



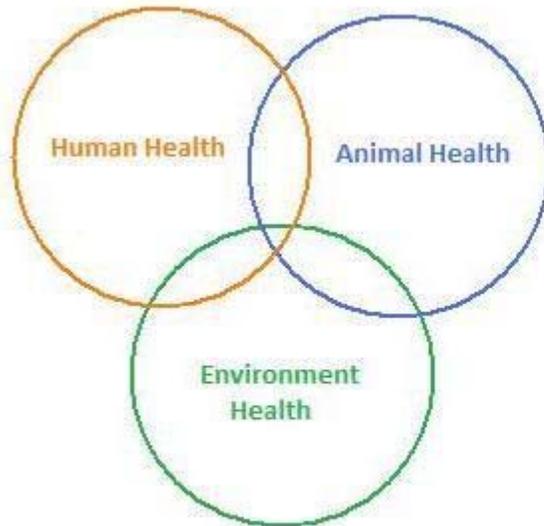
***Salmonella* | 4,5,12:i:- infections
associated with pork
Washington State, 2015**

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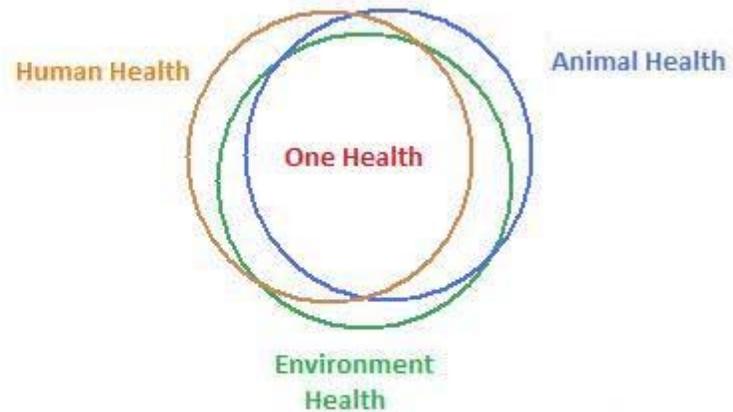
Zoonotic Disease Workshop
September 2016

One Health

<http://www.onehealthinitiative.com/>



Traditional perspective of public health



One Health approach

<https://globalhealthvet.com>

Gaël Lamielle ©



Foodborne *Salmonella*

- 1 million foodborne illnesses and ~400 deaths annually
 - Most people have diarrhea, fever, and abdominal cramps 12–72 hours after infection
- *Salmonella enterica* | 4,5,12:i:-
 - First published: 1946
 - Frequently isolated in humans and pigs
 - Fifth most frequently reported serotype in US in 2012¹



¹Centers for Disease Control and Prevention (CDC). *National Enteric Disease Surveillance: Salmonella Annual Report, 2012.*

Pulsed-Field Gel Electrophoresis (PFGE)

- DNA fingerprint of bacteria  = 
- Isolates with indistinguishable PFGE patterns are more likely to share a common source
- Most cases shared PFGE pattern found in environmental sampling of Establishment A

Key	WA-Xbal-Pattern	ReceivedDate	IsolatDate	SourceType	TypeDetails	SourceSite
21234	TYP334	2015-08-05	2015-07-24	Food	Leftover Pork meat	Pork
21235	TYP334	2015-08-05	2015-07-24	Food	Roasted pork and duck mixed	Pork and duck
21263	TYP334	2015-08-06	2015-07-22	Environmental	Pork carcass 4, 5, 6	pooled swabs
21260	TYP334	2015-08-06	2015-07-31	Human		Stool
21262	TYP334	2015-08-06	2015-07-30	Human		Stool
21269	TYP334	2015-08-10	2015-08-03	Environmental	Pen area(holding)	swab
21270	TYP334	2015-08-10	2015-08-03	Environmental	antemortem pen	swab
21271	TYP334	2015-08-10	2015-08-03	Environmental	truck wash sample	swab
21272	TYP334	2015-08-10	2015-08-03	Environmental	drain	swab
21273	TYP334	2015-08-10		Environmental	knives & table	swab
21275	TYP334	2015-08-10	2015-08-03	Environmental	ev. floor,table,drain	swab

Detecting the outbreak (June 2015)

- Public Health—Seattle & King County (PHSKC)
 - Call about multiple Ethiopian cases with *Salmonella* from a graduation party in mid-June
 - “Here we go again!”
- PHSKC Environmental Health
 - Traceback to Market 1
 - Raw beef suspected as source of illness
- Washington State Public Health Laboratories
 - Identified a serotype match (*Salmonella* | 4,5,12:i:-) between the party attendees

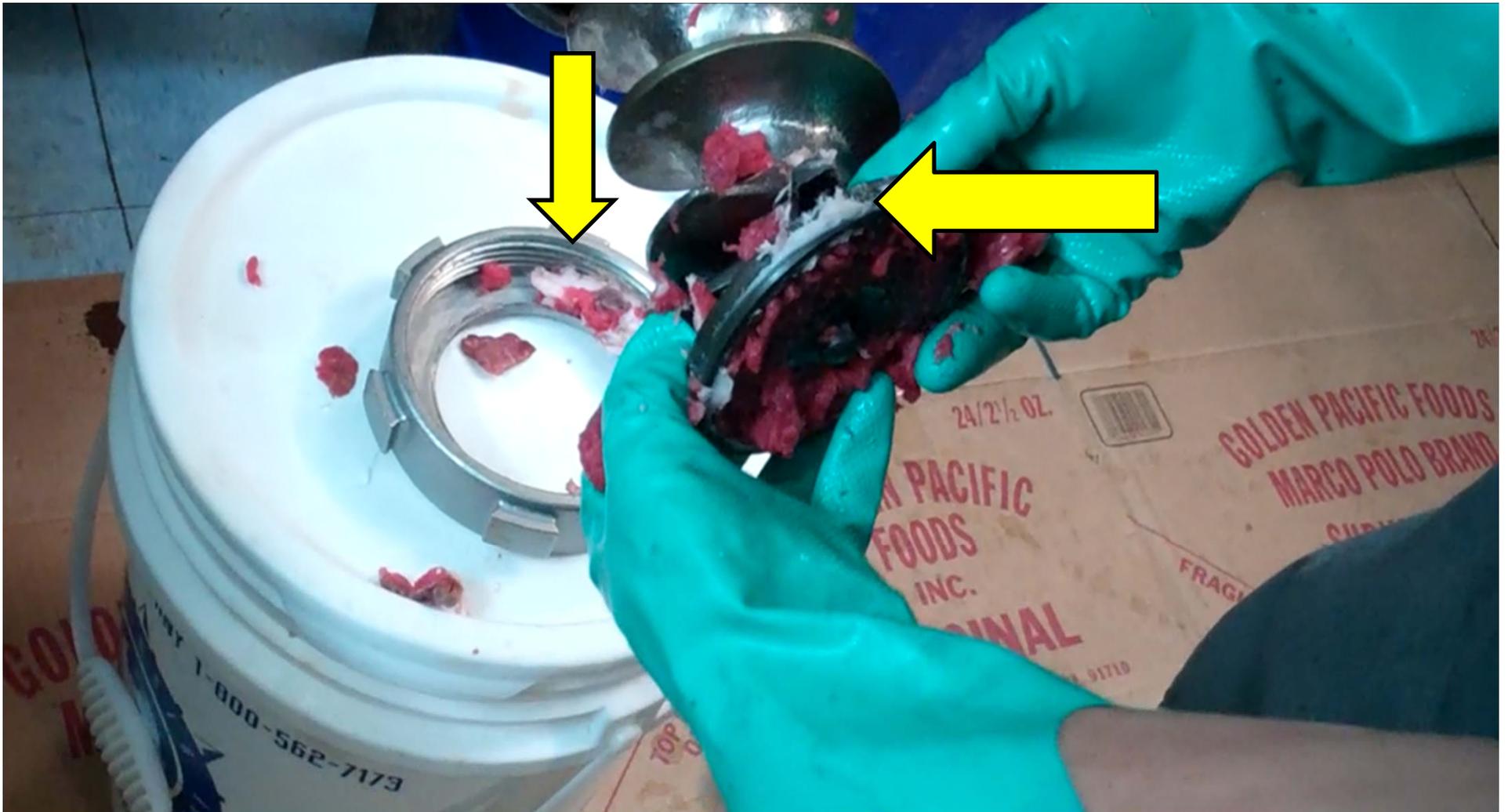


Image courtesy of PHSKC

Market 1

Cross-contamination?

Slide courtesy of PHSKC



Investigating the outbreak (July 2015)

- Public Health—Seattle & King County
 - Ethiopian restaurant cluster (kitfo)
 - 2 additional graduation party clusters (non-Ethiopian, one with food from Asian Restaurant B)
- State labs and epidemiology
 - Pulsed-field gel electrophoresis (PFGE) matches (multiple clusters/venues)
 - Many non-Ethiopian cases link back to pork



Asian Restaurant B

Cross-contamination?

Slide courtesy of PHSKC



Food and environmental testing

Date	Sample #	Description	Result
6/28/15	1	Market 1 - environmental sample: grinder blade.	Negative.
	2	Market 1 - environmental sample: leftover meat from grinder for retail sale.	<i>Salmonella</i> 4,5,12:i:- detected.
	4	Market 1 - environmental sample: screw gear, meat grinder.	Negative.
	6	Market 1 - ground beef (retail).	Negative.
	3,5,7	Market 1- environmental samples: cutting board, used gloves, cleaning rags.	<i>Salmonella</i> 4,5,12:i:- detected.
7/27/15	1	Asian Restaurant B - swabs from whole pigs.	<i>Salmonella</i> 4,5,12:i:- detected.
	2	Asian Restaurant B - meat from whole pigs.	Negative.
	3	Asian Restaurant D - meat from Snohomish household leftovers.	<i>Salmonella</i> 4,5,12:i:- detected in roasted pork/duck. BBQ pork dish negative.
	4	Pig roast-leftover roasted pork.	<i>Salmonella</i> 4,5,12:i:- detected.

Investigating the outbreak (July 2015)

- Multiple types of sub-clusters and exposures:
 - **Ethiopian** restaurant, market, graduation party (suspected cross-contamination with pork)
 - **Asian** restaurants and markets (pork products)
 - **Live pig** exposures
 - **Pig roasts**



Clusters and events by date through July 2015

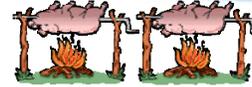
April 25 (first case)
First case



2015



June 20
Pierce Pig Roast 2 (n=1)
Oregon Pig roast (n=1)



June 27
King Pig roast 1 (n=1)
Grays Harbor Pig Roast (n=1)

June 28



July 30
Conference call

July 31
Sampling at
Blishment A

August

August 29
Aid requested

Restaurant A



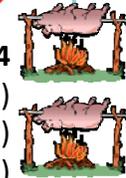
Pig Roast (n=5)

July 19
Bridal shower
Picnic

July 16
Conference call

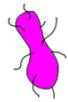


July 4
Mason 1 Pig Roast (n=1)
Mason 2 Pig Roast (n=1)
Snohomish Pig Roast (n=1)
Hood Canal Pig Roast (n=1)



Establishment A



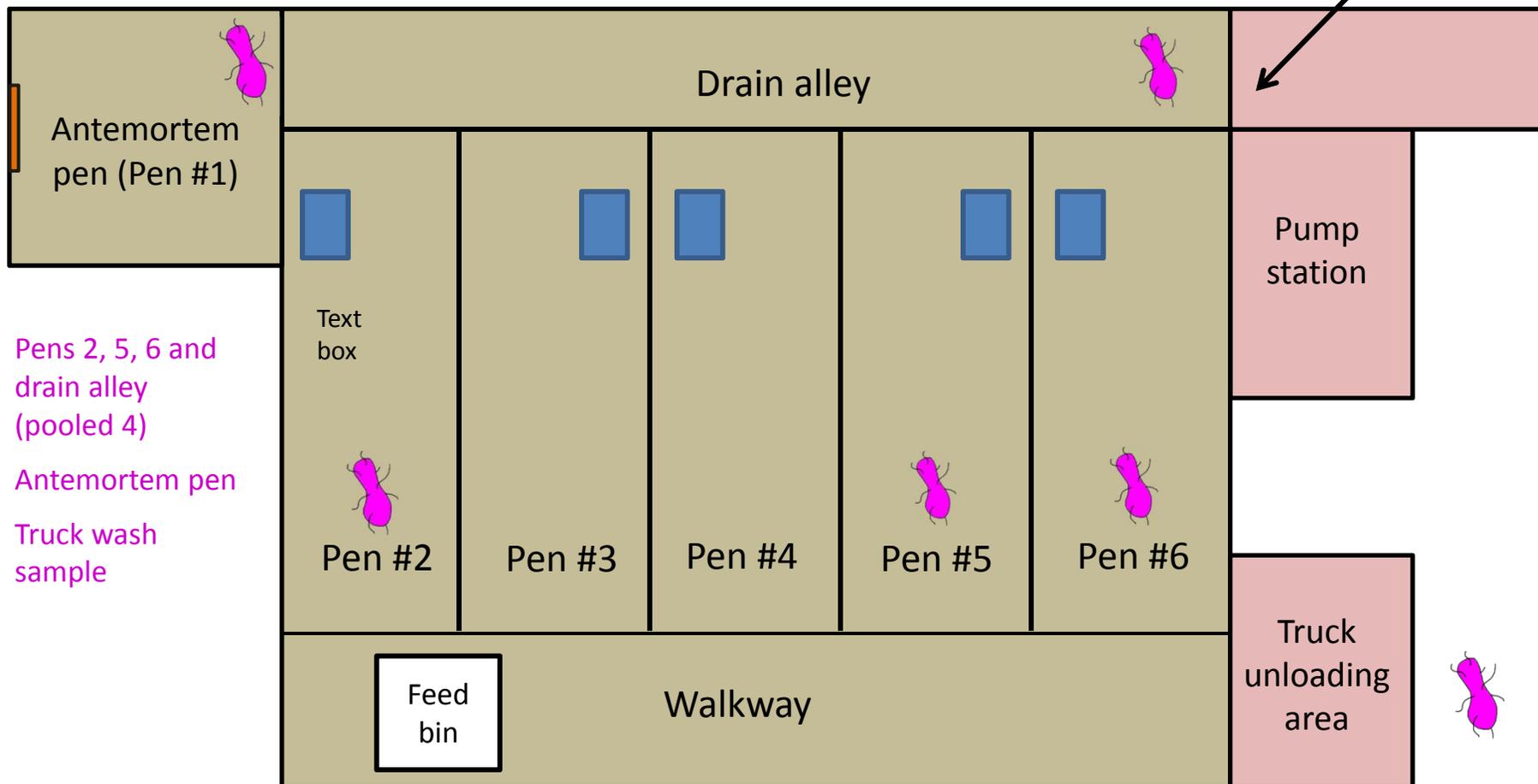


Positive for I 4,5,12:i:-



Waste holding

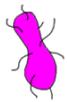
Try to catch solids



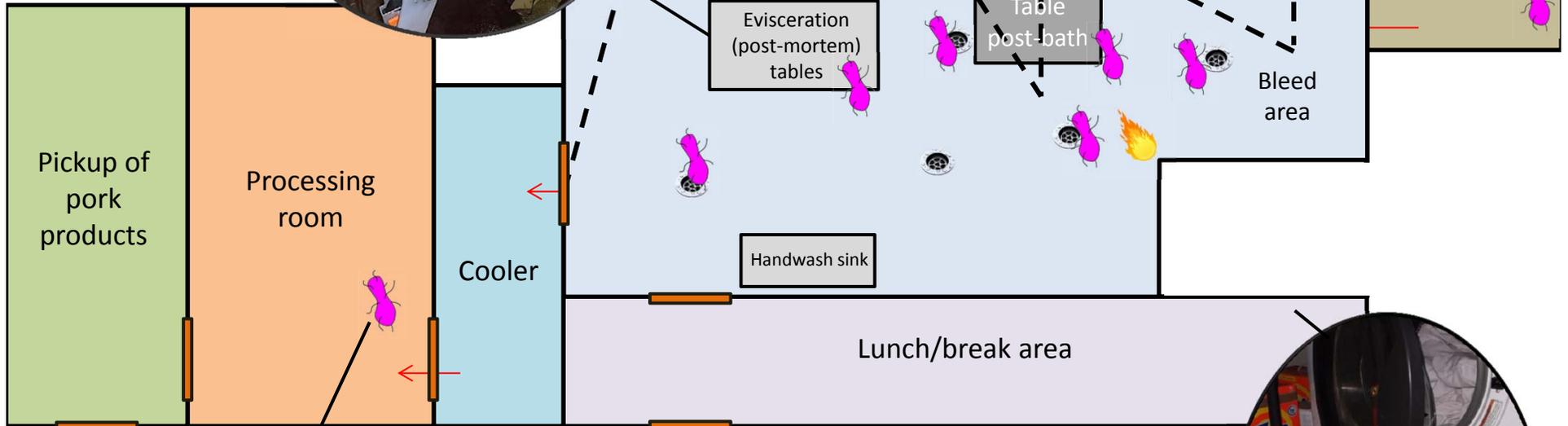
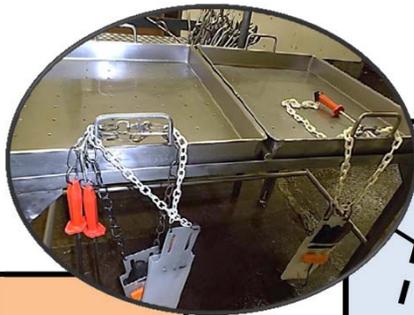
- Pens 2, 5, 6 and drain alley (pooled 4)
- Antemortem pen
- Truck wash sample

*not to scale; sampling locations not exact





Positive for
I 4,5,12:i:-



- Drains by bleeding station (pooled 3)
- Post-bath knives and table
- Various knives and hook (set belonging to one employee)
- Evisceration floor (floor and wall), evisceration tables, evisceration drain (near cooler door)
- Hacksaw table and hacksaw



*not to scale; sampling locations not exact



Recalls and additional sampling

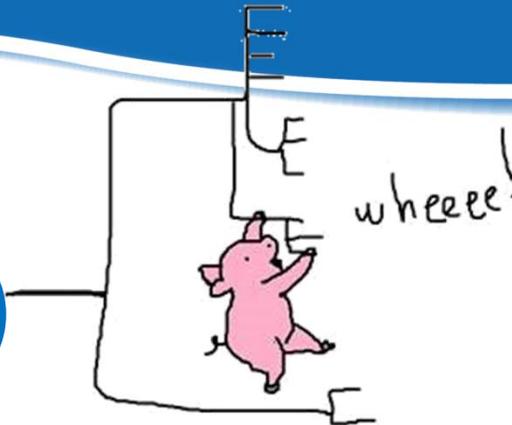
- **August 13**
 - **Recall:** 116,262 pounds of whole hogs for barbecue
 - Produced April 18–July 27
- **August 10–14**
 - USDA FSIS sampling
 - Pre-op sampling (to check for inadequate clean-up)
 - Cecal sampling of hanging carcasses
- **August 27**
 - **Expanded recall:** 523,380 pounds of pork products
 - Produced April 18–August 26
 - Establishment A voluntarily closed operations

Case definition

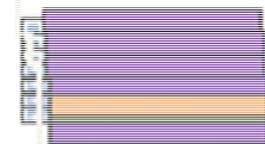
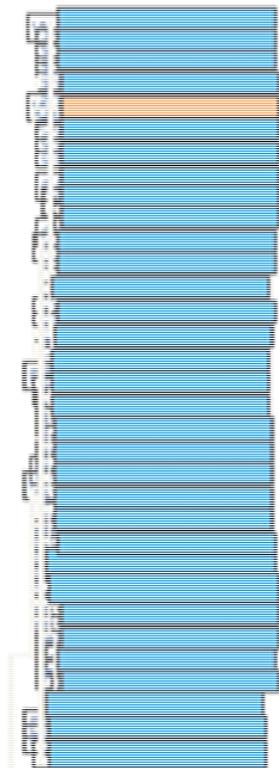
- Confirmed case:
 - Ill person with *Salmonella* I 4,5,12:i:- or Infantis
 - **AND** illness onset April 25–September 25
 - **AND** isolate matching one of 6 PFGE patterns if WA resident
 - **OR** matching PFGE pattern and highly related WGS isolate if non-WA resident

Serotype	Pattern
I 4,5,12:i:-	JPXX01.1314
I 4,5,12:i:-	JPXX01.2429
I 4,5,12:i:-	JPXX01.3161
I 4,5,12:i:-	JPXX01.2311
I 4,5,12:i:-	JPXX01.3336
Infantis	JFXX01.0046

Whole Genome Sequencing (WGS)



- Analyzes an organism's entire genome
- Provides a more definitive relationship than PFGE
- Performed on 49 isolates
 - Human, food, and environmental
- Two distinct clades of highly related isolates
- Two human isolates from one pig roast found in both clades



- Primary clade
- Secondary clade

Tree courtesy Vance Kawakami; drawing courtesy Wendy Inouye

Case characteristics

Case count: 192

– 184 WA

– 1 AK, 2 CA, 2 ID, 3 OR

Median age 35

Range <1–90

97 (51%) female

30/180 (17%) hospitalized

No deaths

Incidence of *Salmonella*
| 4,5,12:i:- cases
matching the 2015
outbreak in Washington

Year	Total
2010	9
2011	10
2012	25
2013	38
2014	70
Total	152

SCHEMATIC DIAGRAM OF ETHIOPIAN SALMONELLA CLUSTER

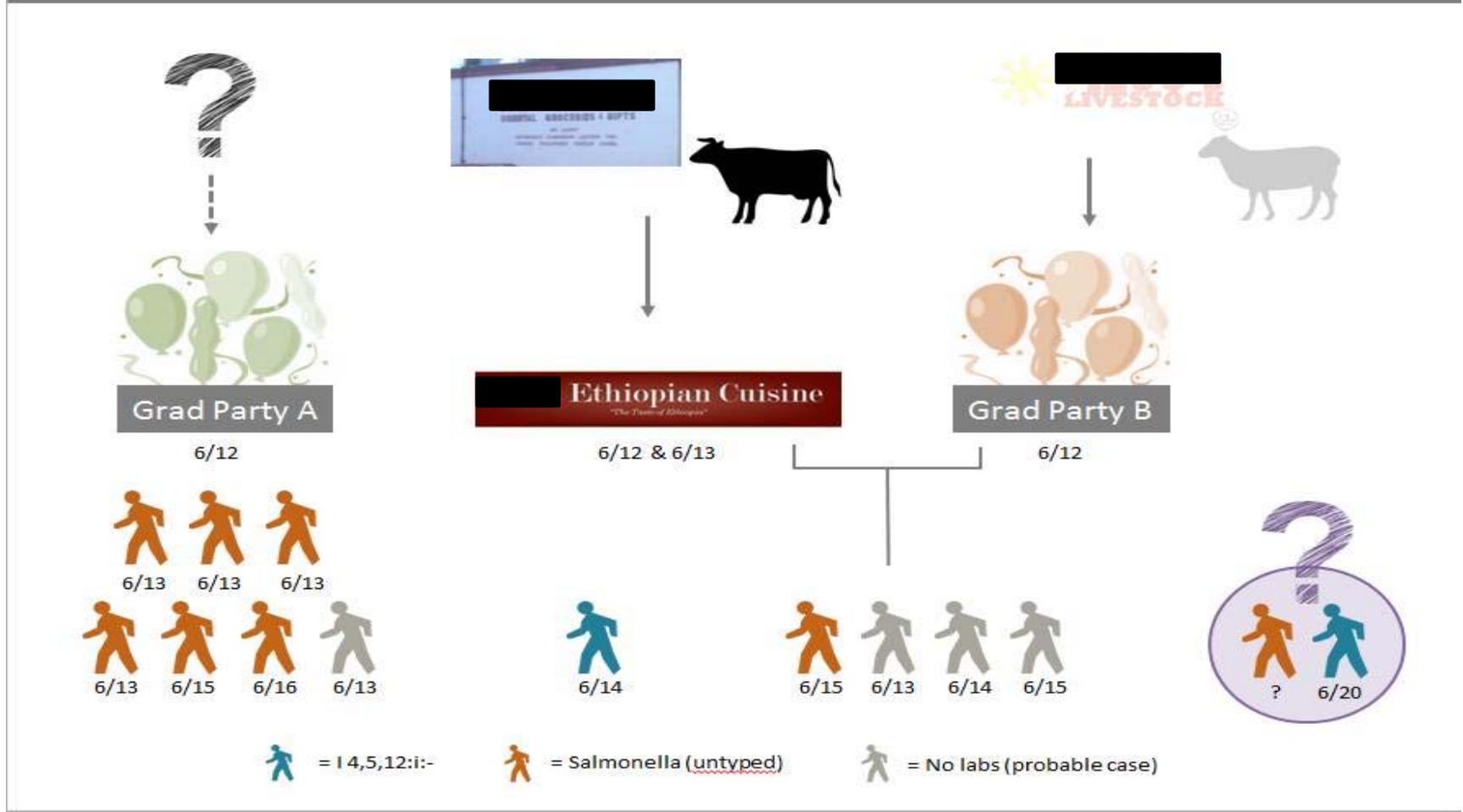
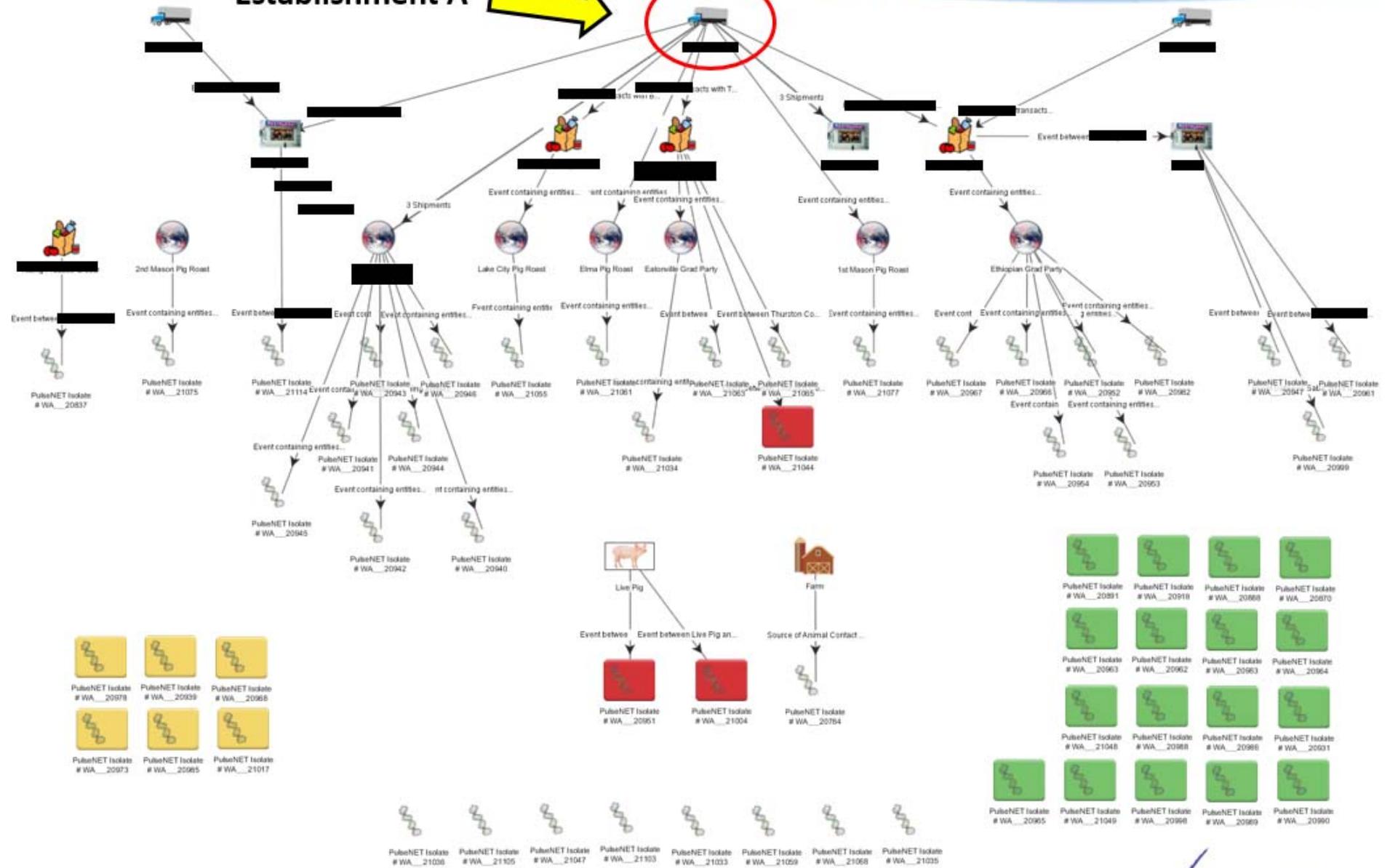
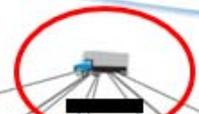
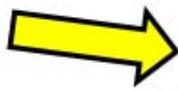


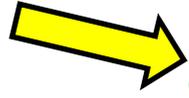
Diagram courtesy of PHSKC

Establishment A

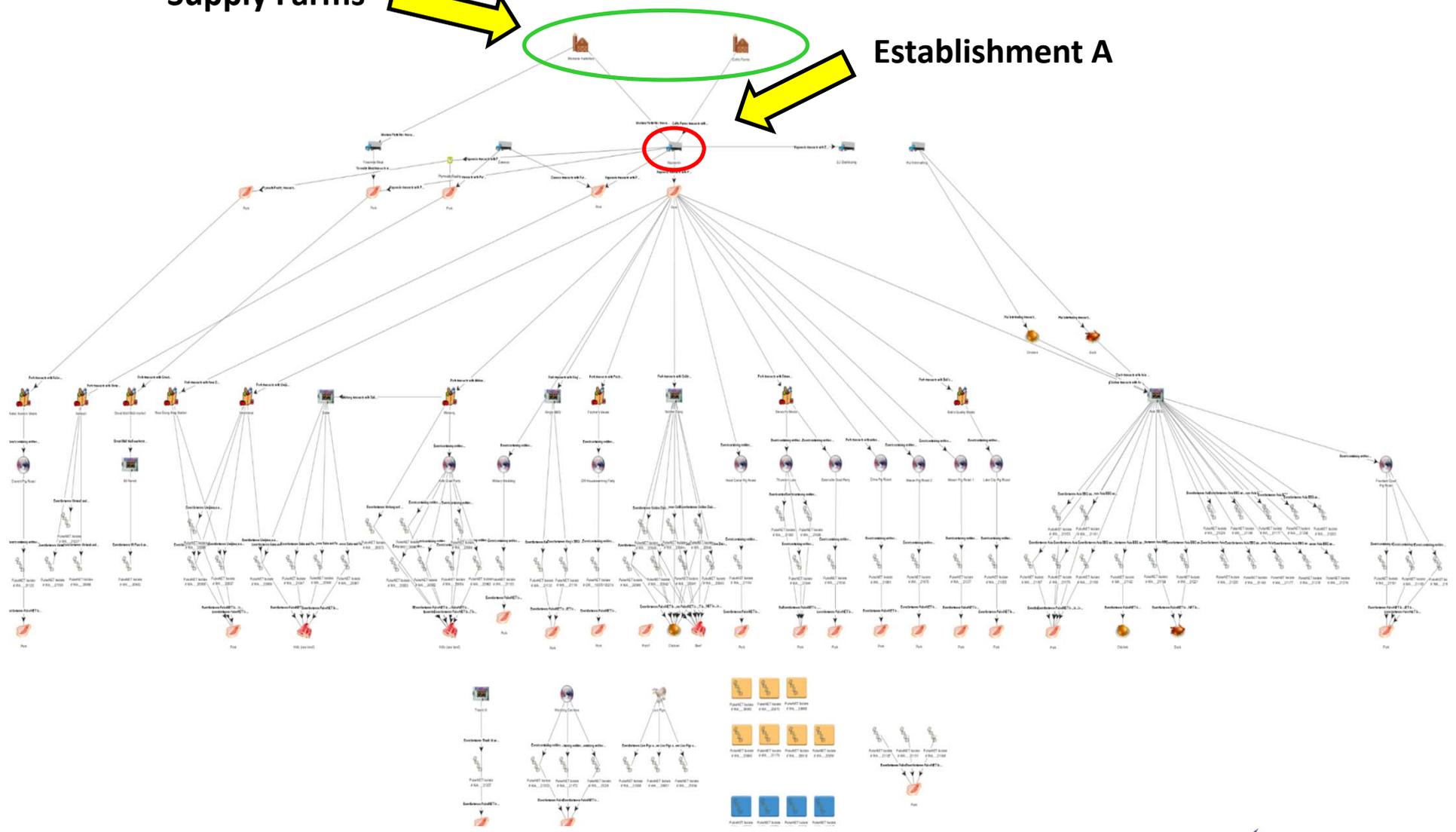


Traceback diagram courtesy Lyndsay Bottichio, CDC

Supply Farms



Establishment A

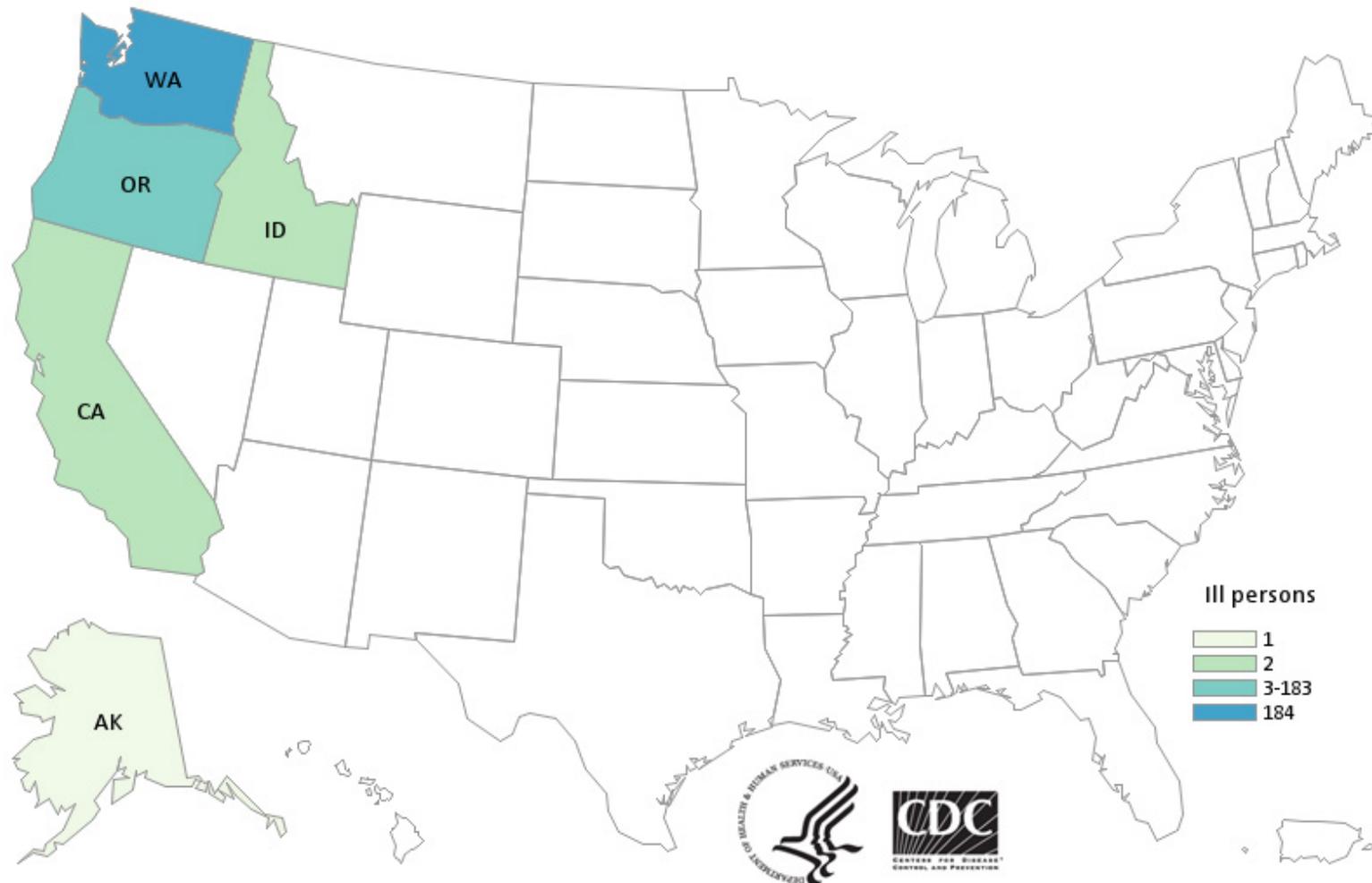


Traceback diagram courtesy Lyndsay Bottichio, CDC

Pig roast sub-clusters

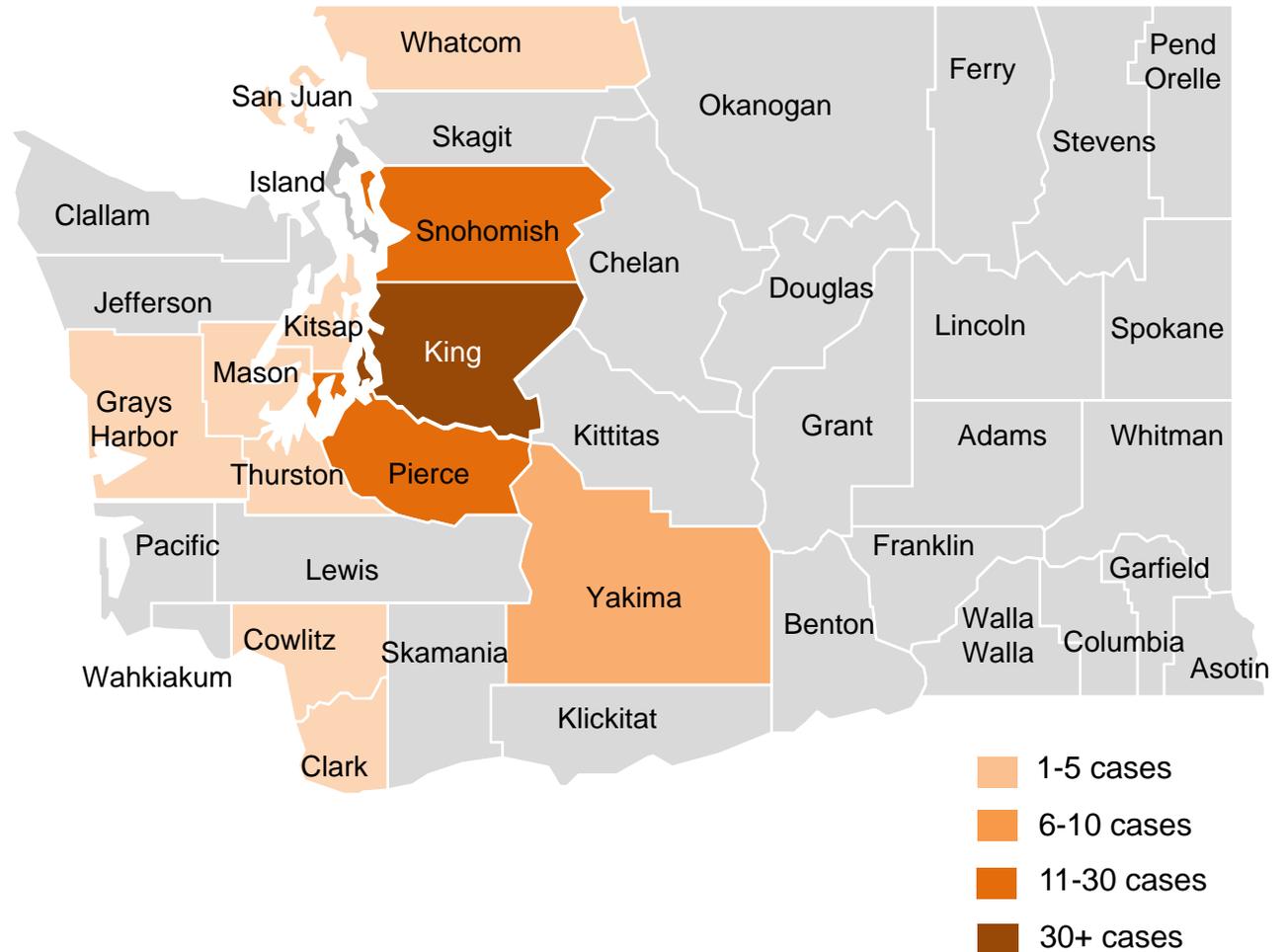
No.	Pig roast location	Date	Purchase traceback
1	Pierce 1	6/14/2015	Establishment A
2	Pierce 2	6/20/2015	Establishment A → Meat seller 1
3	Oregon	6/20/2015	Establishment A → Distributor 1 → Meat seller 2
4	King 1	6/27/2015	Establishment A → Meat seller 3
5	Grays Harbor	6/27/2015	Establishment A
6	Thurston 1	6/28/2015	Establishment A → Meat seller 1
7	Pierce 3	7/3/2015	Establishment A
8	Mason 1	7/4/2015	Establishment A
9	Mason 2	7/4/2015	Establishment A
10	Snohomish 1	7/4/2015	Establishment A → Meat seller 4
11	Hood Canal	7/4/2015	Establishment A
12	King 2	7/16/2015	Establishment A → Asian Restaurant A
13	San Juan	7/25/2015	Establishment A
14	Snohomish 2	7/25/2015	Establishment A → Distributor 1 → Meat seller 5
15	Pierce 4	8/1/2015	Establishment A → Meat seller 6
16	Thurston 2	8/15/2015	Establishment A → Meat seller 7 → Asian Restaurant C
17	King 3	8/15/2015	Establishment A → Asian Restaurant B
18	King 4	8/23/2015	Establishment A → Meat seller 8

People infected with the outbreak strains of *Salmonella* 4,[5],12:i:- or *Salmonella* Infantis, by state of residence, as of November 23, 2015 (n=192)

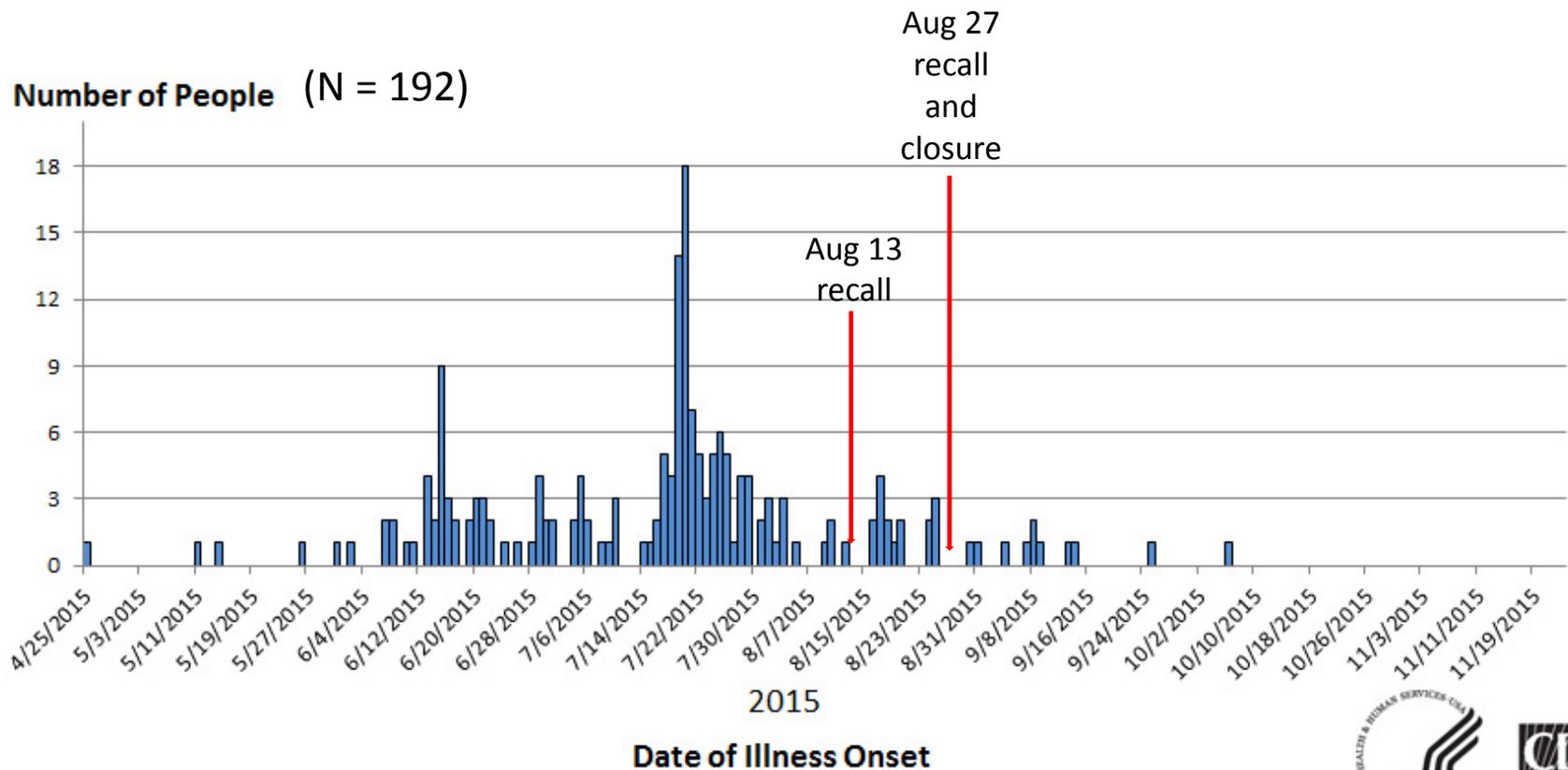


Cases by county in Washington

County	No
Benton	1
Clark	2
Cowlitz	1
Grays Harbor	1
King	107
Kitsap	1
Mason	3
Pierce	20
San Juan	5
Snohomish	29
Thurston	5
Whatcom	2
Yakima	7
Total	184



People infected with the outbreak strains of *Salmonella* 14,[5],12:i:- or *Salmonella* Infantis, by date of illness onset*



*Some illness onset dates have been estimated from other reported information.



Challenges

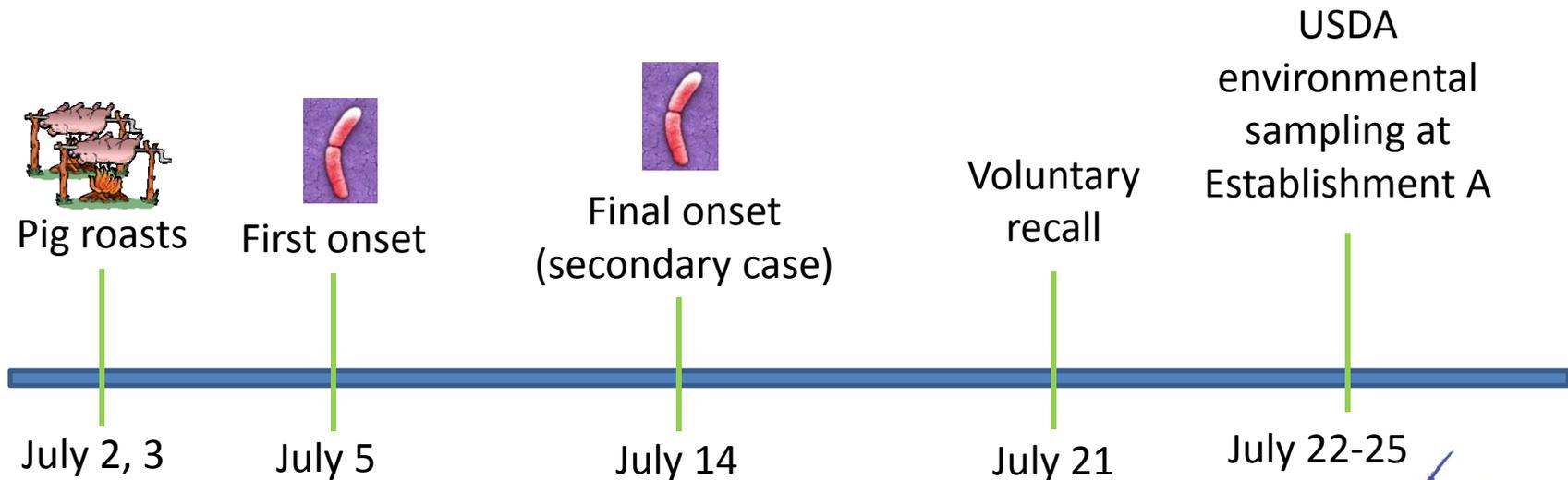
- Sample when possible (and be ready to deal with results)
 - No sampling at commercial farms, leftovers often not available
- Ask, but also verify and document—take pictures!
- Cross contamination:
 - Difficult to prove—need sampling and direct observations
 - Ongoing need to educate consumers and food handlers
- Preventable illnesses
 - Small scope of initial recall
- No case-control study, traceback investigation not uniform
- Scientific unknowns: thermal/antibiotic resistance, pathogenicity

Successes and future considerations

- **Communication**
 - ICS helpful with large outbreak spanning multiple agencies
 - Frequent updates on investigation progress
 - USDA FSIS staff part of Epi-Aid team
- **Cooperative owner of Establishment A**
 - Sampling at establishment, voluntary recalls and closure
- **Sampling other plants, source farms**
 - Identify best practices in establishments with no links to illnesses

Outbreak redux

- Cases with pattern JPXX01.1314
 - 10 confirmed → 9 primary, 1 secondary
 - 8 King, 2 Pierce
 - ASSuT antibiotic resistance
- Establishment A again involved



Acknowledgements

Epi-Aid Team

Vance Kawakami
Lyndsay Bottichio
Kristina Angelo
Bonnie Kissler

Washington State Department of Health

Scott Lindquist
Beth Melius
Laurie Stewart
Hanna Oltean
Joe Graham
Larry French
Ron Wohrle
Donn Moyer

Public Health—Seattle & King County (Epidemiology)

Jeff Duchin
Meagan Kay
Wendy Inouye
Elysia Gonzales
Krista Rietberg
Jennifer Lloyd
Phil Wyman & Environmental Health Team

Other local health jurisdiction staff

Benton-Franklin, Clark, Cowlitz, Grays Harbor, Kitsap, Mason, Pierce, San Juan, Snohomish, Thurston, Whatcom, and Yakima counties

WA Public Health Laboratories (PHL)

Romesh Gautom	Brian Hiatt
William Glover	Gina Olson
Ailyn Perez-Osorio	Nusrat Syed
Jeff Lahti	Thi Uyen Dang
Raymond Gee	Ron Sorrell
Zac Ingham	Elisabeth Lara
Kaye Eckmann	Jen Swoveland
Mi Kang	Roxy Meek
Paula Marshland	Zhen Li
Maryann Watkins	

Public Health—Seattle & King County (Environmental Health)

Phil Wyman	Larry Smith
Angelo Marfa	Todd Yerkes
Chris Skilton	Perry Lee
Henry Doan	Eyob Mazengia

Centers for Disease Control and Prevention

Colin Basler
Matthew Wise
Ian Williams
Eija Trees
Laura Gieraltowski
ORPB, DFWED, EWB
Enteric Disease Laboratory Branch

USDA FSIS and APHIS

Jennifer Sinatra
Thomas Gomez
Matt Erdman
John Huntley
Tom Brignole

Washington State Department of Agriculture (WSDA)

Joe Baker
Minden Buswell

Other state health departments and PHL

AK, CA, ID, MT, OR

MT Department of Livestock

Marty Zaluski

This study was supported in part by an appointment to the Applied Epidemiology Fellowship Program administered by the Council of State and Territorial Epidemiologists (CSTE) and funded by the Centers for Disease Control and Prevention (CDC) Cooperative Agreement Number 1U38OT000143-03.

Thank you

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