



Francisella tularensis (Tularemia)

Fact Sheet

Unless otherwise noted, all information presented in this article is derived from Dennis DT, Inglesby TV, Henderson DA, et al., for the Working Group on Civilian Biodefense. Tularemia as a biological weapon: medical and public health management. *JAMA*. 2001;285:2763-2773.

Background

Naturally occurring tularemia is a zoonotic disease caused by the bacterium *Francisella tularensis*, which is a hardy organism capable of surviving for weeks at low temperatures in water, moist soil, hay, straw, or decaying animal carcasses.

There are 4 subspecies of *F. tularensis*: *F. tularensis* subsp. *tularensis* (Type A), which is the most common type in North America, and is highly virulent in humans and animals; *F. tularensis* subsp. *Holarctica* (Type B), a less virulent type, responsible for human tularemia infection in Europe and Asia as well as North America; *F. tularensis* subsp. *novocida*, another less virulent type; and *F. tularensis* subsp. *mediaasiatica*, which is also of low virulence.

Small mammals such as voles, mice, squirrels, and rabbits are natural reservoirs for *F. tularensis*. These animals acquire tularemia through bites from ticks, fleas, and mosquitoes and also through contact with contaminated environments. Naturally acquired human infection can occur through bites from infected arthropods (usually ticks); contact with infected animal tissues or fluids; direct contact with or ingestion of contaminated water, food, or soil; or inhalation of aerosolized bacteria. Naturally acquired human infection tends to occur predominately in rural areas. *F. tularensis* is so infectious that simply opening a laboratory culture plate without adequate protective equipment can lead to infection.

Tularemia as a Biological Weapon

F. tularensis is considered to be a serious potential bioterrorist threat because it is one of the most infectious pathogenic bacteria known—inhalation of as few as 10 organisms can cause disease—and it has substantial capacity to cause serious illness and death. The bacterium was developed into an aerosol biological weapon by several countries in the past.

Aerosol dissemination of *F. tularensis* in a populated area would be expected to result in the abrupt onset of large numbers of cases of acute, nonspecific respiratory febrile illness beginning 3 to 5 days later. (See “The History of Bioterrorism: Tularemia,” a short video from the Centers for Disease Control and Prevention [CDC], available at <http://www.bt.cdc.gov/training/historyofbt/07tularemia.asp>.)

A World Health Organization (WHO) expert committee reported in 1970 that if 50 kg (110 pounds) of virulent *F. tularensis* was dispersed as an aerosol over a metropolitan area with a population of 5 million, there would be an estimated 250,000 incapacitating casualties, including 19,000 deaths.

Transmission

Human-to-human transmission is not known to occur.

Infection Control Measures

Since tularemia is not spread from person to person, it is not necessary to place patients diagnosed with tularemia in isolation.

Illness

Symptoms of tularemia depend on the virulence of the bacterial strain and route of infection. Symptoms of all forms of tularemia typically include fever, headache, body aches, and malaise. Symptoms usually develop within 3 to 5 days of infection; however, the incubation period can be 1 to 14 days. Naturally occurring tularemia infection can take several forms, as outlined in the table below. Pneumonic tularemia (the form expected from an aerosol release) is likely to cause typical symptoms of pneumonia (eg, fever, cough, and shortness of breath). Definitive diagnosis requires confirmation by laboratory testing.

Clinicians who suspect tularemia should promptly obtain blood and other cultures, as appropriate, and alert the laboratory to the need for special diagnostic and safety procedures. *F. tularensis* may be identified through direct examination of secretions, exudates, or biopsy specimens using Gram stain, direct fluorescent antibody, or immunohistochemical stains. It can be grown from pharyngeal washings, sputum specimens, and even fasting gastric aspirates in a high proportion of patients with inhalational tularemia. It is only occasionally isolated from blood. Rapid diagnostic tests are not widely available; ancillary confirmatory testing via microscopic demonstration of *F. tularensis* using fluorescent-labeled antibodies is a rapid diagnostic procedure performed in designated reference laboratories in the National Public Health Laboratory Network. Test results can be available within several

hours if the laboratory is alerted and prepared. Growth of *F. tularensis* in culture is the definitive means of confirming the diagnosis and usually takes 24 to 48 hours in ideal conditions. However, in some instances, growth of the bacteria can be delayed up to 10 days.

The overall case fatality rate for untreated infections with Type A strains has been 5% to 15%, but in pneumonic or septic cases, without antibiotic treatment, the fatality rate has been as high as 30% to 60%. With treatment, the most recent fatality rates in the U.S. have been 2%.

Prophylaxis and Treatment

Early antibiotic therapy is recommended for persons exposed to or infected with tularemia. Tetracyclines (eg, doxycycline), fluoroquinolones (eg, ciprofloxacin), and aminoglycosides (eg, streptomycin and gentamicin) are all effective treatments and

doxycycline or a fluoroquinolone can be used for prophylaxis after high risk exposure. Following a biological attack, treatment recommendations would depend on antibiotic susceptibility of the strain of bacteria used in the attack.

Since person-to-person transmission is not known to occur, post-exposure prophylaxis of close contacts with persons infected with tularemia is unnecessary.

Countermeasures

In the U.S., a live-attenuated vaccine derived from the avirulent live vaccine strain (LVS) developed by the Department of Defense (DoD) was used to protect laboratory personnel routinely working with *F. tularensis* and military high-risk personnel. The vaccine does not provide a high degree of protection from inhalational infection and is not currently in use.

Tularemia: Forms, Routes of Infection, and Symptoms

Form	Typical route of infection	Symptoms
Ulceroglandular	Handling contaminated carcasses or a bite from an infected arthropod	<ul style="list-style-type: none"> Formation of an ulcer at the site of infection followed by swollen and painful regional lymph glands
Glandular	Handling contaminated carcasses or a bite from an infected arthropod	<ul style="list-style-type: none"> Swollen and painful lymph glands without the development of ulcers
Oculoglandular	Direct contamination of the eye with <i>F. tularensis</i>	<ul style="list-style-type: none"> Pain, redness, swelling, and discharge of the eyes Development of an ulcer on the inside of the eyelid in some cases
Oropharyngeal	Eating or drinking contaminated food or water; inhaling aerosolized <i>F. tularensis</i>	<ul style="list-style-type: none"> Sore throat or tonsillitis Vomiting and diarrhea Possible swelling of the glands in the neck
Pneumonic	Inhaling aerosolized <i>F. tularensis</i> ; or secondary spread to lungs from another site of infection	<ul style="list-style-type: none"> Sore throat and swelling of the lymph nodes in the lungs Sudden fever, chills, headache, muscle aches, joint pain, dry cough, and progressive weakness
Typhoidal	Unspecified	<ul style="list-style-type: none"> Systemic illness (fever, chills, headache, etc.) without indication of site of infection or localized symptoms
Septic	Unspecified	<ul style="list-style-type: none"> Potentially severe and fatal Systemic illness (fever, chills, headache, etc.) Patient typically appears toxic; may develop confusion and coma Without prompt treatment, may lead to septic shock, acute respiratory distress syndrome, and organ failure

See Also

Tularemia key facts Web page. Centers for Disease Control and Prevention, Emergency Preparedness and Response. October 7, 2003. <http://www.bt.cdc.gov/agent/tularemia/pdf/tularemiafacts.pdf>. Accessed September 22, 2011.

Dennis DT, Inglesby TV, Henderson DA, et al., for the Working Group on Civilian Biodefense. Tularemia as a biological weapon: medical and public health management. *JAMA*. 2001;285:2763-2773. <http://jama.ama-assn.org/content/285/21/2763.full>. Accessed September 22, 2011.

Health aspects of chemical and biological weapons, 1st edition. World Health Organization, United Nations; 1970. <http://www.who.int/csr/deliberations/biochem1stenglish/en/index.html>. Accessed September 22, 2011.

Tularemia fact sheet Web page. National Institute of Allergy and Infectious Disease, National Institutes of Health. September 2006. <http://www.niaid.nih.gov/topics/tularemia/Pages/default.aspx>. Accessed September 22, 2011.

Visual Dx: Visual clinical decision support software. <http://www.logicalimages.com/resourcesBTAgents.htm>. Accessed September 22, 2011.

Penn RL. *Francisella tularensis* (tularemia). In: Mandell GL, Bennett JE, Dolin R, eds. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases*. 7th ed. Philadelphia, PA: Churchill Livingstone; 2010.