Piloting HCV GHOST in Michigan

November 29, 2017
Joe Coyle, MPH
Outline

- MDHHS HCV Surveillance
- Basics of HCV GHOST
- Example of GHOST in Action
- Implications for Public Health Surveillance
MDHHS HCV Surveillance
HCV Reporting in MDSS, 2016

- Patients with an HCV Lab: 31,063
- New Chronic Diagnoses: 11,883
- New Acute Diagnoses: 154
New HCV Cases by Year of Birth, 2016

Number of Cases

Year of Birth
New HCV Diagnoses among 18-29 Year Olds
# Epidemiology of 2016 Young Adult HCV Cases

<table>
<thead>
<tr>
<th>Age (n = 2060)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>24.96</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>18 - 29</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex (n = 2057)</th>
<th>Rate per 100,000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>967 (47.0%)</td>
<td>124.92</td>
</tr>
<tr>
<td>Male</td>
<td>1090 (53.0%)</td>
<td>138.09</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Race (n = 1524)</th>
<th>Rate per 100,000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>1351 (88.6%)</td>
<td>110.60</td>
</tr>
<tr>
<td>Black</td>
<td>139 (9.1%)</td>
<td>54.04</td>
</tr>
<tr>
<td>American Indian</td>
<td>22 (1.4%)</td>
<td>178.43</td>
</tr>
<tr>
<td>Asian</td>
<td>12 (0.8%)</td>
<td>24.38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hispanic Ethnicity (n = 1163)</th>
<th>Rate per 100,000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic or Latino</td>
<td>40 (3.4%)</td>
<td>45.77</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>1123 (96.6%)</td>
<td>71.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>History of IVDU (n = 978 )</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>823 (84.2%)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>155 (15.8%)</td>
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</tbody>
</table>
How do you identify an outbreak?
Where to focus resources?

HCV in Young Adults (2010-2015)
- Chronic HCV Case
- Acute HCV Case
Challenges with Traditional HCV Surveillance Alone

- **Large volume of cases**
  - Which cases might really be related to each other?

- **Large number of undiagnosed cases due to asymptomatic infection**
  - “Missing links”

- **Time from exposure to diagnosis (acute vs. chronic)**
  - E.g. a new case in 2016 could be an epi link of a case reported in 2012

- **Geo-spatial-temporal relationships between cases??**
HCV GHOST Basics
Global Health Outbreak Surveillance Technology

**Genome:**
- Single-stranded, (+) strand RNA
- ~9,400 nt

**Proteins:**
- ~3,000 aa polyprotein
- 10 individual proteins
  - 3 structural (C, E1, E2)
  - 7 non-structural
Each patient is infected with numerous genetically distinct but closely related HCV variants (Quasispecies)

Proteins:
- ~3,000 aa polyprotein
- 10 individual proteins
  - 3 structural (C, E1, E2)
  - 7 non-structural
HCV GHOST in practice

Extensive intra-host HCV variability is used to:
- Identify HCV strains
- Track HCV transmissions during outbreak investigations
**GHOST:** Sequences are automatically interpreted into transmission clusters for end-users.
HCV MSM Cluster
Epidemiologic Info

- 5 acute cases, 24 chronic cases per CDC/CSTE HCV case definitions

### Case Epi Info

- **Median Age:** 31
- **Age Range:** 21 – 48 years
- **Sex:** Male (29)
- **Race:** African American (28), Hispanic (1)
- **HCV Genotype:** 1a (16/16)
- **Residence:** Detroit (19), Wayne (5), Oakland (3), Macomb (2)

### Case Risk Factors

- **IVDU:** No (28)
- **“Uppers”:** No (28)
- **HIV:** Positive (29)
- **Sexual History:** MSM or Bi (29)
- **Previous STDs:**
  - Syphilis (21)
  - LGV (6)
  - GC (19)
  - CT (16)
- **Other (Hepatitis A, Giardia, Shigella, Cryptosporidium)**
“Epi Curve”

Date of First Positive HCV Lab

- **Case (n=29)**
- **Suspect Case (n=10)**

<table>
<thead>
<tr>
<th>Quarter-Year</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Q1 2014</td>
<td>0</td>
</tr>
<tr>
<td>Q2 2014</td>
<td>0</td>
</tr>
<tr>
<td>Q3 2014</td>
<td>3</td>
</tr>
<tr>
<td>Q4 2014</td>
<td>3</td>
</tr>
<tr>
<td>Q1 2015</td>
<td>2</td>
</tr>
<tr>
<td>Q2 2015</td>
<td>1</td>
</tr>
<tr>
<td>Q3 2015</td>
<td>2</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>6</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>2</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>4</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>2</td>
</tr>
<tr>
<td>Q4 2016</td>
<td>4</td>
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How large is the cluster?

Are the cases part of the same transmission network?
HCV GHOST Transmission Cluster
Impact of GHOST

- Epidemiological, demographic, risk and partner/contact tracing still crucially important to communicable disease investigation
  - But sometimes this isn’t enough for determining patient relatedness

- Molecular data can help piece together disjointed or unrecognized transmission networks
  - For this cluster in particular, anonymous sex using geosocial networking apps was common (i.e. partners were not often known)
Implications for Public Health Surveillance
GHOST: HCV Transmission Network among PWID
Indiana, 2015
A Theoretical Public Health Response

**Risk Network**
- Persons who are not infected, but are at risk for infection

**Transmission Cluster**
- Persons with confirmed viral hepatitis, but no genetic sequence is available
- Persons with undiagnosed viral hepatitis infection

**Molecular Cluster**
- Persons with confirmed viral hepatitis infection
- Viral genome sequence is available and submitted for analysis
A Theoretical Public Health Response

- Contact tracing
- Education
- Co-location of services:
  - Referral to substance abuse treatment
  - Patient counseling
  - Clean needles
  - Overdose prevention
  - HCV/HIV testing
  - Hepatitis A/B vaccinations
- HCV Treatment?
- Informing other CD/Prevention areas (STD, HIV, etc.)
Application of GHOST in Michigan so far

- Piloting HCV GHOST technology in-house on convenience sample of HCV RNA+ specimens received by the MDHHS BOL
  - 115 specimens have currently undergone GHOST analysis
  - 1 large cluster among the HIV-infected MSM population
  - Handful 2-3 person clusters among suspected PWIDs

- In process of developing protocols for investigation/follow-up
  - How to respond to a cluster?
  - Who responds?
Thanks!

- Council of State and Territorial Epidemiologists:
  - Projects to Assess Emerging Surveillance Issues in Substance Abuse and Mental Health

- Association of Public Health Laboratories:
  - Pilot of Global Hepatitis Outbreak and Surveillance Technology (GHOST) for Molecular Surveillance of HCV Infection

- CDC Division of Viral Hepatitis Laboratory

- MDHHS Bureau of Laboratories

- National Alliance of State and Territorial AIDS Directors
THANKS!

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