

# **Anatomy of Multistate Foodborne Outbreaks -- Focus on Produce-Associated Outbreaks**

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National Center for Emerging Zoonotic and Infectious Diseases  
U.S. Centers for Disease Control and Prevention**

**February 28, 2011**



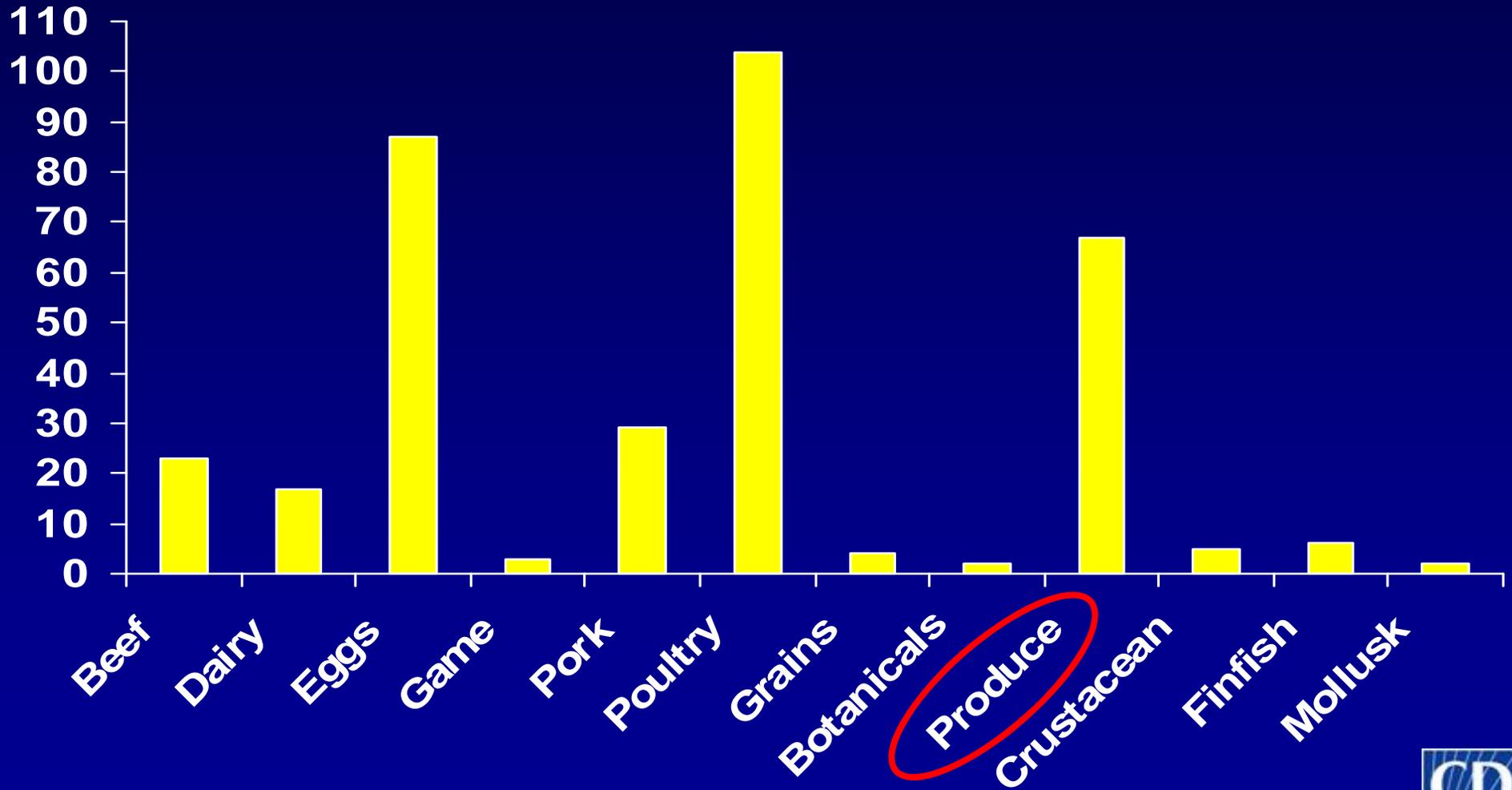
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# Burden of Foodborne Illness

- **Estimated 48 million illnesses annually**
  - 1 out of 6 Americans get a foodborne illness
  - 128,000 hospitalizations
  - 3,000 deaths
- **Certain populations are more susceptible**
  - Children, older persons, immune-compromised
- **Typically causes diarrhea and fever**
  - Can cause life-threatening complications
- **Many sources**
  - Meat, poultry, produce, animal contact

# Number of Salmonellosis Outbreaks by Food Commodity Category of Single Implicated Food, 1998-2005



# Some Recent Large US Multi-State Outbreaks of Foodborne Infections 2006-2010 (n=28)

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- 2006 - *E. coli* O157 and bagged spinach
- 2006 - *E. coli* O157 and shredded lettuce (restaurant chain A)
- 2006 - *E. coli* O157 and shredded lettuce (restaurant chain B)
- 2006 - Botulism and commercial pasteurized carrot juice
- 2006 - *Salmonella* and fresh tomatoes
- 2007 - *E. coli* O157 and frozen pizza
- 2007 - *Salmonella* and peanut butter
- 2007 - *Salmonella* and a vegetarian snack food
- 2007 - *Salmonella* and dry dog food
- 2007 - *Salmonella* and microwaveable pot pies
- 2007 - *Salmonella* and dry puffed breakfast cereal
- 2007 - *E. coli* O157 and ground beef
- 2007 - Botulism and canned chili sauce
- 2008 - *Salmonella* and cantaloupe
- 2008 - *E. coli* O157 and ground beef
- 2008 - *Salmonella* and raw produce (peppers)
- 2009 - *Salmonella* and peanut butter containing foods
- 2009 - *Salmonella* and imported white and black pepper
- 2009 - *Salmonella* and alfalfa sprouts
- 2009 - *E. coli* O157 and prepackaged cookie dough
- 2009 - Multidrug resistant *Salmonella* and ground beef (x2)
- 2009 - *E. coli* O157 and blade tenderized steaks
- 2009 - *Salmonella* and salami made with contaminated pepper
- 2010 - *E. coli* O145 and romaine lettuce
- 2010 - *Salmonella* and alfalfa sprouts
- 2010 - *Salmonella* and frozen meals
- 2010 - *Salmonella* and shell eggs
- 2010 - *Salmonella* and alfalfa sprouts



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**“Produce”  
Outbreaks (n=11)**



# Challenge: A Broad Range of Foods Can Be Contaminated

10 new food vehicles identified in multistate outbreaks since 2006:

- bagged spinach
- carrot juice
- peanut butter
- broccoli powder on a snack food
- dog food
- pot pies
- canned chili sauce
- hot peppers
- white pepper
- raw cookie dough



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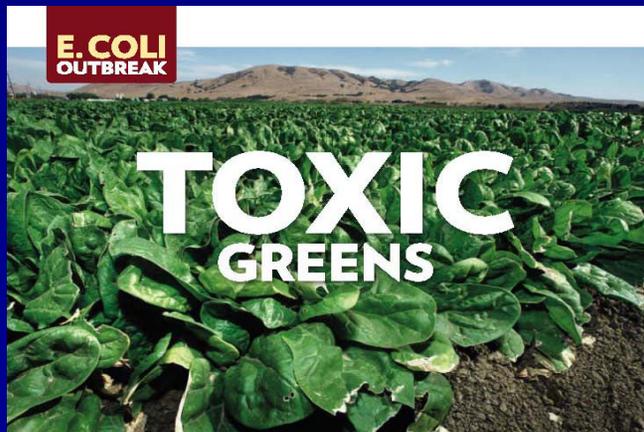


# Produce-associated outbreaks on the rise

- Proportion of all foodborne outbreaks associated with produce increasing over last 30 years
  - From < 1% to 6% of all outbreaks
  - From < 1% to 12% of outbreak associated cases
- Some produce items predominantly associated with particular pathogen
  - *Salmonella*: Almonds, melons, sprouts, tomatoes
  - *E. coli* O157:H7: leafy greens



# Contaminated Food



# What is a foodborne outbreak?

- When 2 or more people get the same illness from the same contaminated food or drink
- Illnesses not part of a recognized outbreak are “sporadic”

# Who investigates foodborne outbreaks?

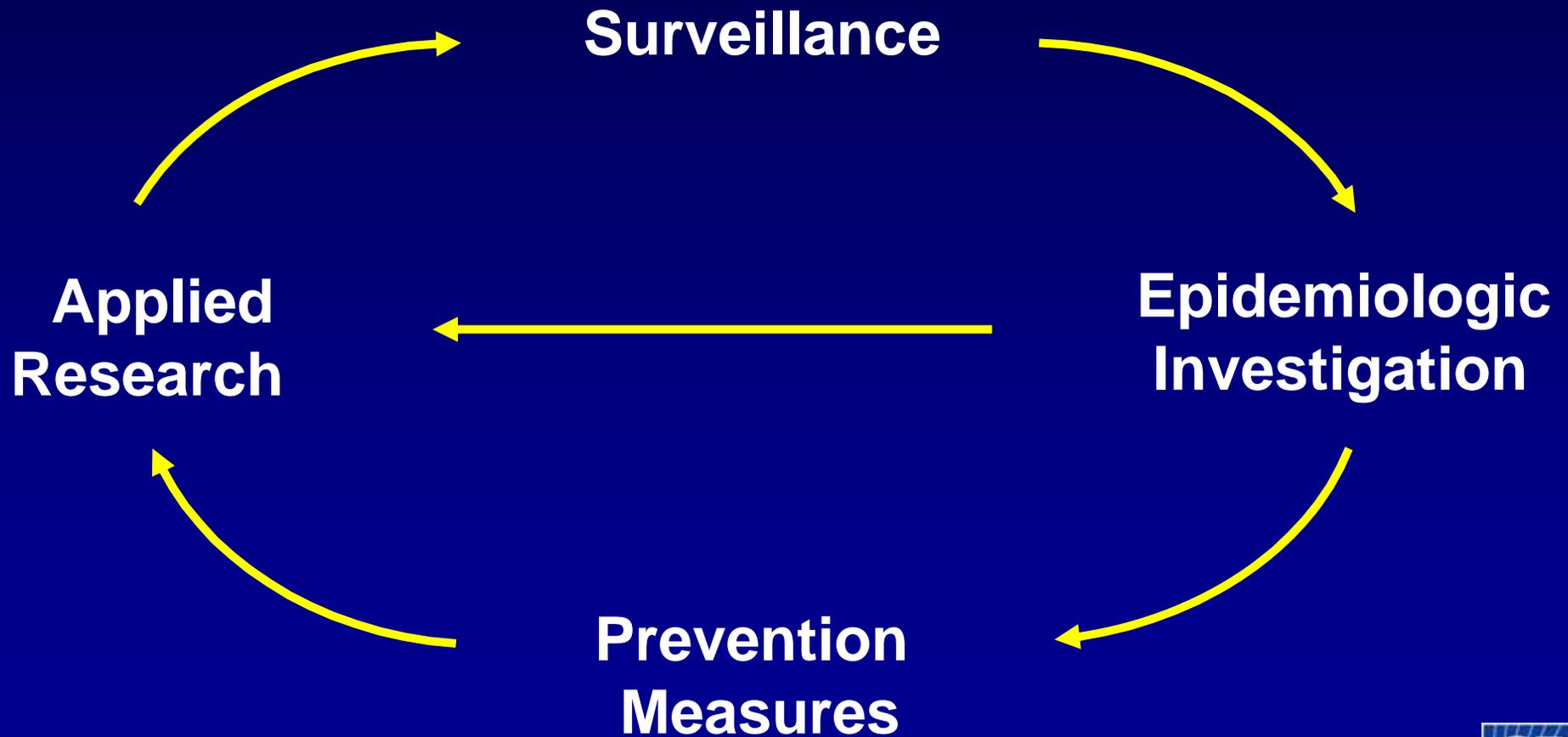
- **Multidisciplinary teams**
  - Epidemiologists
  - Microbiologists
  - Environmental health specialists or sanitarians
  - Regulatory officials and inspectors
- **Other professionals added as investigation proceeds**
  - Food industry can play important role

# What agencies are involved?

- **State and local health departments**
- **State regulatory agencies**
- **CDC**
  - Non-regulatory, public health agency
  - Focus on problem identification and source implication
  - Usually lead multistate outbreak investigations
- **FDA and USDA-FSIS**
  - Regulatory agencies
  - Focus on risk management and source assessment
  - Trace foods to origin, test foods, assess food safety measures in restaurants and food processing facilities, lead farm investigations, announce food recalls



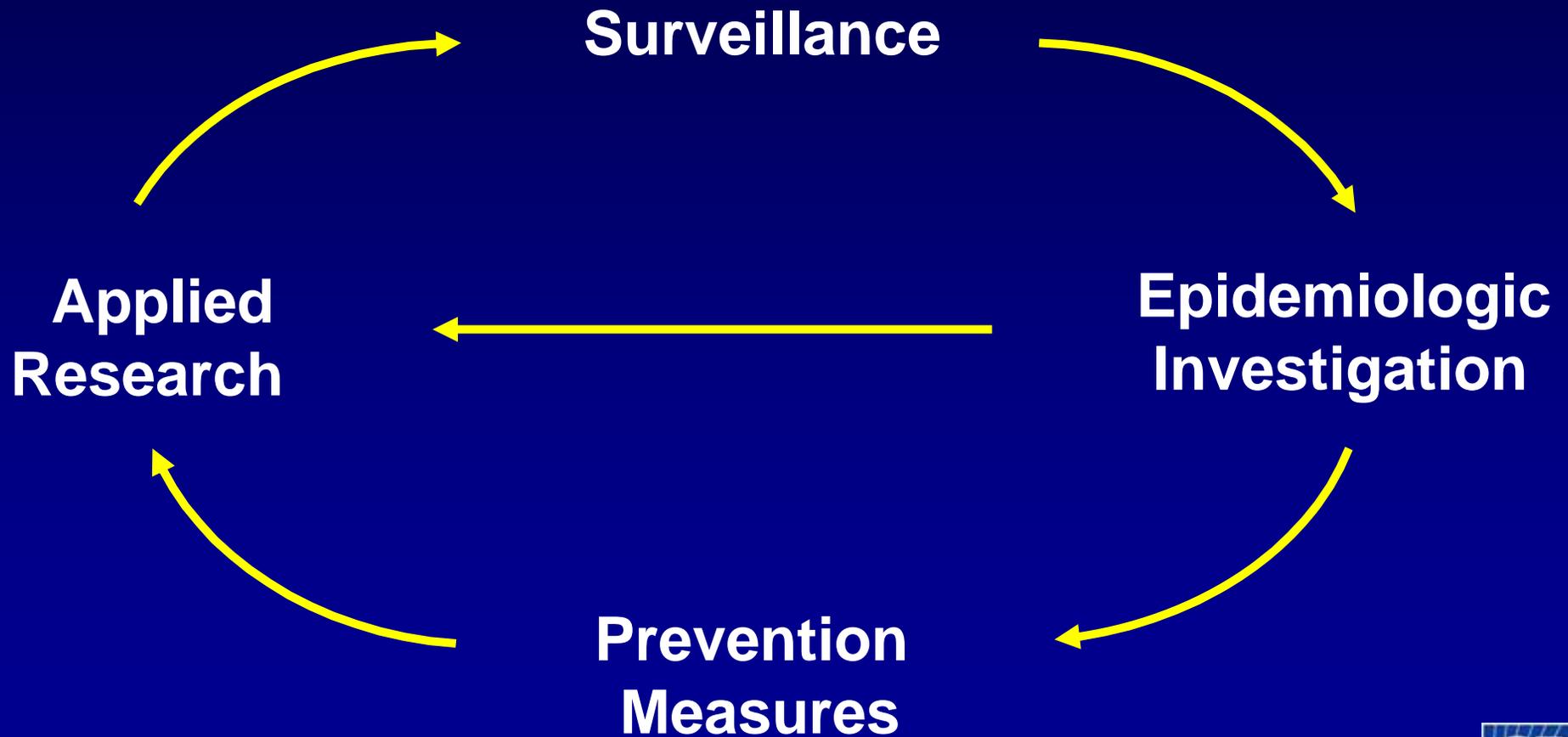
# Cycle of Foodborne Outbreak Control & Prevention



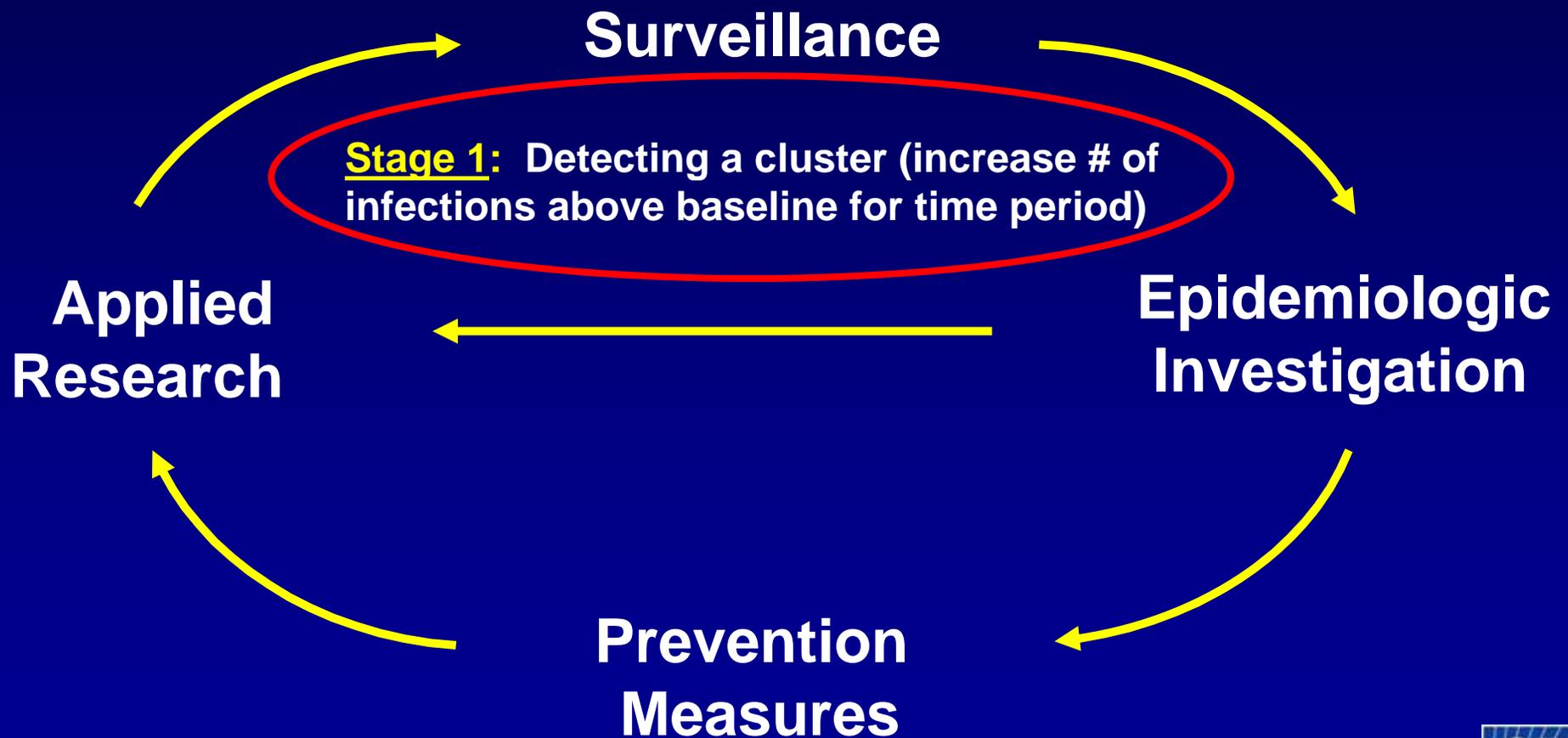
# Foodborne Disease Outbreak Investigations

- **Goals of investigations**
  - Immediate control of outbreak and prevention of illnesses
  - Provide opportunities to identify gaps in food safety systems
- **Outbreak epidemiology changing**
  - Globalization, centralization, industrialization
  - Number of possible outbreaks detected has grown substantially
- **Effective investigations key to reducing burden of foodborne disease**
  - Identify food vehicles and factors which lead to outbreaks

# Cycle of Foodborne Outbreak Control & Prevention



# Cycle of Foodborne Outbreak Control & Prevention: Stages of an Investigation

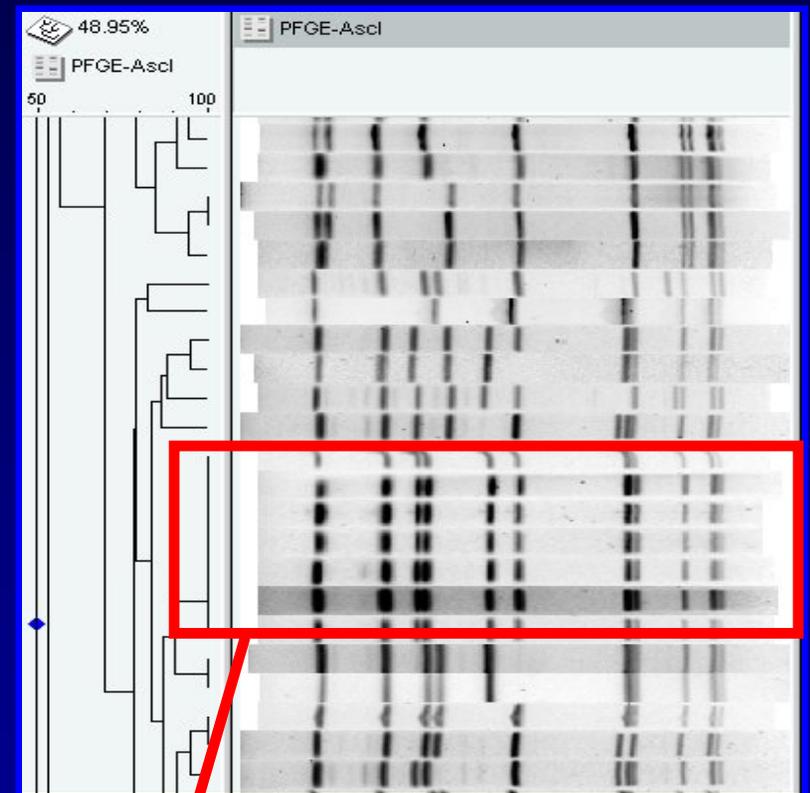


# National Surveillance for Bacterial Foodborne Infections

- Reports to CDC of suspected outbreaks by state and local health departments
- Laboratory-based surveillance of clinical isolates
  - Serotype results
  - PulseNet

# What is PulseNet?

- National molecular subtyping network for foodborne disease surveillance
- Network of >75 public health & regulatory laboratories
- Current method is pulsed-field gel electrophoresis (PFGE)
  - Creates DNA “fingerprints”
- Share DNA “fingerprints” electronically
- DNA “fingerprints” kept in dynamic database at CDC



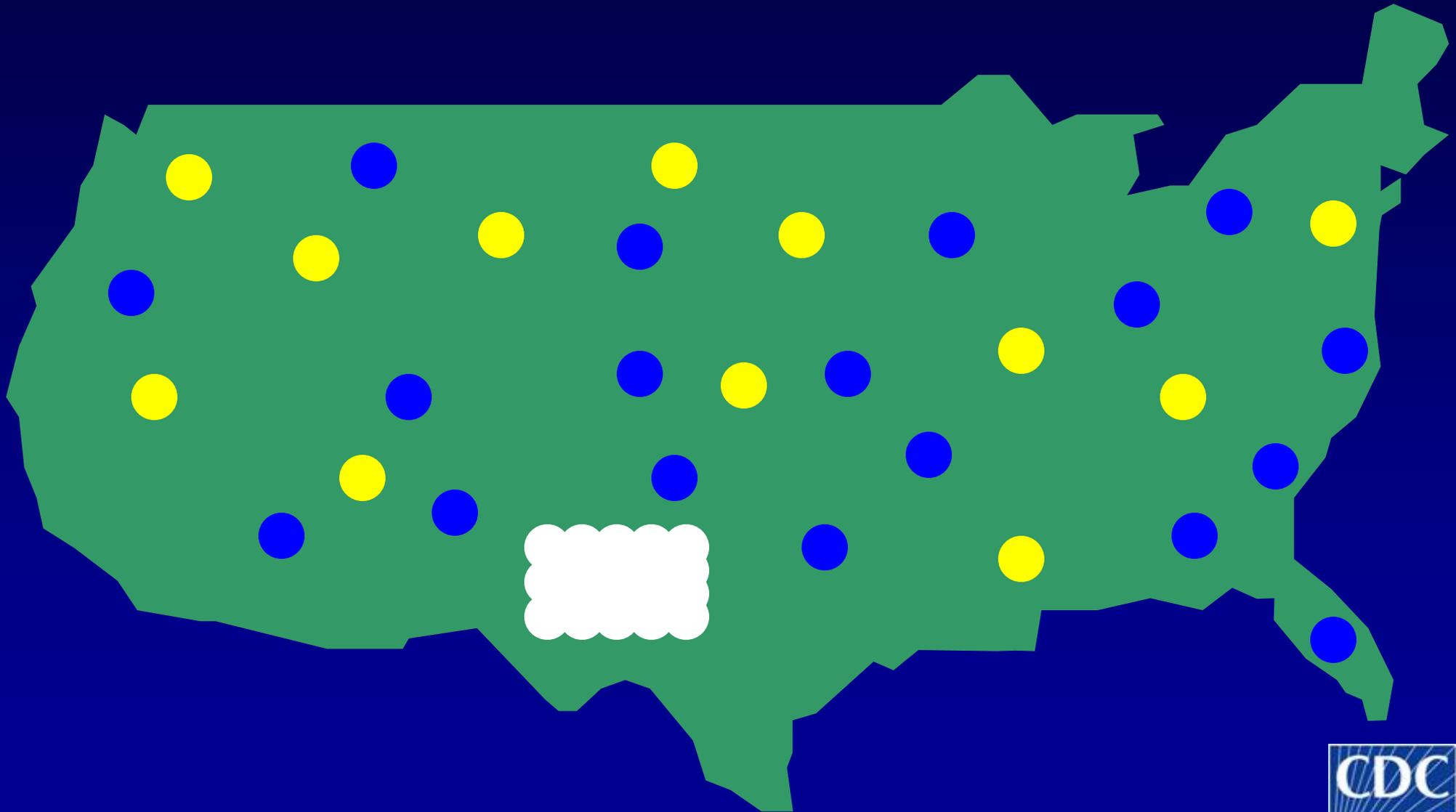
Cluster of indistinguishable patterns as “outbreak strain”

# Outbreak Epidemiology Changes

## Past

- Food distribution localized
- Local outbreaks, large numbers ill
- Identified by affected group
- Improper food handling in single restaurant or event
- Local control measures

# Cluster Identification in the Past



# Outbreak Epidemiology Changes

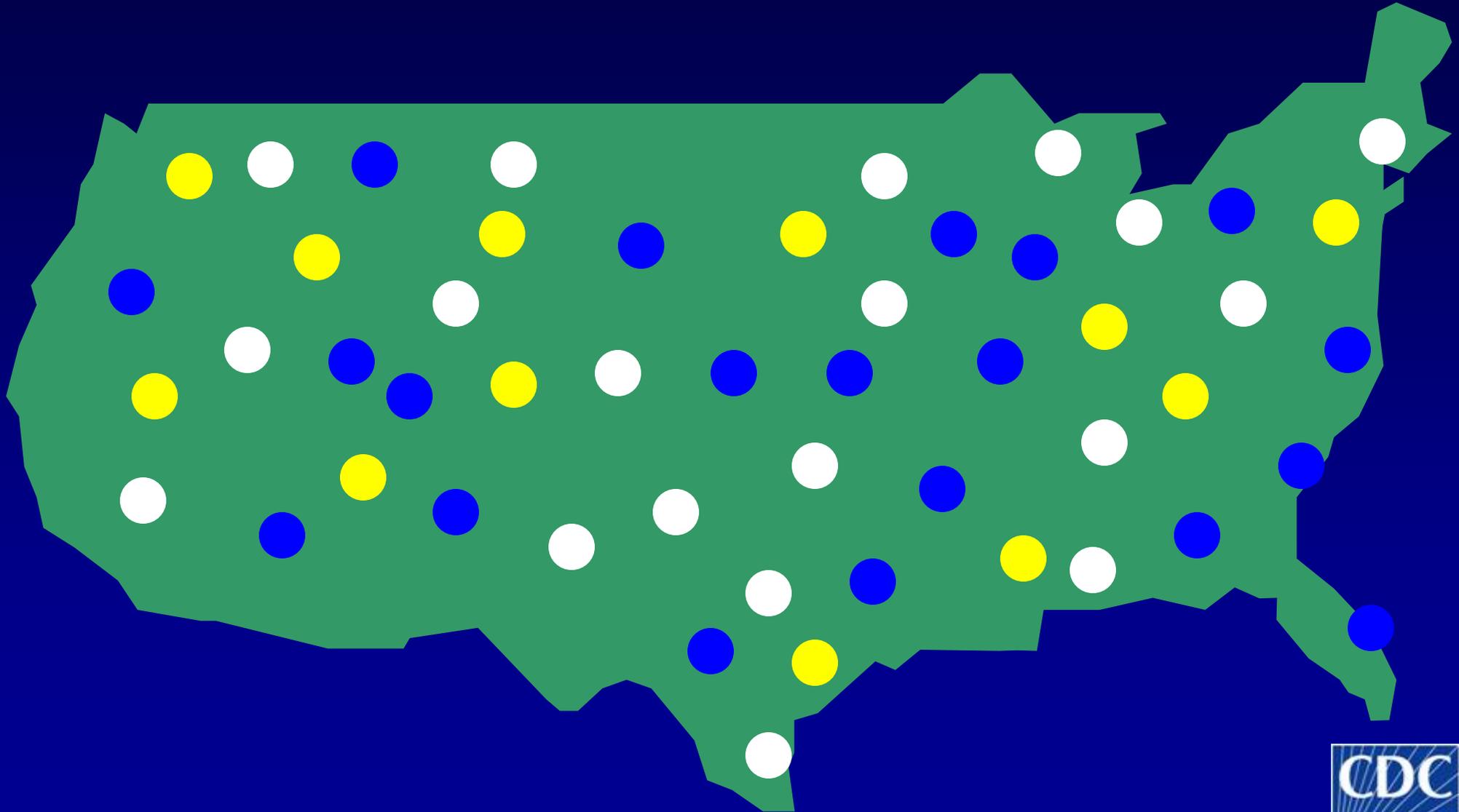
## Past

- Food distribution localized
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## Present

- Food products widely distributed
- Many affected communities with few cases
  - PulseNet detects and connects dispersed cases
    - Communication, coordination critical
- Industrial contamination
  - Large-scale control measures

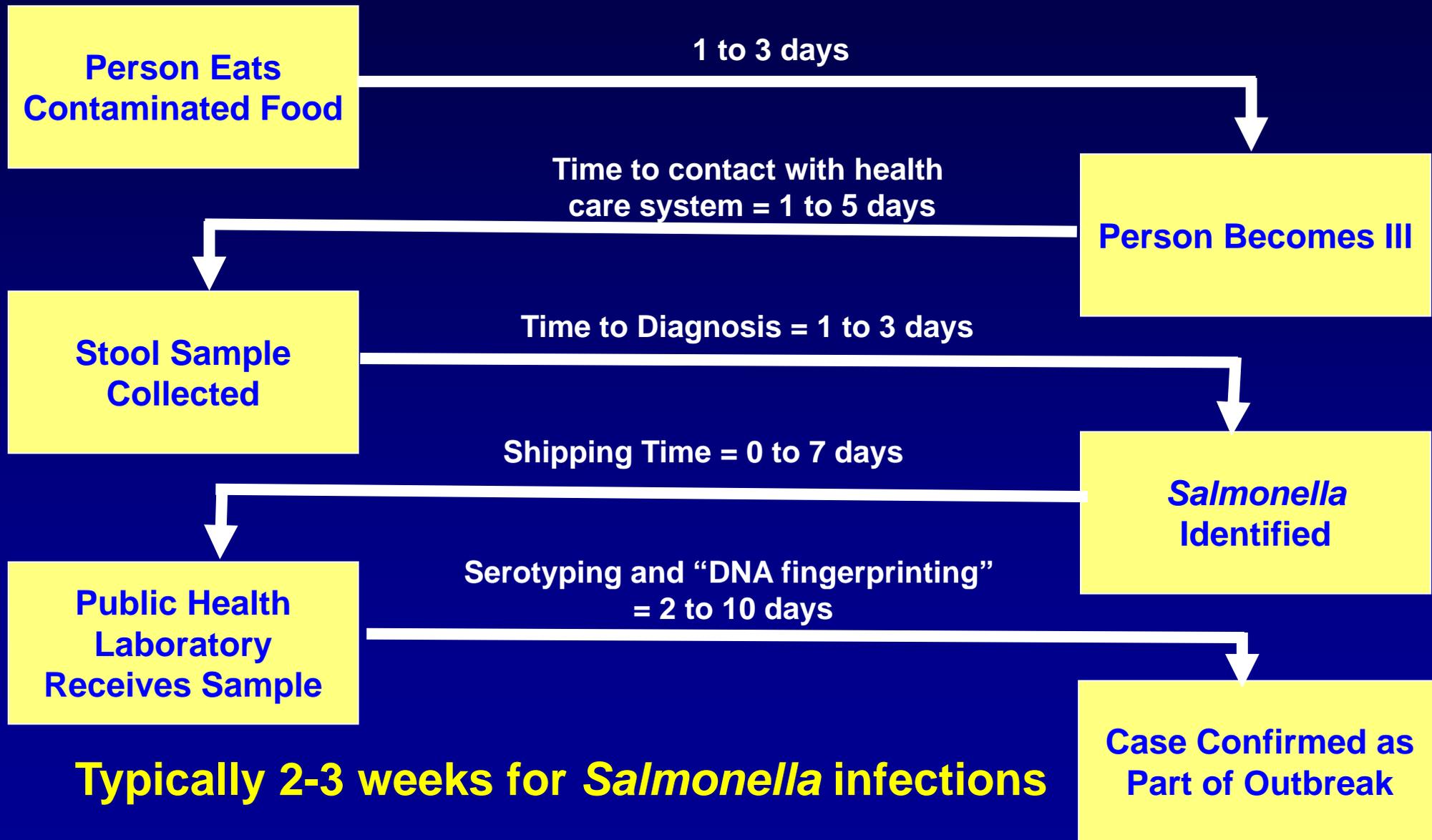
# Cluster Identification Today



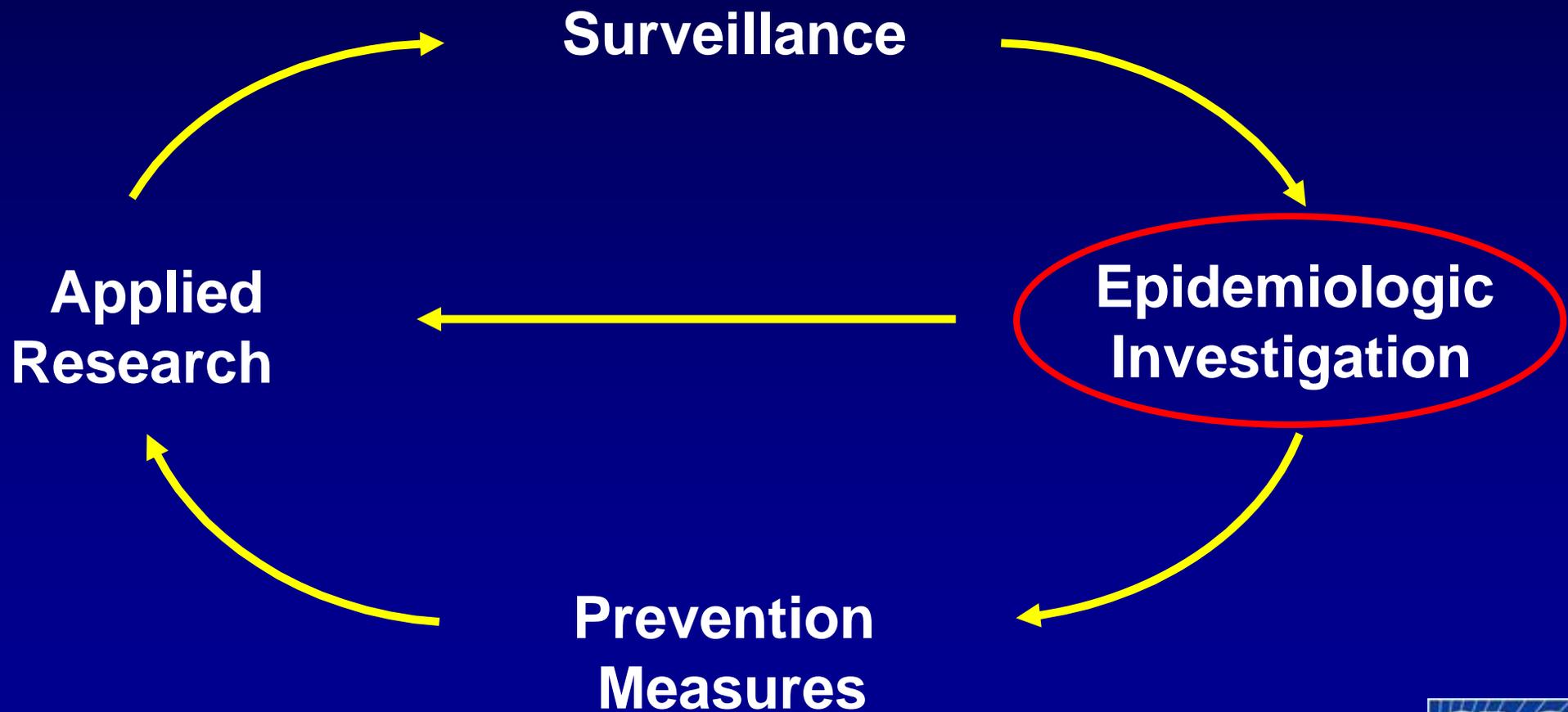
# Burden of Foodborne Diseases



# Timeline for Reporting *Salmonella* Cases



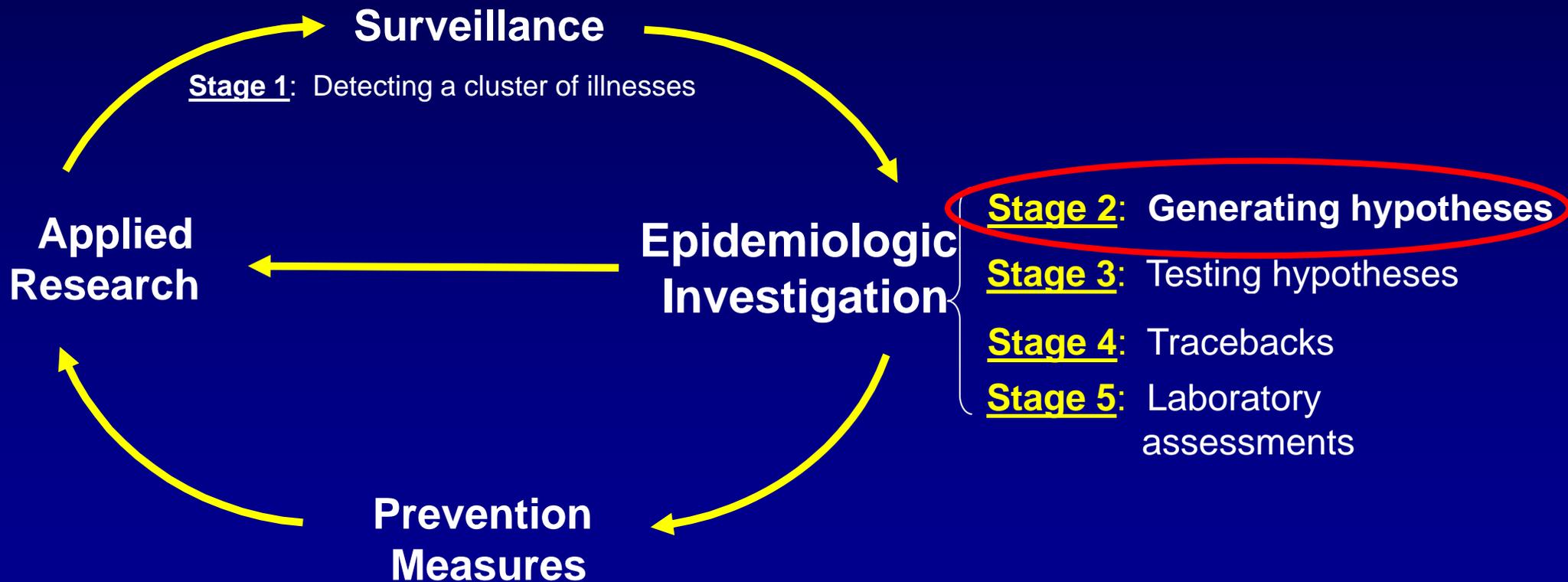
# Cycle of Foodborne Outbreak Control & Prevention



# **ORPB's Outbreak Response Team**

- **Supports national network of epidemiologists and other public health officials who investigate outbreaks of foodborne, waterborne, and other enteric illnesses in the United States**
- **Collaboration between CDC and**
  - **State and local health departments, USDA, FDA**
- **Close partnership with PulseNet**
- **Helps ensure**
  - **Rapid, coordinated detection & response to multi-state enteric disease outbreaks**
  - **Promotes comprehensive outbreak surveillance**

# Cycle of Foodborne Outbreak Control & Prevention: Stages of an Investigation

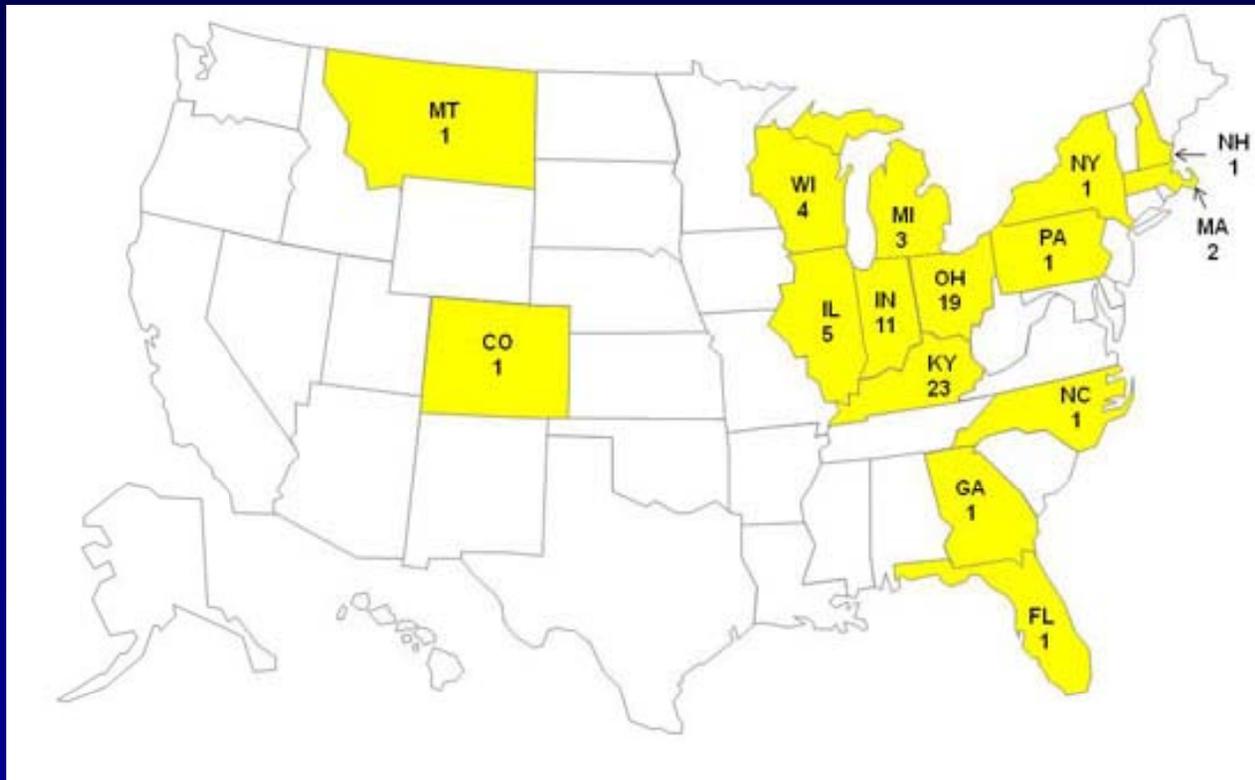


# Generating Hypothesis

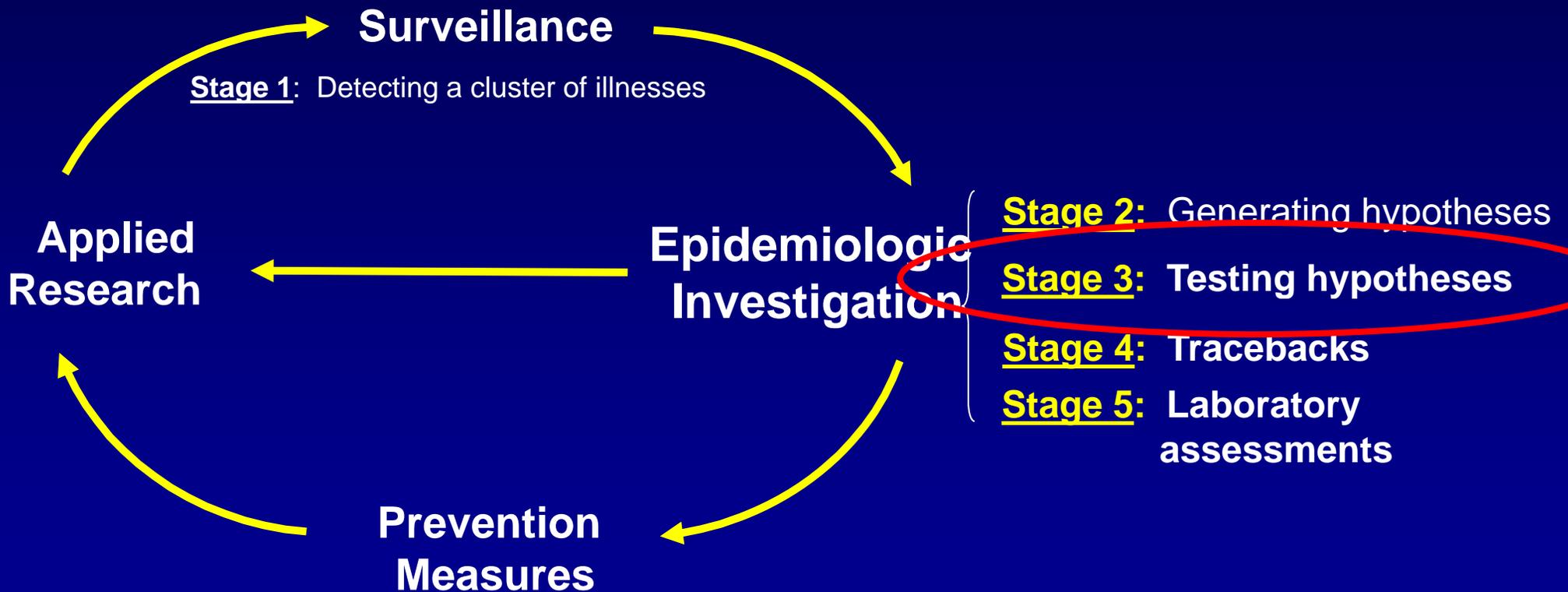
- **Strategies include**
  - Interviews with structured questionnaire
  - Intensive open-ended interviews
  - In-depth interview with people in their homes, including refrigerator, pantry
- **Some combination of all**
- **Attempt to standardize interviews**
- **Review interview data for common exposures**
  - Food items, restaurants, stores
  - Collect shopper card numbers

# Looking for early clues...

- Age distribution
- Gender
- Geography



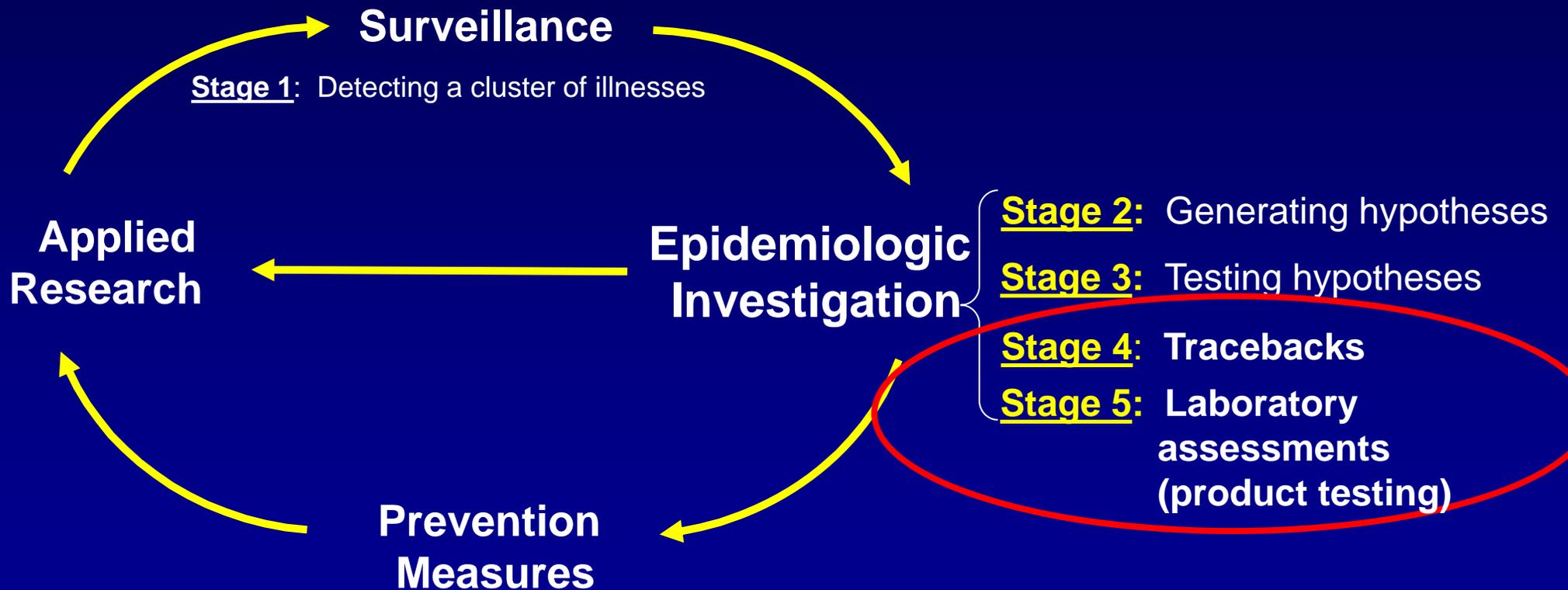
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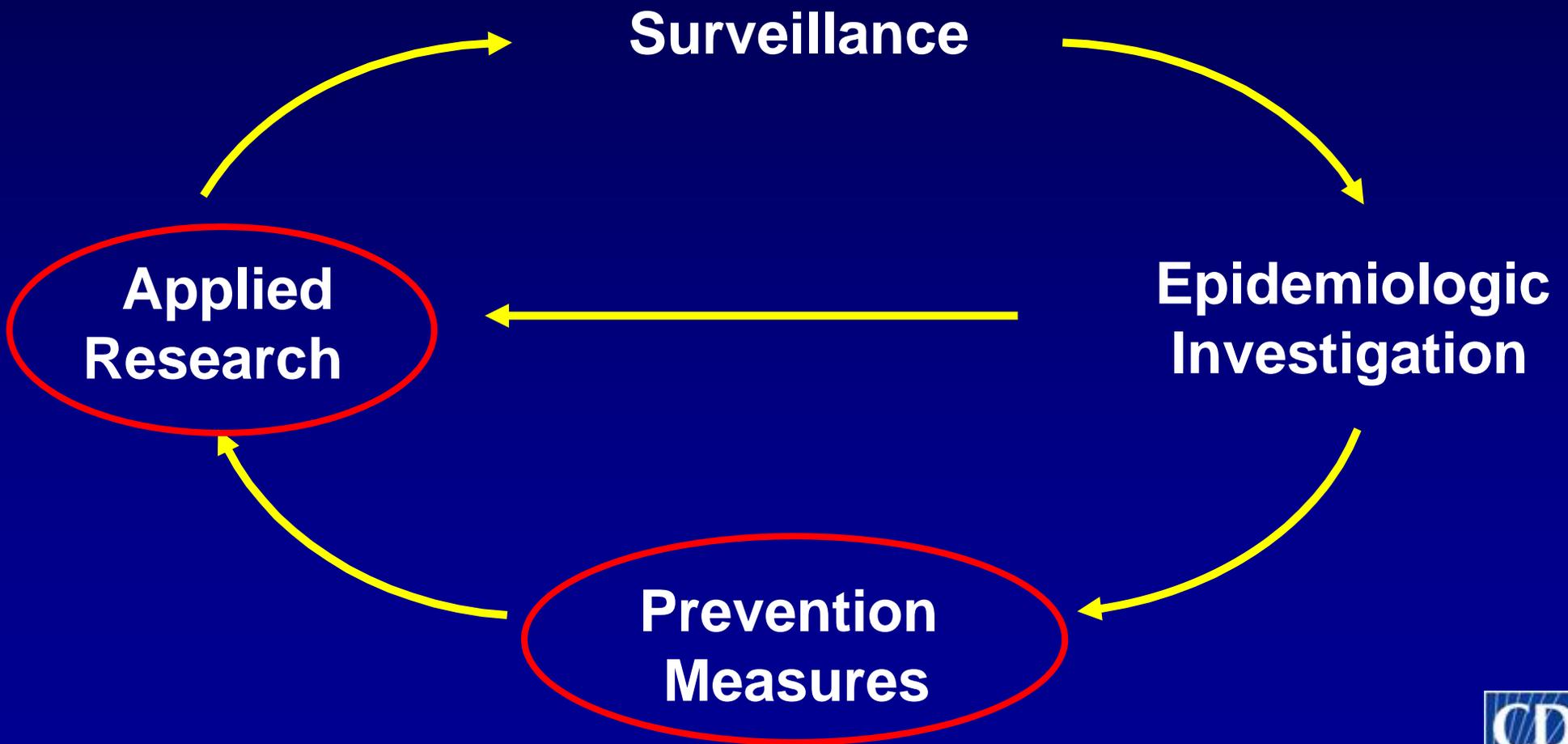
# Case-Control Study

- Study that compares two groups of people:
  - Cases: persons diagnosed with illness
  - Controls: similar group of people without disease
- Study medical and lifestyle histories to determine what risk factors may be associated with illness
- Look for statistical and epidemiologic association with food or other exposure

# Cycle of Foodborne Outbreak Control & Prevention: Stages of an Investigation



# Cycle of Foodborne Outbreak Control & Prevention



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**CDC** Department of Health and Human Services  
Centers for Disease Control and Prevention

Search:

**Salmonella**

Salmonella > Salmonella Outbreak Investigations > Investigation Update: Outbreak of *Salmonella* Typhimurium Infections, 2008–2009

**Investigation Update: Outbreak of *Salmonella* Typhimurium Infections, 2008–2009**

Update for April 29, 2009 (FINAL web update)

**Today's Highlights**

- The numbers of new cases have declined substantially since the peak in December, but illnesses are still being reported among people who ate the recalled brands of peanut butter crackers after the recall. The outbreak is expected to continue at a low level for the next several months since consumers unaware that they have recalled products in their home continue to consume these products, many of which have a long shelf-life. Consumers should avoid eating recalled products. ([See consumer recommendations below](#)).
- Case count is 714 in 46 states with latest confirmed, most recent reported illness beginning on March 31, 2009.
- Major national brands of jarred peanut butter found in grocery stores are NOT on the Peanut Corporation of America (PCA) recall list.
- Consumers may use [FDA's online database](#)\* to see if foods are on the recall list. Those without Internet access may call 1-800-CDC-INFO (available 24 hours a day, seven days a week) for product recall information.
- [Timeline of Infections: Multistate Outbreak of \*Salmonella\* Infections Associated with Peanut Butter and Peanut Butter-Containing Products --- United States, 2008--2009](#) (PDF, 149KB)

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Contact CDC  
  
800-CDC-INFO (232-4636)

**Eat Safely!**  
**Check the Peanut Containing Product Recall List**

[www.fda.gov](http://www.fda.gov) or  
1-800-CDC-INFO




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**MMWR**

Early Release  
January 29, 2009 / 58 (Early Release);1-6

**Multistate Outbreak of *Salmonella* Infections Associated with Peanut Butter and Peanut Butter--Containing Products --- United States, 2008--2009**

On November 25, 2008, an epidemiologic assessment began of a growing cluster of *Salmonella* serotype Typhimurium isolates that shared the same pulsed-field gel electrophoresis (PFGE) pattern in PulseNet.\* As of January 28, 2009, 529 persons from 43 states ([Figure 1](#)) and one person from Canada had been reported infected with the outbreak strain. This report is an interim summary of results from ongoing epidemiologic studies and recall and control activities by CDC, the Food and Drug Administration (FDA), and state and local public health agencies. Confirmed, reported onset of illness dates have ranged from September 1, 2008, to January 16, 2009. A total of 116 patients were reported hospitalized, and the infection might have contributed to eight deaths. Sequential case-control studies have indicated significant associations between illness and consumption of any peanut butter (matched odds ratio [mOR] = 2.53), and specific brands of prepackaged peanut butter crackers (mOR = 12.25), but no association with national brand jarred peanut butter sold in grocery stores. Epidemiologic and laboratory findings indicate that peanut butter and peanut paste produced at one plant are the source of the outbreak. These products also are ingredients in many foods produced and distributed by other companies. This outbreak highlights the complexities of "ingredient-driven" outbreaks and the importance of rapid outbreak detection and investigation. Consumers are advised to discard and not eat products that have been recalled ([Box](#)).

  
**CDC-INFO**

  
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# Preventing Future Outbreaks

- **Outbreak investigations play key role in preventing foodborne diseases**
  - New pathogens, new vehicles, gaps in food safety system
- **Offer opportunities for different authorities and professionals to work together**
- **Raise questions that need research to better understand, prevent, reduce contamination**

# Preventing Future Outbreaks

- **Outbreak investigations and additional research lead to**
  - **Better industry practices**
  - **Regulations and enforcement by regulatory agencies**
  - **Consumer understanding**
- **All should reduce number of foodborne illnesses**



# Gaps in Multistate Outbreak Investigation Methods

- **Need to decrease time to get subtyping results, enhance detection**
- **Limited resources for health departments to conduct interviews**
- **Individual illnesses may appear “sporadic”**
  - **Patients not routinely interviewed**
- **Cluster and outbreak investigations**
  - **Delays in**
    - **Patient interviews due to other priorities**
    - **Lag time from illness to interview, affects recall of foods eaten**
    - **Re-interviewing to collect product information**
  - **Initial questionnaires often not standardized between states**
  - **Lack of a standard database for states to enter interview data**
    - **No electronic transmission of exposure information to CDC**
  - **Rely on hundreds of volunteers to conduct multistate case-control studies**

# Lessons Learned from Past Outbreak Investigations

- **Continually assess how we can better pinpoint cause and source of outbreaks more quickly**
  - Apply lessons to future investigations
- **Powerful role of investigating clusters in restaurants or events during multistate outbreaks**
  - Aided by menus and recipes
  - Makes tracking specific ingredients easier
- **Importance of considering potential “stealth” vehicles that may not be initially reported or considered by ill people**

# Lessons Learned from Past Outbreak Investigations

- Importance of working with industry as soon as possible to correct and identify potential sources of contamination
- Importance of rapid traceback that converges on a single product, producer or manufacturer

# Improving Outbreak Response

- **Improvements in laboratory infrastructure**
  - Make it easier to identify foodborne disease outbreaks
  - Increased number and scope of outbreaks
- **Enhancing capacity and implementing standard approaches at state, local, and federal levels**
  - Make outbreak detection, investigation, and control even faster
- **Accelerated ability to identify cases and interview people faster**
  - Tracebacks to start sooner once food is suspected



# OutbreakNet Sentinel Sites (OSS)

- Facilitate collection of exposure data to more rapidly develop hypotheses and implicate vehicles
- Facilitate collection of specific product information for traceback investigations
- More rapidly collate and analyze epidemiologic and product information from multiple states
- Routinely join epidemiologic and PulseNet data
- Improve quality and speed of product data provided to regulatory agencies for traceback
- Share information in real time with regulatory agencies

**Decrease time to identify how and where  
contamination occurred**



# Final Thoughts

- **Produce is increasingly recognized as a source of foodborne outbreaks, causing more and larger outbreaks**
- **We are continually working to improve foodborne outbreak investigation and response**
- **Food industry can play an important role in outbreak investigations**
- **New science and detection methods for foodborne disease outbreaks are driving our understanding of risks and consequences**
- **Increasing consumer awareness is driving the demand for food safety improvements**

# Public Health Impact

***Salmonella* Outbreak Fuels Food-Safety Efforts**

**THE WALL STREET JOURNAL.**

Feb. 7, 2009

**Peanut Case Shows Holes in Safety Net**

**The New York Times**

Feb. 8, 2009

**Obama Seeks to Improve Food Safety**

**The Washington Post**

Mar. 14, 2009

**The White House Blog Weekly Address:  
Reversing a Troubling Trend in Food Safety**

Mar. 14, 2009





**Thank you**



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