

Typhoid Fever (Salmonella Typhi)

BASIC EPIDEMIOLOGY

Infectious Agent

Salmonella enterica serovar Typhi (*S. Typhi*) is the etiologic agent of typhoid fever.

Transmission

Transmission primarily occurs through ingestion of food or water contaminated with the stool and sometimes urine of a typhoid fever case or an asymptomatic carrier of the organism. It has been documented that typhoid fever has been transmitted sexually from an asymptomatic carrier. Most cases of typhoid fever are travel-related and involve an exposure that occurred in an endemic region (i.e., primarily Asia, Africa, and Latin America). Humans are the only known reservoir of *S. Typhi*.

Incubation Period

Typically, ranges from 8 to 14 days. However, incubation can range from 3 to 60 days.

Communicability

Humans are infectious as long as bacteria are shed in their stool and/or urine. Shedding in stool occurs throughout the course of infection, usually lasting several days to several weeks, with 2-5% of cases becoming chronic carriers capable of excreting the organism for many months. Urinary shedding is less common than fecal shedding. Antibiotic use during the acute illness can prolong the carrier state. Both treated and untreated patients may become chronic carriers of the organism. The most common population for chronic carriers are middle-aged women with a history of biliary duct abnormalities, such as gallstones.

Clinical Illness

Symptoms typically include sustained fever (may reach 103-104 °F), headache, and malaise. Most adults experience constipation, rather than diarrhea. Additional symptoms include anorexia, bradycardia, splenomegaly, non-productive cough, rose spots on the trunk, mental dullness, slight deafness, parotitis, or the development of Peyer patches in the ileum, which may ulcerate and result in intestinal hemorrhage or perforation in 3% of cases. Despite antimicrobial treatment, relapses causing milder illness can occur in 15-20% of cases.

Severity

The severity of Typhoid Fever is dependent on multiple factors; e.g., age, prior exposure (via illness or vaccination), number of organisms ingested, virulence of the strain ingested, duration of illness (including time until treatment is initiated). Cases with mental or neurological symptoms have been associated with higher mortality rates. Mortality rates range from 10%-20% without treatment to 1% with access to antimicrobials.

DEFINITIONS

Clinical Case Definition

An illness caused by *Salmonella Typhi* that is often characterized by insidious onset of sustained fever, headache, malaise, anorexia, relative bradycardia, constipation or diarrhea, and nonproductive cough. However, many mild and atypical infections occur. Carriage of *S. Typhi* can be prolonged.

Laboratory Confirmation

- Isolation of *S. Typhi* from blood, stool, or other clinical specimen.

Case Classifications

- **Confirmed:** A clinically compatible case that is laboratory confirmed.
- **Probable:** A clinically compatible case with *S. Typhi* detected by use of culture independent laboratory methods (non-culture based), **OR**
- A clinically compatible case that is epidemiologically linked to a case that meets the probable or confirmed laboratory criteria for diagnosis

Note: a case should not be counted as a new case if laboratory results were reported within 365 days of a previously reported infection in the same individual, unless additional information is available indicating a separate infection

SURVEILLANCE AND CASE INVESTIGATION

Case Investigation

Local and regional health departments should promptly investigate all reports of *Salmonella Typhi*. Investigations should include an interview of the case or a surrogate to get a detailed exposure history.

Please use the **CDC Typhoid and Paratyphoid Fever Surveillance Report** available on the DSHS website: <http://www.dshs.state.tx.us/idcu/investigation/>.

Case Investigation Checklist

- Confirm laboratory results meet the case definition.
- Contact laboratory to determine if an isolate has been sent to the DSHS laboratory. If an isolate has not been sent, please request a specimen be submitted.
 - Note: The submission of *S. Typhi* isolates is not required by state law, but it is critical for the detection and investigation of outbreaks.
- Review medical records or speak to an infection preventionist or healthcare provider to verify case definition, identify possible risk factors and describe course of illness.
 - Use information from medical records to complete the CDC Typhoid and Paratyphoid Fever Surveillance Report.
- Interview the case to get travel history and other risk factor information.
 - Make special note of the case's travel history. If the case-patient does not report travel outside of the U.S., ask again about travel. If the answer is still negative, inquire about any visitors from a country where typhoid fever is endemic, especially any who might have stayed in the case-patient's household, prepared food, cared for, or had close contact with the case-patient. Ask about prior cases of typhoid fever among members of the household, extended family, or friends. Ask about consumption of raw or undercooked shellfish or bivalves (oysters, scallops etc.) If no history of travel to an endemic country, exposure to an imported case or history of consumption of raw or undercooked seafood is identified, call an EAIDU epidemiologist immediately to discuss the case.
 - Make special note if the case is a food worker. Food workers who are diagnosed with typhoid fever are subject to work exclusion requirements. See Exclusions.
 - Use the **CDC Typhoid and Paratyphoid Fever Surveillance Report** to record information from the interview.
 - If the case is not available or is a child, conduct the interview with a surrogate who would have the most reliable information on the case, such as a parent or guardian.
 - Provide education to the case or his/her surrogate about effective hand washing and food safety practices. See Prevention and Control Measures.
- Fax completed forms to DSHS EAIDU at 512-776-7616 or email securely to an EAIDU epidemiologist at FOODBORNETEXAS@dshs.texas.gov.
 - An EAIDU foodborne epidemiologist will fax the form (de-identified) to the CDC.
 - Please note that the CDC measures the proportion of interviews reported to CDC within 7 days of interview date, so please send the form as soon as possible.
 - For lost to follow-up (LTF) cases, please complete as much information as possible

- obtained from medical/laboratory records (e.g., demographics, symptomology, onset date, etc.) on the investigation form and fax/email securely to DSHSEAIDU noting case is LTF.
- Hospitalized cases should be followed until discharge and patient's outcome recorded on the:
 - Typhoid and Paratyphoid Fever Surveillance Report.
 - Initial reports can be sent to DSHS prior to discharge.
 - In the event of a death, copies of the hospital discharge or death summary should also be faxed to DSHS EAIDU or emailed to FOODBORNETEXAS@dshs.texas.gov.
 - If the case is part of an outbreak or cluster, see Managing Special Situations section.
 - All confirmed case investigations must be entered and submitted for notification in the NEDSS Base System (NBS). Please refer to the *NBS Data Entry Guidelines* for disease specific entry rules.

Prevention and Control Measures

- For those traveling to an endemic region:
 - Receive the Typhoid Fever immunization (1 to 2 weeks prior to travel, timeframe varies based on type of vaccine).
 - Only eat fresh raw fruit and vegetables that can be peeled, peel them yourself, don't eat the peels, and wash your hands before and after handling.
 - Avoid food and drinks sold from street vendors.
 - Avoid ice, frozen drinks, or other items made from an unknown water source.
 - Drink bottled water (or boil non-bottled water for >1min) and avoid swallowing tap water while showering and brushing teeth.
 - Carbonated water is safer to drink than non-carbonated water.
- Practice routine hand washing with soap and warm water, especially:
 - Before preparing or after handling or eating any food.
 - After going to the bathroom.
 - After changing a diaper.
 - After caring for someone with diarrhea.
 - After handling raw food.
- Avoid consuming raw or undercooked shellfish and bivalves (oysters, scallops, mussels etc.), especially in endemic countries.
- Avoid consuming raw milk, unpasteurized dairy products, and undercooked eggs

Exclusions

School/child-care:

Children with *Salmonella* Typhi should be excluded from school/child-care until they are free from fever and diarrhea for 24 hours without the use of fever or diarrhea suppressing medications.

Children must have three consecutive negative stools before being allowed to return to school. The stool specimens should be collected at least 24 hours apart and not sooner than 48 hours after the last dose of antibiotics, if antibiotics were given.

Food Employees:

Symptomatic food employees infected with *Salmonella* Typhi are to be excluded from work.

Food employees can be reinstated with approval from the Regulatory Authority and if the following condition is met:

- Medical documentation by a health practitioner stating that the food employee is free of infection from *Salmonella* Typhi.

Please see Guide to Excluding and Restricting Food Employees in Appendix A.

MANAGING SPECIAL SITUATIONS

Outbreaks

If a *Salmonella* Typhi outbreak is suspected, immediately notify the appropriate regional DSHS office or DSHS EAIDU at **(512) 776-7676**.

The local/regional health department should:

- Interview all cases suspected as being part of the outbreak or cluster.
- Request medical records for any case in your jurisdiction that died, was too ill to be interviewed, or for whom there are no appropriate surrogates to interview.
- Prepare a line list of cases in your jurisdiction. Minimal information needed for the line list might include patient name or other identifier, DSHS or laboratory specimen identification number, specimen source, date of specimen collection, date of birth, county of residence, date of onset (if known), symptoms, underlying conditions, treatments and outcome of case, and risky foods eaten, foods eaten leading up to illness, or other risky exposures, such as animal contact and travel, reported by the case or surrogate.

Line list example:

ID	Name	Age	Sex	Ethnicity	Onset	Symptoms	Food	Animal	Notes
1	NT	34	F	W/N	2/4/16	Bl. D, F	Chicken, eggs	Dog	Dog food
2	PR	2	M	U/U	1/30/16	V,D,F	Chicken, spinach	None	Brother ill

- If the outbreak was reported in association with an apparent common local event (e.g., party, conference, rodeo), a restaurant/caterer/home, or other possible local exposure (e.g., pet store, camp), contact hospitals in your jurisdiction to alert them to the possibility of additional *Salmonella* Typhi cases.
- If isolates have not already been submitted to the DSHS laboratory for confirmation and whole genome sequencing (WGS), request hospital/clinical labs submit isolates for confirmation and WGS testing. See Laboratory Procedures.
- Work with any implicated facilities to ensure staff, students, residents, and volunteers receive hand hygiene education, and review hygiene and sanitary practices currently in place including:
 - Policies on and adherence to hand hygiene
 - Storage and preparation of food
 - Procedures for changing diapers and toilet training
 - Procedures for environmental cleaning
- Recommend that anyone displaying symptoms seeks medical attention from a healthcare provider.
- Restrict individuals from handling food, engaging in child-care, healthcare work, or attending child-care, per the “Exclusions” portion of the Case Investigation section.
- Enter outbreak into NORS at the conclusion of the outbreak investigation. See Reporting and Data Entry Requirements section.

Whole Genome Sequencing (WGS) clusters:

- For clusters of cases with indistinguishable WGS patterns detected by CDC/PulseNet and/or the DSHS laboratory, a member of the DSHS EAIDU

- foodborne team will notify appropriate DSHS regional epidemiologists, usually by email, who will then notify appropriate local health departments of cases within their jurisdiction.
- The local/regional health department with cases in their jurisdiction should:
 - Interview the case patient, even if they have already been interviewed as part of a routine disease investigation, using the cluster specific questionnaire attached in the email notification.
 - Fax the completed questionnaire promptly within timeframe designated in cluster notification to DSHS EAIDU at **512-776-7616** or email securely to an EAIDU foodborne epidemiologist.
 - If the health department having jurisdiction of a case is unable to reach a case- patient after 3 attempts during normal working hours, and they are not able to call after hours, please call the DSHS regional office or DSHS EAIDU to discuss further.
 - If an interview is unattainable or the case is lost to follow-up, fax/securely email medical records and any case information to DSHS EAIDU.
 - Please complete as much information obtained from medical/laboratory records (e.g., demographics, symptomology, onset date, etc.) on investigation form and fax/email securely to DSHS EAIDU noting case is LTF.
 - Local/regional health department with cases will be notified by the EAIDU foodborne team of any CDC or DSHS conference calls and may participate, if able.

Note:

- If a food item or food establishment is implicated, the lead epidemiologist for foodborne diseases will notify the DSHS Division of Regulatory Services about the outbreak and the possibility of a common contaminated food source for the cases.
- Decisions about testing implicated food items can be made after consultation with an EAIDU foodborne epidemiologist and the DSHS Laboratory. The general policy is to test only food samples implicated in suspected outbreaks, not in single cases.

REPORTING AND DATA ENTRY REQUIREMENTS**Provider, School, Child-Care Facility, and General Public Reporting Requirements**

Confirmed and clinically suspected cases are required to be reported **within 1 week** to the local or regional health department or DSHS EAIDU at **(512) 776-7676**.

Local and Regional Reporting and Follow-up Responsibilities

Local and regional health departments should:

- Enter the case into NBS and submit an NBS notification on all **confirmed** and **probable** cases,
 - Please refer to the *NBS Data Entry Guidelines* for disease-specific entry rules.
 - A case should not be counted as a new case if laboratory results were reported within 365 days of a previously reported infection in the same individual, unless additional information is available indicating a separate infection. A notification can be sent as soon as the case criteria have been met. Additional information from the investigation may be entered upon completing the investigation.
- Fax completed Typhoid and Paratyphoid Fever Surveillance Report to DSHS EAIDU at **512-776-7616** or email securely to an EAIDU foodborne epidemiologist at FOODBORNETEXAS@dshs.texas.gov.

When an outbreak is investigated, local and regional health departments should:

- Report outbreaks within 24 hours of identification to the regional DSHS office or to

EAIDU at 512-776-7676

- Enter outbreak information into the **National Outbreak Reporting System (NORS)** at the conclusion of the outbreak investigation.
 - For NORS reporting, the definition of an outbreak is two or more cases of similar illness associated with a common exposure.
 - The following should be reported to NORS:
 - Foodborne disease, waterborne disease, and enteric illness outbreaks with person-to-person, animal contact, environmental contact, or an indeterminate route of transmission.
 - Enter outbreaks into NORS online reporting system at <https://wwwn.cdc.gov/nors/login.aspx>
 - Forms, training materials, and other resources are available at <http://www.cdc.gov/nors/>
- To request a NORS account, please email FoodborneTexas@dshs.texas.gov
 - Please put in Subject Line: NORS User Account Request
 - Information needed from requestor: name, email address, and agency name
 - After an account has been created a reply email will be sent with a username, password, and instructions for logging in.

LABORATORY PROCEDURES**CLINICAL SPECIMENS:**

Submission of *Salmonella* isolates for serotyping and whole genome sequence analysis (WGS) is available through the DSHS Laboratory and is highly encouraged but not required.

In an outbreak or other special situation, the DSHS Laboratory can culture raw stool or stool in transport medium (e.g., Cary-Blair media) for *Salmonella* Typhi. Contact an EAIDU foodborne epidemiologist prior to submitting raw stool or stool in transport medium for culture.

Specimen Collection

- Submit pure cultures on an agar slant at ambient temperature or 2-8°C (*ice pack*) as soon as possible to ensure viability.
- For raw stool or stool in transport medium, please refer to table below:

Specimen type	Transport time to lab from time of collection	Transport temperature
Raw stool	≤24 hours	4°C (ice pack)
Raw stool	>24 hours	Freeze immediately at ≤-70°C. Ship on dry ice.
Stool in transport solution/medium	Time of collection to ≤3 days	Room temp or 4°C (ice pack)
Stool in transport solution/medium	>3 days	Freeze immediately at ≤-70°C. Ship on dry ice.
All	*The above transport times are optimal for recovery of pathogenic organisms. In the interest of public health, specimens will be accepted up to 30 days from date of collection.	*The above transport temperatures are optimal for the recovery of pathogenic organisms. In the interest of public health, specimens will be accepted at non-optimal temperature transport.

* Note: Pathogen recovery rates decrease over time. For best results, submit ASAP.

Submission Form

- Use DSHS Laboratory G-2B form for specimen submission.
- Make sure the patient's name, date of birth and/or other identifier match exactly what is written on the transport tubes and on the G-2B form.
- Fill in the date of collection and select the appropriate test.
- If submitting as part of an outbreak investigation, check “Outbreak association” and write in name of outbreak.
- Payor source:
 - Check “IDEAS” to avoid bill for submitter

Specimen Shipping

- Ship specimens via overnight delivery.
- DO NOT mail on Friday, or state holiday, unless special arrangements have been pre-arranged with an EAIDU foodborne epidemiologist or DSHS Laboratory.
- Ship specimens to:

Laboratory Services Section, MC-1947 Texas
 Department of State Health Services Attn.
 Walter Douglass (512) 776-7569
 1100 West 49th Street
 Austin, TX 78756-3199

Causes for Rejection:

- Missing or discrepant information on form/specimen.
- Specimen not in correct transport medium
- Transport media was expired

FOOD SAMPLES AND ENVIRONMENTAL SWABS:

Testing of food and environmental swabs for *Salmonella* Typhi is available at the DSHS laboratory. Decisions about testing implicated food items can be made after consultation with an EAIDU foodborne epidemiologist and the DSHS Laboratory.

General policy

- The DSHS lab will only test food samples or environmental swabs from facilities implicated in a suspected outbreak (not associated with single cases).
- In outbreaks, the DSHS lab will not test food samples or environmental swabs unless a pathogen has been identified in a clinical specimen.
- Food samples or environmental swabs must be **collected by a registered sanitarian**

For further questions, please contact an EAIDU foodborne epidemiologist to discuss further.

Table 1: Guide to Salmonellosis, Paratyphoid Fever, Typhoid Fever Reporting and Surveillance Forms

<i>Salmonella</i> serotype	Reported in NEDSS as	Surveillance Form
<i>Salmonella</i> Typhi	Typhoid Fever	CDC Typhoid and Paratyphoid Fever Surveillance Report requested

<i>Salmonella</i> Paratyphi A, B*, or C	Salmonellosis	CDC Typhoid and Paratyphoid Fever Surveillance Report requested
all other <i>Salmonella</i> serotypes	Salmonellosis	no CDC or DSHS form requested unless part of outbreak investigation

**Salmonella* Paratyphi B var L(+) tartrate + (formerly var. Java) is associated with routine GI illness and is reported as Salmonellosis and no CDC or DSHS form is requested unless part of an outbreak investigation.

REVISION HISTORY

March 2021

- Updated Case Classifications under Definition section and lab information to replace PFGE with current WGS analysis.