

# Alabama Department of Public Health (ADPH)

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# Collaboration in an Epidemiological Investigation

Alabama Department of Public Health  
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# Bureau of Communicable Diseases

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1. Tuberculosis
2. Sexually Transmitted Diseases
3. HIV/AIDS
4. Immunization
5. Epidemiology

# Division of Epidemiology

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1. Infection Control
2. Toxicology
3. Zoonosis
4. Surveillance
5. Analysis and Reporting

# Alabama Foodborne Outbreak (FBO) Team

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- **Montgomery (Central Office)**
  - Surveillance Branch
    - Registered Nurses, Public Health Research Analyst, and Administrative Assistant
  - Analysis and Reporting Branch
    - Epidemiologists
  - Bureau of Clinical Laboratories (BCL)
    - Microbiologists
- **Throughout the State**
  - Environmentalists
  - Surveillance Field Staff

# Why Investigate Foodborne Outbreaks (FBO)?

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- ADPH Mission: “To serve the people of Alabama by assuring conditions in which they can be healthy.”
- **PREVENT ADDITIONAL ILLNESS**
  - Product: Find a product that should be recalled so others don't get sick.
  - Procedure: Determine what went wrong so specific instructions can be given to the food preparer to prevent a recurrence.

# Annual Foodborne (FB) Disease Burden

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## National<sup>1</sup>:

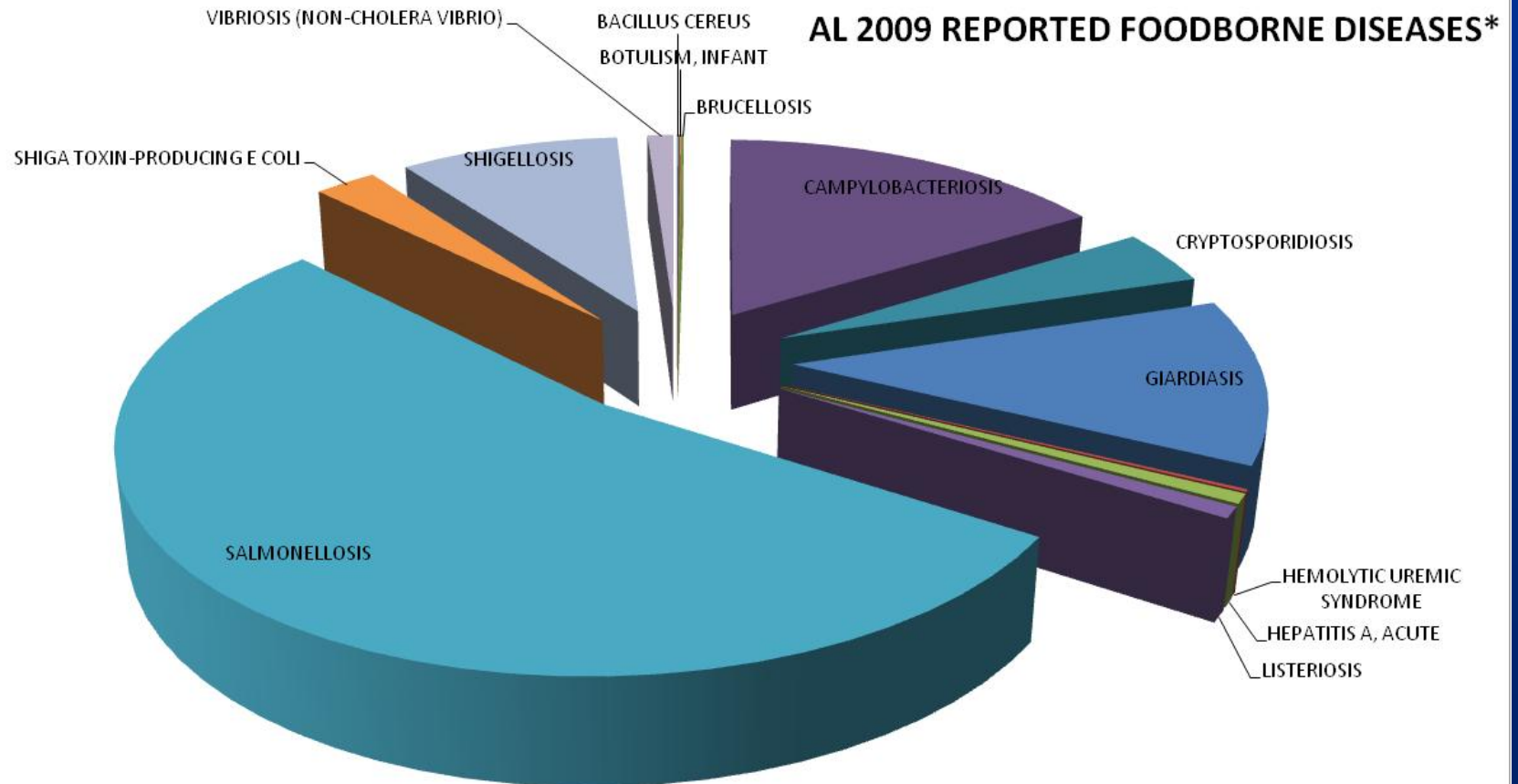
- 76 million illnesses (range 6-81 million)
- 325,000 hospitalizations
- 5,000 deaths

## Alabama:

- 1.3 million illnesses<sup>2</sup>

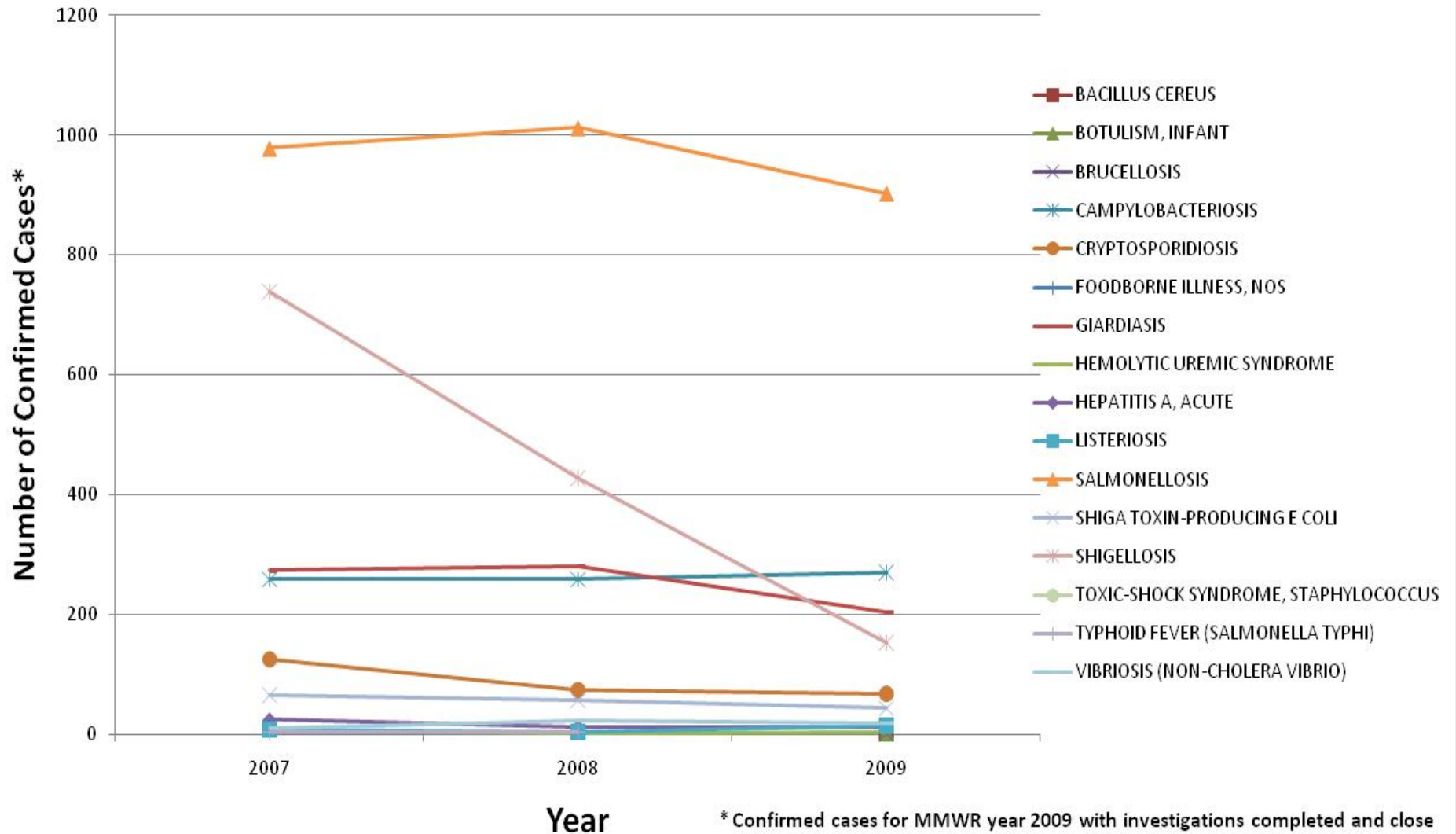
Source: <sup>1</sup>Paul S Mead et al, EID - 1999; <sup>2</sup>The Produce Safety Project at Georgetown University (March 3, 2010)

# Confirmed Cases of FBO Alabama 2009\*



\* Confirmed cases for MMWR year 2009 with investigations completed and close

### Alabama Enteric Diseases\* 2007-2009



# Protocol for Foodborne Outbreaks

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- Developed in 2009 with collaboration Epidemiology, Environmental and Laboratory
- Listed specific functions of each department as well as each discipline
- Defined the leads for these functions
- Cataloged every form, guideline, instruction and “cheat sheets” used during a FBO
- Training performed with staff to review protocol

# ADPH Notifiable Disease Rule

## Defines 57 Notifiable Conditions in AL

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### Common FB conditions

- Salmonellosis
- Shiga toxin producing *E. coli* (*E. coli* O157:H7)
- Botulism
- Campylobacteriosis
- Listeriosis
- Trichinosis
- Typhoid fever
- Vibriosis
- Yersiniosis

### Possible FB conditions

- Shigellosis
- Hepatitis A

### Outbreaks of any kind

- Foodborne Outbreaks
- Waterborne Outbreaks
- Biological Outbreaks
- Chemical Outbreaks

# ADPH Notifiable Disease Rule

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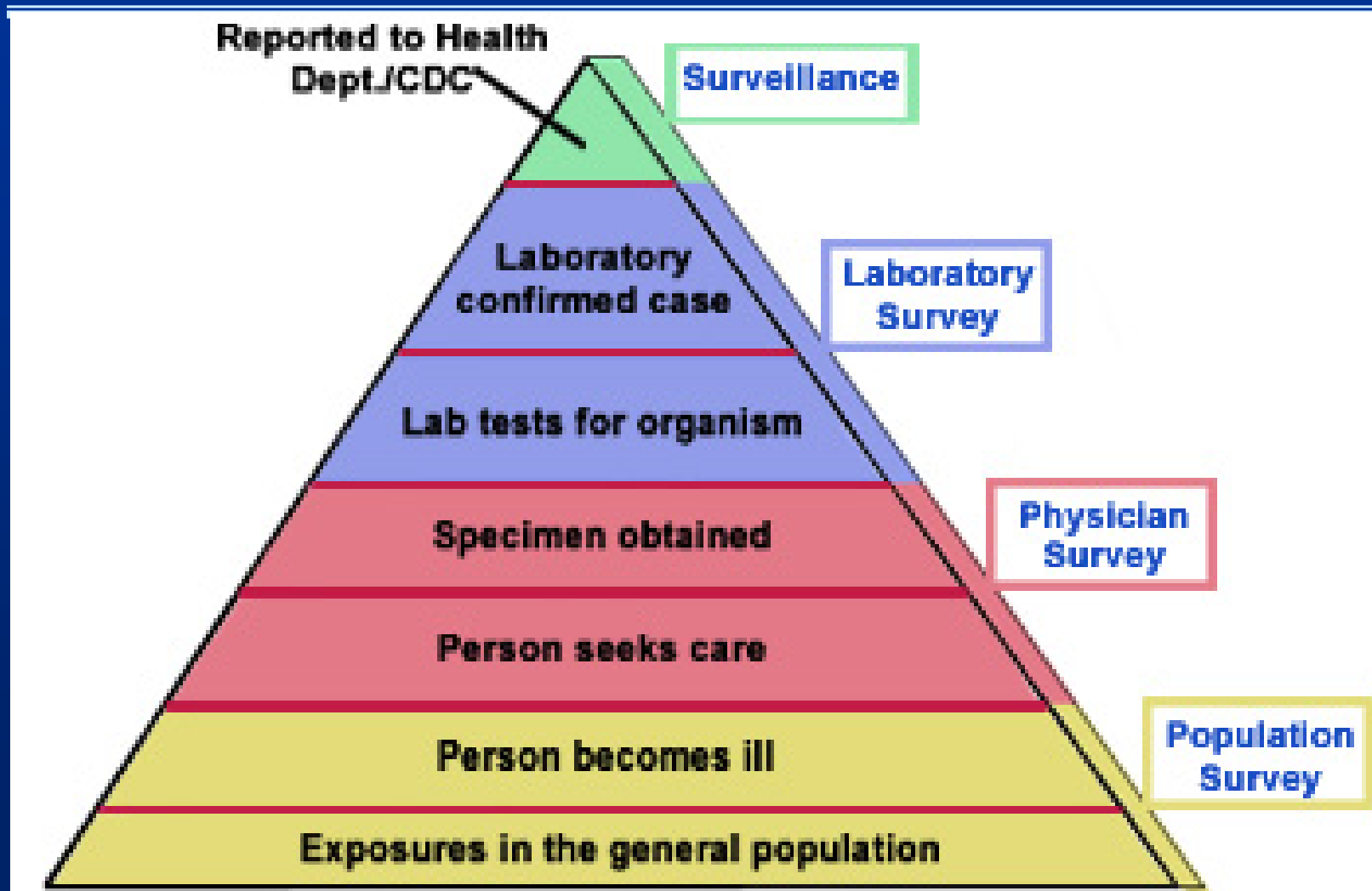
Positive lab results for notifiable conditions must be reported to ADPH.

In order for this to occur:

- Patient symptoms must be severe enough for a physician visit.
- Physician must obtain a specimen.
- Culture must be sent to Bureau of Clinical Laboratories (BCL) for serotyping.

In reality, what ADPH receives is an underestimate of true disease occurrence.

# Burden of Illness Pyramid



# Foodborne Agents

The Main Culprits?



### Acute Foodborne Gastroenteritis Reference Table

Cause	Average incubation	Range incubation	Fever	Vomiting	Diarrhea
Heavy metals	5 -15 min	1 min – 8 hrs	--	+++	++
Staph enterotoxin	2- 4 hrs	30 min - 8 hrs	--	++++	+++
<i>Bacillus cereus</i> emetic syndrome	2 - 4 hrs	30 min - 6 hrs	--	+++	+
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<i>Vibrio parahaemolyticus</i>	12 – 24 hrs	4 - 30 hrs	+	+	+++
<i>Bacillus cereus</i> diarrhea syndrome	12 hrs	6 - 24 hrs	--	+	+++
<i>Salmonella</i>	24 hrs	6 - 72 hrs	++	+	+++
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Norovirus	36 hrs	10 - 50 hrs	+	+++	+++
<i>Vibrio cholerae</i>	2 – 3 days	few hrs - 5 days	--	--	++++
<i>Campylobacter jejuni</i>	2- 5 days	1 - 10 days	++	--	+++
<i>E. coli</i> O157:H7	3 – 4 days	2 – 10 days	++	--	+++
<i>Yersina enterocolitica</i>	4 days	3 - 7 days	++	+	++
<i>Cryptosporidium parvum</i>	7 days	1 - 12 days	+	+	+++

\**Vibrio vulnificus* has an incubation period of 12 hours to 3 days. However, infection with this organism does not present with vomiting or diarrhea, but with fever, septicemia and severe wound infection.

\*\* *Listeria monocytogenes* has an average incubation period of 3 weeks (ranging from 1-70 days).

# Alabama Definition of a Foodborne Outbreak

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- An incident in which two or more persons (not related and from different households) experience a similar illness resulting from the ingestion of a common food.

*Exceptions: botulism and chemical poisoning  
(1 case = outbreak).*

# Did a FBO Occur?

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- Does it meet the definition of a FB outbreak?
- As the investigation progresses, are additional suspicions raised?
  - Who is ill?
  - Is transmission ongoing?
- Is there a public health reason to investigate?
  - Who else is at risk of becoming ill?

# Vulnerable Populations

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# Important Elements in Solving a FBO

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- Early notification: so people remember when they ate what food, and when they first became ill.
- Large enough number of sick cases and well controls: to give power to the statistical evaluation.
- Clinical Specimens: to confirm pathogen
- Food Specimens: to confirm source of infection

# FBO Investigation Team Roles

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- **INVESTIGATION**
  - Area Surveillance Staff
  - State Surveillance Staff
  - Environmentalists
- **ANALYSIS**
  - Epidemiologists
- **CONFIRMATION**
  - Laboratorians

# FBO Investigation Team Roles

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## INVESTIGATION

### Area Surveillance Staff

- Take lead in investigation
- Media contact
- Epidemiology liaison
- Ensure adequate patient specimens are collected

### State Surveillance Staff

- Coordinate and instruct area surveillance staff

### Environmentalists

- Investigate food establishment
- Identify issues with food handling, preparation, storage and source
- Provide appropriate training
- Collect food samples
- Ensure establishment can safely serve food

# FBO Investigation Team Roles

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## ANALYSIS

### Epidemiologists

- Determine if an outbreak exists
- Propose hypothesis
- Develop questionnaire
- Guide investigation
- Develop case definition
- Statistical analysis
- Implicate contaminated food & pathogen
- Report findings

# FBO Investigation Team Roles

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## CONFIRMATION

### Laboratorians

- Confirm suspect agent in patient & food specimens
- Complex analysis (e.g., PFGE)

# Environmentalists Investigate the Food Establishment

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- What was served?
- How was food prepared?
- Is food safe to eat now?
- Were any food handlers ill?
- Institute preliminary control measures.
- Collect & hold food samples for lab testing.
- Epidemiology determines which foods to test & for what pathogen



# Outbreak Investigation

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- When you receive information about a FBO (i.e.,  $\geq 2$  non-related/non-household cases), contact your Area Surveillance staff or Central Office Epidemiology (EPI).
- As part of the FBO investigation, epidemiology will conduct a case-control or a cohort study in order to identify the source of the outbreak.

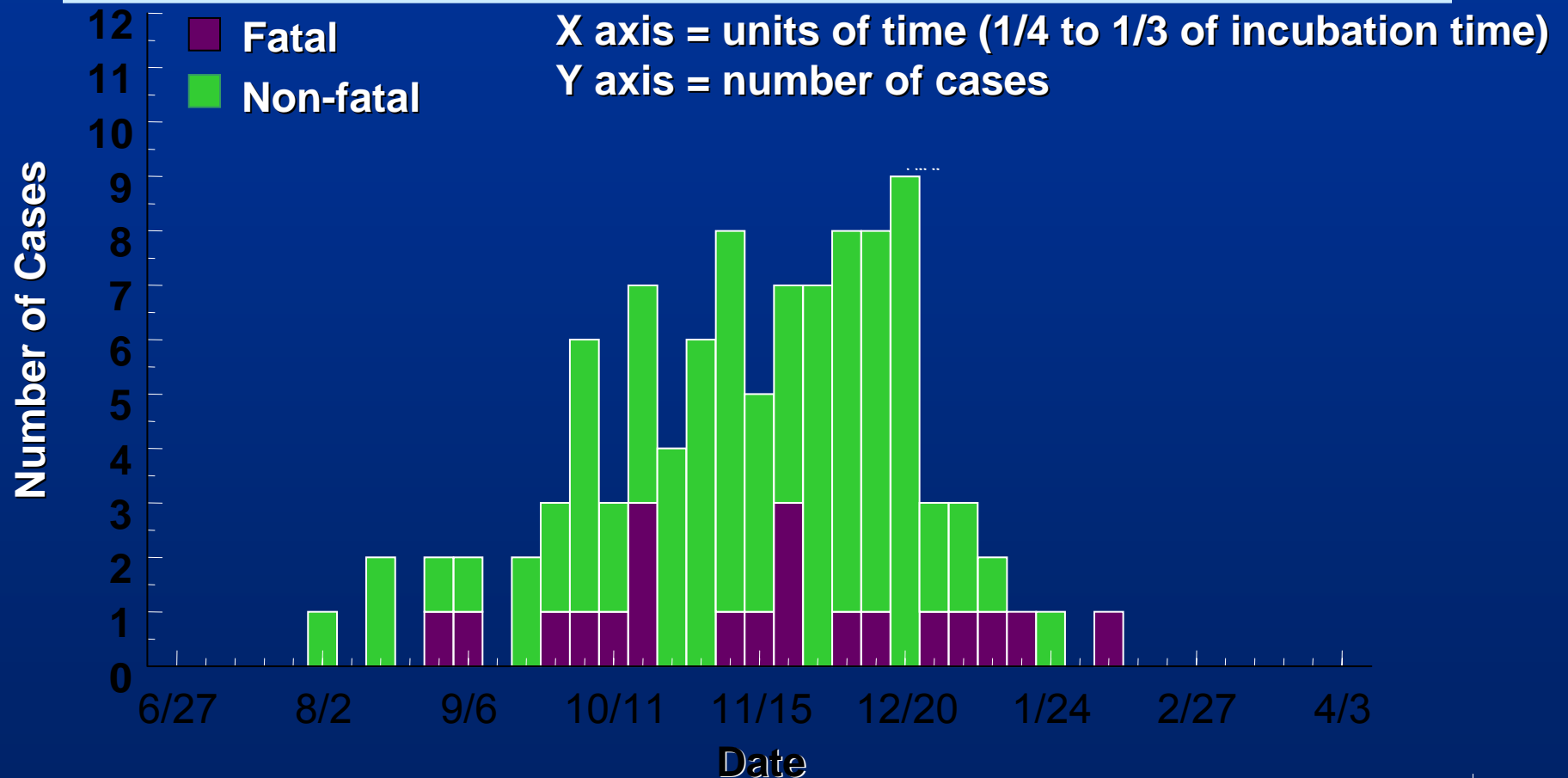
# Epidemiological Study

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- A questionnaire is developed based on a list of foods served or a menu.
- Area Surveillance staff administer the investigation form (Environmentalists may be recruited to help). Cases (ill) and controls (well) are interviewed.
- Specimens are collected (clinical and food).
- Data analysis is performed on the information gathered from interviews and laboratory results.

# An Epidemic Curve

Shows progression of outbreak over time



**There is an inherent delay between the date of illness onset and the date the case is reported to Public Health**

Source: Centers for Disease Control and Prevention

# Solving a Foodborne Outbreak

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- Epidemiology, Environmental, and Laboratory Investigations are interdependent.
- Epidemiology analyzes the data collected & implicates a potential food and hypothesized agent(s).
- Environmentalists submit implicated food(s) to Bureau of Clinical Laboratories (BCL).
- Surveillance staff ensure sufficient human specimens are collected and submitted to BCL.
- Laboratory confirms (or negates) the implicated agent.

# Laboratory Food & Patient Specimens

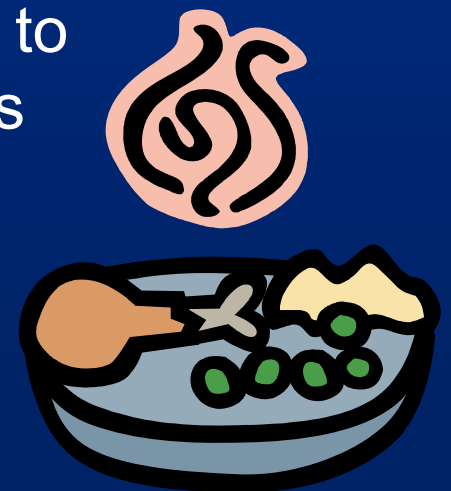
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- Ideally, we want to isolate the agent from 3 patient specimens and the implicated food(s).
- BCL cannot test for everything. Epidemiology must guide testing based on statistical analysis.

# Investigation Team: Things Can Change, Stay Flexible

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- The case definition can evolve as the investigation moves forward.
- Submit food samples to test based on implications from analysis.
- Discuss with Epidemiology (Central Office) to determine what organisms to test for, cases that don't fit, etc.



# Environmental Investigation

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- Obtain a detailed history of implicated food item.
- Restrict all ill foodhandlers.
- In depth education on proper food handling.
  - Proper hand hygiene.
  - Proper cooking, storing temperatures.
  - Proper placement of foods (vegetables above meats in refrigerator).

# Problems Encountered During FBO Investigations

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- The food has been discarded. (Epi-analysis can still implicate a food without food to test).
- The affected individuals have no vomit or stool samples to contribute (Epidemiology can only hypothesize an agent without laboratory confirmation).
- An inadequate number of individuals became ill to do analysis (Epi-analysis not statistically significant).
- No controls (well).
- Chance, Confounding, & Bias (Epidemiology issues with study design).

# Successful FBO Investigations

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- A successful FBO investigation is one that prevents additional illnesses. Investigating potential FBO identifies the **SOURCE** of food contamination.
  - **PRODUCT SOURCE:** Determine if a consumer product is contaminated, issue a recall, and/or alert the public to prevent others from becoming ill.
  - **PROCEDURE SOURCE:** Determine what went wrong during the food handling, preparation and storage process and provide proper training to prevent future contamination.

FBO Example 1:  
Gastrointestinal (GI) Outbreak  
in a Daycare

# GI Outbreak in a Daycare

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- On April 15, 2008, a Houston County daycare experienced acute onset Gastrointestinal (GI) illness following lunch.
- The daycare reported “children vomiting all over the place.”
- Approximately 10-15 children were vomiting in the 1-2 year old classrooms.
- The children ate lunch at 11:00 am and started getting sick at 1:00 pm.

# GI Outbreak in a Daycare

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- Symptoms of vomiting, lethargy, & possible fever. No diarrhea (yet).
- Lunch meal included chicken and rice, green beans and brownies.
- Fire trucks, police, ambulances, and the local media were on site.
- Due to signs & symptoms of severe vomiting, dehydration and lethargy, air was tested for carbon monoxide (CO) gas.

# GI Outbreak in a Daycare

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- Ill children were transported by ambulance to the Emergency Department (ED).
- CO poisoning was ruled out at the ED also.
- Parents were contacted to pick up children and the daycare was closed.
- While closing, more children from all classrooms became ill and were taken ED or local pediatrician by their parents.

# GI Outbreak in a Daycare

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- Environmentalists collected food samples. The cook was no longer present.
- Epidemiology (Central Office) constructed an investigation form.
- Area Surveillance staff interviewed 89 daycare attendees and staff at the local ED and by phone.
- In addition to vomiting, many children began having diarrhea.
- Stool & vomit specimens were collected and sent to BCL.

# GI Outbreak in a Daycare

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- At this stage in the investigation, the lunch meal is only one of many possible sources of illness; no source should be overlooked.
- Environmentalist collected water specimens.
- Environmentalists returned the next day to interview the cook.
- Multiple food handling, preparation & storage problems were identified.

# GI Outbreak in a Daycare

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- Hospital lab initial gram stains implicated both ***Staphylococcus*** and ***Bacillus cereus***.
- Both of these bacteria are capable of producing toxins that cause illness shortly after ingestion.
- Confirmatory cultures at BCL take time to grow.

# GI Outbreak in a Daycare: Environmental Investigation

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- Chicken & rice preparation review found improper handling, temperature & storage.
  - Chicken & rice prepared the day before consumption.
  - Chicken boiled & left out to cool over an hour.
  - Chopped then mixed with rice in huge pot cook could not stir.
  - Stored in a deep dish in refrigerator (improper cooling).
  - Heated in oven to inadequate internal temperature the next day.
- Training course with the cook focused on proper food handling, preparation, and storage before the kitchen was allowed to reopen.

# GI Outbreak in a Daycare: Epidemiology Investigation

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- 89 daycare attendees and staff interviewed. 42 ill and 47 well.
- Symptoms of vomiting and/or diarrhea began 1.5-10.0 hours after consuming lunch.
- 74% of those consuming lunch became ill.
- 0% of those not consuming lunch became ill.
- **Attack Rate: 74% eaters vs. 0% non-eaters**

# GI Outbreak in a Daycare: Epidemiology Investigation

Acute Foodborne Gastroenteritis Reference Table

Cause	Average incubation	Range incubation	Fever	Vomiting	Diarrhea
Heavy metals	5 -15 min	1 min – 8 hrs	--	+++	++
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Norovirus	36 hrs	10 - 50 hrs	+	+++	+++
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\**Vibrio vulnificus* has an incubation period of 12 hours to 3 days. However, infection with this organism does not present with vomiting or diarrhea, but with fever, septicemia and severe wound infection.

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# GI Outbreak in a Daycare: Laboratory Investigation

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- Patient Specimens
  - 11 patients' specimens grew *S. aureus* capable of producing Enterotoxin A (SEA)
  - 2 patients' specimens grew *B. cereus*
- Food Specimens
  - Chicken & Rice, Green Beans and Brownie grew *S. aureus*
  - Chicken & Rice and Green Beans grew *B. cereus*
- A double whammy?!?! Which one is the true culprit?

***Staphylococcus aureus* vs. *Bacillus cereus***

# Analysis of Laboratory Results

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## ***Staphylococcus aureus***

- Chicken & Rice
  - 3,700,000 per gram
- Green Beans
  - 43,000 per gram
- Brownie
  - 100 per gram

## ***Bacillus cereus***

- Chicken & Rice
  - 500 per gram
- Green Beans
  - 500 per gram
- Brownie
  - None isolated

# CDC Guide to Confirming a Diagnosis in Foodborne Disease

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- ***S. aureus***

- Isolation of  $10^5$  organisms/g from epidemiologically implicated food, provided specimen is properly handled

- ***B. cereus***

- Isolation of  $10^5$  organisms/g from epidemiologically implicated food, provided specimen is properly handled

***S. aureus* Entertoxin A caused the GI outbreak**

# GI Outbreak in a DCC

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- *S. aureus* Enterotoxin A was the agent.
- Chicken & rice was the vehicle.
- Improper food handling was the cause.
- Environmentalists perform the public health intervention ensuring future FBO are prevented at the daycare.

FBO Example 2:  
Outbreak at a Christmas Dinner

# Outbreak at a Christmas Dinner

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- On 12/17/2008, ADPH was notified of potential FBO in Calhoun county involving a group of State Troopers experiencing Gastrointestinal (GI) illness after consuming a catered Christmas dinner.
- 40 attendees were identified. 29 were interviewed by Area Surveillance with an investigation form supplied by Epidemiology.
- 22/29 (76%) became ill with diarrhea and abdominal pain. No vomiting or fever.
- Stool specimens were collected and sent to BCL.

# Outbreak at a Christmas Dinner: Environmental Investigation

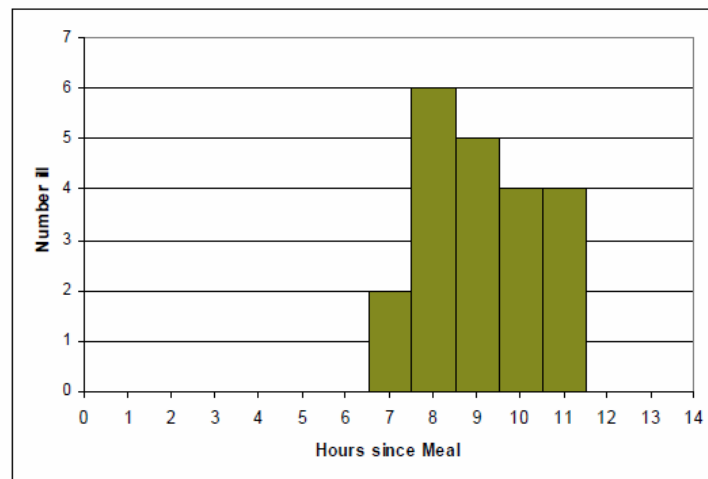
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- Dinner included 12 food items and 2 beverage choices (turkey, dressing, etc).
- Environmentalists collected left-over food samples & investigated the caterer.
- The caterer reported serving 2 meals on 12/16/2008, the trooper meal at 7pm and an earlier lunch meal at 12pm. Both meals contained the same items and the caterer initially reported they were prepared at the same time.
- No attendees of the lunch meal became ill.

# Outbreak at a Christmas Dinner: Epidemiology Investigation

- 22/29 (76%) troopers interviewed met case definition with symptom onset occurring within 7-12 hours of the meal.
- Based on the Epi-curve and symptom complex, *Bacillus cereus* & *Clostridium perfringens* were hypothesized causes.

Figure 1. Hours between Eating Catered Dinner December 16, 2008 at 7PM and Onset of Gastroenteritis.



# Outbreak at a Christmas Dinner: Epidemiology Investigation

Acute Foodborne Gastroenteritis Reference Table

Cause	Average incubation	Range incubation	Fever	Vomiting	Diarrhea
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# Outbreak at a Christmas Dinner: Epidemiology Investigation

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- Epidemiologic analysis of food items served implicated gravy as the contaminated food item (Attack rate 76%, p-value < 0.001).
- No other food items were significant when comparing the attack rate between eaters and non-eaters.
- When contacted again by Environmental, the caterer conceded the gravy was prepared in 2 separate batches immediately prior to the meal.

# Outbreak at a Christmas Dinner: Epidemiology Investigation

Table 1. Association between reported food exposures and cases of *Clostridium perfringens* gastroenteritis at a catered dinner – Calhoun County, December 2008

Exposure	Exposed		Not Exposed		Odds Ratio	p value†
	Ill (n = 22)	Not ill (n = 7)	Ill (n = 22)	Not ill (n = 7)		
Turkey	19	4	3	3	4.75	0.132
Dressing	21	5	0	1	11.73*	0.222
<b>Gravy</b>	<b>22</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>675.00*</b>	<b>&lt; 0.001</b>
Ham	17	6	5	1	0.57	0.545
Sweet Potatoes	15	3	7	4	2.86	0.223
Green Beans	14	4	8	3	1.31	0.547
Mac & Cheese	17	6	5	1	0.57	0.545
Cranberry Sauce	11	2	10	5	2.75	0.258
Rolls	7	5	15	2	0.19	0.080
Peanut Butter Cake	6	3	15	4	0.53	0.400
Chocolate Cake	4	2	17	5	0.59	0.478
Carrot Cake	4	0	17	7	3.85*	0.292
Sweet Tea	16	5	6	2	1.07	0.647
Unsweet Tea	2	0	18	7	2.03*	0.541

\* Logit estimators use a correction of 0.5 in every cell of those tables that contain a zero

† Fisher Exact, 1-tail

# Outbreak at a Christmas Dinner: Laboratory Investigation

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- Based on epidemiologic analysis, BCL tested the patient and food specimens for both *Clostridium perfringens* and *Bacillus cereus*.
- *C. perfringens* was present in both patient stool specimens & the gravy.

2 Scenarios

Now it's YOUR Turn!!!

# Scenario 1

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- A husband, wife, and 2 children eat dinner at a local pizza restaurant and take home three left-over slices of pizza in a doggie-bag. Later that evening, all 4 family members become sick with vomiting. Three also had diarrhea, but none had fever. The family toughed it out at home and did not visit a doctor.
- The following morning, the husband places a complaint with the local health department. He demands the left-over pizza be tested and the restaurant investigated.
- You are sent out to inspect the restaurant and find no problems. No additional complaints regarding the restaurant are received from the public.

# Scenario 1 Discussion

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- Does this constitute a likely FBO?
- Do we have epidemiologic or laboratory evidence to back up a FBO?
- Is it equally likely the family is ill due to meal consumed at home or an entirely unrelated etiology?
- Recall:
  - A FBO is a cluster of 2 or more illnesses caused by the same agent which upon investigation are linked to the same food.
  - ADPH generally requires 2 or more unrelated persons exposed to the same food source within the same time period to become ill before we initiate an investigation.

# Scenario 2

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- You are contacted by 2 couples and a family of 5 who all ate at the same restaurant over the weekend and became sick within 1-2 days; all groups are unrelated. You forward the information to the Area Surveillance staff and inspect the restaurant. You notice internal meat temperatures do not meet standards upon cooking.
- Area Surveillance staff obtains illness information and food histories. The family took 2 small children to the ED where the MD mentioned food-poisoning, but no stool specimens were taken. The family agrees to submit stool specimens to ADPH. Additionally, one of the couples has leftover food for testing.

# Scenario 2 Discussion

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1. Does this constitute a likely FBO?
2. Do we have epidemiologic or laboratory evidence to back up a FBO?
3. Is it equally likely the 3 separate dining parties are ill due to meals consumed at home or an entirely unrelated etiology?

# Contact Epidemiology

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- Division of Epidemiology:

(334) 206-5347 or (800) 338-8EPI

- ADPH website:

[www.adph.org/epi](http://www.adph.org/epi)

# Alabama Department of Public Health (ADPH)

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