Oregon Reportable Diseases & Notable Outbreaks, 2015

June E Bancroft, Epidemiologist, Oregon Public Health Division
Low Incident Notifiable Diseases by Year

<table>
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<th>2010</th>
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Orpheus data, May 20, 2015
Shigellosis
Incidence of *Shigella* infections Oregon and the US, 2001-2015

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<td>2015</td>
<td>2.8</td>
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</table>
Overview

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

![Map of case distribution in the United States](image)

- No Cases
- 1-3 Cases
- 4-10 Cases
- 10-19 Cases
- 20+ Cases
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
## Patient Characteristics

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>%*</th>
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<td>Men</td>
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<td>MSM</td>
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<td>HIV-positive</td>
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<tr>
<td>Drug or alcohol use</td>
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<td>62</td>
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</table>

*Among persons with known values  
**Women excluded
Epidemiologic Shift

Case Count

Symptom Onset

- All cases
- MSM*
- Homeless*

*Three cases were MSM and homeless
# Epidemiologic Shift

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

MSM: Men who have sex with men
95% CI: Ninety-five percent confidence interval
Theories for the Transition

Case Count

Symptom Onset

Group sex event

Homeless
Not homeless
Precipitation (Inches)

Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
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

<table>
<thead>
<tr>
<th>Year</th>
<th>Oregon</th>
<th>U.S.</th>
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<tbody>
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<tr>
<td>2015</td>
<td>5.7</td>
<td>1.7</td>
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STEC cases by Serotype, Oregon, 2015

- **O157**: 57%
- **O26**: 29%
- **O121**: 5%
- **O103**: 9%
- **O145**: 5%
- **O111**: 2%
- **O104**: 1%
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

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

We do it for farmers, animals, the environment, dentists, crane operators, ribbon dancers, magicians, cartographers, and you.
Chipotle Outbreaks

History of outbreaks

– Hazel Dell – norovirus – September 2015
– MN – *Salmonella* Newport – August 2015
– CA – norovirus – August 2015
– Boston – norovirus – September 2015
What was known

• Cases were STEC O26
  – Second most common serotype
• People were hospitalized
• Washington state had the lion's 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
- Directors Building
- Gresham
- Kruse Way
- Lloyd District
- Pearl District
- PSU
- Pearl District
- Washington Square
- Wilsonville
- Clackamas Town Center
- Hillsboro
- Nyberg Woods
- PSU
- Sherwood
- 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\(^{\text{th}}\)** – first PFGE results; still no cases outside of Oregon and Washington

- **November 6\(^{\text{th}}\)** – PFGE match in Minnesota
Outbreak expands

- Nov 9\textsuperscript{th} - MN case has no Chipotle exposure
- Use whole genome sequencing
- Nov 20\textsuperscript{th} – Cases in CA, MN, OH, NY
E. coli O26 Cases, All States and Oregon, 2015

Confirmed Case Count

- Oregon (N=13)
- All States (N=55)

Stores closed

Symptom Onset

Confirmed Case Count

October
November
December
## Descriptive Epidemiology

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<tr>
<th></th>
<th>Oregon (N=13)</th>
<th>All States (N=55)</th>
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<tbody>
<tr>
<td>Median age (range)</td>
<td>18 (11-61)</td>
<td>21 (1-94)</td>
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<tr>
<td>Women, N (%)</td>
<td>8 (61%)</td>
<td>31 (56%)</td>
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<tr>
<td>Bloody diarrhea, N (%)</td>
<td>11 (85%)</td>
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<td>Hospitalized, N (%)</td>
<td>4 (31%)</td>
<td>21 (38%)</td>
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<td>0 (0%)</td>
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<tr>
<td>Deaths, N (%)</td>
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<td>0 (0%)</td>
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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

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<th>Oregon</th>
<th>U.S.</th>
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<td>6.8</td>
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</tr>
<tr>
<td>2010</td>
<td>7.3</td>
<td>8.9</td>
</tr>
<tr>
<td>2011</td>
<td>8.5</td>
<td>6.0</td>
</tr>
<tr>
<td>2012</td>
<td>23.3</td>
<td>15.3</td>
</tr>
<tr>
<td>2013</td>
<td>12.4</td>
<td>9.0</td>
</tr>
<tr>
<td>2014</td>
<td>10.2</td>
<td>10.1</td>
</tr>
<tr>
<td>2015</td>
<td>14.8</td>
<td>5.5</td>
</tr>
</tbody>
</table>

*Highest annual tally since 1953*
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*

*Data as of 12 Nov 2015
Pertussis incidence among infants, Oregon, 2003–2014

Cases/100,000

Age (months)
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.
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

<table>
<thead>
<tr>
<th>Vaccine effectiveness</th>
<th>Timing of maternal vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>91% (83-95)</td>
<td>At least 28 days before birth</td>
</tr>
<tr>
<td>38% (-95-80)</td>
<td>0-6 days before or 1-13 days after birth</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Year</th>
<th>Oregon</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>1.9</td>
<td>0.8</td>
</tr>
<tr>
<td>2002</td>
<td>1.3</td>
<td>0.6</td>
</tr>
<tr>
<td>2003</td>
<td>1.7</td>
<td>0.6</td>
</tr>
<tr>
<td>2004</td>
<td>1.7</td>
<td>0.4</td>
</tr>
<tr>
<td>2005</td>
<td>1.5</td>
<td>0.4</td>
</tr>
<tr>
<td>2006</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>2007</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>2008</td>
<td>1.0</td>
<td>0.3</td>
</tr>
<tr>
<td>2009</td>
<td>1.0</td>
<td>0.3</td>
</tr>
<tr>
<td>2010</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>2011</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>2012</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>2013</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>2014</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>2015</td>
<td>0.7</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Meningococcal disease by Serogroup: Oregon, 2006–2015
Meningococcal Disease by Serogroup, Oregon, 2006-2015

- B: 44%
- C: 22%
- W135: 9%
- Y: 24%
- Other: 1%
University of Oregon Meningococcal Outbreak 2015
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.
University of Oregon Meningococcal Outbreak Timeline
Case #3
19 y/o freshman at U of O

1/13/2015 Case 1
1/31/2015 2/1/2015 Case 2 Case 3
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...**

<table>
<thead>
<tr>
<th>Cases</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 case</td>
<td>Serogrouping of isolate or clinical specimen performed</td>
</tr>
<tr>
<td></td>
<td>• Isolate typed or stored for future molecular typing, or sent to CDC</td>
</tr>
<tr>
<td></td>
<td>• Case investigation</td>
</tr>
<tr>
<td></td>
<td>• Chemoprophylaxis of close contacts</td>
</tr>
<tr>
<td></td>
<td>Same response as after 1 case with the following additions:</td>
</tr>
<tr>
<td></td>
<td>• If both cases have serogroup B disease, the state health department should contact CDC</td>
</tr>
<tr>
<td></td>
<td>• Send isolates to CDC for molecular typing for both cases</td>
</tr>
<tr>
<td>2 cases in 6 months</td>
<td>Same response as after 1 case with the following additions:</td>
</tr>
<tr>
<td></td>
<td>• If all cases have serogroup B disease, the state health department should contact CDC</td>
</tr>
<tr>
<td></td>
<td>• Send isolates from additional cases to CDC for molecular typing and testing to predict strain coverage of vaccine</td>
</tr>
<tr>
<td>3 or more cases in 6 months</td>
<td>Same response as after 1 case with the following additions:</td>
</tr>
<tr>
<td></td>
<td>• 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</td>
</tr>
</tbody>
</table>

*Oregon Health Authority*
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®). 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®). FDA approved this vaccine for use in people 10-25 years of age as a 2-dose series.
Case Demographics

• 75% female
• 75% 19 year olds
• 100% freshman
• 50% lived off-campus
• 50% Greek
### University of Oregon At-Risk Population

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

All University of Oregon undergraduates were included
University of Oregon Meningococcal Outbreak – 2015

Case 1 1/13
Case 2 1/31
Case 3 2/1
Case 4 2/17
Case 5 3/8
Case 6 3/14
Case 7 5/7

Round 1 Mass Vaccination clinic
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

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Vaccination Clinic Attendance Rates</th>
<th>Likelihood Ratio of Attending Vaccination Clinic (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greek</td>
<td>18%</td>
<td>1.3 (1.2-1.4)</td>
</tr>
<tr>
<td>Freshman</td>
<td>26%</td>
<td>2.3 (2.2-2.9)</td>
</tr>
<tr>
<td>Dorm Dwellers</td>
<td>29%</td>
<td>2.4 (2.4-2.6)</td>
</tr>
<tr>
<td></td>
<td>Cost per Dose</td>
<td>Cost per Series</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Estimated Cost</td>
<td>$134</td>
<td>$402</td>
</tr>
<tr>
<td><em>Theoretical</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual Cost</td>
<td>$194.05</td>
<td>$1,576</td>
</tr>
</tbody>
</table>
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

- HCV (n=763)
- HBV (n=196)
- Not Hepatitis

Age-adjusted mortality from HCV and HIV in Oregon and from HCV nationally, 1999-2013
New HCV regimens and their cost

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Manufacturer</th>
<th>Approximate Cost for 12-week Therapy</th>
<th>Date of FDA approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sofosbuvir</td>
<td>Sovaldi</td>
<td>Gilead Sciences</td>
<td>$84,000</td>
<td>12/2013</td>
</tr>
<tr>
<td>Ledipasvir + sofosbuvir</td>
<td>Harvoni</td>
<td>Gilead Sciences</td>
<td>$94,500</td>
<td>10/2014</td>
</tr>
<tr>
<td>Simeprevir</td>
<td>Olysio</td>
<td>Janssen Theraputics</td>
<td>$66,360</td>
<td>11/2013</td>
</tr>
<tr>
<td>dasabuvir/ ombitasvir paritprevir/ ritonavir</td>
<td>Viekira Pak</td>
<td>AbbVie</td>
<td>$83,319</td>
<td>12/2014</td>
</tr>
<tr>
<td>Ombitasvir/paritprevir/ritonavir</td>
<td>Technivie</td>
<td>AbbVie</td>
<td>$76,653</td>
<td>7/2015</td>
</tr>
<tr>
<td>Declatasvir</td>
<td>Daklinza</td>
<td>Bristol-Meyers Squibb</td>
<td>$63,000</td>
<td>7/2015</td>
</tr>
</tbody>
</table>
Comparison of HCV cost effectiveness with other preventive services

$/QALY

- Flu shot, aged 50+
- Hypertension, aged 18+
- Treatment with Harvoni
- Treatment with Viekira Pak
- HIV Testing, aged 13-64
- Cholesterol Screening
- Breast CA, aged 40+
Age Distribution in HCV-related hospitalizations, cases of liver cancer, and deaths in Oregon, 2009-2013

<table>
<thead>
<tr>
<th>HCV-related...</th>
<th>Baby Boomers</th>
<th>&gt; 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalizations</td>
<td>83%</td>
<td>8%</td>
</tr>
<tr>
<td>Liver Cancer</td>
<td>77%</td>
<td>16%</td>
</tr>
<tr>
<td>Deaths</td>
<td>80%</td>
<td>16%</td>
</tr>
</tbody>
</table>
Federal Medicaid Program communications

CMS Issues Notice Regarding Barriers to HCV Treatment

Yesterday, the Centers for Medicare & Medicaid Services (CMS) issued a notice that allows CMS's compliance program to provide prescription drugs beneficiaires, specifically higher-risk beneficiaries with the coverage of the drug for hepatitis C virus (HCV), which comes as a surprise to many. The notice also strengthens beneficiaries' ability to access the drug through the State Medicaid Drug Services.

- Enhanced the states' efforts to ensure that beneficiaries are able to access the drug through the Medicaid Drug Services.
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Medicaid calls on Gilead, AbbVie to answer hep C drug pricing questions

By Andrea Wroblewski | Nov 1, 2019, 8:34 am

Federal Officials Warn States on Hepatitis C Drug Restrictions

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

Covering Costly HCV Tx: Who Makes that Call?

Medicaid budgets face 'Death Star scenario'
What can you do about hepatitis C?
Legionellosis
Incidence of Legionellosis, Oregon and the US, 2006-2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Oregon</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>2007</td>
<td>0.4</td>
<td>0.9</td>
</tr>
<tr>
<td>2008</td>
<td>0.5</td>
<td>1.1</td>
</tr>
<tr>
<td>2009</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>2010</td>
<td>0.5</td>
<td>1.1</td>
</tr>
<tr>
<td>2011</td>
<td>0.6</td>
<td>1.4</td>
</tr>
<tr>
<td>2012</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>2013</td>
<td>0.7</td>
<td>1.6</td>
</tr>
<tr>
<td>2014</td>
<td>1.0</td>
<td>1.6</td>
</tr>
<tr>
<td>2015</td>
<td>1.2</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Incidence of Legionnaire's Disease by age and sex, Oregon 2006-2015

Cases/100,000

Age

Male
Female

Oregon Health Authority
Legionella outbreak at Oregon resort

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Case A</th>
<th>Case B</th>
<th>Case C</th>
<th>Case D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report date</td>
<td>10/7/14</td>
<td>1/16/14</td>
<td>2/26/13</td>
<td>9/27/11</td>
</tr>
<tr>
<td>Age</td>
<td>62</td>
<td>73</td>
<td>57</td>
<td>54</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>County of residence</td>
<td>Marion</td>
<td>Clatsop</td>
<td>Linn</td>
<td>Lane</td>
</tr>
<tr>
<td>Sx Onset</td>
<td>9/24/14</td>
<td>1/11/14</td>
<td>2/19/13</td>
<td>9/19/11</td>
</tr>
<tr>
<td>Stayed at</td>
<td>Condo - 04</td>
<td>Condo - 04</td>
<td>Condo - 03</td>
<td>Single Fam</td>
</tr>
<tr>
<td>Risk factors</td>
<td>Age&gt;60; AC; shower; <strong>used tub</strong></td>
<td>Age; COPD; immunocomp; humidifier; <strong>did not use tub</strong></td>
<td>Smoker; used tub</td>
<td>Smoker; HC worker; used <strong>tub</strong>; other exp.</td>
</tr>
</tbody>
</table>
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 (≤ 0.2 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