# SALMONELLOSIS

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<td>Most vertebrates.</td>
<td>Fecal-oral; direct contact by infected animals or indirectly via arthropods, or contaminated vehicles, equipment, feed, and water.</td>
<td>Mild: gastroenteritis with vomiting, and diarrhea. Severe: additionally anorexia, lethargy, weight loss, pyrexia, polydipsia, dehydration, and ocular lesions; Severe acute septicemia: multifocal petechial hemorrhage, polyserositis, polyarthritis, bronchopneumonia, meningitis or meningoencephalitis, death.</td>
<td>Varies from subclinical carriage to septicemia and death. Septicemic form often is fatal without prior or unobserved clinical signs.</td>
<td>Antibiotics: streptomycin, gentamicin, tetracyclines, doxycycline.</td>
<td>Thorough premise biosecurity, including limits on transport and contact with other facilities such as production. Pest control Sanitation Optimize nutrition and immunity for housed individuals.</td>
<td>Zoonotic potential depending on serovar.</td>
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**Fact Sheet compiled by:** Cornelia J. Ketz-Riley  
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**Fact Sheet Reviewed by:** Anna Catharina Berge; Meredith M. Clancy; Franklyn Garry

**Susceptible animal groups:** Non-typhoidal salmonellosis causes natural infection in all taxa of vertebrates and in some invertebrates. Reptiles are important carriers, and multiple exotic pet species have been implicated in human disease outbreaks. Only humans are, susceptible to *S. typhi*, the causative agent of typhoid.

**Causative organism:** Family: Enterobacteriaceae; Genus: *Salmonella*, with three species:  
- *S. typhi* -- not detailed in depth in this fact sheet  
- *S. enterica* (formerly *cholerasuis*), with 6 subspecies:  
  - *S. enterica* subspecies *enterica* (I)  
  - *S. enterica* subspecies *salamae* (II)  
  - *S. enterica* subspecies *arizonae* (IIIa)  
  - *S. enterica* subspecies *diarizonae* (IIIb)  
  - *S. enterica* subspecies *houtenae* (IV)
**SALMONELLOSIS**

- *S. enterica* subspecies *indica* (VI)
- *S. bongori*, formerly *S. enterica* subspecies V

Over 2500 serovars of *S. enterica* exist, each distinguished by their O and H antigen; serotypes of subspecies I are often named after first geographical and/or species-specific appearance. Serotypes belonging to subspecies IIIa and IIIb were formerly grouped in the genus *Arizona*. The species name for *S. enterica* was recently approved. All of these changes and the constant discovery and isolation of new serotypes can cause confusion. For clarity, the CDC, WHO, and Institut Pasteur all use the Kauffman-White scheme, found at: [http://www.pasteur.fr/ip/portal/action/WebdriveActionEvent/oid/01s-000036-089](http://www.pasteur.fr/ip/portal/action/WebdriveActionEvent/oid/01s-000036-089).

**Zoonotic potential:** High, but it does depend on infecting serovar.

**Distribution:** Worldwide.

**Incubation period:** Generally 1-4 days.

**Clinical signs:**
- **Acute:** Gastroenteritis, pneumonia, lethargy, pyrexia, and anorexia.
- **Severe/septicemic:** anorexia, lethargy, headache, pyrexia, polydipsia, dehydration, petechial hemorrhages on cutaneous and mucosal surfaces, joint pain (polyarthritis), abdominal pain (polyserositis), respiratory signs (bronchopneumonia), neurological signs (meningitis, meningoencephalitis); death possible
- **Chronic:** reduced productivity such as egg and milk production, suppressed growth, decreased fertility, decreased hatchability, and abortion.

**Post mortem, gross, or histologic findings:** Most common findings during gross necropsy include signs of dehydration, gastroenteritis, hepatomegaly with or without military white foci, splenomegaly, and mesenteric lymphadenopathy. Pneumonia can be observed more often in birds and calves. In cases of septicemia, petechial hemorrhages can occur in multiple organs, with muscular necrosis typically involving myocardial and gizzard (in avian species) muscle, nephropathy, polyserositis, and synovitis commonly found. Histopathological findings include multifocal necrotic hepatitis, necrosis of cryptic or surface enterocytes in lower small intestines, cecum and colon, depending on species involved.

**Diagnosis:** Culture of fresh fecal material is still the most commonly used diagnostic tool to detect *Salmonella* shedding. Pre-enrichment media prior to plating is recommended to enhance the ability to recover *Salmonella*. Selective media are used for identification of *Salmonella* sp., including MacConkey, Tetrathionate, Triple-Sugar-iron, and Xylose-Lysin-Desoxycholate. Serological and immunohistochemical methods are commonly used to identify *Salmonella* species and serotypes involved in disease process. These methods are essential when a *Salmonella* infection is suspected, and when isolation of live organisms by culturing is not possible. ELISA and similar modified assays for antibody reactions against *Salmonella* types in individuals is used in surveillance programs. Serological examinations can be used to establish presence of *Salmonella* on herd basis, but are not reliable for individual animal status identification.

PCR is used to recover *Salmonella* DNA in live material (including produce, food particles, meat, egg shells), or dead surfaces. PCR is also used for further classification of *Salmonella* serotypes. Ongoing research is conducted involving more refined molecular and genetic identification methods (nested PCR, real time micro PCR, multiplex PCR, 16S rRNA PCR-high-resolution melt analysis, one-step triplex high-resolution melting analysis, multiplex Luminex-based molecular assay, nucleic acid sequence-based amplification method, immune-gold nanoparticle network ELISA, anti-O12 monoclonal antibody in TUBEX test) for serotyping and virulence testing.

**Material required for laboratory analysis:** For culture, feces, organ tissue, whole blood, milk or other environmental material are recommended. For ELISA and other serologic assays, feces, organ tissue, serum, food, milk, and water may be used. Tissue, feces, whole blood, soil, or processed food can be used for PCR testing.

**Relevant diagnostic laboratories:** Any laboratory that is set up for culture methods can be used for first
screening for *Salmonella*. Serotyping via serological methods and PCR are offered by most medical laboratories specialized in infectious disease diagnostics, or the National Veterinary Services Laboratories.

**Treatment:** Mild infections are self-limiting and are only treated with supportive care, such as rehydration, electrolytes and analgesics. Antibiotic therapy is controversial as elimination is rare, re-infection common, and creation of a carrier state a likely outcome. Animals treated with antibiotics have shown prolonged bacterial shedding post-treatment. Antibiotics should be used only in cases of severe acute and life-threatening infection, when a subsequent bacteremia is anticipated, mainly in immunocompromised and young individuals. If antibiotics are used a long-term treatment for up to three weeks is to be considered. The choice of antibiotics should be based on culture and sensitivity. Recommended antibiotics include: fluoroquinolones, tetracyclines, clindamycin, erythromycin, ampicillin, amoxicillin, gentamicin, streptomycin, and trimethoprim/sulfonamides. Frequent use of antibiotics may have contributed to the development of multidrug resistance of many *Salmonella* serotypes. Resistance to antibiotics including fluoroquinolones ceftriaxone, and azithromycin becoming more common and has been documented around the globe and has become more common over the last decade, especially in human cases of nontyphoidal salmonellosis in developing nations.

**Prevention and control:** Eradication difficult due to asymptomatic carriers. Preventive control programs should consist of a good sanitation protocol and appropriate animal collection management. Multiple non-pharmaceutical therapeutic measures, including food and water additives such as probiotics have been tried to increase intestinal immunity. Vaccination is not possible for most taxa of animals, although vaccines exist for production animals (poultry, cattle, and swine), and vaccine development is on-going. Appropriate education regarding sanitation and potential risks of contamination should be provided to all persons involved in animal care or food processing.

**Suggested disinfectant for housing facilities:** Most commonly used disinfectants, such as diluted hypochlorite, quaternary ammonium based products are effective against *Salmonella* bacteria.

**Notification:** Multiple serotypes cause reportable disease:
- Fowl Typhoid and Pullorum (both serotype Gallinarum), reportable to USDA and OIE
- *Salmonella* Abortusovis, reportable to OIE
- *Salmonella* Dublin, reportable in Alberta

Positive *Salmonella* cultures are reported by diagnostic laboratories to appropriate authorities based on serotype identified, as seen here: [http://www.fsis.usda.gov/wps/wcm/connect/f0da010d-d0f4-423f-9b2a-136d32aa738b/MLG_4_Appendix_1.pdf?MOD=AJPERES](http://www.fsis.usda.gov/wps/wcm/connect/f0da010d-d0f4-423f-9b2a-136d32aa738b/MLG_4_Appendix_1.pdf?MOD=AJPERES).

**Measures required under the Animal Disease Surveillance Plan:** Salmonellosis is part of the National Animal Disease Surveillance Plan, due to its importance as a foodborne bacterial illness. Specific measures required depend on the animal species and nature of the outbreak.

**Measures required for introducing animals to infected animal:** Regular quarantine in a clean environment; reduce access to host animals; separate tools and personnel for quarantined animals; fecal culture as preshipment evaluation and quarantine examination before introduction.

**Conditions for restoring disease-free status after an outbreak:** Quarantine of whole collection; isolation of sick and potentially infected animals; testing of any potentially contaminated feed, water, surface and also healthy animals, as well as personnel, before giving access to previously contaminated area. Multiple cultures of potentially infected animals necessary due to inconsistent shedding of bacteria.

**Experts who may be consulted:**
Centers for Disease Control and Prevention
Division of Foodborne, Waterborne, and Environmental Diseases
1600 Clifton Rd
Atlanta, GA 30333
Salmonellosis

800-CDC-INFO

USDA–APHIS–VS–Center for Epidemiology and Animal Health
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970-494-7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

References:


