

Outbreak of Pertussis in a Unified School District – McPherson County, November 2014 – April 2015



Background

On November 19, 2014 at 4:53 PM, the Kansas Department of Health and Environment (KDHE) Infectious Disease and Epidemiologic Response (IDER) team was notified by the McPherson County Health Department (MCHD) that an eleven-year-old male who tested positive for *Bordetella pertussis* by polymerase chain reaction (PCR) attended a middle school in McPherson, Kansas, where another student with pertussis had been identified four days previously. MCHD and the Unified School District (USD), with the support of KDHE, began an outbreak investigation to identify additional cases, exposed individuals, and to implement prevention and control measures. Continued surveillance and investigation over the next five months revealed additional cases of pertussis among elementary, middle, and high school students of the USD.

The ill students attended five separate schools representing elementary ages 5-10 years, middle school ages 11-13 years, and high school ages 14-18 years. Three out of four elementary school (ES) buildings were involved; ES1, ES2, and ES3 served a population of 302, 268, and 278 students, respectively. With a middle school enrollment of 536 students and a high school enrollment of 755 students, the student population of interest in this outbreak was 2,139 students. The district's entire 2014-2015 enrollment was 2,395 students.¹

Methods

The local health department coordinated with the USD administration and school nurses to identify coughing students or faculty, investigate setting-related exposures, and carry out control measures. Potential cases were investigated and followed until two weeks after cough onset.

A case was defined as a cough illness lasting two weeks or greater with paroxysms of coughing, an inspiratory “whoop”, or post-tussive vomiting in a person associated to one of the district schools from November 1, 2014, to April 21, 2015. A case was considered primary if identified in a student whose exposure to pertussis was most likely at one of the five affected schools, and secondary if the illness was in an individual who, prior to symptom onset, had an epidemiological link to a coughing student who attended one of the five schools. Ill persons with a positive test for pertussis by PCR or epidemiologically linked to a PCR-positive case were considered confirmed. Ill persons without a PCR-positive laboratory result or a link to a PCR-positive case were classified as probable.

Ill persons or their guardians were interviewed by phone using the Kansas Pertussis Supplemental Form to assess symptoms, cough onset date and duration, and vaccination status. Immunization data was also retrieved from the Kansas Immunization Registry or the patient’s medical records.

In accordance with Kansas Administrative Regulation (K.A.R.) 28-1-6, every student suspected of having pertussis was excluded from school until one of the following occurred: three weeks had passed since cough onset, a five-day course of antibiotics was completed, or a medical practitioner confirmed that the illness was not caused by pertussis.

Antibiotic prophylaxis was recommended for household and high-risk contacts of ill persons. A high-risk contact was defined as an individual who was exposed to a person with confirmed or probable pertussis in such a way to put the individual at risk of developing severe disease or developing illness that could transmit pertussis to those at high risk of developing severe disease. This includes infants less than 12 months old, pregnant women in the third trimester of pregnancy and all persons with pre-existing health conditions that may be exacerbated by a pertussis infection.

Based on Advisory Committee on Immunization Practices (ACIP) recommendations², a person was considered up-to-date for pertussis vaccinations with three doses at 12-14 months of age, four doses at 15 months-3 years of age, five doses at 4-10 years of age, and a dose of Tdap at and above 11 years of age. For those persons who were ill with pertussis, only those doses received two weeks before illness onset were included in the total number of doses received and used to calculate the time since the last dose of pertussis containing vaccine was received.

DTap or Tdap was offered to those persons not considered to have up-to-date pertussis vaccination based on ACIP recommendations. MCHD routinely carries out vaccination clinics in the summer prior to children entering the 7th grade to make certain students up-to-date in accordance with K.A.R. 28-1-20 which requires a single dose of Tdap for students entering Grades 7-12, but because pertussis was first identified in the 6th grade population, county-wide Tdap immunization clinics were held again in November-December 2014, to vaccinate 6th graders who were 11 years of age.

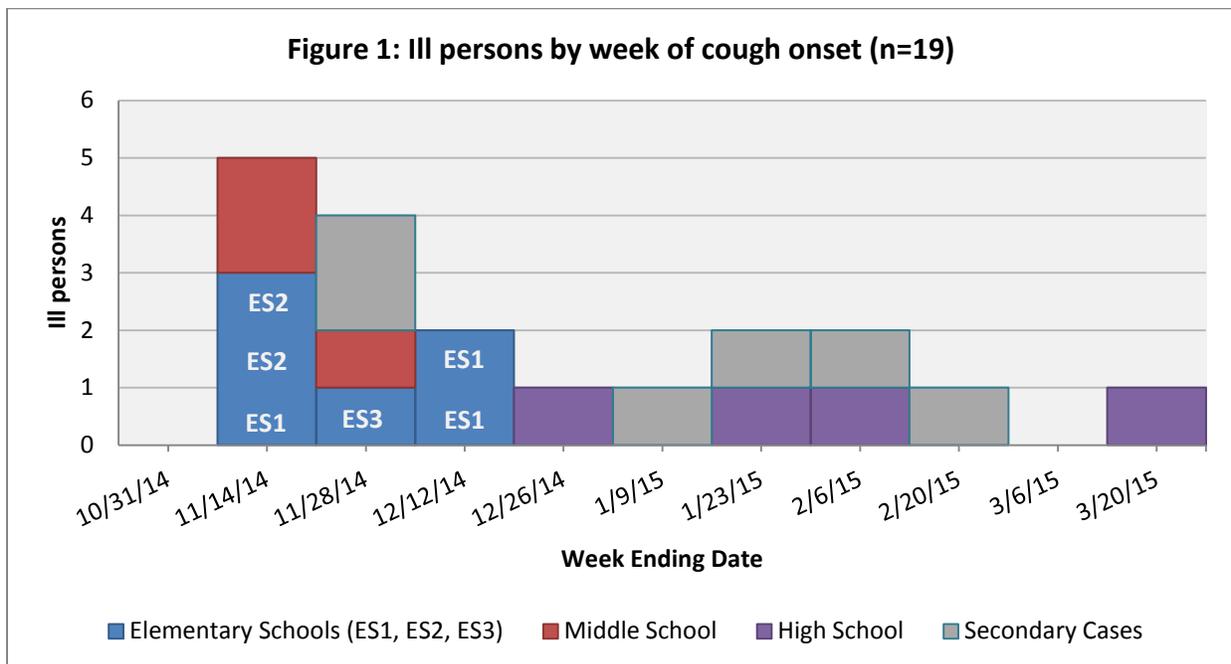
Results

Twenty-nine potential cases of pertussis were investigated with ten excluded from analysis. Those excluded included two ill adults and four ill children with no epidemiological link to the district schools and three ill children and one ill adult living in the school district who did not meet the case definition. Of the remaining 19 ill persons, 17 were classified as confirmed and two were probable. Thirteen were primary cases that were most likely exposed at school and six were secondary cases with exposure in a household, work setting, or family gathering. Ten ill persons were associated to the elementary and high school settings with only three associated to the middle school (Table 1). The median age of those ill was 11 years with a range from one year to 70 years. Race, ethnicity, and gender were available for all ill persons. The ill persons were all Caucasian with 16% reporting Hispanic ethnicity; 63% were male.

Table1: Distribution of ill persons by exposure setting and age (n=19)

Exposure Setting	<i>Number of ill persons (% of total)</i>	<i>Median Age (years)</i>	<i>Age Range (years)</i>
Elementary school	6 (31.6%)	6	5-8
Middle school	3 (15.8%)	11	-
High school	4 (21.1%)	17.5	14-17
Household	3 (15.8%)	2	1-13
Social	3 (15.8%)	31	18-70

The earliest illness onsets were on November 1, 2014, in an elementary student and November 6, 2014, in the middle school; the latest onset, March 10, 2015, was reported by a high school student (Figure 1).



Among the 19 ill persons, no hospitalizations, deaths, pre-existing conditions or pregnancies were reported, but one ill adult was radiologically-diagnosed with pneumonia. Seventeen of the ill persons were diagnosed by a visit to a medical provider. Fifteen patients were positive by PCR, two patients were tested serologically. Clinical information was unknown for whoop or post-tussive vomiting in one ill person (Table2).

<i>Symptoms</i>	<i># with Symptoms (%)</i>
Cough	19 / 19 (100%)
Paroxysms	19 / 19 (100%)
Whoop	11 / 18 (51%)
Post-tussive Vomiting	6 / 18 (33%)
Apnea	1 / 19 (5%)
Cyanosis	1 / 19 (5%)

Six patients had initially been given a penicillin-type antibiotic prior to being diagnosed with pertussis, but all 19 patients did eventually complete antibiotic treatment with clarithromycin or azithromycin. The exact duration of cough was available for thirteen of these patients with a range of 19-63 days and the median duration of 30 days. Earlier antibiotic treatment resulted in shorter cough durations (Table 3), and two patients reporting a cough greater than 60 days had not been diagnosed or treated until after 42 days of cough.

<i>Cough Duration</i>	<i>Number of Cases</i>	<i>Days from onset until receipt of an appropriate antibiotic</i>	
		<i>Median</i>	<i>Range</i>
< 25 days	4	5.0	1-8
25-34 days	4	10.0	2-17
35-42 days	4	13.0	7-28
> 60 days	2	42.0	-

Chemoprophylaxis was recommended for 109 individuals. Sixty-six of these individuals were household contacts and ten were considered high-risk contacts, including seven children attending a home daycare where an infant was present. The remaining 33 contacts were members of an athletic team. A decision was made by the school and local health officer to treat the team after an ill person with pertussis was identified as participating in practices while coughing.

A complete vaccination history was obtained for 17 patients. Those with incomplete vaccination histories were over 31 years of age. Five ill individuals had six doses of pertussis-containing vaccine, and one individual was unvaccinated prior to onset of illness. Of the 17 patients, twelve (70.6%) were considered up-to-date with pertussis containing vaccinations

based on age and ACIP recommendations. The number of years since last pertussis vaccination was examined for the school and household individuals who did have complete vaccination histories (Table 4). Of the four patients who had received pertussis containing vaccine within the last two years, one was an elementary student whose vaccination had occurred within one month of onset.

Table 4: Case-patients by exposure setting and last receipt of pertussis vaccine (n=16)

Exposure Setting	<i>Number of Cases</i>	<i>Years since last received vaccine</i>	<i>Range in years since last received vaccine</i>
Elementary school	6	3.2	0.1-3.8
Middle school	3	6.1	6.0-6.3
High school	4	3.8	2.8-5.7
Household	3	1.7	1.5-1.9

The local health department reported that a total of 520 doses of Tdap were given to county residents from October 1 to December 31, 2014. This included 271 doses of Tdap given at the middle schools vaccination clinics held throughout the county (Table 5).

Table 5: Tdap vaccination clinics held in McPherson County middle schools by location, date, student population, and doses given.

<i>Clinic Location</i>	<i>Date of Clinic</i>	<i>Student population</i>	<i>6th grade population</i>	<i>Doses given</i>
McPherson	11/24/2014	536	162	117
Canton	11/26/2014	163	59	59
Lindsborg	12/10/2014	263	62	62
Moundridge	12/17/2014	113	33	33

Of the 17 ill persons that were seen by a medical provider, two (12%) were reported within 24-hours of a presumptive pertussis diagnosis and 15 (88.2%) were reported to public health within 72 hours. Fourteen (82.4%) reports were initially received through reporting laboratories, and 3 (17.7%) were reported by the school or MCHD. Those ill persons considered primary cases that were diagnosed by a physician were reported to the health department within a median of 10 days after the onset of symptoms (range 2-47 days). Those ill persons considered secondary cases were reported to the health department within a median of 14 days after the onset of symptoms (range 2-21 days). The local health department investigations were started within 0-2 days (median 0 days) of a report being received.

Conclusions

The primary goal of pertussis outbreak control is to decrease morbidity and mortality among infants; a secondary goal is to decrease morbidity among people of all ages.³ MCHD was tasked with these goals while trying to effectively use limited public health resources and

appropriately use antibiotics among patients and contacts. The control efforts focused on active surveillance for symptomatic students in schools, contact tracing to identifying household and high-risk contacts with antibiotic prophylaxis recommendations, and vaccination efforts focused on those considered at risk because of waning or incomplete immunity to pertussis.

It would appear that the outbreak control efforts were successful. During the course of this outbreak, 19 cases of pertussis were identified among students in five schools in McPherson County as well as among household and social contacts of these students. No infants under the age of one year were affected in the outbreak and only one ill person was diagnosed with a severe complication (pneumonia). There were no hospitalizations.

The most successful control efforts appeared to be with the use of pertussis vaccine. The pertussis vaccine is a safe effective way to prevent disease. The Centers for Disease Control and Prevention (CDC) estimates that five doses of pertussis vaccine are 80-90% effective in preventing disease, and vaccination will lower the likelihood of a severe infection.⁴ Unfortunately, there is a modest decrease in vaccine effectiveness seen each year following the completion of the five dose series resulting in previously vaccinated individuals developing pertussis, which is why the ACIP recommends a Tdap booster at 11-12 years.⁵

Within this outbreak, elementary and high school students were observed to develop pertussis after a median of three years post-vaccination, but the biggest wane in immunity was with the middle school 6th graders who were six years from their last vaccination. No other grades were affected in the middle school; most likely because most of the 7th and 8th graders had received a Tdap booster within one year. Holding a second vaccination clinic for 6th graders was a very effective control measure as no new cases were identified in the middle school setting after the vaccination clinics. Based on what was observed in this outbreak, local health departments should consider the timing of the vaccination clinics for 11-year-old students. While Kansas regulations do not require Tdap boosters until 7th grade entry; most students will reach the age of 11 years upon entry into 6th grade. If local resources allow, Tdap clinics for 6th graders during the school year may be more effective than Tdap clinics for incoming 7th grade students during the summer.

Along with the vaccination efforts, a strength of this investigation was the local health department's coordination with the school district. This cooperation was instrumental in preventing further spread of disease. The consultation between the local investigator, school administration, coaching staff, and local health officer was an excellent example of this relationship fostering an environment where risks could be assessed and policies modified to stem the spread of disease.

There were some weaknesses with the outbreak response, especially the lack of reporting by medical providers. In Kansas, state regulations require health care providers to report suspected pertussis cases within four hours to public health; but, during the outbreak, this did not occur. Unless a case was identified by the school or MCHD, public health was not aware of cases until laboratory results were reported to KDHE. It is possible that an underreporting of pertussis-patients that were treated empirically may have resulted. More communication with local health care providers may have improved this situation and could have resulted in additional case finding. A second weakness during this response was that no specimens were collected for culture confirmation, as recommended by CDC for outbreaks of pertussis. These weaknesses did not appear to hamper a successful control effort.

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¹ Kansas State Department of Education. Kansas K-12 Reports- County, District, and School. Accessed April 24, 2015, <http://online.ksde.org/k12/k12.aspx>.

² Centers for Disease Control and Prevention. Pertussis: Summary of Vaccine Recommendations. Accessed April 27, 2015. <http://www.cdc.gov/vaccines/vpd-vac/pertussis/recs-summary.htm>

³ Centers for Disease Control and Prevention. About Pertussis Outbreaks. Accessed April 27, 2015. <http://www.cdc.gov/pertussis/outbreaks/about.html>

⁴ Centers for Disease Control and Prevention. Pertussis: Frequently Asked Questions. Accessed April 28, 2014, <http://www.cdc.gov/pertussis/about/faqs.html>

⁵ Centers for Disease Control and Prevention. Preventing Tetanus, Diphtheria, and Pertussis Among Adolescents: Use of Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccines. Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2006;55(RR-03):1-34. Accessed April 28, 2014, <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5503a1.htm>