

Guidelines for Foodborne Disease Outbreak Response (CIFOR)

*Investigation of Foodborne Diseases: Policies and
Guidelines*

AGSC 5540: Food Policies and Regulations

9-16-2021

Tennessee State University, Nashville, TN

Aliyar Cyrus Fouladkhah: Faculty Director, Public Health Microbiology Laboratory

1

What are we discussing today



Exam structure



The Need for Outbreak
Investigation



Overview of CIFOR
Guidelines and 3 exercises



2

Exam Overview

- We do not need to memorize all the content of slides (>1,000 slides)
- Most important topics are covered in **class exercises**
- We will provide an **exam practice guide** so you all could prepare well for exam (stress?)
- Mid-Term Exam= Will be in class
- Final Exam will be= Take home exam
- 9/23/2021 No Class (Fall Break)
- 9/30/2021 HACCP and discussion of Exam Practice Guide
- 10/07/2021 Mid-Term Exam in Class and Start of FSMA Certification

TSU - ACADEMIC CALENDAR 2021-2022	
FALL SEMESTER 2021	
Aug 6	Faculty contracts begin
Aug 6	Faculty report for fall semester activities
Aug 9	Faculty/ Staff Institute
Aug 11-12	Residence Halls Open (New Students)
Aug 13	Residence Halls Open (Returning Students)
Aug 16	Classes Begin
Aug 16- Aug 20	Late registration/Schedule Adjustment
Sept 6	Holiday-Labor Day
Sept 16	Recognition of Constitution Day
Sept 20-22	Student Study Days- No Activities Scheduled
Sept 23-24	Fall Break
Sept 27 - Oct 1	Mid-term Examination Week-all classes meet as scheduled
Oct 8	Last day to withdraw from a course and/or the University
Oct 13	Founders Day
Oct 24-30	Homecoming
Oct 25 - Jan 21	Registration for Spring 2022
Nov 11	Veterans' Day
Nov 19	Last Day of Classes
Nov 22-24	Final Exams
November 27	COMMENCEMENT
November 29	Faculty must have posted all grades via "MyTSU"
Dec 5	Records Office releases all posted grades via "MyTSU"
Dec 24 - Jan 2	Holiday Break - University Closed

3

AGSC 5540: Food Policies and Regulations (Food Law) FALL 2020 Syllabus

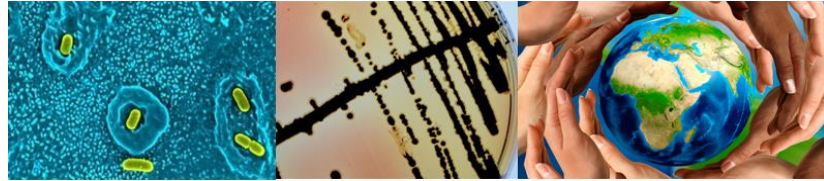


• Evaluation:

- | | |
|-----------------------------------|-------|
| • Term Paper | 30 % |
| • Attendance and Class Activities | 25 % |
| • Mid-term Exams | 25 % |
| • Class Assignments | 10 % |
| • Final Exam (optional) | 10 % |
| • Total | 100 % |

In the class or to be
emailed after class to
instructor at
afouladk@tnstate.edu

4



The Need for Outbreak Investigation

5

Emerging pathogens

Diversity, moving towards "fitness" and *Emerging Pathogens*

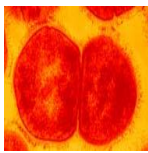
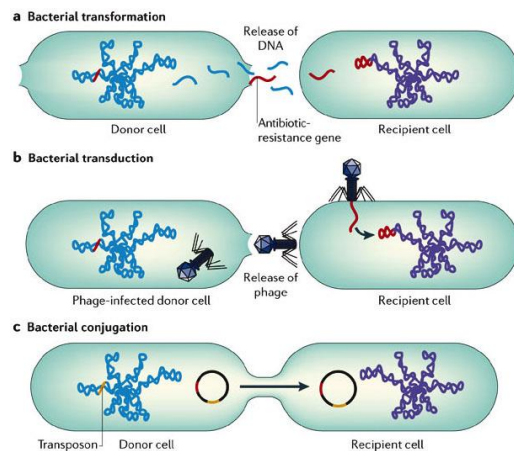
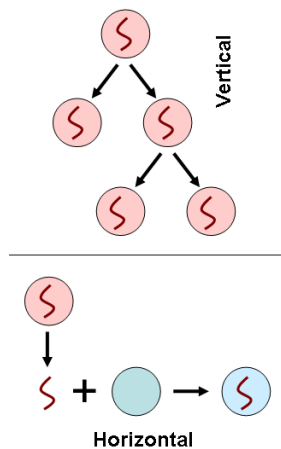


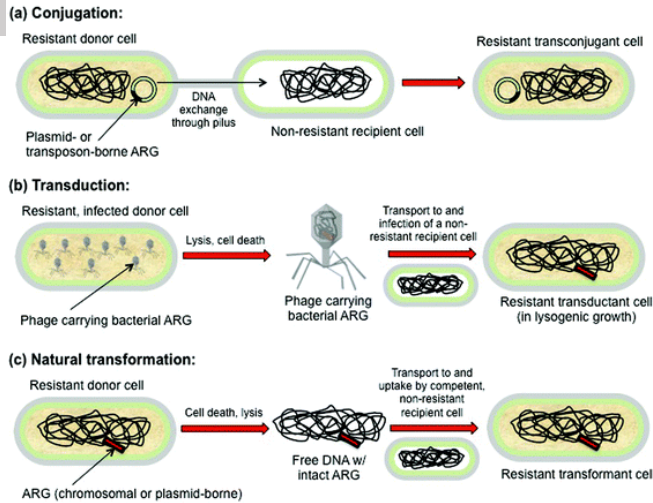
Photo Courtesy:
http://www.davidddarling.info/encyclopedia/B/binary_fission.html



Copyright © 2006 Nature Publishing Group
 Nature Reviews | Microbiology

6

Horizontal Gene Transfer



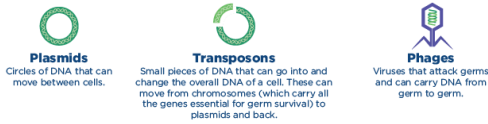
Donn, 2012

7

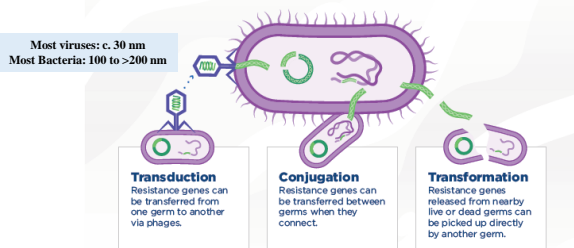
How Antibiotic Resistance Moves Directly Germ to Germ

Any antibiotic use can lead to antibiotic resistance. Antibiotics kill germs like bacteria and fungi, but the resistant survivors remain. Resistance traits can be inherited generation to generation. They can also pass directly from germ to germ by way of **mobile genetic elements**.

Mobile Genetic Elements



How Mobile Genetic Elements Work



A ONE HEALTH CHALLENGE The Interconnected Threat of Antibiotic Resistance

Resistance happens when germs (bacteria and fungi) defeat the drugs designed to kill them. Any antibiotic use—in people, animals, or crops—can lead to resistance. Resistant germs are a One Health problem—they can spread between people, animals, and the environment (e.g., water, soil).

100 trillion bacterial cells: 10 times as many microbial cells in the human body as there are human cells

Examples of How Antibiotic Resistance Affects Humans, Animals & the Environment

HAI: c. 2 m illness/90K death annually

People
Some types of antibiotic-resistant germs can spread person to person. "Nightmare bacteria" carbapenem-resistant Enterobacteriaceae (CRE) can also survive and grow in sink drains at healthcare facilities and spread to patients and to the environment through the wastewater.

Antibiotics: Therapeutic and Sub-therapeutic

Animals
Resistant germs can spread between animals and people through food or contact with animals. For example, *Salmonella* Heidelberg bacteria can make both cattle and people sick.

Environment
Antibiotic-resistant germs can spread in the environment. *Aspergillus fumigatus*, a common mold, can make people with weak immune systems sick. In 2018, resistant *A. fumigatus* was reported in three patients. It was also found in U.S. crop fields treated with fungicides that are similar to antifungals used in human medicine.



8

Planktonic cells and Biofilm Communities

Abiotic: Food processing surfaces
Biotic: Dental biofilms; wounds, GI track, internal organs during infection, and medical devices.

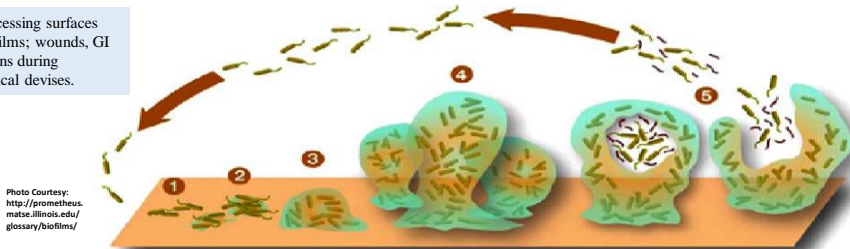


Photo Courtesy: <http://prometheus.mattc.illinois.edu/glossary/biofilms/>

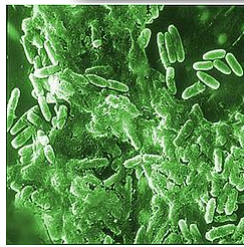


Photo Courtesy: <http://micro-writers.egybio.net/blog/?tag=antibiotic-resistance>

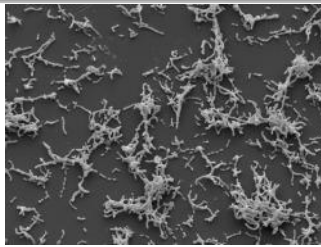


Photo Courtesy: http://www.itenergy.com/50226711/boosting_microbial_fuel_cells_with_biofilm.php

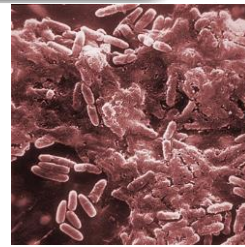


Photo Courtesy: <http://www.microbiologybytes.com/blog/category/biofilms/>

9

Quorum Sensing and Biofilm formation

Shiga toxin-producing E. coli and antibiotics treatment

- Patients with Shiga Toxin producing *E. coli* (STEC) infection, if receive **antibiotics**, STEC will excrete more Shiga toxin, due to quorum sensing, **more risk of HUS**.
- **Antibiotics should not be used to treat this specific infection.**
- **Shows importance of preventive measures** from food and agricultural sciences.

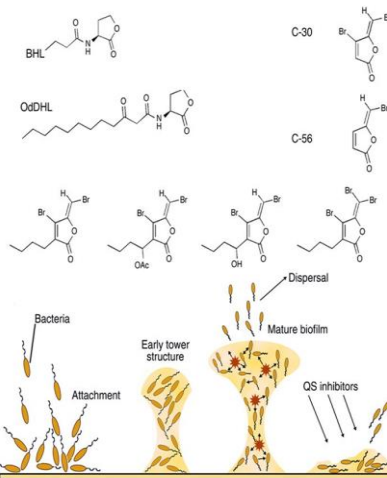


Photo Courtesy: <http://www.jci.org/articles/view/20074/figure/2>

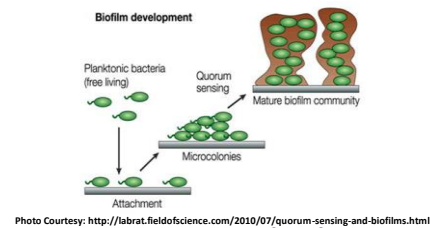


Photo Courtesy: <http://labrat.feldofscience.com/2010/07/quorum-sensing-and-biofilms.html>

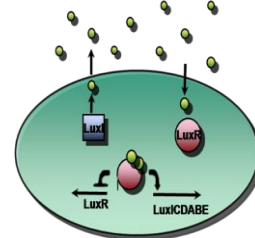
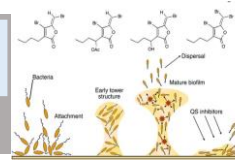


Photo Courtesy: http://2009.igem.org/Team:Aberdeen_Scotland/WetLab/quorum-sensing

10

Infectious Diseases in Animals and Human is a Moving Target...

100 trillion bacterial cells: 10 times as many microbial cells in the human body as there are human cells



- It is estimated only 1% of microbial community has been identified.
- Currently **etiological agent** of 80.3% of foodborne illnesses, **56.2% of hospitalization**, and 55.5% of deaths remain unknown.

“It is the microbes who will have the last word.”

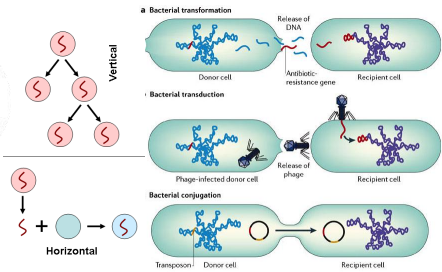
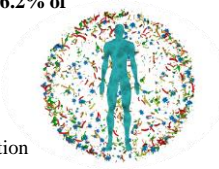
-Louis Pasteur

“Emerging” Pathogens:

- Vertical and horizontal gene transfer spores and biofilm formation
- Quorum sensing and cell to cell communication
- Bacteria estimated to be on earth for **3.5 billion years** (earth age **4.5 billions**; humans originated **<200,000 years**)
- **1674**, when Dutch scientist Antonie van Leeuwenhoek, **before microbial death were mystery**
- **Bobanic Plaque (1347 to 1351), 75 to 200 million death: world population in 1350 about 370 million (Yersinia pestis, vectorborne)**

Now Great treatments: Antibiotics for Bacteria

An Important Challenge: Antibiotics Resistance



Copyright © 2006 Nature Publishing Group Nature Reviews | Microbiology

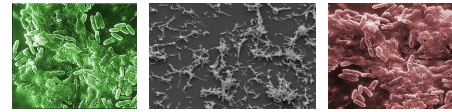


Photo Courtesy: <http://www.microbiologybytes.com/blog/category/biofilms/>
http://www.ilenergy.com/50224711/boosting_microbial_fuel_cells_with_biofilm.php
<http://micro-writers.egbio.net/blog/?tag=antibiotic-resistance>



A superbug resistant to every available antibiotic in the U.S. kills Nevada woman

BY HELEN BRANSWELL, STAT January 13, 2017 at 10:01 AM EST 79424



(HealthDay)—A recent multidrug-resistant (MDR) *Salmonella enterica* serotype Newport outbreak, affecting patients in 32 states, was associated with soft cheese and beef consumption, according to a report published in the Aug. 23 issue of the U.S. Centers for Disease Control and Prevention *Morbidity and Mortality Weekly Report*.

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES

2019



Revised Dec. 2019

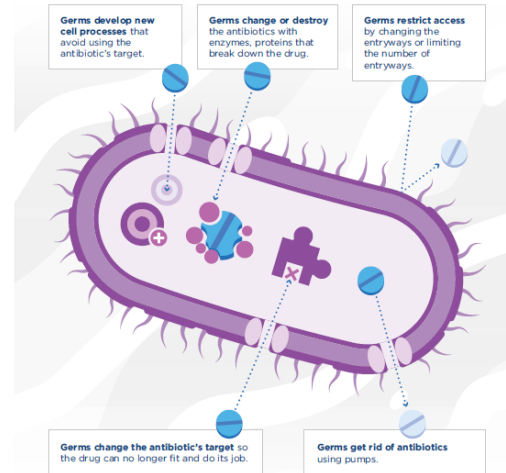
What is Antimicrobials, Antifungals, and Antibiotics

From CDC report 2019

- **Antimicrobials** are drugs that treat infections by killing or slowing the growth of microbes causing infection.
- **Bacteria** cause infections such as strep throat and foodborne illnesses.
- **Bacterial infections** are treated with drugs called **antibiotics**. [Do not work against viruses]
- **Fungi** cause infections like athlete's foot and yeast infections. Fungal infections are treated with drugs called **antifungals**.
- **Antibiotic resistance** happens when germs develop the ability to defeat the drugs designed to kill them. That means the germs are not killed and continue to grow.
- **Multidrug-resistant germs** are resistant to multiple antibiotics available for treatment.
- **Pan-resistant infections** are caused by germs resistant to all antibiotics available for treatment.

How Bacteria and Fungi Fight Back Against Antibiotics

Antibiotics fight germs (bacteria and fungi). But germs fight back and find new ways to survive. Their defense strategies are called **resistance mechanisms**. Only germs, not people, become resistant to antibiotics.



13

The Threat of Antibiotic Resistance in the United States

Antibiotic resistance—when germs (bacteria, fungi) develop the ability to defeat the antibiotics designed to kill them—is one of the greatest global health challenges of modern time.

New National Estimate*

Each year, antibiotic-resistant bacteria and fungi cause at least an estimated:	+	<i>Clostridioides difficile</i> ** is related to antibiotic use and antibiotic resistance:
2,868,700 infections		223,900 cases
35,900 deaths		12,800 deaths

New Antibiotic Resistance Threats List
Updated urgent, serious, and concerning threats—totaling 18

5 urgent threats **2** new threats **NEW:** Watch List with **3** threats

Antibiotic resistance remains a significant One Health problem, affecting humans, animals, and the environment. Data show infection prevention and control is saving lives—especially in hospitals—but threats may undermine this progress without continued aggressive action now.

Learn more: www.cdc.gov/DrugResistance/Biggest-Threats.html

*National burden reflects de-duplicated infection and death estimates.
***Clostridioides difficile* cases from hospitalized patients in 2017.
Revised Dec. 2019

CDC, 2019

14



DRUG-RESISTANT
SHIGELLA

Urgent Threats

- Carbapenem-resistant *Acinetobacter*
- *Candida auris* (*C. auris*)
- *Clostridioides difficile* (*C. difficile*)
- Carbapenem-resistant Enterobacteriaceae (CRE)
- Drug-resistant *Neisseria gonorrhoeae* (*N. gonorrhoeae*)

Serious Threats

- Drug-resistant *Campylobacter*
- Drug-resistant *Candida*
- Extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae
- Vancomycin-resistant Enterococci (VRE)
- Multidrug-resistant *Pseudomonas aeruginosa* (*P. aeruginosa*)
- Drug-resistant nontyphoidal *Salmonella*
- Drug-resistant *Salmonella* serotype Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Drug-resistant *Streptococcus pneumoniae* (*S. pneumoniae*)
- Drug-resistant Tuberculosis (TB)

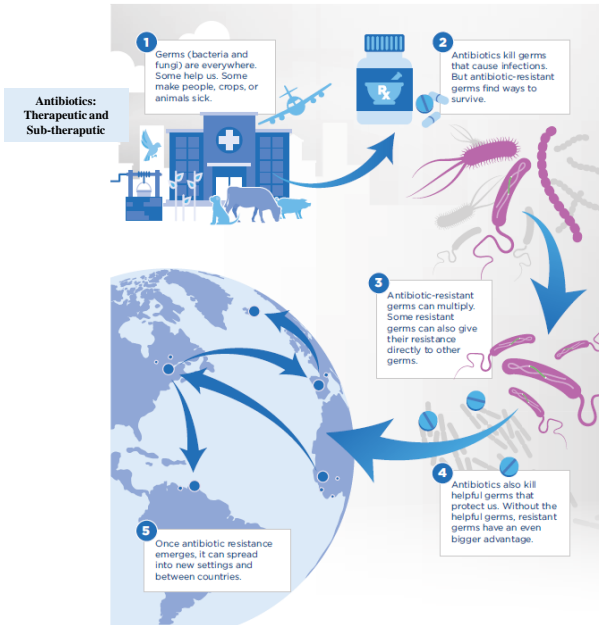
Concerning Threats

- Erythromycin-resistant group A *Streptococcus*
- Clindamycin-resistant group B *Streptococcus*

Watch List

- Azole-resistant *Aspergillus fumigatus* (*A. fumigatus*)
- Drug-resistant *Mycoplasma genitalium* (*M. genitalium*)
- Drug-resistant *Bordetella pertussis* (*B. pertussis*)

How Antibiotic Resistance Spreads



Antibiotic Use

Therapeutic use: Humans and Animals
Sub-therapeutic (prophylactic) use: Mainly in Animal industry
Misuse: As OTC, viral diseases by mistake



- Spread:**
- Foodborne
 - Waterborne
 - Vector borne
 - Human-to-human (fecal-oral-route, respiratory, STD)
 - Animal-to-human (estimated 60% of all and 75% of emerging infections)
 - Airborne
 - Accidental laboratory exposure
 - From abiotic surfaces

CDC, 2019

15

FDA U.S. Food and Drug Administration
 Protecting and Promoting Your Health

Home | Food | Drugs | Medical Devices | Radiation-Emitting Products | Vaccines, Blood & Biologics | Animal & Veterinary | Cosmetics | Tobacco Products

Home > Food > Recalls, Outbreaks & Emergencies > Outbreaks

Outbreaks

Outbreak Investigations
 Environmental Assessments
 About the CORE Network

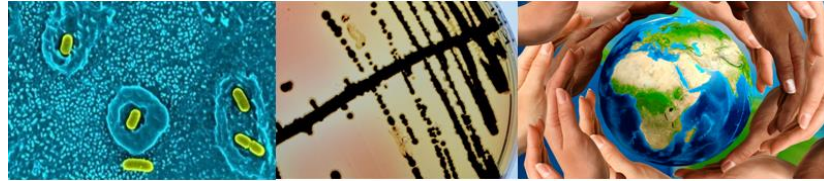
FDA Investigates Multistate Outbreak of E. coli O157 Infections Linked to Rotisserie Chicken Salad from Costco

SHARE | TWEET | LINKEDIN | PIN IT | EMAIL | PRINT



- Investigation by FDA, the USDA FSIS, and the CDC with state and local health officials.
- *E. coli* O157:H7 infections in California, Colorado, Montana, Missouri, Utah, Virginia, and Washington.

16



Overview of CIFOR Guidelines

17

What is CIFOR Guideline?

- **CIFOR:** Council to Improve Foodborne Outbreak Response
- Conceived in 2005 by members of:
 - Council of State and Territorial Epidemiologists (**CSTE**)
 - Association of Public Health Laboratories (**APHL**)
 - Centers for Disease Control and Prevention (**CDC**)
- **Purpose:** Improve local, state and federal agencies for:
 - Foodborne disease **surveillance**
 - **Detection** of diseases
 - **Investigation and response** to outbreaks
- **1st edition:** released in 2006
- CIFOR Toolkit: published in 2011
- **2nd edition:** released in 2014
- **3rd edition:** finalized in 2019



18

What is CIFOR Guideline?

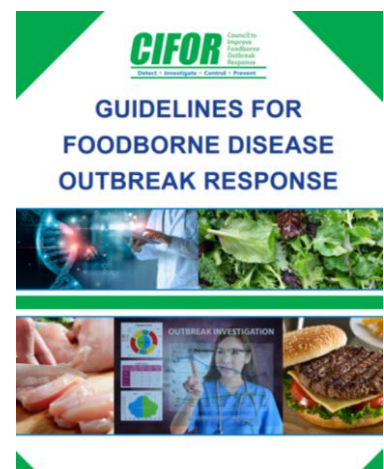
- Both **guideline** and the **toolkit** are references in many **governmental agencies**:
 - Recent survey of public health agencies:
 - 80%: familiar with *CIFOR guidelines*
 - 65%: familiar with *CIFOR toolkit*
 - In 2014, CIFOR Industry Work group also published: *Foodborne Illness Response Guidelines for Owners, Operators and Managers of Food Establishments (CIFOR Industry Guidelines)*
- Purpose:** Assist food industry meet the regulatory requirements



19

What is CIFOR Guideline?

- CIFOR guidelines is a 245-page document
- Has nine chapters:
 1. *Overview of CIFOR Guidelines*
 2. *Fundamental Concepts of Public Health Surveillance and Foodborne Disease*
 3. *Planning and Preparation*
 4. *Foodborne Disease Surveillance and Outbreak Detection*
 5. *Investigation of Clusters and Outbreaks*
 6. *Control Measures*
 7. *Special Considerations for Multijurisdictional Outbreaks*
 8. *Performance Indicators for Foodborne Disease Programs*
 9. *Legal Preparedness for the Surveillance and Control of Foodborne Disease Outbreaks*



20

CIFOR CHAPTER

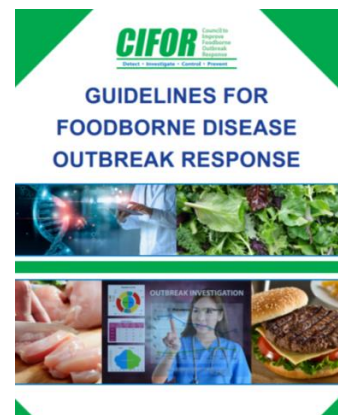
Fundamental Concepts of Public Health Surveillance and Foodborne Disease

21

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease

- Chapter *Fundamental Concepts of Public Health Surveillance and Foodborne Disease* Discusses:
 1. Trends in Diet and Food Industry
 2. Trends in Food Safety Problems
 3. Trends in Surveillance
 4. Ethological Agents Associated with Foodborne Diseases



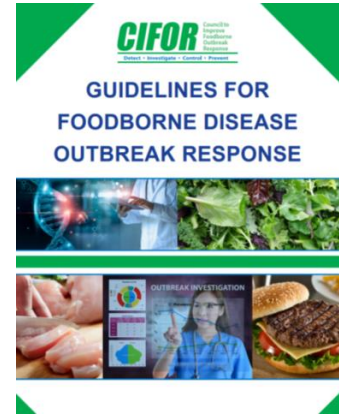
22

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease (1/4) Trends in Diet and Food Industry

• **Dietary Change:**

- Our diet has transformed significantly in recent years:
 - *Broader variety of foods*
 - *Increased consumption of raw fruits and vegetables*
 - *Increased seafood consumption*
 - *Locally grown foods replaced with international commerce and importation*
 - *New culinary practices: undercooked or raw foods (i.e. tartar- or Sous Vide- or sushi grade ground meats)*



23

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease (1/4) Trends in Diet and Food Industry

• **Changes in Food Production and Preparation**

1. **Industrialization** of food production: Concentrated animal feeding operations
2. **Antibiotics (sub-therapeutic)** use in animals: increased human infection by drug resistant bacteria
3. **Multi-state distribution** of food: multistate outbreaks
4. Recent trends for **local food** and direct to consumer sale: less chance for food safety regulation (**exemption**)
5. **Eating meals away from home:** higher chance of food safety illness



24

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(2/4) Trends in Food Safety Problems• **Food Product Recalls:**

- In 2012 USDA/FDA reported:
 - 258 recalls associated with foods
 - Associated with local, national, and international foods
 - **Common recall pathogens:** *Listeria monocytogenes* and Shiga toxin-producing *E. coli*, and *Salmonella* serovars
 - **Common human illness pathogens:** Shiga toxin-producing *E. coli*, and *Salmonella* serovars



25

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(2/4) Trends in Food Safety Problems• **Foodborne Disease and Outbreaks**• **Traditional outbreaks:**

- ✓ These are 95% of current outbreaks
- ✓ **Local outbreak** with **local endpoint** contamination
- ✓ **Short duration**
- ✓ Local patients
- ✓ **Easier to investigate** by local public health agencies



26

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(2/4) Trends in Food Safety Problems

- **Foodborne Disease and Outbreaks**
- **Commercial Outbreaks**: About 2% of episodes
 - ✓ **Commercial foods** (food industry)
 - ✓ Contaminated upstream **prior to sale**
 - ✓ Cases in **multiple locations**
 - ✓ **Requires collaboration of local, state, and federal agencies**
 - ✓ 7% of illness, 31% of hospitalization, and 34% of deaths associated with commercial outbreaks
- (CIFOR Industry Guideline)



27

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance

- **Public health surveillance** are active process of **collection, analyzing, and interpreting** data.
- **Purpose**: **detect** outbreaks and **prevent** diseases
- Some had been in **place for decades**, many are relatively **new**
- **11 surveillance methods** are discussed in the CIFOR guideline



28

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance• **Notifiable Disease Surveillance:**

- ✓ **Healthcare provider** and laboratories: required by law to report selected **diseases** to local public health agencies
 - (1) **Identified specimens (positive sample)**
 - (2) **Specific clinical symptoms**
- ✓ **Local agencies** report the disease to state agencies
- ✓ **State agencies** voluntarily share information with **CDC** through National Notifiable Disease Surveillance System
- ✓ **CDC** publishes the summaries (**publication of statistics**)



29

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance**Foodborne Illness Complaints**

- The system enables public health agencies:
 - ✓ **Receive, triage, and respond** to public concern about possible foodborne illnesses
 - ✓ Complaints are document in **forms** and many cases are **shared electronically (false claims)**
 - ✓ **Large proportion of outbreaks** are detected using this mechanism
 - ✓ **Private websites** as well:
 - ✓ **RUick2 website**
 - ✓ Some states experimenting with social media harvesting tools



30

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease (3/4) Trends in Surveillance

Two similar surveillance:

Contributing Factors and Environmental Antecedent Surveillance

And

Hazard Surveillance during Routine Inspection

Purpose: These data are used for preventing outbreaks by identifying high risk episodes.

• Monitors:

(1) **Contributing factors:**

- General day-to-day inspection of facilities
- Post-outbreak inspection of facilities

(2) **Environmental Antecedents:**

- Climate episodes that could lead to contamination such as **temperature of harvesting of seafood**



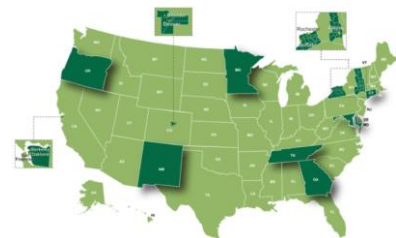
31

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease (3/4) Trends in Surveillance

Foodborne Disease Active Surveillance System (FoodNet):

- 10 participating sites in the U.S.
- Focuses on laboratory-confirmed cases by active surveillance
- **Active surveillance** include contact laboratories and cases to collect **epidemiological data**
- FoodNet also periodically conduct **population surveys:**
 - *Determining population consumption habits*
 - *Determining rate of sporadic cases*



32

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance**Behavioral Risk Factor Surveillance System**

- State-based **phone survey** established by CDC
- Does not detect outbreaks
- Only identify consumer behaviors such as:
 - *Food handling practices*
 - *Number of eating meals at home*
 - *Frequency of food consumptions*

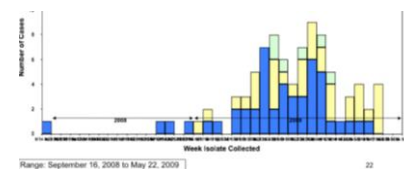
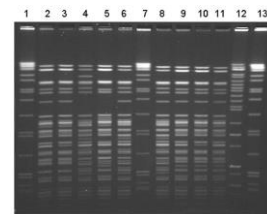


33

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance**National Molecular Subtyping Network for Foodborne Disease Surveillance (PulseNet):**

- A network of local, state, territorial, and federal laboratories
- Perform pulse-field gel electrophoresis (PFGE) on selected enteric pathogen
- Upload **PFGE pattern** to electronic database
- Compare with other isolates from human, food, animal
- **Matches possible linkages**
- **PulseNet has vastly improved rapid detection of outbreaks**
- **Recently: Whole Genome Sequencing**



34

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance

National Antimicrobial Resistance Monitoring System- Enteric Bacteria (NARMS):

- **Conducts sampling** from:
 - *Meat and poultry in market*
 - *Collect laboratory-confirmed animal strains*
 - *Collect laboratory-confirmed human enteric bacteria*
- **Determine the antibiotic resistance** of the strains
- **Purpose:** interaction between antibiotics use in *livestock* and antibiotic resistance in *hospitals*



35

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance

Foodborne Disease Outbreak Surveillance System (FDOSS)

CDC collects:

- Results of **foodborne disease investigation** from states
- In **2009**, **waterborne disease investigations** were added
- Recently **person-to-person** transmission and **animal-to-human** transmission were added as well
- **The expanded system** is called: National outbreak Reporting System (**NORS**)
- Data is publically available for researcher and practitioners



36

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance

National Electronic Norovirus Outbreak Network (CaliciNet):

- CaliciNet is network of public health food-testing laboratories
- Similar to FoodNet and PulseNet, only concentrates on Norovirus

Purpose:

- **Link** human illness to contaminated foods
- Identify **trends** and emerging strains of norovirus



37

CIFOR Guideline

Fundamental Concepts of Public Health Surveillance and Foodborne Disease
(3/4) Trends in Surveillance

Surveillance of the Food Supply

Food and Drug administration leading the effort for:

- Increasing **ISO 17025** laboratories in various states
- These **accredited laboratories then provide testing** results to FDA

Purpose:

- Identifying **high-risk manufacturers**
- Identifying **trends in microbiological profile** of foods



38

CIFOR Guideline
 Fundamental Concepts of Public Health Surveillance and Foodborne Disease
 (4/4) Ethological Agents Associated with Foodborne Diseases

Main organisms of concern:

- *Bacteria*
- *Virus*
- *Prions*
- *Parasite*
- *Marine Algae*

Main chemical concerns:

- *Mushroom toxins*
- *Fish toxins*
- *Toxin made by bacteria (botulism and S. aureus)*
- *Pesticides and indirect additives*

Could cause:

- **Infection** (*Salmonella, Listeria monocytogenes, Cronobacter, Campylobacter*)
- **Toxicoinfection** (*Clostridium perfringens*)
- **Intoxication** (*S. aureus, and C. botulinum*)



39

CIFOR Guideline
 Fundamental Concepts of Public Health Surveillance and Foodborne Disease
 (4/4) Ethological Agents Associated with Foodborne Diseases

Outbreak data indicate:

- **Bacteria** and their toxins: 46% of outbreaks
- **Viruses**: 47% of outbreaks
- **Marine algae and fish toxin**: 4% of outbreaks
- **Others**: around 3%

Main Mode of Transmission for outbreaks

- Foodborne transmission
- Waterborne transmission
- Person-to-person transmission
- Animal to human transmission (some estimate indicate **60% of human infectious diseases** could be tracked back to animals).



40

Exercise 1

- What is CIFOR and what agencies were responsible for development of the document?
- What are CDC, CSTE, and APHL stand for?
- According to CIFOR guideline, what are the recent dietary changes that contribute to increased probability of foodborne diseases?
- According to CIFOR guideline, what are the changes in food production and preparation that contribute to increased probability of foodborne diseases?
- How Notifiable Disease Surveillance operates?
- What is FoodNet and how it operates?
- What is PulseNet and how it operates?
- What is NARMS and how it operates?
- Name common foodborne microorganisms that could cause infection, toxico-infection, and intoxication?

41

CIFOR CHAPTER **Planning and Preparation**

42

CIFOR Guideline Planning and Preparation

This section of CIFOR Guideline recommends
(for health practitioners and food industry employee)

- Identify **agencies** in the region likely to be involved in an outbreak
- Establish **training** of a core outbreak investigation and **control team**
- Identification of **necessary resources**
- Development of **procedures to document complaints**
- Assurance of **legal preparedness**



43

CIFOR Guideline Planning and Preparation Agency Roles

Some foods are regulated by **one agencies**
Some might fall under **jurisdiction of multiple agencies**

Main Regulators of Food:

- **Local** health authorities at counties (**cottage industry**)
- **State** health departments (**food codes for Food-Service**)
- **State** environmental health agencies
- **State** food safety regulatory authority
- DHHS- Centers for Disease Control and Prevention (**Outbreak investigations**)
- DHHS- Food and Drug Administration (HACCP for juices, Shell eggs, seafood; FSMA)
- USDA- Food Safety Inspection Service (HACCP for **meat, poultry, egg products, and cat fish**)



44

CIFOR Guideline
 Planning and Preparation
 Outbreak Investigation Control Team

- CIFOR recommends **stablishing a team** for:
 - Preparing for **outbreak investigations**
 - Recommending **control measures**
 - **Monitoring the implementations**



Suggested **team members**:

- Team leader
- Epidemiologic investigator (field interview) [PUBH 5100 Principles of Epidemiology]
- Environmental investigator (field inspection)
- Laboratory investigators (microbiological analysis)
- Public information officer (health communicator) [PUBH 6020 Health Communication]

45

CIFOR Guideline
 Planning and Preparation
 Outbreak Investigation Control Team

It is further recommended to have:

- **Emergency response unit:**
 - *Senior epidemiologists, environmental scientist, or laboratorians*
- Identification of additional support for **large-scale outbreaks**
 - *Trained individuals outside of the agency or the company*
- **Agency-specific** (or company-specific) protocols
 - *Protocols if company has more than one shift, product specific protocols*
- **Training program** for the team members
 - *Regional and CDC trainings, land-grant university extension programs, self-study modules*



46

CIFOR Guideline
 Planning and Preparation
 Foodborne Illness Complaint Processing

- **Foodborne Illness Complaint Processing**
- **Instrument** to collect the initial complain
- Collection of **contact information**
- Instrument for collection of detailed **food history** (epidemiological questionnaire) **Incubation period?**
- **Designation of a database** for compiling the documents
- Identifying a **person to routinely analyze** and identify the patterns



47

CIFOR Guideline
 Planning and Preparation
 Record Management and Communication

- **Record Management:**
 - **Standardized forms** for collecting outbreak information
 - Development of **database templates**
 - Identifying **tools to analyze** outbreak data
 - **Training of all staff** to become familiar with these resources
- **Communications:**
 - **Companies and agencies** would need to identify a plan for **communication during an outbreak**
 - Specific procedures should be develop for **communication to:**
 - Outbreak **investigation team**
 - Local, state, and **federal health authorities**
 - The **public and social media** (German 2014 outbreak, CO Cantaloupe Outbreak)
 - **Cases and their families**
 - The **media**



48

CIFOR Guideline
 Planning and Preparation
 Planning for Recovery and Follow-up and Legal Preparedness

• **Planning for Recovery**

- Specific guidelines should be established to **re-starting the operation**
 - *Extensive cleaning using validated SSOPs*
 - *Outside inspection and verification*
- Development of transparent **after-action reports**
- **Extensive monitoring** after operation to avoid similar incidences



• **Legal Preparedness**

- **Establishment of a legal authorities** needed to support outbreak investigation (**inside or outside agency**)
- **Training the staff** for understanding legal aspects of outbreak investigation
- Memoranda **agreement with legal resources before outbreak**
- **Written documents on best legal practices** during an outbreak

49

CIFOR CHAPTER
**Foodborne Disease Surveillance and
 Outbreak Detection**

50

CIFOR Guideline Foodborne Disease Surveillance and Outbreak Detection Pathogen-Specific Surveillance

- Medical and Laboratory staff are obligated to:
 - Report specific **positive cases** and **clinical symptoms**
 - Reporting is delivered to **specific public health agencies**
 - The **agencies have further reporting obligations** to state and federal agencies
- **Reportable clinical symptoms:**
 - Hemolytic uremic syndrome (STEC) [*Quorum sensing and antibiotics*]
 - Botulism (*Clostridium botulinum*) [*Incubation period around 72 hours*] [*Infant botulism*]
- **Specific reportable positive cases:** [*Cronobacter, MN*]
 - Shiga toxin-producing *Escherichia coli*
 - *Salmonella* serovars
 - *Campylobacter*
 - *Toxicoplasma gondii*
 - *Listeria monocytogenes*
 - *Norovirus*
 - *Cyclospora cayetanensis*
 - *Shigella* spp.
 - *Yersinia enterocolitica*



51

CIFOR Guideline Foodborne Disease Surveillance and Outbreak Detection Complaint System

- Public health agencies and companies:
 - Would need to **receive**, **triage**, and **respond** to public complains
- Complaint is considered **passive surveillance:**
 - **Multiple reports form one event** (traditional outbreaks): 95%
 - **Multiple individuals** reporting single cases (multi-state outbreaks): 2%
- **Procedure for event complaints:**
 - **Compile list** of event attendees
 - **Confirm ill** individuals have same illness
 - **Interview people**
 - Conducting g a **cohort or case-control study** (epidemiological study)
 - Collecting food and patient **samples** [*Laboratory and epidemiology interaction*]



52

CIFOR Guideline
Foodborne Disease Surveillance and Outbreak Detection
Complaint System

• **Procedure for independent and individual complaint:**

- *Typically more difficult to investigate*
- **Interview of individuals**
- **Food recall questionnaire** to determine exposure by analysis
- Trying to identify a **cluster of illness** (i.e. consuming similar foods)
- *If no suspicious food is identified, most cases outbreak does not go further*



Complaint system:

- Typical identify **local outbreaks**
- **Does not require** identification of **specific agent or syndrome**
- **Are not typically effective** to identify **large scale** multi-state outbreaks

53

CIFOR Guideline
Foodborne Disease Surveillance and Outbreak Detection
Syndromic Surveillance

• **Syndromic surveillance:** [New data mining tools from social media]

- Gathering aggregate data such as:
- School/work absenteeism
- Sales of over-the-counter drugs
- Call for poison control centers, etc.



• **Syndromic surveillance:**

- Could detect **very large ongoing outbreaks** in early stages
- Many times lead to **false-positive** signals
- **Expensive, Not very common specially in under-resourced** health agencies

54

CIFOR CHAPTER

Investigation of Clusters and Outbreaks

55

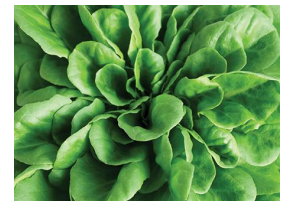
CIFOR Guideline Investigations of Clusters and Outbreaks

- **Outbreaks are detected by:**

- (1) Common exposure among individuals (**epidemiology-based**) (FoodNet)
 - (2) Common molecular pattern among individuals (**laboratory-based** i.e. PFGE and WGS patterns) (PulseNet)
- Outbreaks are typically identified using **laboratory-epidemiology interaction**.

- **Key qualities of outbreak investigation:**

- Accuracy (avoiding **false-positives**)
- Speed (limiting the spread of the outbreak)



56

CIFOR Guideline
Investigations of Clusters and Outbreaks
Principle of Investigation

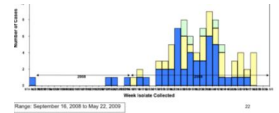
• **Outbreak investigation starts:**

- Suspicious foodborne illness linked to event (PFGE and WGS patterns)
- Unusual cluster of isolates are detected



• **After initiation, Outbreak team:**

- Review of epidemiological and laboratory evidence
- Further interview of the cases (trace back epidemiology)
- Further sampling (patients, companies, homes)
- Generation of hypotheses (e.g. 90% of patients reported eating tomato)
- Assembly of outbreak investigation and control team
- Next phase is...



57

CIFOR Guideline
Investigations of Clusters and Outbreaks
Principle of Investigation

• **The establishing goals and objectives:**

- Identifying the **etiological agents**
 - Identifying the **persons at risk**
 - Identifying **scope of outbreak**
 - Identifying **mode of transmission or vehicle**
 - Identifying **source of contamination**
 - Identifying **contributing factors** (lack of training, equipment failure etc.)
 - Determining the **potential for further transmission** and **need for reduction of risk**
- **Once these established...**



58

CIFOR Guideline
Investigations of Clusters and Outbreaks
Principle of Investigation

• Coordination of Investigation Activities:

- Daily meeting: communication between epidemiologists, laboratory scientist, environmental scientists
 - **Epidemiologist(s)**: updates on patients [questionnaire](#) and [data analyses](#)
 - **Environmental scientist(s)**: updates on sites [inspection report](#) and [interview with workers](#)
 - **Laboratory staff**: updates on **positive samples** from patients and samples and their **PFGE patterns**



- Nest stage...

59

CIFOR Guideline
Investigations of Clusters and Outbreaks
Principle of Investigation

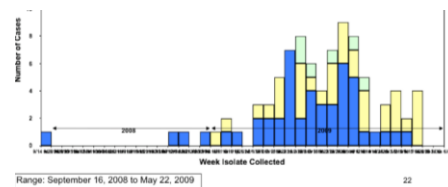
• Compilation for Results and Reevaluation of Goals:

- Compiling results from different team members
- Evaluation of existing goals
- [Modification of the goals](#) if necessary
- [Development of updated epidemic curve](#)

• Interpretation of results:

- Review of **environmental assessment data**
- Review of **epidemiological evidence**
- Review of **laboratory information and epidemic curve**
- Conduct **statistical analysis**: exploring association between **exposure and illness**
- **Determining the source and cause of outbreak**

- Next...



60

CIFOR Guideline
Investigations of Clusters and Outbreaks
Principle of Investigation

- **Debriefing at the end of investigation:**
- Among investigation team for final discussions
- **Summarizing Investigation findings**
- Internal forms, peer review publications, **MMWR**
- **Distribution to report to stakeholders.**



61

Exercise 2

- What are the main regulatory agencies of food safety in the United States?
- What are the suggested team members for investigating foodborne disease according to CIFOR guidelines?
- What are the main elements of successful records management and communication for outbreak investigation according to CIFOR guidelines?
- What are the reportable clinical symptoms and reportable infections based on second edition of CIFOR guidelines?
- What is the procedure associated with investigating series of complaints associated with an event?
- What is the role of an epidemiologist, environmental scientist, and laboratory staff during coordination of investigation activities in and outbreak investigation?
- What are the elements of establishing goals and objective during an outbreak investigation?

62

CIFOR CHAPTER

Control Measures

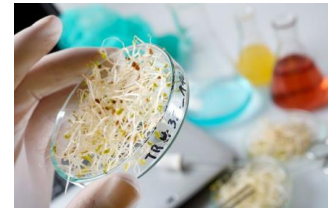
Actions that Health Departments Could Enforce

63

CIFOR Guideline
Control Measures

Control Measures:

- **Purpose:** Minimize public health burden **while investigation is ongoing**
- Could be **specific** or **non-specific** in nature
- **Before implementation risks and benefits** should be evaluated
- **Differ based on type of outbreaks:**
 - (1) Outbreaks association with retail food establishments (**restaurants**)
 - (2) Outbreaks associated with processors and consumers (**food companies**)



Three types of Control Measures:

- (1) Actions to control the source (**prevent exposure to source**)
- (2) Actions to take when **intentional exposure** is suspected (**Anthropogenic episodes**)
- (3) Measures to limit **secondary transmission** (**prevent transmission**)

64

CIFOR Guideline Control Measures



Prevent exposure to the source:

(1) Could be non-specific:

- **Avoiding consumption** of food at suspicious establishment while investigation is ongoing
- Emphasis on **good public health practices:**
 - Hand washing, wearing masks etc. for certain amount of time
 - Avoiding **bare-hand** contact with food

(2) Specific Control Measures:

- Remove an entire **suspicious brand** from market [*2008-09 Peanut Butter and 2012 Cantaloupe Outbreaks*]
- Reinforce **cleaning and sanitation** in suspicious plants and restaurants
- Accelerated **training for staff** in a suspicious facility
- Removing the implicated food from menu/market (FSMA)**
- Closure of facility** while investigation is ongoing

65

CIFOR Guideline Control Measures

Two methods to **remove food from market:**

(1) Contacting the establishment:

- **Food-service recalls:** harmonized by **state** agencies (**food code**)
- **Food-industry recalls:** harmonized by **federal** agencies
 - **USDA FSIS:** meat, poultry, out of shell eggs, catfish (**every operation**)
 - **FDA:** all other food products

(2) Communication with the public: (**stores and media**)

- **Specific information on the product**
- **Procedures to discard the product**



66

CIFOR Guideline Control Measures

Control Measures to Control Secondary Spread:

Excluding individuals from:

- Food preparation
- Health-care center
- Day-care facilities



Current Guidelines:

72 hours elimination from work: if individual showing general symptoms (vomiting and diarrhea) [*Now 14 day quarantine for respiratory symptoms*]

Positive *Salmonella* and *Shigella* among worker: All would need to be tested, **only culture-negative employee** could work

Around 1 million cases of Salmonellosis happen in the US annually.

67

CIFOR CHAPTER Special Consideration for Multijurisdictional Outbreak and Notification Steps (brief overview after 2011)

68

CIFOR Guideline

Special Consideration for Multijurisdictional Outbreak and Notification Steps

- **Prior to 2011** investigating **multijurisdictional outbreaks** were a major public health challenge.
- **Food Safety Modernization Act**, enacted in 2011, had **provided funding** to enhance collaboration among various institutions.

Federal Coordination Offices are:

- Outbreak Response and Prevention Branch: CDC
- Coordinated Outbreak Response and Evaluation Network (CORE) : FDA
- Applied Epidemiology staff, Office of Public Health Sciences: USDA FSIS



69

CIFOR CHAPTER Legal Preparedness for Surveillance and Control

70

CIFOR Guideline

Legal Preparedness for Surveillance and Control

4 CIFOR legal preparedness recommendation for public health agencies and companies:

- Following the **reportable disease** guidelines:
 - *Reportable infection disease:*
 - *Reportable syndromes (HUS and botulism)*
- **Enforcement of recalls** to food-service and food processors
- Taking appropriate action when **inspection violations** observed:
 - *Food Safety Modernization Act (FDA)*
 - *Egg Product Inspection Act (FDA)*
 - *Poultry Products Inspection Act (USDA)*
 - *Federal Meat Inspection Act (USDA)*
- Protection of **confidentiality** of cases:
 - *During epidemiological studies:*
 - *Laboratory testing and medical information*



71

CIFOR CHAPTER Performance Measures for Foodborne Disease Programs

72



CIFOR Guideline Performance Measures for Foodborne Disease Programs

10 CIFOR performance measures in health agencies and companies:

- Success of **foodborne complaints investigations**
- Reported **cases interviewed with specific foodborne illness**
- Number of **isolates and culture-independent analysis** leading to pathogen detection
- Number of foodborne **outbreaks investigated**
- Number of **case clusters investigated**
- Number of **infected food handlers** identified
- **Advisory documents generated** to stakeholders related to outbreaks
- Number of **recalls investigated**
- Number of **after-action report** generated after an investigation
- Number of **foodborne vehicles** identified

73

Summary

- **CIFOR**: Council to Improve Foodborne Outbreak Response
- Conceived in 2005 by members of:
 - Council of State and Territorial Epidemiologists (**CSTE**)
 - Association of Public Health Laboratories (**APHL**)
 - Centers for Disease Control and Prevention (**CDC**)
- Both **guideline** and the **toolkit** are references in many **governmental agencies**:
- Recent survey of public health agencies:
 - *80%: familiar with CIFOR guidelines*
 - *65%: familiar with CIFOR toolkit*
- In 2014, CIFOR Industry Work group also published:

Foodborne Illness Response Guidelines for Owners, Operators and Managers of Food Establishments (**CIFOR Industry Guidelines**)

Purpose: Assist food industry meet the regulatory requirements



74

Exercise 3

- Name specific and non-specific control measures in an ongoing outbreak investigation?
- What are the CIFOR control measures to “control secondary spread,” in an outbreak?
- What are the three primary federal agencies for coordinating foodborne diseases investigation?
- What are the 10 CIFOR performance measures in health agencies and companies?
- What are the 4 CIFOR legal preparedness recommendation for public health agencies and companies?

75

Thank you

Dr. Aliyar Cyrus Fouladkhah,
Faculty Director, Public
Health Microbiology
Laboratory, Tennessee State
University
afouladk@tnstate.edu
Phone: (970) 690-7392



Photos Courtesy: Adobe Stock, royalty purchased (standard license) by public health microbiology laboratory, unless stated otherwise

76