



Trichinellosis (also known as Trichinosis)

Disease Plan

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Last updated: October 13, 2015, by Laine McCullough

Questions about this disease plan?

Contact the Utah Department of Health Bureau of Epidemiology: 801-538-6191.

✓ WHY TRICHINELLOSIS IS IMPORTANT TO PUBLIC HEALTH?

Trichinella is a parasite that is found worldwide, most commonly in parts of Europe and the United States (U.S.). The parasite is found in the meat of pigs and wild animals, and when ingested, causes the infection trichinellosis, also known as trichinosis. Worldwide, an estimated 10,000 cases of trichinellosis occur every year. In the U.S., trichinellosis cases are reported much less commonly now than in the past, due in part to improved pig-raising practices in the pork industry, commercial and home freezing of pork, and public awareness of the danger of eating raw or undercooked meat products. Between 2008-2010, an average of 20 cases were reported each year to the Centers for Disease Control and Prevention (CDC). Typically, Utah has less than one case reported each year. Outbreaks occur in settings where multiple people consume the same *Trichinella*-infected meat. Trichinellosis is not transmitted person-to-person, but serious illness can occur. Correct diagnosis and interview of ill persons is crucial in identifying sources of illness and other potential cases, and in preventing additional cases and outbreaks.

✓ DISEASE AND EPIDEMIOLOGY

Clinical Description

The clinical illness of a trichinellosis infection is highly variable and can range from asymptomatic infection to a fulminating, fatal disease, depending on the number of larvae ingested. As a result, most infections in the U.S. are asymptomatic. *Trichinella* infection can be divided into two phases in the human host: enteral (intestinal) and parenteral (muscular). The enteral phase symptoms can occur 1-2 days after infection and usually last from 2-7 days, though they can persist for weeks. Nausea, diarrhea, vomiting, and abdominal pain are among the first symptoms of trichinellosis. Soreness and pain with edema of the upper eyelids, photophobia, and eye swelling can occur.

Headache, fever, chills, cough, eye swelling, aching joints and muscle pain, itchy skin, or continued gastrointestinal symptoms follow the first symptoms and correspond to the parenteral phase of acute illness. During this time, the larval parasites invade the muscle, which stimulates inflammatory and allergic responses. The entire acute phase can last one to eight weeks, but can also be asymptomatic, especially if the number of infective larvae ingested is low. If the infection is heavy, patients may experience difficulty coordinating movements and have heart and breathing problems in the third to sixth week due to larvae invading the heart or lung tissue, respectively. For mild to moderate infections, most symptoms subside within a few months. In the most severe cases, death due to myocardial failure may occur in either the first to second week, or between the fourth and eighth weeks.

Causative Agent

Trichinellosis is an infection caused by nematodes (roundworms) of the genus *Trichinella*. There are several species of *Trichinella* that are capable of causing infection in mammals, but *T. spiralis* is the most common cause of human infection.

The muscle of infected animals contains encysted larvae. When humans ingest undercooked infected meat, the larvae are released from the cysts after exposure to gastric acid and pepsin. The larvae then invade the intestinal mucosa where they mature into adult worms. After one week, the fertilized females release larvae for up to five weeks. This stage may be asymptomatic, or may be accompanied by gastrointestinal symptoms. The newly released larvae migrate to striated muscles where they encyst. As larvae enter skeletal muscles, muscle pain, tenderness, swelling, and weakness develop.



Larva of *Trichinella* liberated from bear meat
(CDC Photo, 2013)

Differential Diagnosis

The differential diagnosis for trichinellosis includes gastroenteritis, muscular rheumatism, visceral larva migrans, strongyloidiasis, cysticercosis, dermatomyositis, and sarcocystosis.

Laboratory Identification

Antibodies to *Trichinella* are usually not detectable until after three or more weeks of infection, so are not useful for early diagnosis. A variety of techniques exist to measure antibody levels, including enzyme-linked immunosorbent assays (ELISAs), indirect immunofluorescence (IFA), and latex agglutination. Serology is generally reliable, and results can be confirmed with a Western blot. Testing paired acute and convalescent serum specimens is usually diagnostic. Skin tests for *Trichinella* may remain positive for several years after infection, and therefore cannot differentiate between current or past infection. Muscle biopsies are usually unnecessary; however, they can be performed to confirm the diagnosis.

UPHL: The Utah Public Health Laboratory (UPHL) does not perform testing for *Trichinella*. ARUP does perform testing for *Trichinella* using an ELISA test.

Treatment

Albendazole or mebendazole should be given as early in the course of illness as possible; both are beneficial in the intestinal stage and in the muscular stage, though treatment may not completely eliminate the infection and associated symptoms once larvae have become established in skeletal muscle cells. If treatment is not initiated within the first several days of infection, more prolonged or repeated courses of treatment may be necessary. Albendazole and mebendazole are not approved for use in pregnant women or children under the age of two years.

In rare situations where infected meat is known to have been consumed, prompt administration of anthelmintic treatment may prevent the development of symptoms. Corticosteroids can be lifesaving in severe cases when the central nervous system or heart is involved; however, they delay elimination of adult worms from the intestine.

Drug	Adult and pediatric dose
Albendazole	400 mg twice a day by mouth for 8 to 14 days
Mebendazole	200 to 400 mg three times a day by mouth for 3 days, then 400 to 500 mg three times a day by mouth for 10 days

For additional information regarding treatment for trichinellosis, see:

http://www.cdc.gov/parasites/trichinellosis/health_professionals/index.html#tx.

Case Fatality

Mortality among persons infected with *Trichinella* is not common, but may occur.

Reservoir

Pigs, dogs, cats, horses, rats, and many wild animals such as bear, wolf, wild boar, fox and Arctic marine mammals can serve as reservoirs for *Trichinella*.

Transmission

Trichinellosis is acquired by eating raw or insufficiently cooked meat containing viable encysted larvae. Historically, pork and pork products were the most likely source. Beef products, which may inadvertently become contaminated with raw pork during processing, can also be a source. However, since the discontinuation of feeding raw-meat garbage to hogs, the adoption of commercial and home freezing of pork, and public awareness of the danger of eating raw or undercooked pork products, cases in the U.S. are less commonly associated with pork products and are more often associated with eating raw or undercooked wild game meats. There is no person-to-person spread of trichinellosis.

The minimum infectious dose causing disease in humans is not clearly defined. It is estimated that ingestion of between 100 and 300 larvae of *Trichinella spiralis* can cause disease, and that intake between 1,000 and 3,000 or more larvae causes severe disease.

Susceptibility

All people are susceptible. People who ingest raw or undercooked meat, especially pork and wild animal meat, are at an increased risk for infection. Infection results in only partial immunity.

Incubation Period

Gastrointestinal symptoms (enteral phase) may appear within a few days of exposure. Systemic symptoms (parenteral phase) usually appear about 8-15 days after ingestion of infected meat; this varies from 5-45 days, depending on the number of parasites involved.

Period of Communicability

Trichinellosis is not transmitted directly from person-to-person. Animal hosts remain infective for months, and their meat stays infective for appreciable periods unless cooked, frozen, or irradiated to kill the larvae.

Epidemiology

Trichinellosis occurs worldwide and affects people of all ages. Countries where *Trichinella* sp. infections cannot develop for the lack of potential reservoirs have very low case numbers, and infections of humans only occur accidentally upon the importation of *Trichinella*-infected meat.

Trichinella infection in humans is strongly associated with the consumption of raw or undercooked meat. Historically, pork has been a main source of human infection, but changes in pig-raising practices, among other interventions, has contributed to the decrease in cases acquired from pork. Common sources of infection now stem from ingestion of meats other than pork, such as venison, horse meat, and particularly meats from wild carnivorous or omnivorous game (bear, boar, seal, and walrus). Outbreaks can occur when individuals eat the same contaminated meat.

From 2009-2014, there has been an average of less than one case of trichinellosis reported each year in Utah. Common exposures include eating undercooked wild game meat.

✓ PUBLIC HEALTH CONTROL MEASURES

Public Health Responsibility

- Investigate all cases of disease; complete and submit appropriate disease investigation forms.
- Provide education to the general public, clinicians, and first responders regarding disease transmission and prevention.
- Identify cases and sources to prevent further transmission.
- Identify clusters or outbreaks of this disease and determine the source.

Prevention

Personal Preventive Measures/Education

To avoid trichinellosis, individuals should be made aware of the following:

- The best way to prevent trichinellosis is to cook meat to safe temperatures. A food thermometer should be used to measure the internal temperature of cooked meat. Do not sample meat until it is cooked. USDA recommends the following for meat preparation:

Type of Meat	Cooking Guidelines
Whole Cuts of Meat (excluding poultry and wild game)	Cook to at least 145° F (63° C) as measured with a food thermometer placed in the thickest part of the meat, then allow to rest* for three minutes before carving or consuming
For Ground Meat (including wild game, excluding poultry)	Cook to at least 160° F (71° C); ground meats do not require a rest* time
All Wild Game (whole cuts and ground)	Cook to at least 160° F (71° C)
All Poultry (whole cuts and ground)	Cook to at least 165° F (74° C), and for whole poultry, allow the meat to rest* for three minutes before carving or consuming

*According to USDA, "A 'rest time' is the amount of time the product remains at the final temperature, after it has been removed from a grill, oven, or other heat source. During the three minutes after meat is removed from the heat source, its temperature remains constant or continues to rise, which destroys pathogens."

- Wash your hands with warm water and soap after handling raw meat.
- Freezing pork less than 6 inches thick for 20 days at 5°F will kill the larvae, but freezing wild game meats may leave some larvae alive.
- Grind pork in a separate grinder, and thoroughly disinfect the grinder between uses.
- Meat products should be processed by heating, freezing, or irradiating prior to drying or smoking for jerky.
- Cook any meat fed to pigs or to other animals.
- Pigs should not be allowed to eat uncooked carcasses of other animals, including rats, which may be infected with trichinellosis.
- Be aware that curing (salting), drying, smoking, or microwaving meat does not consistently kill infective larvae.
- Individuals known to have recently ingested the same product as a case being investigated for trichinellosis should be treated.

Chemoprophylaxis

None.

Vaccine

None.

Isolation and Quarantine Requirements

Isolation: N/A

Hospital: N/A

Quarantine: N/A

✓ CASE INVESTIGATION

Reporting

Report any illness to public health authorities that meets any of the following criteria:

1. A person with demonstration of *Trichinella* larvae in tissue obtained by biopsy and any of the following: fever, myalgia, periorbital edema, or eosinophilia.
2. A person with a positive serologic test for *Trichinella* and any of the following: fever, myalgia, periorbital edema, or eosinophilia.
3. A person who shared an epidemiologically implicated meal, or ate an epidemiologically-implicated meat product, and has a clinically compatible illness, without laboratory confirmation.
4. A person with a clinically compatible illness associated with an epidemiologically compatible exposure for which no human serum/tissue is available, but for which the parasite can be demonstrated in the epidemiologically-implicated meat or meal.

Reporting Table:

Table of criteria to determine whether a case should be reported to public health authorities

Criterion	1	2	3	4
<i>Clinical Evidence</i>				
Fever	O	O	O	O
Myalgia	O	O	O	O
Periorbital edema	O	O	O	O
Eosinophilia	O	O	O	O
<i>Laboratory Evidence</i>				
Positive serologic test for <i>Trichinella</i>		N		
Demonstration of <i>Trichinella</i> larvae in tissue obtained by muscle biopsy	N			
<i>Trichinella</i> larvae detected in epidemiologically implicated meat product or meal				N
<i>Epidemiological Evidence</i>				
Consumption of an epidemiologically implicated meat product or meal			N	N

Notes:

N = All "N" criteria in the same column are Necessary to report a case.

O = At least one of these "O" (Optional) criteria in each category (e.g., clinical evidence and laboratory evidence) in the same column—in conjunction with all "N" criteria in the same column—is required to report a case.

Disease-Specific Data Elements:

Disease-specific data elements to be included in the initial report are listed below.

Epidemiological risk factors

- History of recent consumption of raw or undercooked pork or wild game meats.
- History of consumption of an epidemiologically-implicated meat product.

Case Definition

Trichinellosis (2014)

Clinical Description

A disease caused by ingestion of *Trichinella* larvae, usually through consumption of *Trichinella*-containing meat—or food contaminated with such meat—that has been inadequately cooked prior to consumption. The disease has variable clinical manifestations. Common signs and symptoms among symptomatic persons include eosinophilia, fever, myalgia, and periorbital edema.

Laboratory Criteria for Diagnosis (Human specimens)

- Demonstration of *Trichinella* larvae in tissue obtained by biopsy, OR
- Positive serologic test for *Trichinella*

Laboratory Criteria for Diagnosis (Food specimens)

- Demonstration of *Trichinella* larvae in the food item (probable)

Case Classification

Confirmed:

A clinically compatible illness that is laboratory confirmed in the patient.

Probable:

A clinically compatible illness in a person who shared an epidemiologically-implicated meal or ate an epidemiologically-implicated meat product.

A clinically compatible illness in a person who consumed a meat product in which the parasite was demonstrated.

Suspect:

Instances where there is no clinically compatible illness should be reported as suspect if the person shared an epidemiologically-implicated meal, or ate an epidemiologically-implicated meat product, and has a positive serologic test for trichinellosis (and no known prior history of *Trichinella* infection).

Comments:

Epidemiologically-implicated meals or meat products are defined as a meal or meat product that was consumed by a person who subsequently developed a clinically compatible illness that was laboratory confirmed.

Negative serologic results may not accurately reflect disease status if blood was drawn less than 3-4 weeks from symptom onset (Wilson et. al, 2006).

Epidemiologic Linkage

Persons who shared the implicated meat/meal should be investigated and considered for case status as described above.

Criteria to distinguish a new case of this disease or condition from reports or notifications which should not be enumerated as a new case for surveillance

Serial or subsequent cases of trichinellosis experienced by one individual should only be counted if there is an additional epidemiologically compatible exposure. Because the duration of antibodies to *Trichinella* spp. is not known, mere presence of antibodies without a clinically-compatible illness AND an epidemiologically compatible exposure may not indicate a new infection, especially among persons with frequent consumption of wild game that is known to harbor the parasite.

Case Classification Table

Criteria for defining a case of trichinellosis

Criterion	Confirmed	Probable		Suspect
	1	1	2	1
<i>Clinical Evidence</i>				
Fever	O	O	O	A
Myalgia	O	O	O	A
Periorbital edema	O	O	O	A
Eosinophilia	O	O	O	A
<i>Laboratory Evidence</i>				
Positive serologic test for <i>Trichinella</i>	O	A	A	N
Demonstration of <i>Trichinella</i> larvae in tissue obtained by muscle biopsy	O	A	A	
<i>Trichinella</i> larvae detected in epidemiologically implicated meat product or meal			N	
<i>Epidemiologic Evidence</i>				
Consumption of an epidemiologically implicated meat product or meal		N	N	N
<i>Criteria to Distinguish a New Case</i>				
No prior history of trichinellosis, unless separate epidemiologically compatible exposures can be documented				N

Notes:

N = All "N" criteria in the same column are Necessary to classify a case. A number following an "N" indicates that this criterion is only required for a specific disease/condition subtype (see below).

A = This criterion must be absent (e.g., NOT present) for the case to meet the classification criteria.

O = At least one of these "O" (Optional) criteria in each category (e.g., clinical evidence and laboratory evidence) in the same column—in conjunction with all "N" criteria in the same column—is required to classify a case. (These optional criteria are alternatives, which mean that a single column will have either no O criteria or multiple O criteria; no column should have only one O.) A number following an "O" indicates that this criterion is only required for a specific disease/condition subtype.

Case Investigation Process

All probable and confirmed cases should be interviewed with the trichinellosis case report form to determine the source of the infection. Family members and persons who have eaten meat suspected as the source of infection should also be evaluated. Any remaining suspected food should be disposed of.

Outbreaks

CDC defines a food-borne outbreak as, "an incident in which two or more persons experience a similar illness resulting from the ingestion of a common food." Outbreaks of trichinellosis should be investigated to determine the source of infection. A common vehicle (e.g., food derived from pork or game meat) should be sought, and applicable preventive or control measures should be instituted (e.g., removing an implicated food item from the environment) in any identified outbreak investigation. Infected herds of swine should be eliminated.

Identify Case Contacts

Contacts of trichinellosis cases may include household members or persons who have eaten meat suspected as the source of infection. These contacts may be identified through interview of the case-patient, or through physician notes.

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✓ VERSION CONTROL

Updated December 2014 – CSTE case definition and case classification swim lanes included.

Updated August 2015 – "Why is Trichinosis Important to Public Health" section added. "Clinical Description" section updated. "Causative Agent" section updated to include biological mechanisms. "Differential Diagnosis" section updated to include specific diseases. "Laboratory Identification" updated to include specific local testing practices for Trichinellosis. "Treatment" updated to account for new treatment options. "Transmission" updated to include infectious dose. "Incubation Period" updated to include information on two phases. "Epidemiology" section updated to include Utah trends and common sources of infection. CSTE reporting criteria and swim lanes included. "Case Investigation Process" prompts evaluation of contacts. "Outbreaks" updated to include control measures. "Identify Case Contacts" section updated and separated "Acknowledgements," "Version Control," and "Minimum Data Set" sections added.

Updated October 2015 – "Treatment" and "Prevention" sections updated with graphs from the CDC.

✓ UT-NEDSS Minimum/Required Fields by Tab

Demographic

- Last Name
- First Name
- State
- County
- Date of Birth
- Area Code
- Phone Number
- Birth Gender
- Ethnicity
- Race

Clinical

- Disease
- Onset Date
- Date Diagnosed
- Died
- Date of Death
- Did the patient have symptoms?
 - (if yes) Photophobia
 - (if yes) Myalgia
 - (if yes) Periorbital edema
 - (if yes) Nausea
 - (if yes) Vomiting
 - (if yes) Abdominal pain
 - (if yes) Diarrhea
 - (if yes) Fever
 - (if yes) Specify temperature:

Laboratory

- Were laboratory tests performed?
 - (if yes) Antibody/antigen detection
 - (if yes) Test result:
 - (if yes) CBC with differential
 - (if yes) Does patient have eosinophilia (elevated eosinophils)?
 - (if yes) Muscle biopsy
 - (if yes) Test result:
- Was suspect food examined for larvae?
 - (if yes) Specify food examined:
 - (if yes) Were larvae present or absent

Contacts

- Any contacts ill with similar symptoms?

Epidemiological

- Imported From
- Risk Factors
- Risk Factor Notes

Investigation

- Date 45 days before disease onset:
- Date 5 days before disease onset:
- Did the patient travel outside the USA during the exposure period?
 - (if yes) Describe travel (location, dates, mode, if others were ill, etc.):
- Did the patient travel outside Utah, but inside the USA during the exposure period?
 - (if yes) Describe travel (location, dates, mode, if others were ill, etc.):
- Did the patient eat any pork during the exposure period?
- Did the patient eat any non pork meat during the exposure period?
- If yes was answered to any of the previous two meat questions, the following questions must be asked:
 - Specify type:
 - Specify details on type of pork:
 - Date non pork was consumed:
 - Where did the patient obtain the non pork?
 - Specify details on where non pork was obtained (dates, locations, etc.):
 - How was the non pork processed after purchasing?
 - Specify processing details:
 - What was the method of cooking for the non pork?
 - Specify cooking details

Reporting

- Date first reported to public health

Administrative

- State Case Status (completed by UDOH)
- Outbreak Associated
- Outbreak Name