Massachusetts Department of Public Health

Getting to the source:

A review of data collected during foodborne outbreak investigations and how it is used

MHOA 2025 Annual Conference

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Johanna Vostok, MPH

Bureau of Infectious Disease & Laboratory Sciences

Division of Epidemiology

Geena Chiumento, MPH

Bureau of Infectious Disease & Laboratory Sciences

Division of Epidemiology

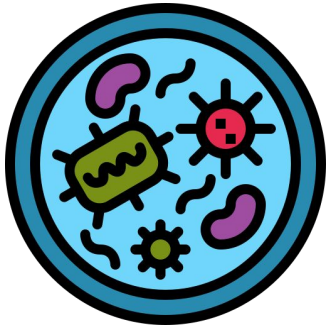
Nichol Smith, MS

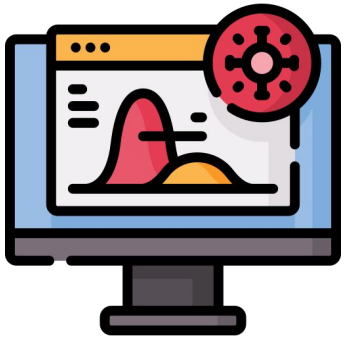
Bureau of Climate & Environmental Health

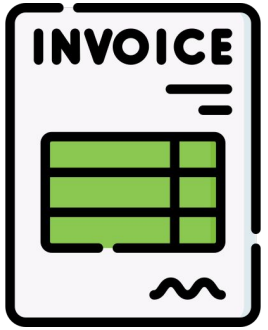
Division of Food Protection

Overview

- Detection & investigation of foodborne illness outbreaks
- Data used during outbreak investigations
  - Patron or customer lists
  - Menu and ingredient lists
  - Receipts and invoices
- Wrap up







Kratom

Wild Songbird

Charcuterie Meats

Cucumbers

Diced Onions

Mini Pastries

Flour

Cantaloupe

Small Turtle

Tuna

Peanut Butter

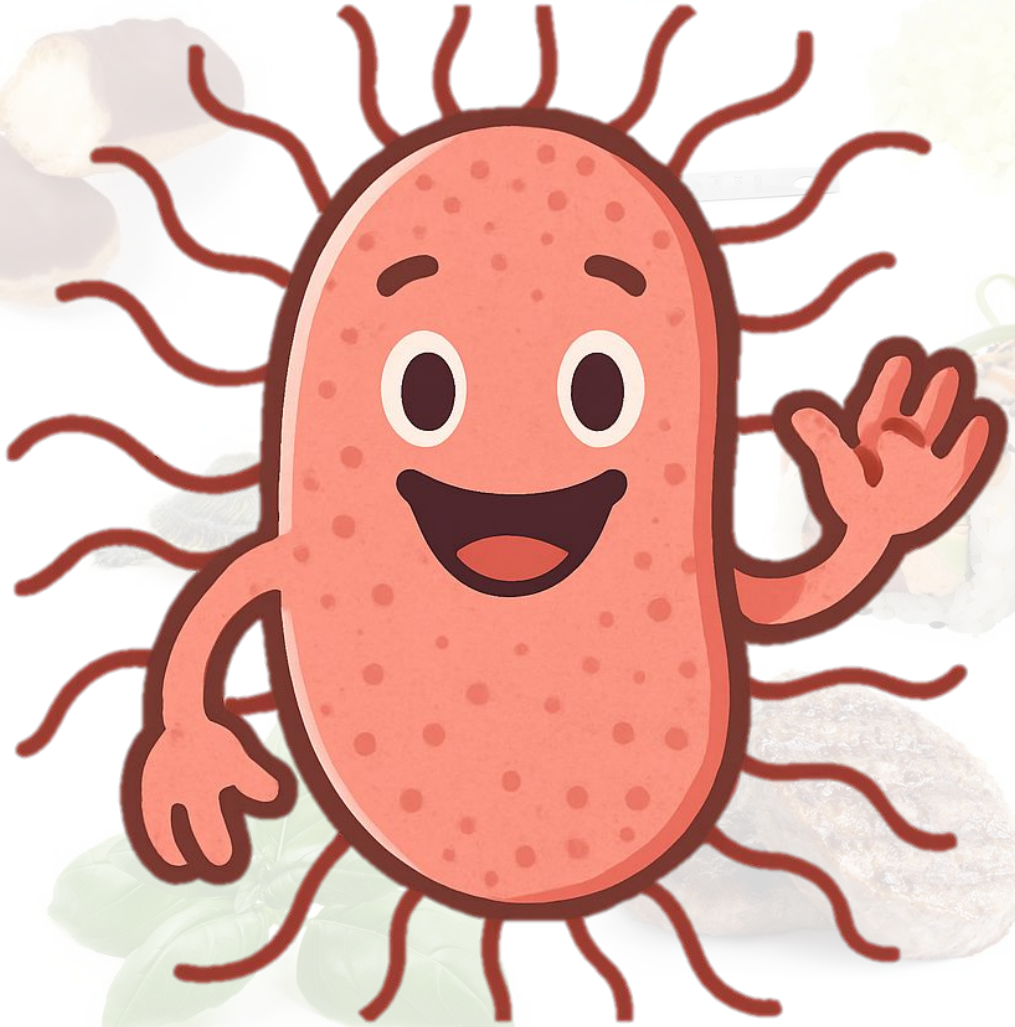
Gecko

Basil

Ground Beef

Backyard Poultry

All have been implicated as the cause of a national *Salmonella* outbreak



Detection & investigation of outbreaks

Reportable diseases associated with foodborne illness

Bacteria	Botulism Campylobacteriosis Listeriosis Shiga toxin-producing *E. coli* (STEC)	Salmonellosis Shigellosis Vibriosis Yersiniosis
Parasites	Amebiasis Cryptosporidiosis	Cyclosporiasis Giardiasis
Viruses	Norovirus Hepatitis A	
Toxins	Foodborne illness due to toxins (including mushroom toxins, ciguatera toxins, scombrotoxin, tetrodotoxin, paralytic shellfish toxin and amnesic shellfish toxin, staphylococcus enterotoxin and others)*	

*These are reportable by healthcare providers and often are not confirmed by laboratory testing.

105 CMR 300: Reportable diseases, surveillance, and isolation and quarantine requirements

How we learn about foodborne illness outbreaks

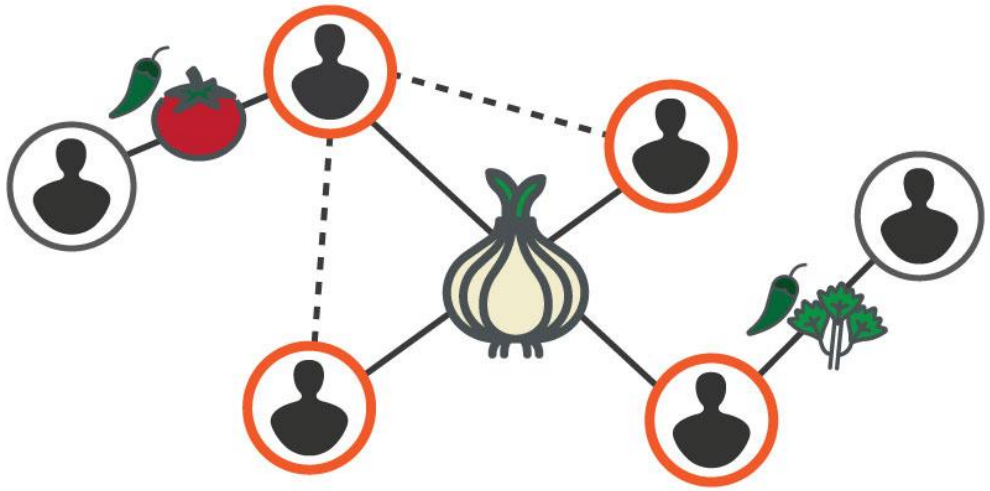
Common food exposure reported by diagnosed cases	Two lab-confirmed *Campylobacter* cases report consuming raw milk from the same dairy.
Undiagnosed reports from the public	An individual reports diarrhea and vomiting after attending a retirement party. They know of a couple others with similar symptoms.
Reports from community members*	A school nurse reports 20 elementary school students began vomiting an hour after eating school lunch.
Laboratory testing	Whole genome sequencing performed at the State Lab indicates five *Salmonella* cases are genetically related. Interviews of cases identify a common restaurant exposure.

*Community members: health care providers, schools, daycares, hospitals, institutions, camps

Foodborne illness outbreak definition

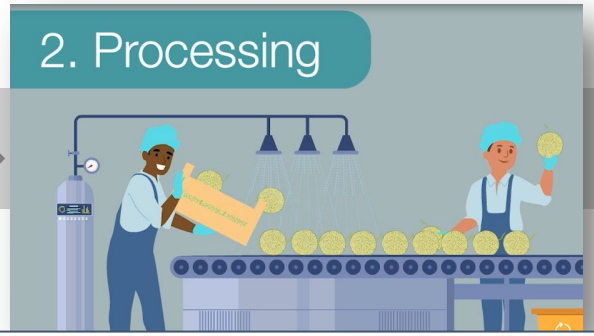
An incident in which two or more persons from different households experience similar illness resulting from a shared food exposure.

- Individuals do not need to have a diagnosis to initiate an outbreak investigation



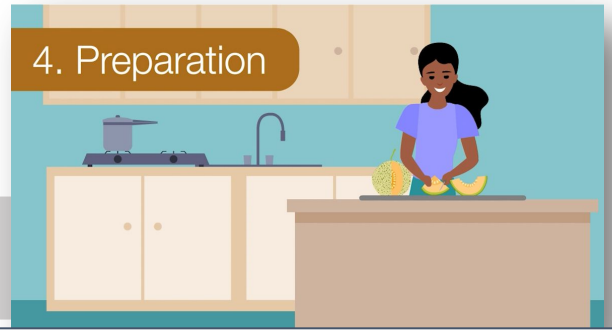
How food gets contaminated

Contaminated irrigation water is sprayed on romaine lettuce prior to harvest



Processing at a peanut butter production facility leads to contamination

Refrigerated food left on a loading dock allows for bacteria to grow



A local church improperly cooks turkey served to community members on Thanksgiving

Steps in a foodborne outbreak investigation

DETECT

FIND

GENERATE

TEST

1

Detect a possible outbreak through public health surveillance.

2

Find more cases in the outbreak.

3

Generate hypothesis through interviews with sick people.

4

Test hypotheses to find a likely source.
If no source is found and cases continue, return to Step 3.

Center for Disease Control and Prevention [CDC], 2022

Steps in a foodborne outbreak investigation

SOLVE

5

Solve source of the outbreak & ultimate point of contamination.

CONTROL

6

Control outbreak through changes in practices, recalls, & facility Improvements.

DECIDE

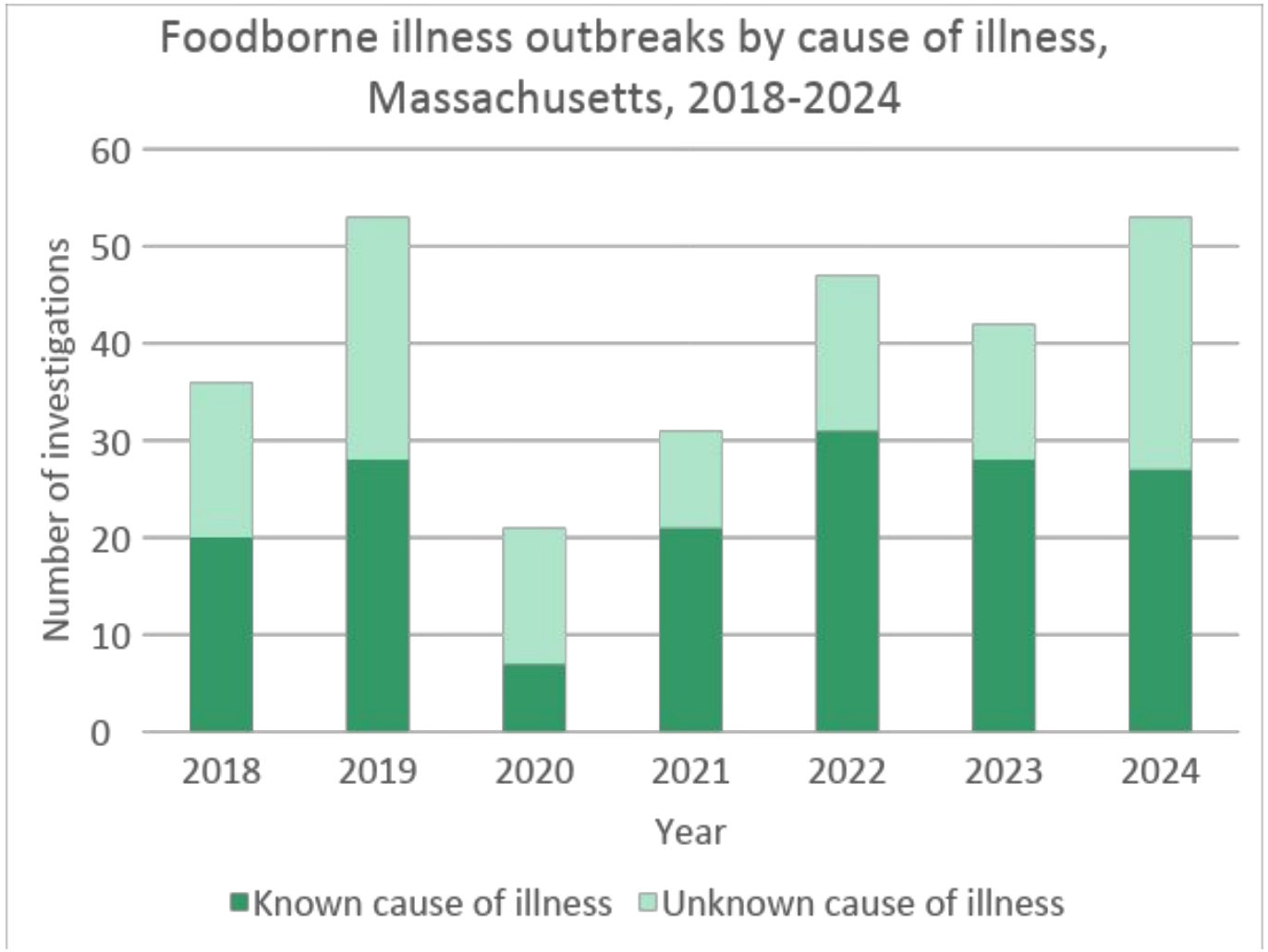
7

Decide an outbreak is over and the public is no longer at risk. If cases go up again, continue or restart the investigation.

Foodborne outbreak investigations are dynamic. In reality, some steps may happen at the same time.

Center for Disease Control and Prevention [CDC], 2022

Foodborne outbreak data in Massachusetts

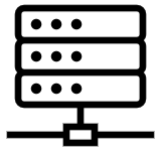


Source: Bureau of Infectious Disease and Laboratory Science. Data as of 10/8/25 and subject to change.

Key Points

- Average of 47 foodborne outbreaks investigated annually 2022-2024
- 50-60% of foodborne outbreaks have a known etiology
- Approximately half of outbreaks with a known etiology are caused by *Salmonella*

Outbreak investigation team

Responsibility	Local Health	MA Department of Public Health	Federal Agencies
Ill or exposed people 	Public health nurse Epidemiologist	**Division of Epidemiology** Foodborne Epidemiologist	CDC
Food establishment 	Health Inspector Sanitarian	**Division of Food Protection** Environmental Analyst	FDA USDA
Clinical, food, environmental testing 		**State Public Health Laboratory** Laboratorian	
Data management 		**Division of Surveillance, Analytics, and Informatics** Surveillance Epidemiologist	

Data used during foodborne outbreak investigations

Types of data used during foodborne outbreaks

Epidemiologic	Data that describes illness distributions, reveals common exposures
Environmental	Informational traceback and environmental assessment data that identify common contamination points and factors in the distribution chain
Testing	Identifies outbreak-associated strains in implicated foods or environmental samples

Data allows for public health action:
warning to public, temporary restaurant closure, product recall

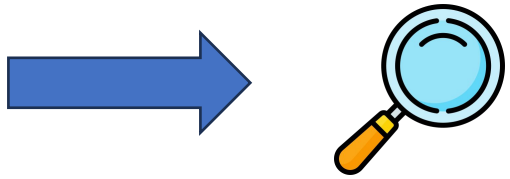
Data used during outbreak investigations

Customer & patron lists

Why do we need customer and patron lists?

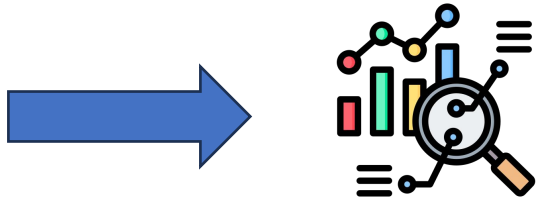
To determine the size and scope of an outbreak, as well as to identify the outbreak mode of transmission and vehicle.

1. Contact others exposed to find out if they became ill



Case Finding

2. Interview individuals who did not become ill about outbreak-associated exposures



Test hypotheses

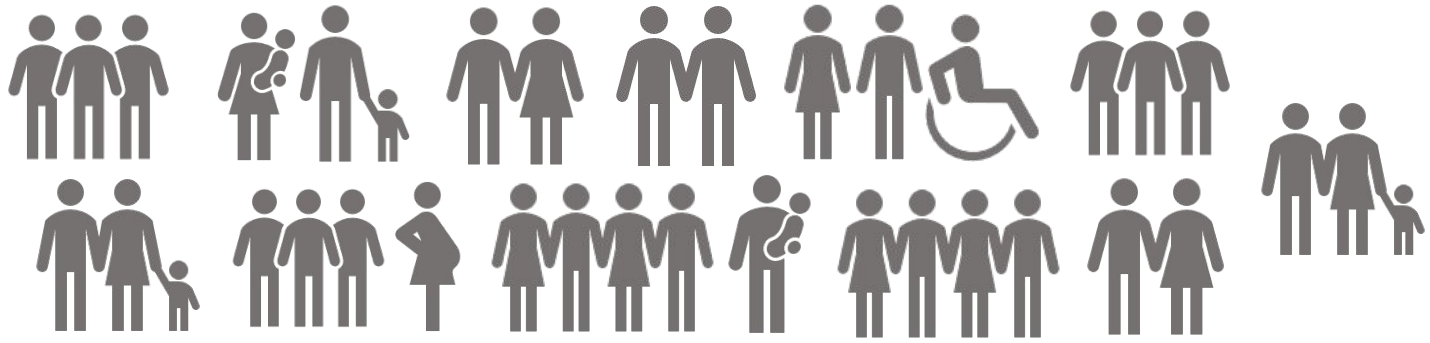
Example: Brazilian-Style Restaurant Outbreak

Ill people who dined at a Brazilian-style restaurant

Food	% with food exposure
White Rice	91.4%
Brown Beans	78.8%
Chicken Salad (Salpicao)	77.1%
Fried Banana	68.6%
Pasta	53.1%
French Fries	52.9%
Picanha	47.2%
Potato Salad (Maionese)	42.9%
Feijao Tropeiro	35.3%
Green Salad	33.3%
Roasted Chicken with Potatoes	31.4%

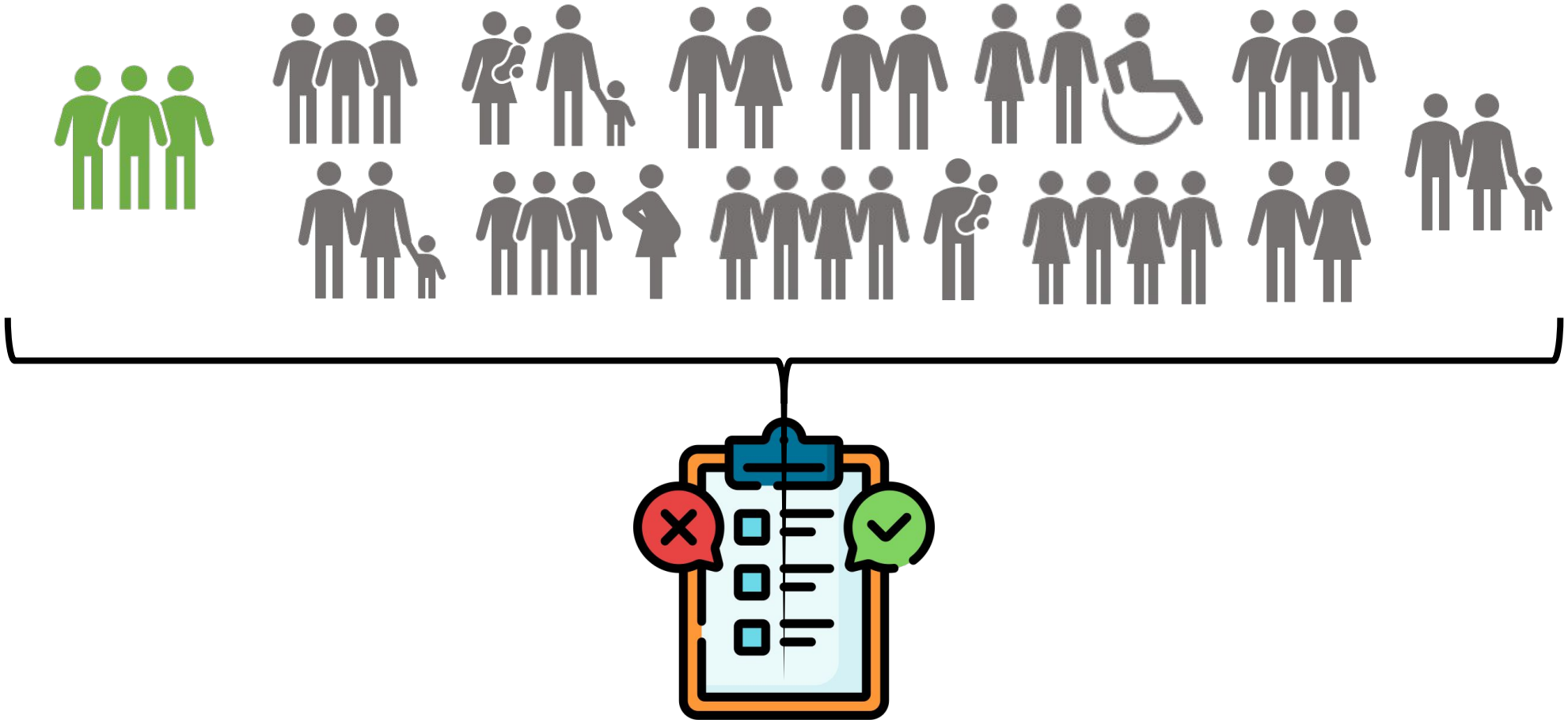
How do these food exposures compare to others who dined at the restaurant?

Need a comparison group!



Other restaurant patrons

How customer/patron lists are used

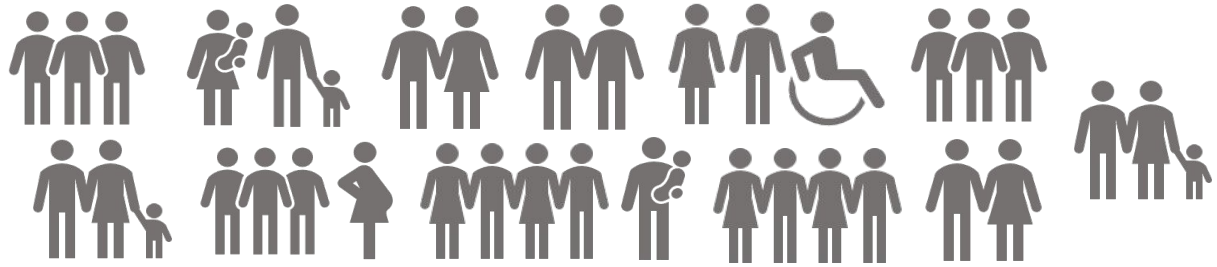


Interview all restaurant patrons with a standard questionnaire

Example: Brazilian-style restaurant outbreak

Ill people

Other restaurant patrons

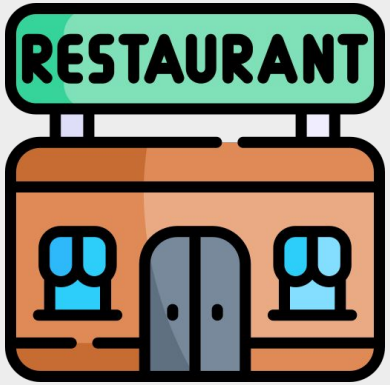


	% with Food Exposure	
Food	**Ill**	**Not Ill**
White Rice	91.4%	85.7%
Brown Beans	78.8%	42.9%
Chicken Salad (Salpicao)	77.1%	7.7%
Fried Banana	68.6%	71.4%
Pasta	53.1%	50.0%
French Fries	52.9%	50.0%
Picanha	47.2%	21.4%
Potato Salad (Maionese)	42.9%	21.4%
Feijao Tropeiro	35.3%	30.8%
Green Salad	33.3%	15.4%
Roasted Chicken with Potatoes	31.4%	25.0%

Identifying additional persons at risk

From patrons

- Dining companions
- Guest list for event outbreaks



From food establishments

- Reservations
- Take-out orders
- Group event or catering orders

From third-party companies

- Online ordering or delivery services (UberEats, DoorDash, GrubHub)

Alternative approach: restaurant sales data

- Provides frequency of the sale of individual items
- Can be used to estimate how often a menu item or ingredient is consumed
- Provides the denominator of patrons served
- Data format:
  - Product mix (pmix) data
  - Itemized receipts printed from point of service system

Alternative approach: restaurant sales data

Menu Name	Menu Group	Menu Item	Avg Price	Item Qty
ALL MENUS			8.01006086	8729
COUNTER	Entrees	SUPER BURRITO*	10.3760693	489
COUNTER	Entrees	BURRITO*	9.21285714	455
COUNTER	Entrees	BOWL*	10.4860963	186
COUNTER	Entrees	QUESADILLA*	9.66923077	208
COUNTER	Entrees	SUPER QUESADILLA*	11.1411765	17
COUNTER	Entrees	TORTILLA SALAD*	9.25833333	12
COUNTER	Entrees	TACO*	3.63713647	447
COUNTER	Entrees	BAJA TACO*	4.3199115	113
COUNTER	Entrees	NACHOS*	12.19	75
COUNTER	Entrees	PLAIN CHEESE QUESADILLA*	6	6

Dining option	Orders	Net sales	Discount amount	Gross sales	Tax amount
GRUBHUB - TAKE OUT	9	148.1	0	148.1	10.39
CATERING PICK UP	1	526	0	526	0
Event	2	3050	0	3050	0
UBER EATS - DELIVERY	32	589.55	0	589.55	41.22
SNACKPASS	5	80.7	0	80.7	5.65
CATERING DELIVERY	2	1126.5	0	1126.5	36.57
ROOF BAR	1318	22521.8	187.5	22709.25	1574.75
UBER EATS - TAKE OUT	137	3583.05	0	3583.05	193.17
DOOR DASH - TAKEOUT	99	1965.9	0	1965.9	137.54
Website Ordering - Takeout	33	754.8	0	754.8	50.47
GRUBHUB - DELIVERY	18	377.9	0	377.9	26.43
Website Ordering - Delivery	6	237.38	0	237.38	10.9
BAR	420	6978.3	29.75	7008.05	487.98
QR	54	656.9	0	656.9	45.99
Online Ordering - Delivery	4	211.65	0	211.65	12.98
Online Ordering - Takeout	28	657.35	0	657.35	45.96
COUNTER	1463	19247.3	347.35	19594.65	1346.27
Total	3631	62713.1	564.6	63277.73	4026.27

Customer list wrap up

- Customer lists can come from several different sources
- Customers are contacted to understand the background rate of outbreak-associated exposures
  - An alternative method is to obtain restaurant sales data
- Information collected allows us to understand the size and scope of the outbreak and identify the outbreak vehicle

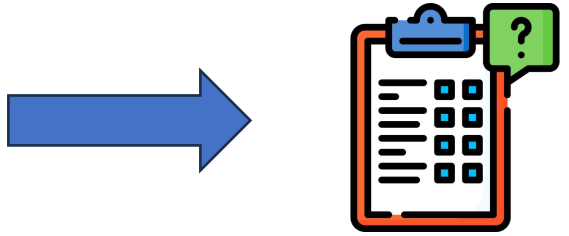
Data used during outbreak investigations

Menus & ingredient lists

Why do we need menus & ingredient lists?

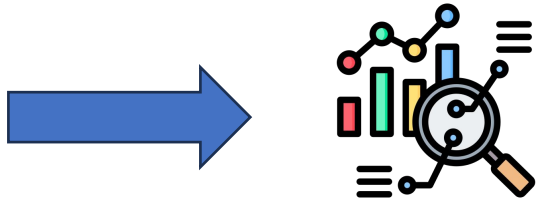
To identify the possible meal or ingredient that made people sick to inform next steps in the outbreak investigation

1. Use menu to develop an outbreak questionnaire for ill and non-ill persons to complete



Generate hypotheses

2. Analyze questionnaire data using an epidemiological study



Test hypotheses

Considerations when obtaining menus

Time Period

- Are illnesses limited to a single point in time (e.g., a catered event)?
- Are illnesses spread across days or weeks?

Specials

- Were there any chef specials served during the time period of interest?

Buffets

- What were all the food items served on the buffet during the time period of interest?

Modifications

- Is the menu customizable (e.g., create your own bowl or burrito)?
- Did patrons make any substitutes or modifications to a menu item?

Outside Food Items (mostly applies to catered events)

- Where any foods (e.g., desserts) brought in from another establishment or made at home by an attendee?

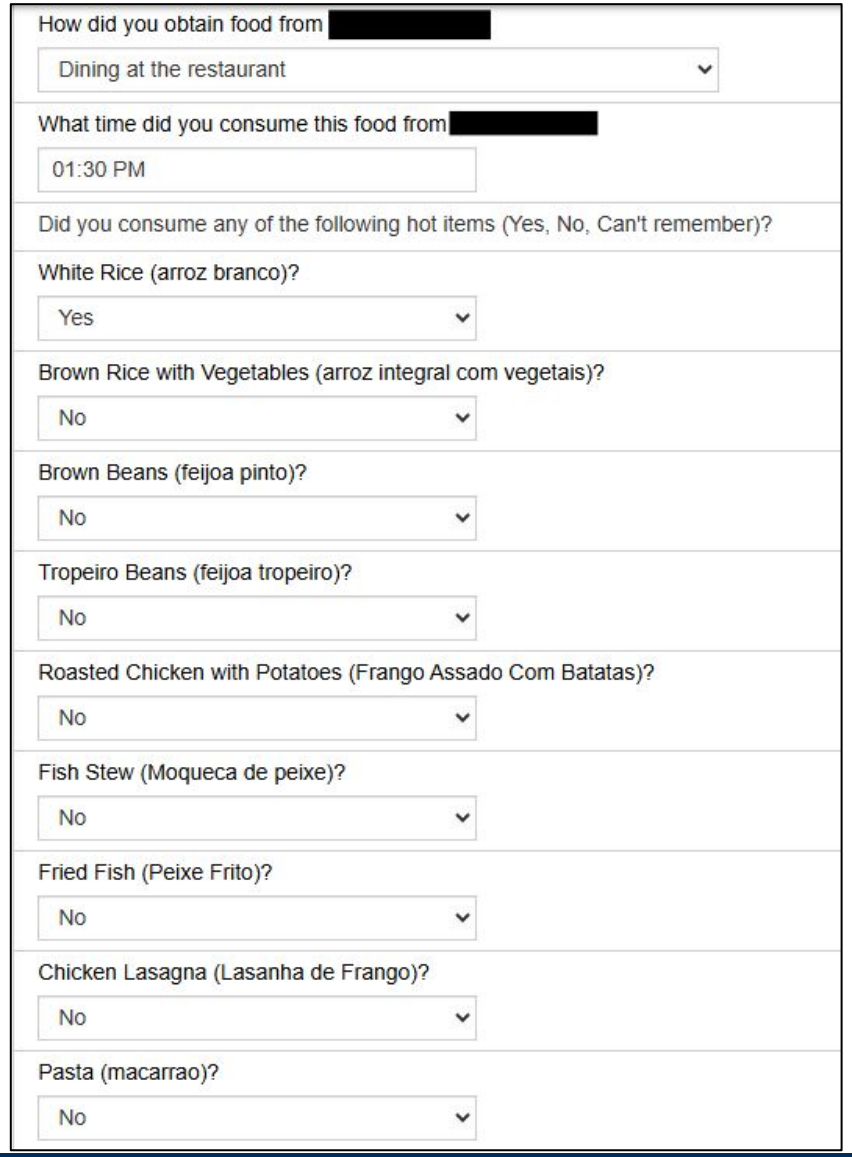
Development of questionnaires

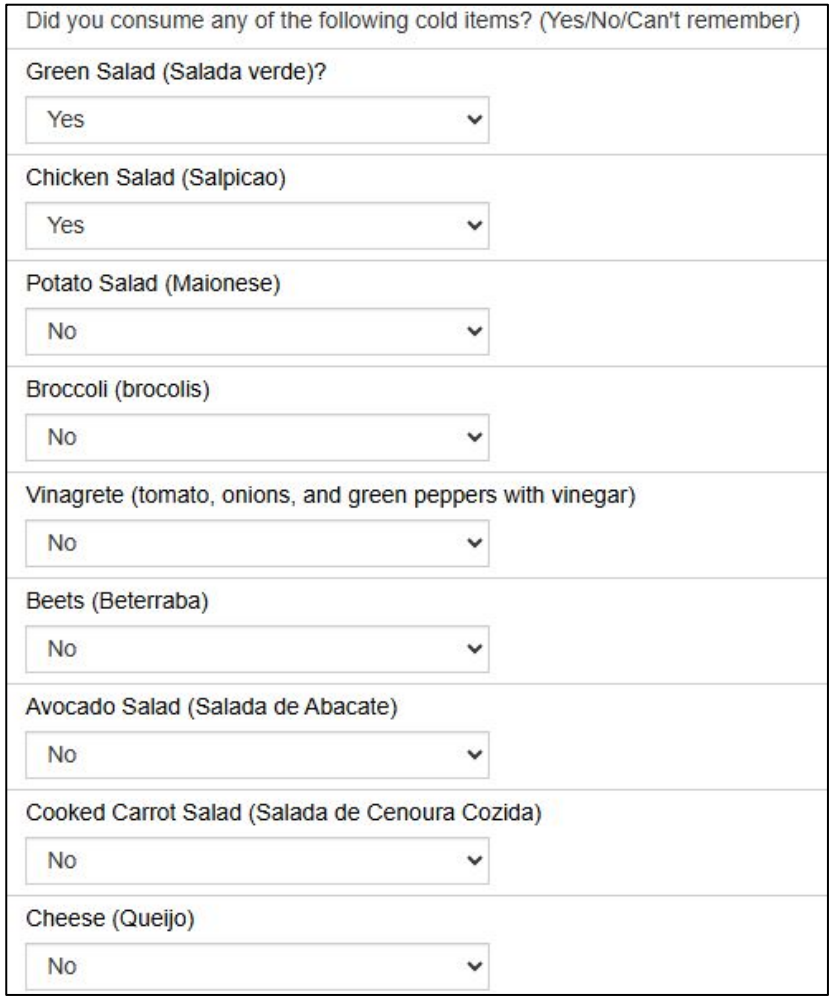
- Must ask about:
  - Patron/attendee demographics (e.g., age, gender)
  - Illness after exposure to event or food establishment
    - Determine date and time of illness onset
    - Indicate any symptoms experienced
    - Indicate if medical attention was sought or stool sample tested
  - All meals or food items that individuals could have consumed
    - An answer (Yes/No/Cannot recall) should be given for every single menu item
  - Any drinks or desserts that individuals could have consumed

Example: Brazilian-style restaurant outbreak

How food was obtained and when it was consumed

What hot items were served





What cold items were served

Analyze questionnaire results

- Goal of an epidemiological (epi) study is to test hypotheses by analyzing the association between illness and exposures
  - Type of epi study done depends on
    1. Outbreak setting
    2. Number of ill people (cases) reported
    3. Public health resources available
- Results should inform environmental assessment and/or traceback

Example: Brazilian-style restaurant outbreak

Menu items served on 7/14 were collected and used to make an outbreak-specific questionnaire

Patrons were interviewed using questionnaire, including:

- Individuals with reported *Salmonella* infection and their dining partners
- Individuals who ordered delivery on 7/14

Case-control study

77% of patrons who became ill ate chicken salad	**8%** of patrons who did not become ill ate chicken salad

Odds Ratio=40.50
P-value<0.001

Those ill were **40** times more likely than those who were not ill to have eaten the chicken salad (salpicao).

Ingredient lists

Once a suspect dish is implicated, we then want to determine if a particular process or ingredient could be the problem

- Is there an ingredient in the dish commonly associated with the outbreak pathogen or serotype?
- Is the ingredient used only in the suspect dish or in multiple dishes?
- Is the ingredient prepared differently across dishes?
- Was the ingredient already contaminated before entering the restaurant?

Example: Brazilian-style restaurant outbreak

Source: https://easybrazilianfood.com/brazilian-chicken-salad-salpicao-de-frango/

*Not an image of the implicated dish from the restaurant

Ingredients in the chicken salad (salpicao):

- Chicken tenders ⚠
- Deli ham (fully cooked)
- Diced carrots (raw)
- Pea/corn/carrot mix (frozen)
- Raisins
- Mayonnaise
- Whole green olives with pepper
- Potato sticks
- Chicken base

Menus and ingredient lists wrap up

- Obtaining a menu is key to knowing what food or drink ill and non-ill persons were exposed to
- If possible, a questionnaire can be developed and deployed to conduct an epi study
- If a dish is statistically implicated, it can inform environmental follow-up, including traceback of certain ingredients

Data used during outbreak investigations

Receipts & invoices

Why do we need receipts and invoices?

To obtain details on product identity, consumers' purchase dates and locations, and product distribution.

1. Determine what specific food products ill persons consumed if recall is poor or details are unknown

Generate hypotheses

2. Trace back suspect products through the supply chain to determine whether they converge on a common source or supplier

Test hypotheses

The Shopper History Outbreak Partnership (SHOP)

AFDO.org

Traceback overview

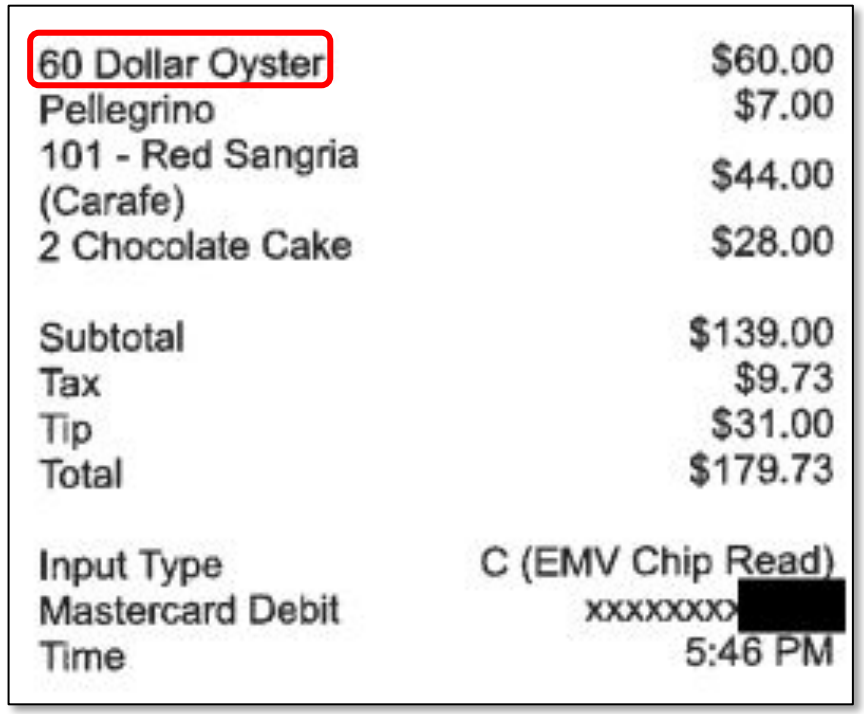
Informational

- Epidemiological traceback
- Determine if food items consumed by multiple cases have a common source or point of distribution
- Information collected is incomplete or not verified through documentation

Regulatory

- Food product is traced back through supply chain and verified through official documentation such as invoices and bills of lading

Receipts



60 Dollar Oyster	$60.00
Pellegrino	$7.00
101 - Red Sangria (Carafe)	$44.00
2 Chocolate Cake	$28.00
Subtotal	$139.00
Tax	$9.73
Tip	$31.00
Total	$179.73
Input Type	C (EMV Chip Read)
Mastercard Debit	xxxxxxx[redacted]
Time	5:46 PM

#343/2 08/13/25-A 4:09pm
Guests 2 [redacted] Table 70
2E-46JR-5263

1 Mango Margarita	14.00
Pleasant Bay Oyst	10.50
>3 ea @ $3.50/ea	
1 Fried Clams	35.99
Side Caesar	2.00
Items	62.49
Tax	4.36
Tip	12.00
TOTAL	78.85
Visa	78.85

01.23324186 VISA [redacted] Chp VISA CARDHOLDE
08-13-2025 17:03:36 SIG 78.85
CHASE VISA [redacted]
0000000000/0000

Check 343 CHARGED 5:10pm 5295#9-A

2 Beausoleil	$7.00
6 Arcadian Petite	$21.00
4 Spinney Creek	$16.00
8 Katama Bay	$32.00
2 Duxbury	$7.00
14 Oyster Special	$20.86
1 Fried Clams	$32.00
1 Herb Fries	$8.00
1 Mojito	$12.00
1 Old Fashioned	$12.00
Subtotal	$167.86
Tax	$11.73
Total	$179.59
Credit Card	Contactless

Vibrio traceback

Information collected during case interview

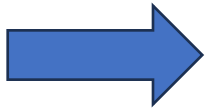
8) **Party size** 2

9) **Payment method**

■Credit Card ☐Cash ☐Unknown

☐Other/Comments

Ex: 1234



Vibrio traceback

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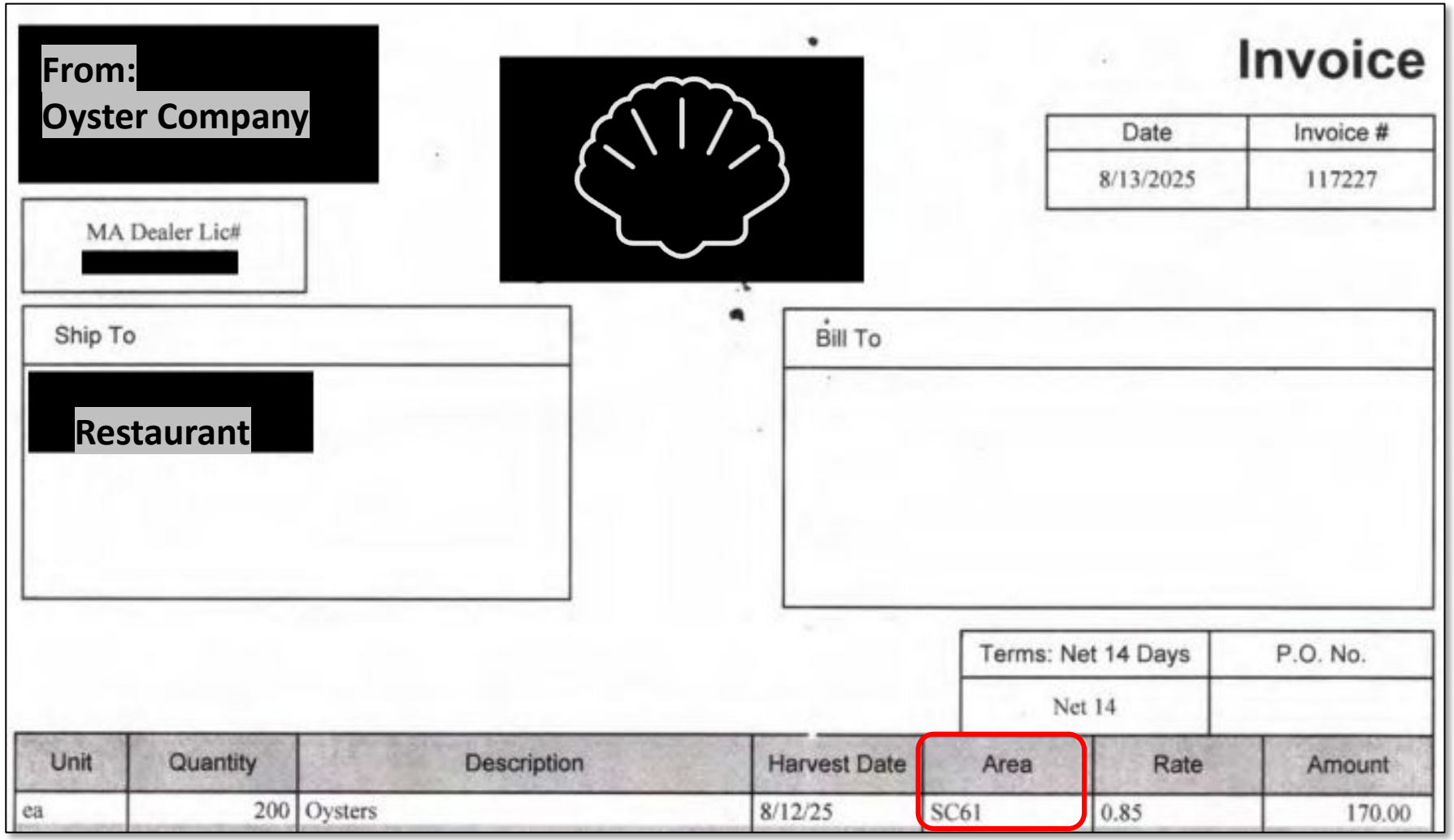


From:
Oyster Company

MA Dealer Lic# [redacted]

Invoice

Date	Invoice #
8/13/2025	117227

Ship To

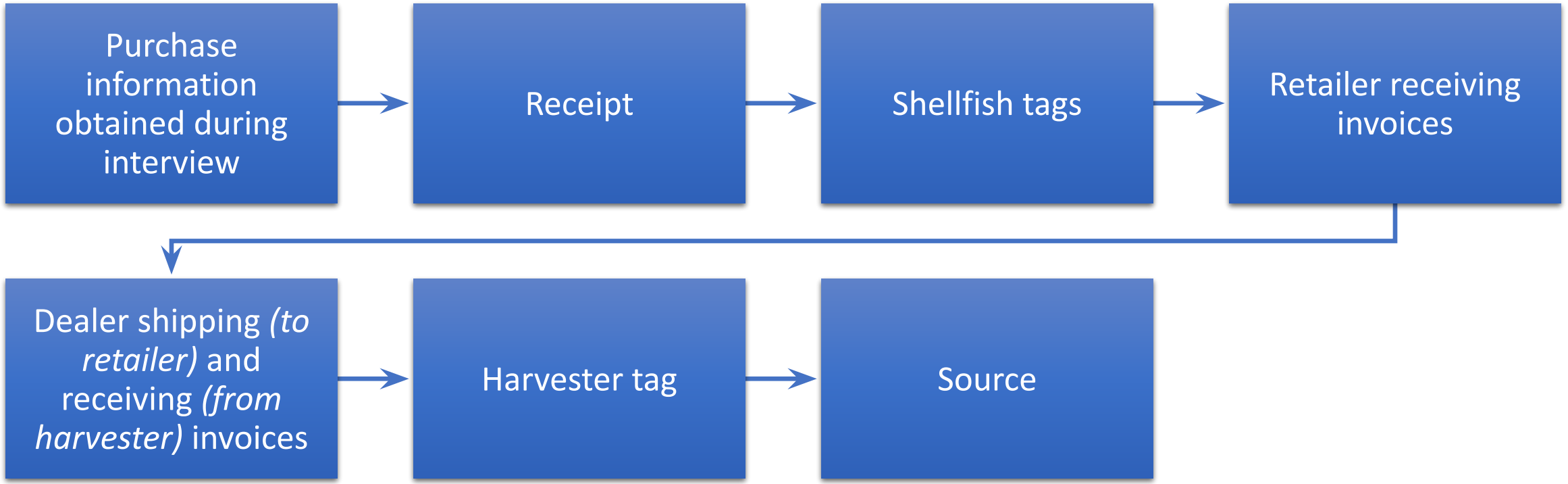
[redacted] Restaurant

Bill To

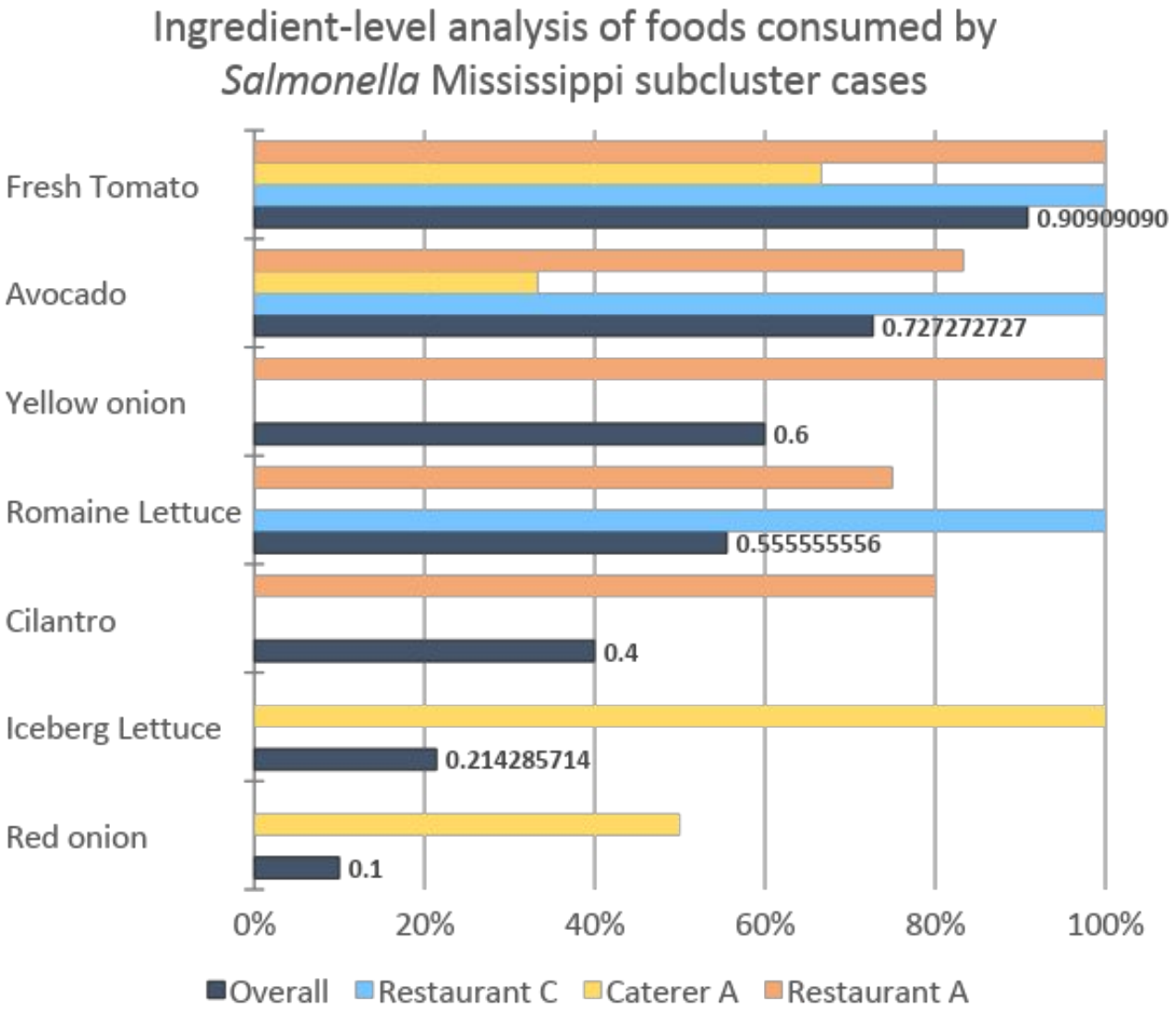
Terms: Net 14 Days	P.O. No.
Net 14	

Unit	Quantity	Description	Harvest Date	Area	Rate	Amount
ea	200	Oysters	8/12/25	SC61	0.85	170.00

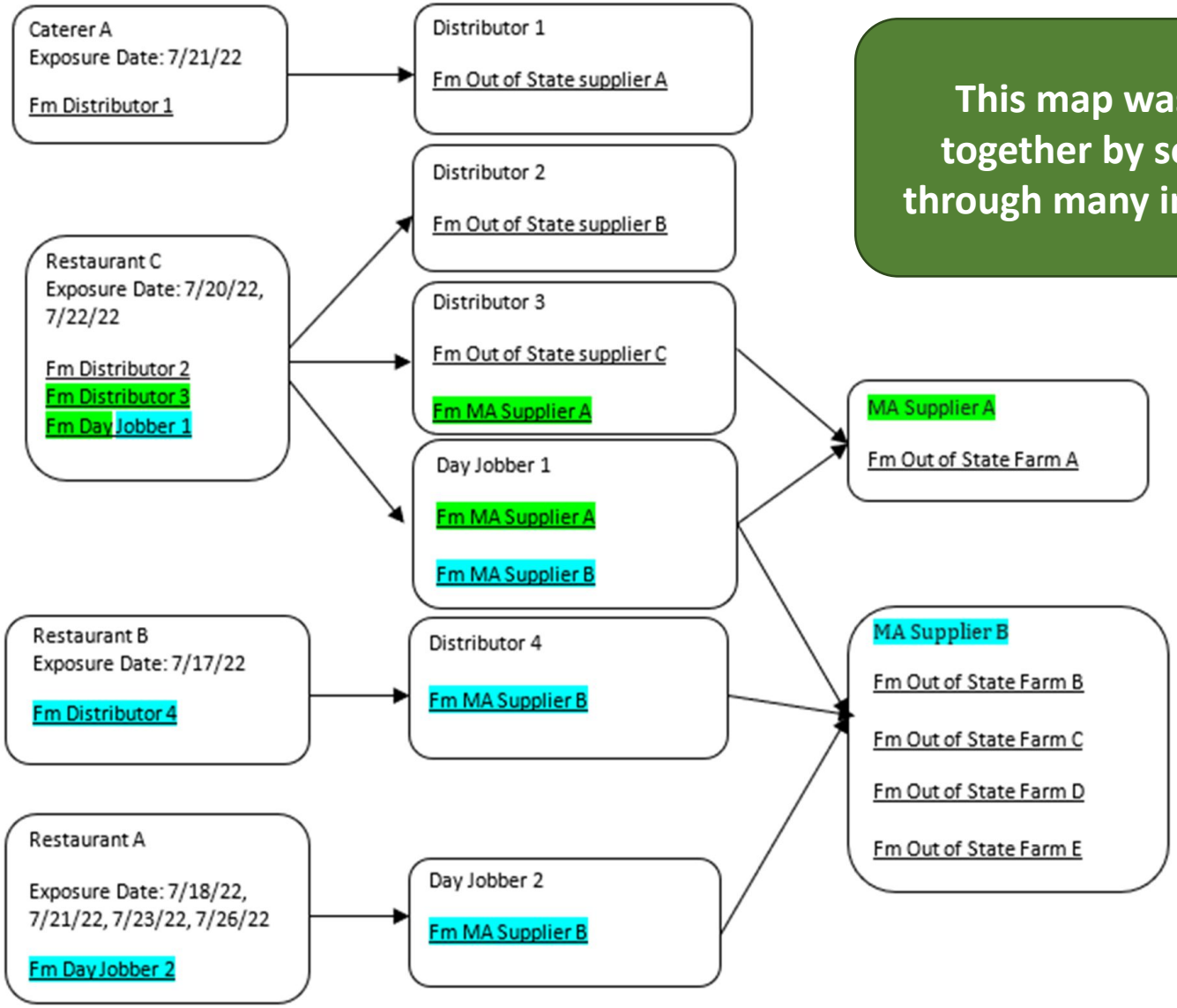
Vibrio traceback full traceback pathway



Salmonella Mississippi 2022



Salmonella Mississippi – Tomato (*suspect*) (July-Sept 2022)
MA Traceback Investigation Redacted Master Flow Diagram



This map was put together by sorting through many invoices!

Retail locations

Source

Receipts and invoices wrap up

The information you are able to collect during an interview can be vital to an investigation!

- Last 4 of credit card or shopper card
- Size of dining party
- Other items purchased on bill
- Date and time of purchase
- Seated inside or outside
- Ordered from specials menu?
- Ingredients in their “Chicken Burrito”

Wrap Up

Key takeaways

- Epidemiologic, environmental, and laboratory data are critical to the success of foodborne outbreak investigations
- Close collaboration and communication between retail establishments, local boards of health, and DPH facilitates prompt collection of data
- Small details collected throughout an investigation can be the key to solving an outbreak or preventing further illness

Thank you!

Johanna.Vostok@mass.gov
Geena.M.Chiumento@mass.gov
Nichol.L.Smith@mass.gov