

Guidelines for Foodborne Disease Outbreak Response (CIFOR)

Investigation of Foodborne Diseases: Policies and Guidelines

AGSC 5540: Food Policies and Regulations

9-17-2020

Tennessee State University, Nashville, TN

A. Fouladkhah: Faculty Director, Public Health Microbiology Laboratory

What are we discussing today



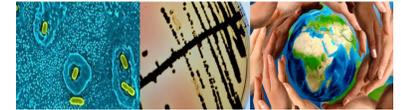
Exam structure



The Need for Outbreak
Investigation



Overview of CIFOR
Guidelines

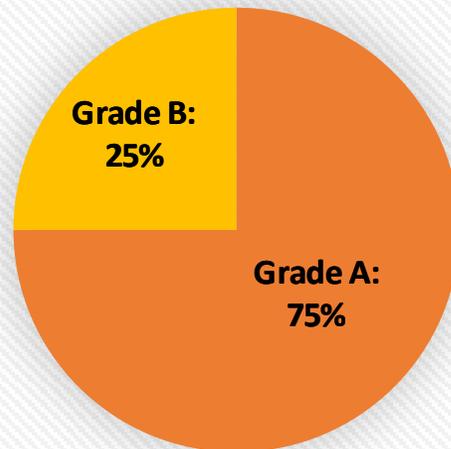


Exam Overview

- 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

- Mid-Term exam= Will be in class/virtual
- Final Exam will be= Take home exam

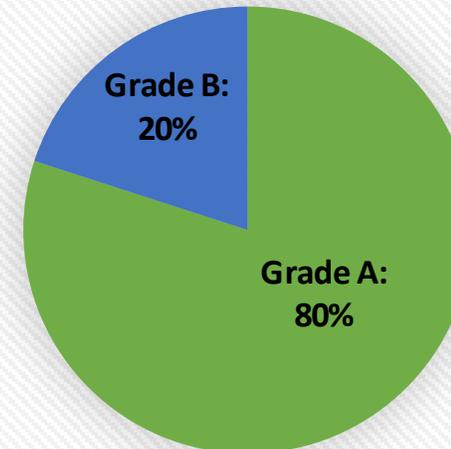
2018 Food Policies and Regulations



Grade A Grade B Grade C or less

Grade C or less:
None

2019 Food Policies and Regulations



Grade A Grade B Grade C or less

Grade C or less:
None

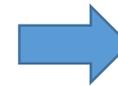


AGSC 5540: Food Policies and Regulations (Food Law)

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 %



To be emailed after
class to instructor at
afouladk@tnstate.edu

Term Paper Example

Papers will be analyzed for similarity index

Option 1: Brief Term Paper

10 pages double Space



Food For Thought: The Complexity of Obesity with the Black Community

Lauren Odum

Studies show that two-thirds of African Americans 20 years of age or older are obese or overweight. The purpose of this paper is to outline why obesity is such a prevalent issue within the black community, and actions that can be taken to reduce these staggering statistics. Topics explored will include effects of being overweight, lack of access to healthy, affordable food and adequate health care, along with the cultural standards within the black community that perpetuate this epidemic. The goal of this research is to shed light on an often-overlooked topic and provide possible long-term solutions.

Option 2: An Outreach Article

10-20 pages double Space

To be converted to 3-page outreach article

Protecting Yourself and Your Family from Extra Salt in Diet

Contributors: Aliyar Fouladkhah, Jenelle Robinson, and Yonda Richardson



Sodium chloride, commonly known as salt, is essential for health and has historically been part of our diet. It is also an indispensable part of food manufacturing, and an ingredient in a wide array of manufactured packaged food products in market. Higher than recommended amounts of salt in diet, however, have considerable deleterious effects on our health. At current time, American adults of nearly all ages, consume considerably higher than recommended amount, the level that is currently recognized as safe for maintaining health⁽¹⁾. Extra salt in diet, is strongly linked to elevated levels of blood pressure and other chronic diseases⁽²⁾. Unfortunately, hypertension (high blood pressure) in adults is one of the leading underlying causes of preventable and premature deaths, both nationally and internationally⁽³⁾.

At current time, 26% of people around the world suffer from hypertension, one of the direct consequences of extra salt in diet. As high as 27% of U.S. adults are also currently suffering from hypertension and another 31% have a condition called prehypertension that can lead to hypertension. Overall, in American adults, lifetime probability of developing these conditions is approaching 90%⁽⁴⁾. So stakes are very high and many people are negatively affected by extra salt in diet. New studies also show that extra amount of salt in our diet could be responsible for increased likelihood of other health complications such as cardiovascular diseases, several types of cancer, obesity incidences, and development of asthma⁽⁵⁾. Now that we know the extent of the problem, let's see where the extra salt in diet comes from, and how we can avoid extra dietary salt to prevent or reduce these health complications for ourselves and our families.

USDA Dietary Guidelines estimate about 75% of dietary sodium comes from the consumption of processed foods and ready-to-eat products, items that we buy from supermarket⁽¹⁾. Salt is one of the cheapest ingredients (around 15 cents per pound) and also improves taste and increases shelf-life of many products. So for taste, quality, and also economic reasons, salt is a very common ingredient in many packaged foods we buy from supermarket. Another study similarly estimated that 77% of salt in western diets comes from consumption of processed foods, 12% from existing salt in natural foods, 6% from added salt during dining, and 5% from added salt during cooking⁽⁴⁾. Just to give an example, natural sodium content of beef (topside roast) and raw salmon are about 48 and 110 mg in 3-oz (100 g) portions, but the sodium content of canned corned beef and smoked salmon is about 950 and 1880 mg in same portion sizes of 3-oz. We can all reduce salt intake by reading the nutrition labels on the back of packaged products prior to purchase. So with moderation and balance in consumption of high-sodium foods or if possible, by avoiding them from diet, it is possible to protect our health meaningfully from the above-mentioned health complications. Of course we can try what public health professionals call "stealth approach," by trying to reduce extra salt in diet gradually to adopt our taste to a diet with moderate amount of sodium. Interestingly, avoiding salt entirely in our diet could also lead to negative health consequences, so just like many other health and nutrition practices, moderation and balance is the key.

Do you know what the main high-sodium food products are? Review of recent studies show that processed meats, breads, cheeses, sauces, and spreads are some of the main contributors of extra dietary sodium⁽⁵⁾. More specifically, around 40% of sodium in a typical western diet comes from breads and rolls, cold cuts/cured meats, pizza, poultry, soups, sandwiches, cheese, pasta mixed dishes, meat mixed dishes, and savory snacks⁽⁶⁾. So by minimizing consumption of these high-sodium foods, by carefully examining the nutritional labels of packaged food, trying to gradually adopt our taste to a diet with lower amount of salt, and with moderation and balance we can move towards even



Option 3: Review Paper



microorganisms



Review

Outbreak History, Biofilm Formation, and Preventive Measures for Control of *Cronobacter sakazakii* in Infant Formula and Infant Care Settings

Monica Henry¹ and Aliyar Fouladkhah^{1,2,*}

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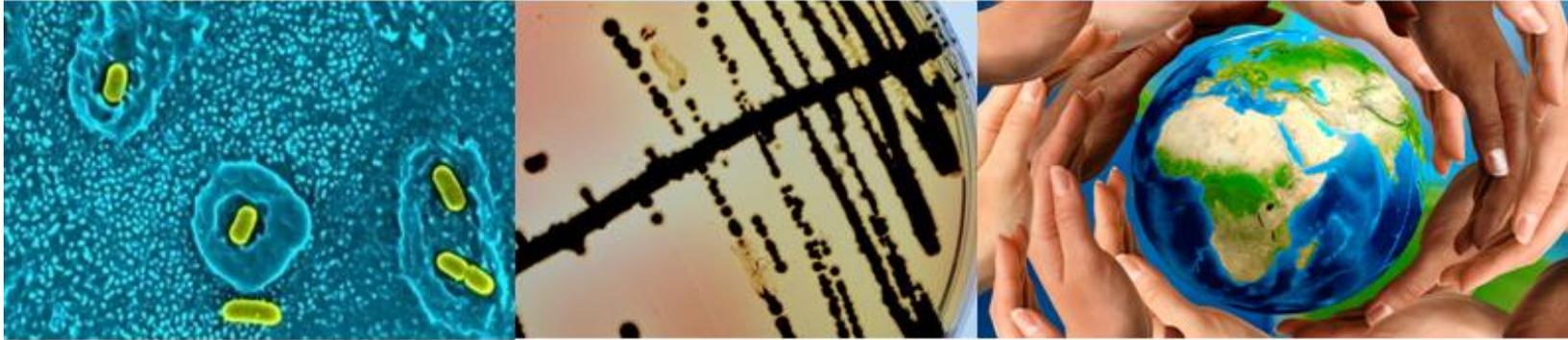
* Correspondence: afouladk@tnstate.edu or aliyar.fouladkhah@aya.yale.edu; Tel: +1-970-690-7392

Received: 18 January 2019; Accepted: 9 March 2019; Published: 12 March 2019



Abstract: Previously known as *Enterobacter sakazakii* from 1980 to 2007, *Cronobacter sakazakii* is an opportunistic bacterium that survives and persists in dry and low-moisture environments, such as powdered infant formula. Although *C. sakazakii* causes disease in all age groups, infections caused by this pathogen are particularly fatal in infants born premature and those younger than two months. The pathogen has been isolated from various environments such as powdered infant formula manufacturing facilities, healthcare settings, and domestic environments, increasing the chance of infection through cross-contamination. The current study discusses the outbreak history of *C. sakazakii* and the ability of the microorganism to produce biofilms on biotic and abiotic surfaces. The study further discusses the fate of the pathogen in low-moisture environments, articulates preventive measures for healthcare providers and nursing parents, and delineates interventions that could be utilized in infant formula manufacturing to minimize the risk of contamination with *Cronobacter sakazakii*.

Keywords: *Cronobacter sakazakii*; powdered infant formula; *Cronobacter* outbreaks; preventive measures; infant care setting



The Need for Outbreak Investigation

Emerging pathogens

Diversity, moving towards “fitness” and Emerging Pathogens

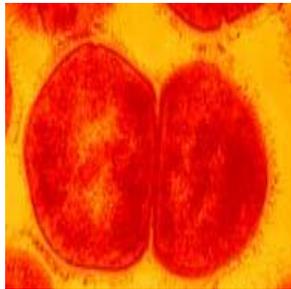
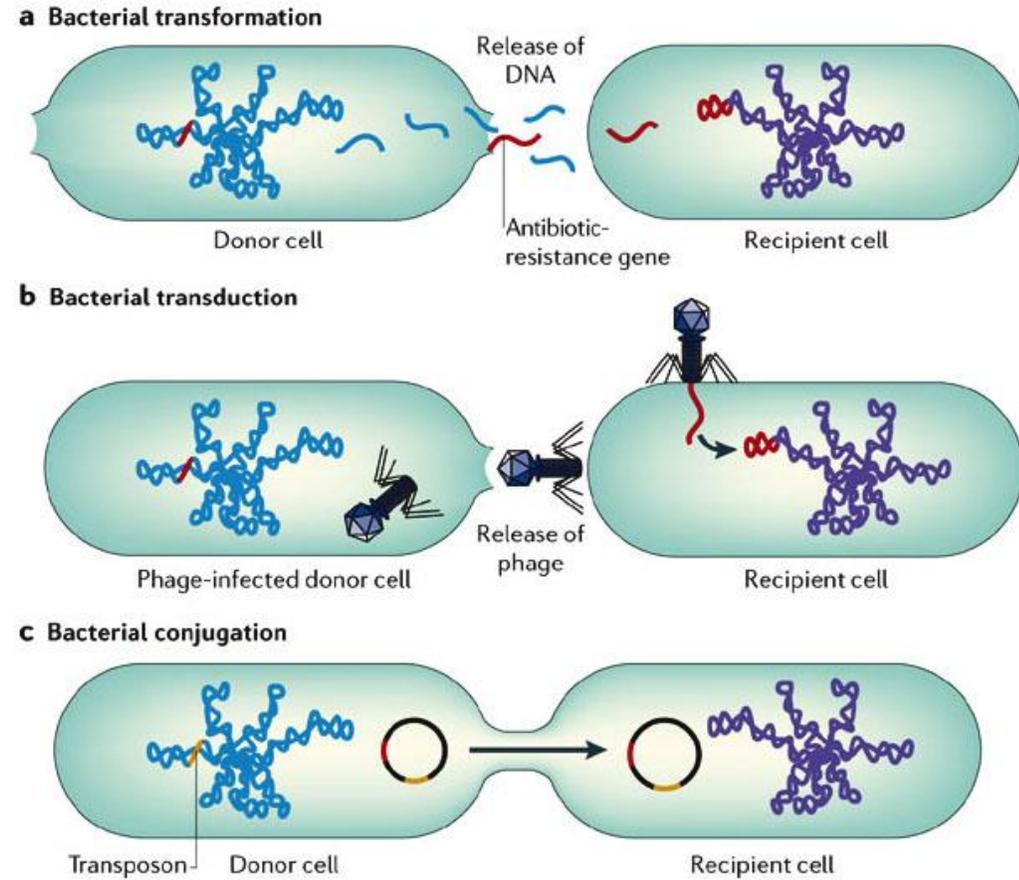
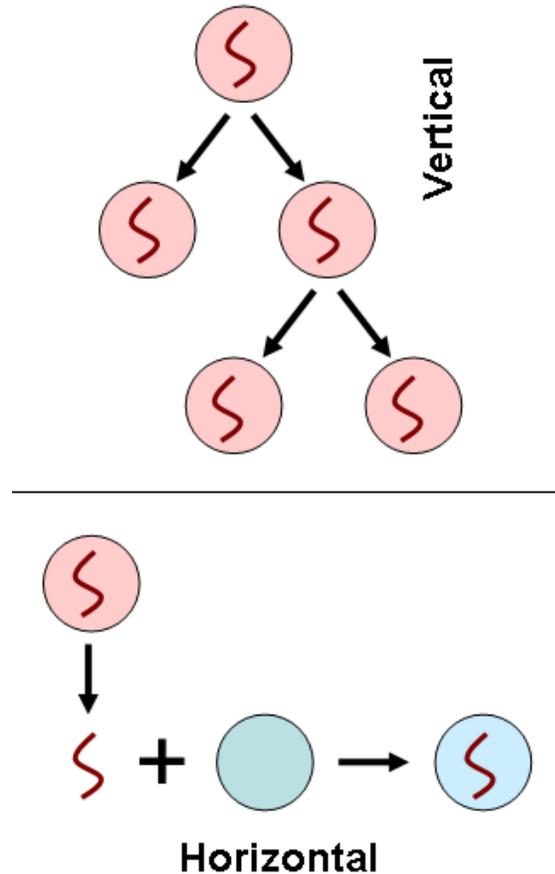
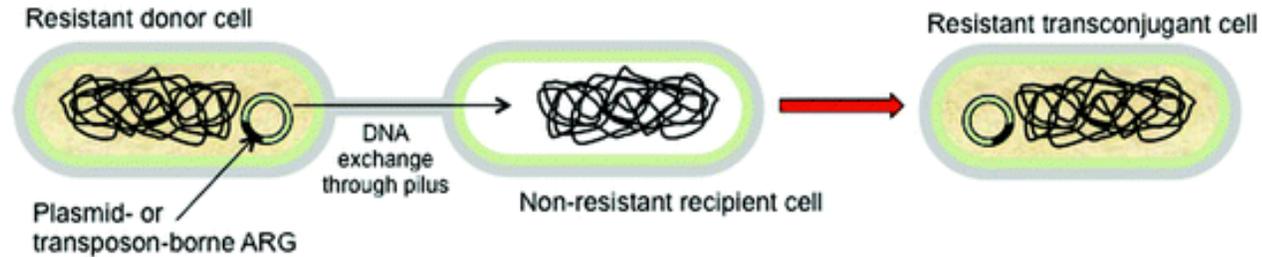


Photo Courtesy:
http://www.daviddarling.info/encyclopedia/B/binary_fission.html

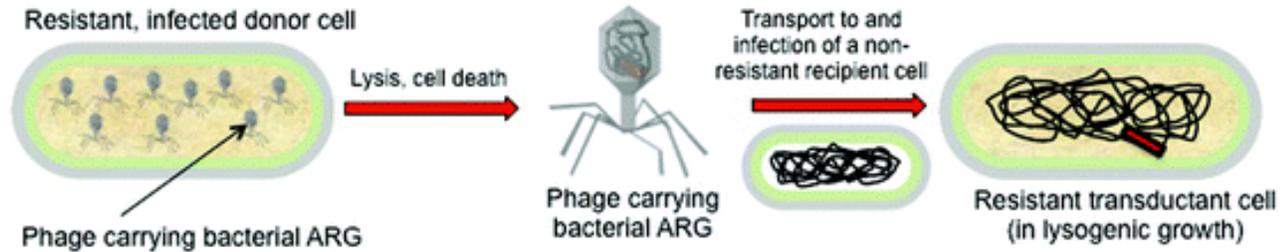


Horizontal Gene Transfer

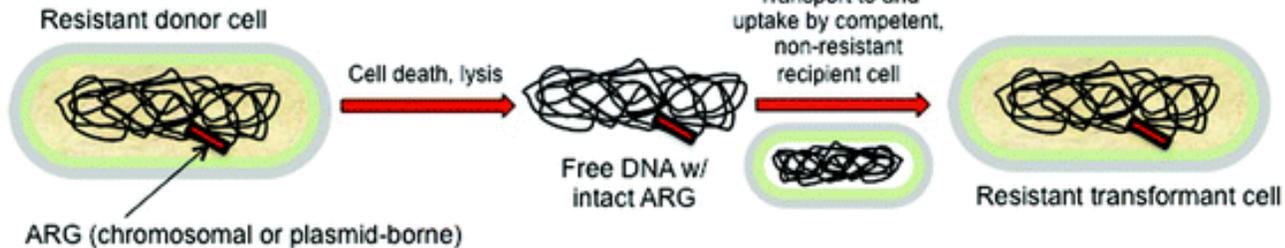
(a) Conjugation:



(b) Transduction:



(c) Natural transformation:



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



Plasmids

Circles of DNA that can move between cells.



Transposons

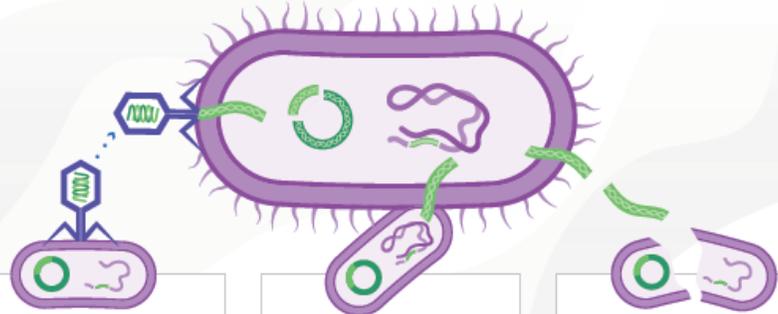
Small pieces of DNA that can go into and change the overall DNA of a cell. These can move from chromosomes (which carry all the genes essential for germ survival) to plasmids and back.



Phages

Viruses that attack germs and can carry DNA from germ to germ.

How Mobile Genetic Elements Work



Transduction

Resistance genes can be transferred from one germ to another via phages.

Conjugation

Resistance genes can be transferred between germs when they connect.

Transformation

Resistance genes released from nearby live or dead germs can be picked up directly by another germ.

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

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).



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

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.



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.



Planktonic cells and Biofilm Communities

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

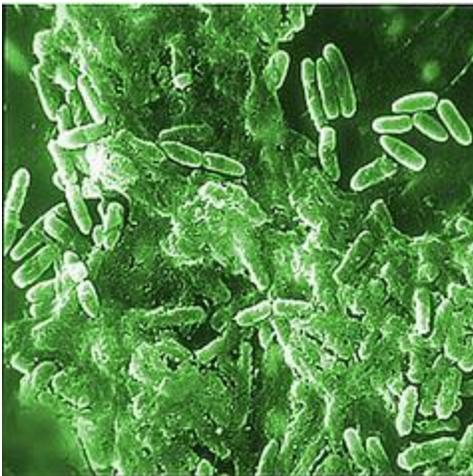
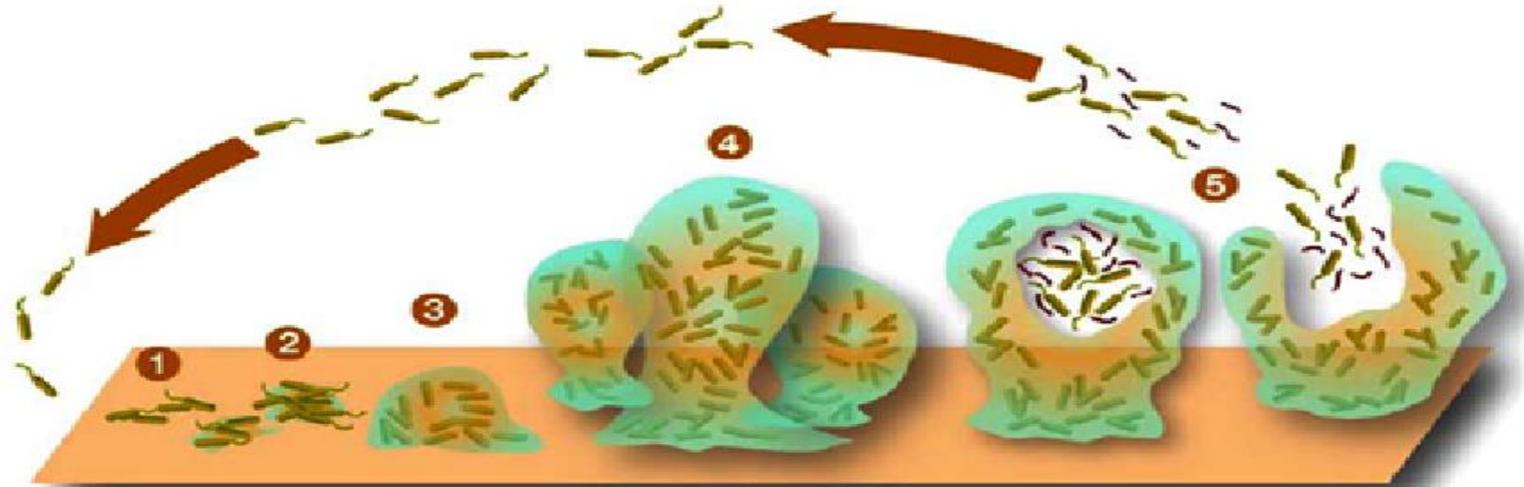


Photo Courtesy: <http://micro-writers.egybio.net/blog/?tag=antibiotic-resistance>

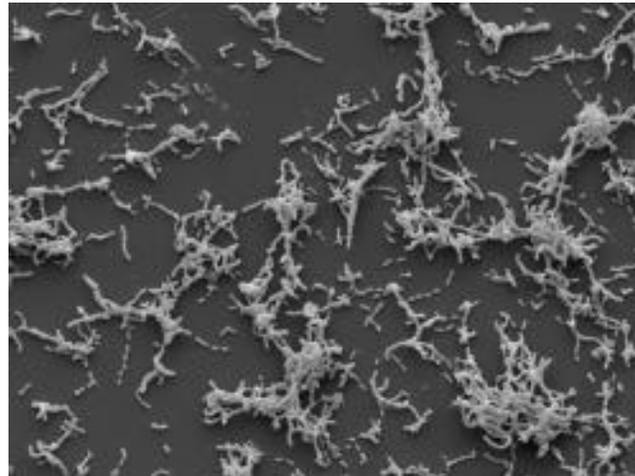


Photo Courtesy: http://www.ifenergy.com/50226711/boosting_microbial_fuel_cells_with_biofilm.php

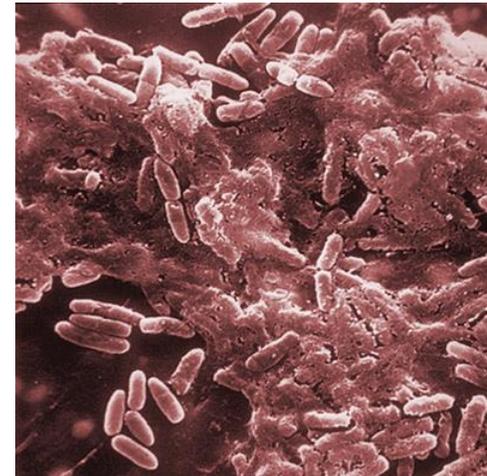


Photo Courtesy: <http://www.microbiologybytes.com/blog/category/biofilms/>

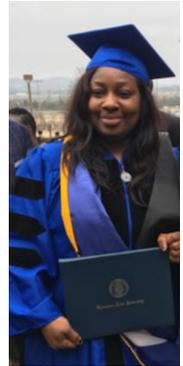
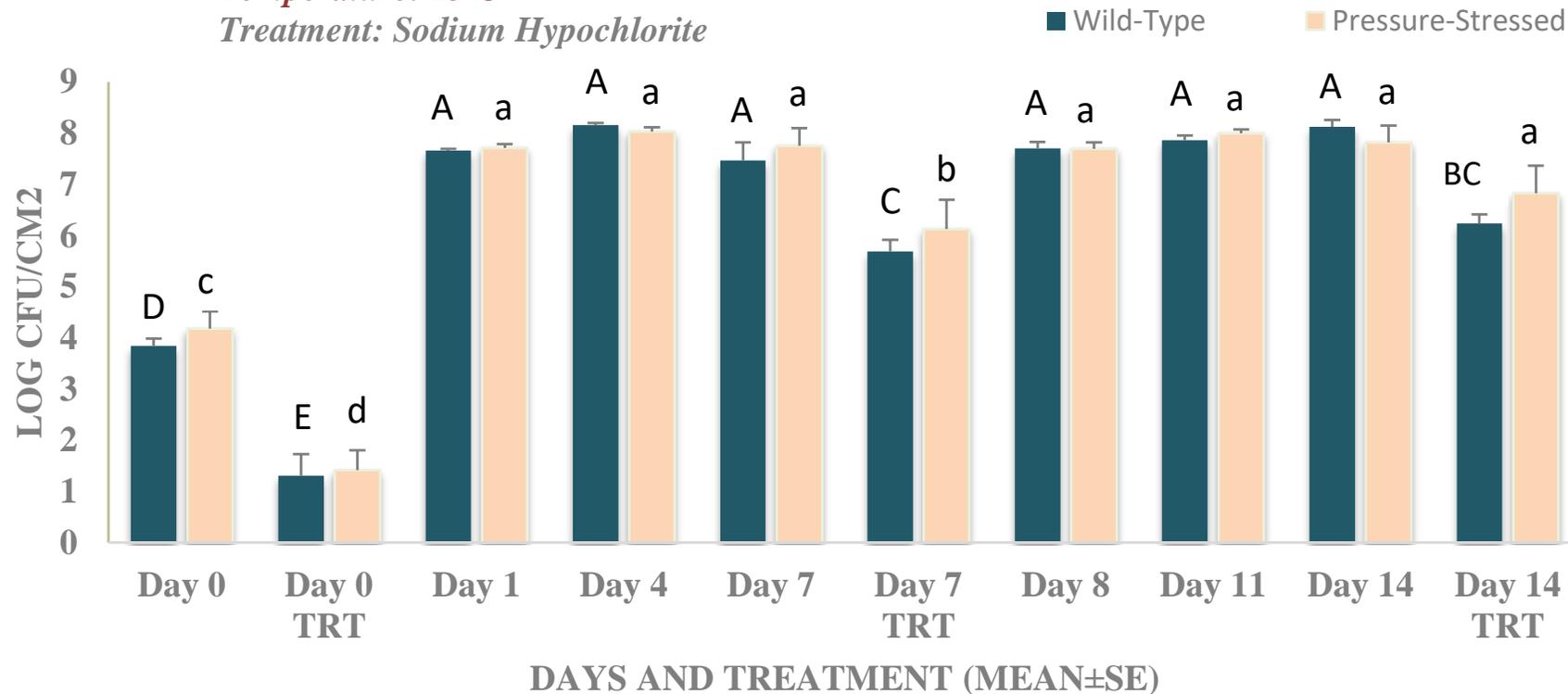
Cronobacter sakazakii

Two outbreaks in Tennessee (1998, Memphis; 2001 Knoxville)

Biofilm Formation and Decontamination of Wild-Type and Pressure-Stressed *Cronobacter Sakazakii*

Temperature: 25°C

Treatment: Sodium Hypochlorite



Allison et al., 2020



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.

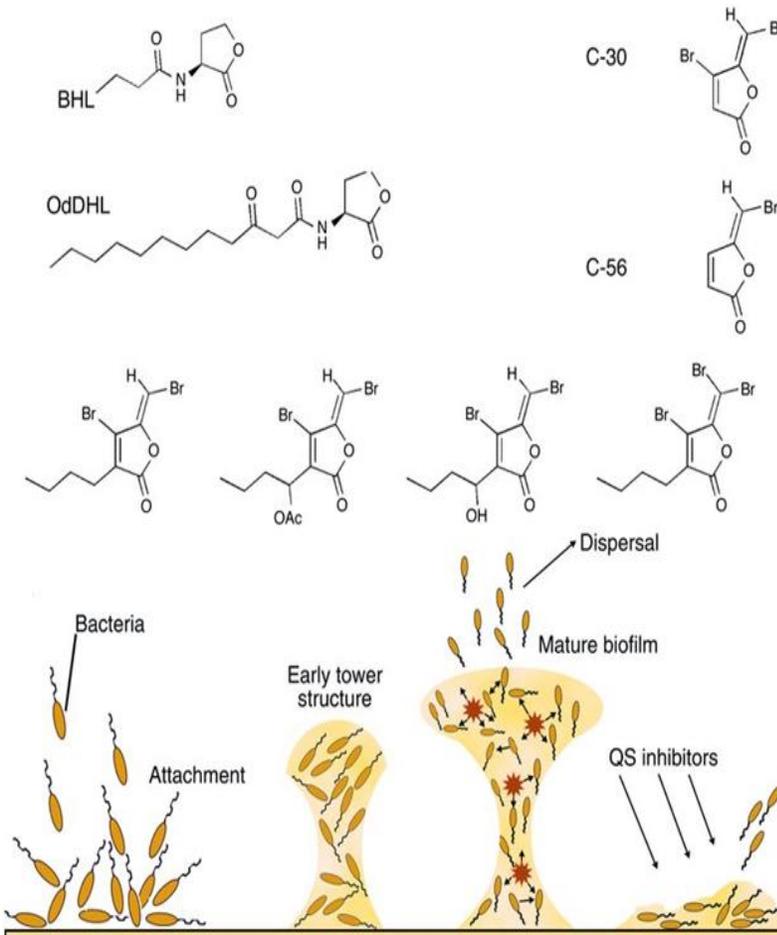


Photo Courtesy: <http://www.jci.org/articles/view/20074/figure/2>

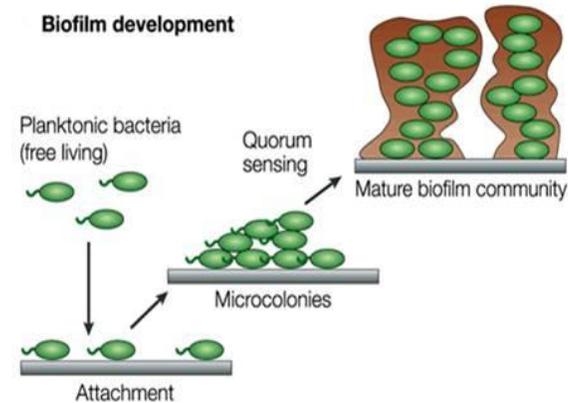


Photo Courtesy: <http://labrat.fieldofscience.com/2010/07/quorum-sensing-and-biofilms.html>

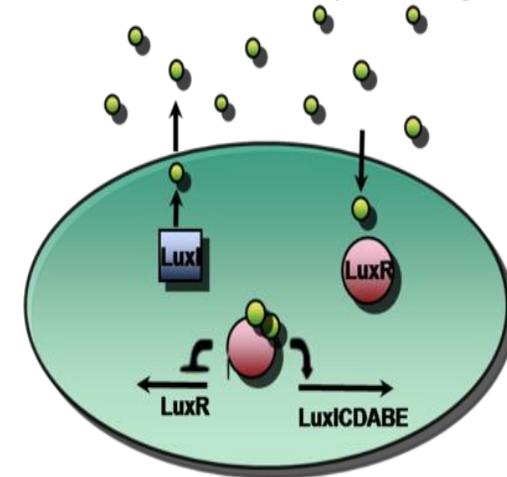


Photo Courtesy: http://2009.igem.org/Team:Aberdeen_Scotland/WetLab/quorumsensing

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

- 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.

“Emerging” Pathogens:

- Vertical and horizontal gene transfer spores and biofilm formation
- Quorum sensing and cell to cell communication

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

-Louis Pasteur

An Important Challenge:

Antibiotics Resistance

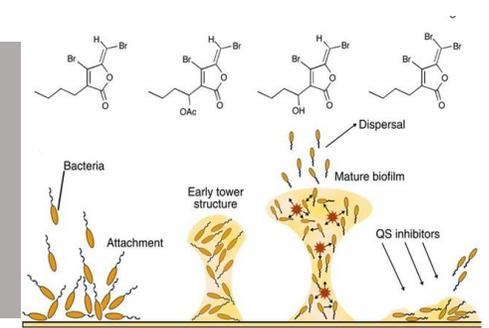
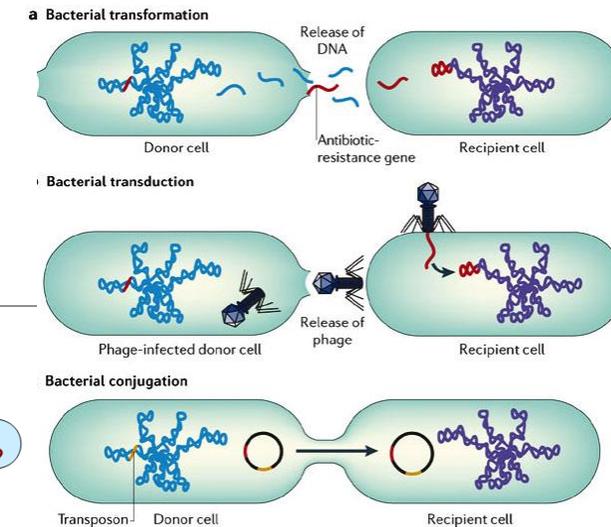
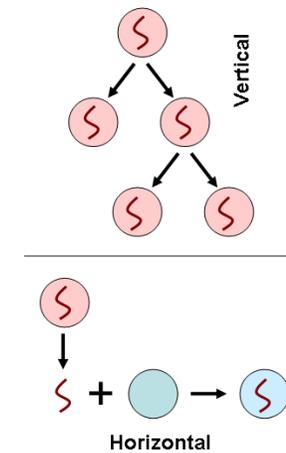


Photo Courtesy: <http://www.jci.org/articles/view/20074/figure/2>



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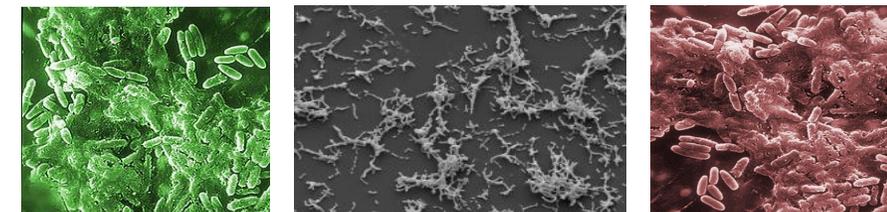


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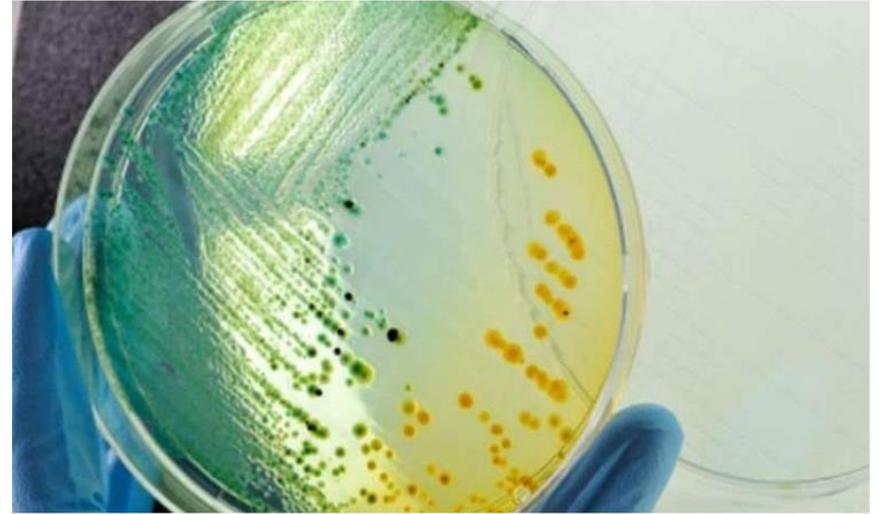
A superbug resistant to every available antibiotic in the U.S. kills Nevada woman

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



Multidrug-resistant salmonella outbreak characterized



(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



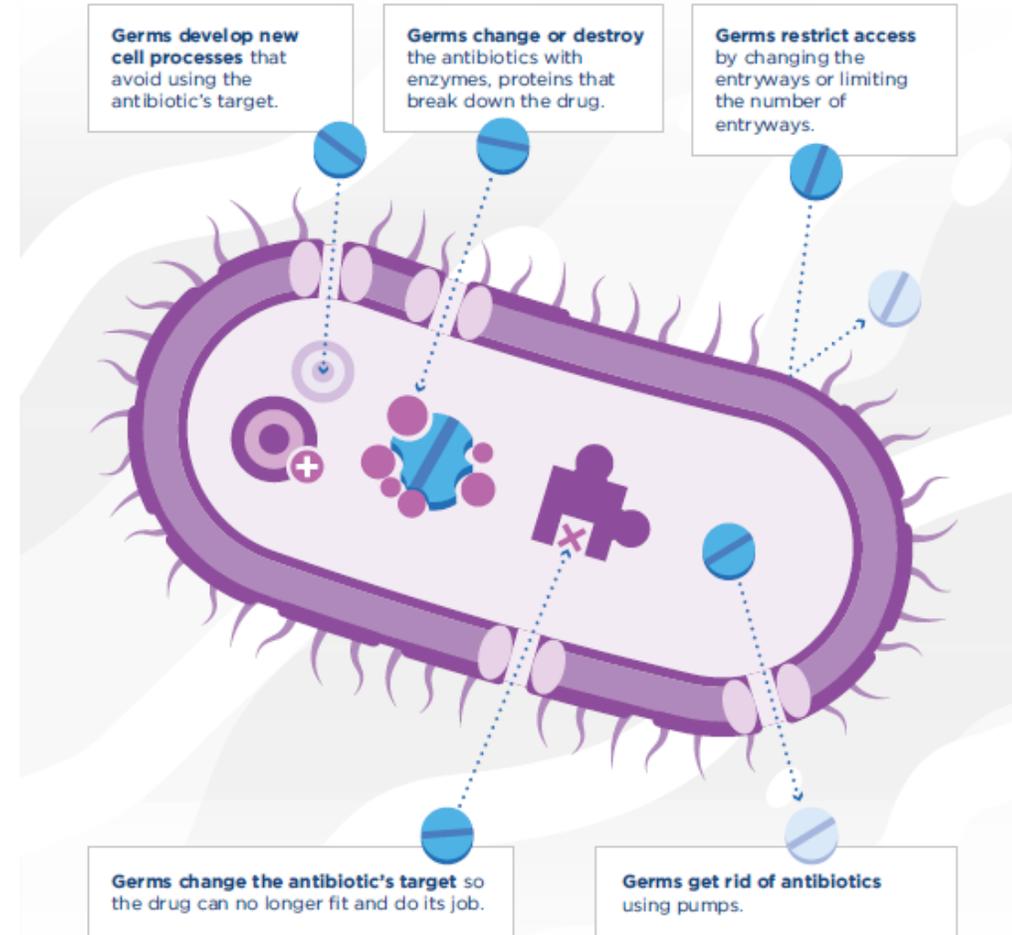
What is Antimicrobials, Antifungals, and Antibiotics

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.



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:

 **2,868,700** infections

 **35,900** deaths



*Clostridioides difficile*** is related to antibiotic use and antibiotic resistance:

 **223,900** cases

 **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



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)

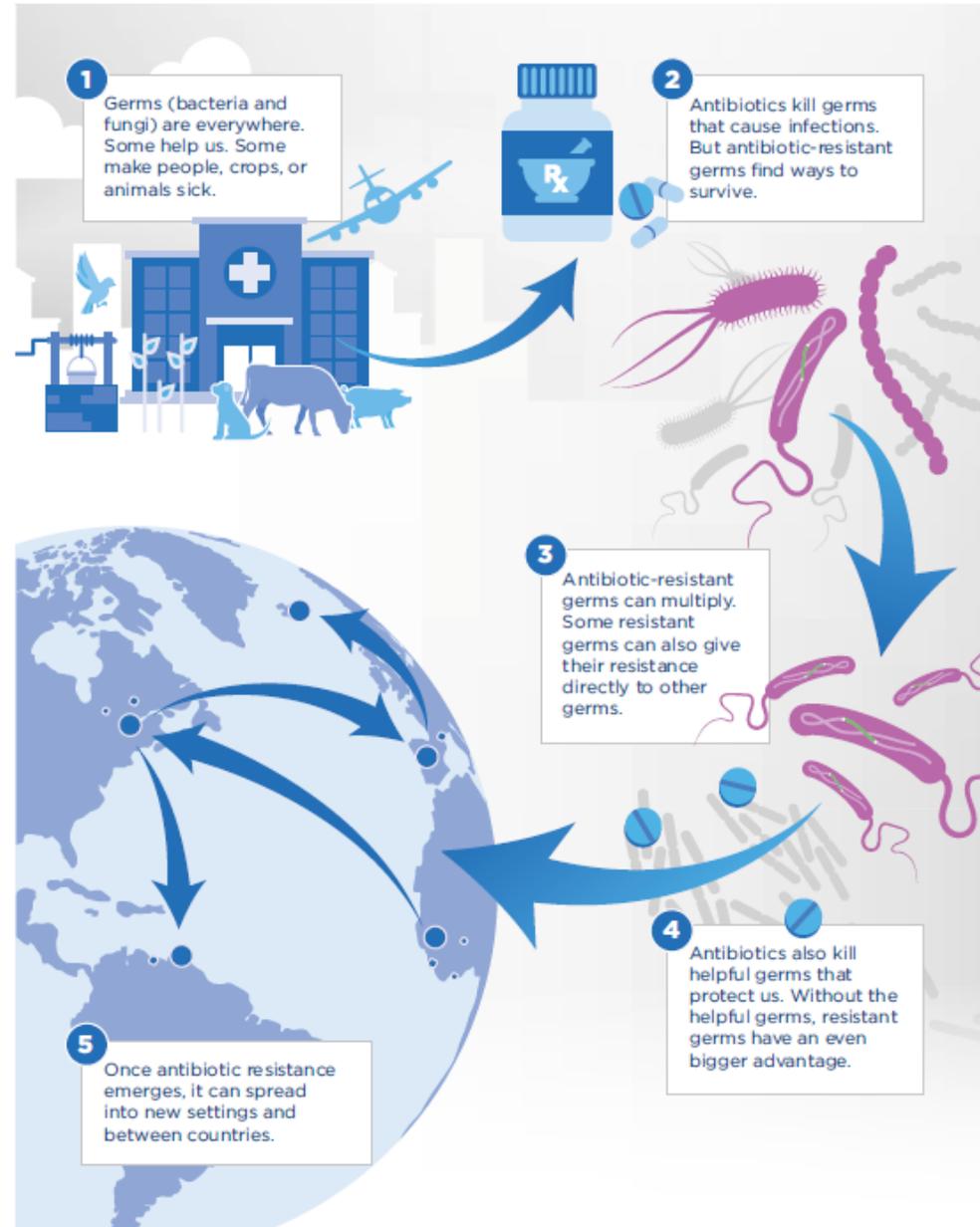
Concerning Threats

- 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

Airborne

Accidental laboratory exposure

From Abiotic surfaces

Mitigating the Risk of Antimicrobial Resistance?

- Preventive measures and infection control
- Outbreak control



COMBAT ANTIBIOTIC RESISTANCE

Protect Yourself & Your Family

Infections caused by antibiotic-resistant germs are difficult, and sometimes impossible, to treat—but we can help stop the spread of these germs. Antibiotic resistance happens when germs like bacteria and fungi develop the ability to defeat the drugs designed to kill them.

No one can completely avoid getting an infection, but there are steps you can take to reduce your risk.

Know Your Risks, Ask Questions, & Take Care

Ask your healthcare provider about risks for certain infections and sepsis. Speak up with questions or concerns. Keep cuts clean and covered until healed, and take good care of chronic conditions, like diabetes or heart disease.

Clean Your Hands

Keeping your hands clean is one of the best ways to prevent infections, avoid getting sick, and prevent spreading germs.

Get Vaccinated

Vaccines are an important step to prevent infections, including resistant infections.

Be Aware of Changes in Your Health

Talk to your healthcare provider about how to recognize signs and symptoms of infections, or if you think you have an infection. If an infection isn't stopped, it can lead to additional complications like sepsis, a life-threatening medical emergency.

Use Antibiotics Appropriately

Talk with your healthcare provider or veterinarian about the best treatment when you, your family, or your animal is sick. Antibiotics save lives, but any time they are used they can cause side effects and lead to antibiotic resistance.

Practice Healthy Habits Around Animals

Always clean your hands after touching, feeding, or caring for animals, and keep your animals healthy.

Prepare Food Safely

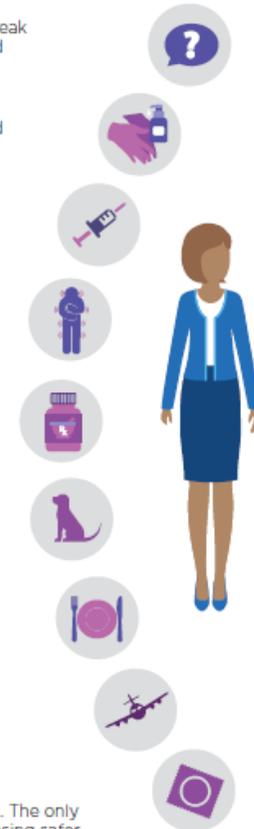
Follow four simple steps to avoid foodborne infections. Clean your hands, cooking utensils, and surfaces. Separate raw meat from other foods. Cook foods to safe temperatures. Chill leftovers and other foods promptly.

Stay Healthy When Traveling Abroad

Be vigilant when traveling abroad. Know what vaccinations are needed, check health alerts, stick to safe food and drinks, plan in advance in case you get sick, and learn about the risks of medical tourism.

Prevent STDs

Gonorrhea, a common STD, can be resistant to the drugs designed to treat it. The only way to avoid STDs is to not have sex. If you have sex, lower your risk by choosing safer sexual activities and using condoms the right way from start to finish. You and your partner should be treated right away if you test positive to keep from getting infected again.





Food

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Outbreaks

[Outbreak Investigations](#)

[Environmental Assessments](#)

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



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PIN IT



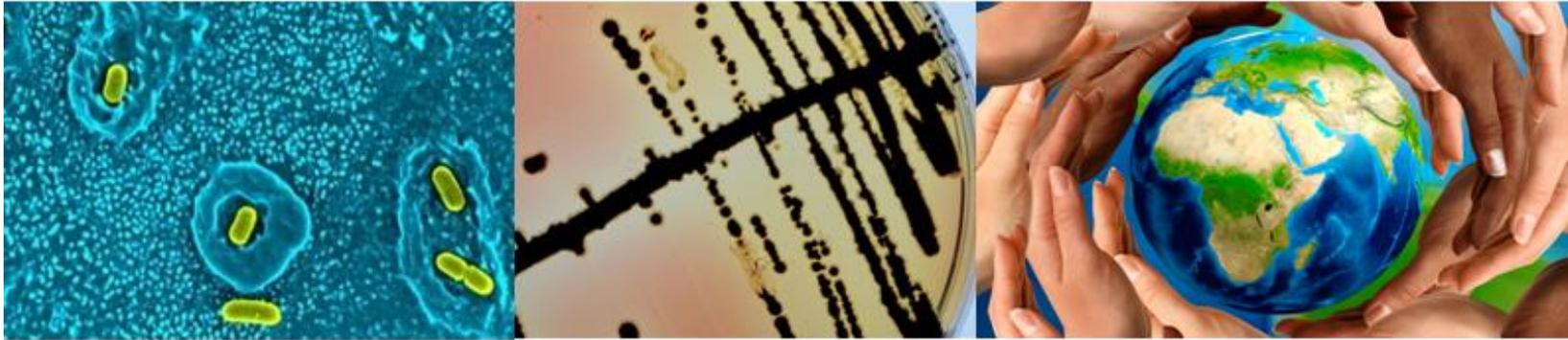
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PRINT



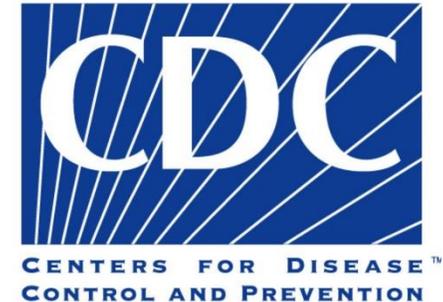
- Investigation by FDA, the USDA FSIS, and the CDC with state and local health officials.
- *E. coli* O157:H7 infections in California, Colorado, Montana, Missouri, Utah, Virginia, and Washington.



Overview of CIFOR Guidelines

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



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:

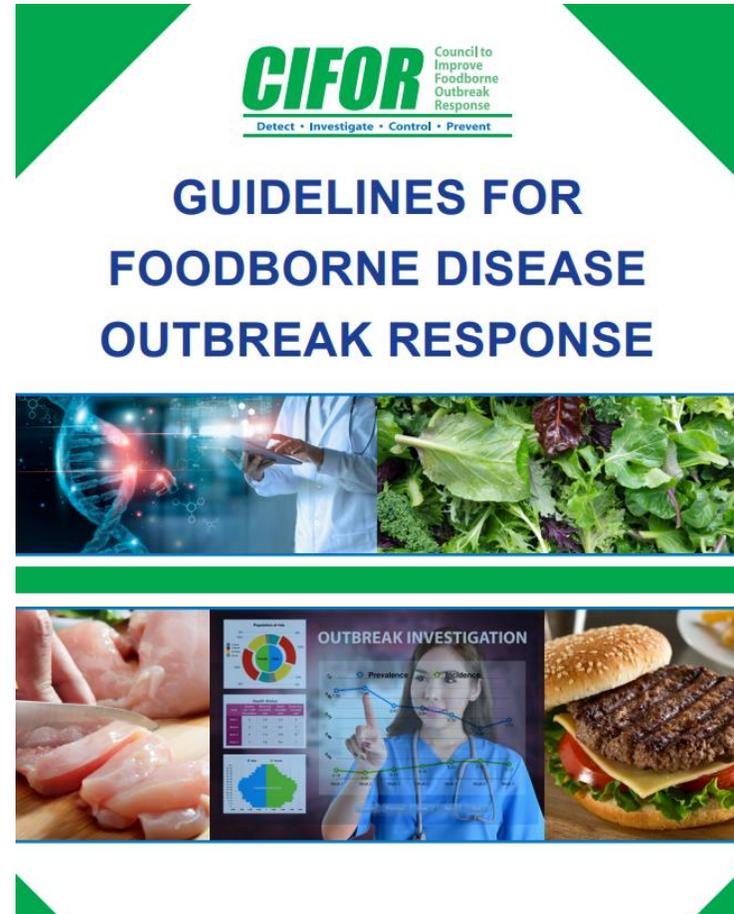
Foodborne Illness Response Guidelines for Owners, Operators and Managers of Food Establishments (CIFOR Industry Guidelines)

Purpose: **Assist food industry** meet the regulatory requirements



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*



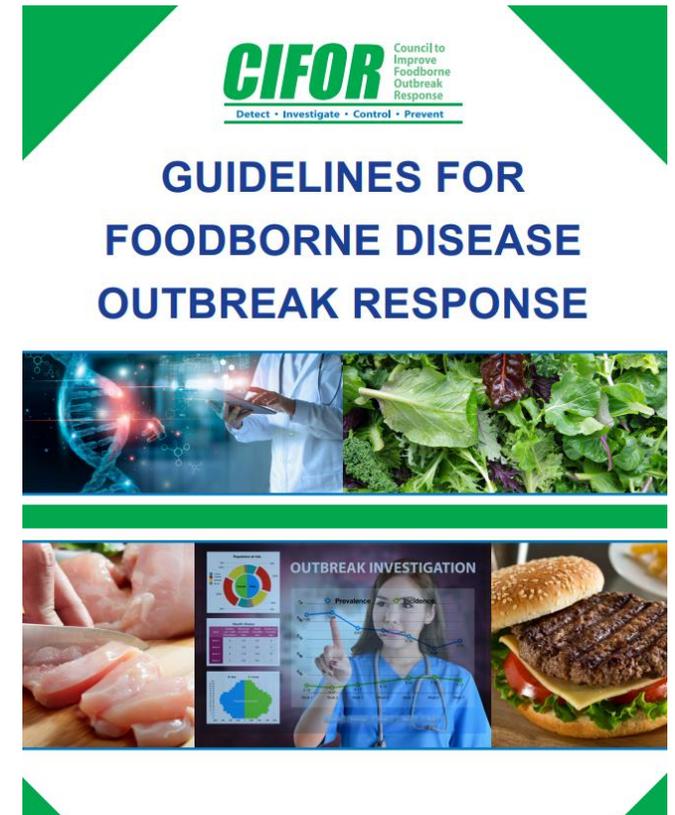
CIFOR CHAPTER

Fundamental Concepts of Public Health Surveillance and Foodborne Disease

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

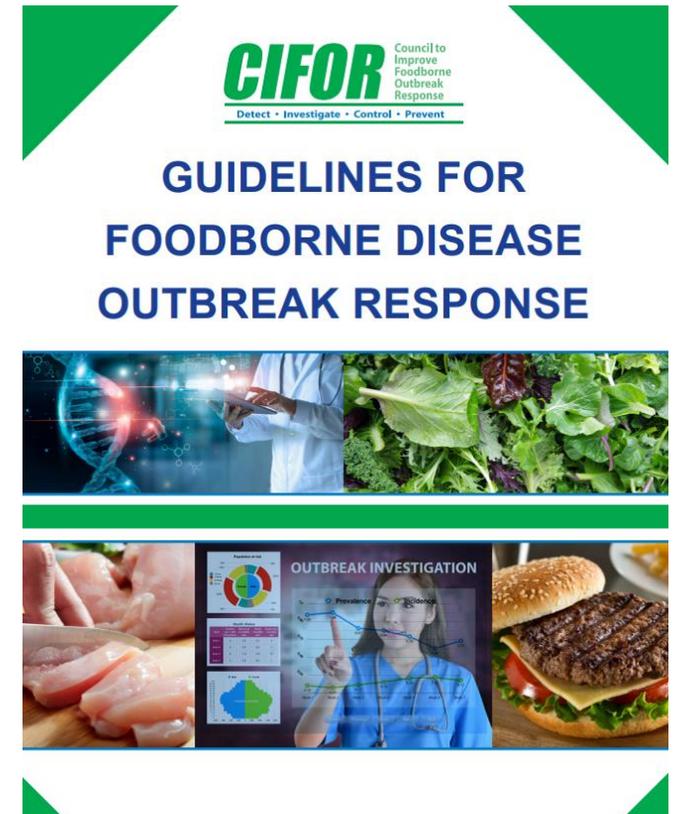


CIFOR Guideline

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)*



• **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



- **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



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



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
- **(CIFORE Industry Guideline)**



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



- **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**)



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:
 - ✓ **RUsick2 website**
 - ✓ **Some states experimenting with social media harvesting tools**



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**

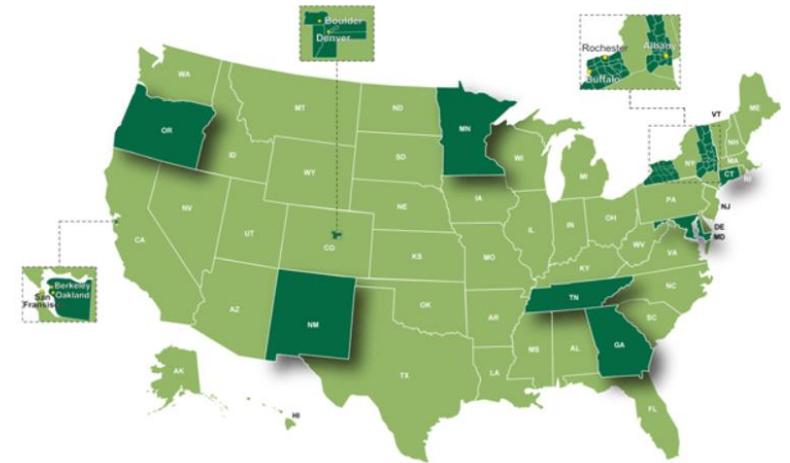


CIFOR Guideline

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***



CIFOR Guideline

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

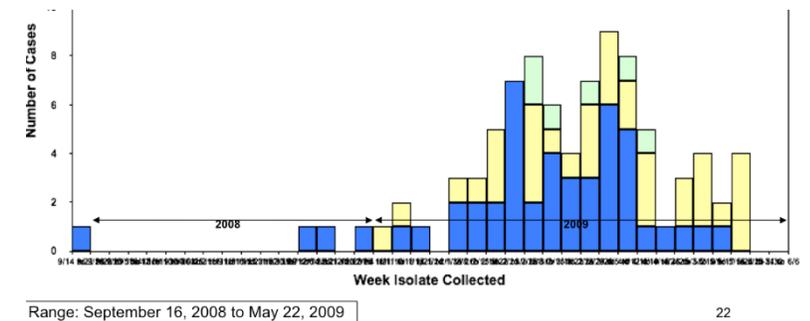
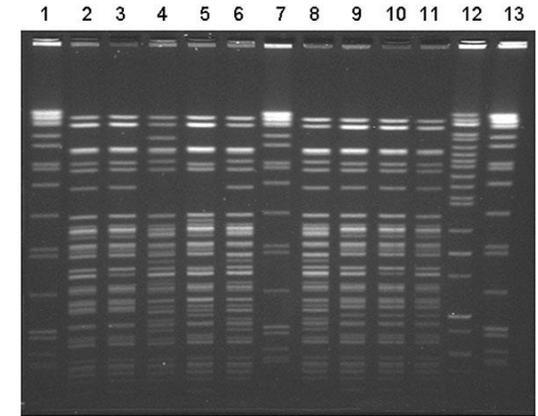
Behavioral Risk Factor Surveillance System

- 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*



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**



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**



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



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



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



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*)



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).



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?

CIFOR CHAPTER
Planning and Preparation

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**



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**)



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) [\[PUBH 6020 Health Communication\]](#)



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*



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



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 developed 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**

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



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

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*



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 a **cohort or case-control** study (epidemiological study)
 - Collecting food and patient **samples** [**Laboratory and epidemiology interaction**]



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



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



CIFOR CHAPTER
**Investigation of Clusters and
Outbreaks**

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)

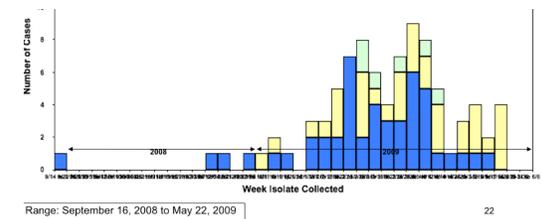


- **Outbreak investigation starts:**

- **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...



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...**



- **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...**

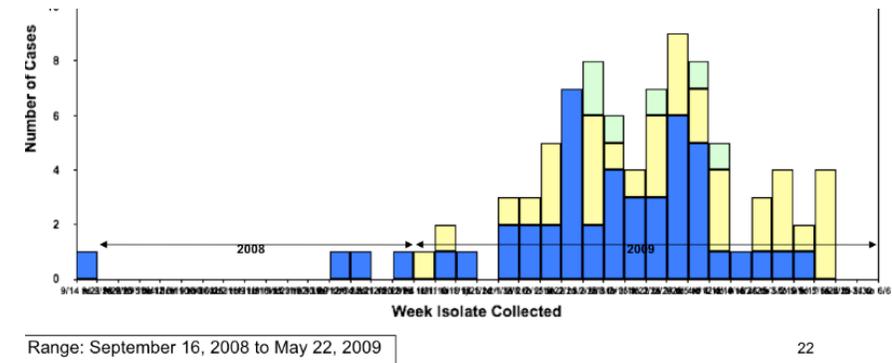


- **Compilation for Results and Reevaluation of Goals:**

- 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...**



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.**



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?

CIFOR CHAPTER Control Measures

Actions that Health Departments Could Enforce

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**)

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

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**



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.



CIFOR CHAPTER

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

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



CIFOR CHAPTER
**Legal Preparedness for Surveillance
and Control**

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*



CIFOR CHAPTER

Performance Measures for Foodborne Disease Programs

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



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?

Thank you

