

ENTERIC DISEASES

Focus on foodborne diseases

Burden of Disease: Foodborne diseases result in significant morbidity and mortality worldwide, affecting persons of all ages, but in particular individuals living in low- and middle-income regions of the world and children younger than five years of age. The full extent and economic cost of unsafe food remains unknown. A report prepared by the World Health Organization Foodborne Disease Burden Epidemiology Group estimates that 31 foodborne hazards resulted in an estimated 600 (95% uncertainty interval (UI) 420-960) million foodborne illnesses and 420 000 (95% UI 310 000- 600 000) deaths globally in 2010.

Epidemiology: Foodborne diseases result from ingestion of a wide variety of foods contaminated with pathogenic microorganisms (viruses, bacteria, parasites, marine organisms, fungi), microbial toxins (bacterial, marine organisms, fungal) or chemicals (e.g. organophosphates, carbamates). Foodborne diseases can result from contamination of food at any stage of the food production, delivery and consumption chain as well as through unsafe food storage and processing, or environmental contamination. Most foodborne agents can also be transmitted through routes other than food, such as ingestion of contaminated water or contact with infected farm animals, pets or humans. Over two hundred foodborne diseases have been described.

Norovirus is responsible for almost 20% of the total foodborne diseases burden worldwide; common food vehicles include fresh and ready-to-eat produce, fresh and frozen berries, raw/ undercooked bivalve mollusks. *Salmonella*, *Campylobacter*,

and enterohaemorrhagic *Escherichia coli* are among the most common bacterial foodborne pathogens. Foods implicated in outbreaks of salmonellosis include eggs, meat (particularly poultry), fresh produce, dairy products, and nuts; campylobacteriosis is mainly associated with meat (particularly poultry), and raw dairy products; and enterohaemorrhagic *Escherichia coli* is associated with meat (particularly beef), and fresh produce. *Listeria* is found in a range of food commodities, including unpasteurised dairy products, meat and seafood, fresh produce, and various ready-to-eat foods; while hepatitis A virus spreads typically through raw or undercooked seafood or contaminated raw produce. Infected food handlers can also be the source of food contamination for several pathogens, particularly norovirus, hepatitis A, and salmonellosis.

The landscape of foodborne diseases is ever expanding. Noroviruses are now recognised as the commonest cause of foodborne disease in the United States, known agents are newly identified as aetiological agents of foodborne illness (including enteroaggregative *E. coli*), novel diarrhoeagenic *E. coli* strains that produce Shiga toxin have emerged, and many pathogens have developed drug resistance. Previously unrecognised food vehicles have been identified as important sources of infection, for example fresh produce, nuts, and frozen foods.

Foodborne diseases are often recognised by the typical clinical features that they produce and putative incubation period. Features of the more common infectious foodborne diseases are summarised in Table 1.

Table 1: Common infectious causes of foodborne disease

| Aetiologic Agent | Incubation Period | Clinical Syndrome |
|--|-----------------------------|---|
| <i>Bacillus cereus</i> – vomiting toxin | 1-6 hours | Vomiting; some patients with diarrhoea; fever uncommon |
| <i>Bacillus cereus</i> –diarrhoeal toxin | 6-24 hours | Diarrhoea, abdominal cramps, and vomiting in some patients; fever uncommon |
| <i>Campylobacter jejuni/coli</i> | 2-10 days | Diarrhoea (often bloody), abdominal pain, fever |
| <i>Clostridium perfringens</i> | 6-24 hours | Diarrhoea, abdominal cramps; vomiting and fever uncommon |
| <i>Escherichia coli</i> -enterohemorrhagic/Shiga toxin-producing (<i>E.coli</i> O157:H7 and others) | 1-10 days; usually 3-4 days | Diarrhoea (often bloody), abdominal cramps (often severe), little or no fever |
| <i>Escherichia coli</i> -enterotoxigenic (ETEC) | 6-48 hours | Diarrhoea, abdominal cramps, nausea; vomiting and fever less common |
| <i>Escherichia coli</i> -enteropathogenic (EPEC) | Variable | Diarrhoea, fever, abdominal cramps |
| <i>Escherichia coli</i> -enteroinvasive (EIEC) | Variable | Diarrhoea (might be bloody), fever, abdominal cramps |

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| Aetiologic Agent | Incubation Period | Clinical Syndrome |
|--|--|--|
| <i>Listeria monocytogenes</i> - invasive disease | 2-6 weeks | Meningitis, neonatal sepsis, fever |
| <i>Listeria monocytogenes</i> - diarrhoeal disease | Unknown | Diarrhoea, abdominal cramps, fever |
| Nontyphoidal <i>Salmonella</i> | 6 hours – 10 days; usually 6-48 hours | Diarrhoea, often with fever and abdominal cramps |
| <i>Salmonella</i> Typhi | 3-60 days; usually 7-14 days | Fever, anorexia, malaise, headache, and myalgia; sometimes diarrhoea or constipation |
| <i>Shigella</i> spp. | 12 hours-6 days; usually 2-4 days | Diarrhoea (sometimes bloody), often accompanied by fever and abdominal cramps |
| <i>Staphylococcus aureus</i> | 30 minutes- 8 hours; usually 2-4 hours | Vomiting, diarrhoea |
| Norovirus | 18-72 hours; usually 24-48 hours | Abdominal cramps, vomiting, diarrhoea; fever in about 50% of cases |
| Hepatitis A | 15-48 days; usually about 30 days | Systemic illness (typically jaundice) |

Modified from: Centers for Disease Control and Prevention; Guide to Confirming an Etiology in Foodborne Disease Outbreak

Individuals at extremes of age, young children, pregnant women and immunocompromised persons are at higher risk of acquiring foodborne disease or experiencing more severe illness. Some foodborne illnesses can result in long-term sequelae such as impaired renal function following haemolytic uraemic syndrome (induced by Shiga toxin-producing *Escherichia coli*), reactive arthritis following campylobacteriosis, shigellosis or nontyphoidal salmonellosis, and Guillain-Barré syndrome following campylobacteriosis.

Sporadic foodborne disease: Most foodborne illnesses are sporadic and many people with foodborne illness do not seek medical care. The healthcare practitioner should always consider a foodborne (or waterborne) origin of a gastrointestinal illness and the potential that more people are affected.

Foodborne disease outbreaks: A foodborne disease outbreak should be considered when an acute illness, especially with gastrointestinal or neurologic manifestations, affects two or more people who shared a meal. Outbreaks may be localised to a few people who ate a common meal or product or geographically widespread, for example if food is contaminated prior to distribution and is widely consumed by many people in many areas. In South Africa, a foodborne disease outbreak is a category 1 notifiable medical condition, defined as 'an incident in which two or more persons experience a similar illness (gastrointestinal) and are epidemiologically linked'. Reporting of potential outbreaks is essential to trigger timely investigation.

Laboratory diagnosis: The majority of acute diarrhoeal episodes are mild, self-resolving and uncomplicated and do not require diagnostic testing. However, in the context of a possible outbreak, laboratory diagnosis is important to identify additional cases and investigate possible sources of infection. Specimens from multiple patients, as well as samples from food, food preparation environments and food handlers may be tested to identify the aetiological agent. Bacterial pathogens are typically isolated by culture, which also allows for antimicrobial susceptibility testing and subtyping. Parasites require microscopic visualisation, and antigens or toxins of infectious agents may be detected in stool or food samples. Not all laboratories are able to offer testing for the relevant pathogens; some bacteria have specific growth requirements, and testing for the preformed enteric toxins of *S. aureus*, *B. cereus* and *C. perfringens* is only available at public health laboratories or at food microbiological laboratories. Molecular diagnostic tests are required to detect enteric viruses.

Management: Supportive treatment, particularly fluid and electrolyte replacement (over-the-counter oral rehydration fluids or intravenous solutions) is the cornerstone of management of foodborne illnesses. Antiemetics and antimotility agents are usually not recommended for children and are contraindicated in adult patients with high fever, bloody diarrhoea or faecal leucocytes indicating invasive diarrhoea. Most bacterial diarrhoeal diseases are self-limiting and do not require antibiotic treatment in otherwise healthy hosts not at the extremes of age. Antibiotic therapy is indicated only in selected bacterial infections (See Table 2).

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Table 2: Antibiotic therapy for common bacterial pathogens causing foodborne disease

| Usefulness of Antibiotics | Example organisms |
|---|--|
| Antibiotics are indicated for patients with moderate- to- severe disease only | <i>Shigella</i> spp; enteroinvasive <i>Escherichia coli</i> , enterotoxigenic <i>E. coli</i> |
| Antibiotics are only indicated for patients with severe or prolonged illness, or in immunocompromised hosts | <i>Campylobacter jejuni</i> |
| Antibiotics may prolong excretion of organisms. Antibiotics should only be used in persons at high risk of developing invasive disease (adults >50 years with atherosclerosis, infants <12 months, persons with cardiac or joint prostheses, immunocompromised persons) | Nontyphoidal <i>Salmonella</i> spp. |
| Antibiotics have demonstrated no clear benefit and in some studies, particularly in children, may increase risk for complications (such as haemolytic-uraemic syndrome). | Shiga toxin-producing <i>E. coli</i> |

Modified from Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 8th Ed.

Prevention: Contamination of food may occur at any stage in the process from 'farm-to-table'. While the primary responsibility for food safety lies with food producers, a large proportion of foodborne disease incidents are caused by foods improperly

prepared or mishandled at home, in food service establishments or at markets. Food handlers, consumers and travelers should practice the WHO's 'Five Keys to Safer Food'; the core messages of which are: (1) keep clean; (2) separate raw and cooked; (3) cook thoroughly; (4) keep food at safe temperatures; and (5) use safe water and raw materials. Travelers should also make use of available vaccines to prevent foodborne diseases.