TN Department of Health

Conducting Environmental Assessments During Foodborne Illness Investigations

AFDO Bootcamp
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January 9, 2025

1

Objectives

- Discuss foodborne illness impact
- Describe the foodborne investigation team
- Discuss contributing factors and their antecedents
- Describe the methods of an environmental assessment
- Summarize traceback investigations and control measures
- Provide case-in-point investigation summarizing the methods of an environmental assessment

2

Poll Question 1

Indicate the number of years you have worked as an environmental health specialist (EHS) and/or in food safety.

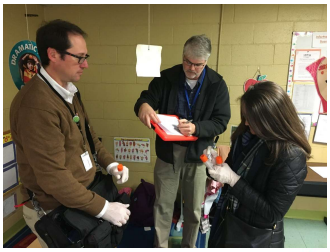
A. <1 year
B. 1-5 years
C. 5-10 years
D. >10 years
E. I do not work as an EHS or in food safety

3

Poll Question 2

How many foodborne outbreak investigations have you participated in?

A. 0
B. 1-5
C. 6-10
D. >10



4

Foodborne Illness in the United States

- 47.8 million cases per year
- 128,000 hospitalizations
- 3000 deaths

5

Cost Associated with Foodborne Illness

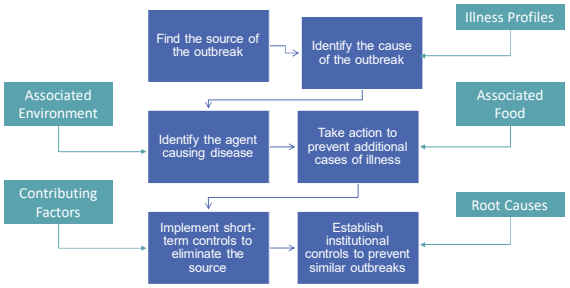
Average annual economic burden associated with the 15 major pathogens identified through outbreak response = **$15.5 billion**

- Acute and chronic illness medical costs
- Costs associated with lost wages
- Costs associated with premature deaths

Source: United States Department of Agriculture - Economic Research Service (2014)

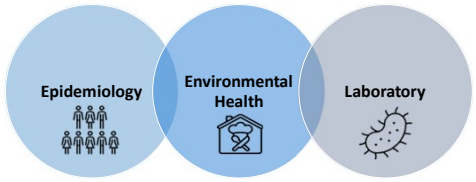
6

Goals of the Outbreak Investigation



7

Three Core Disciplines of Outbreak Team



- Case-based surveillance
- Interviews
- Hypotheses generation
- Conducts Epi studies
- Data analysis
- Final reporting

- Investigates environments linked to illness
- Collects data and samples
- Interviews workers
- Reviews food systems
- Initiates control measures

- Analyzes clinical, food, and environmental samples
- Interprets test results
- Coordinates testing among laboratories

8

Purpose of the Environmental Investigation

- Determine what went wrong and why
- Initiate control measures
- Communicate findings to the team

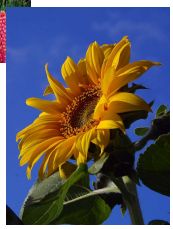
9

Environmental Health Activities

10

Routine Inspection vs Environmental Assessment

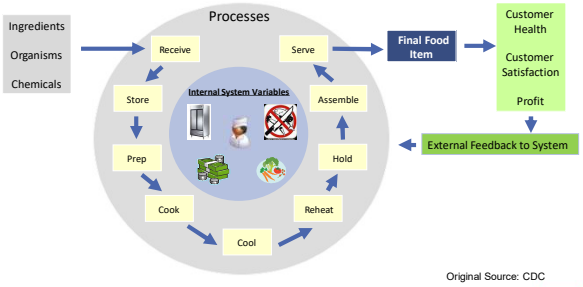
Environmental Assessment
- Focusses on a hypothesis
- Targets specific food, process, people and/or point in time
- Identify system failures



Routine Inspection
- Broad snapshot
- Non-targeted
- Code/regulation based
- Identify violations

11

Retail Food Establishment System



12

Contributing Factors

Contributing Factor(s) – are the most likely conditions that contribute to the contamination, proliferation and/or survival of the etiologic agent or suspected agent. (CDC – NEARS)

- **CONTAMINATION** → **How pathogens or other hazards are introduced into food**
- **PROLIFERATION** → **How pathogens increase in food**
- **SURVIVAL** → **How pathogens survive a kill process**

https://www.cdc.gov/nceh/ehs/nears/cf-definitions.htm

13

Contributing Factor Examples

C1 - C15	P1 - P12	S1 – S5
Contamination	**Proliferation**	**Survival**
Natural toxin	Improper refrigeration	Inadequate acidification
Poisonous substance	Prolonged cold storage	Improper reheating
Infected worker handling food	Improper hot-holding	Improper cooking of raw foods of animal origin
Unclean equipment	Inadequate cooling	
Raw/ready-to-eat contamination	Inadequate thawing of frozen foods	
Bare hand contact of ready-to-eat food	Anaerobic packaging	
Contaminated food eaten raw or lightly cooked	Excessive time and temperature abuse during preparation	

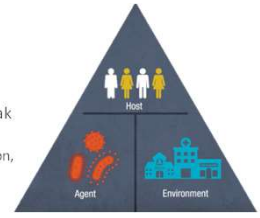
14

Determining Contributing Factors

Use available Information
- Environmental assessment
- Epidemiologic studies
- Laboratory findings

Consider applicability and impact on the outbreak
- Must make logical sense
- Must have a relationship with food, practice, person, and/or etiology
- Not always limited to one contributing factor

Understand contributing factor ambiguity
- Subject to interpretation
- Team consensus



Source: CDC

15

Determining Contributing Factors

You are investigating a Lab-confirmed *Salmonella* outbreak
- 7 people from 4 households are ill
- Several *different* foods reported
- No clear Epi-link to any one food
- All reported foods were prepared on or stored in prep cooler A

Observational findings:
1. Raw chicken juice on Cooler A prep table
2. Reach-in dairy cooler at 55ºF
3. Hand sink out of order in public restroom
4. Rice improperly reheated to 115ºF

16

Poll Question 3

Given the environmental observations:
1. Raw chicken juice on Cooler A prep table
2. Reach-in dairy cooler at 55ºF
3. Hand sink out of order in public restroom
4. Rice improperly reheated to 115ºF

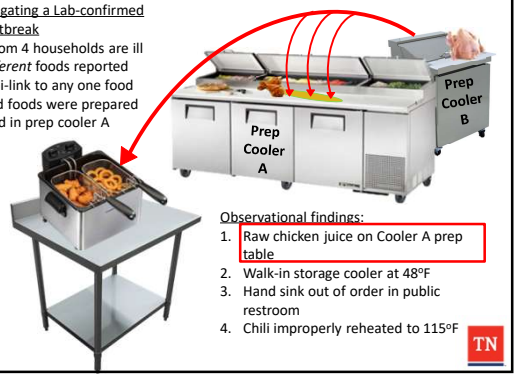
Which observation(s) are the most appropriate to report as contributing factor(s) for this outbreak?

A. Observation 1
B. Observations 1 and 2
C. Observations 1, 2, and 4
D. Observations 1-4

17

Determining Contributing Factors

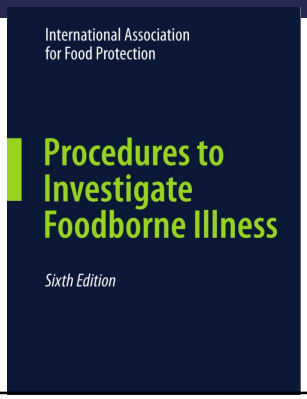
You are investigating a Lab-confirmed *Salmonella* outbreak
- 7 people from 4 households are ill
- Several *different* foods reported
- No clear Epi-link to any one food
- All reported foods were prepared on or stored in prep cooler A



Observational findings:
1. Raw chicken juice on Cooler A prep table
2. Walk-in storage cooler at 48ºF
3. Hand sink out of order in public restroom
4. Chili improperly reheated to 115ºF

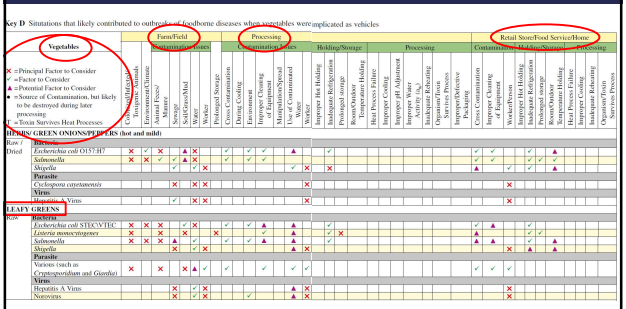
18

Contributing Factor Hypothesis Generation - Resources



19

Contributing Factor Hypothesis Generation – Resources Example



20

Contributing Factor Hypothesis Generation -*Salmonella*

Vegetables	Retail Store/Food Service/Home												
	Contamination		Holding/Storage					Processing					
✕ =Principal Factor to Consider ✓ =Factor to Consider ▲ =Potential Factor to Consider ● =Source of Contamination, but likely to be destroyed during later processing T =Toxin Survives Heat Processes	Cross Contamination	Improper Cleaning of Equipment	Worker/Person	Improper Hot Holding	Inadequate Refrigeration	Prolonged storage	Room/Outdoor Temperature Holding	Heat Process Failure	Improper Cooling	Inadequate Reheating	Organism/Toxin Survives Process		
HERBS/ GREEN ONIONS/PEPPERS													
Raw / Dried	**Bacteria**												
	Escherichia coli O157:H7	✓	✓			✓		▲					
	Salmonella	✓	✓			✓	✓	✓					
	Shigella	▲		✓		✓		▲					
	Parasite												
	Cyclospora cayetanensis			✕									
	Virus												
	Hepatitis A Virus			✕									
LEAFY GREENS													
Raw	**Bacteria**												
	Escherichia coli STEC/VTEC	✓	▲			✓							
	Listeria monocytogenes	▲				✓	✓						
	Salmonella	▲	▲			✓		▲					
	Shigella			✕		▲		▲					
	Parasite												
	Various (such as *Cryptosporidium* and *Giardia*)	✓	✓	✓									
	Virus												
	Hepatitis A Virus			✕									
	Norovirus			✕									

21

Contributing Factor Hypothesis Generation – Norovirus

Vegetables	Retail Store/Food Service/Home												
	Contamination		Holding/Storage					Processing					
✕ =Principal Factor to Consider ✓ =Factor to Consider ▲ =Potential Factor to Consider ● =Source of Contamination, but likely to be destroyed during later processing T =Toxin Survives Heat Processes	Cross Contamination	Improper Cleaning of Equipment	Worker/Person	Improper Hot Holding	Inadequate Refrigeration	Prolonged storage	Room/Outdoor Temperature Holding	Heat Process Failure	Improper Cooling	Inadequate Reheating	Organism/Toxin Survives Process		
HERBS/ GREEN ONIONS/PEPPERS													
Raw / Dried	**Bacteria**												
	Escherichia coli O157:H7	✓	✓		✓		▲						
	Salmonella	✓	✓		✓	✓	✓						
	Shigella	▲		✓	✓		▲						
	Parasite												
	Cyclospora cayetanensis			✕									
	Virus												
	Hepatitis A Virus			✕									
LEAFY GREENS													
Raw	**Bacteria**												
	Escherichia coli STEC/VTEC	✓	▲		✓								
	Listeria monocytogenes	▲			✓	✓							
	Salmonella	▲	▲		✓		▲						
	Shigella			✕	▲		▲						
	Parasite												
	Various (such as *Cryptosporidium* and *Giardia*)	✓	✓	✓									
	Virus												
	Hepatitis A Virus			✕									
	Norovirus			✕									

22

Environmental Antecedents

Environmental Antecedent(s) – Environmental antecedents are conditions leading to the contamination, survival, or increase of biological or chemical agents in food. (CDC-NEARS)

- Equipment
- Economics
- Processes
- Food
- People

23

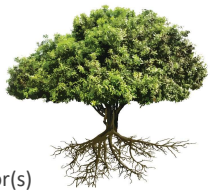
Determining Environmental Antecedents

Primarily determined by interview
- Managers
- Food workers

Often multiple potential antecedents

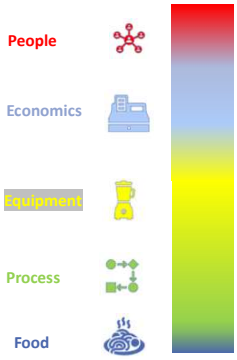
Consider those that best apply
- Should make logical sense
- Should relate to your contributing factor(s)
- Should relate to implemented control measures

Ask the "5 Why's"



24

Environmental Antecedent Examples



- Lack of training on specific process
- Lack of managerial oversight
- Poor attitude/food safety culture
- High employee turnover
- Insignificant staffing
- Lack of sick leave for good practices
- Lack of needed supplies
- Insignificant capacity of equipment
- Improperly sized or installed equipment
- Lack preventative maintenance on equipment
- Poor facility layout
- Equipment improperly used
- Staff not following facility process
- Insufficient process to mitigate hazard
- Improperly used TCS/non-TCS food

25

Applying the "5 Why's"

Contributing factor: Insufficient Cooking of ground beef (S-1) was identified

Why was the raw ground beef undercooked?
- **A new deli/pizza worker who was assigned to the cook line that night, undercooked the food**

Why did the pizza/deli worker undercook the food?
- **Worker stated he was not trained on the gill line prior to that evening**

Why was the pizza/deli worker not trained properly?
- **The manager forgot to go over the basic cooking protocols with the deli/pizza worker that evening**

Why did manager forget to inform the worker about the cooking protocols?
- **The manager was overwhelmed due to the shortage in staff that evening**

Why was there a staff shortage?
- **Manager stated that they cannot compete with salary demands necessary to keep a fully-staffed team on board**

26

Poll Question 4

Which of the following environmental antecedent categories *best* represents the poorly trained and managed pizza/deli worker and the staffing challenges?

A. Food
B. People
C. Economics
D. People and Economics

27

Applying the "5 Why's"

Contributing factor: Insufficient Cooking of ground beef (S-1) was identified

Q1: Why was the raw ground beef undercooked?
- **A1: Deli/pizza worker assigned to cook line that night who undercooked the food**

Q2: Why did the pizza/deli worker undercook the food?
- **A2: Worker stated he was not trained on the gill line prior to that evening**

POOR TRAINING

Q3: Why was the pizza/deli worker not trained properly?
- **A3: The manager forgot to go over the basic cooking protocols with the deli/pizza worker that evening**

LACK OF MANAGERIAL OVERSIGHT

Q4: Why did manager forget to inform the worker about the cooking protocols?
- **A4: The manager was overwhelmed due to the shortage in staff that evening**

Q5: Why was there a staff shortage?
- **A5: Manager stated that they cannot compete with the wage demands required to keep a fully-staffed team on board**

ECONOMICS

Equipment
Economics
Processes
Food
People

28

Contributing Factor and Environmental Antecedent Examples

AGENT	ENVIRONMENTAL FINDINGS	CONTRIBUTING FACTOR	ENVIRONMENTAL ANTECEDENT
E. coli	Burgers cooked to 140°F. Employee not trained.	Survival	Improper training (**People**)
Salmonella	Raw eggs used as ingredient for dressing.	Contamination	Contaminated ingredient (**Food**)
Norovirus	Poor handwashing due to lack of kitchen hand sink.	Contamination	Inadequate sinks available (**Equipment**)
C. Perfringens	Cooler holding food at 50°F. Repairs too costly.	Proliferation	Financial difficulties (**Economics**)
B. cereus	Inadequate acidification of sushi rice	Proliferation	Protocol not followed (**Process**)

29

Environmental Assessment

Environmental Assessment: The systems-based component of a foodborne illness outbreak response that fully describes how the environment contributed to the introduction and/or transmission of agents that cause illness or could cause illness – CDC NEARS

- Pre-Preparation
- Manager Interview
- Observation
- Sample Collection
- Record Collection
- Control Measures
- Reporting

30

DATA-DRIVEN Assessments

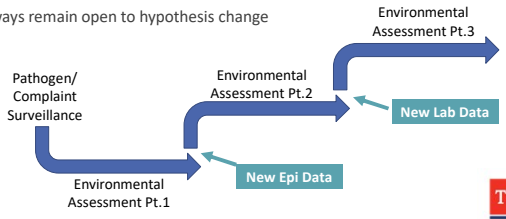
Outbreaks are always limited to information and data

Plan assessment activities around the data available

Assessments may require several visits, depending on new developments

Focus and direction may change significantly with new data

Always remain open to hypothesis change



31

Preparing for the Assessment

CONSULT WITH YOUR OUTBREAK TEAM

Examine available outbreak information
- Causative agent
- Onset of illness among cases
- Likely exposure dates/meals/locations
- Build a working hypothesis

Collect food establishment information
- Existing regulatory records
- Menus, recipes, product formulations
- Relationships among chain establishments
- Consult with routine inspector

Prepare a checklist of questions
- Unusual events, equipment failures/repairs
- Changes in processes or operations
- Employee and customer feedback
- Related processes, food, and conditions

32

Manager Interview

Introduction
- Establish rapport
- Inform the manager of the purpose of visit

Avoid accusations

Avoid leading questions and bias

Consider communication barriers

Be prepared for potential questions
- Appropriate feedback – general outbreak information
- Inappropriate feedback – specific case information

33

Establishment Observation

Should be conducted with manager or person in charge

Facilitates understanding of general layout, flow of food, and systems

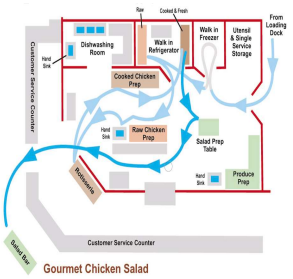
Collect objective data on foods or activities with epi signals

If pathogen driven response, focus may narrow on specific conditions or practices

If food or pathogen is not Epi/Lab implicated:
- Form a hypothesis and use critical thinking skills
- Focus on available data
- Commonly-associated pathogen/food/practice relationships

34

General Facility Flow Diagram

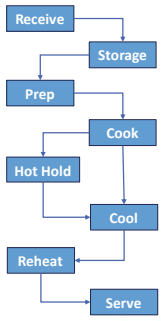


Source: Selman and Guzewich

35

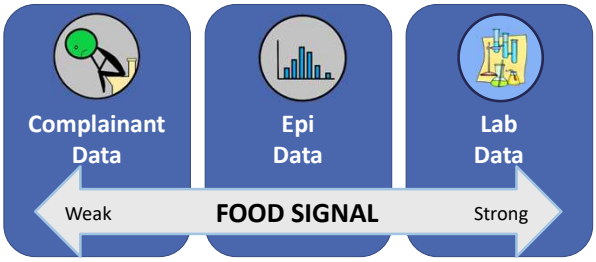
Specific Food Flows

- ☑ Valuable for Complex multi-ingredient and/or multi-day prep food vehicles
- ☑ Provides insight into the people, processes, and ingredients
- ☑ Helps target specific steps for observation/recreation of events
- ☑ Can help rule in or rule out contributing factors
- ☑ Allow better insight into potential environmental antecedents
- ☑ Can help laser-focus control measures



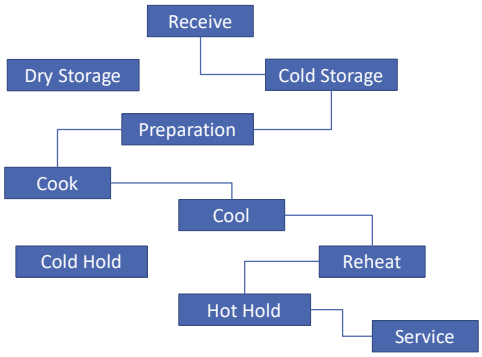
36

When is a food flow appropriate?



37

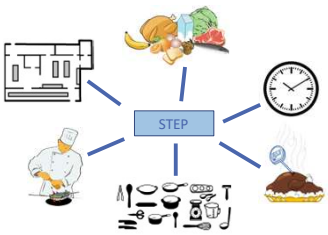
Process Food Flows



38

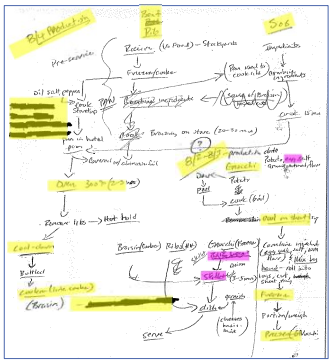
Specific Data for Each Step

- Location within the facility
- Specific ingredients
- Date, time, and duration
- Critical limits
- Equipment involved
- People involved



39

Food Flow Example



40

Reconstruction of Events

- Helps to better understand what did and did not occur
- Visual observation of specific food preparation or activity
- May be broad (entire build) or narrowly focused (single step)
- Measure critical limits and document observations
- Focus on deviations from initial descriptions or provided protocols
- Other activities to consider during reconstruction of an event:
  - Employee interviews
  - Food sampling
  - Environmental sampling
  - Records collection

41

Employee (worker) Interviews

Should occur as soon as possible

Target staff who made implicated food

Ask open-ended questions

Use food flow (if available) to assist

Interview workers in private

Take detailed notes

May be scheduled at later time
- Epi may request to conduct interviews
- Important to get contact information
- Ill employee data are subject to HIPAA

42

Poll Question 5

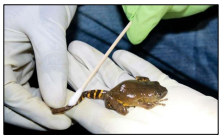
Have you ever collected environmental samples?

A. Yes
B. No

43

Sampling

- Stool Specimens
- Food Samples
- Water Samples
- Environmental Samples



44

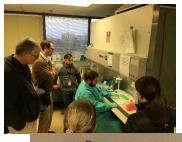
Environmental Surface Sampling

- Environmental sampling can be a powerful tool to support the outbreak investigation
- Collaborate with laboratory **before** an outbreak occurs to determine:
  - Proper methodology
  - Proper swab materials to use
  - Proper transportation and storage
  - Chain-of-Custody (COC)
- Collaborate with laboratory **during** outbreak to determine:
  - If sampling is appropriate
  - How many swabs to collect
  - When to expect delivery of samples to the lab
  - Confirm appropriate tools and delivery method

45

Environmental Sampling Considerations

Planning and Preparation
- Coordinate and Communicate with Epi and Lab
  - What to Sample
  - Where to Sample
  - When will they arrive at the Lab
- Supplies
  - Sterile
  - Swabs vs Sponges
  - Make Sure they are not Expired
- Procedures
  - Aseptic?
- Team
  - Establish and Bring a Sampling Team



46

Environmental Sampling Steps

Site Visit
- **Observe**
  - Walk through the facility
  - Identify Worker Practices
  - Identify Areas of Concern
- **Interview Workers**
  - Review What You See vs What They Say
- **Identify locations**
  - Bases on Your Epi, Lab, EH Coordination
  - Based on Interview and Observations
- **Conduct Sampling**
- **Wrap Up and Submission**

47

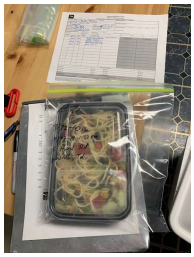
Food, Water, and Stool Collection

Have a plan in advance
- Appropriate collection forms
- Necessary collection tools
- Appropriate training on collection methods
- Consider logistics and preservation of samples

Holding food or water samples
- Hold notices should be well understood
- Best to obtain possession

Consult with laboratory services
- Amounts needed
- Appropriate storage
- Transportation

Communication with partnering regulatory agencies if will be receiving samples



48

Record Collection

What records are needed?
- Consult with outbreak team
- Epi, Lab, and partnering agencies may have special requests

Collect records as soon as possible
- May be removed or disappear in time

Make use of cameras where appropriated
- Facilitate quick communication
- Beware of people and branding

- Menu
- Recipes
- Food labels
- Food receipts, invoices
- Customer receipts
- Catering or delivery orders
- Temperature, pH, acidity, time, sanitizer logs
- Illness policies
- Employee names
- Employee attendance records
- Sanitation policies
- Food preparation policies
- Numbers of meals served

49

Short and Long-Term Controls

Short-Term (immediate)

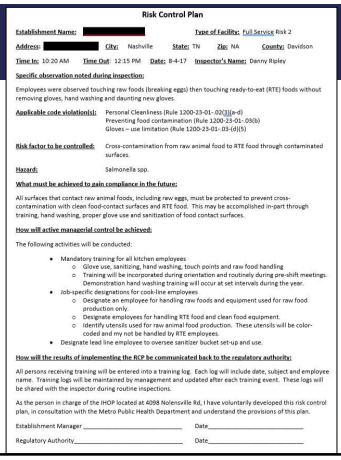
Address contributing factor(s)
- Hold
- Seize
- Cease/desist
- License sanctions
- Menu limitations
- Food embargo
- Closure
- Worker exclusion or restriction
- Food recalls

Long-Term

May be specific to environmental antecedents
- Risk control plan
- HACCP plan
- Training
- Menu modifications
- Process modifications
- Equipment changes
- Supplier modifications
- Increase follow-up inspection frequency

50

Risk Control Plan



Risk Control Plan

Establishment Name: [redacted] **Type of Facility:** Full Service Risk 2

Address: [redacted] **City:** Nashville **State:** TN **Zip:** NA **County:** Davidson

Time In: 10:20 AM **Time Out:** 12:15 PM **Date:** 8-4-17 **Inspector's Name:** Danny Ripley

Specific observation noted during inspection:

Employees were observed touching raw foods (breaking eggs) then touching ready-to-eat (RTE) foods without removing gloves, hand washing and daunting new gloves.

Applicable code violation(s): Personal Cleanliness (Rule 1200-23-01-.02(3)(a-d))
Preventing food contamination (Rule 1200-23-01-.03(b)
Gloves – use limitation (Rule 1200-23-01-.03-(d)(5)

Risk factor to be controlled: Cross-contamination from raw animal food to RTE food through contaminated surfaces.

Hazard: Salmonella spp.

What must be achieved to gain compliance in the future:

All surfaces that contact raw animal foods, including raw eggs, must be protected to prevent cross-contamination with clean food-contact surfaces and RTE food. This may be accomplished in-part through training, hand washing, proper glove use and sanitization of food contact surfaces.

How will active managerial control be achieved:

The following activities will be conducted:
- Mandatory training for all kitchen employees
  - Glove use, sanitizing, hand washing, touch points and raw food handling
  - Training will be incorporated during orientation and routinely during pre-shift meetings. Demonstration hand washing training will occur at set intervals during the year.
- Job-specific designations for cook-line employees
  - Designate an employee for handling raw foods and equipment used for raw food production only.
  - Designate employees for handling RTE food and clean food equipment.
  - Identify utensils used for raw animal food production. These utensils will be color-coded and my not be handled by RTE employees.
- Designate lead line employee to oversee sanitizer bucket set-up and use.

How will the results of implementing the RCP be communicated back to the regulatory authority:

All persons receiving training will be entered into a training log. Each log will include date, subject and employee name. Training logs will be maintained by management and updated after each training event. These logs will be shared with the inspector during routine inspections.

As the person in charge of the IHOP located at 4098 Nolensville Rd, I have voluntarily developed this risk control plan, in consultation with the Metro Public Health Department and understand the provisions of this plan.

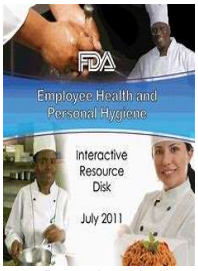
Establishment Manager_____ Date_____

Regulatory Authority_____ Date_____

51

Restriction or Exclusion of Ill Food Employees

- Exclude from work or restrict from food preparation based on the disease-causing agent
- Follow state and local guidance where applicable
- FDA food code has a section on food employee exclusion and restriction
- Exclusions and restrictions may not be adequate in all situations - Norovirus



https://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/IndustryandRegulatoryAssistance/TrainingResources/UCM194575.pdf

52

What if a contributing factor is not identified?

Implement general control measures
- Target Risk Factors for foodborne illness

- Poor personal hygiene
- Improper food holding/time and temperature
- Contaminated equipment/protection from contamination
- Inadequate cooking
- Food obtained from unsafe sources

53

Communication of Findings

Observation and interview data must be well-documented
- May become evidentiary
- Must be professional and legible
- Should be summarized and shared with outbreak team frequently
- Findings should be summarized

Contributing factor data should be consistent with Epi reports
- Ensure collaboration during final reporting
- Contributing factor should make sense

Environmental data from epi reports should match Environmental reports
- Ensure EH has input regarding contributing factors
- Ensure EH participates in final summary reporting

54

NEARS

National Environmental Assessment Reporting System (NEARS)

Study of characteristics associated with outbreak establishments

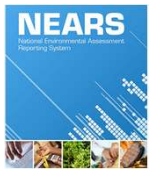
Provides information that contribute to food safety

Local and state EHS collect and contribute data

Help meet FDA Retail Food Standard 5

Not an environmental assessment

Seven-part formal data collection instrument



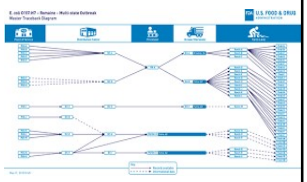
55

Traceback and Traceforward Investigations

The processes of following a food from point-of-service to source; then following from source to additional points-of-service

Purpose
- Determine source of contamination
- Facilitate recall efforts
- Find additional illnesses
- Test hypothesis about source

Two Categories
- Investigational Traceback Investigation
- Regulatory (Formal) Traceback Investigation



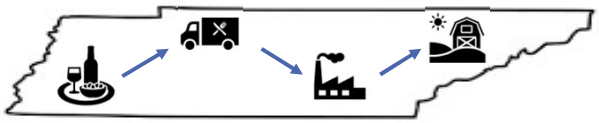
56

Investigational Traceback

Local or State Agency Involvement (TDH, TDA, Metro's)

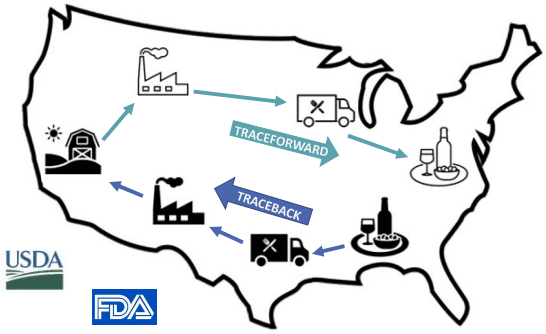
Informational or rapid source tracing

Strong laboratory, epi, and environmental evidence needed to initiate



57

Regulatory Traceback Investigations



58

Role of Local Health Departments

Your investigation could herald a multi-state investigation and traceback investigation

Your investigation should
- Implicate specific food item(s)
- Rule out point-of-service contamination

Interview cases for product details and where they purchased the food

Collect paperwork (e.g., receipts, invoices, shipping documents) from retail food establishments

Communicate findings to appropriate partnering agencies

59

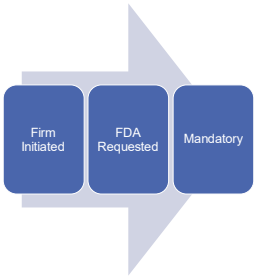
Poll Question 6

Which of the following must occur before a regulatory traceback investigation can occur?

A. A food/ingredient must be implicated
B. Records must connect the implicated food with the point of service
C. Contamination at point of service must be ruled out
D. All of the above

60

Product Recall



Class 1: Will cause serious adverse health consequences or death

Class 2: The probability of serious adverse health consequences is remote

Class 3: The product is not likely to cause adverse health consequences

61

Environmental Assessment Tools and Training Products

Integrated Food Safety Centers of Excellence
- https://www.cdc.gov/foodsafety/centers/index.html

Environmental Health Specialist Network
- https://www.cdc.gov/nceh/ehs/ehsnet/resources/index.htm
- https://www.cdc.gov/nceh/ehs/nears/index.htm
- https://www.cdc.gov/nceh/ehs/elearn/eats/index.html

Food and Drug Administration
- Employee Health Policy Tool (fda.gov)
- https://www.fda.gov/media/123908/download

Association of Food and Drug Officials
- https://www.afdo.org/resources/sampling-resources/

Council to Improve Foodborne Outbreak Response
- https://cifor.us/downloads/clearinghouse/CIFOR-Guidelines-Complete-third-Ed.-FINAL.pdf

International Association for Food Protection Procedures to Investigate Foodborne Illness – 6th Edition

62

TN Department of Health

November 2020 Chili Cook-off Outbreak Involving *Salmonella* Muenchen

63

Foothills of Great Smoky Mountains

64

Outbreak Identification

USDA United States Department of Agriculture

eCCF - Electronic Consumer Complaint Reporting Form

65

Background

Annual 1-day event

November 12, 2020

5:00 – 8:00PM

30-year history

13 local competitors

Over a 1000 consumers/participants

66

Epi Investigation

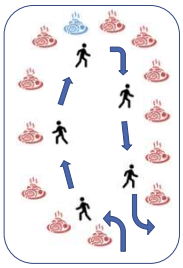
Contact Chamber of Commerce

Acquired registration contact list

Event-specific questionnaire emailed to participants

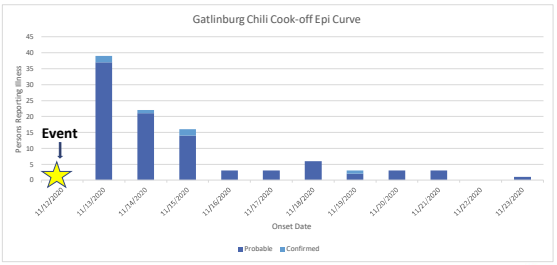
Case-control Study
- Univariate analysis
- Bivariate analysis
- Multivariate logistic regression analysis

Case – Salmonella symptoms, November 13-24, attended chili cook-off



67

Epi Curve



68

Exposure Analysis

All information is current as of 12/20/2020 at 1300
Analysis Excludes Missing Responses

Exposure	Number Ill		Number Not Ill		Odds Ratio	95% Confidence Interval		Chi-Square p-value
	Exposed	Not Exposed	Exposed	Not Exposed		Lower Limit	Upper Limit	
Rest A	84	11	134	33	1.88	0.90	3.92	0.0885
Rest B	85	10	127	35	2.34	1.10	4.98	0.0241
Rest C	76	16	101	55	2.59	1.38	4.86	0.0026
Rest D	**84**	**12**	**109**	**50**	**3.21**	**1.61**	**6.41**	**0.0006**
Rest E	87	8	138	26	2.05	0.89	4.73	0.0878
Rest F	87	7	132	29	2.73	1.15	6.51	0.0194
Rest G	76	18	124	33	1.12	0.59	2.13	0.7215
Rest H	75	19	126	39	1.22	0.66	2.27	0.5251
Rest I	83	10	129	37	2.38	1.12	5.04	0.0208
Rest J	76	17	121	43	1.59	0.85	2.98	0.1482
Rest K	77	16	107	50	2.25	1.19	4.24	0.0111
Rest L	71	20	105	58	1.96	1.09	3.54	0.0242
Rest M	77	18	129	34	1.13	0.60	2.13	0.7120

69

Multivariate Analysis

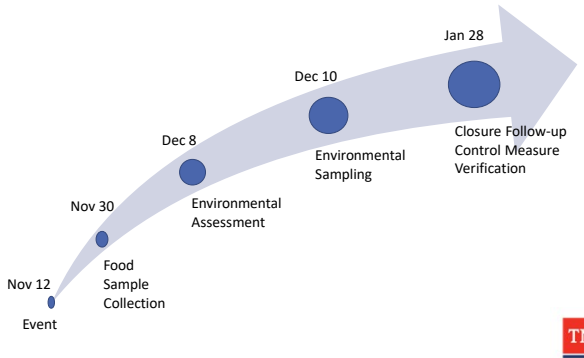
Analysis Excludes Missing Responses
Logistic Regression including All Exposures

Exposure (n=209)	Odds Ratio	95% Confidence Interval		Chi-Square p-value
		Lower Limit	Upper Limit	
Rest A	1.42	0.54	3.76	0.4769
Rest B	1.10	0.38	3.20	0.8654
Rest C	2.11	0.761	5.829	0.1514
Rest D	**3.50**	**1.23**	**9.94**	**0.0188**
Rest E	1.77	0.56	5.57	0.3276
Rest F	2.08	0.55	7.87	0.2803
Rest G	0.33	0.12	0.95	0.0393
Rest H	0.39	0.14	1.08	0.0701
Rest I	1.73	0.61	4.90	0.3059
Rest J	0.55	0.20	1.49	0.2380
Rest K	1.48	0.50	4.44	0.4820
Rest L	0.81	0.36	1.79	0.5950
Rest M	0.84	0.35	2.02	0.7007
Late Arrival - After 6:00PM	1.96	0.99	3.88	0.0544

The odds of having eaten at restaurant D is 3.5 times higher among those that are ill as compared to those that are not ill, with a 95% confidence the true value lies between 1.23 and 9.94.

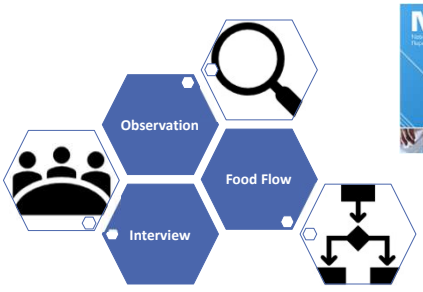
70

Environmental Investigation Overview



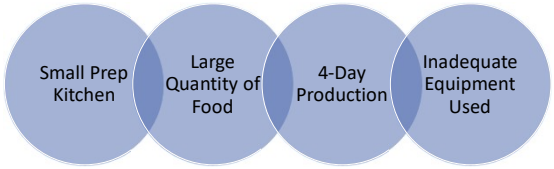
71

Environmental Assessment



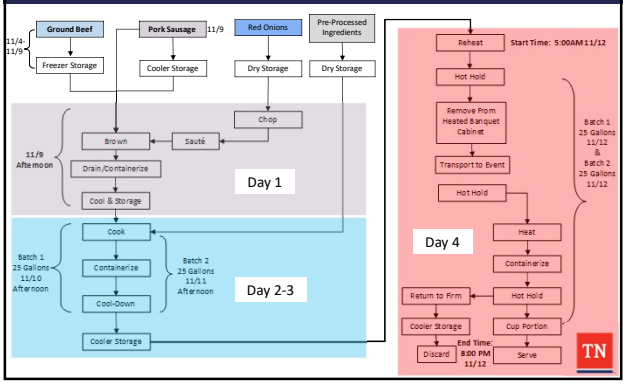
72

Production Characteristics



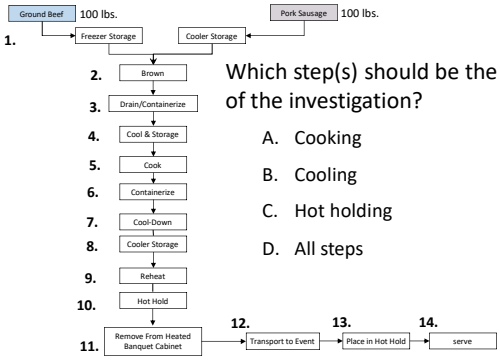
73

Chili Food Flow



74

Poll Question 7

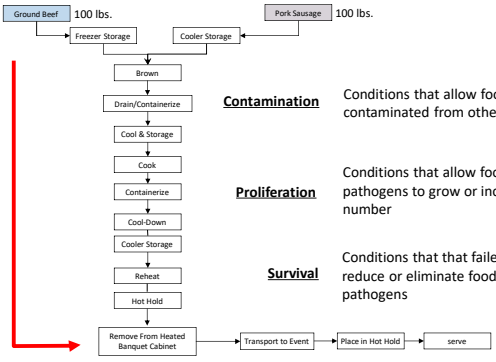


Which step(s) should be the focus of the investigation?

A. Cooking
B. Cooling
C. Hot holding
D. All steps

75

Which steps should be investigated? All Steps!



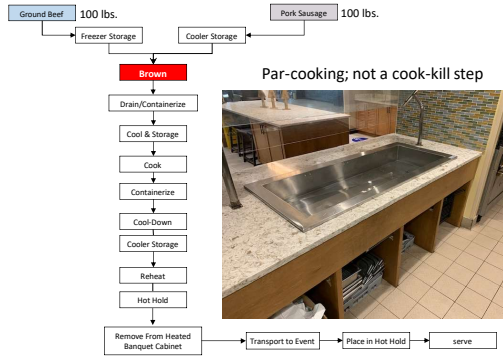
Contamination — Conditions that allow foods to be contaminated from other exposures

Proliferation — Conditions that allow foodborne pathogens to grow or increase in number

Survival — Conditions that that failed to reduce or eliminate foodborne pathogens

76

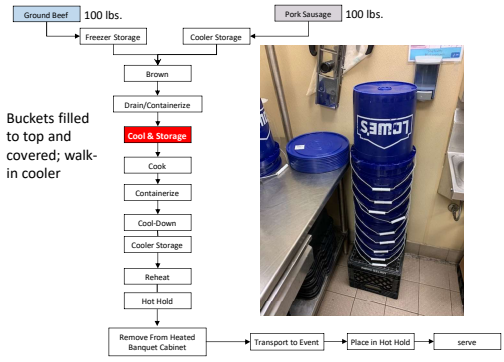
Contributing Factors



Par-cooking; not a cook-kill step

77

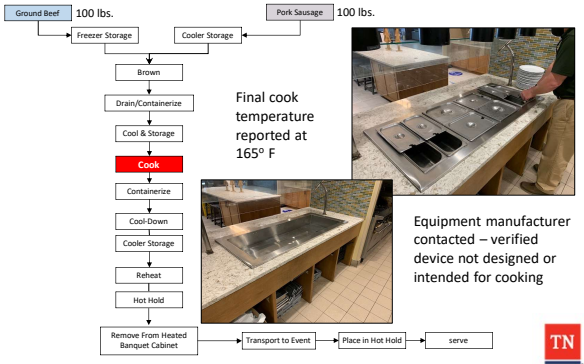
Contributing Factors



Buckets filled to top and covered; walk-in cooler

78

Contributing Factors

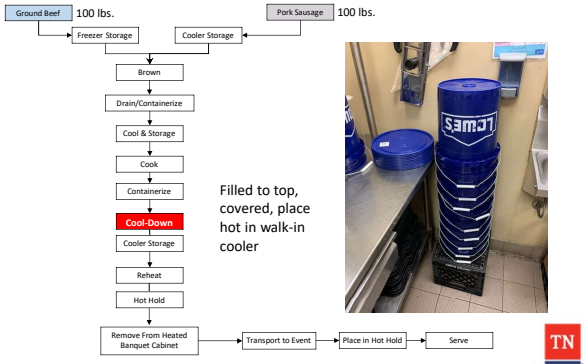


Final cook temperature reported at 165° F

Equipment manufacturer contacted – verified device not designed or intended for cooking

79

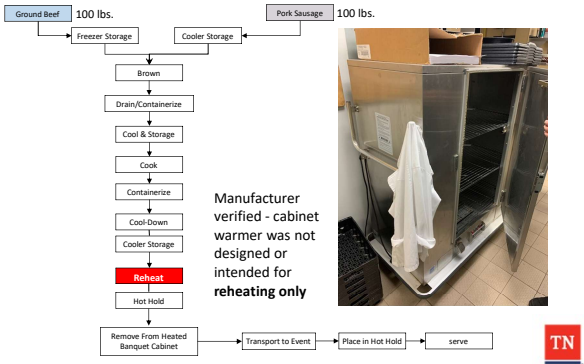
Contributing Factors



Filled to top, covered, place hot in walk-in cooler

80

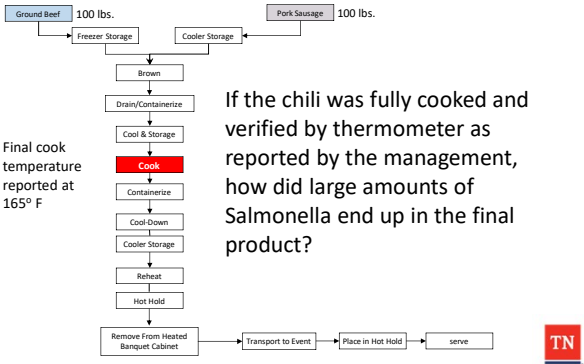
Contributing Factors



Manufacturer verified - cabinet warmer was not designed or intended for **reheating only**

81

Critical Thinking Question

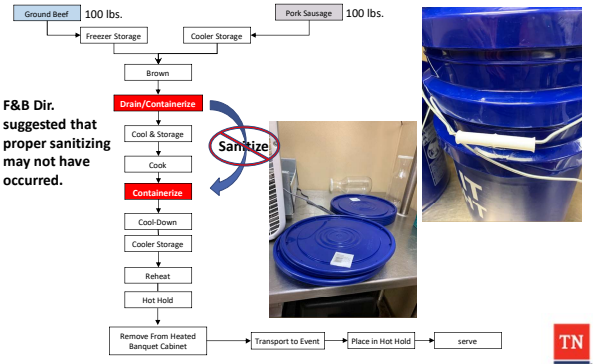


Final cook temperature reported at 165° F

If the chili was fully cooked and verified by thermometer as reported by the management, how did large amounts of Salmonella end up in the final product?

82

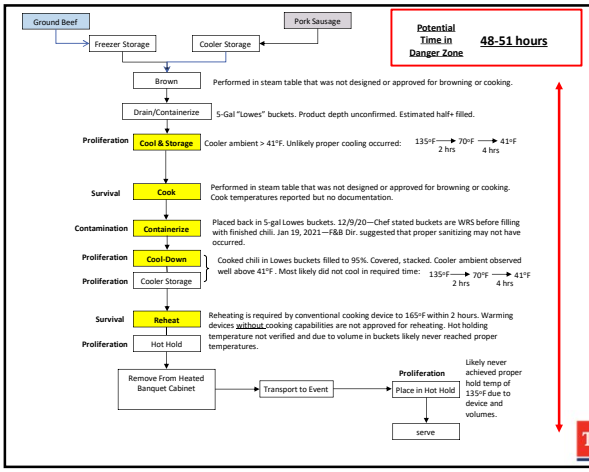
Stealth Preparation Steps



F&B Dir. suggested that proper sanitizing may not have occurred.

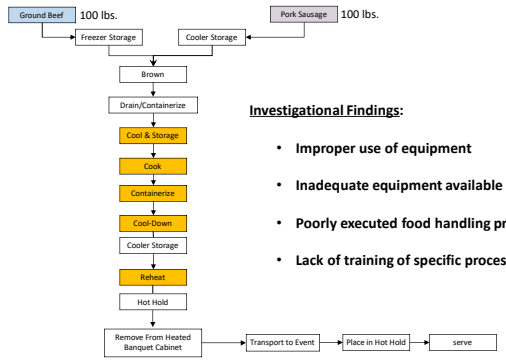
Sanitize

83



84

Why did these contributing factors occur?



Investigational Findings:

- **Improper use of equipment**
- **Inadequate equipment available**
- **Poorly executed food handling process**
- **Lack of training of specific processes**

85

Poll Question 8

Given:

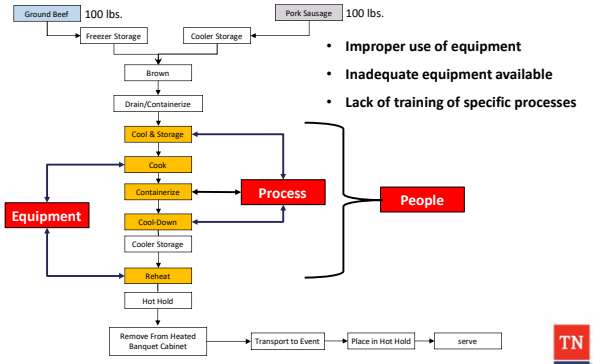
- ✓ Improper use of equipment
- ✓ Inadequate equipment available
- ✓ Poorly executed food handling processes
- ✓ Lack of training of specific processes

Which environmental antecedents should be reported?

A. Equipment, process
B. Equipment, process, people
C. Equipment, process, people, food
D. Equipment, process, People, food, economics

86

Why did these contributing factors occur?



- **Improper use of equipment**
- **Inadequate equipment available**
- **Lack of training of specific processes**

87

Food & Environmental Sampling

No leftover chili from Restaurant D

Samples collected from two additional restaurants

Collected 9 environmental samples on December 10

88

Lab Analysis

6 clinical isolates

Salmonella muenchen positive (0-6 alleles)

Food and Environmental samples were negative

USDA pork sample linked to our isolates

- Isolated September 9, 2020
- Routine USDA FSIS pig intestine sample
- Same firm where 100 lbs. sausage was purchased
- Whole Genome Sequence (WGS) - linked

89

Conclusions

528 individuals contacted/300 responded

99 cases and 175 controls (24 States)

4 hospitalizations; 0 deaths

Only Restaurant D's chili was associated (OR=3.50; 95% CI=1.23-9.94)

Six (6) patient isolates and 1 USDA isolate were *Salmonella* Muenchen positive

WGS-linked (0-6 alleles)

90

Conclusions Cont.

Four (4) contributing factors identified
- Survival (inadequate cooking)
- Contamination (use of buckets w/o sanitizing)
- Proliferation (improper cooling)
- Survival (inadequate reheating)

Environmental antecedents identified
- Improper use and type of equipment
- Improper training

Targeted control measures implemented
- Training
- Notices to address proper equipment use
- Notices to address proper food preparation practices

91

Thanks!

Acknowledgments:

- TDH Foodborne and Enteric Diseases (FED) Program
- TDH State Public Health Lab Team
- TDH Environmental Health Team
- CDC EHS-Net
- AFDO
- Contact information: cedep.ehsnet@tn.gov

92