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# Oregon Reportable Diseases & Notable Outbreaks, 2015

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Health Division





# Low Incident Notifiable Diseases by Year

Orpheus data, May 20, 2015

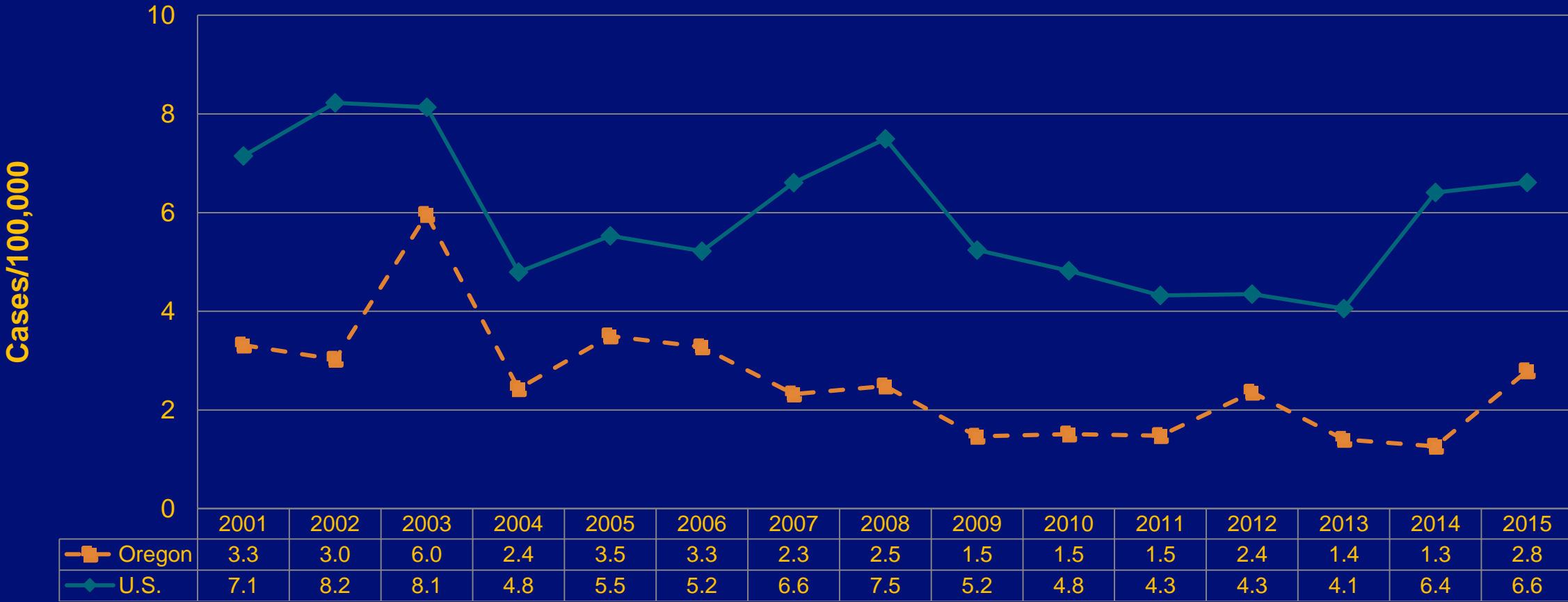
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Babesiosis	0	0	0	1	0	1	0	0	2	2	6
Botulism	0	1	2	0	1	3	6	4	2	3	22
Brucellosis	0	2	1	3	1	1	0	2	2	0	12
Chikungunya	0	0	0	0	0	0	0	0	14	4	18
Colorado Tick Fever	0	0	3	1	0	1	1	0	1	0	7
Cryptococcus	0	0	0	0	0	0	0	2	59	73	134
Cyclosporiasis	2	0	0	0	0	0	1	0	2	0	5
Dengue Fever	2	4	6	4	8	2	4	4	6	0	40
Ehrlichiosis	1	1	1	3	0	6	0	1	0	4	17
Hantavirus pulmonary	1	1	0	2	3	2	2	1	2	0	14
Leprosy	0	1	1	2	0	0	0	0	0	0	4
Leptospirosis	1	0	1	0	0	1	0	0	4	0	7
Mumps	22	2	1	2	3	4	6	3	2	3	48
Non Mycobacterium TB	0	0	1	0	0	0	1	11	82	41	136
Plague	0	0	0	0	2	1	2	0	0	2	7
Psittacosis	3	1	1	0	0	0	0	2	0	0	7
Q fever	0	2	1	4	3	1	4	3	18	2	38
Relapsing Fever	2	0	4	3	0	0	3	1	8	3	24
Rocky Mtn Spotted fev	2	2	3	0	1	0	1	2	2	0	13
Rubella	0	0	0	0	0	0	0	1	0	0	1
Taeniasis	3	3	11	50	3	5	5	2	6	3	91
Tetanus	0	0	0	0	0	0	0	1	0	0	1
Tularemia	3	3	4	1	3	5	0	3	8	7	37
Typhus (murine)	0	0	0	0	0	0	0	3	1	0	4
Total	42	23	41	76	28	33	36	46	221	147	693



Recently Reportable

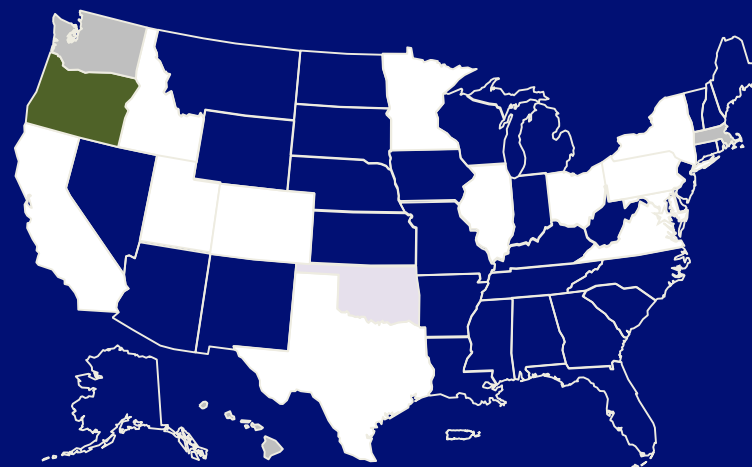
# Shigellosis

# Incidence of *Shigella* infections Oregon and the US, 2001-2015



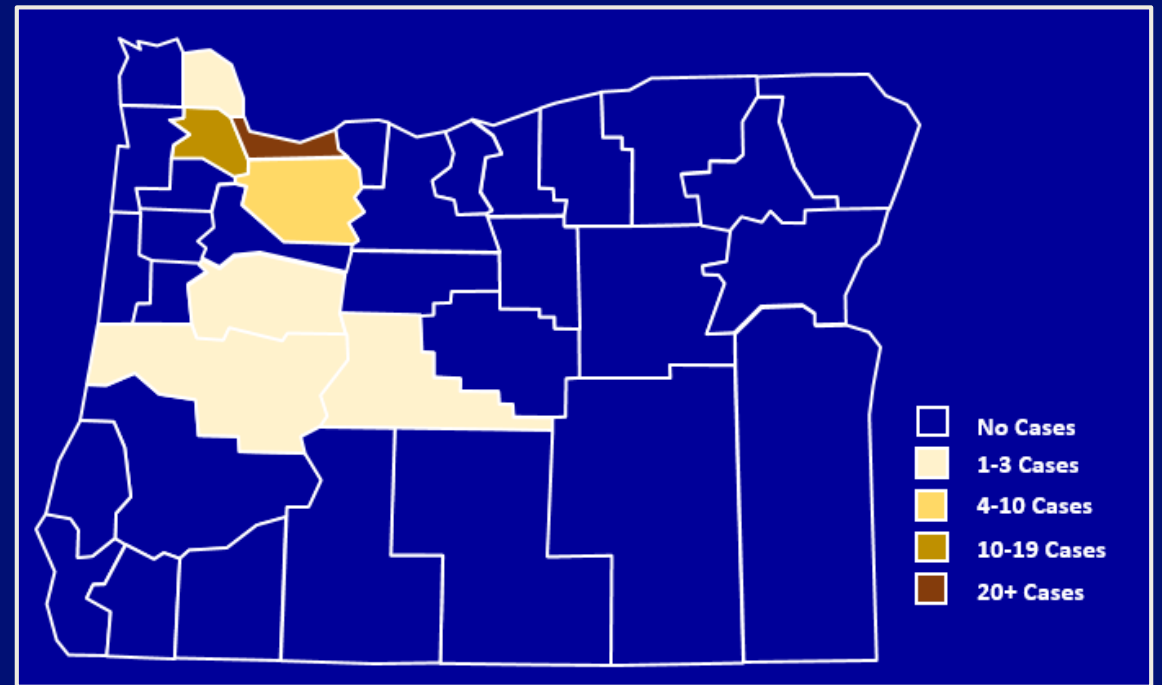
## Overview

- **Multistate *Shigella sonnei* outbreak**
  - June 2015
  - **175 infections**
    - 102 (58%) in Oregon
  - **Men who have sex with men (MSM)**
  - **People experiencing homelessness**



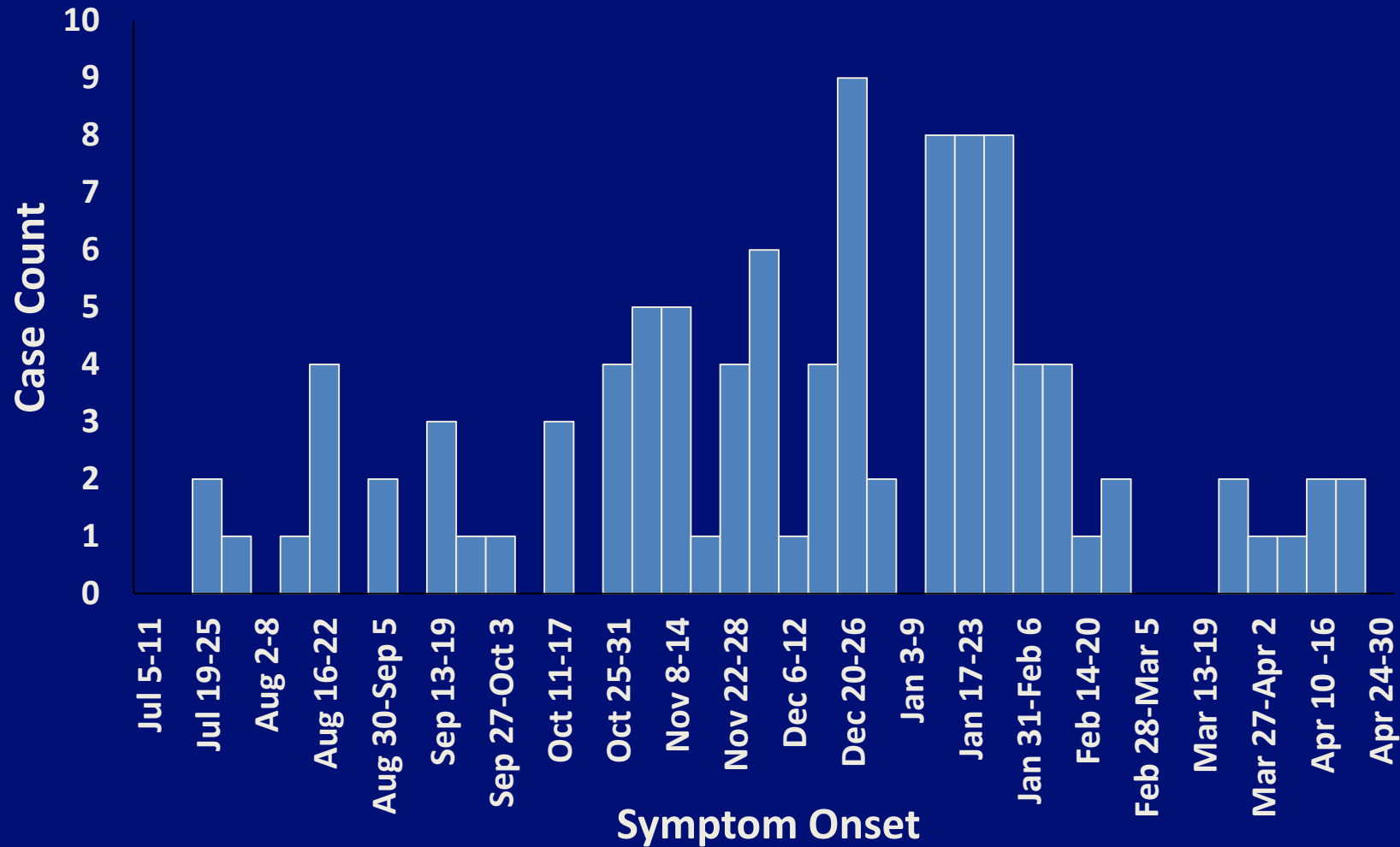
## *Shigella* Outbreak

- 102 confirmed cases as of 5/16/16
- 7 Oregon counties
- Median age: 43 years old (range 18-90)
- Onsets: 7/21/15 – 4/22/16
  - 38\* (40%) with bloody diarrhea
  - 46 (45%) hospitalized
  - 0 deaths



\*Among persons whose symptoms are known

## *S. sonnei* Infections — July 2015–April 2016





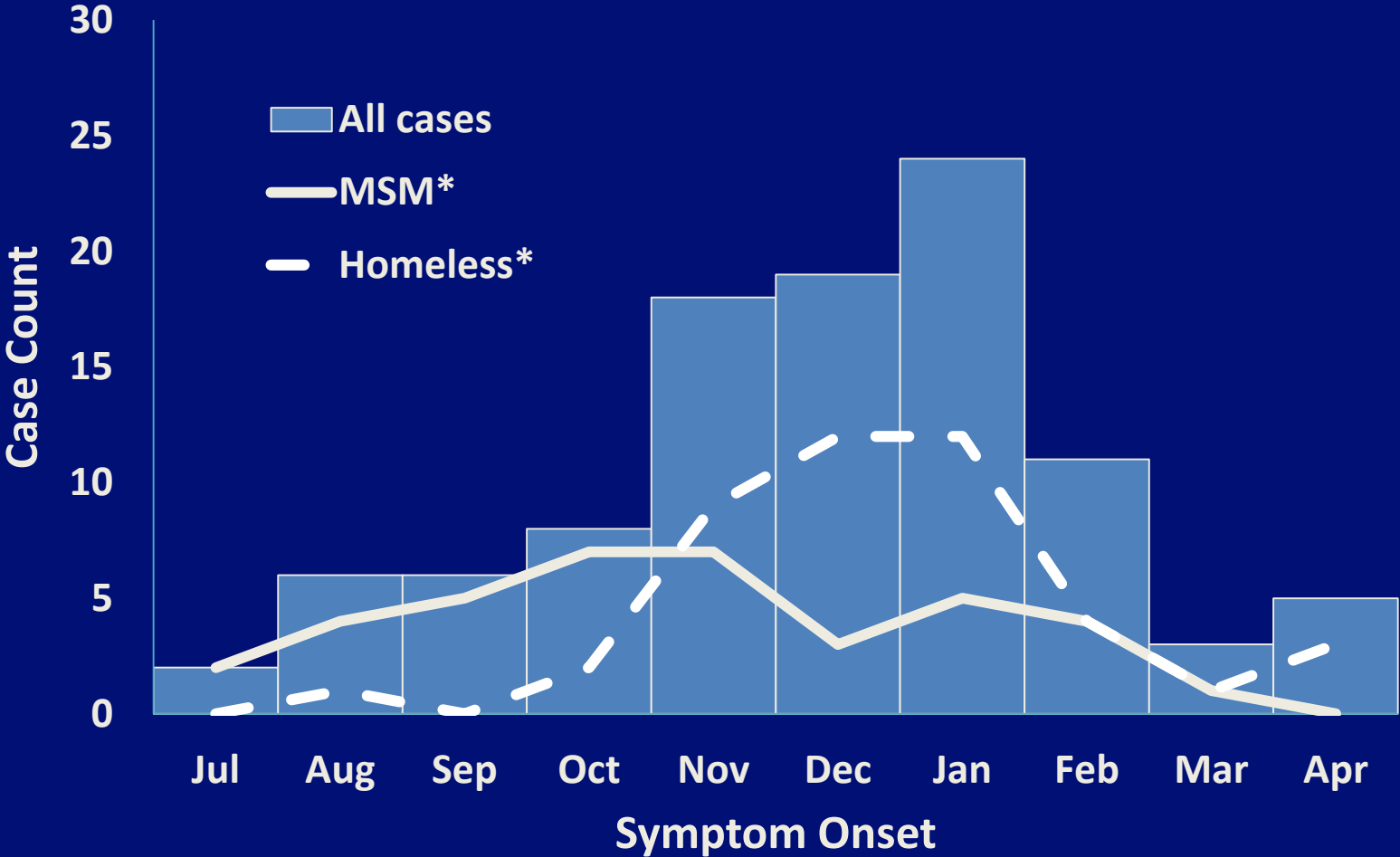
## Patient Characteristics

	N	%*
Women	25	25
Men	77	75
MSM	38**	68
Homeless	44	44
Contact with homeless	12	40
HIV-positive	24	37
Drug or alcohol use	42	62

\*Among persons with known values

\*\*Women excluded

# Epidemiologic Shift



\*Three cases were MSM and homeless

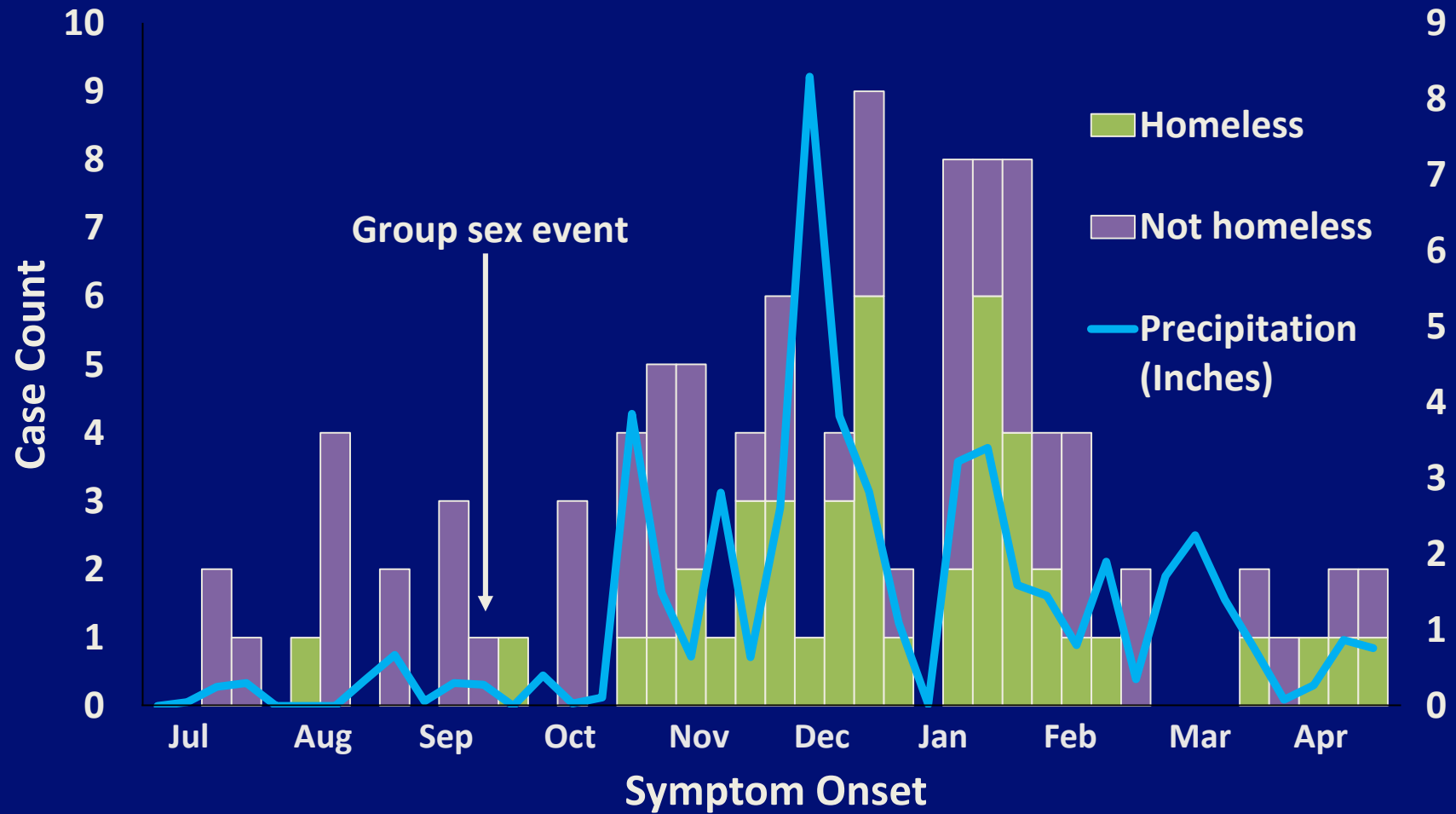
## Epidemiologic Shift

	<b>Before Nov 1 N (%)</b>	<b>After Nov 1 N (%)</b>	<b>Prevalence Ratio (95% CI)</b>
<b>MSM</b>	<b>18 (82%)</b>	<b>20 (25%)</b>	<b>3.3 (2.1–5.0)</b>
<b>Homelessness</b>	<b>3 (14%)</b>	<b>41 (51%)</b>	<b>0.3 (0.1–0.8)</b>

MSM: Men who have sex with men

95% CI: Ninety-five percent confidence interval

# Theories for the Transition

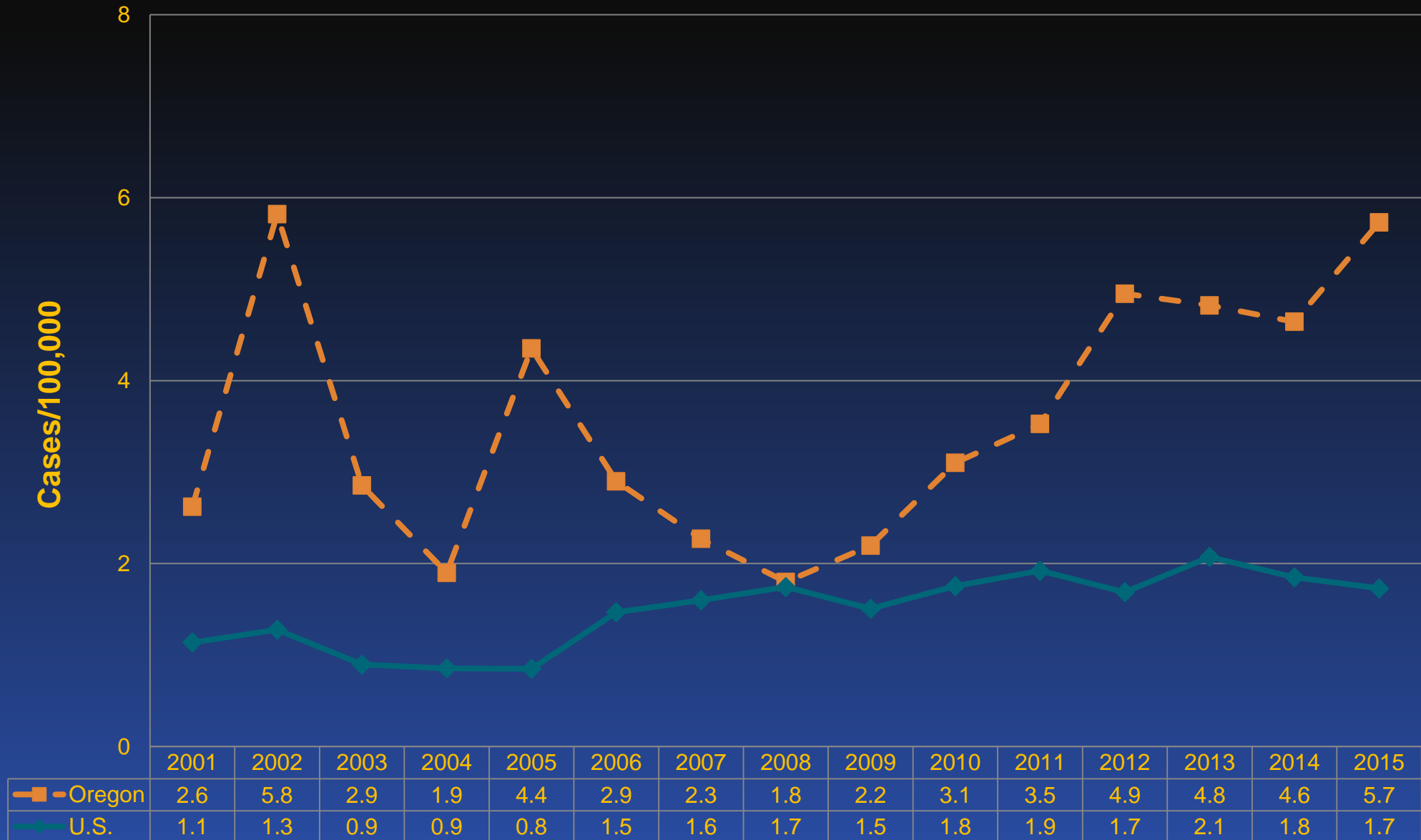


## Summary

- Largest *Shigella* outbreak in Oregon
- Began among MSM, shifted into homeless people
- Unsure why the epidemiologic shift occurred
- Infections continue to occur

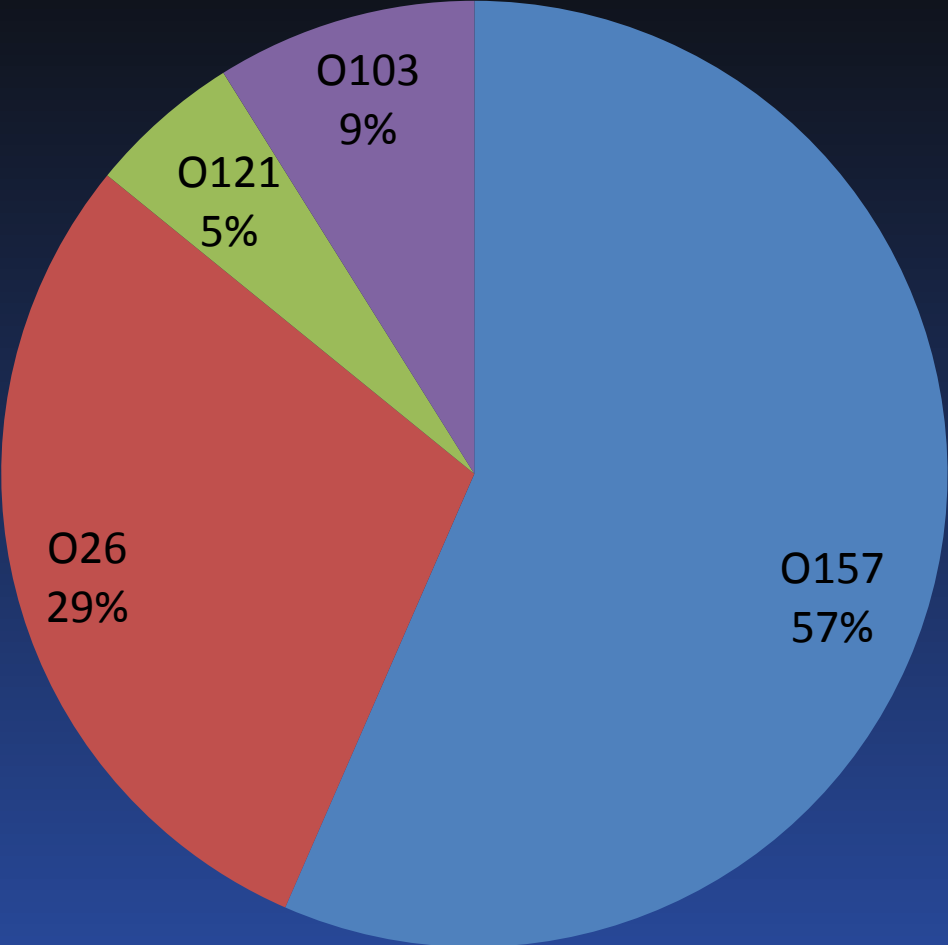
Shiga toxin-producing *E. coli* (STEC)

# Incidence of Shiga toxin-producing *E. coli* infections Oregon and the US, 2001-2015



# STEC cases by Serotype, Oregon, 2015

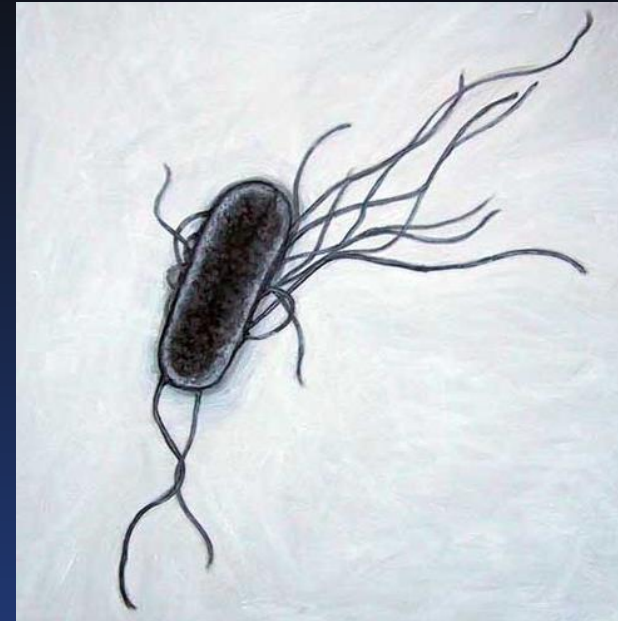
subtype





## *E. coli* O26

- Produces Shiga toxin
- Foodborne and person-to-person
- Most common non-O157 STEC
  - Spectrum of illness
  - Less severe disease
- Outbreaks
  - Day care centers
  - Raw clover sprouts



# It started with a neighborly call

- 10-27-15, Clark County reported 5 STEC cases, onsets 10/21-10/24
  - Epi-linked, but no info on serotypes or PFGE patterns
  - Multiple locations suggested a contaminated food item in the supply chain rather vs. an ill food handler
  - No lab confirmed cases in Multnomah County



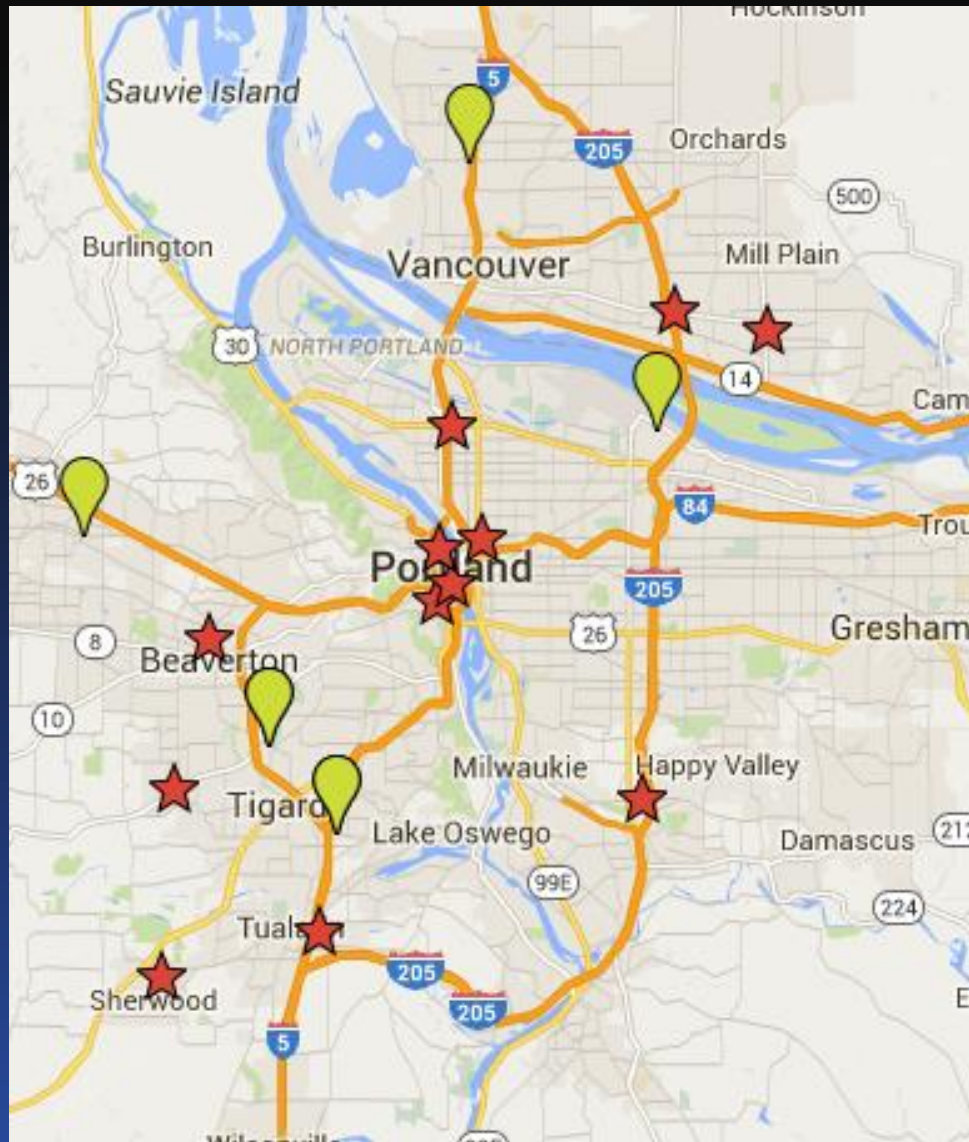
# Environmental Health Inspection



- 10/29: Clark Co. closed Hazel Dell: (4/8 cases linked) probable source of contamination.
- 10/29 Cascade Station Inspection (3/8 cases linked)
  - Inquired about ill food workers
  - Food samples
    - Produce (e.g. cilantro, jalapeños, lime juice, tomatoes, salsa, corn)
    - Cheese
  - Inspection mostly unremarkable

# Justification for Closure

- Severe illness (bloody diarrhea, ~30% hospitalized, ~85% visited ED)
- Potential to affect a lot of people
- Clear epi-link to Chipotle
- Ultimately multi-state
- Agreement among Health Officers in multiple counties

# Chipotle Stores in Metro Area



-  No confirmed cases
-  Confirmed cases

# Chipotle 101

- Corporation that had influence from McDonald's
- Opened in 1993 – 'fresh fast food'
- Dramatic success through the 2000s
  - Customers looking for healthy fast-food alternative

# Food with Integrity

DAY AFTER DAY  
WE'RE COMMITTED



We do it for farmers

animals

the environment

dentists

crane operators

ribbon dancers

magicians

cartographers

and you.

We're committed because we understand the connection between how food is raised and prepared, and how it tastes.

# Chipotle Outbreaks

## History of outbreaks

- Hazel Dell – norovirus – September 2015
- MN – *Salmonella* Newport – August 2015
- CA – norovirus – August 2015
- Boston – norovirus – September 2015
- E coli – 2009, Ohio - norovirus 2008, CA- Hep A 2008



# What was known

- Cases were STEC O26
  - Second most common serotype
- People were hospitalized
- Washington state had the lions share of cases with earlier onset dates
- All cases had eaten food from Chipotle
- An unusually high number of shiga toxin positive specimens had arrived at OSPHL to be subtyped
- Most items served at Chipotle have cilantro, lime juice and red onion
- There are a lot of Chipotle locations
- The media were interested

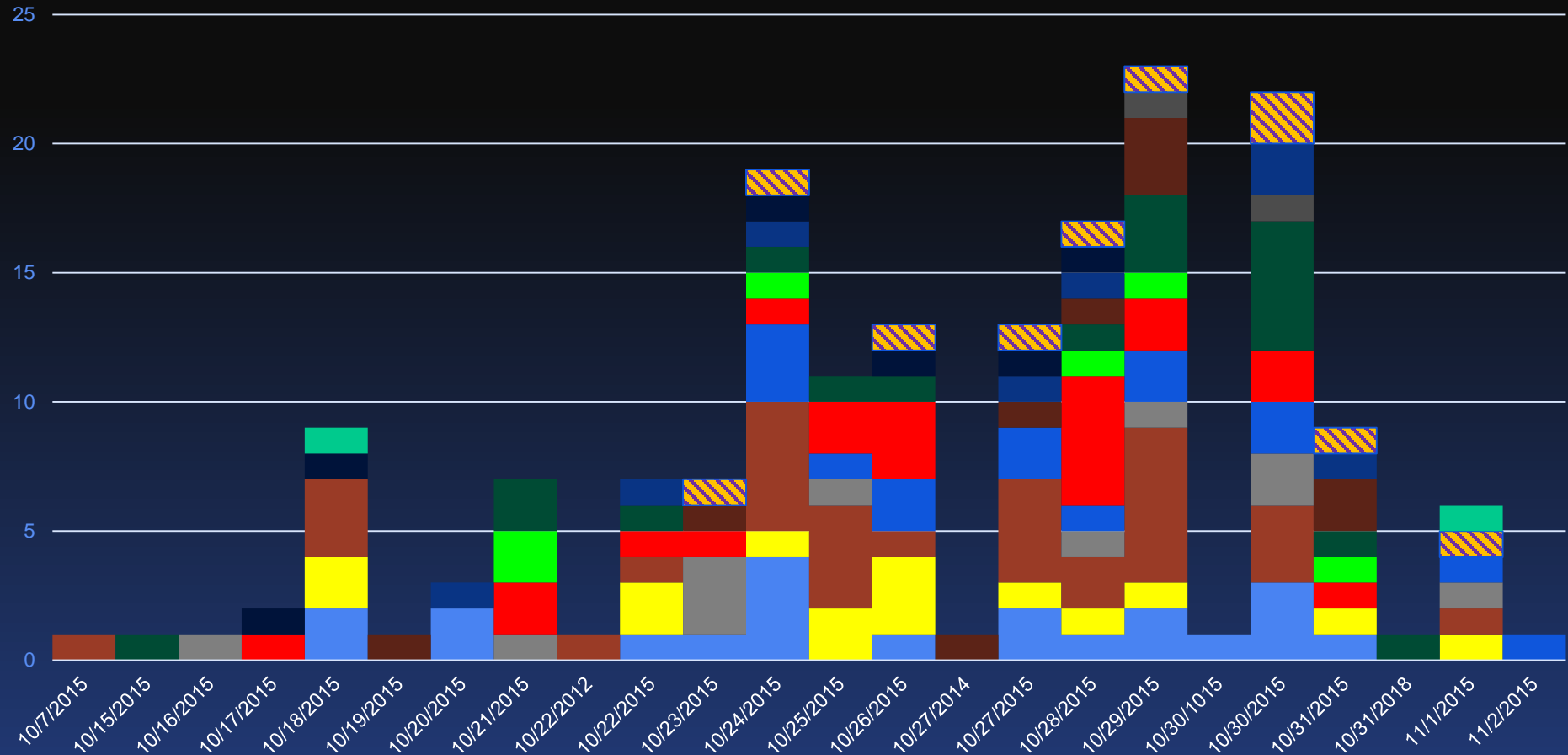
# What was not known

- Extent of illnesses
- If there were additional risk factors among cases
- Whether the PFGE' s matched each other and the best case definition to use
- What the vehicle was that was causing illness
- What Chipotle ingredients only went to Oregon and Washington

# Epidemiologist' s toolkit

- Created a questionnaire & database for case interviews
- Used Survey Monkey with online orders
- Provider alert
- Case control study – matched on meal date and location
- Queried our syndromic surveillance system
- Request that OSPHL prioritize STEC specimens

Survey Monkey respondents with 3± loose stools or bloody diarrhea by location



- Beaverton
- Cascade station
- Clackamas Town Center
- Directors Building
- Gresham
- Hillsboro
- Kruse Way
- Lloyd District
- Pearl District
- PSU
- Sherwood
- Washington Square
- Wilsonville



## Chipotle illness outbreak showcases improved surveillance, lagging solutions

Nov 11, 2015

# Case definition

- Any Oregon resident with symptoms consistent with STEC, onset on or after Oct 7th and:
  - **Confirmed** :Positive culture for *E.coli* O26 with match PFGE pattern for outbreak strain (Xba1 EVCX01.1180)
  - **Presumptive** : Positive culture for *E.coli* O26 with pending PFGE

# Exposure and onset dates

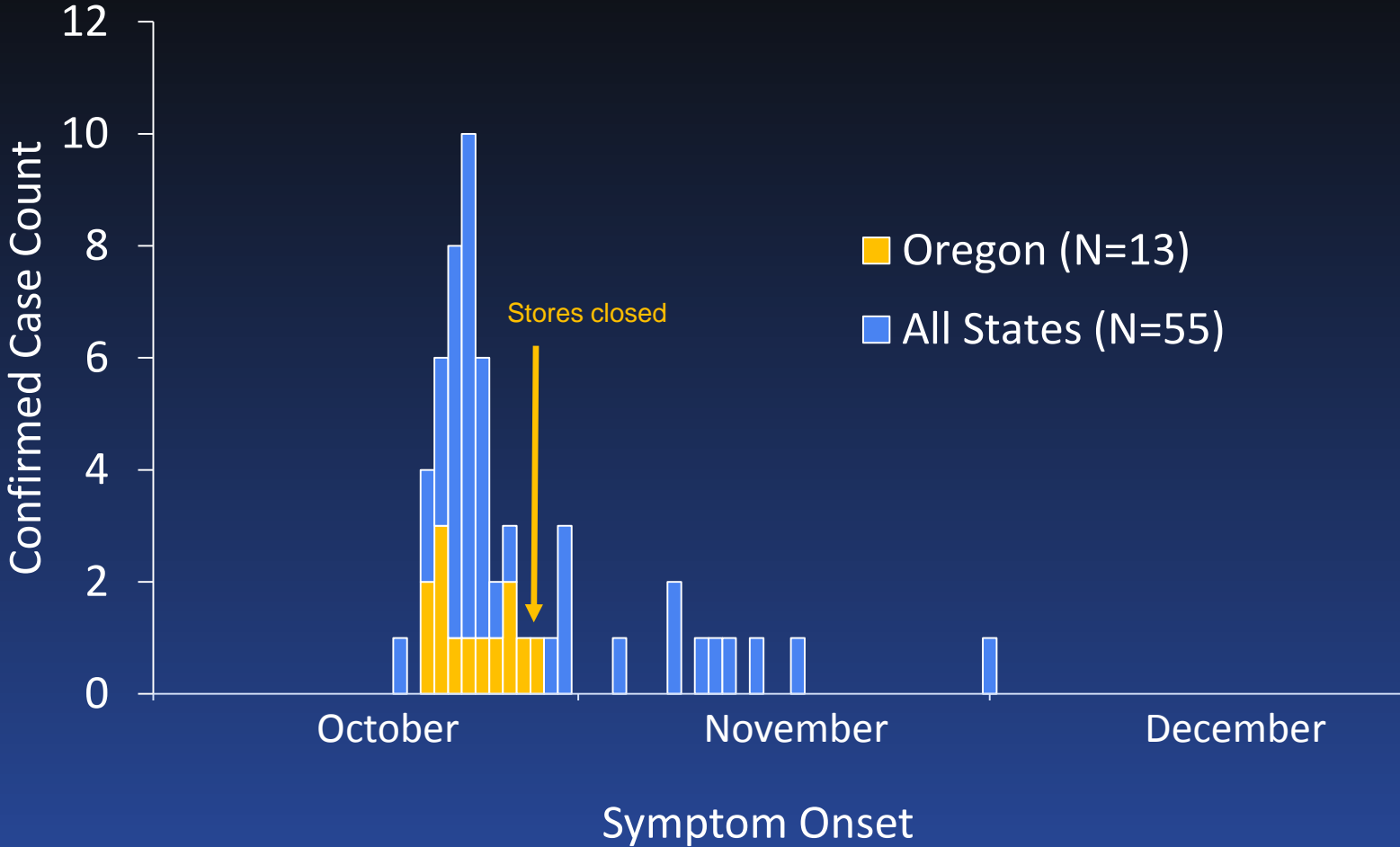
- Washington state
  - meal dates 10/15-10/24
  - onset dates 10/19-10/31
- Oregon cases –
  - meal dates 10/18-10/24
  - onset dates 10/21-10/29
- November 4<sup>th</sup> – first PFGE results; still no cases outside of Oregon and Washington
- November 6<sup>th</sup> – PFGE match in Minnesota

# Outbreak expands

- Nov 9<sup>th</sup> - MN case has no Chipotle exposure
- Use whole genome sequencing
- Nov 20<sup>th</sup> – Cases in CA, MN, OH, NY



# *E. coli* O26 Cases, All States and Oregon, 2015



# Descriptive Epidemiology

	Oregon (N=13)	All States (N=55)
Median age (range)	18 (11-61)	21 (1-94)
Women, N (%)	8 (61%)	31 (56%)
Bloody diarrhea, N (%)	11 (85%)	NA
Hospitalized, N (%)	4 (31%)	21 (38%)
HUS, N (%)	0 (0%)	0 (0%)
Deaths, N (%)	0 (0%)	0 (0%)

# States With Confirmed Cases

- California – 3
- Delaware – 1
- Illinois – 1
- Kentucky – 1
- Maryland – 1
- Minnesota – 2
- New York – 1
- Ohio – 3
- Oregon – 13
- Pennsylvania – 2
- Washington – 27

# Reopening Criteria

1. Food(s) implicated as the potential source(s) of illnesses by epidemiologic data or food testing results is obtained from a new source.
2. All food contact surfaces are thoroughly cleaned and sanitized. \*
3. All fresh or frozen produce items that were in the facility on or before Friday, Oct 31, 2015 are removed from the premises. \*
4. All food employees complete the Chipotle “Employee Symptom Survey”. Food employees will be cleared to work when they indicate no symptoms (vomiting, nausea, diarrhea, abdominal cramps, or fever). Any food employees with symptoms are excluded. Symptomatic food employees will be reviewed and reinstated on a case by case basis.
5. Produce rinsing procedures are revised to ensure all produce is rinsed under cold, running water before any preparation occurs (such as cutting, chopping, or soaking).

\*Verified by health department officials prior to reopening.

# Challenges

- Case definitions – Issues with being ahead of laboratory test results
  - Analysis issues with changing definitions
- Active case finding - 108 suspect cases interviewed
- Multiple meal dates and locations complicate analysis
- Initial focus on regional food distribution due to geographic clustering
  - Laboratory time lags – changing the scope of the investigation – required reconsideration of the hypotheses

# Challenges

- Shiga toxin-producing tests – not specific for O type
- Shiga toxin profiles varied at local labs
- Other O26 cases distributed statewide with no Chipotle connection
  - At one point there were 19 Oregon “cases”
- Shiga toxin positive, symptomatic persons later culture negative

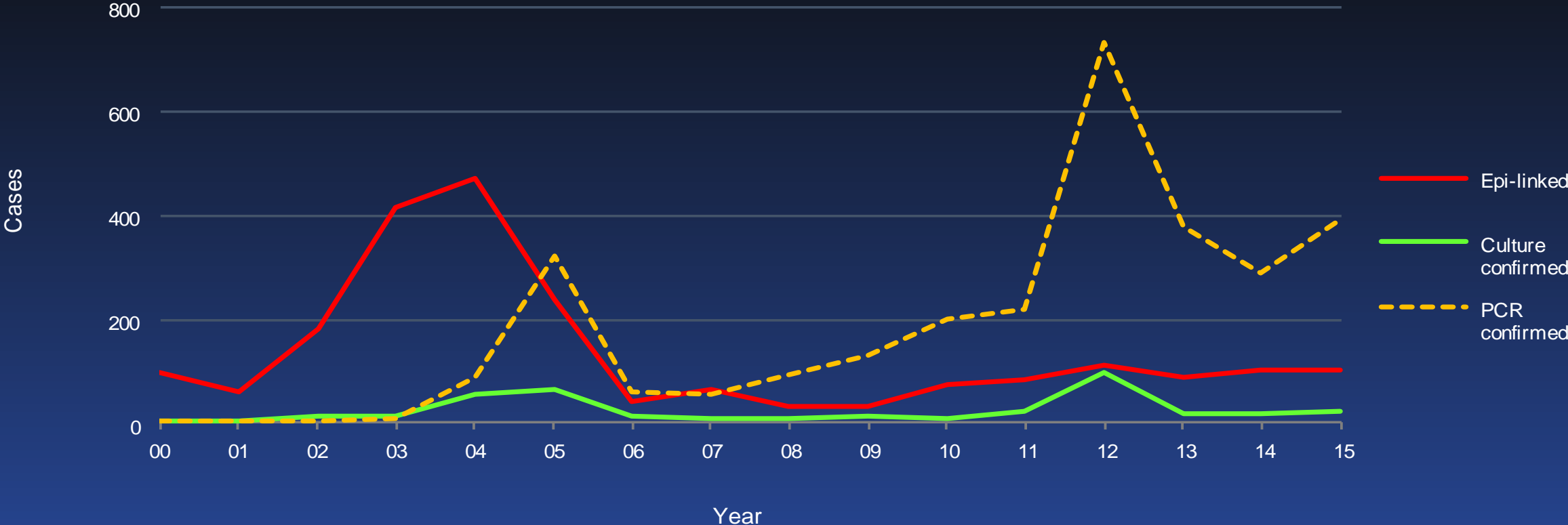
# Pertussis

# Incidence of Pertussis infections, Oregon and US, 2001-2015



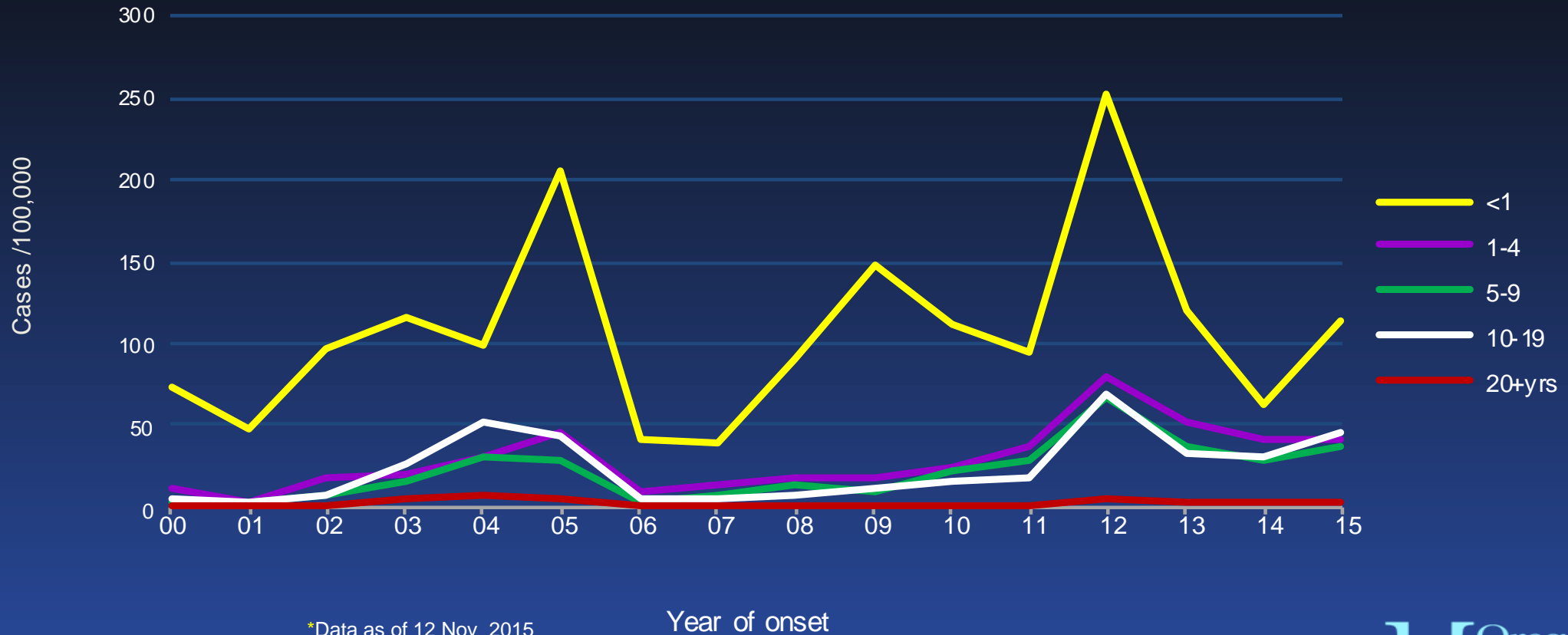


# Pertussis cases by epi linkage and test type, Oregon, 2000–2015\*

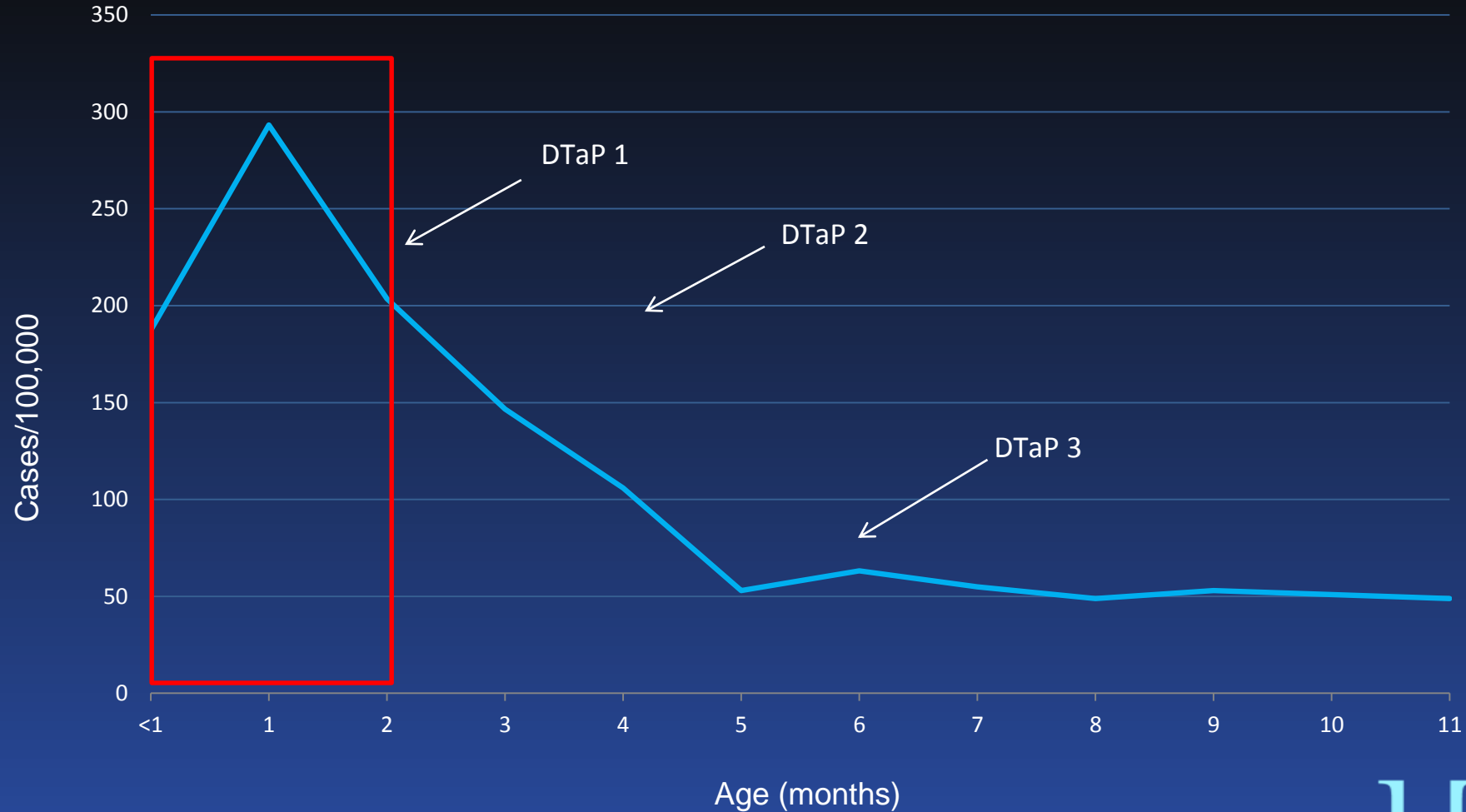


\*Data as of 12 Nov 2015

# Pertussis Incidence by Age Group, Oregon, 2000–2015\*



# Pertussis incidence among infants, Oregon, 2003–2014



## Suffer the Infants

- Most of the suffering from pertussis is experienced by infants too young to be vaccinated
- The focus of Oregon's pertussis prevention and control efforts is the protection of infants, who are at greatest risk for hospitalization and death.



Photo courtesy of CDC

## Vaccination During Pregnancy

- Believed to be the most effective means of protecting young infants
- Provides earlier benefit to mother, thereby protecting infant at birth
- High levels of transplacental maternal antibodies in infants of mothers vaccinated during pregnancy
  - Likely provides direct immunity to infant
- Women should receive a dose of Tdap with every pregnancy
  - Optimal timing between 27 and 36 weeks gestation to maximize maternal antibody response and passive antibody transfer to infant



# Agreement of high effectiveness of maternal pertussis vaccination -- United Kingdom

## Observational study

- Vaccine screening method
- For infants <3 months of age at onset of pertussis

Vaccine effectiveness	Timing of maternal vaccination
91% (83-95)	At least 28 days before birth
38% (-95-80)	0-6 days before or 1-13 days after birth

## Case-Control study

- Cases: infants <2 months of age at onset pertussis infection
- 58 cases, 55 controls
  - Mothers vaccinated during pregnancy: 10 cases (17%) and 39 controls (71%)
- Unadjusted VE = 91% (77%-97%)
- Adjusted VE = 93% (81%-97%)

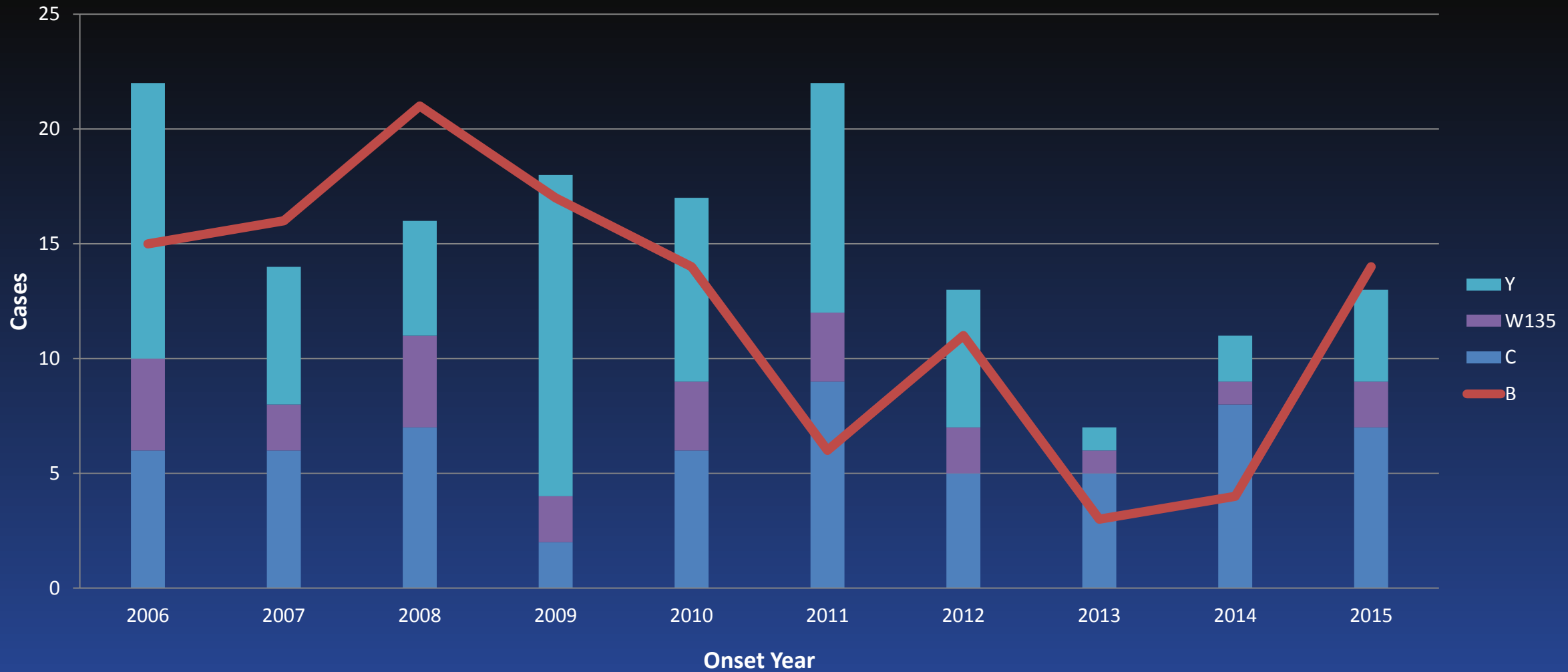
# Meningococcal Disease

# Incidence of Meningococcal Disease Oregon and the US, 2001-2015

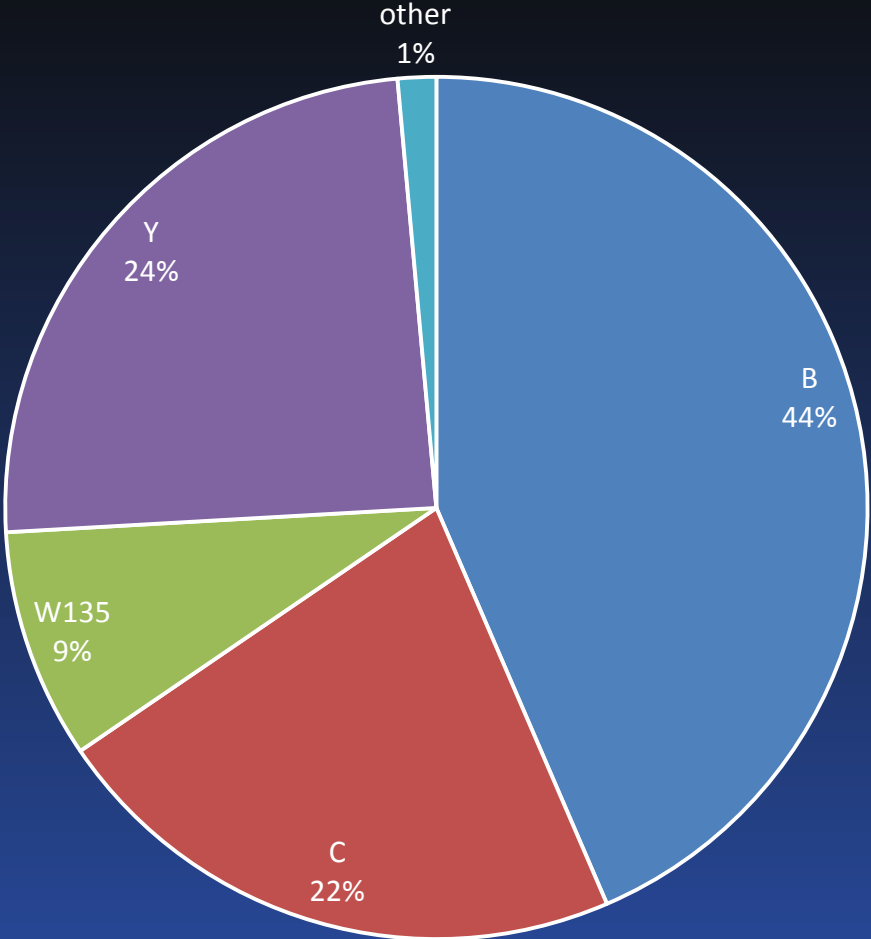




# Meningococcal disease by Serogroup: Oregon, 2006–2015



# Meningococcal Disease by Serogroup, Oregon, 2006-2015

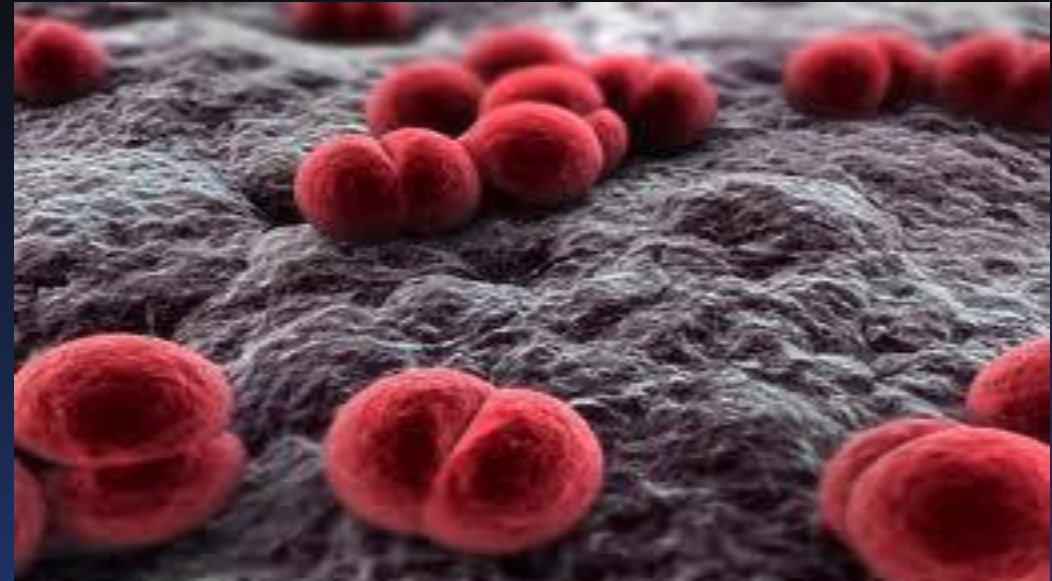




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# Infection and Transmission

- ▶ Humans are the only natural reservoir for *N. meningitidis*
- ▶ Infection
  - ▶ Bacterium attaches to the surface of mucosal cells of the nasopharynx
  - ▶ Can penetrate the mucosa and gain access to the bloodstream, resulting in systemic disease
  - ▶ Up to 10% of population are colonized
- ▶ Transmission
  - ▶ Human to human through direct contact with large droplet respiratory secretions
  - ▶ Incubation period is usually 3-4 days



*Neisseria meningitidis*

University of Oregon Meningococcal Outbreak Timeline  
Case #3  
19 y/o freshman at U of O



# Control Measures

- ▶ Antibiotic prophylaxis was recommended to all close contacts of each case
- ▶ Vaccination?
  - For serogroup C outbreaks...
  - ▶ Vaccination of the population at risk should be considered if the attack rate is  $>10$  cases/100,000 persons.
    - ▶ Attack rate for U of O campus population is 2.4/100,000

“B”UT....

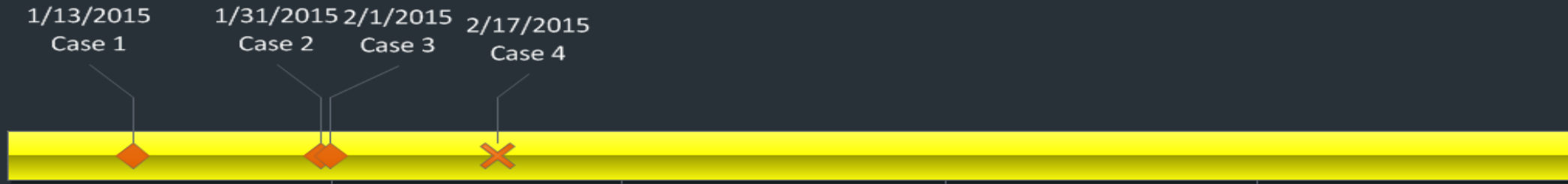
# Interim Serogroup B Guidance...

1 case	Serogrouping of isolate or clinical specimen performed <ul style="list-style-type: none"><li>• Isolate typed or stored for future molecular typing, or sent to CDC</li><li>• Case investigation</li><li>• Chemoprophylaxis of close contacts</li></ul>
2 cases in 6 months	Same response as after 1 case with the following additions: <ul style="list-style-type: none"><li>• If both cases have serogroup B disease, the state health department should contact CDC</li><li>• Send isolates to CDC for molecular typing for both cases</li></ul>
3 or more cases in 6 months	Same response as after 1 case with the following additions: <ul style="list-style-type: none"><li>• If all cases have serogroup B disease, the state health department should contact CDC</li><li>• Send isolates from additional cases to CDC for molecular typing and testing to predict strain coverage of vaccine</li><li>• <b><i>If all cases have serogroup B disease and available information supports use of MenB vaccine, consult CDC regarding the use of MenB vaccine using a CDC-sponsored expanded access IND</i></b></li></ul>

# University of Oregon Meningococcal Outbreak Timeline

## Case #4

18 y/o freshman at U of O – fatal case





# Serogroup B Meningococcal Vaccines

- October 29, 2014, the FDA licensed the first serogroup B meningococcal vaccine ([Trumenba<sup>®</sup>](#)). FDA approved this vaccine for use in people 10-25 years of age as a 3-dose series.
- January 23, 2015, FDA licensed a second serogroup B meningococcal vaccine ([Bexsero<sup>®</sup>](#)). FDA approved this vaccine for use in people 10-25 years of age as a 2-dose series.



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**GET THE VAX**

MARCH 2-5 MENINGITIS  
VACCINATION CLINIC

**LIFE  
HAPPENS  
HERE**

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# Case Demographics

- 75% female
- 75% 19 year olds
- 100% freshman
- 50% lived off-campus
- 50% Greek

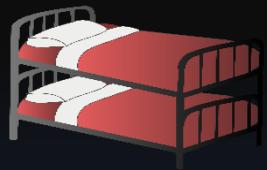


# University of Oregon At-Risk Population

<u>Population</u>	<u>Cases</u>	<u>Denominator</u>	<u>Attack Rate</u>
Undergraduates	4	19,250	21/100,000
Dorm Dwellers	2	3,505	57/100,000
Greek society members	2	3,158	63/100,000
Freshman	4	3,780	106/100,000

All University of Oregon undergraduates were included

# University of Oregon Meningococcal Outbreak – 2015



Case 1  
1/13



Jan

Case 2  
1/31



Feb

Case 3  
2/1



Case 4  
2/17



Mar



Round 1 Mass  
Vaccination clinic

Case 5  
3/8



Apr



Case 6  
3/14



Case 7 5/7



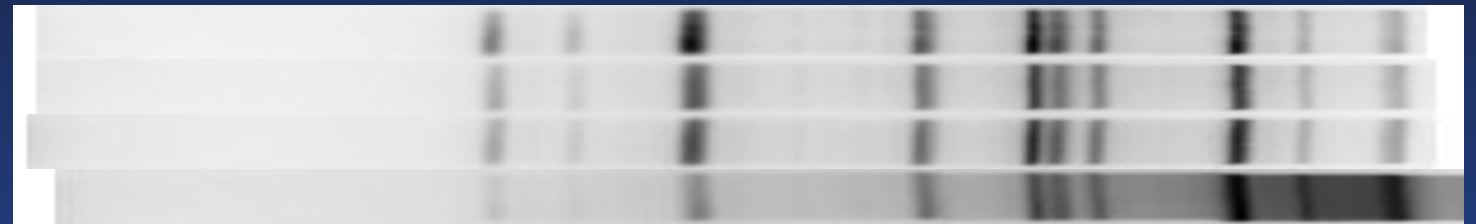
May



Round 2 Mass  
Vaccination clinic

# University of Oregon Cases

- All serogroup B
- All match by PFGE
  - Match by WGS



# Likelihood Ratio of Attending a Vaccination Clinic by Risk Category

<u>Risk Group</u>	<u>Vaccination Clinic Attendance Rates</u>	<u>Likelihood Ratio of Attending Vaccination Clinic (95% CI)</u>
Greek	18%	1.3 (1.2-1.4)
Freshman	26%	2.3 (2.2-2.9)
Dorm Dwellers	29%	2.4 (2.4-2.6)

## Cost

	<u>Cost per Dose</u>	<u>Cost per Series</u>	<u>Total Cost</u>	<u>Number (%) Fully Vaccinated</u>
<b>Estimated Cost</b> <i>Theoretical</i>	<b>\$134</b>	<b>\$402</b>	<b>\$7.7 million</b>	<b>19,250 (100%)</b>
<b>Actual Cost</b>	<b>\$194.05</b>	<b>\$1,576</b>	<b>\$1.8 million</b>	<b>1,122 (6%)</b>

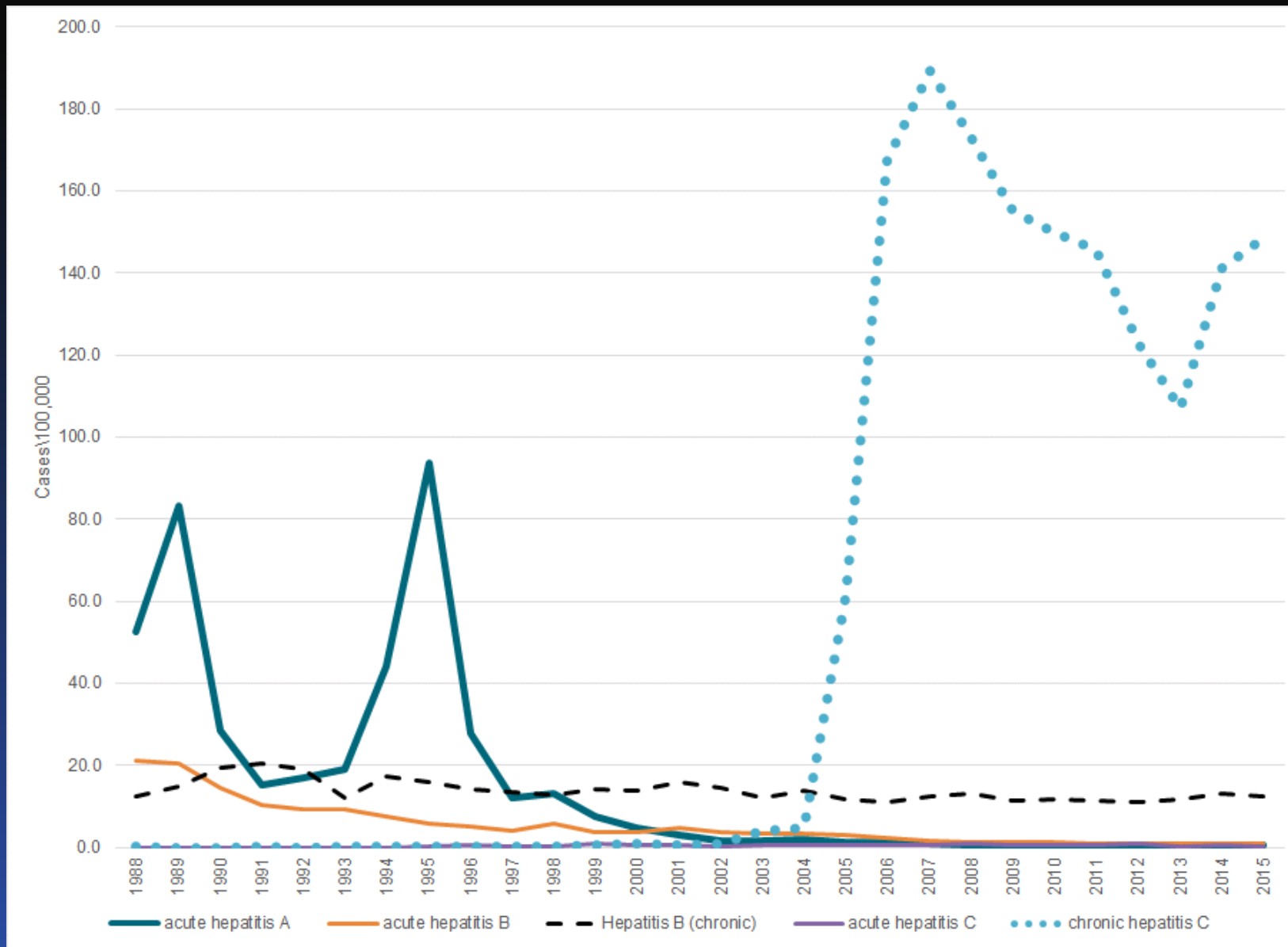


# Summary

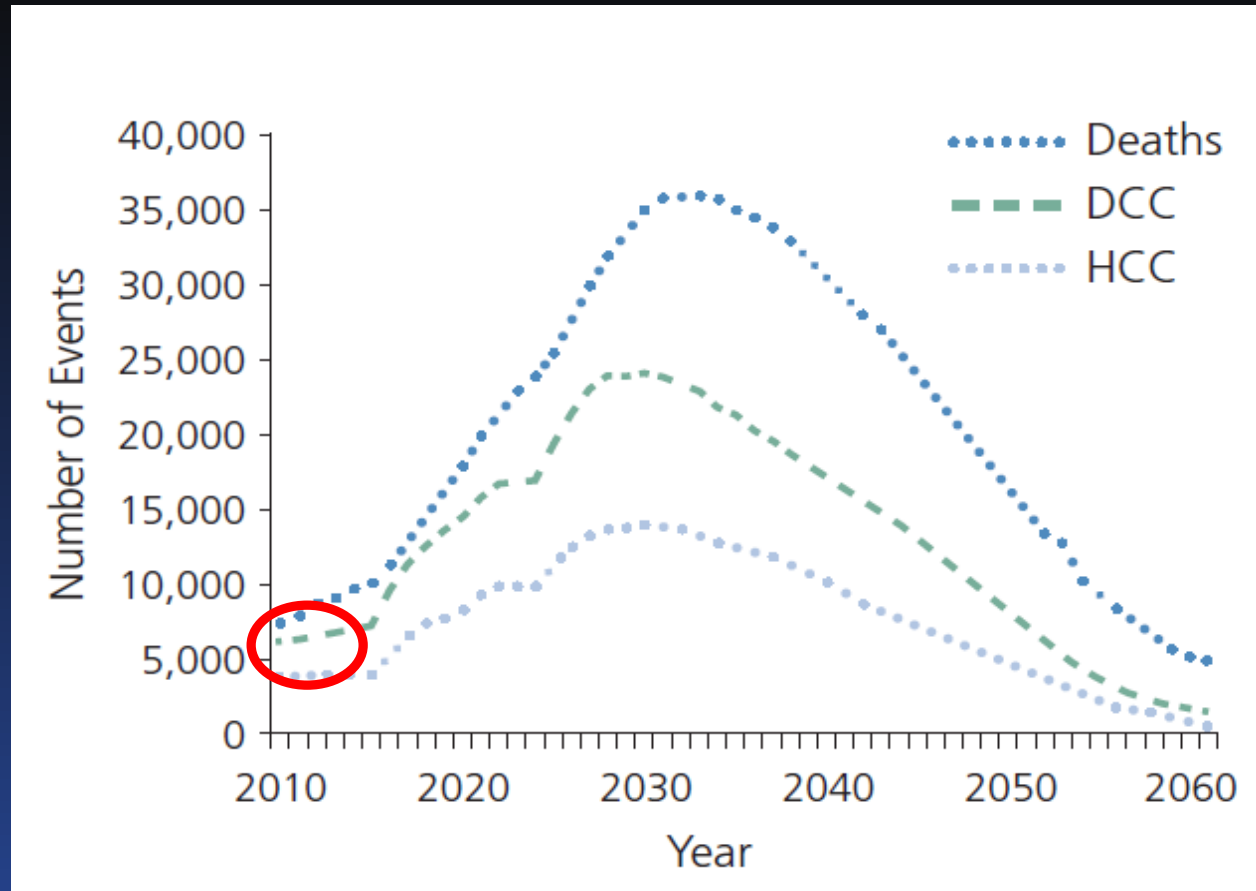
- 7 cases of serogroup B meningococcal disease associated with University of Oregon undergraduates
  - 1 fatal
- Control measures:
  - Prophylaxis of close contacts
  - Vaccination campaign
- Ongoing efforts to maximize vaccination rates
- Learning from this...
  - Who gets vaccinated
  - Communications
  - Carriage & Herd Immunity?

# Hepatitides

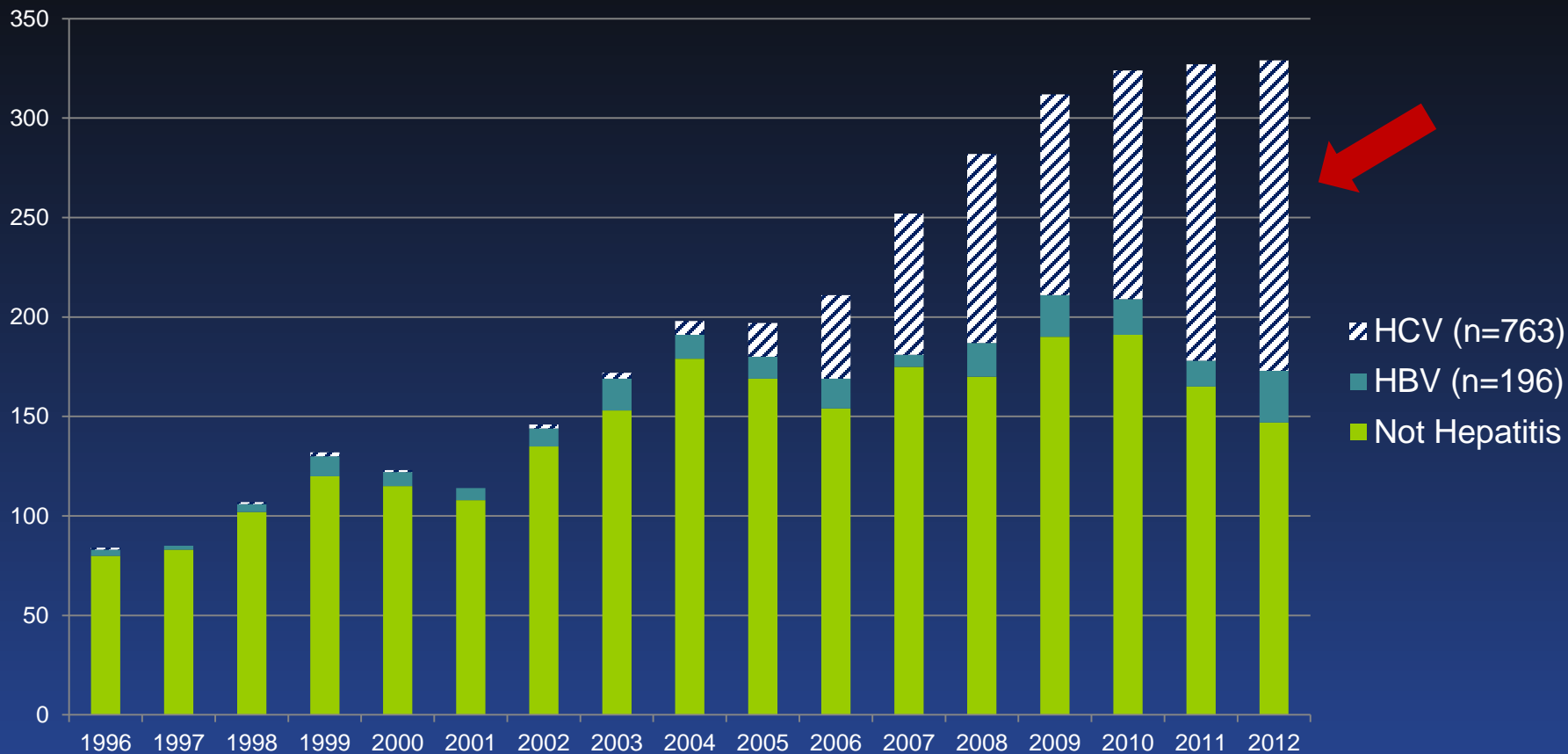
# Incidence of Hepatitides, Oregon, 1988-2015



# Projected burden of HCV related mortality, decompensated cirrhosis (DCC), and hepatocellular carcinoma (HCC)

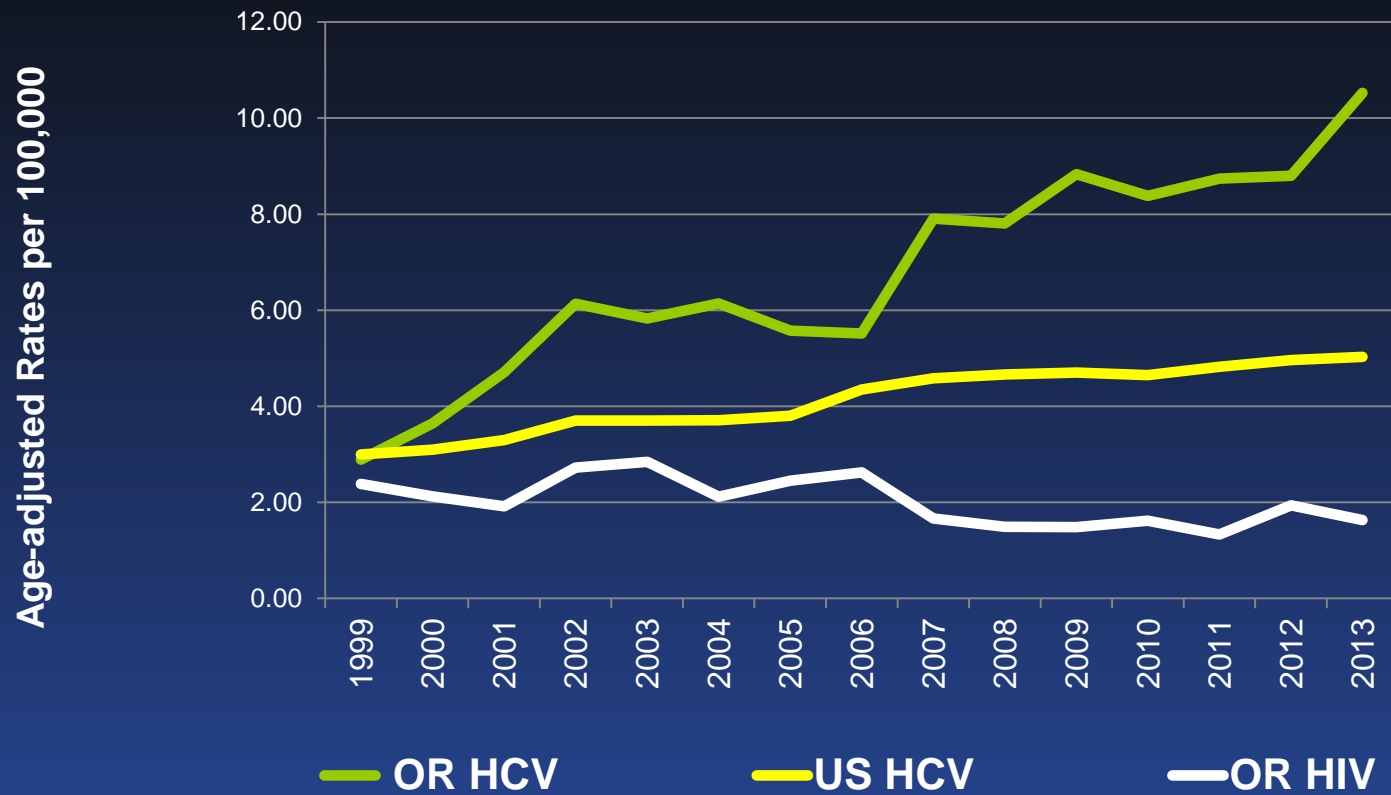


# Chronic viral hepatitis cases by year of liver cancer diagnosis, Oregon, 1996-2012



# Age-adjusted mortality from HCV and HIV in Oregon and from HCV nationally, 1999-2013

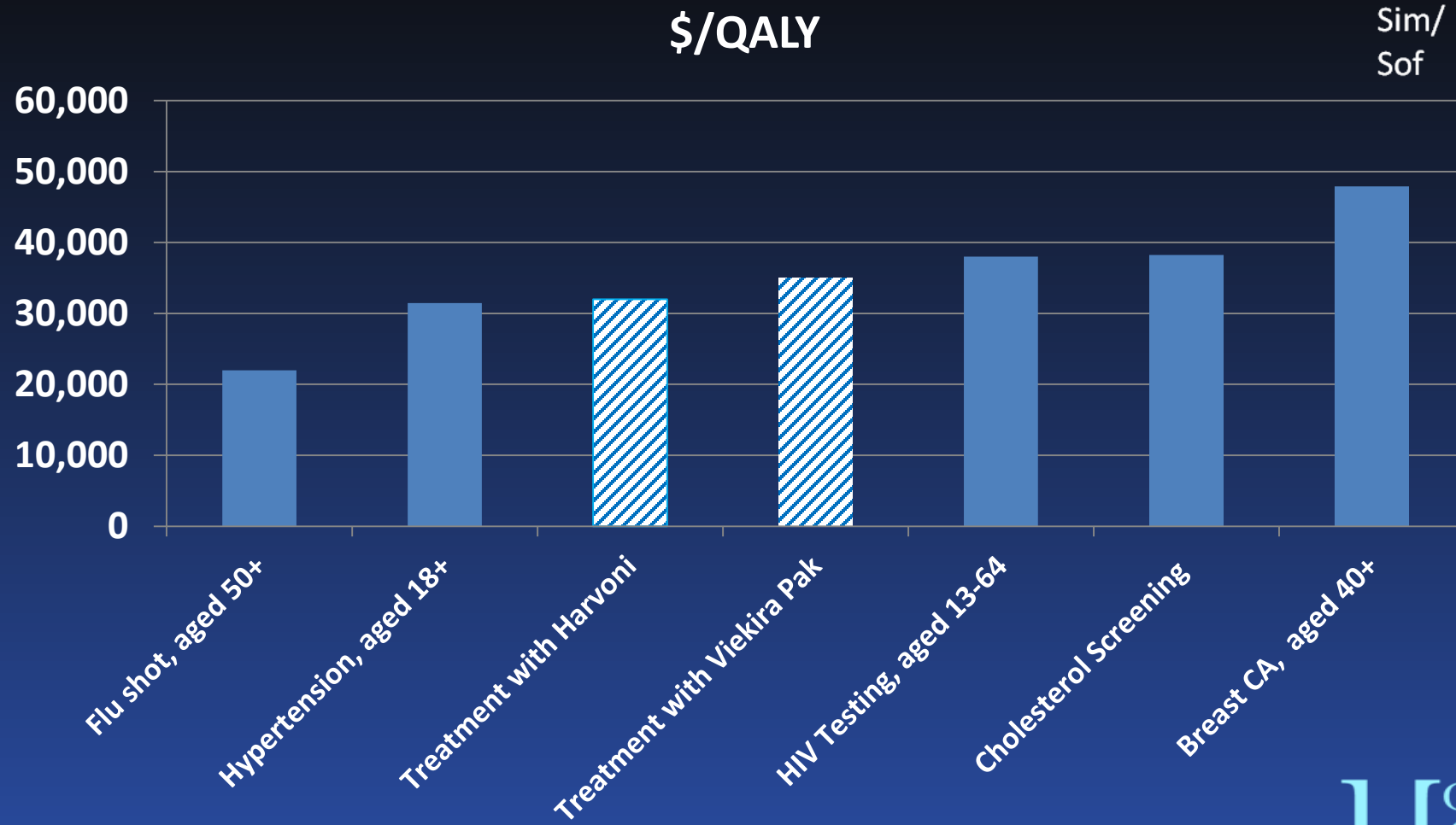
Age-adjusted mortality rates



# New HCV regimens and their cost

Generic Name	Brand Name	Manufacturer	Approximate Cost for 12-week Therapy	Date of FDA approval
Sofosbuvir	Sovaldi	Gilead Sciences	\$84,000	12/2013
Ledipasvir + sofosbuvir	Harvoni	Gilead Sciences	\$94,500	10/2014
Simeprevir	Olysio	Janssen Therapeutics	\$66,360	11/2013
dasabuvir/ ombitasvir paritprevir/ ritonavir	Viekira Pak	AbbVie	\$83,319	12/2014
Ombitasvir/ paritprevir/ ritonavir	Technivie	AbbVie	\$76,653	7/2015
Decatasvir	Daklinza	Bristol-Meyers Squibb	\$63,000	7/2015

# Comparison of HCV cost effectiveness with other preventive services





# Age Distribution in HCV-related hospitalizations, cases of liver cancer, and deaths in Oregon, 2009-2013

HCV-related...	Baby Boomers	> 65
Hospitalizations	83%	8%
Liver Cancer	77%	16%
Deaths	80%	16%

# Federal Medicaid Program communications

## CMS Issues Notice Regarding Barriers to HCV Treatment

By Dalia Deak

Yesterday, the Centers for Medicare & Medicaid Services (CMS) issued a [notice](#) that affirmed CMS's commitment to provide prescription drugs to beneficiaries, specifically highlighting beneficiaries suffering from hepatitis C virus (HCV). The notice comes at a moment of heightened interest in the cost of prescription drugs (particularly on the federal level as an inquiry in the [Senate](#) has been initiated regarding rising drug prices).

In the statement, CMS:

- Reminded the states of their obligation, under the terms of the Social Security Act, that Medicaid programs must cover prescription drugs for medically accepted indications if the manufacturer of the drug is a manufacturer with whom they have entered into a rebate agreement with;
- Discussed the concern regarding costs of direct-acting antiviral (DAA) HCV drugs, emphasizing the role of competition and negotiation in bringing down the drug prices;
- Expressed concern regarding some states' policies to restrict access to the DAA HCV drugs that may be contrary to their obligations under the Social Security Act;
- Encouraged states to ensure that their policies do not unreasonably restrict coverage of effective treatment;
- Reminded states that drugs available under the states' fee-for-service programs must also be available to beneficiaries of Medicaid managed care organizations; and
- Indicated that CMS will monitor state Medicaid policies for DAA HCV drug coverage to ensure that they are compliant with approved state plans, statutes, and regulations.

CMS also followed up its notice with a [letter](#) to the CEO of AbbVie asking for additional information regarding the types of value-based purchasing arrangements offered to payers and to state Medicaid agencies by December 31, 2015.

Regulatory

## Medicaid calls on Gilead, AbbVie to answer hep C drug pricing questions

by Emily Wasserman | Nov 6, 2015 9:34am

## Federal Officials Warn States on Hepatitis C Drug Restrictions

U.S. Officials say state Medicaid programs may be violating law by denying expensive medicine

## Medicaid Denial for Hep C Drugs Nearing 50% in Some States

Laird Harrison  
November 18, 2015

## Covering Costly HCV Tx: Who Makes that Call?

— Medicaid budgets face 'Death Star scenario'



# What can you do about hepatitis C?

**USER FRIENDLY**



**#TimeForAction**  
TO INCREASE  
**HEPATITIS TESTING**



**FIND OUT IF YOU HAVE HEPATITIS C**  
**IT COULD SAVE YOUR LIFE**

**BORN FROM 1945-1965?**  
SOME PEOPLE DON'T KNOW HOW OR WHEN THEY WERE INFECTED

People born from 1945-1965 are **5x MORE LIKELY TO BE INFECTED WITH HEPATITIS C**

**3 OUT OF EVERY 4** people with Hepatitis C are born between these years

**75%** of people living with Hepatitis C do NOT know they are infected

Many people can live with HEPATITIS C for DECADES WITH NO SYMPTOMS

**CDC recommends anyone born from 1945-1965 GET TESTED**

**TESTED**      **NOT TESTED**

**Ever injected?  
Get tested**

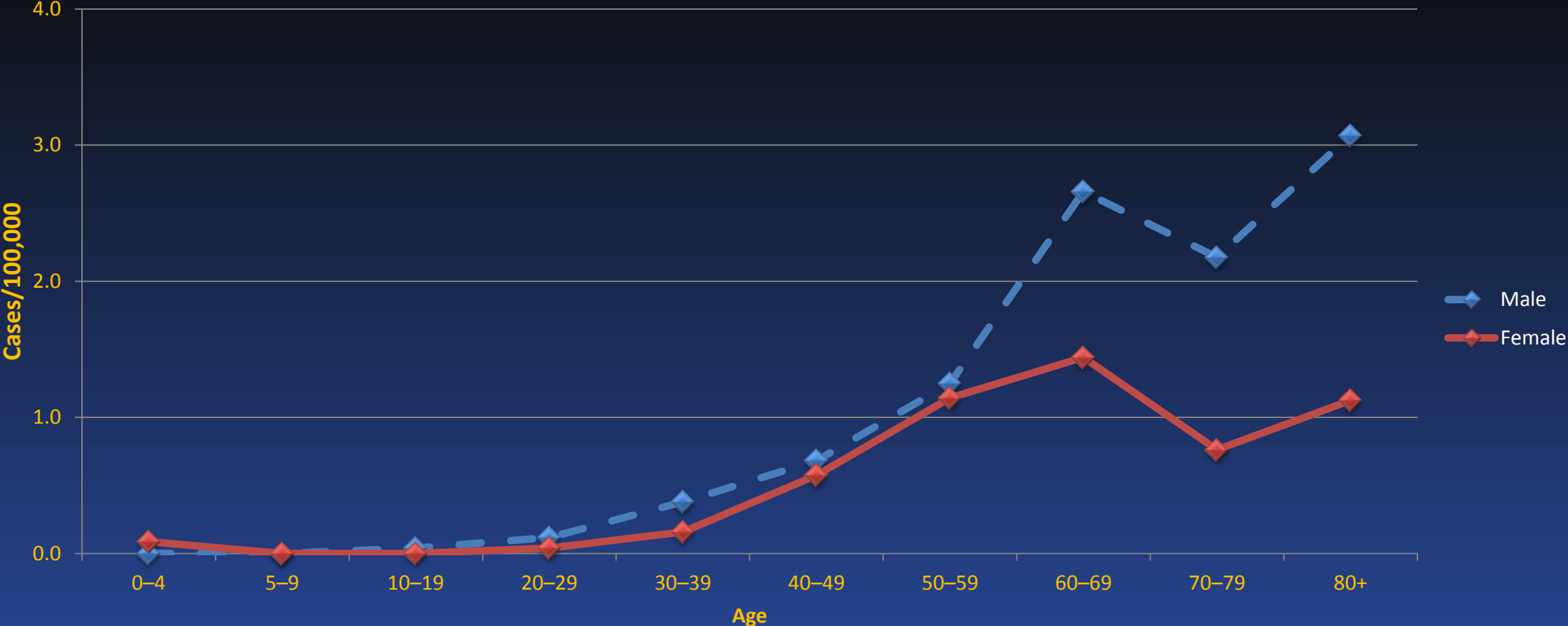


# Legionellosis

# Incidence of Legionellosis, Oregon and the US, 2006-2015



# Incidence of Legionnaire's Disease by age and sex, Oregon 2006-2015



# Legionella outbreak at Oregon resort

Characteristics	Case A	Case B	Case C	Case D
Report date	10/7/14	1/16/14	2/26/13	9/27/11
Age	62	73	57	54
Gender	Male	Female	Male	Female
County of residence	Marion	Clatsop	Linn	Lane
Travel dates	9/21 - 9/28	12/27-12/30	2/14-2/15	9/15-9/16
Sx Onset	9/24/14	1/11/14	2/19/13	9/19/11
Stayed at	Condo - 04	Condo - 04	Condo - 03	Single Fam
Risk factors	Age>60;AC; shower; <b>used tub</b>	Age; COPD; immunocomp humidifier; <b>did not use tub</b>	Smoker; used tub	Smoker; HC worker; <b>used tub</b> ; other exp.

# Outbreak Investigation - Methods

Conducted environmental assessment

- physical testing
- collected samples

Performed lab testing

Increased awareness of Legionella

- provided resources



# Field Trip to the Site



# Outbreak Investigation

## - Results

### Raw water sample chemistry:

- Free chlorine 0.0
- Combined Chlorine 0.0
- pH 8.2
- Alkalinity 40 ppm
- Ca Hardness 50ppm
- Temperature 104 F (?)

### Lab test results – positive for

- all three samples from shower head
- one from kitchen sink faucet

# Outbreak Investigation

## - Results

- ▶ **Type of facility** – private, members only; not licensed or inspected by local PH
- ▶ **Water supply** - supplied by well water; these were pretty deep @ 736 ft. and 800 ft.; water **not chlorinated**
- ▶ **Occupancy** – high --more than 90% occupied at any given time
- ▶ **Cleaning procedures** met standard guidelines, there was **no recent maintenance** in the building implicated, and **no recent reports** of people calling sick

# Implement Control & Prevention Measures

- ▶ Immediate steps
  - Close implicated units
  - Remediate
- ▶ Long terms steps
  - Recommend expert advice
  - Identify and implement control measures, including thermal disinfection & hyper-chlorination
- ▶ Identify & report new cases
- ▶ Report progress on eradication of pathogen

# Environmental Protection Agency & Legionella

Technologies for Legionella Control: Scientific Literature Review, November, 2015

- Major public health concern – high morbidity and mortality
- Natural in environment, colonizes biofilms in premise plumbing\*
  - 62% of waterborne disease outbreaks – Legionella
  - 80% caused by environmental conditions within water systems of buildings
- Surface Water Treatment Rule (SWTR) – 1989
  - Presumes that compliance with treatment requirements will control for *Legionella*
- \*premise plumbing – after service connection to the tap. Conditions can lead to Legionella proliferation – water heating, long residence time, low disinfectant residuals, cross connections, installation and repairs

# Rules pertaining to public water systems

- ▶ Low concentrations of Legionella entering buildings from these sources may colonize and regrow in hot water systems
- ▶ Large buildings with lots of plumbing and recirculating hot water systems (for example: hospitals, hotels, casinos) may be most susceptible
  - ▶ Hospitals particularly concerned due to increased susceptibility of patients

# Rules pertaining to public water systems

- Large building owners are considering treatment or other practices to reduce risk
- OHA-DWS regulates the Safe Drinking Water Act up to the user's meter – beyond that is the responsibility of the property owner and Plumbing Code
- Building owners that add treatment need to be regulated as a public water system
  - Plan review and approval
  - Monitoring requirements
  - Operator certification



# Control Technologies

- Chlorine – effective but residual maintenance is important, efficacy ↑ with ↑ temperature
  - Biofilms and *Legionella* in the amoeba shields it from chlorine
  - Potential water quality issues with byproducts, taste, odor and corrosion
- Monochloramine – wide range of inactivation, efficacy ↑ with ↑ temperature
  - Several studies showed > penetration of biofilms than chlorine
  - Potential water quality issues with byproducts, nitrification. Corrosion
- Chlorine Dioxide – effectiveness at low doses, can penetrate biofilms and amoebae, efficacy ↑ with ↑ temperature
  - Potential water quality issues – formation of chlorite/chlorate, taste, odors and corrosion



# Control Technologies

- Copper-Silver ionization(CSI) – can reduce cultivability of Legionella
  - Biofilms and *Legionella* in the amoeba shields it from CSI
  - Potential water quality issues high copper concentrations and corrosion
  - Legionella strains appear to develop resistance
- Ultraviolet disinfection – shown effective at decreasing/eliminating at low doses
  - Only effective on water flowing through reactor – requires supplemental tx if *Legionella* is in premise plumbing
  - Some reactors ? Tolerance of high temp or disinfectants
  - Iron, manganese, calcium, and magnesium may decrease UV output
- Ozone– effectiveness wide range of conditions
  - effects on biofilms and amoebae, efficacy not well characterized
  - Decomposes quickly – hard to maintain residual, especially at high temps.
  - Potential water quality issues – formation byproducts and corrosion

# Control Technologies

- Point-of-use filtration
  - Shown to be effective
  - Dependent on pore size ( $\leq 0.2 \text{ um}$ )
  - Depth filtration, use of silver incorporated BAC filtration – not effective
  - Filters may clog
- Preventative and Remediation – multi barrier approach

# Emergency Disinfection



## Shock Chlorination

- Inject elevated Chlorine 20-50 ppm for specific time
- Mixed success
- Legionella can be protected within amoeba which can survive chlorine [50ppm]



## Emergency Measure: Thermal Disinfection ("super heat and flush")

- Increase water temperature to 71-77° C (160-171°F)
- While flushing outlet for at least 30 min
- Regrowth is an issue
  - may not provide long-term control
- Has been effective in hospital outbreak scenarios

# Continuous Treatment: Regulatory Considerations

- If treatment for a regulated contaminant is applied, they become a public water system
- Monitoring & reporting requirements
  - Chlorine residual levels
  - MCLs, MRDL, TTs must be met
- Operator of the treatment must be certified to properly operate & maintain equipment
- Plan review approval of equipment & chemicals used

# Challenges

- Thorough evaluation of WS facilities & plumbing is needed to determine appropriate treatment
- Some methods have not always proven completely successful or provide permanent protection from recolonization
- A combination of treatment options may be needed
- Consult with professionals experienced with Legionella & pathogen control measures is advised
- Monitoring effectiveness of treatment is critical!

# Conclusion

- Water treatment processes & regulations have reduced transmission of illnesses in public DW supplies
- Outbreaks have led to increased interest in preventing Legionella occurrence & minimize exposure
- Research is needed to understand factors promoting biofilm growth, pathogen survival & proliferation
- EPA guidance to be released in 2015 on treatment technologies for facilities installing secondary disinfection to address Legionella