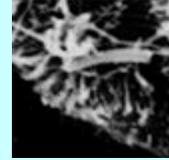


Bad Bug Book

U.S. Food & Drug Administration
Center for Food Safety & Applied Nutrition
Foodborne Pathogenic Microorganisms
and Natural Toxins Handbook



Salmonella spp.

Education

CDC/MMWR

NIH/PubMed

1. Name of the Organism:
Salmonella spp.

Salmonella is a rod-shaped, motile bacterium -- nonmotile exceptions *S. gallinarum* and *S. pullorum*--, nonsporeforming and [Gram-negative](#). There is a widespread occurrence in animals, especially in poultry and swine. Environmental sources of the organism include water, soil, insects, factory surfaces, kitchen surfaces, animal feces, raw meats, raw poultry, and raw seafoods, to name only a few.

2. Nature of Acute Disease:

S. typhi and the paratyphoid bacteria are normally caused septicemic and produce [typhoid](#) or typhoid-like fever in humans. Other forms of salmonellosis generally produce milder symptoms.

3. Nature of Disease:

Acute symptoms -- Nausea, vomiting, abdominal cramps, minimal diarrhea, fever, and headache. Chronic consequences -- arthritic symptoms may follow 3-4 weeks after onset of acute symptoms.

Onset time -- 6-48 hours.

Infective dose -- As few as 15-20 cells; depends upon age and health of host, and strain differences among the members of the genus.

Duration of symptoms -- Acute symptoms may last for 1 to 2 days or may be prolonged, again depending on host factors, ingested dose, and strain characteristics.

Cause of disease -- Penetration and passage of Salmonella organisms from gut lumen into epithelium of small intestine where inflammation occurs; there is evidence that an [enterotoxin](#) may be produced, perhaps within the enterocyte.

4. Diagnosis of Human Illness:

Serological identification of culture isolated from stool.

5. Associated Foods:

Raw meats, poultry, eggs, milk and dairy products, fish,

shrimp, frog legs, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa, and chocolate.

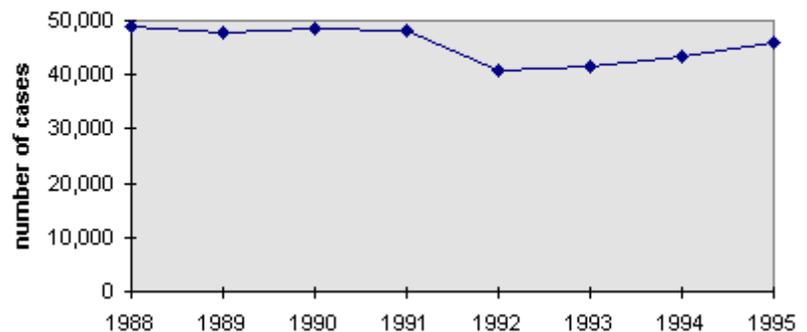
Various *Salmonella* species have long been isolated from the outside of egg shells. The present situation with *S. enteritidis* is complicated by the presence of the organism inside the egg, in the yolk. This and other information strongly suggest vertical transmission, i.e., deposition of the organism in the yolk by an infected layer hen prior to shell deposition. Foods other than eggs have also caused outbreaks of *S. enteritidis* disease.

6. Relative Frequency of Disease:

It is estimated that from 2 to 4 million cases of salmonellosis occur in the U.S. annually.

The incidence of salmonellosis appears to be rising both in the U.S. and in other industrialized nations. *S. enteritidis* isolations from humans have shown a dramatic rise in the past decade, particularly in the northeast United States (6-fold or more), and the increase in human infections is spreading south and west, with sporadic outbreaks in other regions.

Reported cases Salmonellosis excluding typhoid fever, United States 1988-1995



Summary of Notifiable Diseases, United States MMWR 44(53): 1996 October 25

7. Complications:

S. typhi and *S. paratyphi* A, B, and C produce typhoid and typhoid-like fever in humans. Various organs may be infected, leading to lesions. The fatality rate of typhoid fever is 10% compared to less than 1% for most forms of salmonellosis. *S. dublin* has a 15% mortality rate when septicemic in the elderly, and *S. enteritidis* is demonstrating approximately a 3.6% mortality rate in hospital/nursing home outbreaks, with the elderly being particularly affected.

Salmonella septicemia has been associated with subsequent infection of virtually every organ system.

Postenteritis reactive arthritis and [Reiter's syndrome](#) have also been reported to occur generally after 3 weeks. Reactive arthritis may occur with a frequency of about 2% of culture-proven cases. Septic arthritis, subsequent or coincident with septicemia, also occurs and can be difficult to treat.

8. Target Populations:

All age groups are susceptible, but symptoms are most severe in the elderly, infants, and the infirm. [AIDS](#) patients suffer salmonellosis frequently (estimated 20-fold more than general population) and suffer from recurrent episodes.

9. Foods Analysis:

Methods have been developed for many foods having prior history of Salmonella contamination. Although conventional culture methods require 5 days for presumptive results, several rapid methods are available which require only 2 days.

10. Selected Outbreaks:

In 1985, a salmonellosis outbreak involving 16,000 confirmed cases in 6 states was caused by low fat and whole milk from one Chicago dairy. This was the largest outbreak of foodborne salmonellosis in the U.S. FDA inspectors discovered that the pasteurization equipment had been modified to facilitate the running off of raw milk, resulting in the pasteurized milk being contaminated with raw milk under certain conditions. The dairy has subsequently disconnected the cross-linking line. Persons on antibiotic therapy were more apt to be affected in this outbreak.

In August and September, 1985, *S. enteritidis* was isolated from employees and patrons of three restaurants of a chain in Maryland. The outbreak in one restaurant had at least 71 illnesses resulting in 17 hospitalizations. Scrambled eggs from a breakfast bar were epidemiologically implicated in this outbreak and in possibly one other of the three restaurants. The plasmid profiles of isolates from patients all three restaurants matched.

The Centers for Disease Control (CDC) has recorded more than 120 outbreaks of *S. enteritidis* to date, many occurring in restaurants, and some in nursing homes, hospitals and prisons.

In 1984, 186 cases of salmonellosis (*S. enteritidis*) were reported on 29 flights to the United States on a single international airline. An estimated 2,747 passengers were

affected overall. No specific food item was implicated, but food ordered from the first class menu was strongly associated with disease.

S. enteritidis outbreaks continue to occur in the U.S. ([Table 1](#)). The CDC estimates that 75% of those outbreaks are associated with the consumption of raw or inadequately cooked Grade A whole shell eggs. The U.S. Department of Agriculture published Regulations on February 16, 1990, in the Federal Register establishing a mandatory testing program for egg-producing breeder flocks and commercial flocks implicated in causing human illnesses. This testing should lead to a reduction in cases of gastroenteritis caused by the consumption of Grade A whole shell eggs.

Salmonellosis associated with a Thanksgiving Dinner in Nevada in 1995 is reported in [MMWR 45\(46\):1996 Nov 22](#).

[MMWR 45\(34\):1996 Aug 30](#) reports on several outbreaks of *Salmonella enteritidis* infection associated with the consumption of raw shell eggs in the United States from 1994 to 1995.

A report of an outbreak of *Salmonella* Serotype Typhimurium infection associated with the consumption of raw ground beef may be found in [MMWR 44\(49\):1995 Dec 15](#).

[MMWR 44\(42\):1995 Oct 27](#) reports on an outbreak of Salmonellosis associated with beef jerky in New Mexico in 1995.

The report on the outbreak of *Salmonella* from commercially prepared ice cream is found in [MMWR 43\(40\):1994 Oct 14](#).

An outbreak of *S. enteritidis* in homemade ice cream is reported in this [MMWR 43\(36\):1994 Sep 16](#).

A series of *S. enteritidis* outbreaks in California are summarized in the following [MMWR 42\(41\):1993 Oct 22](#).

For information on an outbreak of *Salmonella* Serotype Tennessee in Powdered Milk Products and Infant Formula -- see this [MMWR 42\(26\):1993 Jul 09](#).

Summaries of *Salmonella* outbreaks associated with Grade A

eggs are reported in [MMWR 37\(32\):1988 Aug 19](#) and [MMWR 39\(50\):1990 Dec 21](#).

For more information on recent outbreaks see the [Morbidity and Mortality Weekly Reports](#) from CDC.

11. Education:

The CDC provides an informational brochure on preventing [Salmonella enteritidis infection](#).

[Food Safety Facts for Consumers](#) (July 1999)

12. Other Resources:

A [Loci index for genome *Salmonella enteritidis*](#) is available from GenBank.

CDC/MMWR

The CDC/MMWR link will provide a list of Morbidity and Mortality Weekly Reports at CDC relating to this organism or toxin. The date shown is the date the item was posted on the Web, not the date of the MMWR. The summary statement shown are the initial words of the overall document. The specific article of interest may be just one article or item within the overall report.

NIH/PubMed

The NIH/PubMed button at the top of the page will provide a list of research abstracts contained in the National Library of Medicine's MEDLINE database for this organism or toxin.

mow@cfsan.fda.gov

January 1992 with periodic updates

[Bad Bug Book](#) | [Home](#)

Hypertext last updated by mow/xxz/ear 2000-MAR-08