Food Borne Out Breaks

Testing Procedures and Prevention Measures

Definition

- An incident in which two or more persons experience a similar illness after ingestion of a common food, and epidemiologic analysis implicates the food as the source of the illness.
- A food borne disease outbreak occurs when two or more people get the same illness from the same contaminated food or drink.
- A foodborne disease (FBD) outbreak is defined as an incident in which

1) Two or more persons experience a similar illness after exposure to the same food source
2) Epidemiologic evidence implicates the food as the likely source of the illness.

Steps in a food born outbreak investigation

- Step 1 Detection of a possible outbreak
- Step 2 Define and find cases
- Step 3 Generate hypothesis about likely sources
- Step 4 Test Hypothesis
- Step 5 Solve point contamination and Sources of the food
- Step 6 Control an outbreak
- Step 7 decide an Outbreak is over

Step 1 Detection of a possible outbreak

- Detecting an outbreak is the first step in investigating a multistate foodborne outbreak
- An outbreak with multiple sick people can be missed if they are spread out over a wide area
- Outbreaks are detected by using public health surveillance methods, including PulseNet, formal reports of illnesses, and informal reports of illnesses

Key words:

- **Public health surveillance:** Routine gathering of reports of illnesses by health professionals
- **Cluster:** A larger number of people than expected with the same illness in a given time period and area
- **Outbreak:** A group of illnesses in a cluster of people who have something in common that caused the illness
- **PulseNet:** A national laboratory network that connects local and multistate foodborne illness cases to detect outbreaks. PulseNet uses DNA fingerprinting, or patterns of bacteria making people s. It can take several weeks from the ay the person became ill to the day the results of fingerprinting the bacteria are added to the PulseNet database.

Procedure

- The patient may be asked to submit a stool sample (or some other type of sample) to help figure out what germ is making them ill.
- The patient's sample is sent to a clinical laboratory.
- The clinical laboratory tests and may identify the germ (for example a bacteria or virus) that is making them ill.
- The clinical laboratory tells the doctor's office the results of their testing so the doctor can treat the illness.
- The germ may then be sent to the state public health laboratory for DNA fingerprinting.

Routine Investigation and Controlling Further Spread

- **Outbreaks can be detected through Notifiable Conditions reporting, bacterial isolate sub-typing in the laboratory, consumer complaints, and syndromic surveillance systems. Even when resources are severely limited, local health jurisdictions should investigate outbreaks and suspected outbreaks that meet the following criteria:**
- **Illness is severe (e.g., hospitalization or death in 1 or more people, marine neurotoxin, mushroom poisoning, hepatitis)**
- **Illness is due to a confirmed or suspected bacterial source (e.g., bloody diarrhea, toxin)**
- **Outbreak is large (involves >10 ill people) or ongoing**
- **Illness is associated with shellfish from a commercial source or growing area**
- **Exposures have occurred in a setting with a vulnerable population**
- **Illness is suspected to be associated with a commercially-distributed food**

Step 2: Define and Find Cases

Finding sick people is important to help public health officials understand the size, timing, severity, and possible sources of an outbreak. A case definition is developed to define who will be included as part of an outbreak. Investigators use the case definition to search for illnesses related to the outbreak. Illnesses are plotted on an epidemic curve (epi curve) so that public health officials can track when illnesses occur over time.

Key words:

- **Case Definition:** A list of criteria used to determine if an individual is included as a case in an outbreak investigation
- **Case Count:** The number of illnesses that meet the case definition
- **Epidemic Curve (Epi Curve):** A graph that shows the number of illnesses over time

Procedure

- Case definitions are developed by health officials to spell out who will be included as part of the outbreak

Case definitions may include details about:

- Features of the illness
- DNA fingerprint (if the pathogen is tracked by PulseNet)
- The pathogen or toxin (if known)
- Certain symptoms typical for that pathogen or toxin
- Time range for when the illnesses occurred
- Geographic range, such as residency in a state or region

Investigators use a graph called an epidemic curve or epi curve to track the number of illnesses over time. The pattern of the epi curve helps investigators decide if sick people were exposed to the same source of illness over a short period or if the exposure to the source was over a longer time.

How are cases of illness found?

- Using the case definition, investigators search for more illnesses related to the outbreak. They do this by:
- Reviewing laboratory reports to PulseNet
- Reviewing regular surveillance reports
- Asking local clinical and laboratory professionals to report cases of the particular illness more quickly, as soon as they suspect the diagnosis
- Reviewing emergency room records for similar illnesses
- Surveying groups that may have been exposed
- Asking health officials in surrounding areas to look for illnesses that might be related

How are cases tracked?

- Investigators watch the progression of an outbreak by tracking:
- Who becomes ill
- When they become ill
- Where they live

Step 3: Generate Hypotheses about Likely Sources

- **Hypothesis generation is an ongoing process. Possible explanations of an outbreak are continually changed or disproved as more information is gathered. Interviews, questionnaires, and home visits are helpful in narrowing down how and where people in the outbreak got sick.**

Key words:

- **Hypothesis:** A suggested explanation for the source of a foodborne outbreak
- **Hypothesis-Generating Interviews:** Interviews with sick people that disclose what and where they ate in the days or weeks before they got sick
- **Incubation Period:** The time it takes to get sick after eating a contaminated food
- **Shotgun Questionnaire:** A standardized questionnaire with a list of questions about foods, meals, shopping habits, travel, restaurants, and events attended

Procedure

What is a shotgun questionnaire?

If there is no obvious place where ill person got sick (like all eating at the same restaurant), investigators may use a standardized questionnaire known as a shotgun questionnaire.

Shotgun questionnaires include questions about:

- **A standard list of food items**
- **Each meal a person ate before becoming ill**
- **Food shopping habits**
- **Travel**
- **Restaurant dining**
- **Attendance at events where food was served**

Shotgun interviews can only suggest hypotheses that are contained on the questionnaire. This approach may not lead to an exact and testable hypothesis. Intensive open-ended interviews can help in this situation.

What do investigators do with information collected from interviews?

- Create a short list of the foods and drinks that sick people have in common
- Look at other information, such as past experience with the suspected pathogen, and the age or ethnicities of sick people
- Make a hypothesis about the likely source of the outbreak
- Challenges of Hypothesis Generation
- Interviews rely on memory. It can be several weeks from the time someone becomes sick to confirming they are part of an outbreak. Someone may not remember in detail what they ate that long ago.
- The task is even harder when the contaminated food is an ingredient (such as eggs, spices, or herbs) because people often don’t remember or know specific ingredients of the foods they ate.
- Multiple interviews may be necessary as new ideas arise about possible sources.
- Home visits can be helpful to look at the foods in a sick person’s pantry and refrigerator.

Step 4: Test Hypotheses

A hypothesis is tested to determine if the outbreak source has been correctly identified. Investigators use many methods to test their hypotheses.

Two main methods are analytic epidemiologic studies and food testing.

Epidemiologic Studies

- The most common type of study conducted during foodborne outbreaks are case-control studies
- Investigators collect information from sick people (cases) and non-sick people (controls) to see if sick people were more likely to have eaten a certain food or to report a particular exposure
- Case-control studies try to include controls who have had the same opportunities to be exposed to an unsafe food item as a case has. To achieve this goal, controls are carefully chosen using matching or selection techniques.

The Epidemiology of food borne diseases

A. Etiologic Agents, Descriptions of Illness and Incubation Periods

- **Etiologic agents of foodborne disease (FBD) can be grouped into 5 general categories:**

1. Bacterial toxins (e.g., *Bacillus cereus emetic and diarrheal toxins, Clostridium perfringens toxin, Staphylococcus aureus toxin, Clostridium botulinum toxin)*

2. Bacterial infections (e.g., *Shigella, Salmonella, Shiga toxin-producing E. coli, Campylobacter jejuni, Listeria monocytogenes, Yersinia enterocolita, Vibrio)*

3. Viruses (e.g., Norovirus, hepatitis A virus)

4. Parasites (e.g., *Cryptosporidium, Cyclospora cayetanensis, Giardia, Trichinella)*

5. Noninfectious agents (e.g., metals, scombroid, mushroom and shellfish toxins)

FBD most commonly manifests with abdominal cramps, vomiting, and/or diarrhea. However, for some agents, FBD can present with neurologic symptoms (e.g., botulism, paralytic shellfish poisoning). Listeriosis can result in meningitis in older persons as well as fetal loss during pregnancy.

B. Reservoirs

- **Humans are the reservoir of hepatitis A virus, norovirus, *Shigella, Salmonella Typhi, Staphylococcus aureus, and toxigenic Vibrio cholera.***
- **Animals are the primary reservoirs of *Brucella, Campylobacter jejuni, Cryptosporidium parvum, Shiga toxin-producing Escherichia coli, Giardia, Salmonella (non-Typhi), Trichinella spiralis, and Yersinia enterocolitica.***
- ***Vibrio are organisms that occur naturally in coastal waters. Shellfish can concentrate these organisms while filter feeding.***
- ***Bacillus cereus, Clostridium, heavy metals, and Listeria monocytogenes are found in the environment.***

Food Testing

- **Food testing can provide useful information and help to support a hypothesis. Finding bacteria with the same DNA fingerprint in an unopened package of food and in the stool samples of sick people can be convincing evidence of a source. However, relying only on food testing can also lead to results that are confusing or unhelpful.**

When is food testing not usually helpful?

- **Food items with a short shelf life: The food is usually no longer available for testing by the time the outbreak is known (ex. produce).**
- **Spoiled food: A pathogen may be difficult to find if other organisms have overgrown it.**
- **Leftover food or food in open containers: The food may have been contaminated after the outbreak or from contact with the food that actually caused the outbreak.**
- **No test exists: Some pathogens do not have a test that can detect them in the suspected food.**

Key words:

- **Hypothesis:** A suggested explanation for the cause of a foodborne outbreak
- **Case:** A sick person
- **Control:** A non-sick person
- **Strength of association:** How likely it is that illness has occurred due to the food rather than chance
- **Stealth food:** Foods that people are unlikely to remember eating

Examples: garnishes and ingredients that are part of a food item

Procedure

Statistical Testing

- If eating a particular food is reported more often by sick people than by well people, it may be causing illness.
- Investigators can determine the strength of the association between food and illness in an epidemiologic study by using statistical tests.
- Investigators also use statistical tests to decide if more than one food might be involved in the outbreak.

Factors Considered When Interpreting Study Results:

- Frequencies of exposure to a specific food item
- The food’s production, distribution, preparation, and service

Step 5: Solve Point of Contamination and Source of the Food

Health officials use three types of data to link illnesses to contaminated foods and solve outbreaks:

- **Epidemiologic**
- **Traceback**
- **Food and environmental testing**

- **Health officials assess all of these types of data together to try to find the likely source of the outbreak**
- **A contamination can happen anywhere along the chain of food production, processing, transportation, handling, and preparation**

- **What epidemiologic data is used to help find the likely source of the outbreak?**
- **Patterns in the geographic distribution of illnesses, the time periods when people got sick, and past outbreaks involving the same germ.**
- **Foods or other exposures occurring more often in sick people than expected**
- **Clusters of unrelated sick people who ate at the same restaurant, shopped at the same grocery store, or attended the same event**

Key words:

- **Traceback: An investigation that starts with the sick people or restaurants and works its way back through the chain of food production to search for a common point between the people or places to find the contamination source**

Modes of Transmission

1. Food items contaminated from nature

Raw contaminated food items that can be made safe by sufficient cooking include improperly canned products containing heat-labile botulinum toxin, foods with bacterial contamination, and animal-derived foods containing parasites.

Examples:

- **Raw milk or milk products contaminated with Brucella, Campylobacter, Listeria monocytogenes, Salmonella or Cryptosporidium parvum**
- **Eggs or poultry contaminated with Salmonella or Campylobacter species;**
- **Ground beef or wild game contaminated with E. coli O157**
- **Pork contaminated with Yersinia enterocolitica; and bivalve shellfish contaminated with Vibrio parahaemolyticus. Wild game meat can contain Trichinella spiralis, a parasitic roundworm.**
- **FBD caused by toxins within fish or shellfish include ciguatera, scombroid, and paralytic shellfish poisoning**

2. Food items contaminated by an ill food handler

- **Ill food handlers can contaminate food through their feces (on unwashed hands), vomitus or infected lesions.**
- **FBD outbreaks due to Shigella, hepatitis A, and norovirus are generally caused by contamination of uncooked or cooled food by an infected food handler.**
- **FBD outbreaks of hepatitis A and norovirus infection have been associated with consumption of raw oysters contaminated with human sewage before harvest or less commonly during processing by ill food handlers.**
- **Staphylococcus aureus introduced into food from a food handler's infected eye, skin, or nasopharynx can multiply at room temperature and produce a heat-stable toxin not destroyed by subsequent cooking.**

3. Food items cross-contaminated by a contaminated food or the environment

- **Bacteria from animal-derived foods (e.g. beef and eggs) can cross-contaminate raw foods through cooking utensils, the hands of food workers, unclean food preparation surfaces, or improper storage.**
- **Contaminated water, dirt or sewage can introduce a number of agents into previously safe food. Clostridium perfringens and Bacillus cereus are found in the environment and may occur in grains or spices. Their spores are not inactivated by routine cooking. Outbreaks caused by these bacteria generally result from holding cooked food at temperatures that allow the bacteria to proliferate (between 45°–140°F, usually).**

4. Food items intentionally contaminated

- **FBD agents can be intentionally added to foods to cause illness.**

Procedure

- A traceback investigation that starts with the sick people or restaurants and works its way back through the chain of food production to search for a common point between the people or places where the contamination is likely to have happened.
- The decision about when product tracing is needed, and for what food item(s), depends on the evaluation of the epidemiologic data.
- Investigators may conduct environmental assessments at common points in food production facilities, farms, and restaurants to identify any food safety risks which may have led to the contamination.
- Investigators may collect suspect food items from a sick person’s home, a retail location, or in the food production environment to test and try and find the germ that caused illness
- DNA fingerprinting may be used to link germs found in foods or production environments to germs found in sick people.

Step 6: Control an Outbreak

- Once the food source of an outbreak is determined, control measures must be taken. If contaminated food stays on store shelves, in restaurant kitchens, or in home pantries, more people may get sick. There are several different outbreak control measures that can be taken. Public health officials choose measures based on the information available to them. Measures can change as the investigation goes on.

What are outbreak control measures?

- Cleaning and disinfecting food facilities
- Temporarily closing a restaurant or processing plant
- Recalling food items
- Telling the public how to make the food safe (such as cooking to a certain temperature) or to avoid it completely
- Telling consumers to throw away the suspect food from their pantry or refrigerator

Procedure

How are control measures chosen?

- Public health officials may decide on control measures based on strong epidemiological evidence of the disease's origin, spread, and development. They do not need to wait for proof of contamination from the laboratory. This practice can result in earlier action to protect the public's health. As officials learn more during the investigation, they may change, focus, or expand control measures and advice to the public.

How are outbreaks communicated?

- One of the most important actions public health officials can take to prevent illness is warning consumers quickly about a contaminated food. Public health officials take action to communicate to the public when there is clear and convincing information linking illness to a contaminated food. CDC is most likely to warn consumers when the investigation identifies a specific food linked to illness, and there is a continuing risk to public health because the food is still in stores or homes. In this scenario, there are specific, clear, and actionable steps for consumers to take to protect themselves from contaminated food.

Step 7: Decide an Outbreak is Over

- An outbreak is over when the number of new illnesses drops back to what investigators normally expect
- With continued public health surveillance, if the number of illnesses rises again, the investigation continues or restarts

Procedure

When is an outbreak over?

- **An outbreak ends when the number of new reported illnesses drops back to the number normally expected. The epidemic curve helps investigators see that illnesses are declining. Even when illnesses from the outbreak appear to have stopped, public health officials continue surveillance for a few weeks to be sure cases don't start to increase again.**

What if the number of new illnesses increases?

- **It could be that the source was not completely controlled**
- **A second contamination involving another food or location is linked to the first outbreak**
- **The investigation continues or restarts**