

Salmonellosis



Wetlands supporting
groups of
susceptible animals

Wildlife ✓
Livestock ✓
Human ✓



Synonyms: non-typhoidal salmonellosis, paratyphoid, Salmonella

KEY FACTS

What is salmonellosis?

An infectious zoonotic disease found in a range of animals including birds, caused by their exposure to species of *Salmonella spp.* bacteria. The bacteria are found in the intestines of humans and animals but are also widespread in the environment and are commonly found in farm effluents, human sewage and any material that is contaminated with infected faeces. The bacteria can survive for several months in the environment, particularly in warm and wet substrates such as faecal slurries.

The disease can affect all species of domestic animals, and many animals, especially pigs and poultry, may be infected but show no signs of illness. The infection can spread rapidly between animals, particularly when they are gathered in dense concentrations. Salmonellosis can occur at any time of year, however, salmonellosis outbreaks may be more common in certain seasons (*e.g.* European garden bird salmonellosis outbreaks occur most frequently during the winter months).

Humans usually contract the bacteria through the consumption and handling of contaminated foods of animal origin and water, but also through direct contact with infected animals and their faeces. Salmonellosis is one of the most common and widely distributed food-borne diseases in humans globally, constituting a major public health burden and representing a significant cost in many countries.

Causal agent

Two species of bacteria from the genus *Salmonella*: *Salmonella enterica*, and *S. bongori*. Within these, there are over 2,300 strains which are grouped into 'serovars'.

Species affected

Many species of domestic and wild animals including birds, reptiles, amphibians, fish and invertebrates can be infected with *Salmonella spp.* The importance of each *Salmonella* serovar (and phage type) differs between the host species. Some *Salmonella* serovars (and phage types) have a broad host range and others are thought to be highly host-adapted. Infection is most commonly seen in poultry, pigs and reptiles. All species seem to be susceptible to salmonellosis but clinical disease is more common in some animals than others. For example, disease is common in cattle, pigs and horses, but uncommon in cats and dogs.

The frequency of occurrence of *Salmonella spp.* infection and salmonellosis varies amongst wild bird species. Salmonellosis outbreaks, caused by certain phage types of *S. typhimurium*, commonly affect passerine species that are gregarious and seed-eating (*e.g.* finches and sparrows). Outbreaks of passerine salmonellosis are typically observed in the vicinity of supplementary feeding stations in garden habitats. Salmonellosis outbreaks have also been reported in colonial nesting birds, such as gulls and terns. Birds of prey can become infected with *Salmonella spp.* bacteria from prey items.

Humans are very susceptible to illness caused by certain *Salmonella spp.* Children, the elderly, and people with weakened immune systems are at greatest risk of developing severe disease.

Geographic distribution Found worldwide but most common in areas of intensive animal husbandry, especially in pigs, calves and poultry reared in confined spaces. The importance of each serovar differs between geographical regions. Eradication programmes have nearly eliminated salmonellosis in domestic animals and humans in some countries but wild animal *Salmonella spp.* reservoirs remain.

Environment Any environment supporting *Salmonella spp.* and their animal hosts.

TRANSMISSION AND SPREAD

Vector(s) Salmonellosis can be spread mechanically by animals and insects. In general infection is transmitted by infected hosts, their faeces or contaminated inanimate objects.

How is *Salmonella* transmitted to animals? Direct contact with infected faeces and through ingesting water and food (including pastures) contaminated with bacteria (often through faecal contamination). In mammals, the bacteria can be transmitted from an infected female to the foetus, and in birds, from an infected adult to the egg. Carnivores may be infected through ingesting infected animals and their products. Bacteria may also be inhaled in closely confined areas.

How does *Salmonella* spread between groups of animals? Spread by infected animals which shed the bacteria into the environment in their faeces. Bacteria may also be introduced to herds and flocks on shoes, equipment and other contaminated objects (fomites). Birds, rodents and insects can spread bacteria to other animals. How the infection spreads between and within herds and flocks is not fully understood due to the difficulties of detecting clinical signs in animals infected with *Salmonella spp.*

How is *Salmonella* transmitted to humans? Most commonly transmitted by handling and ingesting contaminated water and food, particularly undercooked foods of animal origin, such as meat, eggs or unpasteurised milk and dairy products, or from cross-contamination of other foods by these items. Also transmitted through direct contact with infected animals and their faeces, particularly those of reptiles, chicks and ducklings, but also of livestock, dogs, cats, adult poultry and cage birds. The bacteria may be spread through person-to-person contact if hygiene is poor.

IDENTIFICATION AND RESPONSE

Field signs Many infected animals will not show any clinical signs and hence *Salmonella spp.* can be difficult to detect. Infected livestock may develop enteritis and septicaemia and commonly show signs of diarrhoea, dehydration, depression, abdominal pain and rapid weight loss. Pregnant animals may abort, either with or without other clinical signs. Clinical signs usually last for 2-7 days but death can occur within 24-48 hours in some species. Loss of condition, emaciation and lethargy may be seen in surviving livestock. In poultry, disease is usually seen in very young birds. Clinical signs may include ruffled feathers, lethargy, diarrhoea and increased thirst. Chronically infected birds often appear severely emaciated. Some may show poor coordination, tremors, convulsions and blindness.

Clinical disease usually appears when animals are stressed by factors such as transportation, crowding, food shortage or deprivation, weaning, giving birth, exposure to cold, a concurrent viral or parasitic disease, sudden change of feed, or overfeeding following a fast.

Infection in humans often causes gastroenteritis but a wide range of clinical signs may be seen and death can occur in severe cases. Illness usually occurs in single, sporadic cases, but outbreaks can also occur. Humans may suffer from fever, abdominal pain, diarrhoea, nausea and sometimes vomiting. Infection may last for 1-7 days. The elderly, children and those with weakened immune systems may suffer from severe dehydration and more severe illnesses, such as septicaemia. Some infected people do not show any symptoms at all.

Recommended action if suspected Salmonellosis in sheep and goats is a notifiable disease and suspected cases must be reported immediately to local and national authorities and the OIE. In general, contact and seek assistance from human and animal health professionals immediately if there is any illness in people and/or livestock. An outbreak may mean that many humans and animals have been exposed to a common contaminated food item or water source.

Diagnosis Isolation of the causative agent by health professionals is needed for a definitive diagnosis. Faeces or blood cultures are used for isolating the bacterium in humans, and in animals and birds, faeces, rectal swabs and/or caecal contents are required. Ideally, fresh faeces should be collected, preferably without traces of urine. Samples should be prevented from drying out. A medium should be used for transporting swabs.

For dead animals, whole carcasses should be submitted to a diagnostic laboratory. If the whole carcass cannot be submitted, submit the intestine, and if possible, the liver and heart. Wrap each sample in a separate piece of aluminium foil. Place the foil-wrapped specimens in tightly sealed plastic bags, and ship them frozen. After an abortion, samples should be collected from the placenta, vagina and foetal stomach. Whole eggs, egg shells and shell membranes can also be cultured for bacteria providing that the egg fragments have not been subjected to environmental conditions that would destroy the bacteria.

PREVENTION AND CONTROL IN WETLANDS

Environment Prevention and control measures are limited in wetlands with free-living animals, many of whom will carry the bacteria without any noticeable clinical signs and untoward effects. Transmission of bacteria from animals to humans and between captive animals can be more easily prevented and controlled.

Monitoring and surveillance

Recording the incidence of outbreaks can identify trends in salmonellosis infections and evaluate the feasibility of control programmes. Monitoring of outbreaks in animals and humans can also help assess the contribution of animals to human illness.

Livestock The control of *Salmonella spp.* along the food chain is most effective when the colonisation of living animals with bacteria can be prevented.

A number of measures can be taken to help prevent or control infection:

- Good biosecurity will help protect captive animals from bacterial infection and prevent cross-contamination:
 - Have disinfection facilities for hands, footwear, clothing, equipment and vehicles/trailers on entering or leaving areas with livestock and after contact with animals. *Salmonella spp.* are susceptible to many disinfectants including 1% sodium hypochlorite, 70% ethanol, 2% glutaraldehyde, iodine-based disinfectants, phenolics and formaldehyde.
 - Wear protective clothing and footwear, either disposable or, if reusable, easily disinfected (*e.g.* waterproof clothing, face shields, gloves and boots).
 - Have separate clothing and utensils for each person using areas with livestock.

Note that biosecurity does not guarantee a *Salmonella spp.*-free flock or herd at the time of slaughter.

- Disease can be reduced by good hygiene and optimal animal husbandry and by minimising stressful events.
- Rodent control will help prevent/reduce transfer of bacteria from rodents to animals.
- Fence stream banks and watering holes to limit access by livestock to water contaminated by faeces from infected animals and to reduce animals contaminating water courses. Provide clean drinking water in separate watering tanks located away from potentially contaminated water bodies.
- Treat sewage to reduce the release of bacteria into water courses.
 - **Chlorinate** contained drinking water sources and prevent faecal contamination of food and water where possible. Do not chlorinate natural water bodies as this will have an adverse effect on the wetland ecosystem.
 - **Feed sources** should be *Salmonella spp.*-free. Store feed in rodent and insect-proof sealed containers.
 - **Avoid mixing** potentially infected and susceptible animals.
 - **Isolate** newly acquired animals.
- Buy animals or eggs from *Salmonella spp.*-free sources.
- During a herd outbreak, animals carrying bacteria should be identified and either isolated and treated, or culled. Contaminated materials should be disposed of.
- Vaccination can reduce the level of colonisation and shedding of the bacteria into the environment, as well as clinical disease. Vaccines are available for some serovars such as *Salmonella dublin*, *S. typhimurium*, *S. abortusequi* and *S. choleraesuis*, in some countries.
- Re-test treated animals several times to ensure that they no longer carry *Salmonella spp.*
- Adequate colostrum intake is important in preventing disease in young animals.
- Antibiotics may help with overcoming an outbreak but will not eliminate carriers, and transmission of bacteria from an infected adult to the egg or foetus may result in new outbreaks and disease spread.
- Maintain low densities of livestock to reduce cycles of salmonellosis within populations.

Wildlife

- Eliminating point sources of infection should be the key activity for preventing and controlling salmonellosis in wild bird and other animal populations:
 - Feeding stations encourage birds to congregate, sometimes in large densities, thereby increasing the potential for disease to spread between individuals when outbreaks occur. Ensure that garden bird feeding stations are regularly cleaned. Remove spilled and soiled feed from the area under the feeder. Rotate the locations of feeders to help avoid accumulation of faeces and contamination of particular areas. If bird baths are used, ensure that water is clean and fresh on a daily basis.
 - Regularly disinfect feeders using a dilution (1:10 ratio) of household bleach and water or an aviary-safe disinfectant. Ensure that feeders are rinsed with clean water and air-dried before re-use.
 - Thoroughly disinfect feeding stations and discontinue use temporarily if a salmonellosis outbreak occurs. This is to reduce the opportunity for transmission of *Salmonella spp.* which might be increased when garden birds feed together in high densities at shared food and water sources.
- Avoid contaminating wetlands with wastewater known to harbour bacteria *e.g.* by use of constructed treatment wetland. This often happens when:
 - existing wetlands receive wastewater discharges
 - agricultural fields receive manure and slurries as fertiliser
 - development of landfill, livestock, and poultry operations are proposed.
- Ensure that waste, sewage wastewater, and wastewater discharges are properly treated, secure and contained away from livestock, poultry and wetlands:
 - wastewater should be stored in lagoons and treated for a combined period of 20 days to eliminate bacteria *e.g.* a primary lagoon for eight days, secondary lagoon for five days, detention pond for two days, and recycle pond for five days.

Humans

- Avoid consuming un-pasteurised dairy products (*e.g.* milk, cheese and colostrum), eggs and untreated surface water.
- Cook food thoroughly, especially eggs, meat and poultry. All meat should be cooked so that it is without blood and no longer pink.
- Wash fruit and vegetables thoroughly, particularly if they are eaten raw. Ideally vegetables and fruit should be peeled.
- People with weakened immune systems should avoid contact with reptiles, young chicks and ducklings.
- Good personal hygiene:
 - wash hands thoroughly with soap and warm water: before preparing and eating food; after handling raw food; after going to the toilet or after/before changing a baby's nappy; after contact with animals and (especially) reptiles or contact with items they have touched; after working outside; and frequently if you have symptoms such as diarrhoea.
- Prevent contamination of food in the kitchen.

No human vaccines to prevent salmonellosis exist.

Most people who have salmonellosis recover without treatment within 2-7 days. It is important to drink plenty of fluids as diarrhoea or vomiting can lead to dehydration and loss of minerals. Re-hydration solutions may also be useful. Antibiotics may be given to treat severe infections.

IMPORTANCE

Effect on wildlife

Many infected animals will not show any clinical signs at all and clinical disease is uncommon in healthy, unstressed adult birds and mammals. The prevalence of bacteria in most wild bird populations is generally low although large-scale mortalities of birds using feeding stations have become common in the United States and also occur with some frequency in Canada and Europe.

Effect on livestock

Many infected animals will not show any clinical signs at all and disease is uncommon in healthy, unstressed adult birds and mammals. In mammals, clinical disease is most common in very young, pregnant or lactating animals, and often occurs after a stressful event. Outbreaks in young ruminants, pigs and poultry can result in a high morbidity rate, and sometimes, a high mortality rate. In outbreaks of septicaemia, the morbidity and mortality rates may approach 100%. There are reports of domestic cats suffering gastroenteritis with the *S. typhimurium* phage types that affect garden birds. This is thought to occur when cats predate sick passerine prey.

Effect on humans

Salmonellosis is common in humans and is a major cause of food-borne illness throughout the world. Most people recover from infection without treatment. Infection often causes gastroenteritis but a wide range of clinical signs may be seen and death can occur in severe cases. The incidence and severity of the disease is higher in younger children, the elderly and those with weakened immune systems. The overall mortality rate for most forms of salmonellosis is less than 1%.

Economic importance

There is potential for significant economic losses to the livestock industry, with ruminants, pigs and poultry particularly affected, due to illness and loss of infected animals and likely trade restrictions imposed during and after an outbreak.

Illness in humans can result in significant economic losses due to the time lost from normal activities and medical costs incurred.

FURTHER INFORMATION

Useful publications and websites

- ☐ Friend, M. & Franson, J.C. (2001). **Salmonellosis**. In: Field manual of wildlife diseases: general field procedures and diseases of birds. E. A. Ciganovich (ed.). pp. 99-110. U.S. Department of the Interior and U.S. Geological Survey, Washington, DC. www.nwhc.usgs.gov/publications/field_manual/chapter_9.pdf [Accessed March 2012].
- ☐ Center for Food Security and Public Health (CFSPH). **Factsheet: salmonellosis**. www.cfsph.iastate.edu/Factsheets/pdfs/nontyphoidal_salmonellosis.pdf [Accessed March 2012].
- ☐ World Organisation for Animal Health (OIE). **Chapter 2.09.09: Salmonellosis**. Manual of diagnostic tests and vaccines for terrestrial animals. http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.09.09_SALMONELLOSIS.pdf [Accessed March 2012].
- ☐ Wetlands International. **Wetlands & water, sanitation and hygiene (WASH) - understanding the linkages (2010)**. <http://www.wetlands.org/WatchRead/Currentpublications/tabid/56/mod/1570/articleType/downloadinfo/articleId/2467/Default.aspx> [Accessed March 2012].
- ☞ World Health Organisation (WHO). **Salmonella**. www.who.int/topics/salmonella/en/ [Accessed March 2012].
- ☞ Centre for Disease Control and Prevention (CDC). **Salmonellosis**. www.cdc.gov/nczved/divisions/dfbmd/diseases/salmonellosis/additional.html [Accessed March 2012].
- ☞ Wildpro. **Salmonellosis**. <http://wildpro.twycrosszoo.org/S/00dis/Bacterial/Salmonellosis.htm> [Accessed March 2012].

Contacts

- ✉ **WHO Communicable Diseases Surveillance and Response (CSR)**. zoonotic_alert@who.int fmeslin@who.int and outbreak@who.int.
- ☞ **FAO Animal Production and Health Division**. www.fao.org/ag/againfo/home/en/who.htm.