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Food-Borne Diseases

INTRODUCTION

The term Food-borne diseases, including food-borne intoxications and food-borne infections, covers illnesses acquired through consumption of contaminated food, and are also frequently referred to as food poisoning.

Worldwide, food-borne diseases are a major health burden leading to high morbidity and mortality. The global burden of infectious diarrhoea involves 3-5 billion cases and nearly 1.8 million deaths annually, mainly in young children, caused by contaminated food and water. According to the CDC, an estimated 76 million cases of food-borne disease are reported annually in the United States with approximately 5000 deaths.

Food-borne disease outbreaks are defined as the occurrence of 2 or more cases of a similar illness resulting from ingestion of a common food or when observed number of cases of a particular disease exceeds the expected number. These can be confirmed (when at least one causal agent is identified) or suspected (based on clinical and epidemiological information). Although most cases are sporadic, these diseases draw attention due to outbreaks, investigation of which can help in initiating control measures.

1. Food poisoning of Infectious origin

In India, food poisoning affecting 78 personnel was reported in 1998 by the armed forces at high altitude, wherein *Salmonella enteritidis* was identified as the etiological agend and frozen fowl was the implicated food source for the outbreak. A food poisoning outbreak due to *Salmonella paratyphi* A that affected 33 people, due to vegetarian food was reported from Yavatmal (Maharashtra) in 1995. Two separate food poisoning outbreaks due to *Salmonella weltevreden* and *Salmonella wein* affecting 34 and 10 people respectively, due to non-vegetarian food (chicken and fish) were reported from Mangalore in 2008-09.

Environmental studies in the nineties documented the presence of Salmonella sp from the hands of butchers as well as abattoir equipment from Punjab. Nearly 8% of eggs and 7% of egg-storing trays from retail markets in Coimbatore were found to be contaminated with Salmonella sp (mainly *Salmonella enteritidis*) in 2006. *Listeria monocytogenes* was isolated from 105 (5%) milk samples collected from 52 farms in Maharashtra in 2007. Enterotoxigenic *Bacillus cereus* was isolated from 29% of fish (finfish, prawns and clams) samples in a study from Cochin in 2009.

In 1995, outbreaks due to *Clostridium perfringens* (in which mutton and peas were implicated as the food source) and *Bacillus cereus* (due to a bakery product) were reported, and in 2002, watermelon was implicated as the food source in another outbreak affecting 6 members of a family. A food poisoning outbreak due to *Yersinia enterocolitica* was reported in 1997 from Tamil Nadu affecting 25 people, in which buttermilk was incriminated as the food source. An outbreak of food-borne botulism due to *Clostridium butyricum* affecting 34 students from a residential school in Gujarat was reported in 1996, and the food sample found to be contaminated was sevu (crisp made from gram flour). An outbreak of *Staphylococcal aureus* food poisoning due to contaminated “bhalla” (a snack made up of potato balls fried in vegetable oil) affected more than 100 children and adults in Madhya Pradesh in 2007. A food-borne outbreak affecting 130 nurses from a Delhi hospital, associated with

eating salad sandwiches, was diagnosed to be due to Norwalk-like virus in 2002.

2. Chemical Food poisoning

Toxic compounds like lectins and glycoalkaloids are naturally present in some vegetables like potatoes and legumes. Many marine toxins produced by dinoflagellates occurring secondarily in molluscs and mussels can lead to food poisoning in humans. Other toxic compounds like pesticides, heavy metals and toxins of fungal or bacterial origin could also contaminate food during manufacture, storage or transportation.

India's production of pesticides was 85,000 metric tonnes in 2004, and rampant use of these chemicals has lead to several short-term and long-term effects. The first report of pesticide poisoning in India was from Kerala in 1958, where over 100 people died after consuming food made from wheat flour contaminated with parathion. In 1997, a food-borne outbreak of organophosphate (malathion) poisoning affected 60 men (and was fatal for one) who ate a communal lunch prepared from food stored in open jute bags which was contaminated with the pesticide sprayed in the kitchen that morning. It is estimated that 51% of food commodities are contaminated with pesticide residues in India.

CLASSIFICATION OF FOOD-BORNE ILLNESSES

- ***Food-borne infections*** - caused by consuming foods or liquids contaminated with bacteria, viruses, or parasites. These pathogens cause infection by:
  - Invading and multiplying in the lining of the intestines and/or other tissues
  - Invading and multiplying in the intestinal tract and releasing a toxin (bacteria only)
- ***Food-borne intoxications*** - caused by consuming foods or beverages already contaminated with a toxin. Sources of toxins are as follows:
  - Certain bacteria (pre-formed toxins)
  - Poisonous chemicals
  - Natural toxins found in animals, plants, and fungi

Mycotoxins of importance in India include alfatoxins, fumonisins, trichothecenes, ergot alkaloids and ochratoxins. Inorganic forms of Arsenic predominate in rice and spices, and are a real threat to human health. An outbreak of food poisoning due to epidemic dropsy (mustard oil contaminated with argemone oil) was reported from Delhi in 1998 in which 60 persons lost their lives and more than 3000 cases were hospitalized.

Under the Integrated Disease Surveillance Project (IDSP) in India, food poisoning outbreaks reported from all over India in 2009 increased to more than double as compared to the previous year (120 outbreaks in 2009, as compared to 50 in the year 2008). This could be due to improved reporting. Etiological diagnosis was not made in any outbreak, though appropriate samples (food and/or stool) reached to the lab in 18 outbreaks. In one outbreak, groundnuts were reported as the implicated food. It is important to keep in mind that these are only the reported outbreaks and actual number of outbreaks may be much higher, since all cases or outbreaks do not get reported.

INFECTIONS VERSUS INTOXICATIONS

	INFECTIONS	INTOXICATIONS
Cause	Bacteria / Viruses / Parasites	Toxin
Mechanism	Invade and / or multiply within the lining of the intestines	No invasion or multiplication
Incubation period	Hours to days	Minutes to hours
Symptoms	DiarrhoeaNausea / Vomiting Abdominal cramps± Fever	Vomiting, Nausea, Diarrhoea Double vision Weakness Respiratory failure Numbness Sensory and motor dysfunction
Transmission	Can spread from person-to-person via the faeco-oral route	Not communicable
Factors related to food contamination	Inadequate cooking Croos-contaminatio Poor personal hygiene Bare hand contact	Inadequate cooking Improper holding temperatures

PATHOGENESIS

Food-borne illness is typically caused by micro-organisms or their toxins, and most often manifests with gastro-intestinal symptoms, which can vary in severity and duration. In addition to food-borne pathogens (bacteria, viruses and

parasites), food-borne disease may also be caused by contaminants like heavy metals, chemicals, pesticides and toxic substances present naturally in food like toxic mushrooms, plants, fish or shellfish.

The food-borne diseases due to infectious causes form the majority of cases, and are largely dependent on the inoculum size or the infective dose of the pathogen. This may be as small as 10 to 100 bacteria or cysts for Shigella, Entero-Haemorrhagic *E. coli* (EHEC), *Giardia lamblia* and *Entamoeba histolytica*, requiring minor lapses in hygiene for the faeco-oral transmission. The infective dose for *Vibrio cholerae* on the other hand is usually 10^5 – 10^8, and may be variable for Salmonella sp

FOOD-BORNE TRANSMISSION OF PATHOGENS AND TOXINS

Food may become contaminated during production and processing or during food preparation and handling.

o *Food production and processing*

Foods, such as fruits and vegetables, may be contaminated if washed or irrigated with water that is contaminated with pathogens from animal or human faeces. Animals naturally harbour many food-borne bacteria in their intestines that can cause illness in humans, but often do not cause illness in the animals. During slaughter, meat and poultry carcasses can become contaminated if they are exposed to small amounts of intestinal contents.

o *Food preparation and handling*

- *Infected individuals* - Most food-borne pathogens are shed in the faeces of infected persons and these pathogens may be transferred to others through food via the faecal-oral route. Bacteria present in infected lesions and normal nasal flora may also be transmitted from an infected food-handler to ready-to-eat foods.
- *Cross-contamination* - Pathogens naturally present in one food may be transferred to other foods during food preparation if same cooking equipment and utensils are used without washing and disinfecting in between, especially in case of ready-to-eat foods.
- *Inadequate cooking temperature* - With insufficient cooking bacteria can multiply and produce toxins within the food. Many bacterial toxins are heat stable and may not be destroyed by cooking.

o *Improper storage*

Food held or stored at warm (10-50ºC*)* temperature allows multiplication of pathogens and is an important cause of food-borne outbreaks.

TYPES OF BACTERIAL FOOD POISONING

Mechanism	Location	Illness	Stool M/E	Examples
Non-inflammatory (enterotoxin)	Proximal small intestine	Watery diarrhoea	No faecal leukocytes	*Vibrio cholerae,* ETEC, EAggEC, *Cl. perfringens, Bacillus cereus, Staph aureus,* rotavirus, norovirus, enteric adenoviruses, *Giardia lamblia,* Cryptosporidium, Cyclospora, Microsporidia
Inflammatory (invasion / cytotoxin)	Colon / distal small intestine	Dysentery / inflammatory diarrhoea	PMN faecal leukocytes	Shigella, Salmonella, *C. jejuni,* EHEC, *enterocolitica, Vibrio parahaemolyticus, Cl. difficile, E. histolytica*
Penetrating	Distal small intestine	Enteric fever	Mono-nuclear faecal leukocytes	*Salmonella typhi, Y. enterocolitica, Campylobacter fetus*

BACTERIAL FOOD POISONING

I.P.	Cause	Symptoms	Common foods
1-6 hours	*Staph aureus*	Nausea, Vomiting, Diarrhoea	Ham, poultry, potato / egg salad, mayonnaise, cream pastries
	Bacillus cereus	Nausea, Vomiting, Diarrhoea	Fried rice
8-16 hours	*Cl. perfringens*	Abdominal cramps, diarrhoea (vomiting rare)	Beef, poultry, legumes, gravies
	B. cereus		Meats, vegetables, dried beans, cereals
>16 hours	*Vibrio cholerae*	Watery diarrhoea	Shell-fish
	ETEC	Watery diarrhoea	Salad, cheese, meats, water
	EHEC	Bloody diarrhoea	Beef, salami, raw milk / vegetables, apple juice
	Salmonella sp	Inflammatory diarrhoea	Beef, poultry, eggs, diary products
	Campylobacter jejuni	Inflammatory diarrhoea	Poultry, raw milk
	Shigella sp	Dysentery	Potato / egg salad, lettuce, raw eggs
	V. parahaemolyticus	Dysentery	Molluscs, crustaceans

SOME IMPORTANT FOOD-BORNE PATHOGENS, TOXINS AND CHEMICALS

PATHOGENS

Bacteria		
Aeromonas hydrophila	Entero Toxigenic *E. coli* (ETEC)	Salmonella (non Typhi) sps
Bacillus cereus	Entero Pathogenic *E. coli* (EPEC)	Shigella spp
Brucella spp	Entero-Haemorrhagic *E. coli* (EHEC)	*Staphylococcus aureus*
Campylobacter spp	Entero-Invasive *E. coli* (EIEC)	*Vibrio cholerae* O1 and O139
Clostridium botulinum	*Listeria monocytogenes*	*Vibrio parahaemolyticus*
Clostridium perfringens	*Salmonella typhi*	*Vibrio vulnificus*
Escherichia coli spp	*S. paratyphi*	*Yersinia enterocolitica*
Viruses		
Hepatitis A virus	Norovirus	Rotavirus
Hepatitis E virus	Poliovirus	
Protozoa		
Cryptosporidium spp	*Entamoeba histolytica*	*Toxoplasma gondii*
Cyclospora cayetanensis	*Giardia lamblia*	
Trematodes		
Clonorchis sinensis	*Fasciolopsis buski*	*Opisthorchis viverrin*
Fasciola hepatica	*Opisthorchis felineus*	*Paragonimus westermani*
Cestodes		
Diphyllobothrium spp	Echinococcus spp	*Hymenolepis nana*
Taenia solium / saginata		
Nematodes		
Anisakis spp	*Ascaris lumbricoides*	*Trichinella spiralis*
Trichuris trichiura		

Toxins		
Marine biotoxins	Tetrodotoxin (pufferfish)	Pyrrolizidine alka
Ciguatera poisoning bean poisoning)	Mushroom toxins	Phytohaemagglutinin (red kidney
Shellfish toxins (paralytic, neurotoxic, diarrhoeal, amnesic)	Mycotoxins (e.g. aflatoxins)	Grayanotoxin (honey intoxication)
Scombroid poisoning/ histamine	Plant toxicants	
Chemicals		
Pesticides (organophos-phates, antimony	Radionuclides	Nitrites (food preservatives)
Toxic metals (cadmium, copper, lead, mercury, tin)	Fluoride	Sodium hydroxide
Polychlorinated biphenyls	Zinc	Monosodium glutamate

It is essential to have a high index of suspicion for food-borne illnesses for early diagnosis, better evaluation and management of these cases. During the initial assessment of patients with suspected food-borne illness, the clinical history is very important. The time of onset (incubation period), duration of illness, clinical symptoms, history of recent travel, or antibiotic use, as well as presence of blood or mucus in the stool, recent meals (including type of food, especially raw or uncooked food, unpasteurised milk or food products), cooking and refrigeration as well as details of others affected by similar symptoms can provide valuable clues to the aetiology.

During the clinical examination, special attention should be focussed on vital signs, degree of dehydration and abdominal examination. In an Indian study of diarrhoeal deaths in children, patients with moderate or severe dehydration or those suffering from Shigellosis had a significantly higher chance of having a fatal outcome. Presence of fever, systemic symptoms, and bloody diarrhoea suggests invasive diarrhoeal illness.

INVESTIGATION

The investigation and control of food-borne disease outbreaks require multi-disciplinary skills in the areas of clinical medicine, epidemiology, laboratory medicine, food microbiology and chemistry, food safety and food control, besides risk communication and management.

Steps of Outbreak Investigation

1. Establishing the existence of an outbreak

Detailed baseline epidemiological information should be collected as soon as possible, which includes, but is not limited to, the following:

- Information about the person(s) reporting the potential outbreak
- Number of persons suffering from the illness
- Date and time of consumption of food and onset of illness for each ill person
- Specific symptoms experienced
- Presumptive diagnosis
- Total number of persons exposed / not exposed, both ill and not ill
- Location where food was prepared and eaten
- Specific food item or drink consumed, including ice
- Other commonalities, including other shared meals or activities
- Number of stool samples collected for testing
- Additional information, including specific activities and medications taken before the onset of illness

MAJOR FOOD-BORNE HAZARDS: CLINICAL FEATURES & SAMPLES

(WHO. Foodborne disease outbreaks: guidelines for investigation and control. Geneva; 2008)

Time to onset of symptoms	Predominant symptoms	Associated organism or toxin	Samples from cases (and food-handlers)
	Upper gastrointestinal tract symptoms (nausea, vomiting) occur first or predominate		
<1 hour	Nausea, vomiting, unusual taste, burning of mouth.	Metallic salts	Vomit, urine, blood, stool
1–2 hours	Nausea, vomiting, cyanosis, headache, dizziness, dyspnoea, trembling, weakness, loss of consciousness	Nitrites	Blood
1–6 (mean 2–4) hours	Nausea, vomiting, retching, diarrhoea, abdominal pain, prostration.	*Staphylococcus aureus* and its enterotoxins	Stool, vomit, (swabs from nostril, skin lesions)
8–16 hours (2–4 hours if emesis predominant)	Vomiting, abdominal cramps, diarrhoea, nausea	*Bacillus cereus*	Rectal swab, stool
6–24 hours	Nausea, vomiting, diarrhoea, thirst, dilation of pupils, collapse, coma	Mycotoxins (Amanita sp. Fungi)	Urine, blood (SGOT, SGPT), vomit
12–48 (median 36 hours)	Nausea, vomiting, watery non-bloody diarrhoea, dehydration	Norovirus	Stool
	Lower gastrointestinal tract symptoms (abdominal cramps, diarrhoea) occur first or predominate		
2-36 (mean 6-12) hours	Abdominal cramps, diarrhoea (putrefactive diarrhoea - *Clostridium perfringens)*, sometimes nausea and vomiting	*Clostridium perfringens, Bacillus cereus*	Rectal swabs, stool
6-96 hours (usually 1-3 days)	Fever, abdominal cramps, diarrhoea, vomiting, headache	*S*almonella spp, Shigella, Aeromonas, Entero-Pathogenic *E. coli*	Rectal swabs, stool
6 hours to 5 days	Abdominal cramps, diarrhoea, vomiting, fever, malaise, nausea, headache, dehydration (sometimes bloody or mucoid diarrhoea, cutaneous lesions associated with *Vibrio vulnificus)*	*Vibrio cholerae* (O1 and non-O1), *V. vulnificus, V. fluvialis, V. parahaemolyticus*	Stool
1-10 (median 3-4) days	Diarrhoea (often bloody), abdominal pain, nausea, vomiting, malaise, fever (uncommon with *E. coli* O157)	Entero-Haemorrhagic *E. coli* (including *E. coli* O157), *Campylobacter*	Stool, rectal swabs
3-5 days	Fever, vomiting, watery non-inflammatory diarrhoea	Rotavirus, astrovirus, enteric adenoviruses	Stool, vomit
3-7 days	Fever, diarrhoea, abdominal pain (can mimic acute appendicitis)	*Yersinia enterocolitica*	Stool
1-6 weeks	Mucoid diarrhoea (fatty stools) abdominal pain, flatulence, weight loss	*Giardia lamblia*	Stool
1 to several weeks	Abdominal pain, diarrhoea, constipation, headache, drowsiness, ulcers, variable •often asymptomatic	*Entamoeba histolytica*	Stool
3-6 months	Nervousness, insomnia, hunger pains, anorexia, weight loss, abdominal pain, sometimes gastroenteritis	*Taenia saginata, T. solium*	Stool, rectal swab

Time to onset of symptoms	Predominant symptoms	Associated organism or toxin	Samples from cases (and food-handlers)
	Neurological symptoms (visual disturbances, vertigo, tingling, paralysis)		
Less than 1 hour	Neurological and/or gastrointestinal symptoms	Shellfish toxin	Gastric washing
	Gastroenteritis, nervousness, blurred vision, chest pain, cyanosis, twitching, convulsions	Organic phosphate	Blood, urine, fat biopsy
	Excessive salivation, perspiration, gastroenteritis, irregular pulse, pupils constricted, asthmatic breathing	Muscaria-type mushrooms	Vomit
1-6 hours	Tingling, numbness, gastroenteritis (GE), temperature reversal, dizziness, dry mouth, muscular aches, dilated pupils, blurred vision, paralysis	Ciguatera toxin	
	Nausea, vomiting, tingling, dizziness, weakness, anorexia, weight loss, confusion	Chlorinated hydrocarbons (insecticides, pesticides)	Blood, urine, stool, gastric washing
2 hours to 6 days, usually 12-36 hours	Vertigo, double / blurred vision, loss of light reflex, difficulty in swallowing, speaking & breathing, dry mouth, weakness - descending, bilateral flaccid paralysis (respiratory paralysis), with preserved sensorium	*Clostridium botulinum* and its neurotoxins	Blood, stool, gastric washing
> 72 hours	Numbness, weakness of legs, spastic paralysis, impairment of vision, blindness, coma	Organic mercury	Urine, blood, hair
	Allergic symptoms (facial flushing, itching)		
Less than 1 hour	Headache, dizziness, nausea, vomiting, peppery taste in mouth, burning of throat, facial swelling / flushing, stomach pain, itching	Histamine (scombroid)	Vomit
	Peri-oral numbness, tingling sensation, flushing, dizziness, headache, nausea	Monosodium glutamate	
	Flushing, itching, abdominal pain, puffing of face and knees	Nicotinic acid (additive / preservative)	
	Generalized infection symptoms (fever, chills, malaise, prostration, aches, swollen lymph nodes)		
4-28 (mean 9) days	Gastroenteritis, fever, oedema around eyes, perspiration, muscular pain, chills, prostration, laboured breathing	*Trichinella spiralis*	Serum, muscle tissue (biopsy)
7-28 (mean 14) days	Malaise, headache, fever, cough, nausea, vomiting, constipation, abdominal pain, chills, rose spots, bloody stools	*Salmonella typhi*	Rectal swab, stool
Varying periods (depends on specific illness)	Fever, chills, headache, arthralgia, prostration, malaise, swollen lymph nodes, etc	*C. jejuni, B. anthracis, Brucells sp, C. burnetii, Fr. tularensis, L. monocytogenes, P. multocida*	

2. Coordination with key personnel

A successful investigation requires a teamwork approach and collaboration among, but not limited to medical investigators, epidemiologists, food inspectors, microbiologists and healthcare providers.

3. Collection and transport of clinical specimens and food samples for laboratory testing

For most food-borne disease outbreaks, food and stool samples have to be collected from persons experiencing diarrhoea to identify or confirm the pathogen. Blood cultures or serological testing are recommended for systemic infections, such as Enteric fever, Listeriosis or viral hepatitis, although, serology has a limited role for most other food-borne illnesses.

Stool sample collection should be encouraged whenever a person is experiencing or has recently experienced a diarrhoeal illness. If possible, collection of stool samples should begin during the initial food-borne illness report, and may continue during the outbreak investigation.

- Testing of all ill individuals is neither useful nor recommended for optimal utilization of resources. Collection of stool specimens from few randomly selected patients is usually sufficient to confirm the diagnosis in outbreak situtation.
- Laboratory testing may still be beneficial even after symptoms have ceased. For many food-borne illnesses, an ill person may continue to shed the pathogen in their stool even a few days after symptoms have disappeared and stool appears normal.
- Even in the absence of any laboratory confirmation, positive results, or definitive diagnosis, pathogens may still be implicated and public health measures may be implemented solely based on clinical and epidemiological information collected during the outbreak investigation.

4. Implementation of control and preventive measures

Usually most of these outbreaks are self-limiting. Precautions and prevention are aimed at preventing future outbreaks.

Investigators should respond and implement appropriate public health action as soon as possible including, but should not be limited to, the following:

- Removal of contaminated food
- Exclusion and restriction of persons who are at high risk of spreading illness, including food handlers, day care attendees and providers, and persons involved with direct patient care
- Emphasizing hand hygiene
- Closing the food establishment, if implicated.

5. Definition of cases, population at risk and finding cases

Preliminary information obtained during the early stages of an outbreak investigation can be organized using a line list.

The case definition in the setting of an outbreak investigation usually includes four criteria: clinical information and information related to time, place, and person.

A case definition should be developed for every outbreak to ensure that ill persons are classified appropriately. Good case definitions often include simple and objective clinical criteria (e.g. diarrhoea [defined as three or more loose stools in a 24-hour period] with vomiting or nausea). The population at risk provides the denominator based on which various attack rates can be calculated.

6. Description of epidemiology (in time, place, and person)

Tools that may be used to organize and depict the outbreak by time, place, and person include epidemic curves, maps and frequency tables.

7. Development of possible hypotheses

Develop a hypothesis as an educated guess about the cause of the outbreak and the factors that may have contributed to the illness.

8. *Planning and conducting an epidemiological study to evaluate the hypotheses*

The questionnaire and the study design are important tools used to further analyse the outbreak and make comparisons between those affected and not affected by the outbreak.

9. *Analysis of the data collected and interpretation of results*

Important tasks that should be performed to finalize the data include the following:

- Re-evaluate the case definition and ensure all cases meet the case definition
- Update previously plotted epidemic curves
- Calculate frequencies and percentages
- Compute the median and ranges for the incubation period and recovery period
- In a retrospective cohort study, calculate the attack rate, food-specific attack rates and relative risk ratios
- If the study design was a case-control study, calculate the odds ratios
- Determine if results obtained are statistically significant

10. *Reporting the findings of the outbreak investigation*

Documentation is extremely important as a written record of the public health rationale for the activities as well as the findings of the investigation. A written report provides a record of performance, provides an account of the outbreak for potential medico-legal issues, and can improve the quality of future investigations.

- Prepare and write the report following a scientific format - introduction, background, methods, results, discussion, recommendations and supporting documents.
- A preliminary or summary report should be prepared and disseminated until the final report is completed.

LABORATORY DIAGNOSIS OF FOOD-BORNE ILLNESSES

The main objectives of laboratory analysis during food-borne outbreak investigations are to

(1) Confirm the clinical diagnosis by isolation of causative agent from human specimens

(2) Ensure proper identification of the disease, and

(3) Determine if the same causative agent is present in implicated food sources, using relevant epidemiological markers like biotyping, serotyping, antimicrobial susceptibility profile, phage typing, plasmid profile, pulsed field gel electrophoresis, PCR, etc.

Most food-borne infections are diagnosed through the identification of the pathogen in stool collected from infected persons. Vomitus has also been used to detect certain organisms and confirm the aetiology. Blood samples are recommended for cases with systemic involvement.

Stool Specimens

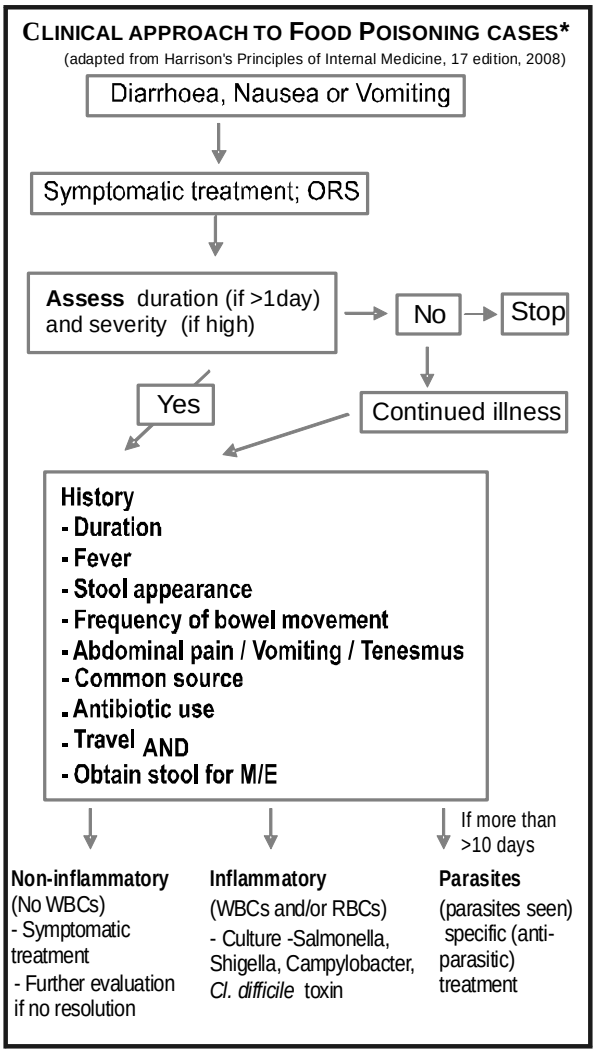
Proper collection and transport of stool specimens requires the appropriate transport medium (modified Cary-Blair medium), and encouraging ill persons to submit a stool specimen.

Vomitus / gastric aspirate can also be tested for organisms and toxins, and should be collected as soon as possible after onset of illness. Instruct the patient to vomit directly into a sterile specimen container, such as a screw-capped bottle (or a urine specimen container). If this is not possible, ask the patient to vomit in a clean container, bowl or plastic bag and transfer the vomitus to the screw-capped container with a clean spoon. Place the cap securely on the container and seal the lid with tape.

Food specimens

Microbiological analysis of food supports the epidemiological investigation of a food-borne disease outbreak. The purpose of testing is to isolate and identify pathogenic micro-organisms in food samples, which have been implicated in the outbreak. Samples collected as part of the

investigation should be treated as official samples and should be collected in a manner that reflects the food as it was prepared, served, or used in preparation of the suspected meal.



Food samples must be collected using aseptic techniques and appropriate containers. Samples must be refrigerated during storage and transport and must arrive at the food microbiology laboratory within three days of collection. Samples collected frozen should be stored and transported frozen on dry ice.

- Whenever possible, food samples should be submitted in the original container as contamination of a sample may occur during manipulation.
- Samples that cannot be shipped in their original container should be collected aseptically using sterile and leak-proof collection containers.
    - o Representative sample of the solid food item should be taken from the geometric centre as well as several other locations in the food item.
    - o Stir or shake the liquid food item and pour or ladle the sample into the sterile leak-proof container.
- Collection of an adequate amount of the food sample (minimum of 100 grams).
- Containers should be filled not more than 75% of their capacity and sealed.
- Food samples should be placed in vaccine carrier with ice packs.
- Sample labelling should include the following - name and type of product, brand of product, product manufacturer and code or lot number, collected by, date, time, and place of collection, and establishment's name.

Labelled specimen containers should be placed in a zip-lock bag and sealed. Cold chain should be maintained during transport by sending sample in vaccine carrier with ice packs, avoid freezing. Investigation forms should be filled for each specimen obtained along with relevant clinical details.

The collection of prepared food samples for outbreak investigation does not have medico-legal implications and do not fall under the Prevention of Food Adulteration Act, 1954.

TREATMENT

Initial treatment of patients with food-poisoning should focus on assessment and reversal of dehydration, either through oral rehydration therapy (ORT) especially in children, or through IV fluids in seriously dehydrated cases.

Specific treatment in case of pesticide poisoning with chelating agents may be done based on epidemiological and clinical features, under medical supervision.

The earlier standard Oral Rehydration Salts (ORS) provided a solution containing 90 mEq/l of sodium with a total osmolarity of 311 mOsm/l. In 2003, the "improved" ORS having lower osmolarity was formulated by reducing the solution's glucose and salt concentrations. Because of the improved effectiveness of reduced osmolarity ORS solution, especially for children with acute, non-cholera diarrhoea, WHO and UNICEF now recommend that countries use

and manufacture the following formulation in place of the previously recommended ORS solution.

REDUCED OSMOLARITY ORS FORMULATION

Preparation of ORS: Mix the following in one litre of clean drinking water:

Formula	grams/ litre
Sodium chloride	2.6
Glucose, anhydrous	13.5
Potassium chloride	1.5
Trisodium citrate, dihydrate	2.9

Constituents	mmol/ litre	Acceptable Range
Sodium	75	60-90
Chloride	65	50-80
Glucose, anhydrous	75	= Na but ≤111 mmol/l
Potassium	20	15-25
Citrate	10	8-12
Total Osmolarity	245	200-310 mmol/l

PREVENTION

Hazard Analysis and Critical Control Point (HACCP) is a systematic preventive approach to food safety that addresses physical, chemical, and biological hazards as a means of prevention rather than finished product inspection. HACCP is used in the food industry to identify potential food safety hazards, so that key actions can be taken at these Critical Control Points (CCPs). The system is used in the food industry at all stages of food production and preparation processes including packaging, distribution, etc. HACCP is an effective approach to food safety and protecting public health.

Apart from food contamination, transmission of infection occurs by direct contact, favoured by the habits and customs of people, improper storage and handling of cooked food is equally responsible for food-borne illnesses, as during storage, especially at ambient temperatures (28-38 degree C) there is higher risk of multiplication of pathogenic organisms. Food safety education is a critical pre-requisite to prevent food-borne outbreaks by education of food-handlers and the community about proper practices in cooking and storage of food, and personal hygiene. Handwashing is one of the key interventions, not just by food handlers, but also by the community at large. Environmental measures include discouraging sewage farming for growing vegetables and fruits.

PRINCIPLES OF HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP)

1. **Analyse hazards -** Potential hazards associated with a food and measures to control those hazards (biological, e.g. a microbe; chemical, e.g. a toxin; or physical, e.g. ground glass or metal fragments) are identified.
2. **Identify critical control points -** These are points in a food's production - from its raw state through processing and shipping to consumption by the consumer - at which the potential hazard can be controlled or eliminated. Examples are cooking, cooling, packaging, and metal detection.
3. **Establish preventive measures with critical limits for each control point** - For a cooked food, for example, this might include setting the minimum cooking temperature and time required to ensure the elimination of any harmful microbes.
4. **Establish procedures to monitor the critical control points -** Such procedures include determining how and who should monitor the cooking time and temperature.
5. **Establish corrective actions when monitoring shows that a critical limit has not been met** - For example, reprocessing or disposing of food if the minimum cooking temperature is not met.
6. **Establish procedures to verify that the system is working properly** - For example, testing time-and-temperature recording devices to verify that a cooking unit is working properly.
7. **Establish effective record keeping for documentation -** This would include records of hazards and their control methods, monitoring of safety requirements and action taken to correct potential problems.

FIVE KEYS TO SAFER FOOD

1. Keep Clean

- Wash your hands before handling food and often during food preparation
- Wash your hands after going to the toilet
- Wash and sanitize all surfaces and equipment used for food preparation
- Protect kitchen areas and food from insects, pests and other animals

2. Separate raw and cooked food

- Separate raw meat, poultry and seafood from other foods
- Use separate utensils such as knives and cutting boards for handling raw foods
- Store food in containers to avoid contact between raw and prepared foods

3. Cook thoroughly

- Cook food thoroughly, especially meat, poultry, eggs and seafood
- Bring foods like soups and stews to boiling to make sure that they have reached 70°C
- Reheat cooked food thoroughly

4. Keep food at safe temperatures

- Do not leave cooked food at room temperature for more than 2 hours
- Refrigerate promptly all cooked and perishable food (preferably below 5°C)
- Keep cooked food piping hot (more than 60°C) prior to serving
- Do not store food too long even in the refrigerator
- Do not thaw frozen food at room temperature

5. Use safe water and raw materials

- Use safe water or treat it to make it safe
- Select fresh and wholesome foods
- Choose foods processed for safety, such as pasteurized milk
- Wash fruits and vegetables, especially if eaten raw
- Do not use food beyond its expiry date

* Foodborne disease outbreaks: Guidelines for investigation and control. WHO, 2008

...about CD Alert

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