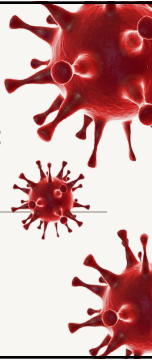
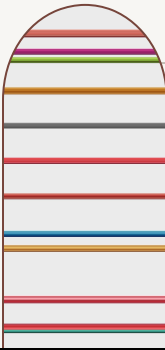


When Microbes Make the News: Exploring Recent U.S. Outbreaks

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- Outbreaks often first appear as individual patient specimens
- The clinical laboratory may recognize a pattern before the source is known
- Laboratory findings become part of a larger epidemiologic investigation

One result
can be a clue

Multiple connected
results can reveal an
outbreak

2

Objectives

1. Describe the organisms associated with several recent infectious disease outbreaks in the U.S.
2. Discuss the epidemiological factors that contributed to the emergence, transmission, and spread of recent outbreaks.
3. Evaluate the role of regulatory agencies in the surveillance, detection, and response to infectious disease outbreaks.

3

What Qualifies as an Outbreak?



- Disease occurrence above the expected level in a defined population, location, or period
- May involve a few linked cases or thousands of illnesses
- Clusters must be evaluated to determine whether cases are genuinely connected

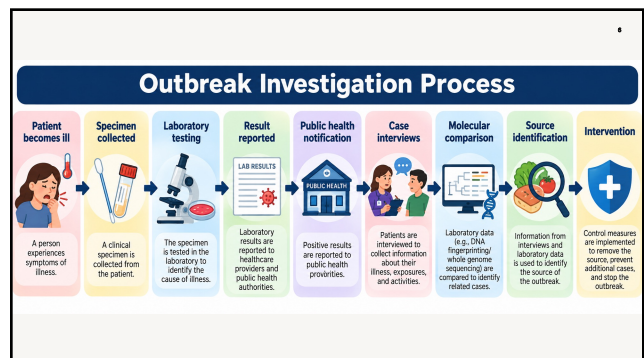
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General Terms



- **Cluster:** Aggregation of cases in place and time
- **Outbreak:** Cases above the expected level in a defined setting or population
- **Epidemic:** Broader increase affecting community or region
- **Pandemic:** Sustained disease spread across multiple countries or continents

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Why “Case Counts” Never Tell the Entire Story

- Some exposed individuals do not become symptomatic
- Mildly ill patients may not seek care
- Testing may not be ordered
- An organism may not be included in the initial testing algorithm
- Culture-independent tests may not produce isolates
- Reports may be delayed

Publicly reported cases represent a fraction of the true number of illnesses

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Outbreaks Require More Than A Pathogen

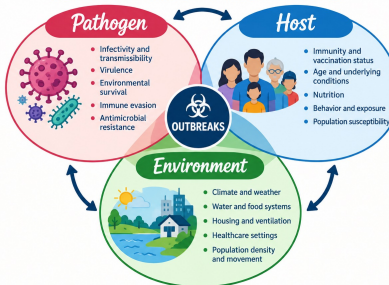
- Pathogen is introduced into susceptible population
- Pathogen reaches host through effective route of transmission
- Biological, environmental, or social conditions permit continued spread
- Prevention, surveillance, or control measures fail to interrupt transmission



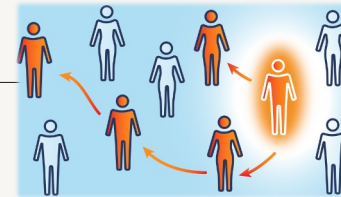
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Pathogen – Host – Environment Model

THE INTERPLAY THAT DRIVES INFECTIOUS DISEASE



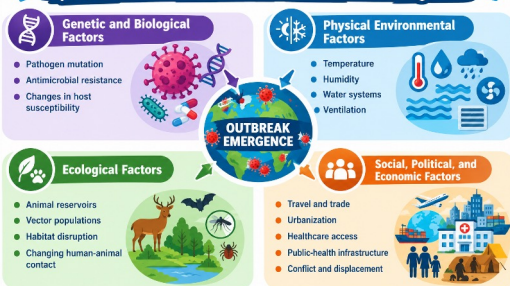
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A highly virulent organism is not necessarily highly transmissible. Likewise, infection does not always produce recognizable disease because some infections remain asymptomatic or subclinical

10

Four Domains that Drive Outbreak Emergence



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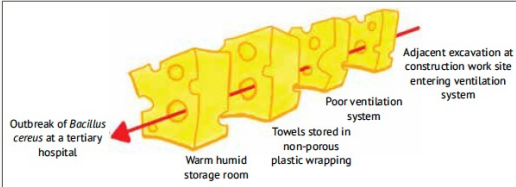
Routes of Transmission Create Different Outbreak Patterns

Route of transmission	Common setting/source	Factors affecting spread
Airborne or droplet	Healthcare facilities, schools, crowded settings	Ventilation, distance, humidity, population density
Foodborne	Production, processing, distribution, preparation	Storage, contamination level, cooking, distribution
Water-related	Drinking water, building systems, pools, cooling towers	Treatment, storage, distribution, temperature
Vector-borne	Mosquitoes, ticks, fleas, other vectors	Climate, ecology, travel, vector population
Bloodborne	Needles, transfusion, procedures, blood exposure	Sterilization, screening, sharps safety, risky behavior

Adapted from Sox, J., Moore, C., Guo, G., & Heymann, D. (2020). 2. What causes outbreaks? Infectious Disease Emergencies: Preparedness and Response.

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Bacillus cereus Outbreak Development



Soo, J., Moore, C., Gao, G., & Heymann, D. (2025). 2. What causes outbreaks? Infectious Disease Emergence: Preparedness and Response.

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Every Outbreak Factor has a Possible Intervention Point

Outbreak factor	Possible intervention	Outbreak factor	Possible intervention
Susceptible host population	Vaccination, prophylaxis, education	Inadequate testing	Improved algorithms and specimen collection
Food or water contamination	Processing controls, oversight, recall	Missing isolates	Reflex culture and specimen retention
Ineffective ventilation	Engineering and environmental controls	Delayed reporting	Electronic and urgent reporting pathways
Delayed recognition	Clinical alerts and staff education	Continued exposure	Contact tracing, source control, public advisories

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Clinical Lab's Role as an Outbreak Sentinel



- Correct specimen collection and transport
- Rapid organism detection
- Recognition of unusual results
- Preservation and submission of isolates or specimens
- Prompt reporting of notifiable pathogens
- Communication with infection control and public health

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Phenotypic Identification is Important

- Gram stain results
- Colonial morphology & growth requirements
- Proper identification – Biochemicals and/or MALDI-TOF
- Antimicrobial susceptibility studies
- Serogrouping or serotyping (if appropriate)



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Reporting

- Reportable organisms are established through state laws or regulations
- Labs may have organism-specific reporting deadlines
- Some conditions require isolate submission
- Follow institutional policy and health department instructions

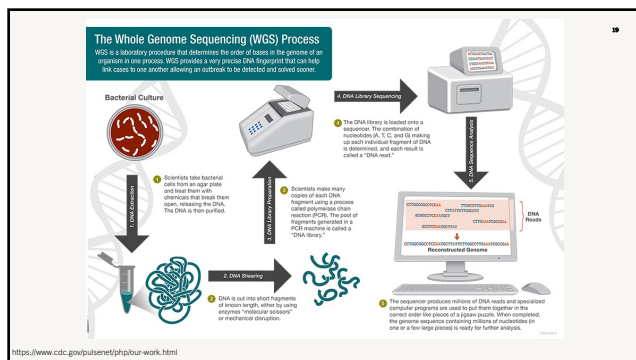


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Whole Genome Sequencing

- Compares the DNA sequence of isolates
- Helps identify closely related isolates
- May connect patients

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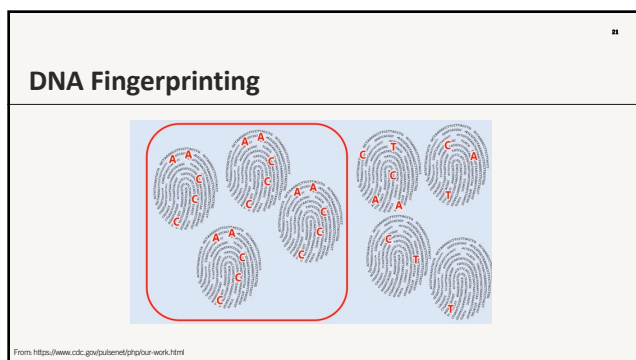


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PulseNet: Cluster Detection

- National molecular surveillance network
- Use WGS to piece together and identify DNA fingerprints of bacteria
- Compare bacterial isolates associated with foodborne illness
- Aids in detection of multistate clusters
- Helps identify cases that may not initially appear connected

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HEALTH ALERT
SALMONELLA OUTBREAK FORCES FOOD RECALLS

THOUSANDS OF AMERICANS IMPACTED BY NEW ILLNESS

Foodborne Outbreaks in the Headlines

22

Why Foodborne Outbreaks Dominate the News

- Broad distribution & complex supply chains
- High profile recalls
- Severe health risk and visible symptoms
- Political and policy debates

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Foodborne Investigation

Epidemiologic evidence	Laboratory evidence	Traceback evidence
Exposure histories	Organism identification	Product records
Illness clusters	WGS	Supplier information
Case-control comparisons	Food or environmental testing	Facility findings

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CDC Outbreak Notices

Contaminated Food	Germ	Year	Contaminated Food	Germ	Year
Raw Milk Cheese	E. coli O26	2026	Raw Dairy	E. coli O157:H7	2026
Breastfed Spinach	Salmonella Bovismorbificans	2026	Moringa Powder Capsules	Salmonella Newport	2026
Alfalfa Sprouts	E. coli O26:H11, O103:H25, and O168:H9 and Salmonella Agona	2026	Super Greens Supplement Powders	Salmonella Typhimurium	2026
Shell Eggs	Salmonella	2026	Raw Oysters	Salmonella Telegiovis	2025
Jalapenos	Salmonella	2026	Infant Formula	Clostridium botulinum	2025
Iceberg Lettuce	Cyclospora	2026	Moringa Leaf Powder	Salmonella Richmond	2025
Frozen Blueberries	E. coli O145	2026	Home Delivery Meals	Salmonella Enteritidis	2025
Powdered Infant Formula	Clostridium botulinum	2026	Eggs	Salmonella Enteritidis	2025
Requeson/Soft Ricotta Cheese	Listeria monocytogenes	2026	Frozen Sprouted Beans	Salmonella Anatum	2025
Moringa Capsules	Salmonella Typhimurium	2026	Prepared Pasta Meals	Listeria monocytogenes	2025

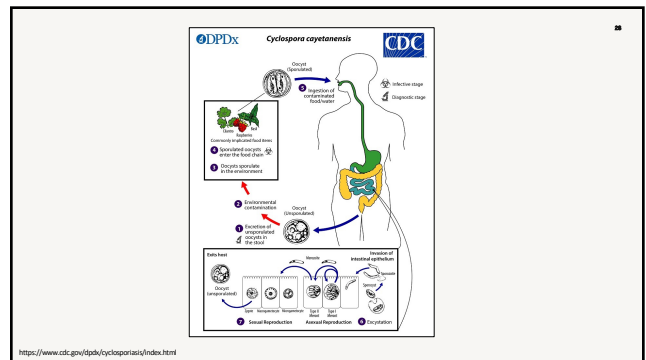
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2026 Spotlight: *Cyclospora cayentanensis*

- Protozoan parasite
- Causes cyclosporiasis
- Relapsing illness may occur
- U.S. cases often seasonal
- Frequently associated with fresh produce

- Symptoms:**
 - Watery diarrhea
 - Loss of appetite
 - Weight loss
 - Abdominal cramping and bloating
 - Flatulence
 - Nausea
 - Fatigue

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Cyclospora – Lab Identification

- Stool is primary specimen
- Modified acid-fast stain to visualize oocysts
- Oocyst demonstrate autofluorescence under UV light
- Concentration technique
- Molecular panels may include *Cyclospora*

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The 2026 *Cyclospora* Headline

As of September 11, 2026, CDC reported 12,883 laboratory-confirmed domestically acquired cases with symptom onset during the May 1 through August 31 season. The total included illnesses associated with the large iceberg-lettuce outbreak as well as infections not linked to that outbreak.

Number of Sick People

- 1 to 350
- 351 to 450
- 451 to 1,000
- 1,001 to 2,500
- 2,501 to 5,000
- 5,001 to 7,500
- 7,501 to 10,000

<https://www.cdc.gov/cyclosporiasis/outbreaks/07-26/locations.html>

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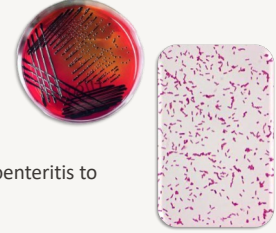
Factors Driving the *Cyclospora* Outbreak

- Broad distribution of a commonly consumed ingredient
- Fresh produce consumed raw
- Ingredient may be mixed into multiple menu items
- Long incubation period
- Difficulty recalling individual ingredients
- Product consumed or discarded before investigation
- Delayed diagnosis and reporting

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Another Foodborne Illness in the News: *Salmonella*

- Gram-negative bacillus
- Facultatively anaerobic
- H₂S (+), Non-lactose fermenter
- Numerous serotypes
- Clinical severity ranges from gastroenteritis to bacteremia to invasive disease



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Salmonella – Lab Identification

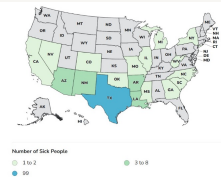
- Stool culture
- Identification by biochemicals or MALDI-TOF
- Susceptibility testing
- Isolate retention and submission
- Serotyping by public health lab
- WGS for cluster detection



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2026 *Salmonella* Outbreak – Shell Eggs

- Organism: *Salmonella* Enteritidis
- 134 cases in 18 states
- 34 hospitalizations
- Illness onset 11/21/26 to 8/12/26
- Midwest Poultry Services, L.P. out of Texas
- Outbreak declared over on 9/3/26



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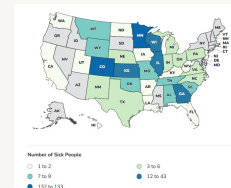
Evidence That Supported the Egg Investigation

Laboratory evidence	Epidemiologic evidence	Traceback evidence
 Clinical isolation WGS relatedness PulseNet cluster detection	 Patient interviews 85% patients reported egg consumption	 Distribution review Identification of producer Product recall

35

2026 *Salmonella* Outbreak – Jalapeños

- Organism: *Salmonella* Javiana
- 488 cases in 34 states
- 65 hospitalizations
- Illness onset 6/16/26 to 8/26/26
- Traced to jalapeño peppers from Mexico that supplies to Coast Citrus Distributors
- Outbreak declared over on 10/2/26



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2026 Salmonella Outbreak – Broccoli

- Organism: *Salmonella* Bovismorbificans
- 32 cases in 6 states
- 3 hospitalizations
- Outbreak announced 9/3/26
- Linked to a specific seed lot number
- Ongoing investigation



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Most current outbreak – Alfalfa sprouts

- Organisms: *E. coli* and *Salmonella*
- 3 people infected with both organisms
- 76 cases in 16 states
- 6 hospitalizations
- Recall by Everything Sprouts, LLC
- Ongoing investigation



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The Challenges with Produce-associated Outbreaks

- Produce often consumed raw
- Contamination can occur at multiple points
- Ingredients may come from several suppliers
- Product passes quickly through the supply chain
- Patients may not recognize or remember ingredients
- Restaurant meals contain multiple exposures



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2026 STEC Outbreak - Raw milk cheese

- STEC → Shiga toxin-producing *Escherichia coli*
 - *E. coli* O157:H7 or EHEC
- As of 9/25/26
 - 13 cases in 9 states
 - 8 hospitalized
 - 3 developed HUS
- 100% of people interviewed ate Sierra Nevada Cheese Company's Graziers raw milk cheese



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Other 2026 STEC Outbreaks

- Frozen organic blueberries supplied by Frutas y Hortalizas del Sur
 - Variety of brands recalled including Great Value Berry Blend
 - 17 cases, 6 hospitalizations, 2 states
- Raw Farm raw cheddar cheese
 - 9 cases, 3 hospitalizations, 1 HUS, 3 states



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2024: McDonald's in the News

- Yellow onions from Taylor Farms
- 104 cases, 14 states
- 34 hospitalizations, 4 HUS, 1 death
- 81 patients interviewed: 99% ate at McDonald's
 - 84% ate menu item with onions



42



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2024-2026: *Listeria* Outbreaks

- *Listeria monocytogenes*
 - Persist in food-processing environments
 - Contaminant many foods
- Infection is rare, but serious
- Grow in temps from 29°F to 113°F
 - Multiplies slowly in refrigerator
 - Killed by high heat (165°F)

Highest risk:

- Pregnant women
- Newborns
- Adults over age 65
- Immunocompromised

44

2025-2026: *Listeria* Outbreaks

- Soft cheese (Clover Hill Dairy)
 - 15 cases, 1 death
- Prepared pasta meals (Nate's Fine Foods, Inc.)
 - 28 cases, 7 deaths
- Ready-to-eat foods (Fresh & Ready Foods LLC)
 - 10 cases, 1 death
- Supplement shakes (Lyons Magnus LLC)
 - 42 cases, 14 deaths

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PRESS RELEASE

Blue Bell Creameries Ordered To Pay \$17.25 Million In Criminal Penalties In Connection With 2015 *Listeria* Contamination

<https://www.justice.gov/archives/opa/pr/blue-bell-creameries-ordered-pay-1725-million-criminal-penalties-connection-2015-listeria>

46

2022 *Cronobacter* – powdered infant formula

- Organism: *Cronobacter sakazakii*
 - Ubiquitous in nature
 - Dry environments
- 4 cases, 2 deaths
- Clinical isolates did not genetically match facility isolates at Abbott Nutrition

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Scientific Uncertainty

- Exposure history may identify a product of concern
- Environmental findings may justify regulatory action
- Facility contamination does not automatically prove source of individual infection
- Limited isolate availability can restrict genomic comparisons
- Public-health intervention may occur before all uncertainties are resolved

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Respiratory and Environmentally Acquired Outbreaks

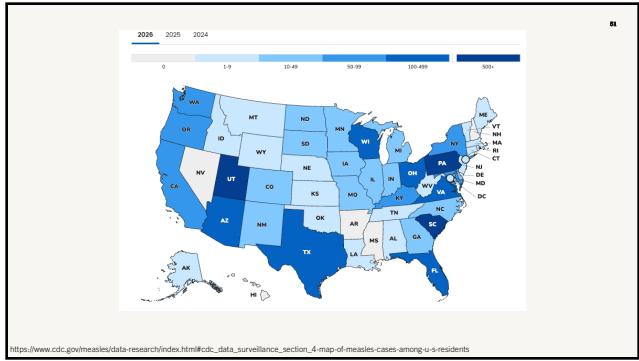
- Measles
- COVID-19
- Legionnaires' Disease

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Measles Returns to the Headlines

- Highly contagious airborne infection
- Outbreaks may follow importation into under-vaccinated communities
- Early symptoms may resemble other respiratory illnesses
- Drives transmission:
 - Delayed recognition/diagnosis
 - Vaccination gaps
 - Travel

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Measles Testing & Lab Safety

- Contact public health if measles is suspected
- Respiratory specimens may be collected for RT-PCR
- Urine may be collected
- Antibody testing is available
- Patient isolation should not wait for confirmation

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2 Legionnaires' disease cases prompt investigation at Staten Island apartment complex

Confirmed Legionnaires' disease cases at the Bronx Apartments on Staten Island have prompted an investigation.

5 days ago

NYC legionnaires disease: Air Force veteran, 88, dies in Upper East Side outbreak; family blames cooling tower

An 88-year-old man has died after battling Legionnaires' disease in New York City's Upper East Side outbreak.

Jul 20, 2026

Cooling towers at Yankee Stadium test positive for Legionnaires' in new cluster

The New York City Health Department has ordered 10 cooling towers in the South Bronx to be cleaned and disinfected after preliminary testing...

1 month ago

NYC Health officials order the cleaning of 10 cooling towers

The New York City Department of Health is taking new action against a deadly Legionnaires' disease cluster in the Bronx.

1 month ago

Legionnaires' disease outbreak kills one and infects others in the South Bronx

The disease is a form of pneumonia caused by Legionella bacteria, which can grow in water and spread through mist produced by cooling...

5th person dies from Legionnaires' disease in New York City: Health officials

A fifth person has died in New York City amid an ongoing cluster of Legionnaires' disease on the city's Upper East Side neighborhood, according...

Jul 21, 2026

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Legionnaire's Disease Hits the News

- *Legionella pneumophila*
- Fastidious, aerobic, Gram-negative bacilli
- Growth in water systems
- Infections follows inhalation of contaminated aerosols or aspiration of contaminated water
 - Cooling towers can disperse contaminated mist over a geographic area

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2026 South Bronx Cluster

- Investigation focused on area cooling towers
- July news: 90-94 cases in Manhattan's Upper East Side; 11 deaths
 - 77 cooling towers tested positive
- September (Yew York City Health):
 - Cluster in South Bronx
 - 10 cooling towers tested PCR (+) for Legionella
 - 7 tested culture (+)
 - 23 confirmed cases; 2 deaths



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How COVID-19 Changed Laboratory Practice

- Expansion of molecular testing capacity & genomic sequencing
- Greater reliance on decentralized testing
- Increased public familiarity with lab terminology
- Incomplete surveillance from unreported home testing
- Increased communication among clinical labs, public health, administrators, and the public
- Greater attention to testing access and turnaround time

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Public Health & Regulatory Response



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Who Does What During an Outbreak?

Clinical laboratory	Infection Control	Local health departments	State health departments
Public health laboratories	CDC	FDA	USDA-FSIS

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Major Surveillance and Response Networks



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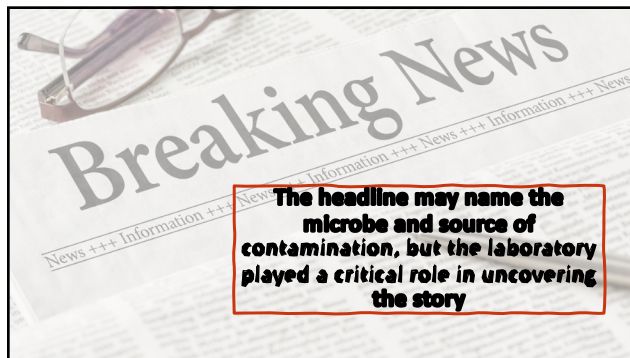
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Sometimes the Source can be Difficult to Prove

- Positive patient result establishes infection, not food source
- Negative food test does not necessarily exclude the product
- Organism may be unevenly distributed
- Product may no longer be available

Epidemiologic and traceback evidence may be especially important

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