The Disease and Its Epidemiology

A. Etiologic Agent

Typhoid fever is a systemic bacterial disease caused primarily by *Salmonella* Typhi (not to be confused with *Salmonella* Typhimurium). Paratyphoid fever is a similar illness, but is usually much milder and is caused by the organism *Salmonella* Paratyphi A or S. Paratyphi B or S. Paratyphi C (these three serotypes will be referred to in this chapter as “Paratyphi”).

B. Clinical Description

Typhoid fever has a different presentation than common salmonellosis. Initial symptoms typically include sustained fever, anorexia, lethargy, malaise, dull continuous headache and non-productive cough. Vomiting and diarrhea are typically absent, but constipation is frequently reported. During the second week of illness, there is often a protracted fever and mental dullness, which is how the disease got the name “typhoid,” which means “stupor-like.” After the first week or so, many cases develop a maculopapular rash on the trunk and upper abdomen. Other symptoms can include intestinal bleeding, slight deafness and parotitis. Mild and atypical infections are common, but as many as 10-20% of untreated infections may be fatal (the case-fatality rate is <1% with prompt antibiotic treatment). Relapses are not uncommon.

Persons infected with *S. Paratyphi* may develop paratyphoid fever, a milder version of typhoid fever, or may have a gastrointestinal illness consistent with common salmonellosis.

C. Reservoirs

Humans are the reservoir for *S. Typhi* and *S. Paratyphi*. Domestic animals may harbor *S. Paratyphi*, but this is rare. Chronic carriers are the most important reservoirs for *S. Typhi*. About 2-5% of typhoid fever cases become chronic carriers.

D. Modes of Transmission

*S. Typhi* is transmitted by ingestion of food or water contaminated with feces or urine of infected people or directly from person-to-person. Shellfish harvested from sewage-contaminated water are potential vehicles, as are fruits and vegetables grown in soil fertilized with human waste (“night soil”) in developing countries. Person-to-person transmission can also occur through certain types of sexual contact (e.g., oral-anal contact).
E. Incubation Period
The incubation period for typhoid fever ranges from 3 days to 2 months (depending on the infecting dose), with a usual range of 1 to 2 weeks. For paratyphoid fever, the incubation period is usually 1 to 10 days.

F. Period of Communicability or Infectious Period
The disease is communicable for as long as the infected person excretes S. Typhi or S. Paratyphi in the feces or urine. This usually begins about a week after onset of illness and continues through convalescence and for a variable period thereafter. If a carrier state develops, excretion could be permanent, although carriage may be eliminated with antibiotics. Less is known about the likelihood of becoming a chronic carrier after paratyphoid fever; however, it appears that persons with S. Paratyphi infections become carriers less frequently than person infected with S. Typhi.

G. Epidemiology
In the United States, approximately 400 cases of typhoid fever occur each year, and 70% of these are acquired while traveling internationally. Between 2010 and 2014, a median of five cases of typhoid fever and three cases of paratyphoid fever were reported each year in Colorado. Antimicrobial-resistant strains are becoming increasingly prevalent.

Colorado typhoid fever statistics are available at the CDPHE website: https://www.colorado.gov/pacific/cdphe/colorado-reportable-disease-data

Case Definition
Note: this chapter contains information about S. Typhi and S. Paratyphi infections. For case reporting purposes, persons infected with S. Paratyphi should be entered in CEDRS as cases of salmonellosis.

Typhoid Fever
Clinical Description
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. Many mild and atypical infections occur. Carriage of S. Typhi may be prolonged.

Laboratory Criteria for Diagnosis
Isolation (i.e., culture) of S. Typhi from blood, stool, or other clinical specimen.

Case Classification
| Confirmed: | A clinically compatible case that is laboratory confirmed. |
| Probable:  | A clinically compatible case that is epidemiologically linked to a confirmed case. |

Salmonellosis (use for paratyphoid fever)
Clinical Description
An illness of variable severity commonly manifested by diarrhea (sometimes bloody), abdominal pain, nausea, and sometimes vomiting. A mild typhoid fever-like illness may occur. Asymptomatic infections may occur and the organism may cause extra-intestinal infections.

Laboratory Criteria for Diagnosis
Isolation (i.e., culture) of Salmonella from a clinical specimen (including stool, blood, wound, and urine).
Case Classification

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<td>Confirmed:</td>
<td>A case that is laboratory confirmed. Confirmed cases include asymptomatic infections and infections at sites other than the gastrointestinal tract that are laboratory confirmed.</td>
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<tr>
<td>Probable:</td>
<td>A clinically compatible case that is epidemiologically linked to a confirmed case.</td>
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Reporting Criteria

What to Report to the Colorado Department of Public Health and Environment (CDPHE) or local health agency

- Confirmed and probable typhoid fever or salmonellosis (for paratyphoid fever) cases.
- Typhoid fever cases should be reported within 24 hours of diagnosis or a positive laboratory test.
- Cases should be reported using the Colorado Electronic Disease Reporting System (CEDRS), fax or telephone to CDPHE or local health departments. See below for phone and fax numbers.
- Suspected foodborne/enteric disease outbreaks should be reported to CDPHE or local health departments within 24 hours, even if the causative agent is not yet known.

Purpose of Surveillance and Reporting

- To identify cases for investigation and potential outbreaks
- To monitor trends in disease incidence

Important Telephone and Fax Numbers

CDPHE Communicable Disease Epidemiology Branch

- Phone: 303-692-2700 or 800-866-2759
- Fax: 303-782-0338
- After hours: 303-370-9395

CDPHE Microbiology laboratory: 303-692-3480


State Laboratory Services

Laboratory Testing Services Available

The services listed below are for public health purposes; clinical laboratories are not charged for these services.

- CDPHE Laboratory requests all S. Typhi and S. Paratyphi isolates or clinical material from clinical laboratories be submitted for serotyping and pulsed-field gel electrophoresis (PFGE) testing (i.e., molecular subtying).
- The CDPHE Laboratory will test bulk stool or rectal swab specimens from cases and contacts of cases for the presence of S. Typhi or S. Paratyphi in situations where such testing is warranted for public health purposes.
  Note: Authorization by the CDPHE Communicable Disease Branch is required before submitting bulk stool, rectal swabs, or implicated food items to the CDPHE Laboratory.
- For more information on S. Typhi or S. Paratyphi testing, contact the CDPHE Microbiology Laboratory.
- See Disease Control Measures, section E (Environmental Measures), for more information about food testing.
Case Investigation

Typhoid fever cases should be reported within 24 hours and should be interviewed as soon as possible, including interviews of symptomatic contacts of confirmed cases and others whose symptoms are suspected to be caused by S. Typhi. The goals of typhoid fever case investigation are to determine:

- Potential source of infection (In Colorado, the majority of typhoid fever cases report international travel during their incubation period. If a case reports appropriately timed international travel then the focus of the rest of the interview should be disease control efforts. If a case has had no international contact, then an intense investigation should occur to determine the source of the patient’s infection.)
- If others are ill
- If the case or the case’s contacts may be a source of infection for others (e.g., a high-risk worker or a diapered child), and if so, prevent further transmission
- When the case can be released from public health surveillance (i.e., has not become a carrier, as demonstrated by three consecutive negative stools)

Local public health agencies have primary responsibility for interviews of sporadic cases in their jurisdictions. Smaller agencies should consult with regional epidemiologists to establish primary responsibility for interviews of sporadic cases. CDPHE is available to assist with case investigation.

A. Case Investigation / Forms

For single cases, complete all sections of the CDPHE Typhoid Fever Case Investigation Form. Interview all cases, regardless of specimen source (stool, blood, wound, urine, etc.).

When the interview is done, complete the CEDRS record for all cases and send the completed form to CDPHE. CDPHE staff will extract necessary information and transmit the required data to CDC on the CDC form. If an outbreak is suspected, please contact CDPHE for assistance.

Because a significant proportion of persons infected with S. Typhi become chronic carriers, every typhoid fever case should be followed by public health until three consecutive stool cultures taken 24 hours apart, beginning at least one month after onset of illness (and no sooner than 48 hours after antibiotics are completed), are negative. Bulk stool is preferred over rectal swabs for this testing. Urine should also be tested if the case has a history of schistosomiasis or urinary tract disease. If cultures from the first round of testing are positive, the patient should be retested after at least one month has passed. This testing pattern should continue until a patient has three consecutive negative cultures as described above.

During this time, if the case does not work in a sensitive occupation (such as child care, health care, or food handling) s/he may return to work, provided symptoms have resolved. Cases undergoing follow up testing should be instructed in good hygiene, not to prepare food for others, and to alert the health department if they move so that continued follow up can be provided. Patients are not considered chronic carriers until they have continued to test positive for at least one year after initial illness.

Persons infected with S. Paratyphi are usually reported as salmonellosis cases. Serotyping information may not be available for several days, often not until the initial case investigation as a salmonellosis case is complete. For this reason, CDPHE may contact local public health agencies and request additional information be collected from cases who subsequently are found to have serotypes Paratyphi A, B or C. Local public health agencies that are aware of a paratyphi case before interviewing should use the typhoid fever case investigation form. The follow up needed for paratyphoid fever cases is considerably less standardized. CDPHE recommends that local public health agencies follow the guidance for salmonellosis cases and perform no additional follow up for cases who do not work in sensitive occupations (i.e., no requirement to obtain negative stool cultures). However, if a case works in a sensitive occupation (such as child care, health care, or food handling), then CDPHE strongly recommends that the local public health agency obtain three negative stools before allowing the case to resume normal work activities and follow the additional guidance in Case Investigation, section A (Case Investigation/Forms) for typhoid fever.
B. Identify and Evaluate Contacts

Symptomatic Contacts

- Contacts of a confirmed case who are ill with symptoms consistent with typhoid fever should be referred to a health care provider for evaluation and testing. Contacts who report symptoms that have resolved should be asked to submit stool for testing. All contacts with current or resolved symptoms should be considered probable cases and should be handled the same as confirmed cases for disease control purposes. See Disease Control Measures section, below.
- Complete the Typhoid Fever Case Investigation Form for all epidemiologically-linked individuals having symptoms compatible with typhoid fever and fax the form to CDPHE.

Asymptomatic Contacts

- Ask all household and other close contacts about sensitive occupations, food handling, childcare, and/or school.
- Contacts who are in sensitive occupations (e.g., food handlers, health care, child care) should not work until two negative stool cultures have been obtained at least 24 hours apart.
- Provide information about symptoms and preventive measures. See Disease Control Measures, section C (Education).

C. Reported Incidence Is Higher than Usual/Outbreak Suspected

If you suspect an outbreak, investigate to determine the source of infection and mode of transmission. Consult with a CDPHE Communicable Disease Epidemiologist. CDPHE staff can assist local public health agencies to investigate outbreaks and determine a course of action to prevent further cases, and can coordinate surveillance of cases that cross county lines.

Disease Control Measures

CDC has information for the public on their website at: https://www.cdc.gov/typhoid-fever/index.html

A. Treatment

Typhoid fever can be treated with antibiotics, however antimicrobial resistance is a growing problem with S. Typhi. Persons given antibiotics usually begin to feel better within 2 to 3 days, and deaths rarely occur. However, persons who do not get treatment may continue to have fever for weeks or months, and as many as 20% may die from complications of the infection.

B. Prophylaxis

No prophylactic treatment or vaccination of close contacts is recommended. For people traveling to a country where typhoid is common, vaccination against typhoid should be considered. The vaccination does not protect against paratyphoid fever. Typhoid fever travel and vaccination information is available at the CDC’s website: http://wwwnc.cdc.gov/travel/diseases/typhoid.

C. Education

- Educate case and household contacts on proper hand washing techniques.
- Always wash hands thoroughly with soap and water before eating or preparing food, after using the toilet, after changing diapers, and after touching pets or other animals (especially stool of puppies and kittens with diarrhea).
- After changing diapers, wash your hands AND the child’s hands.
- In a childcare setting, dispose of stool and soiled diapers in a sanitary manner.
- Avoid sexual practices that may permit fecal-oral transmission. Latex barrier protection should be emphasized as a way to prevent the spread of typhoid fever to sexual partners as well as being a way to prevent the exposure to and transmission of other pathogens.
D. Managing Special Situations

Food Handlers
- Food handlers with S. Typhi must be excluded from work.
- Food handlers may only return to work after producing three consecutive negative stool specimens each taken no less than 24 hours apart, at least 48 hours after antibiotics are completed, and collected no sooner than 1 month after illness onset.

Childcare/ Preschool
- Children or staff members in a childcare center who test positive for S. Typhi should be excluded until they have produced three consecutive negative stool specimens each taken no less than 24 hours apart, at least 48 hours after antibiotics are completed, and collected no sooner than 1 month after illness onset. However, if the case is toilet-trained and hygienic practices at the center are deemed excellent, it may be possible to shorten the duration of exclusion.
- Parents of cases should be counseled not to take their children to another childcare facility during this period of exclusion.
- In addition, stool specimens from all staff and attendees in the same classroom should be tested and all infected individuals excluded as well.
- Since most staff are considered food handlers, see Disease Control Measures, section D (Managing Special Situations), Food Handlers above.
- Reinforce the importance of meticulous handwashing with childcare center staff.

School
In general, school-aged children may return to school once they are feeling well enough to attend and have not had diarrhea for at least 24 hours. As with all cases, public health follow-up should continue until the case has three negative stools as described above.
- If there are concerns about the case’s hygiene (e.g., the case has developmental disabilities and wears diapers) the case should not return to school until he/she has submitted three consecutive negative stool specimens each taken no less than 24 hours apart, at least 48 hours after antibiotics are completed, and collected no sooner than 1 month after illness onset.
- Students or staff who handle food and have a S. Typhi infection must not prepare food until they are cleared by public health (three negative stools). See Disease Control Measures, section D (Managing Special Situations), Food Handlers.

Community Residential Programs (facilities serving the developmentally disabled)
Actions taken in response to a case of typhoid fever in a community residential program will depend on the type of program and the level of functioning of the residents. In general:
- Residents with typhoid fever should be placed on contact precautions until their symptoms subside.
- If the resident has questionable hygiene, is incontinent, or there are other concerns, the resident should remain on contact precautions symptoms subside and until he/she has submitted three consecutive negative stool specimens each taken no less than 24 hours apart, at least 48 hours after antibiotics are completed, and collected no sooner than 1 month after illness onset.
- Residents with typhoid fever must not handle or prepare food for others until their symptoms have resolved and until have had provided three consecutive stool cultures as described above.
- Staff members who provide direct patient care (e.g., feed patients, give mouth or denture care, or give medications) are considered food handlers and are subject to foodhandler restrictions. See Disease Control Measures, section D (Managing Special Situations), Food Handlers.

Patients and Staff in Health Care Facilities (Hospitals and Long Term Care Facilities)
Hospitals and long term care facilities generally have written infection control policies and procedures for handling cases of communicable disease among patients and staff members. If a facility does not have such policies in place, provide the following recommendations:
- Patients with typhoid fever should be placed on contact precautions until their symptoms subside.
- If the patient has questionable hygiene, is incontinent, or there are other concerns, the patient should remain on contact precautions until symptoms subside and until three consecutive negative stool
specimens each taken no less than 24 hours apart, at least 48 hours after antibiotics are completed, and collected no sooner than 1 month after illness onset.

- Healthcare workers should be excluded from work until symptoms subside and until they have provided three consecutive stool cultures as described above.

E. Environmental Measures

- Implicated food items must be removed from the environment.
- A decision about testing suspect/implicated food items must be made in consultation with CDPHE Communicable Disease Branch.
- If a commercial product is suspected, CDPHE Communicable Disease Branch will coordinate follow-up with the CDPHE Division of Environmental Health and Sustainability and relevant outside agencies.
- The Instructions for Enteric and Food Specimen Packaging and Shipping are available on the Specimen Collection Guidelines webpage.

References


CDC Website: http://www.cdc.gov (click on “Diseases and Conditions”)