Typhoid

Also known as Typhoid fever is a systemic infection caused by *Salmonella typhi*, usually through ingestion of contaminated food or water or through close contact with someone who's infected. Typhoid fever is rare in industrialized countries. However, it remains a serious health threat in the developing world, especially for children. It occurs predominantly in association with poor sanitation and lack of clean drinking water. According to the most recent estimates, between 11 and 21 million cases and 128 000 to 161 000 typhoid-related deaths occur annually worldwide. A similar but often less severe disease, paratyphoid fever, is caused by *Salmonella paratyphi* A and B (or uncommonly Paratyphi C).

Occurrence and history

Epidemics in history

430–424 BC: Typhoid fever epidemic ravages Athens, whiping out about one third of its population.

1861–1865- About 80,000 soldiers die as a result of typhoid fever or dysentery in the American Civil War.

1897–1898- Typhoid fever epidemic breaks out in Maidstone, England, involving 2,000 people and claiming 143 lives.

1899–1902- Second Boer War. Typhoid fever is estimated to be the cause of twice as many deaths as from weapons.

1907–1915- Mary Mallon "Typhoid Mary"

Mary Mallon, also commonly known as Typhoid Mary, was the most widely known carrier of typhoid fever. She was the first person in the United States to be identified as a carrier of the pathogen responsible for the disease, without experiencing symptoms related to the condition. She worked as a cook and throughout her career is thought to have infected 51 people, of which 3 cases proved fatal. She was forcibly isolated for quarantine purposes twice in her life, once in 1907 and again in 1915. The second time she was not released and she died in isolation at the age of 69.

1927- Typhoid fever epidemic breaks out in Montreal. 5,353 cases and 538 deaths are recorded. Milk is found to be the source of the outbreak.

1972–1973- Typhoid fever epidemic breaks out in Mexico City, involving 9,000 cases. Contamination of a municipal water supply is found to be the source of the outbreak.

1975–1976- Typhoid fever epidemic breaks out in Maharashtra. 2,343 cases and 39 deaths are calculated.

1997- Quinolone-resistant typhoid breaks out in Tajikistan, involving 8,000 people and claiming 150 lives.

2001- Typhoid fever epidemic breaks out in vaccinated members of the French Armed Forces in Ivory Coast.

2012- Typhoid fever epidemic breaks out in Harare, Zimbabwe. Contaminated water sources are associated.

In industrialized nations, water sanitation and food handling improvements have reduced the number of cases. Developing nations, such as those found in parts of Asia and Africa, have the highest rates of typhoid fever. These areas have a lack of access to clean water, proper sanitation systems, and proper health-care facilities.

Discovery and development of vaccine

William Budd, a doctor in Bristol demonstrated in 1873, that typhoid fever could be transmitted by a specific toxin present in excrement and that the contamination of water by the feces of patients was responsible for that propagation. It was Karl Joseph Eberth, doctor and student of Rudolf Virchow, who in 1879 discovered the bacillus in the abdominal lymph nodes and the spleen. He had published his observations in 1880 and 1881. His discovery was then verified by Georg Theodor August Gaffky (1850–1918) in 1884. The genus "*Salmonella*" was named after Daniel Elmer Salmon, an American veterinary pathologist, who was the administrator of the USDA research program, and thus the organism was named after him, despite the fact that a variety of scientists had contributed to the quest. The first effective vaccine for typhoid was developed by Almroth Edward Wright and was introduced for military use in 1896.

Throughout the 20th century, the incidence of typhoid fever steadily declined, which was due to the introduction of vaccinations and improvements in public sanitation and hygiene. In particular, the chlorination of drinking water made a significant impact on the number of individuals affected by the disease.

Route of transmission (Fecal-oral route)

The bacteria that cause typhoid fever spread through contaminated food or water and occasionally through direct contact with someone who is infected. In developing nations, where typhoid fever is established (endemic), most cases result from contaminated drinking water and poor sanitation. The majority of people in industrialized countries pick up typhoid bacteria while traveling and spread it to others through the fecal-oral route.

This means that *Salmonella typhi* is passed in the feces and sometimes in the urine of infected people. A person can contract the infection by eating food handled by infected person with contaminated hands or by drinking water contaminated with the bacteria. After the ingestion of contaminated food or water, the Salmonella bacteria invade the small intestine and enter the bloodstream temporarily. The bacteria are carried by white blood cells in the liver, spleen, and bone marrow, where they multiply and reenter the bloodstream. People develop symptoms, including fever, at this point. Bacteria invade the gallbladder, biliary system, and the lymphatic tissue of the bowel. Here, they multiply in high numbers. The bacteria pass into the intestinal tract and can be identified in stool samples.

Typhoid carriers

Even after treatment with antibiotics, a small number of people who recover from typhoid fever continue to harbor the bacteria in their intestinal tracts or gallbladders, often for years. These people, called chronic carriers, shed the bacteria in their feces and are capable of infecting others, although they no longer have signs or symptoms of the disease themselves. About 3%-5% of people become carriers of the bacteria after the acute illness.

Risk factors involved

Typhoid fever remains a serious worldwide threat — especially in the developing world — affecting an estimated 26 million or more people each year. The disease is established (endemic) in India, Southeast Asia, Africa, South America and many other areas.

Worldwide, children are at greatest risk of getting the disease, although they generally have milder symptoms than adults do.

Symtoms:

Symptoms may vary from mild to severe, and usually develop gradually- often appearing one to three weeks after exposure to the disease.

Fever that starts low and increases daily, possibly reaching as high as 104.9 F (40.5 C), headache, weakness and fatigue, muscle aches, sweating, dry cough, loss of appetite and weight loss, abdominal pain, diarrhea or constipation, rash with rose coloured spot and swollen

abdomen. Later on the patient may develop serious complications including intestinal bleeding or holes (perforations) in the intestine. This may develop in the third week of illness causing intestinal contents to leak into abdominal cavity and triggering signs and symptoms such as severe abdominal pain, nausea, vomiting and bloodstream infection (sepsis). This life-threatening complication requires immediate medical care. Surgery may be needed to repair the intestinal damage.

Diagnosis:

The bacteria can be identified in blood, bone marrow and stool cultures. The following tests are implied for the diagnosis:

Widal test: It is used to identify specific antibodies in serum of people with typhoid by using antigen-antibody interactions. In this test, the serum is mixed with a dead bacterial suspension of salmonella having specific antigens on it. If the patient's serum is carrying antibodies against those antigens then they get attached to them forming clumping which indicated the positivity of the test. If clumping does not occur then the test is negative. The Widal test is time-consuming and prone to significant false positive results. The test may also be falsely negative in the early course of illness.

Tubex test:

Tubex test contains two types of particles brown magnetic particles coated with antigen and blue indicator particles coated with O9 antibody. During the test, if antibodies are present in the serum then they will get attached to the brown magnetic particles and settle down at the base and the blue indicator particles remain up in the solution giving a blue color that indicates positivity of the test.

If the serum does not have an antibody in it then the blue particle gets attached to the brown particles and settled down at the bottom giving no color to the solution which means the test is negative and they do not have typhoid

Treatment:

The disease is treated with antibiotics such as azithromycin, fluoroquinolones, or third-generation cephalosporins. Resistance to these antibiotics has been developing, which has made treatment of the disease more difficult.

Prevention and eradication:

Sanitation and hygiene are important to prevent typhoid. It can only spread in environments where human feces are able to come into contact with food or drinking water. Careful food preparation and washing of hands are crucial to prevent typhoid. According to statistics from the United States Centers for Disease Control and Prevention, the chlorination of drinking water has led to dramatic decreases in the transmission of typhoid fever in the United States

Three typhoid vaccines are currently recommended by WHO for control of endemic and epidemic typhoid fever:

- an injectable typhoid conjugate vaccine (TCV), consisting of Vi polysaccharide antigen linked to tetanus toxoid protein licensed for children from 6 months of age and adults up to 45 years of age;
- an injectable unconjugated polysaccharide vaccine based on the purified Vi antigen (known as Vi-PS vaccine) for persons aged two years and above; and
- an oral live attenuated Ty21a vaccine in capsule formulation for those over six years of age.

Among the available typhoid vaccines, TCV is preferred at all ages for routine programmatic use in view of its improved immunological properties, suitability for use in younger children and expected longer duration of protection. WHO has recommended that all typhoid fever vaccination programmes should be implemented in the context of other efforts to control the disease, including health education, water quality and sanitation improvements, and training of health professionals in diagnosis and treatment.

Neither vaccine is 100 percent effective, and require repeat immunizations, as vaccine effectiveness diminishes over time. Vaccines usually are reserved for those who may be exposed to the disease or are traveling to areas where typhoid fever is common.

Because the vaccine won't provide complete protection, the following guidelines have been recommended while traveling to high-risk areas:

- Frequent hand-washing in hot, soapy water is the best way to control infection. Wash before eating or preparing food and after using the toilet. Carry an alcohol-based hand sanitizer for times when water isn't available.
- **Avoid drinking untreated water.** Contaminated drinking water is a particular problem in areas where typhoid fever is endemic. For that reason, drink only bottled water or canned or bottled carbonated beverages, wine and beer. Carbonated bottled water is safer than uncarbonated bottled water is.

- **Avoid raw fruits and vegetables.** Because raw produce may have been washed in unsafe water, avoid fruits and vegetables that you can't peel, especially lettuce. To be absolutely safe, you may want to avoid raw foods entirely.

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