

AAVMC/APTR One Health Case Study



Zoonotic Diseases and Local Response Tabletop Training Exercise (Reader's Version)

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This scenario is designed to present human cases of a disease of animal origin (zoonotic disease). You are a public health official working for the Buckeye County Health District (BCHD) in your state. Some questions to think about as you work through the scenario –

- What steps should be taken during the early investigation and response to an outbreak in your community of an unknown infectious disease?
- Who will you work with as this case progresses (from the local to federal levels) and how will different agencies and professionals work together?
- How would you differentiate a natural outbreak of zoonotic disease from a natural occurrence, accidental release or a bioterrorism attack?
- Why did this outbreak happen and what can be done to prevent future occurrences?

Friday, May 18th

9:30 AM

You receive a call from the school nurse at Northside elementary school. Northside elementary is a K-5 school with a student body of 407 schoolchildren. Since Wednesday May 16th, they have had 40 students and 5 staff members absent due to flu-like symptoms. Two staff members have been hospitalized with pneumonia. This is a very high number of cases for one week at the school.

11:00 AM

You receive a call from Ruby Dolor, the Infection Preventionist (IP) at Smallsville Hospital. They have seen seven patients in the last three days who were complaining of fever, cough, chest pain and severe retrobulbar (behind the eye) headache. All patients were diagnosed with Community Acquired Pneumonia (CAP) and two were hospitalized. All patients were negative for Influenza virus, and sputum and blood cultures were also negative for bacteria. Five are treated as outpatients with azithromycin and the two hospitalized patients are being treated with cefotaxime and azithromycin. The two hospitalized patients are not improving and two of the outpatients were seen this morning for worsening of symptoms. Ms. Dolor wants to know if any other reports have been made.

NOTE:

Diagnosis of **Community Acquired Pneumonia** typically involves chest radiography, leukocyte count, sputum Gram stain and culture, 2 sets of blood cultures and urine antigens. Typical bacterial pathogens that cause this condition include *Streptococcus pneumoniae* (penicillin-sensitive and -resistant strains), *Haemophilus influenzae* (ampicillin-sensitive and -resistant strains), and *Moraxella catarrhalis* (all strains penicillin-resistant). These 3 pathogens account for approximately 85% of all CAP cases (Howard LS, 2005). **Community Acquired Pneumonia** can also be caused by a number of respiratory viruses including Influenza A and B, Parainfluenza viruses, Respiratory Syncytial Virus and Adenovirus (Lutfiyya MN, 2006). Pneumonia not caused by one of these bacteria or viruses is considered atypical pneumonia. Atypical pneumonia is usually caused by *Chlamydia pneumoniae*, *Legionella pneumophila*, *Histoplasma capsulatum* or *Mycoplasma pneumonia* among others. In cases where tests for all these pathogens are negative, unusual cause of pneumonia such as Q-Fever, Hantavirus, Tularemia and endemic fungi should be further investigated (Mandell LA, 2007; Niederman, 2015).

2:30 PM

Later that day, you receive another call from Greis Nursing Home, a skilled nursing facility with on-site respiratory support facilities. You know this nursing home is located just a few blocks from Northside Elementary School. They have two residents who developed pneumonia on Wednesday, May 16th and three who developed pneumonia on Thursday May 17th. All cases are being managed in house. All are negative for influenza virus. Bacterial sputum and blood cultures are negative for the first 2 cases and pending for the remaining three cases. Legionella urine antigen tests are also negative.

QUESTION #1

IS THIS OF PUBLIC HEALTH CONCERN THAT REQUIRES FURTHER ATTENTION? WHY OR WHY NOT?

QUESTION #2

AT THIS POINT IN TIME, WHAT WOULD BE THE APPROPRIATE RESPONSE FOR THE LOCAL HEALTH DEPARTMENT?

NOTE:

It is important to understand that to obtain information from students may not be an easy task as their records are protected by the Federal Educational Rights and Privacy Act (FERPA). This law prohibits the release of students' records without written parental consent *except* under the following circumstances (34 CFR § 99.31):

- School officials with legitimate educational interest;
- Other schools to which a student is transferring;
- Specified officials for audit or evaluation purposes;
- Appropriate parties in connection with financial aid to a student;
- Organizations conducting certain studies for or on behalf of the school;
- Accrediting organizations;
- To comply with a judicial order or lawfully issued subpoena;
- State and local authorities, within a juvenile justice system, pursuant to specific State law; and
- Appropriate officials in cases of health and safety emergencies.

In our particular scenario the last point it is likely to apply. Therefore, it could be helpful to use phrases (as appropriate) such as “public health emergency” and “imminent threat” when speaking to school officials to improve the likelihood of cooperation. Conversely, if the school nurse is unwilling to release contact information at this point, you could start with contacting ill staff members and request that the school contact the student’s families to ask them to call the Local Health Department (LHD) directly.

A very helpful resource, *Speaking Education's Language: A Guide for Public Health Professionals Working in the Education Sector* (2013) can be accessed at: <http://www.chronicdisease.org/?SchoolHealthPubs>.

4:30 PM

Your LHD has developed an initial suspect *Case Definition* and questionnaire to aid in *Case Finding/Identification* and *Hypothesis Generation*. You begin to contact suspect cases to perform initial interviews. A Public Information Officer (PIO) has been designated and preliminary information is being compiled to distribute to community stakeholders (hospitals, physicians and school district administrators). You prepare to continue interviews and staff phone lines over the weekend if necessary.

NOTE:

The CDC has many useful resources to aid in conducting an unexplained respiratory outbreak investigation (<http://www.cdc.gov/urdo/outbreak.html>) as well as on how to construct a case definition (<http://www.cdc.gov/ophss/csels/dsepd/SS1978/Lesson6/Section2.html>). The steps of an outbreak response are summarized in Appendix A.

INSTRUCTOR:

At this point it is important to customize the scenario to the **Local Government Authority** present in your state. There are two types of authority given by the state to the local governments in the USA: Narrow Government Authority or **Dillon's Rule**, and Broad Government Authority or **Home Rule**. Details about this classification are provided here: <http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-powers/local-government-authority>

QUESTION #3

**WHAT TYPE OF INFORMATION WILL YOU REQUEST FROM THE PATIENTS DURING YOUR INTERVIEWS?
WHAT QUESTIONS WILL YOU ASK TO FIND THE CAUSE OF THE SYMPTOMS??**

Saturday, May 19th

Buckeye County Health Department Staff are continuing to perform phone interviews with affected individuals. The hospital reports 3 new cases today: 2 students and 1 staff member from Northside Elementary School.

The superintendent of Buckeye County School District contacts Buckeye County Health Department to discuss whether or not the school should be closed until a cause can be determined.

Sunday, May 20th

Preliminary analysis of the data from the initial phone interviews reveals that all cases, including those at the hospital, are limited to the individuals at the school, nursing home and surrounding neighborhood. The hospital reports 1 new case and the nursing home reports 2 new cases today. No cause has yet been identified. The PIO prepares a press release describing what is happening and what steps are being taken to investigate and control the outbreak.

Monday, May 21st - 9:00 AM

Buckeye School District elects to close Northside Elementary School pending further investigation. The hospital and nursing home report all cases are negative for the most common causes of atypical pneumonia (see note above). **Buckeye County Health Department (BCHD)** conducts a conference call with the **State Health Department (SHD)** and Ms. Dolor, the IP from Smallsville Hospital to determine what additional samples should be submitted for further testing and where they should be sent. After reviewing the histories and the consensus of the expert opinions, they decide to perform additional tests for *Francisella tularensis*, Hantavirus and *Coxiella burnetti*. Ms. Dolor agrees to collect the samples that the experts recommend and ship them overnight to the corresponding lab.

The hospital reports two new cases today; no new cases have been identified at the nursing home or elementary school. You also received a call from the SHD reporting the results of the additional tests for the first 6 patients: **All six were positive for Q-Fever (Coxiella burnetii) on PCR.** Q-Fever is a nationally notifiable disease in the US, so the BCHD and the SHD contact the **Centers for Disease Control and Prevention (CDC)** to report these cases and to request assistance in continuing the epidemiologic investigation. The PIO prepares another press release.

NOTE:

- **Q-Fever** is a zoonotic disease caused by infection with the bacterium *Coxiella burnetii*. **Humans most commonly contract Q-Fever after exposure to the organism in birthing materials of infected livestock, consumption of unpasteurized milk and milk products, or exposure to contaminated dust. Human to human transmission is unlikely.** In humans, 60% of exposed individuals do not develop symptoms. Those that become symptomatic typically suffer from acute fever accompanied by rigors, myalgia, malaise and a severe retrobulbar headache. Severe disease can include atypical pneumonia, hepatitis or meningoencephalitis. Some individuals will develop chronic infection typically resulting in endocarditis. *C. burnetii* is difficult to culture and is a potential hazard to laboratory personnel. In an outbreak situation, PCR testing would be the most rapid way of diagnosing *C. burnetii* as the causative agent (Fournier PE, 1998, 2003).
- **The primary reservoirs for *C. burnetii* are sheep, goats and cattle** and the disease is global in distribution. The bacteria are shed in very large numbers in birthing materials, but can also be shed in feces, urine or milk. Although *C. burnetii* can cause abortion in affected sheep, goats and cattle, most affected animals are asymptomatic carriers (Arricau-Bouvery N, 2005).
- **Q-Fever has been a human reportable disease in the United States since 1999 and is considered a Class B bioterrorism agent.** When *C. burnetii* is suspected in a patient, cannot be ruled out, and/or when a bioterrorism incident is suspected the following steps should be taken: Immediately contact the local infection control professional and/or hospital epidemiologist. Follow the facility protocol for prompt notification of local and state health department (CDC, 2013).

QUESTION #4

AS THE INVESTIGATION REALLY BEGINS, WHAT KIND OF INFORMATION DO YOU WANT TO PROVIDE TO THE PUBLIC ABOUT THE SITUATION AT THIS POINT AND THEIR CHANCE OF GETTING SICK?

BCHD, SHD, **State Animal Health Office (SAHO)**, Local Law Enforcement, **Federal Bureau of Investigation (FBI)**, CDC and **United States Department of Agriculture (USDA)** conduct a conference call. The decision is made to have each agency investigate the possible source of the outbreak most relevant to their area of expertise.

- BCHD, with support from SHD and CDC, will focus on the patients and explore possible foodborne and occupational sources of exposure.
- The Local Law Enforcement and the FBI will investigate possible bioterrorism or a criminal act as the source of exposure.
- SAHO, in conjunction with USDA-APHIS-VS, will investigate any link to agriculture and test the hypothesis that this outbreak is the result of airborne contamination from nearby farms.

QUESTION #7

NOW THAT Q-FEVER HAS BEEN IDENTIFIED AS THE LIKELY CAUSE OF THE OUTBREAK, WHAT FURTHER STEPS SHOULD EACH AGENCY INVOLVED WITH THE OUTBREAK INVESTIGATION TAKE?

Steps to be taken by Public Health Agencies (BCHD, SHD, CDC):

Steps to be taken by Law Enforcement Agencies (Local Law Enforcement, FBI):

Steps to be taken by Agricultural Agencies (SAHO, USDA-APHIS-VS):

QUESTION #8

AS THE INVESTIGATION GROWS AND THE PUBLIC STARTS TO WORRY, WHO MIGHT YOU INVOLVE TO HELP WITH EDUCATION ABOUT Q-FEVER?

2:00 PM

It is decided to visit all farms within a 3 mile radius upwind of the elementary school and nursing home since that is where most of the cases are clustered. A 3 mile radius is chosen based on information gathered from study of the 2007-2010 Q-Fever outbreaks in the Netherlands (Roest, 2011). SDA/BAH and USDA will also inspect farms that were visited by affected individuals within the past 30 days.

Thursday, May 24th

SAHO and USDA identify 3 active livestock producers within a 3 mile radius of the elementary school and nursing home. BCHD has also identified 2 additional farms visited by affected individuals within the last 30 days. **Veterinary Medical Officers (VMO)** from SAHO and USDA are dispatched to interview these producers.

NOTE:

The USDA does not list Q-Fever as a nationally notifiable animal disease. However, individual states may include this disease on their own list of reportable animal diseases. Each state has a State Animal Health Official that is responsible for updating and maintaining the list for their state.

If Q-Fever is notifiable in your state, the producers in this exercise can be compelled to complete a disease investigation on their facility to determine if they may have animals infected with the disease.

If Q-Fever is not notifiable in your state, the producers may have the right to refuse an investigation. Therefore, the SAHO could not force producers to participate in interviews or any kind of testing on their premises. While some producers may be willing to cooperate in the interest of learning the source of infection and controlling the outbreak, others may be more concerned about the possible liability if their farm is implicated in the human outbreak and refuse to speak to the VMOs. If this is the case, it is important to work with your state public health officials, as if the facility is suspected of being linked to a human disease outbreak the producers could be compelled to collaborate in the investigation.

In many cases states do not have the authority to compel farmers to have their animals tested, but they could have the authority to quarantine animals when they believe there is a dangerously contagious or infectious disease present. However, this would not be done without the possibility of defining the terms for quarantine release (such as eradicating the pathogen from the farm). This would be a major issue in this case because it would be impossible to decontaminate the premises adequately and eliminate *C. burnetti* from the farm; therefore, it would be very unlikely to establish a quarantine.

QUESTION #9

WHAT QUESTIONS SHOULD SAHO ASK LOCAL LIVESTOCK PRODUCERS (ASSUMING THEY ARE REQUIRED OR WILLING TO SPEAK WITH THE VMO)?

Friday, May 25th

No new cases are reported today.

SAHO field staff have identified a sheep farm (Farm A) located 0.5 miles west of Northside Elementary School and Greis Nursing Home that had an unusually high rate of abortion in the flock in February. At that time fetuses were sent to State Animal Disease Diagnostic Laboratory and *Coxiella burnetti* was identified as the cause. At the time, no restrictions were placed on the farm and veterinary instructions encompassed management of abortion cases and occupation safety instructions. Placentas and other birthing materials were collected with manure from the barn and placed in a manure storage area on the farm. Farm A has 300 sheep on premises, and they do not receive visitors or take out the animals for exhibition purposes. They also do not directly sell milk or milk products. However, the owner of the sheep farm reports spreading untreated manure on his fields on April 30th. These fields are in close proximity and upwind from the Elementary school and nursing home (See Appendix C).

QUESTION #10

NOW THAT THE VMOs HAVE COMPLETED THEIR FARM EVALUATION, WHAT SHOULD BE THE NEXT STEP(S)?

3:00 PM

Serum and fecal samples are submitted to the State Animal Disease Diagnostic Lab for testing.

Sunday, May 27th

The health department is finishing the second round of interviews with infected individuals using the Q-Fever Interview Survey and beginning to compile and analyze the data they have collected. No food source has been linked to the cases nor have any of the patients recently visited a farm or agricultural fair. In addition none of the cases have agricultural ties or work with animals.

Local Law Enforcement and/or the FBI Weapons of Mass Destruction coordinator conclude the Threat Credibility Evaluation. No method of dispersal has been identified, no credible threats were made and no individual or group has stepped forward to claim responsibility. They concluded this event was an unlikely bioterrorism incident.

The hospital reports one new case today (The distribution of cases as well as the location of the nursing home and school is shown in Appendix C).

The SDA/BAH reports that 45% of serum samples from the sheep tested at the state lab are positive for *C. burnetii*.

QUESTION #11

WHAT DO YOU THINK HAPPEN?

QUESTION #12

NOW THAT A POTENTIAL SOURCE HAS BEEN IDENTIFIED, WHAT PREVENTION AND CONTROL MEASURES WOULD YOU RECOMMEND AT THIS TIME (FOR BOTH HUMAN AND ANIMAL)?

Public Health Response and Prevention Messaging

Agricultural Response

NOTE:

Be aware when disclosing the potential source of this outbreak as there is currently no practical or readily available way to type *C. burnetti*, outside of research settings. Therefore, it might be impossible (or will take a major effort and extended period) to definitively link the human infections to the outbreak on the sheep farm by molecular epidemiological methods.

NOTE:

The following link discusses the USEPA's policies for manure management <http://www.epa.gov/ghgreporting/subpart-ij-manure-management>. However, state and local regulations can vary so it is recommended to be familiar with the local area's environmental policies when investigating health concerns related to manure management.

SCENARIO WRAP-UP

This scenario was presented to illustrate the importance of co-operation between human and veterinary health officials to uncover the source of an outbreak of a zoonotic disease in humans. This scenario was loosely based on a massive outbreak of Q-Fever which occurred in the Netherlands, where 4,026 human cases were identified (Schneeberger, 2014). From 2007 to 2010 this outbreak was associated with the windborne spread of contaminated dust into nearby communities from affected dairy goat farms. The outbreak was finally brought under control by removing (culling) all pregnant goats on affected farms (>50,000), restricting movement of goats and human visitors to such farms, vaccination of goats and requiring all manure be plowed into soil immediately after it was spread. **This outbreak took 3 years to bring under control due in large part to the fact that human public health officials were not aware of the ongoing Q-Fever outbreak on the dairy goat farms due to limited communication with veterinary public health officials** (Roest, 2011a). This scenario also illustrated the appropriate response to a potential bioterrorism attack. Approximately 70% of all bioterrorism agents are zoonotic in nature and many occur naturally in the United States. When a potential bioterrorism attack occurs, it is important to be familiar with the appropriate steps to investigate the outbreak keeping present during such process the possible connection to a bioterrorism attack. In conclusion, this scenario was developed to illustrate the importance of co-operation between human and veterinary health officials to uncover the source of an outbreak of a zoonotic disease in humans.

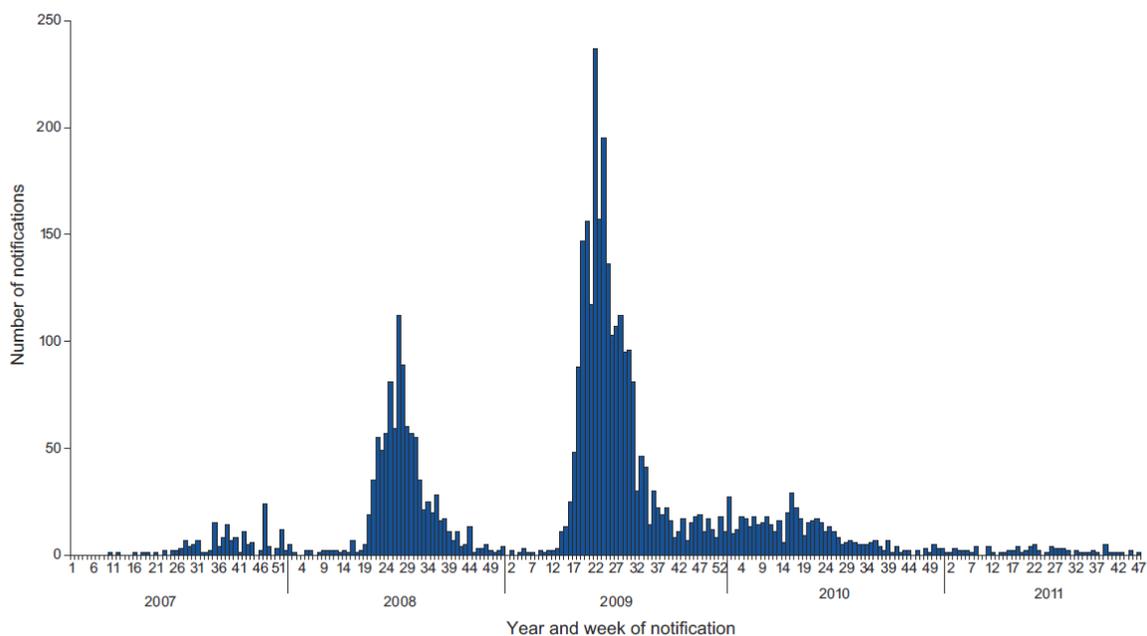


Fig. 2. Acute Q fever notifications, the Netherlands, 1 January (week 1) 2007 – 30 November (week 48) 2011.
Déclaration de fièvre Q aux Pays-Bas, du 1 janvier (semaine 1) 2007 – au 30 novembre (semaine 48) 2011.

Appendix A

Steps in an outbreak investigation:

- 1 • Prepare for Field Work
- 2 • Establish the Existence of an Outbreak
- 3 • Verify the Diagnosis
- 4 • Define and Identify Cases
- 5 • Describe and Orient the Data in Terms of Time, Place, and Person
- 6 • Develop hypotheses
- 7 • Evaluate Hypotheses
- 8 • Refine Hypotheses and Carry Out Additional Studies
- 9 • Implement Control and Preventive Measures
- 10 • Communicate Findings

More information can be found at: Epidemiology in the Classroom:

<http://www.cdc.gov/EXCITE/classroom.html>

Appendix B

Q-Fever Information

Q-Fever is a zoonotic disease caused by infection with the bacterium *Coxiella burnetii*. Humans most commonly contract Q-Fever after exposure to the organism in birthing materials of infected livestock, consumption of unpasteurized milk and milk products, or exposure to contaminated dust. Human to human transmission is unlikely. In humans, 60% of exposed individuals do not develop symptoms. Those that become symptomatic typically suffer from acute fever accompanied by rigors, myalgia, malaise and a severe retrobulbar headache. Severe disease can include atypical pneumonia, hepatitis or meningoencephalitis. Some individuals will develop chronic infection typically resulting in endocarditis. *C. burnetii* is difficult to culture and is a potential hazard to laboratory personnel. Diagnosis in humans is made by identification of a fourfold increase in IgG titer to phase II antigen in paired sera. An IgG titer of > or = 1:128 for phase II antigen is considered supportive of a diagnosis of Q-Fever (CDC, 2012). It should be noted that antibody titers may not be positive for up to two weeks after onset of clinical signs. **In an outbreak situation, PCR testing would be the most rapid way of diagnosing *C. burnetii* causative agent** (Fournier PE, 1998 & 2003).

The primary reservoirs for *C. burnetii* are sheep, goats and cattle and the disease is global in distribution. The bacteria are shed in large numbers in birthing materials but can be shed in feces, urine or milk. Although *C. burnetii* can cause abortion in affected sheep, goats and cattle, most affected animals are asymptomatic carriers (Arricau-Bouvery N, 2005).

Q-Fever has been a human reportable disease in the United States since 1999 and is considered a Class B bioterrorism agent. When *C. burnetii* is suspected, cannot be ruled out, and/or **when a bioterrorism incident is suspected the following steps should be taken: Immediately contact the local infection control professional (ICP) and/or hospital epidemiologist.** Follow the facility protocol for prompt notification of local and state health department epidemiologists or health officers (CDC, 2013).

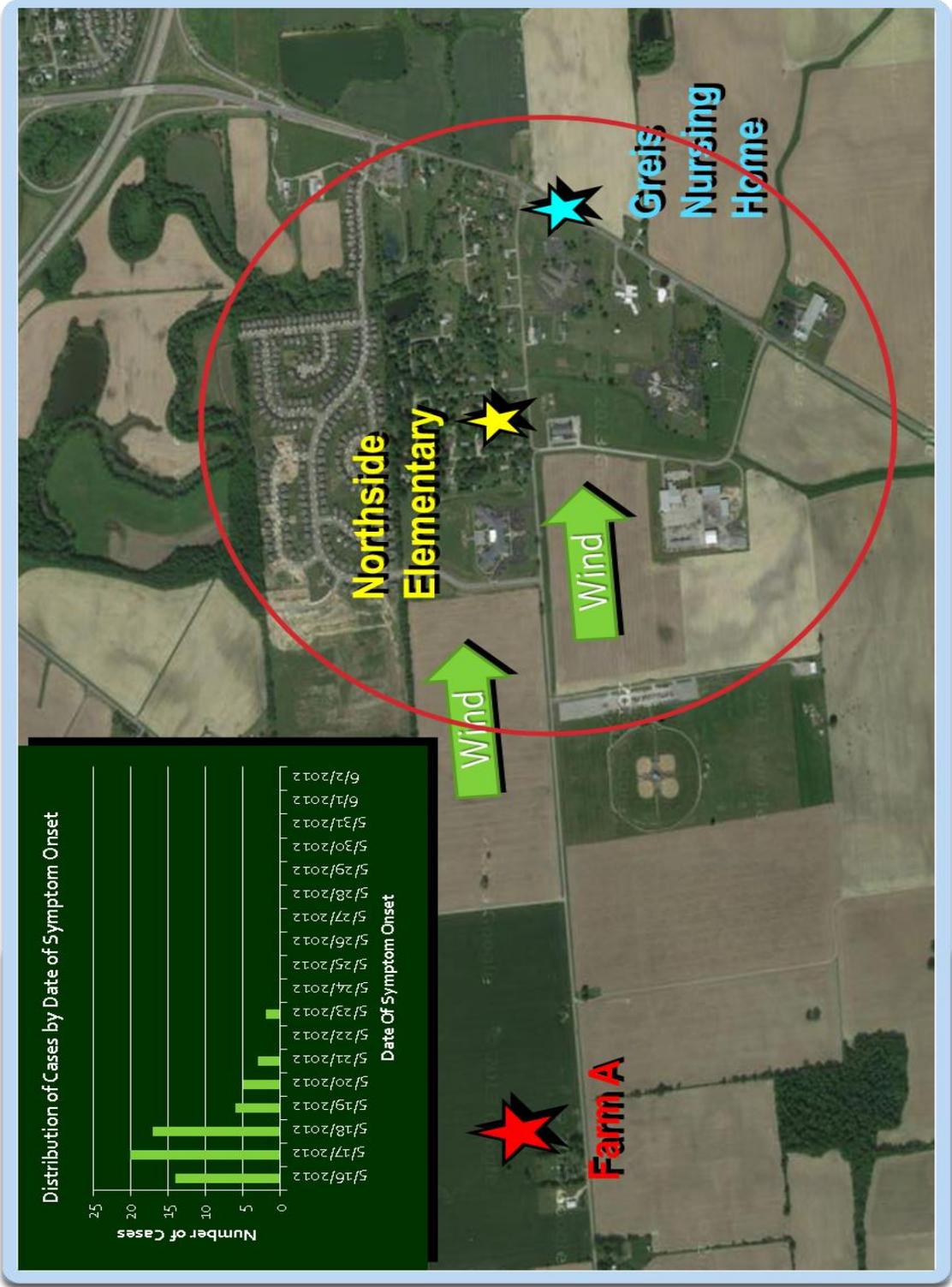
The CDC's case report form can be found at:

http://www.cdc.gov/qfever/pdfs/qfevercasereport_2010.pdf.

Between 120-150 cases are reported every year with hospitalization rates approaching 50%. Three to five cases of acute or chronic Q-Fever are reported in Ohio each year. However, it is likely that mild Q-Fever infections that do not require hospitalization go unrecognized and are therefore, under-reported in current national surveillance systems. Most cases occur in the spring and summer and seven states (California, Colorado, Illinois, Kentucky, Missouri, Tennessee and Texas) account for more than 50% of cases every year (CDC, 2012).

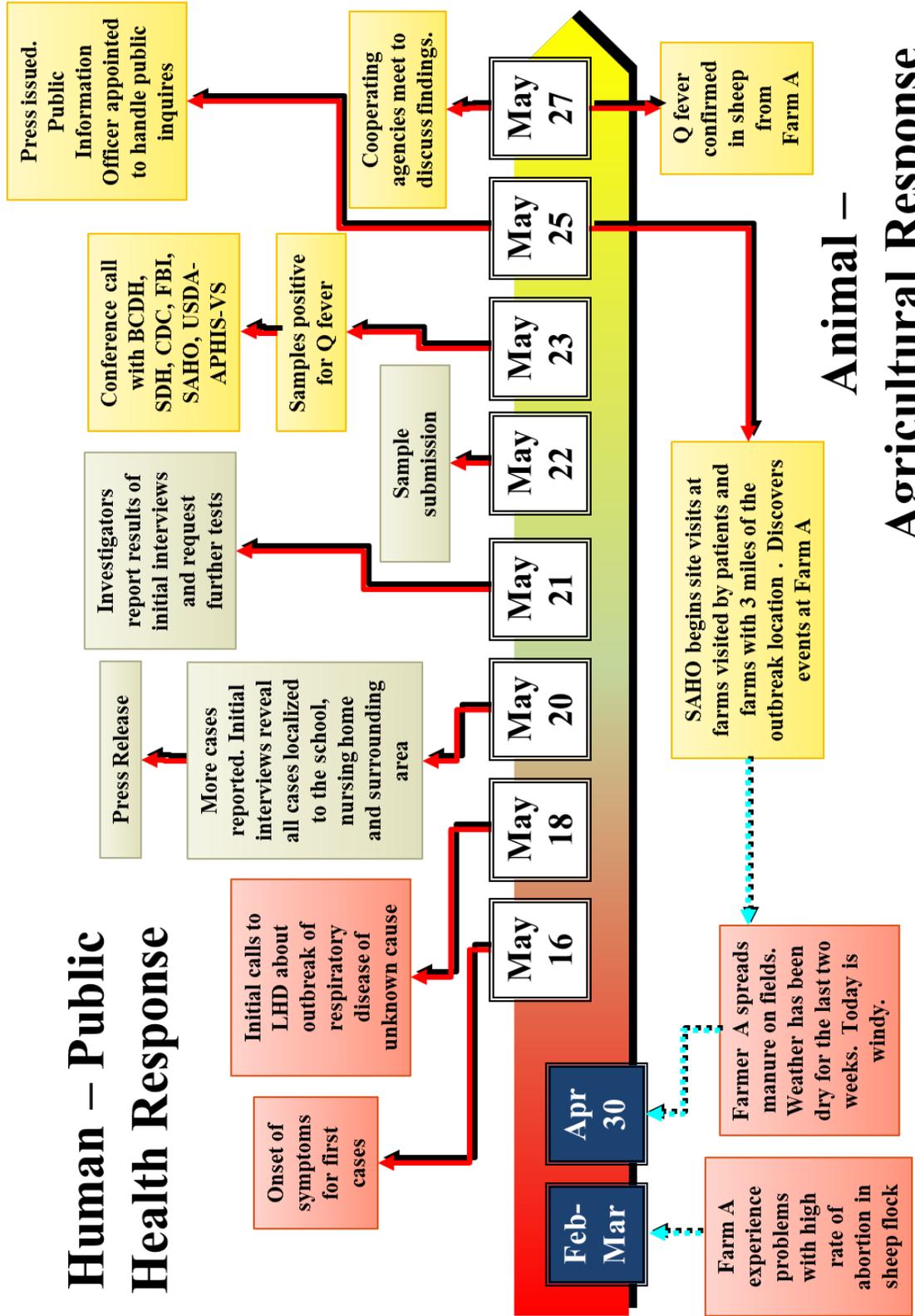
Class B bioterrorism agents are considered the second highest priority because they are moderately easy to disseminate, result in moderate morbidity and low mortality rates and require specific enhancements of the CDC's diagnostic capacity and enhanced disease surveillance. An outbreak of a Class B Bioterrorism agent would trigger an investigation by law enforcement officials (CDC, 2012).

Appendix C



Appendix D

Human – Public Health Response



Animal – Agricultural Response

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