

YERSINIOSIS

Animal Group(s) Affected	Transmission	Clinical Signs	Severity	Treatment	Prevention and Control	Zoonotic
Mammals, including humans, Birds Reptiles Fish	Ingestion of fecal contaminated food and water; ingestion of raw meat and milk; blood transfusions (humans)	Diarrhea, abdominal pain, fever, weakness, septicemia, weight loss, enlarged lymph nodes, sudden death	Ranges from subclinical to acutely fatal or a chronic wasting form, depending on individual and species	Third generation cephalosporins, fluoroquinolones; supportive therapy	Good hygiene protocols; pest control program; vaccination; minimize stress	Yes

Fact Sheet compiled by: Rae Gandolf and Genevieve Vega Weaver

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Fact Sheet Reviewed by: Shuping Zhang, Christine Kaandorp

Disease Significance: Yersiniosis is considered among the most important diseases of farmed deer in the U.S. as well as New Zealand and Australia. Among zoological facilities in the U.S., major outbreaks with mortalities have occurred among captive antelope, birds and non-human primates, with sporadic events in other species such as a cougar, lion and Siberian tiger. Enzootics have affected free-ranging musk ox in Canada, and brown hares and hedgehogs in Europe. Yersiniosis is also zoonotic; human exposure is typically foodborne.

Susceptible animal groups: *Yersinia pseudotuberculosis* has been detected in >110 species including humans, other mammals (rodents, non-human primates, hedgehogs, hares, domestic dogs, ruminants, bats, suids and felids), birds (guinea fowl, turkey), reptiles, and fish. Rodents wild boar, deer, insects, and wild birds are believed to be reservoirs; however, there has been some debate about their exact role in transmission. Outbreaks occur in farmed 4-8 mo old deer in fall/winter in the U.S. *Yersinia pseudotuberculosis* can also survive for months to years in the soil, water and vegetation. Sensitive species and groups include: callitrichids, capybaras, agouti, mara, turacos, toucans, lemurs, guenons, fruit bats, squirrels, and deer. *Yersinia enterocolitica*, in contrast, is a less common cause of yersiniosis and has only been reported to cause disease in a few species of non-human primates, chinchillas, guinea pigs, domestic pigs, wild boars, deer, dogs, cats, and humans. Young, old, immunosuppressed, and animals with chronic liver disease animals appear to be most susceptible to severe disease associated with both *Yersinia* species. Alpine ibex have been identified as a potential carrier of pathogenic *Y. enterocolitica*. Outbreaks of *Y. pseudotuberculosis* most commonly occur during winter months, due to stress and overcrowding as well as the enhanced virulence factors of the organism at lower temperatures. In contrast, *Y. enterocolitica* occurs more commonly in the summer and autumn.

Causative organisms: *Yersinia pseudotuberculosis* and *Y. enterocolitica* are non-spore forming Gram-negative aerobic coccobacilli belonging to the Enterobacteriaceae family. They are facultative intracellular bacteria. *Yersinia pseudotuberculosis* consists of 15 serotypes plus additional subtypes, while *Y. enterocolitica* has over 60 serotypes of which four (O3, O5/27, O8, and O9) are believed to be pathogenic.

Zoonotic potential: Yes

Distribution: Worldwide except Antarctica, especially in temperate climates. Highly prevalent in Europe.

Incubation period: < 10 days

Clinical signs: Disease is predominantly gastrointestinal, although extraintestinal yersiniosis also occurs. Disease may be acute, subacute or chronic. Signs vary by species and individual, but most typically consist of

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gastroenteritis. Severe cases progress to septicemia. Signs may include lethargy, anorexia, green to bloody diarrhea, respiratory distress, incoordination, emaciation, and sudden death. Other forms of the disease include: abortion and mastitis in ungulates; chronic disease resulting in wasting syndrome and enlarged, palpable mesenteric lymph nodes in various species; skin rash, desquamation, erythema nodosum and arthritis caused by certain serotypes; granulomatous conjunctivitis in dairy goats; and appendicitis, gastroenteritis, abdominal pain and reactive arthritis in humans. A carrier state can also develop.

Post mortem, gross, or histologic findings: *Yersinia pseudotuberculosis* can cause ulcerative enterocolitis, hepatomegaly and splenomegaly, multifocal necrosis seen as white-gray nodules on the liver and spleen and possibly the lungs and kidneys (organisms are seen in the lesions), interstitial pneumonia, enlargement and abscessation of abdominal lymph nodes and adhesive peritonitis. *Yersinia enterocolitica* often results in lesions in the lymphoid tissue of the head and neck, particularly the tonsils and submandibular lymph nodes. Subclinical cases may demonstrate minimal gross and histologic changes.

Diagnosis: Diagnosis is based on characteristic gross and histopathologic lesions with the presence of gram-negative coccobacilli, identification from bacterial culture (cold enrichment), and identification using conventional or real-time PCR. A commercially available IgM ELISA for domestic pigs has been used with muscle and tonsillar tissue. Serotyping can be done by slide agglutination or PCR. Isolates can be further characterized using pulse field gel electrophoresis (PFGE).

Material required for laboratory analysis: The organism is most reliably cultured from organs demonstrating lesions, particularly the liver and spleen, but also the lungs, mesenteric lymph nodes, and intestines. Blood culture is used in humans and can be used in non-human primates in cases of suspected septicemia. Culture may also be performed on feces. However, shedding of the organism can be intermittent; therefore fecal culture is not always reliable. For PCR: Rectal or cloacal swab, 0.5 g feces, 0.5 g fresh, frozen or fixed tissue, or (*Y. pseudotuberculosis*) 0.5 ml whole blood in EDTA (purple top) or ACD (yellow top) tube.

Relevant diagnostic laboratories: Any diagnostic laboratory with Biosafety Level 2 practices that can perform bacterial culture and sensitivity. Care should be taken because of the zoonotic potential. *Yersinia pseudotuberculosis* and *Y. enterocolitica* do not grow well on routine culture media, therefore submitted samples should indicate that these organisms are suspected. For more rapid detection, PCR is available: Zoologix (B0062) for qualitative ultra-sensitive detection of *Yersinia pseudotuberculosis*, and (B0073) for detection of *Yersinia enterocolitica*.

Treatment: There has been little success with treatment of clinical cases. Prophylactic treatment of animals in contact with an individual demonstrating clinical signs is recommended. Antibiotic treatment should be based on sensitivity. Although different strains have demonstrated variable sensitivities, most strains are susceptible to third generation cephalosporins, fluoroquinolones and chloramphenicol. There have been reports of some resistance by certain strains, particularly those of *Y. enterocolitica*, to amoxicillin-clavulanic acid, ampicillin, tetracyclines, sulfonamides, macrolides, florfenicol, and fluorquinolones. Multi-drug resistant strains of *Y. enterocolitica* have been found in humans and pigs. In patients with chronic liver lesions, long term antibiotic treatment might be needed. Fluid therapy should be administered as dehydration is a common development.

Prevention and control: The bacteria can survive in both animal and environmental reservoirs. Outbreaks of yersiniosis are associated with stressors such as cold and wet weather, decreases or changes in food availability, overcrowding, intestinal parasitism, or animal capture. Measures should therefore be taken to minimize these stressors.

Affected animals should be isolated and enclosures should be disinfected. In some cases, euthanasia of groups of animals may be necessary. Preventive measures include: implementing a rodent and bird control program; practicing good hygiene including disinfection, changing substrate, removing contaminated or old food and water from enclosures; minimizing stress, competition, and overcrowding in enclosures; and avoiding raw meat in non-human primates.

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A killed whole cell vaccine for *Y. pseudotuberculosis* (Pseudovac®, Department of Veterinary Pathology, Utrecht University, The Netherlands) is available and used mainly in European zoos before the winter, and a killed vaccine (Yersiniavax®, Intervet) used for cervid farms in New Zealand. A new vaccine of a live, attenuated strain (IP32680) of *Y. pseudotuberculosis* administered orally has shown to provide adequate protection against severe infection in experimentally infected guinea pigs and mice and has demonstrated superior efficacy over Pseudovac®.

Suggested disinfectant for housing facilities: 1% sodium hypochlorite, 70% ethanol, 2% glutaraldehyde, iodines, phenolics, formaldehyde, moist heat (121° C for at least 15 min), dry heat (160-170° C for at least 1 hour).

Notification: Notification of public health officials is required in human cases

Measures required under the Animal Disease Surveillance Plan: None

Measures required for introducing animals to infected animal: Not recommended. In some cases, euthanasia of symptomatic individuals may be warranted in order to avoid a carrier state. Following exposure, only animals free of clinical signs and with multiple negative cultures should be allowed to comingle with new animals.

Conditions for restoring disease-free status after an outbreak: Since the organism is ubiquitous in the environment and appears sporadically in some zoos, it is problematic to designate an institution disease-free. Yersiniosis appears to be endemic in some European zoos.

Experts who may be consulted:

Shuping Zhang, DVM, PhD

Associate Professor

Director of Clinical Microbiology

Veterinary Medical Teaching Hospital, College of Veterinary Medicine

Texas A&M University

College Station, TX 77843-4467

979-845-9189

ShupingZhang@cvm.tamu.edu

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