Chapter 7 – Household Settings

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Household outbreak: 2 or more cases; the outbreak case definition may be used to count cases if one case has been confirmed. Household contacts should be considered "epidemiology linked."

BACKGROUND

Due to close proximity and long duration of exposure, transmission of pertussis from cases to susceptible contacts living in the same household is a frequent occurrence. In vaccine efficacy studies conducted in the early years of vaccine development and licensure, attack rates of 80% and more among unvaccinated susceptible household members were reported.[1,2] Reported secondary attack rates in households varied greatly depending on factors such as definition of a secondary case, age and vaccination status of the contacts, treatment of the index cases, prophylaxis of the contacts, and duration of follow-up of the contacts.[1,3-15]

The source of infection and transmission patterns in households have been studied (see **Table 7-1**). In many studies, older children were reported as the sources of infection in the households.[1,8,15-23] These children infected other household members, including younger siblings. There are also data indicating parents with pertussis as sources of infection for young children,[8,16,26] although cases first brought for medical attention (i.e., index case) were usually young children who tended to have more severe disease.[18,27] Mother-to-child transmission has been a documented cause of pertussis among newborn children.[28,29]

One study reported lack of transmission of pertussis to unvaccinated children at the time of occurrence of a case in the household, but later development of pertussis 2-8 months after the household occurrence due to exposure outside the household.[15] However, not contracting infection in the household and remaining susceptible is a rare occurrence; reasons for it are unclear (i.e., intensity of exposure or host factors that may affect transmission).

Several studies have suggested that early treatment of index cases and chemoprophylaxis of contacts with erythromycin reduces secondary attack rates in households (see **Chapter 3: Treatment and Chemoprophylaxis**). Therefore, it is important to identify patients in the early stages of pertussis (see **Chapter 1: Background**) and provide treatment and prophylaxis as soon as possible.

DEFINITION OF OUTBREAK IN A HOUSEHOLD

Two or more cases; the outbreak case definition may be used to count cases if one case has been confirmed (see **Chapter 11: Definitions**). A household consists of all persons who occupy a particular housing unit as their usual residence or who live there at the time

of the disease of the case. Household contacts should be considered "epidemiologically linked."

IDENTIFYING AND INVESTIGATING CASES AND CONTACTS

Investigation of household contacts should begin immediately after reporting a suspected case of pertussis. Although all susceptible household contacts are at risk for contracting pertussis, special emphasis should be given to identifying those at high risk for developing severe pertussis (i.e., infants) or those who may transmit the disease to high-risk cases (see **Chapter 11: Definitions**). Although they may not be included in the definition of household contacts, investigation should include contacts such as child's care giver who comes to the house regularly or friends or relatives who visit often.

An interview with these contacts may reveal unreported cases who had cough illness with onset before to the first reported case. Usually laboratory confirmation of pertussis in such unreported cases is difficult due to delayed recognition; therefore, for surveillance purposes, these cases may be confirmed based on clinical symptoms and epidemiologic linkage.

CONTROL MEASURES

1. Treatment and Chemoprophylaxis

a. ***Cases.*** Antimicrobial treatment should be initiated as soon as pertussis is suspected in a patient. The antimicrobial agent of choice is erythromycin. Initiating treatment $\geq$ 3 weeks after cough onset has limited benefit to the patient or contacts. However, treatment is recommended up to 6 weeks after cough onset in high-risk cases. For dosage and duration of therapy and further information, see **Chapter 3: Treatment and Chemoprophylaxis.**

b. ***Contacts.*** If pertussis is highly suspected in a patient, chemoprophylaxis of all household contacts with erythromycin is recommended regardless of their age and vaccination status. Initiating chemoprophylaxis $\geq$3 weeks after exposure has limited benefit for the contacts. However, chemoprophylaxis should be considered for high-risk contacts up to 6 weeks after exposure. For more information, including information about chemoprophylaxis of neonates, see **Chapter 3: Treatment and Chemoprophylaxis**.

2. Vaccination

a. All contacts $\leq$ 6 years of age who have not completed the four-dose series should complete the series with the minimum intervals. Children aged 4-6 years who have completed a primary series but have not received the pertussis vaccination booster dose should be given this dose. Pertussis vaccines are not currently licensed for use in persons $\geq$ 7 years of age. For more detailed information, see **Chapter 4: Use of Pertussis Vaccine in**

Outbreaks.

3. Isolation

a. Isolation of patients is not feasible and therefore not recommended in households. However, patients should refrain from contact outside the household for the first 5 days of a full course of antimicrobial treatment or for 21 days from onset of cough in those who do not receive antimicrobial therapy.

Table 7-1. Results from studies with data on source of infection and transmission patterns for pertussis in household settings.

Author & Year (ref)	Setting	Type of study	Primary case definition	Secondary case definition	Transmission/source	Prophylaxis	Vaccination status	Attack rates
Kendrick, 1940 (2)	Grand Rapids, MI	Observational household study	Individual with first onset of pertussis	Onset of pertussis >3 days of onset of primary case	172 primary cases: ~30% aged <5 yrs 212 secondary cases: 80% aged <5 yrs	Not reported	Vaccinated as part of an efficacy study	Unvaccinated: 92% Vaccinated: 36%
Nelson, 1978 (16)	Dallas, TX	Retrospective review of 400 cases	Culture or DFA positive cases	Not defined	Infants aged <12 weeks acquired pertussis: 1965-71 from children; 1971-77 from adults. In neonatal period, more an adult was a source. Among 15 adult sources in HHs, 7 were mothers.	Cases treated with parenteral ampicillin or oral erythromycin	Not reported	Not reported
Broome, 1981 (13)	Atlanta, GA	Observational cross sectional	First symptomatic case, clinical or lab	Case with onset >7-28 days from onset of symptoms of primary case	78 primary cases: 28 (36%) aged <1 yr; 28 (36%) 1-5 yrs; 8 (10%) 6-10 yrs; 9 (12%) 11-20 yrs; 5 (6%) >20 yrs.	Not reported	77% children aged 1-10 yrs had ≥3 doses	Overall: 22% Age <1 yr: 81% Age 1-5 yrs: 56%
Mertsola, 1983 (22)	Finland	Prospective observational study. 21 families (76 members) followed-up 3-15 mo	First symptomatic case in the household	Serologically diagnosed pertussis infection, either symptomatic or asymptomatic	21 primary cases: 9 (43%) aged <2 yrs; 12 (57%) 2-15 yrs. 63 secondary cases (29 asymptomatic): 11 (17%) <2 yrs; 17 (27%) 2-15 yrs; 35 (56%) >15 yrs. Asymptomatic cases more common in those aged >15 yrs.	52 members received erythromycin and 10 other antibiotics	31 (91%) of children aged 2-15 yrs and 3 (27%) of children <2 yrs had 3-4 DTP	83% (46% of these were asymptomatic)
Thomas, 1987 (17)	Britain	Prospective, observational	Typical: prolonged paroxysmal cough with whoop, vomiting or apnea	Typical or atypical (brief non-paroxysmal cough without other symptoms)	26 families followed to identify source: parents in 4 HH; children in 22 HH . Atypical pertussis in secondary cases, rather than primary cases.	Only children with typical pertussis received erythromycin	Not reported	Overall: 70%
Biellik, 1988 (19)	Marshfield, WI	Case-control	HHs of culture-confirmed cases	Neighborhood and community control HHs	61 case HH: 76 primary cases (80%>11 yrs), 18 secondary cases (67% >11 yrs). Compared to both control groups, case HHs had higher number of adolescents and infants aged <6 months. 6 of 8 primary infant cases acquired pertussis from adult or babysitter outside home.	Controlled for erythromycin therapy and prophylaxis	Case and control HHs had similar vaccination coverage	Overall: 10%

Table 7-1 (Continued). Results from studies with data on source of infection and transmission patterns for pertussis in household settings.

Author & Year	Setting	Type of study	Primary case definition	Secondary case definition	Transmission/source	Prophylaxis	Vaccination status	Attack rates
Christie, 1989 (29)	New Haven, CT	Case report	Culture confirmed and symptomatic	Prolonged cough illness	Previous to their cough onset, three hospitalized neonates had adolescent mothers with prolonged cough illness	None were diagnosed and treated with erythromycin prior to their child	N/A	N/A
Long, 1990 (27)	Philadelphia PA	Observational prospective	Positive for culture, DFA or serology	Not defined	4 index cases and 18 HH contacts: Index cases less immunized and younger than contacts. Five contacts had cough illness 14-30 before index.	Erythro given to index cases and recommended to HH contacts	Contacts received 2-5 doses	Overall: 83% Infected contacts were adolescents
Izurieta, 1993 (26)	Chicago, IL	Case-control study	<7 mo age, culture (+) with any duration of cough or probable case (CDC case definition)	Controls: <7 mo age, <7 days cough, had appointment at the same hospital, and from the same zip-code as ≥ 1 case	Infants of adolescents mothers (OR=6.4; 95%CI 1.3-41.4); infants of mothers who suffered ≥ 7 days of cough during child's incubation period (OR=12; 95% CI 1.4 to infinity)	Not reported	Similar coverage between cases and controls	N/A
Deen, 1995 (18)	Los Angeles CA	Observationalc ross- sectional HH study	First case occurring in HH; Clinical pertussis: CSTE probable case def. Lab: serology, DFA or culture	Onset of cough 7-28 days after primary case	39 primary cases: 11 (28%) aged <4 yrs; 23 (53%) aged ≥ 13 yrs.	Not reported	36% of clinical pertussis cases adequately immunized vs. 90% of other contacts	Mild pertussis: 21% Clinical pertussis: 35%
Wirsing von Konig, 1995 (8)	Germany	HH study, nested in a vaccine efficacy trial	≥21 days paroxysmal cough and lab (culture, serology) confirmation	≥ 7 days paroxysmal cough and lab confirmation, onset ≥7 days after primary case	122 primary cases: 104 (85%) in children; 18 (15%) in adults. Social status, size of household, and age of children with pertussis were not significant risk factor for spread.	Erythromycin therapy of index case reduced AR	Reported for symptomatic patients.	Adults: 27%, children: 64%.
Trollfors, 1997 (15)	Sweden	Double blind, placebo controlled, randomized. Study families with pertussis evaluated	Confirmed (culture, serology, or PCR), probable or clinical pertussis by WHO case definition	WHO case definition, onset 6 days after onset in the first case and 60 days after onset in the last case (coprimary cases-excluded)	In 245 families with a case, primary cases were: 13 (5%) a parent 230 (94%) an older sibling 1 (0.4%) a twin 1 (0.4%) a younger sibling	Erythromycin recommended for infants aged <6 mo and with severe underlying disease, and siblings of infants aged 6-11 mo	Randomly assigned to receive DT, or DTaP at 3, 5, and 12 mo	DT recipients: 81% (64 cases) DTaP recipients (3 doses): 20% (20 cases)

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