

Role of PulseNet in Laboratory Based Foodborne Disease Surveillance

*Seventh Dubai International Food Safety Conference &
IAFP's First Middle East Symposium on Food Safety
21-23 February 2012*

Peter Gerner-Smidt, MD, PhD
Enteric Diseases Laboratory Branch

National Center for Emerging and Zoonotic Infectious Diseases

Division of Foodborne, Waterborne and Environmental Disease



What is PulseNet?

- *A network national and international laboratory networks dedicated to molecular surveillance of bacterial foodborne infections*
- *Perform standardized molecular subtyping of foodborne disease-causing bacteria by Pulsed-Field Gel Electrophoresis (PFGE) [and other DNA “fingerprinting” methods]*
 - *High discriminatory subtyping methods enable you to identify bacterial isolates that are related to each other with a high degree of confidence*
- *Share DNA “fingerprints” electronically*
- *In United States:*
 - *> 80 State & local health departments, Federal agencies (USDA, FDA)*
 - *Dynamic database of DNA “fingerprints” at CDC*
 - *Database available on-demand to participants*

PulseNet Protocols

- *Salmonella*
- *Shigella*
- *E. coli* O157
- Non-O157 STEC (VTEC)
- *Listeria monocytogenes*
- *Vibrio cholerae*
- *Vibrio parahaemolyticus*
- *Campylobacter jejuni/coli*
- *Clostridium perfringens*
- *Clostridium botulinum*
- *Yersinia pestis*

What is PulseNet?

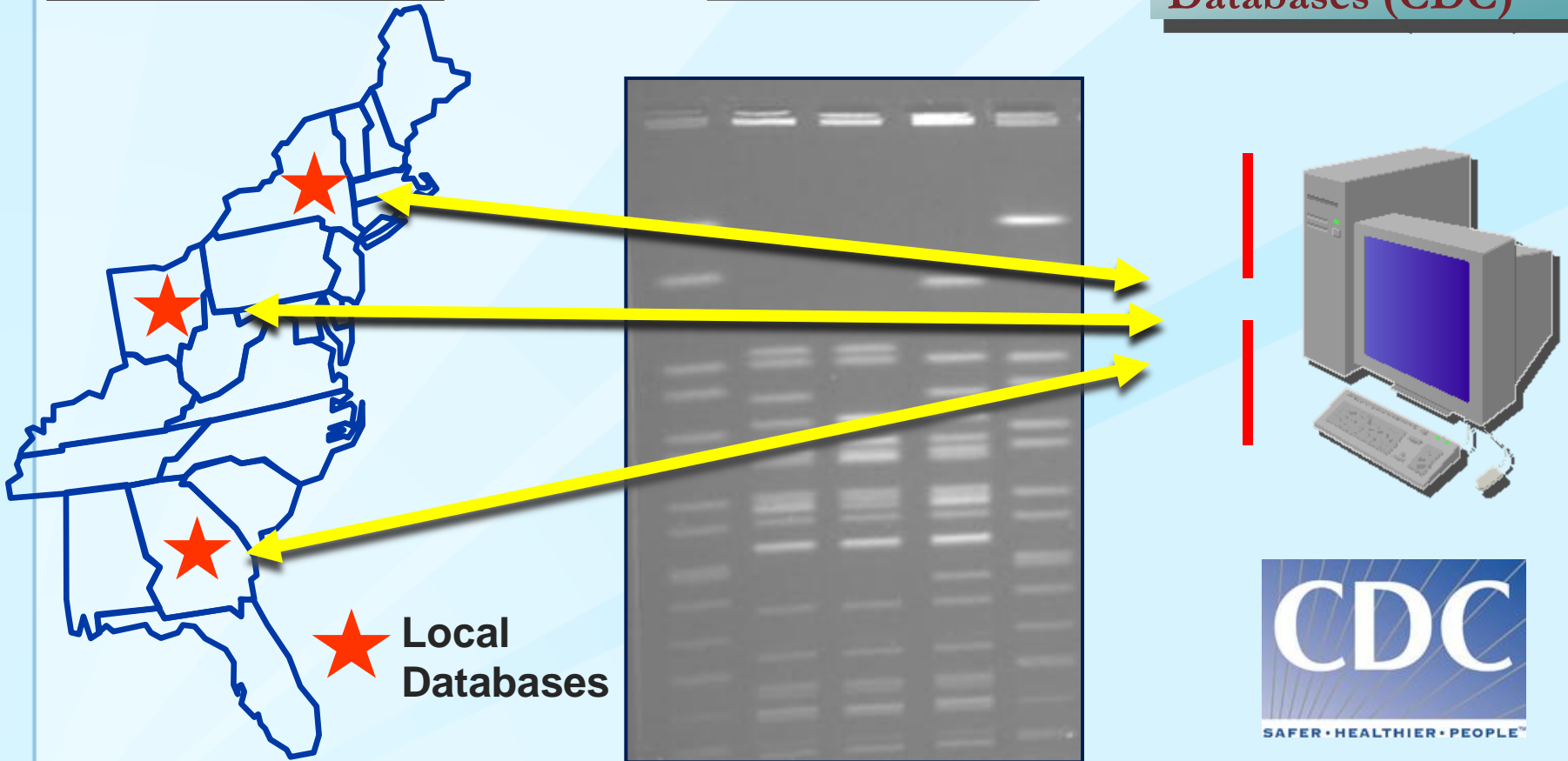
- *A network national and international laboratory networks dedicated to molecular surveillance of bacterial foodborne infections*
- *Perform standardized molecular subtyping of foodborne disease-causing bacteria by Pulsed-Field Gel Electrophoresis (PFGE) [and other DNA “fingerprinting” methods]*
 - *High discriminatory subtyping methods enable you to identify bacterial isolates that are related to each other with a high degree of confidence*
- *Share DNA “fingerprints” electronically*

PulseNet Laboratory Network

Participating Labs

PFGE Patterns

PulseNet National
Databases (CDC)



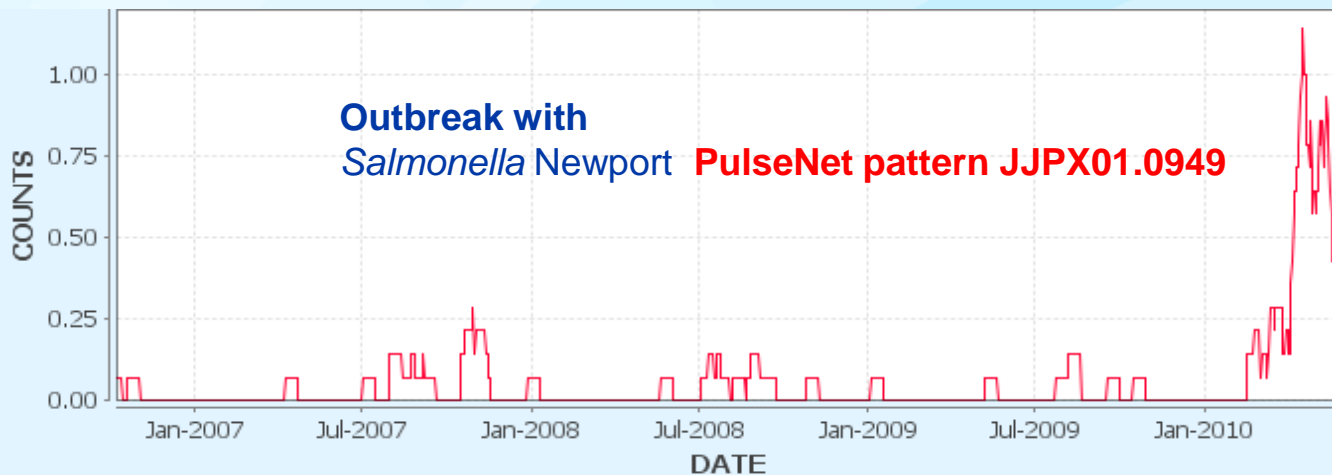
What is PulseNet?

- *A network national and international laboratory networks dedicated to molecular surveillance of bacterial foodborne infections*
- *Perform standardized molecular subtyping of foodborne disease-causing bacteria by Pulsed-Field Gel Electrophoresis (PFGE) [and other DNA “fingerprinting” methods]*
 - *High discriminatory subtyping methods enable you to identify bacterial isolates that are related to each other with a high degree of confidence*
- *Share DNA “fingerprints” electronically*
- *In United States:*
 - *> 80 State & local health departments, Federal agencies (USDA, FDA)*
 - *Dynamic database of DNA “fingerprints” at CDC*
 - *Database available on-demand to participants*

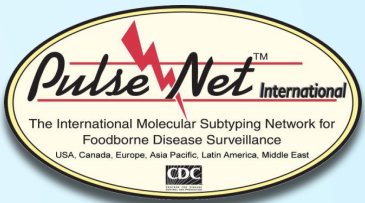
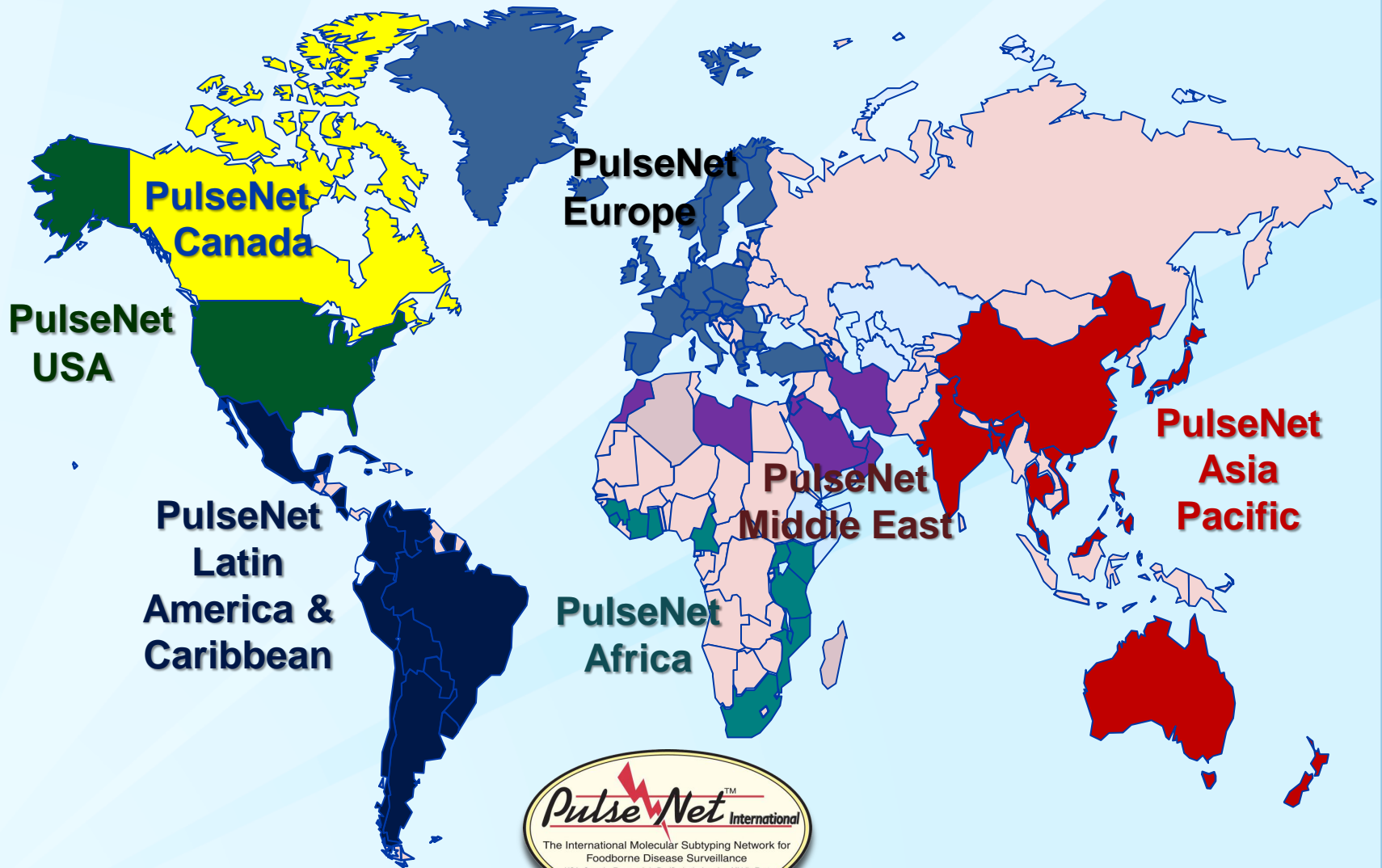
Tranquility or Trouble? What does PulseNet think?



PulseNet Verdict: *Trouble!*



83 member countries from 7 national and regional PulseNet networks



Role of PulseNet

- *Detect foodborne disease case clusters by PFGE*
 - *Facilitate early identification of common source outbreaks*
- *Assist epidemiologists in investigating outbreaks*
 - *Separate outbreak-associated cases from other sporadic cases*
 - *Assist in rapidly identifying the source of outbreaks*
 - *Act as a rapid and effective means of communication between public health laboratories*

Integrated Food Safety Surveillance From “Farm to Fork”

Responsibility of:
Veterinary, National & Local Food Safety
Authorities

Public Health
Authorities



Farm



**Transport
Processing
Distribution**



Preparation



Healthcare

It is what makes people sick that is the focus of food safety measures in the production chain

Detecting and Fixing Problems in the Food Supply



**Outbreak
investigation**

Limit ongoing illness

Detecting and Fixing Problems in the Food Supply



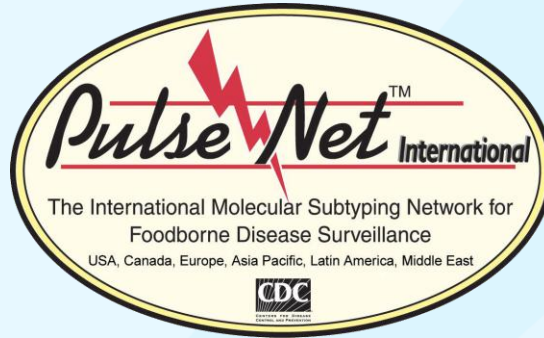
Outbreak
investigation

Limit ongoing illness

fix underlying problems

Outbreak Investigations and the role of PulseNet

	Pathogen-based	Event-based	Individual complaints	Syndromic
<i>Speed of outbreak detection</i>	<i>Relatively slow</i>	<i>Fast</i>	<i>Fast</i>	<i>Potentially fast</i>
<i># cases needed for detection</i>	<i>Very low</i>	<i>Low</i>	<i>Intermediate</i>	<i>High</i>
<i>Sensitivity for low-level widespread events</i>	<i>Very high</i>	<i>Intermediate</i>	<i>Low</i>	<i>Low</i>
<i>Signal to noise ratio</i>	<i>High (Very high with PulseNet)</i>	<i>High</i>	<i>Low to moderate</i>	<i>Low</i>
<i>Types of outbreaks detected</i>	<i>Limited to diseases under surveillance</i>	<i>Any</i>	<i>Any</i>	<i>Limited to syndromes under surveillance</i>
<i>Role of subtyping - PulseNet</i>	<i>Detection, Delineation, Culture confirmation</i>	<i>Delineation, Culture confirmation</i>	<i>Delineation, Culture confirmation</i>	<i>Delineation, Culture confirmation</i>

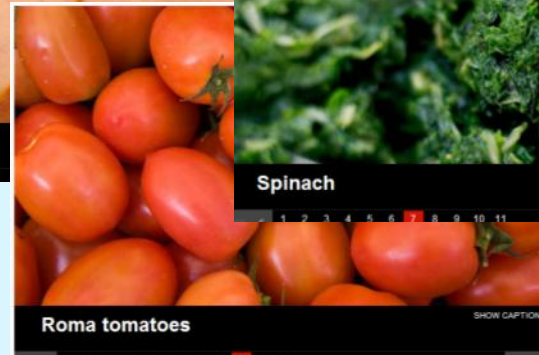
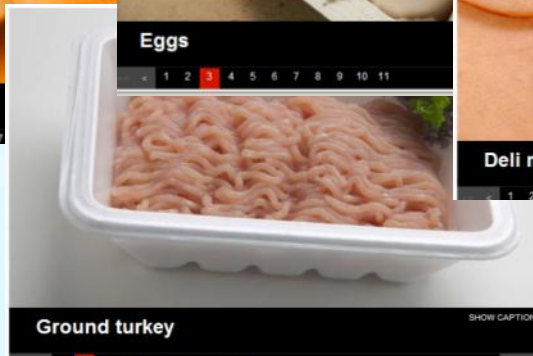
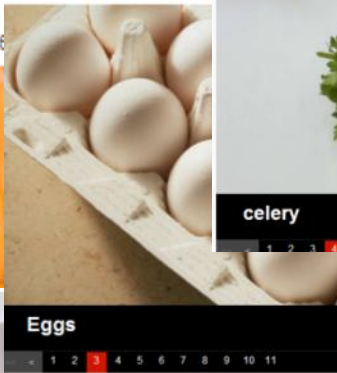
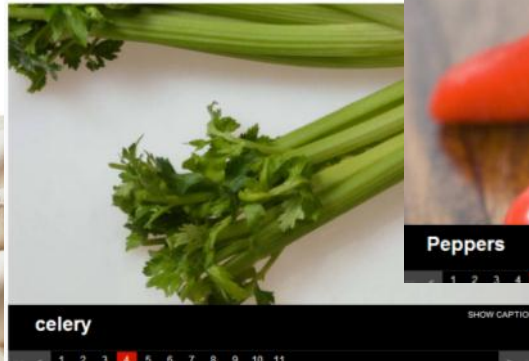
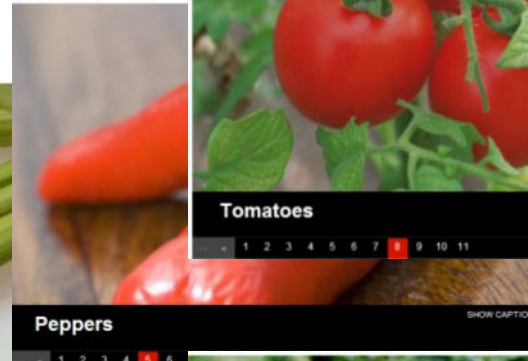


Detect - Investigate – Confirm

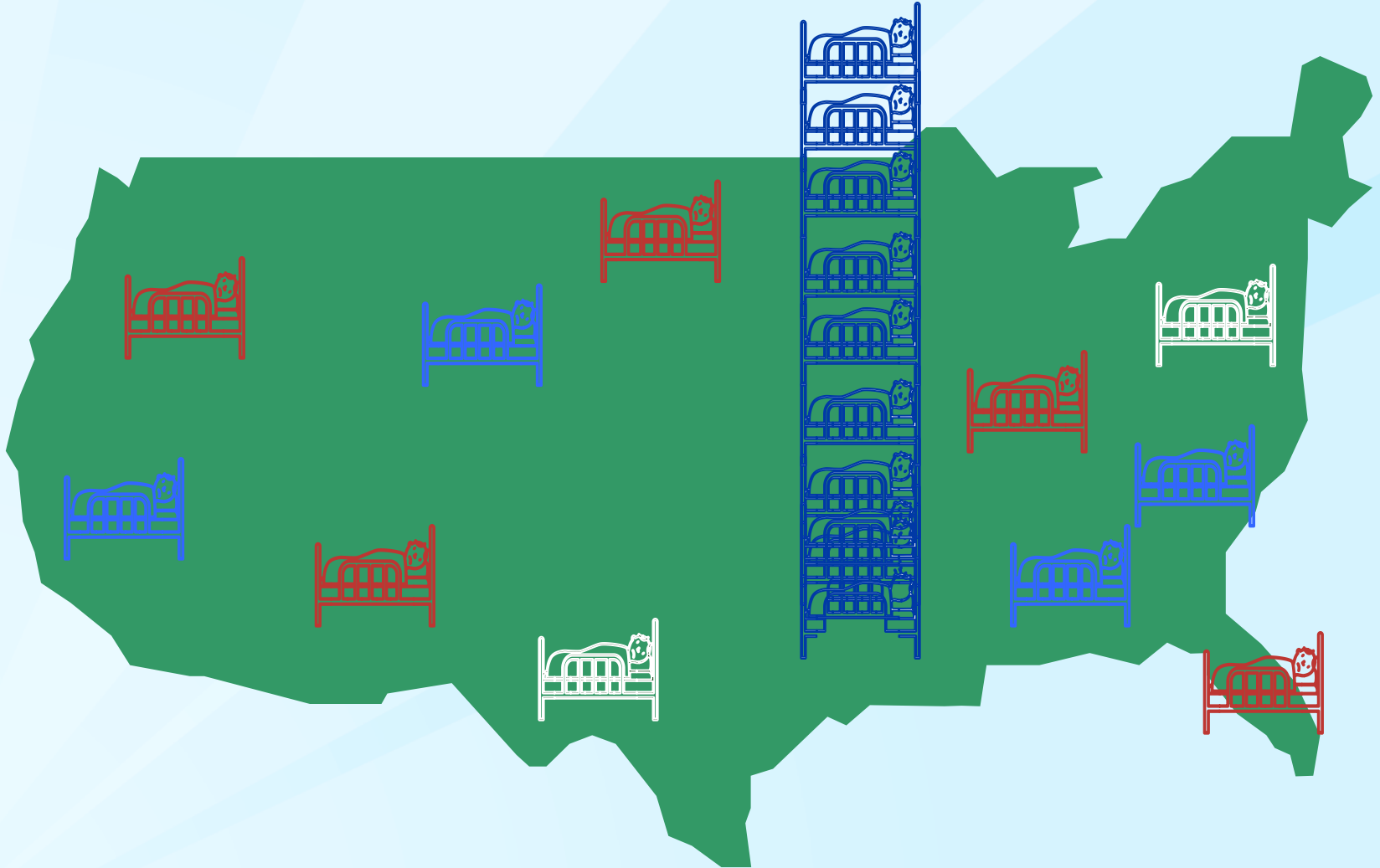
outbreaks of foodborne infections

The decade's 10 biggest food-borne illness outbreaks

By **Jacque Wilson**, CNN
 updated 11:04 AM EST, Fri September 13, 2013

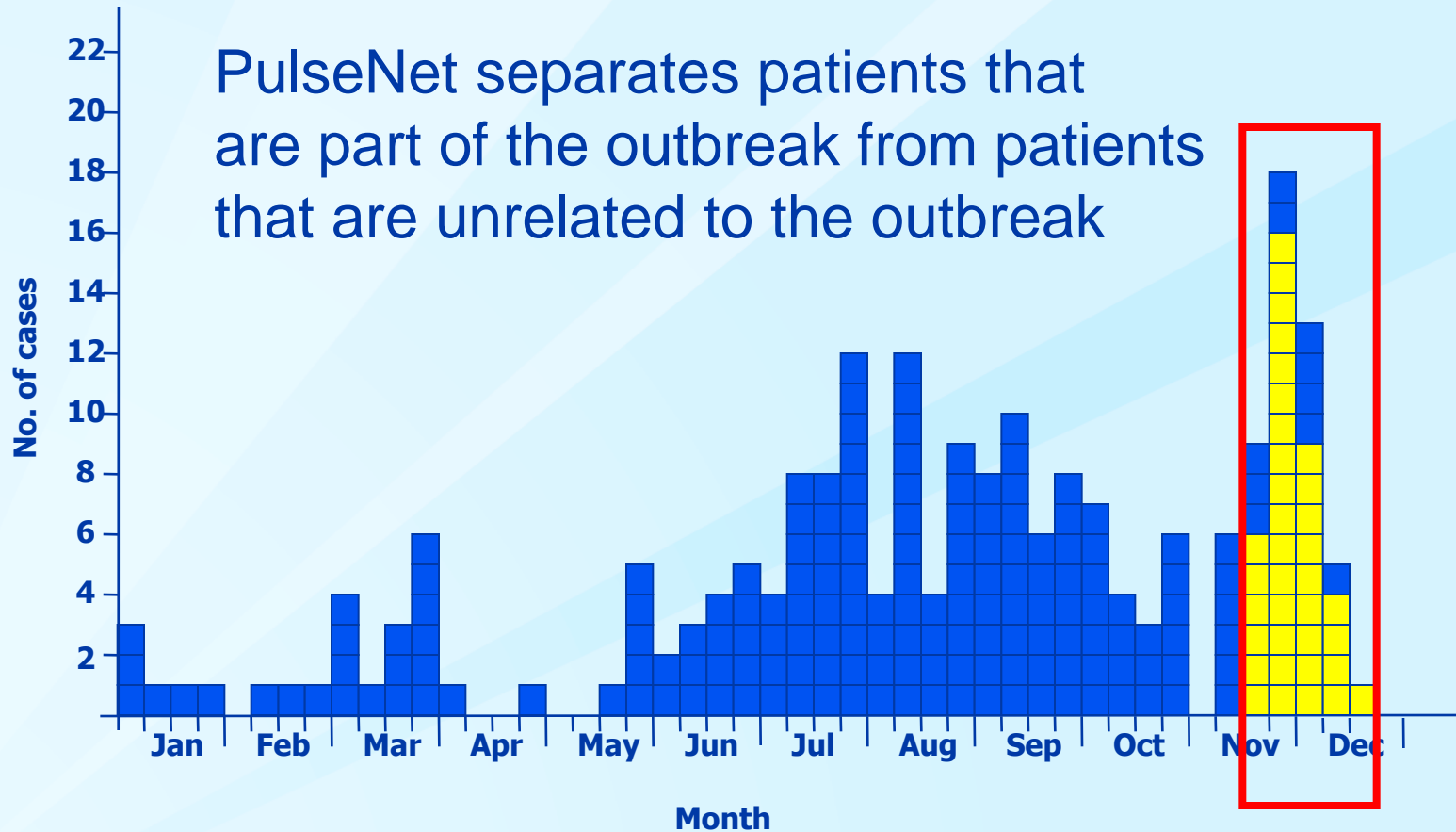


A large outbreak in one place may be obvious



PulseNet in a local outbreak investigation

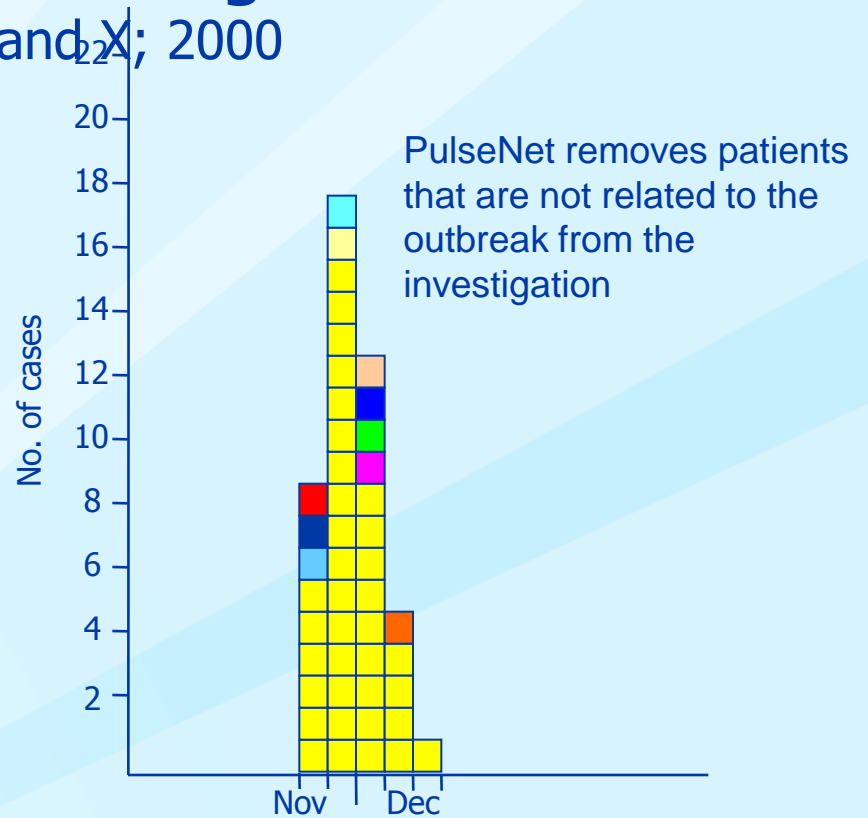
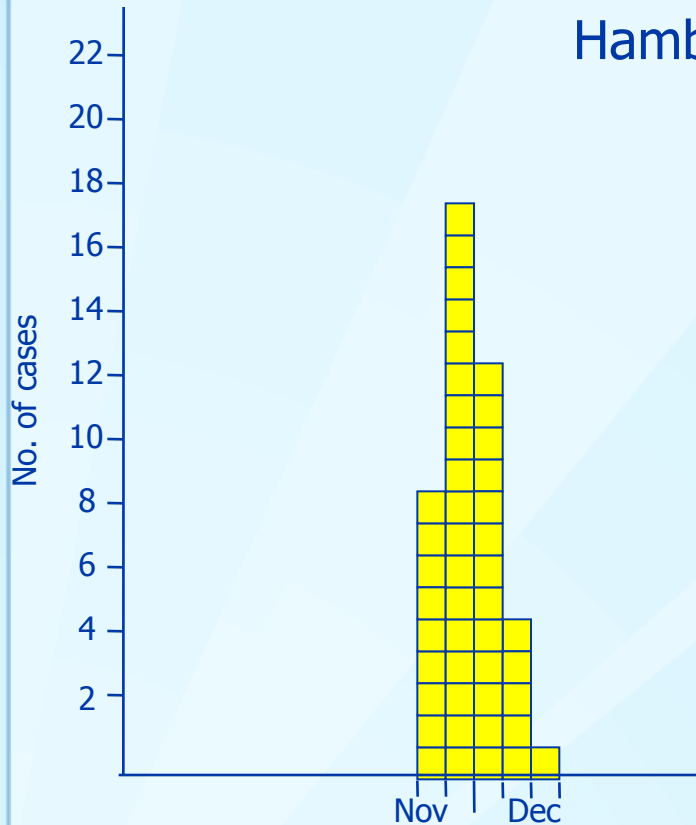
E. coli O157:H7 Outbreak Minnesota, 2000



Courtesy J. Besser Minnesota DoH

PulseNet strengthens the association to the source in an outbreak investigation

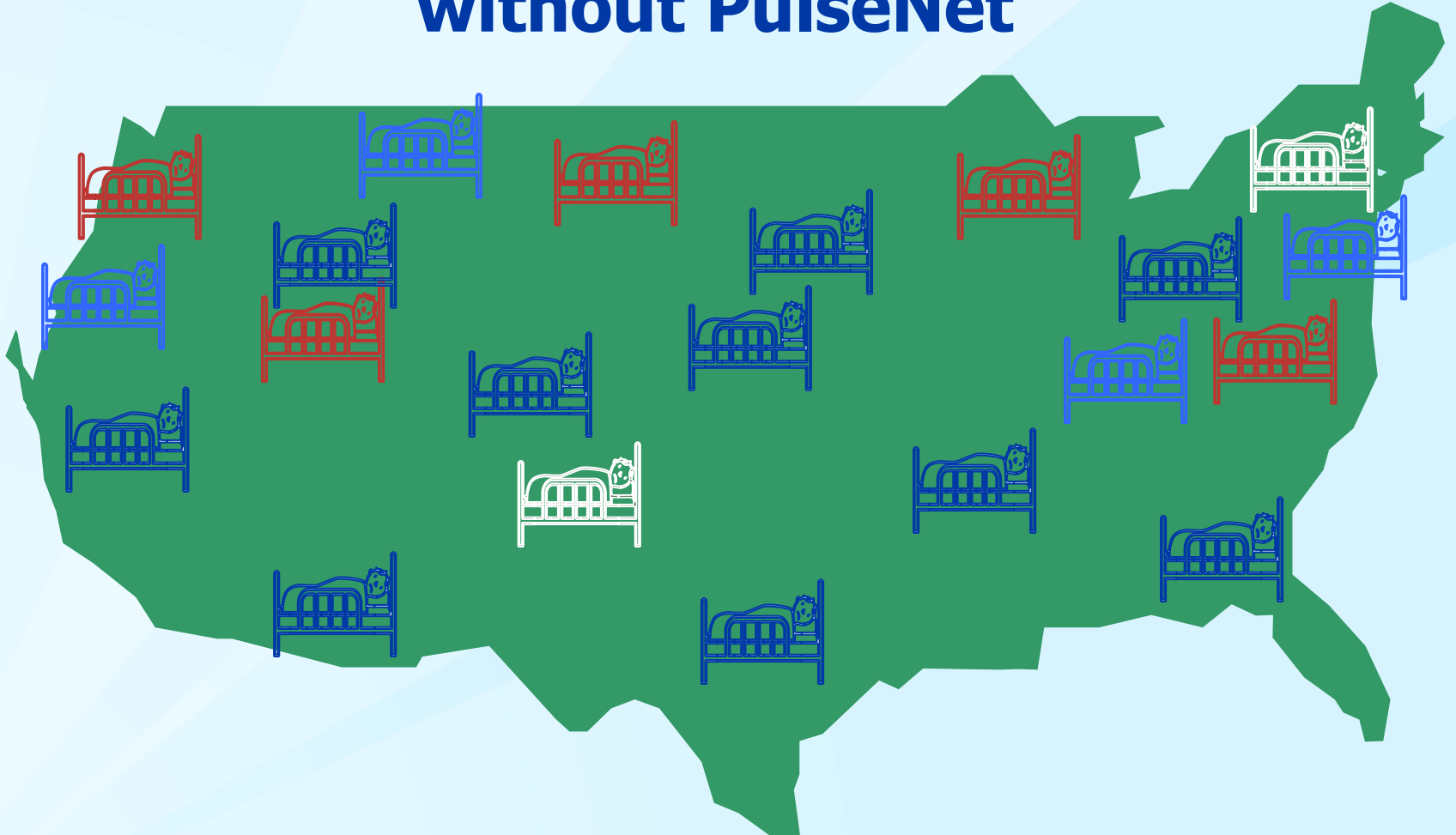
Hamburger Brand X; 2000



Without PFGE
OR = 1.93; $p = 0.31$
-NOT significant-

With PFGE
OR = 17.1; $p = 0.005$
-SIGNIFICANT-

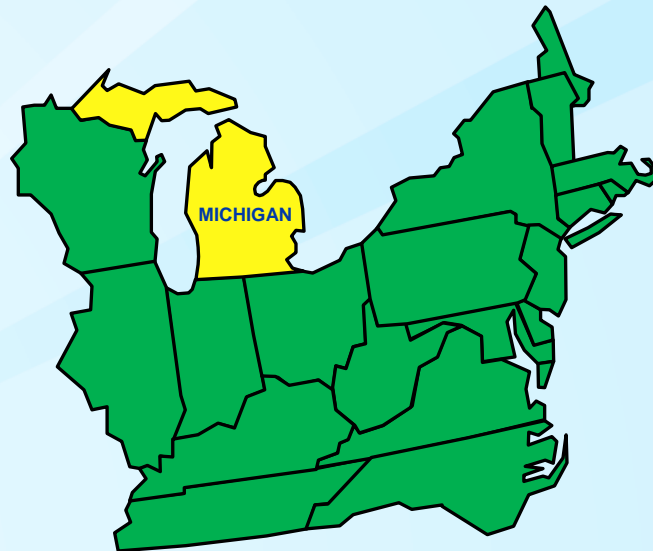
Linking patients in many places to the same outbreak may be difficult without PulseNet



Outbreak of Shiga toxin-producing *E. coli* O145 2010

□ April 16

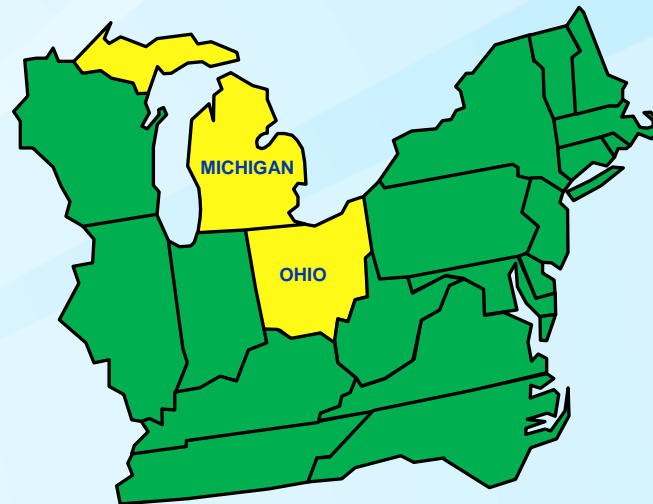
- 16 persons diarrhea with link to University dining halls in Michigan
- On site inspection does not reveal any food preparation errors
- **PulseNet** PFGE available on one patient
 - Indistinguishable from old unrelated isolate of STEC O145



Outbreak of Shiga toxin-producing *E. coli* O145 2010

□ April 22

- 4 persons with non-O157 illness in Ohio with link to college dining hall
- **PulseNet** PFGE matching MI cases
 - Likely a common vehicle of both outbreaks



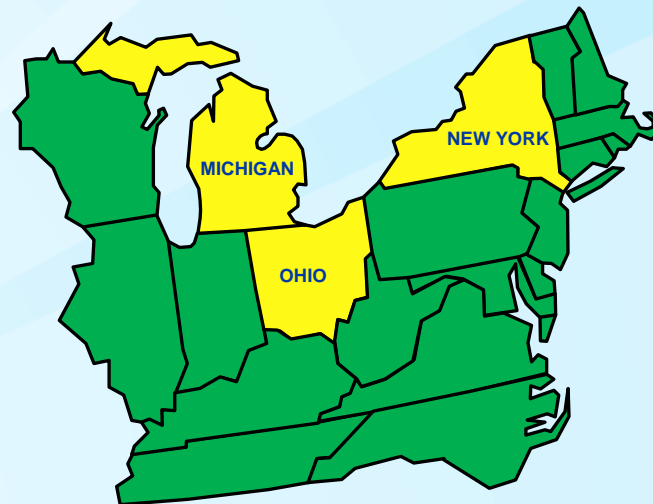
Outbreak of Shiga toxin-producing *E. coli* O145 2010

□ April 26

- 12 persons with bloody diarrhea in New York also
- associated with college
- PulseNet PFGE matching MI and OH cases

□ April 28

- Epi-investigation indicates vehicle to be romaine lettuce from supplier A



Outbreak of Shiga toxin-producing *E. coli* O145 2010

□ May 20

- 26 confirmed cases in 5 states (3 HUS)
- Outbreak traced back to one batch of lettuce from supplier A originating from a single farm in Arizona
- Culture confirmed by **PulseNet**
 - The outbreaks in MI, OH and NY would not have been linked without PulseNet
 - The cases in Tennessee and Pennsylvania would not have been recognized as being part of an outbreak without PulseNet



PulseNet in an outbreak related to imported food

July 25, 2011 12:56 PM

PRINT TEXT

Papaya recalled over salmonella fears: What you must know to stay safe

By Ryan Jaslow Topics News , Food and Drink , Recalls

Add Comment Have Your Say **Email Story** Send to a Friend **Share This** Tell Your Friends **Tweet This** Tweet This **More** Share It

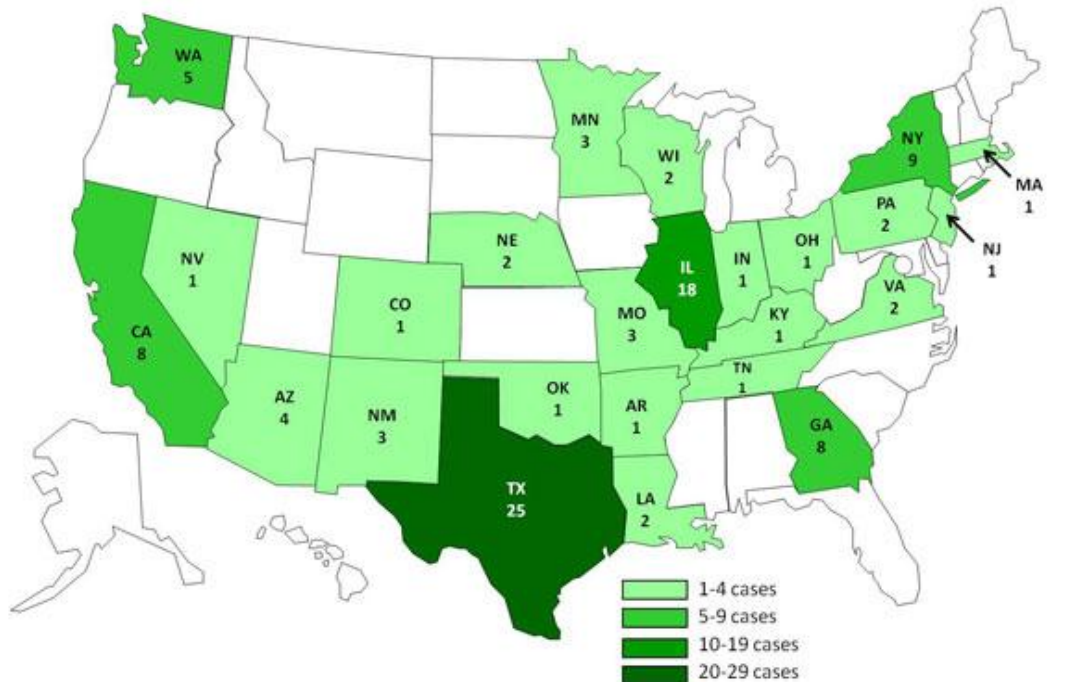


(Credit: Flickr (janineomg))

(CBS/AP) Papayas are a popular summertime treat. But the FDA is warni responsible for r

PICTURES: 10 d mistakes

Agromod Produc Mexico. It says tt Tastylicious brar linked to 97 repr



PulseNet in another outbreak related to imported food

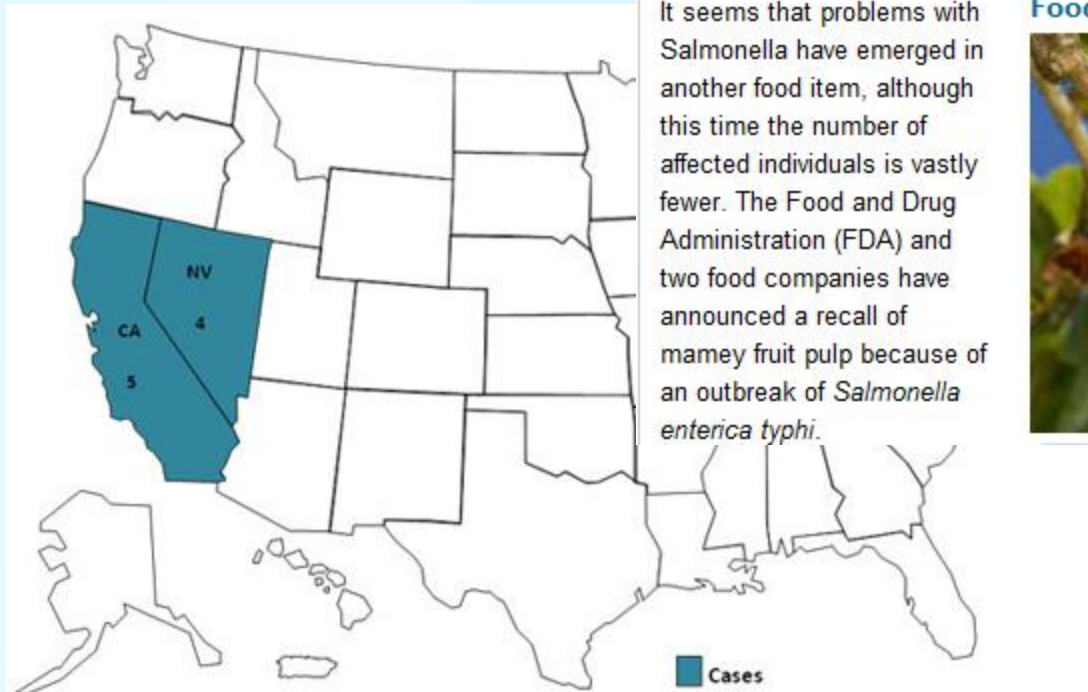
Salmonella typhi Linked to Mamey Fruit,

[Recall regulations](#) New CPSIA & CPSC Recall Guide Nation's #1 Recall
[Free Coupons - Print Now](#) Print Free Coupons, Redeem At Your Local S
[Fun Brain Test Games](#) Test and Improve your Brain With Scientifically D
[Delicious Fruit Flavor](#) Low Calorie Crystal Light has Over 30 Flavors, Inc
< >

By [Deborah Mitchell](#) on August 24, 2010 - 12:31pm [✉](#) for eMaxHealth

Food Safety

It seems that problems with Salmonella have emerged in another food item, although this time the number of affected individuals is vastly fewer. The Food and Drug Administration (FDA) and two food companies have announced a recall of mamey fruit pulp because of an outbreak of *Salmonella enterica typhi*.



14 New Vehicles in Outbreaks in the United States, 2006 - 2011

Data Sources: PulseNet, OutbreakNet,
Foodborne Disease Outbreak Surveillance System

- ❑ *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*
- ❑ *Whole, raw papaya*
- ❑ *Mamey fruit*
- ❑ *Hazelnuts*
- ❑ *Pine nuts*



***Listeria* outbreak 1109COGX6-1**

Listeria Cantaloupe Outbreak Officially Over As Death Toll Climbs By One



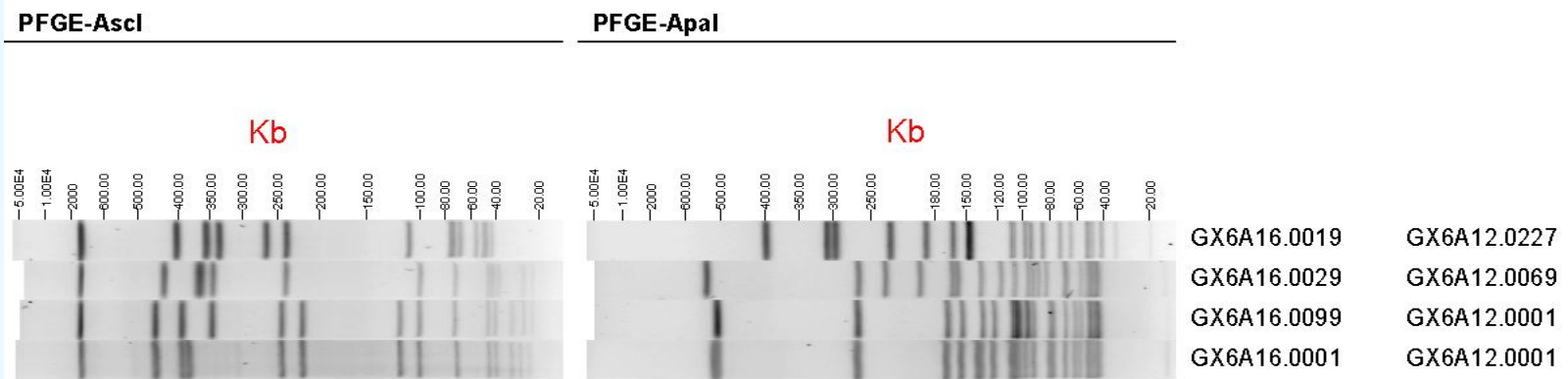
12/ 8/11 06:57 PM ET | **Ap**



- The most deadly outbreak of foodborne illness in the United States for more than a decade
 - *146 case patients*
 - *30 deaths*
 - *1 miscarriage*

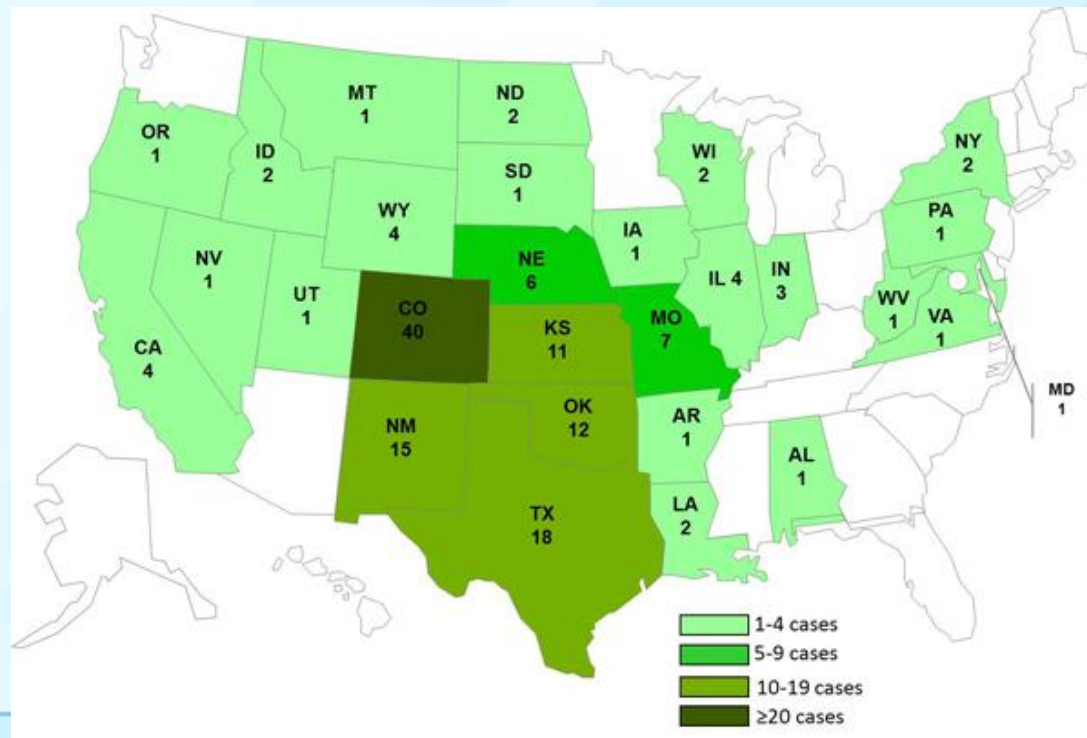
Listeria outbreak 1109COGX6-1 (Cantaloupe 2011)

- ❑ Detected by the Colorado Department of Public Health and Environment after 7 listeriosis illnesses had been notified during the last week of August 2011
 - Not detected by PulseNet
- ❑ *PulseNet* reports 4 PFGE pattern combinations among the 7 isolates and starts looking for case patients in other states:



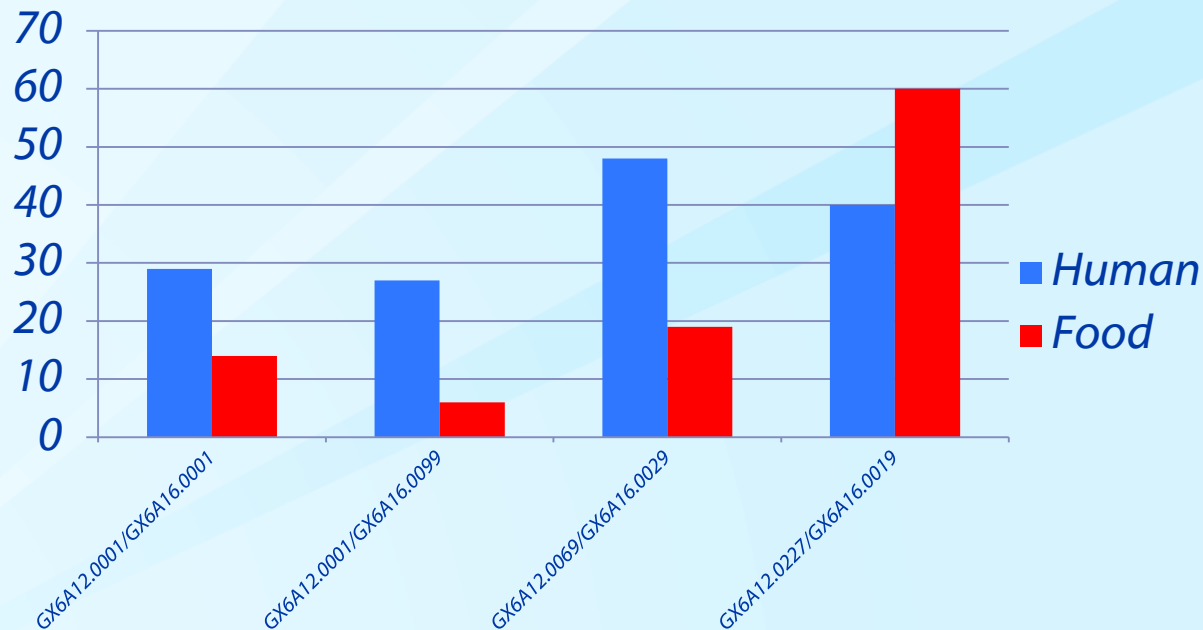
Listeria outbreak 1109COGX6-1 (Cantaloupe 2011)

- ❑ PulseNet identifies case patients in 28 other states infected with strains with one of the outbreak PFGE patterns
 - *It would not be possible to link all these patients without PulseNet*

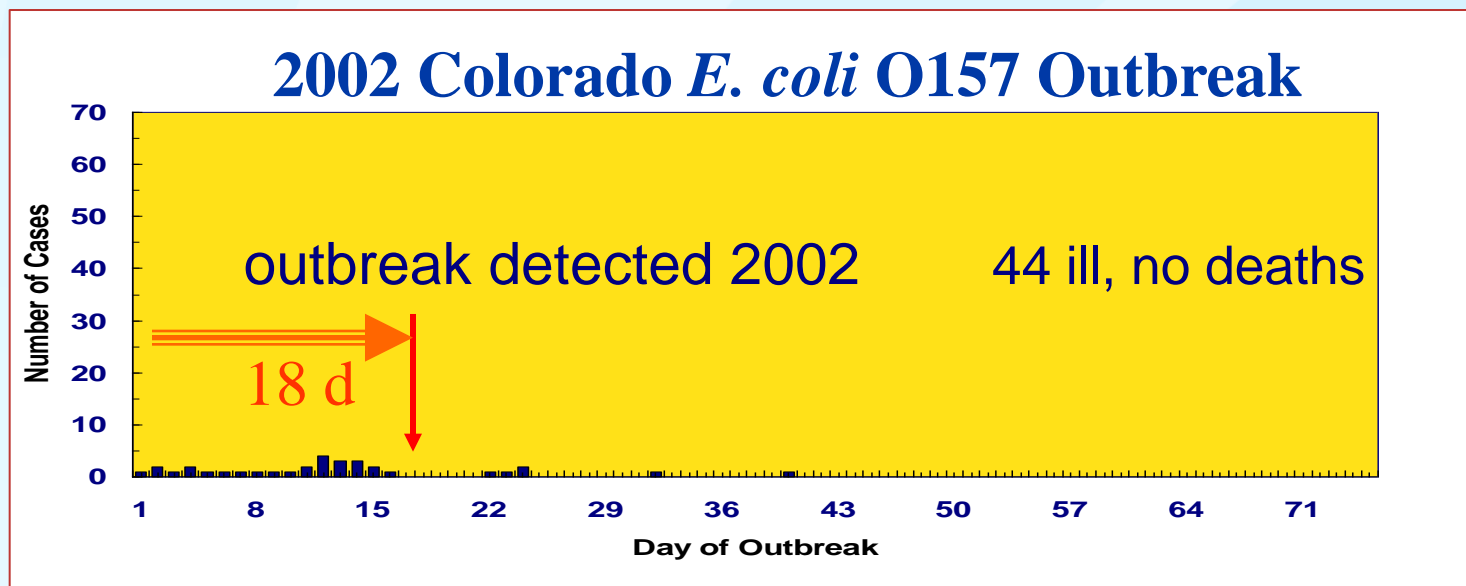


Listeria outbreak 1109COGX6-1 (Cantaloupe 2011)

- **Listeria isolates matching all outbreak patterns eventually cultured from the implicated cantaloupes produced on a single farm in Colorado**
 - *Culture confirms the vehicle of the outbreak*



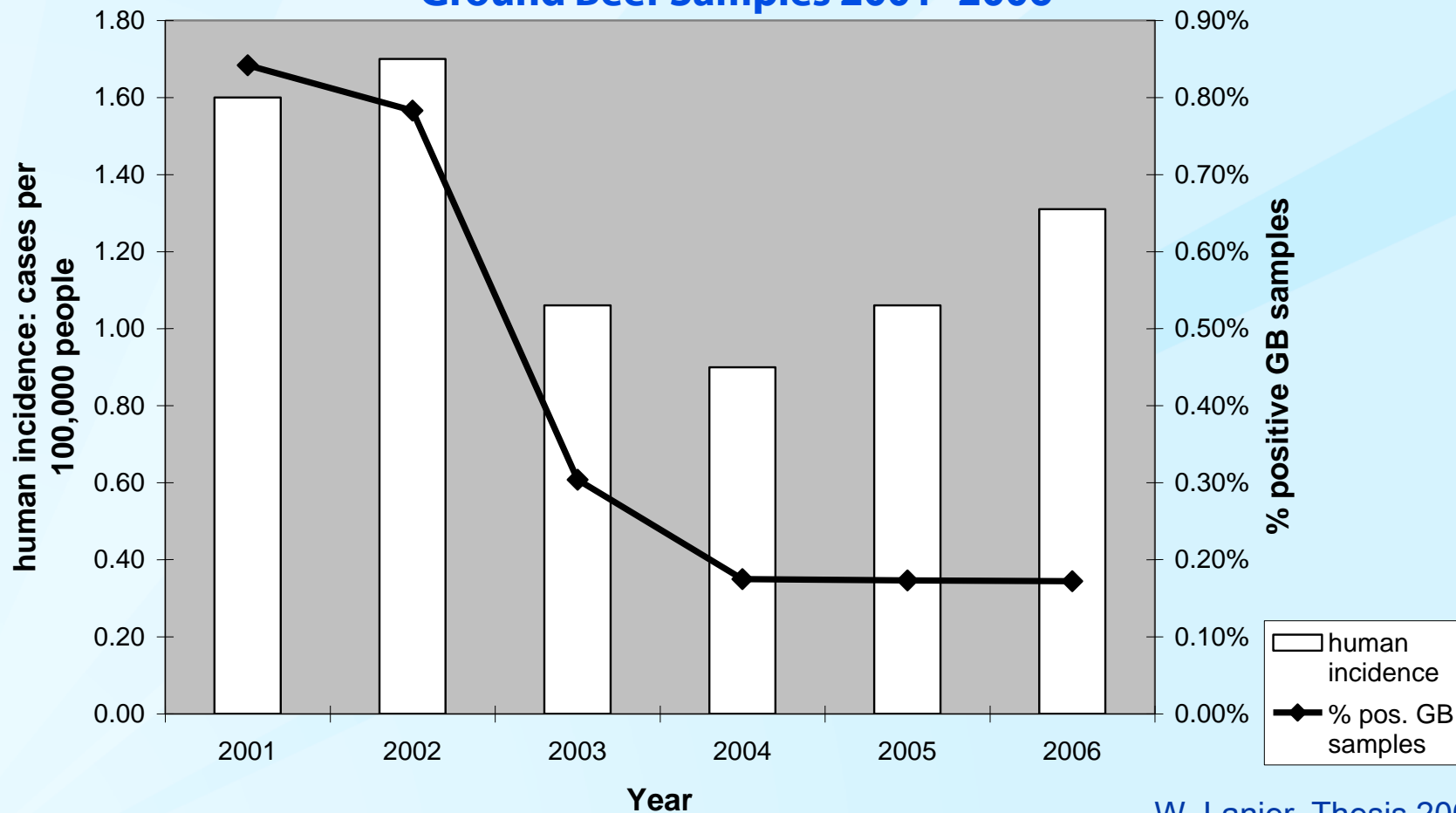
Non-human isolates in the PulseNet database may provide clues to the source of an outbreak



- ❑ When the 2002 Colorado *E. coli* O157 outbreak was detected by PulseNet, the PFGE pattern of isolates obtained by USDA/FSIS during regulatory sampling from the vehicle, ground beef, had been submitted a couple of weeks before
- ❑ **Simple outbreak investigation**
- ❑ Expanded recall of ~ 18 million pounds of beef contained the outbreak

Outbreak investigations lead to improved food safety practices in the industry

FoodNet-estimated Incidence of STEC O157 Infection ~ % FSIS Positive Ground Beef Samples 2001- 2006



W. Lanier, Thesis 2008

Outbreaks motivates producers to focus on food safety

Turkey meat producer announces a second recall

By Tom Watkins, CNN

September 12, 2011 7:26 p.m. EDT

Recommend



arms around a naturally and randomly occurring bacterium that exists throughout the environment," said Mike Martin, director of communications for the company in Wichita, Kansas.

"It is frustrating but it strengthens our resolve to also do more to find additional methods and measures that are going to further reduce the potential for pathogens that can cause food-borne illnesses."

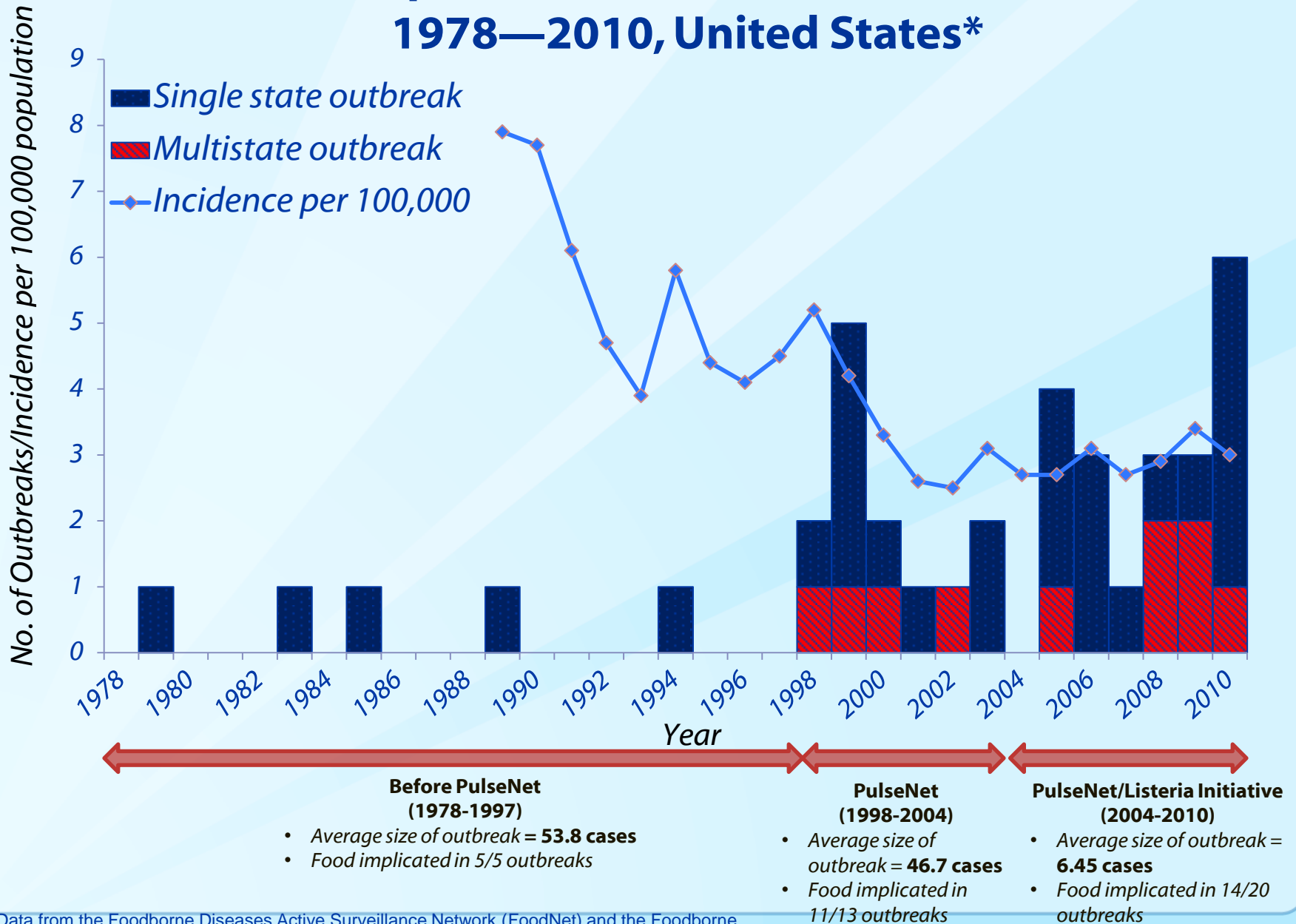
The latest recall, of 185,000 pounds of ground turkey meat, was announced Sunday for products produced August 23 and 24, and 30 and 31 from the company's establishment in Springdale, Arkansas.

Cargill announced

STORY HIGHLIGHTS

- Cargill Meat Solutions recalls 185,000 pounds of ground turkey meat
- Last month, the company recalled 30 million pounds of ground turkey meat

Incidence of reported cases and outbreaks of listeriosis, 1978—2010, United States*

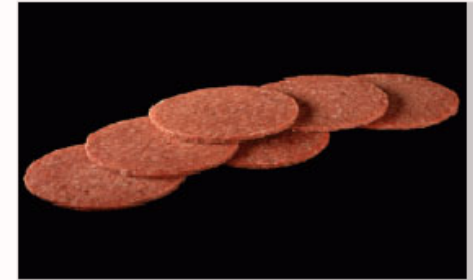


*Data from the Foodborne Diseases Active Surveillance Network (FoodNet) and the Foodborne Disease Outbreak Surveillance System (FDOSS); FDOSS and FoodNet data current as of June, 2010.

Examples of international PulseNet Investigations

International outbreak of *E. coli* O157 infections linked to ground beef patties of a particular brand

CDC, October 26, 2007



Canadian Food Inspection Service
Department of Health
Inspection Service
Source of a multi-state outbreak of *E. coli* O157:h7 infections in the USA, linked to a Canadian beef-producing firm. The outbreak was significant in that it involved over 94.7 million pounds of fresh beef recalled.

International Outbreaks of shigellosis in Denmark and Australia in 2007 associated with imported baby corn from Thailand

By author name and date

Two outbreaks of *Shigella sonnei* infections simultaneously detected in Denmark and Australia were found to be linked to the same baby corn packing house in Thailand. PulseNet played a key role in confirming this link when



International outbreak of *Shigella sonnei* associated with air travel to Hawaii in 2004

By multiple authors, Japan Journal of Infectious Diseases, July 13, 2006

In September 2004, investigations of two outbreaks of *Shigella sonnei* took place simultaneously in Japan and the United States. The collaboration through PulseNet International linked both outbreaks to the same source: air travel to Hawaii. In the United States, the Hawaii



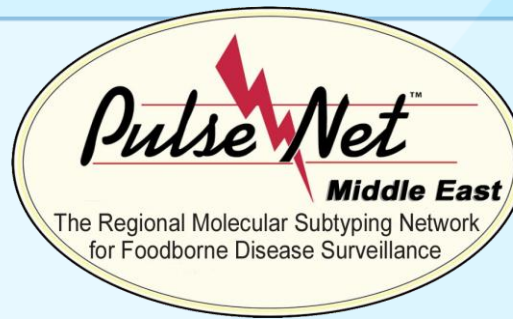
Department of Health contacted the Minnesota Department of Health (MN) to inform them of a potential outbreak of *S. sonnei* associated with domestic and international air travel to Hawaii. PulseNet USA participants in the MN laboratory alerted the rest of PulseNet USA via the PulseNet listserv by posting two different *S. sonnei* patterns digested with XbaI that were obtained from

International outbreak of *Salmonella* Senftenberg infection in 2007 associated with consumption of fresh basil imported from Israel

Multiple authors, Eurosurveillance, Volume 12, Issue 24, 14 June 2007

PFGE analysis performed according to the PulseNet *Salmonella* protocol by researchers in Europe and the United States, and shared through the PulseNet International network and the former European Enter-net, was instrumental in delineating this outbreak caused by *Salmonella* Senftenberg and confirming its source: fresh basil from Israel. [Read original](#)





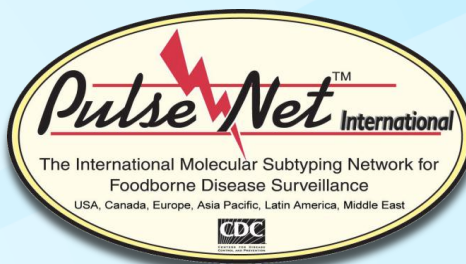
- **Established in December 2006**
- **Coordinator:**
 - **Dr. Suleiman Al-Busaidy, Central Public Health Laboratory, Muscat, Oman**
- **Training/Quality assurance program coordination:**
 - **NAMRU-3, Cairo**
- **March 25- 29 training and strategic planning meeting in Amman, Jordan**
 - **Participants from 16 countries**

Conclusions

PulseNet is an indispensable tool for the

- ***Fast and efficient Detection***
- ***Fast and efficient Investigation***
- ***Culture confirmation***

of bacterial foodborne outbreaks



... Thank you

Disclaimer:

The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333

Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348

E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

National Center for Emerging and Zoonotic Infectious Diseases

Division of Foodborne, Waterborne, and Environmental Diseases

