yr to 6 yrs[2]		
> 6yrs[3]		

NPA – nasopharyngeal aspirate; NPS – nasopharyngeal swab; PNS – pernasal swab; RVPBRU - Respiratory & Vaccine Preventable Bacteria Diseases Reference Unit, Colindale

**Ideally respiratory specimens (NPA/PNA/NPS) should be taken as soon as possible post-onset. Where this is not possible, RVPBRU will still accept these specimens from ≤ 1 yr hospitalised patients.*

[1]RVPBRU does not offer culture for Bordetella pertussis. HPUs must ascertain whether this is offered by their local hospital laboratory. Please ask local laboratory for any putative B. pertussis isolates to be sent to RVPBRU, Colindale for confirmation/serotyping/genotyping.

[2] Serological results in young children (from 2 months to 6 years) may be difficult to interpret, especially if taken within 1 year of their most recent pertussis vaccination and serological testing is therefore not usually recommended in infants. Liaise with local microbiologist or RVPBRU for further advice

[3]In this age group, serological results will be unlikely to be confounded by previous vaccination but a vaccine history should be ascertained to ensure that this has not occurred within one year of testing.

Late (more than two weeks from onset of cough)

Serology can be undertaken but is not usually recommended for this age group (< 1yr) as the antibody response of infants may not be typical of that seen in older children and adults and results may also be confounded by recent vaccination. Liaise with local microbiologist or RVPBRU for further advice.

- ***CHILDREN OVER 12 MONTHS AND ADULTS***

Early (within two weeks of onset or 48 hours of antibiotic therapy)

Culture is recommended in the early stages of illness.

Late (more than two weeks from onset of cough)

Serology is recommended for individuals whose onset of cough is greater than fourteen days **AND** who have not been immunised against pertussis in the previous year.

Swab types and sampling

The posterior nasopharynx should be sampled using a nasopharyngeal swab/pernasal swab [typically flexible ultrafine twisted wire shaft with nylon/Rayon swab]. The Copan style swab is also acceptable or a nasopharyngeal aspirate.

N. B.: Throat swabs and anterior nasal swabs should not be taken.

2.5 Case management

2.5.1 Exclusion

Children with suspected, epidemiologically linked or confirmed pertussis should be excluded from schools or nurseries for five days from commencing appropriate/ recommended antibiotic therapy or for 21 days from onset of symptoms (in those who are not treated) [108]. If the case is a healthcare worker, or patient in a healthcare setting, see HPA Guidelines for management of pertussis incidents in healthcare settings [57] for further details. For cases working in other settings,

contact with 'vulnerable' individuals (as defined in section 1.6) should be avoided for five days from commencing appropriate/recommended antibiotic therapy or for 21 days from onset of symptoms (in those who are not treated).

2.5.2 Antibiotic therapy

For suspected, epidemiologically linked or confirmed cases, recommended antibiotic regimens are summarised in Table 2. 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.

Clarithromycin is the preferred agent for use in infants below one month of age. Azithromycin may be used although there are limited data in this age group. Azithromycin and clarithromycin are the preferred antibiotics in children over 1 year and adults given the adverse effects associated with erythromycin. For individuals in whom macrolides are contra-indicated or not tolerated, co-trimoxazole may be used although this is not licensed in infants below six weeks of age.

Erythromycin is the preferred antibiotic for treating women in the last month of pregnancy to prevent ongoing transmission to their infant. Whilst erythromycin can be administered for treatment earlier in pregnancy, this needs to be a clinical decision based on the likely clinical benefit for the woman. Use of erythromycin before the last month of pregnancy would only be of value for treatment if administered early in the course of the illness. Although any potential concern regarding the use of erythromycin in pregnancy has been largely refuted, avoidance of all drugs in the first trimester is generally advised.

Table 2: Recommended antibiotic treatment and post exposure prophylaxis for pertussis by age group.

Age group	Clarithromycin	Azithromycin	Erythromycin	Co-trimoxazole*[a]
Neonates (<1 month)	Preferred in neonates 7.5mg/kg twice a day for 7 days	10mg/kg once a day for 3 days	Not recommended due to association with hypertrophic pyloric stenosis	Not licensed for infants below 6 weeks
Infants (1 month – 12 months)	**Under 8kgs**: 7.5mg/kg twice a day for 7 days **8-11kg**: 62.5mg twice a day for 7 days	**1-12 months**: 10mg/kg once a day for 3 days	**1-12 months:** 125mg every 6 hours for 7 days	**6 weeks–6 months:** 120mg twice a day for 7 days **6 months–1 year:** 240mg twice a day for 7 days
Children	**12-19kg**: 125 mg twice a day for 7 days **20-29kg:** 187.5mg twice a day for 7 days **30-40kg**: 250mg twice a day for 7 days	**> 1 year** 10mg/kg (max 500mg) once a day for 3 days	**1-2 years** 125mg every 6 hours for 7 days **2-8 years** 250mg every 6 hours for 7 days **> 8 years** 500mg every 6 hours for 7 days	**1-5 years:** 240mg twice a day for 7 days **6-12 years**: 480mg twice a day for 7 days **12-18years:** 960mg twice a day for 7 days
Adults	500mg twice a day for 7 days	500mg once a day for 3 days	500 mg every 6 hours for 7 days	960mg twice a day for 7 days
Pregnant women[b]	Not recommended	Not recommended	Preferred antibiotic. Not known to be harmful.	Contraindicated in pregnancy
***** Please note that the doses for treatment and prophylaxis are the same for all ages				

[a] consider if macrolides contra-indicated or not tolerated

[b] For pregnant contacts, a risk assessment would need to be done to look at the risk and benefits of antibiotic therapy /prophylaxis. The aim of treating / prophylaxing women in pregnancy is to prevent transmission to the newborn infant. Where possible, pregnant women should begin treatment 3 days prior to delivery.

2.5.3 Immunisation

It is important that unvaccinated and partially immunised cases up to ten years of age complete their course of primary immunisation and booster vaccine once they have recovered from their acute illness, according to the HPA guidance document "Vaccination of individuals with uncertain or incomplete immunisation status".

Pregnant women who have been diagnosed with pertussis (at any stage of pregnancy) should still be offered a dose of pertussis-containing vaccine from 28 weeks of pregnancy in line with the current temporary pertussis vaccination programme for pregnant women [95].

2.6. Contact management

Management of contacts should proceed for all clinically suspected, epidemiologically linked and laboratory confirmed cases.

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. boarding school dormitories during the infectious period should also be considered close contacts. 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. Please refer to 'HPA Guidelines for the Public Health Management of Pertussis Incidents in Healthcare Settings" [57] for the definition of a significant exposure in a healthcare setting.

Definition of contacts considered as priority groups for public health action

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

Group 1. Individuals at increased risk of severe complications ('Vulnerable')

- Infants under 1 year who have received less than 3 doses of pertussis containing vaccine

Group 2. Individuals at increased risk of transmitting to 'vulnerable' individuals in 'group 1' who have not received a pertussis containing vaccine more than 1 week and less than 5 years ago

a) Pregnant women (> 32 weeks gestation)
b) Healthcare workers working with infants and pregnant women
c) People whose work involves regular, close or prolonged contact with infants too young to be fully vaccinated (< 4 months)
d) People who share a household with an infant too young to be fully vaccinated (< 4 months)

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 close contact in one of the priority groups 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 2). Chemoprophylaxis is **NOT** required where there are no close contacts in the priority groups defined in section 2.6. Pregnant women exposed after 32

weeks pregnancy (group 2a) should be offered erythromycin if they have not received a pertussis containing vaccine within the past 5 years. For pregnant contacts who have received a pertussis containing vaccine within the past 1 week, chemoprophylaxis would still be indicated given the delay in antibody response. For individuals who fall into groups 2b, 2c or 2d who happen to be pregnant as well, chemoprophylaxis and vaccine is recommended at any stage of pregnancy. A further dose of pertussis containing vaccine will be required after 28 weeks of pregnancy. For pregnant women with suspected or confirmed pertussis, who are still infectious at delivery (i.e. within twenty one days of onset), the newborn infant should be offered chemoprophylaxis with clarithromycin or azithromycin.

2.6.3 Immunisation

Immunisation should be considered for those who have been offered chemoprophylaxis.

- Unimmunised and partially immunised contacts up to the age of ten years should complete the schedule with the appropriate vaccine.
- A booster dose of pertussis containing vaccine is recommended for individuals aged 10 years or older (including pregnant women >32 weeks gestation), who have not received a dose of pertussis-containing vaccine in the last five years and no Td-IPV vaccine in the preceding month.

2.7 Special situations

2.7.1 Outbreaks

Where disease transmission is widespread, the benefit of wider chemoprophylaxis is likely to be of limited value. In the event of a hospital or community outbreak, an outbreak control team should be convened at the earliest opportunity and the local HPU informed. The priority in these circumstances is active case finding and therefore a less specific case definition should be used to ensure no cases are missed. Further guidance on the management of cases during heightened periods of pertussis activity is available on the HPA intranet.

An appropriate hospital incident control team is likely to include:

- Director of Infection Prevention and Control
- Hospital Microbiologist (if different)
- Infection control nurse
- Consultant/s from relevant clinical specialties
- Occupational health physician/nurse
- HPU representative
- Communications leads (from HPA and acute trust as necessary)

For community outbreaks, include the relevant individuals listed above plus

- Director of Public Health or their nominated representative
- General Practitioners or GP representative
- School nursing service representative for a school outbreak

Expert advice on outbreak investigation and management is available from the Immunisation, Hepatitis and Blood Safety Department, HPS-Colindale, HPA (020 8200 6868/4400) and on laboratory investigation from the Bordetella Reference Laboratory, RVPBRU (0208 327 7327).

2.7.2 Healthcare settings

Healthcare workers can be an important source of pertussis transmission to high risk patients, particularly infants and pregnant women in the later stages of pregnancy (>32 weeks gestation).

Specific guidance for the public health management of pertussis incidents in healthcare settings [57] is available on the HPA website.

2.7.3 Nursery and school settings

Confirmed and suspected cases should be excluded from nursery or school for five days from commencing appropriate/ recommended antibiotic therapy or for 21 days

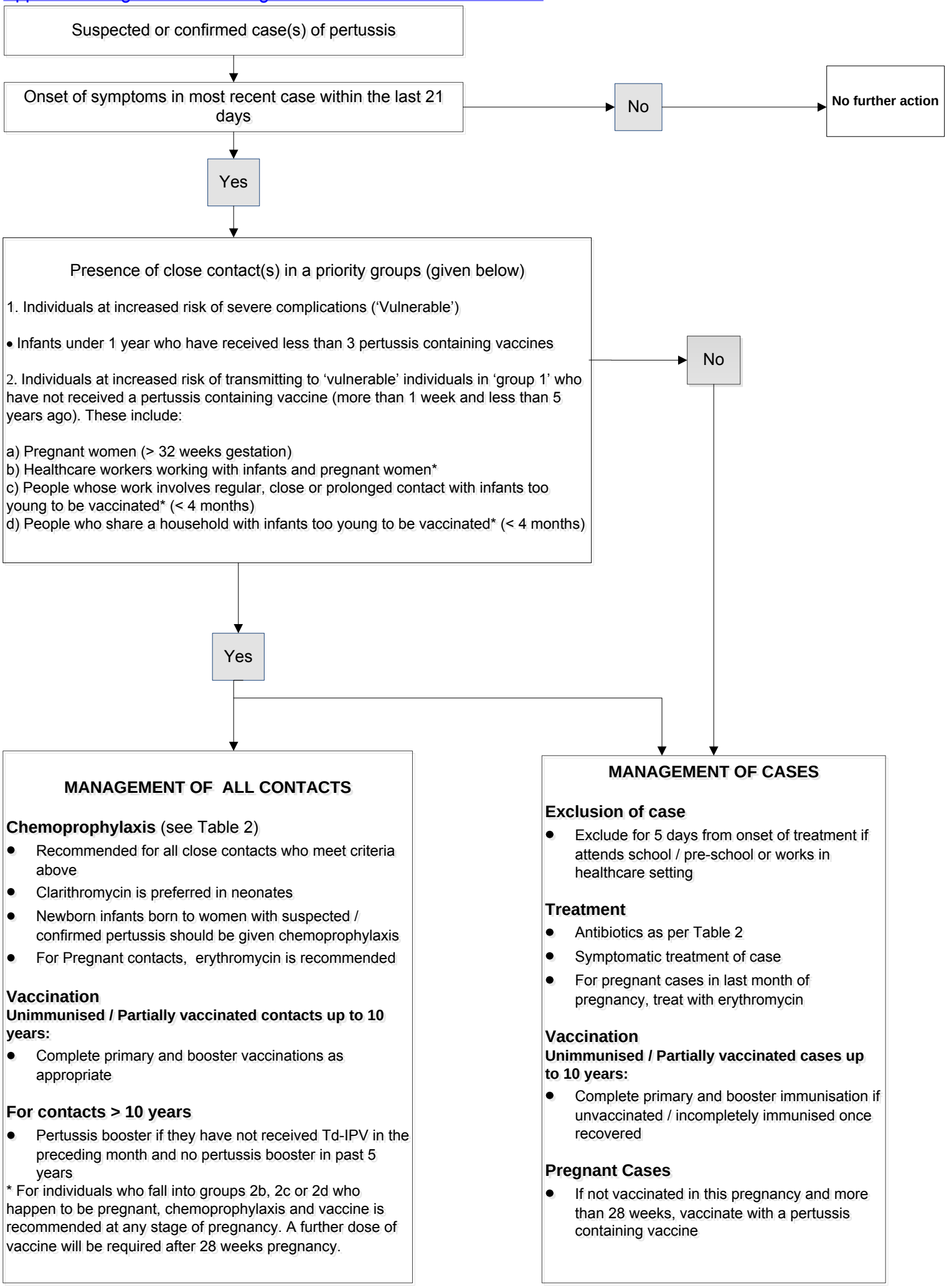
from onset of symptoms (in those who are not treated). Asymptomatic contacts do **NOT** need to be excluded.

In certain circumstances, wider chemoprophylaxis and vaccination 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 and/or vaccination
- Presence of a clearly defined group who can be identified for chemoprophylaxis and/or vaccination
- Practicality and feasibility of widespread chemoprophylaxis and/or vaccination
- Acceptability and compliance with antibiotics.
- Residential setting e.g. boarding school, children's respite care homes. Once a single case of pertussis has arisen in a boarding school setting it is highly likely that further cases will arise because of the enhanced opportunities for transmission.

Where there has been more than one case reported from an educational institution, other parents should be informed in order to raise awareness including emphasising the groups at risk of severe infection and to encourage timely reporting of further cases to enhance case finding. Regardless of these control measures, this should be used as an opportunity to remind parents about routine immunisations and ensure children are up to date.

Appendix 1: Algorithm for Management of Cases & Close Contacts



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

Appendix 2: 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, healthcare workers and others working with infants and pregnant women with suspected/ epidemiologically linked / confirmed pertussis should be excluded from school/ nursery/ work for 5 days from commencing antibiotic therapy	**Indicated**
Suspected / epidemiologically linked/ confirmed cases should be treated with antibiotics	**Strongly recommended**
Unvaccinated and partially immunised cases and contacts up to 10 years of age should complete their course of primary immunisation and booster vaccine according to the recommended UK schedule	**Indicated**
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 close contact in a priority group present	**Recommended**
For those who are offered chemoprophylaxis, a booster dose of pertussis containing vaccine is recommended for contacts aged 10 years or above (including pregnant women >32 weeks) who have not received a dose of pertussis containing vaccine in the last 5 years and no Td-IPV vaccine in the preceding month	**Indicated**

Appendix 3: Enhanced Surveillance Form

In Confidence

Health Protection Agency

Form version 10/12

Health Protection Agency
Enhanced Pertussis Surveillance

Follow-up of laboratory confirmed *B. pertussis* infection

You have been sent this form following laboratory confirmation of *B. pertussis* infection by culture, serology or PCR.

For HPA use only	Date of laboratory confirmation	Date of specimen

Study no

Please complete as far as possible, ticking appropriate boxes where applicable.

Are you happy for us to contact this patient / parent or guardian directly? Yes ☐ No ☐

Patient Details

Surname:	First name:	Sex:
NHS number:	Date of birth: _____/_____/_____	Age:

Clinical History of Patient

Date of first symptom onset: _____/_____/_____

Please indicate whether the following complications were present:

Apnoeic attacks:	Yes ☐	No ☐	NK ☐	Pneumonia:	Yes ☐	No ☐ NK ☐
Convulsions:	Yes ☐	No ☐	NK ☐	Conjunctival haemorrhage:	Yes ☐	No ☐ NK ☐

Death: Yes ☐ No ☐ NK ☐ If yes, date of death: _____/_____/_____

Please indicate if this patient is: ☐ diagnosed with chronic respiratory disease (incl. asthma)

☐ diagnosed with chronic heart disease, ☐diabetic; ☐ immunocompromised; ☐pregnant

☐ diagnosed with another condition – please specify_____

Did the patient receive erythromycin or another macrolide? Yes ☐ No ☐ NK ☐

If yes, was this: For prevention: Yes ☐ No ☐ NK ☐ If yes, date started: _____/_____/_____

For treatment: Yes ☐ No ☐ NK ☐ If yes, Date started: _____/_____/_____

Was the patient admitted to hospital? Yes ☐ No ☐ NK ☐ If yes, which hospital_____
Date admitted: _____/_____/_____ Date discharged: _____/_____/_____

If this patient was admitted please include a copy of the hospital discharge summary with this form.

VACCINATION HISTORY OF CASE

Had this patient been immunised against pertussis before symptom onset? Yes ☐ No ☐ NK ☐
How many doses of pertussis vaccine did they receive before symptom onset?_____

1st dose _____/_____/_____ 2nd dose _____/_____/_____
3rd dose _____/_____/_____ 4th dose _____/_____/_____

VACCINATION HISTORY OF MOTHER (PLEASE COMPLETE FOR INFANTS AGED LESS THAN 1 YEAR)

Was the mother immunised against pertussis during pregnancy Yes ☐ No ☐ NK ☐
If YES, date of vaccination _____/_____/_____ Number of weeks gestation at vaccination_____
Number of weeks gestation at delivery_____ Mother's date of birth_____/_____/_____

Did the patient have contact with a suspected or known case of pertussis in the month before onset?

Yes ☐ No ☐ NK ☐ **If yes, please specify where the contact took place:**

home ☐ **playgroup** ☐ **school** ☐ **work** ☐ **hospital** ☐ **other** ☐

And the age of the contact: **<1** ☐ **1-4** ☐ **5-9** ☐ **10-14** ☐ **15-44** ☐ **45+** ☐

If in the home, was the contact the: mother ☐ **father** ☐ **sibling** ☐ **other** ☐

Completed by (please print):_____	Telephone No::_____
Date: _____	Position:_____

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