

## Salmonella

(*S. enterica*, various subspecies and serotypes)

### Classification

Gram-negative, rod-shaped, aerobic bacterium

### Family

Enterobacteriaceae

*Salmonella* nomenclature is complicated and in a state of flux. It is easiest to refer to *S. enterica* as an unit, although it is divided into six subspecies, and over 1500 serotypes. Differentiation of subspecies or serotypes should be left to diagnostic laboratories.

### Affected species

All laboratory rodents are susceptible to *Salmonella* infection. *Salmonella* serotypes are also found in cold-blooded animals and free-living in the environment. *Salmonella* is potentially a zoonotic infection that may cause serious illness or even fatalities in immunocompromised caretakers.

### Frequency

Vanishingly rare in modern laboratory animal colonies. Varying prevalence among pet animals, and common among wild animals.

### Transmission

Transmission is via the fecal-oral route, via fomites, or possibly vertically.

### Clinical Signs and Lesions

Salmonellosis in mice and rats is commonly subclinical. When clinical signs are present, they include diarrhea, anorexia, a general appearance of rodent illness (ruffled coat, hunched posture), weight loss, conjunctivitis, variable morbidity and mortality rates, and in rats, porphyrin staining at the external nares.

On necropsy, if changes are noted, they will be most evident in the liver, spleen, and intestinal tract. Splenomegaly may be present, and the liver often contains multifocal pale foci. The intestinal tract is often grossly normal, but there may be hyperemia and distention or thickening of the wall accompanied

by scant fluid contents rather than normal stool. On microscopic examination, multifocal histiocytic granulomata, venous thrombosis, and multifocal necrosis may be seen in the liver, spleen, mesenteric lymph nodes, and gut-associated lymphatic tissue. Gut changes seen microscopically may include edema of the lamina propria, leukocytic infiltration, and involvement of the crypt epithelium.

### Diagnosis

Diagnosis is usually made through direct culture of feces, intestinal contents, or mesenteric lymph nodes, which may be positive when feces are negative. Selenite broth is usually used to detect *Salmonella*. Serology is not available commercially. *Salmonella* serotypes may be distinguished through biochemical reactions or via PCR of ribosomal subunit DNA.

### Interference with Research

The most important interference with research associated with a *Salmonella*-infected colony is the potential infection of workers. Since rodents with *Salmonella* infections may also become clinically ill, these animals are not suitable for use in research. Infections in apparently healthy chronic carrier animals may recrudescence under the stress of handling or experimental protocols and serve as sources of infection for other animals and caretakers. Carrier animals often have lesions associated with salmonellosis on histology and there are undoubtedly effects on the immune system, gastrointestinal system, and hepatobiliary system that would confound results obtained using these animals.

### Prevention and Treatment

*Salmonella* infection is uncommon in modern laboratory populations. Incoming animals should always be quarantined, however, and routine intestinal culture should be a normal part of health monitoring for any rodent colony. Wild rodents should be excluded from the facility, and a pest control program put in place. Since at least one *Salmonella* outbreak in laboratory animals was linked to cockroaches found in the facility, pest control programs should include

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invertebrate as well as vertebrate pests. Staff who work in the animal houses must not have rodents as pets. Salmonellosis in rodents may be used as a model of human salmonellosis and these experiments should be conducted under proper biosecurity precautions.

If an infection with *Salmonella* is diagnosed, all animals in the colony must be euthanized. Treatment of animals with antimicrobials may serve to treat illness, but rarely, if ever, resolves the carrier state, nor will antibiotic treatment eliminate bacteria from the bedding or cage surfaces. *Salmonella* isolated from human disease outbreaks are commonly multi-drug resistant, and this should be taken into consideration if treatment is attempted.

Thus, treatment is only recommended as a temporary measure to ameliorate clinical signs and allow animals to survive for rederivation purposes. *Salmonella* forms biofilms that adhere to surfaces and can survive for months in dust and debris found in barrier rooms. These facts should not be overlooked in cleaning animal housing and experimental areas. The animal house and attendant materials must be cleaned and sterilized, and non-essential or easily replaced materials discarded. Chlorine dioxide, vaporized hydrogen peroxide, sodium hypochlorite, and the temperatures and pressures achieved in an autoclave have all been shown to be effective against *Salmonella*. Hysterectomy rederivation may not be effective due to the potential for vertical transmission, so offspring should be carefully screened prior to release into the general animal population. Alternatively, to obtain a *Salmonella*-free colony, animals may be rederived through embryo transfer into *Salmonella*-free dams, although testing of offspring is still prudent.

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