Measles in Orange County, 2015

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July, 2015
On January 2, 2015:

• A 3 yo Riverside patient was admitted to Children’s Hospital of Orange County, differential diagnosis included measles
  – No travel
  – Did recently go to Disneyland

• 8 month old sibling admitted to CHOC on January 5

• Both diagnosed with measles by PCR
Measles Virus

- Infects only humans
- Contains:
  - Single-stranded, negative-sense RNA
  - Lipid envelope
Measles in the United States
Measles Around the World

• Endemic measles eliminated in United States in 2000
• Virus continues to be endemic in many parts of the world
• France had a major outbreak in 2010-2012
• Philippines had major outbreak from 2013-present
By the end of the Day on January 5

• 11 y.o. Orange County Resident also PCR positive for measles
• Went to Disneyland on 12/18
• 3 additional confirmed and 6 suspect cases of measles
• 7 in CA, 2 in UT
• All at Disneyland 12/17 or 12/18
Measles Nationally

- From January 1 to June 26, 178 cases have been reported from 24 states
- 6% trace to Disneyland outbreak
- On April 17, 2015 measles outbreak was declared over in California
Measles in Orange County, 2015

• 35 cases
• 17 females
• Age range 9 months-70 years
• 14 children
• 5 hospitalized
• 22 cases in our County in first three months of 2014
Orange County Measles Cases
Rash Onset Dates 2015 (n=35)
Immunization Status of Orange County Cases, 2014 and 2015

- 9 with 2 MMRs
- 2 with 1 MMRs
- 3 with evidence of seroimmunity
- 23 with uncertain immunization status
- 20 with no immunizations
  - 18 of 19 pediatric cases with no MMR
  - Two under one year of age
  - 10 vaccine refusers
Measles Symptoms
Measles Prodrome

• 8-12 day incubation period
• Prodrome lasts for 2-4 days and consists of:
  – Fever
  – Cough
  – Coryza
  – Conjunctivitis
  – Koplik’s Spots
  – Prodromal phase makes people sick!
Rash Develops at About 14 Days

- Starts on face, often top of forehead, sometimes behind ears
- Spreads downward
- Initially maculopapular, then becomes confluent
- Most prominent on the face
Symptoms of 2014-15 Measles Cases

• Fever: 4 of 57 did not report fever;
  – For those with temperature information, all but 1 reported a fever over 101°F (101.2 to 104.7)
• Cough: 72%
• Coryza: 6%
• Koplik Spots (N = 41): 22%
• Conjunctivitis: 49%
• Diarrhea: 10%
### Symptoms by Immunization Status, 2014 and 2015 OC Measles Cases

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Not vaccinated (n=20)</th>
<th>Vaccinated/serologic proof of immunity (n=12)</th>
<th>Unknown Vaccination Status (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>100%</td>
<td>75%</td>
<td>92%</td>
</tr>
<tr>
<td>Cough</td>
<td>83%</td>
<td>42%</td>
<td>73%</td>
</tr>
<tr>
<td>Coryza</td>
<td>89%</td>
<td>25%</td>
<td>62%</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>72%</td>
<td>8%</td>
<td>42%</td>
</tr>
<tr>
<td>Koplik spots</td>
<td>38%</td>
<td>12%</td>
<td>0%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>11%</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Rash duration</td>
<td>6 days (4-8d)</td>
<td>4.2 days (4-5d)</td>
<td>5 days (2-9d)</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>20%</td>
<td>0%</td>
<td>19%</td>
</tr>
</tbody>
</table>
Hospitalization & Complications

Most common complications include:

• Pneumonia
• Encephalitis
• Thrombocytopenia
• Otitis media
• 1 in 1000 die due to measles complications
• 12 hospitalized in Orange County with measles-related disease in 2014-2015
  – One otitis media
  – One pneumonia
Measles Testing
Measles Polymerase Chain Reaction (PCR) Testing

• Most specific test for diagnosis
• Oropharyngeal PCR very sensitive in first three days after rash starts
  – Nasopharyngeal PCR may be a bit less sensitive
  – In many instances, this is only test we would order
• Urine testing also sensitive, especially useful days 4-9 after rash starts
Measles Testing Results for 57 Measles Cases in 2014-15

<table>
<thead>
<tr>
<th></th>
<th>IgM</th>
<th>OP PCR</th>
<th>Urine PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>35</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>Negative</td>
<td>13</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Not done</td>
<td>9</td>
<td>7</td>
<td>32</td>
</tr>
</tbody>
</table>

All 15 unvaccinated patients tested were IgM +

For 10 Vaccinated Patients:

- 5 IgM negative, 3 IgM positive, 2 Not Done
- All 9 tested were OP PCR positive
Satellite Clinic Site

- For testing of suspect cases who have already been assessed by a medical provider
- Tests performed included:
  - Oropharyngeal PCRs
  - Serum IgM
Measles is Passed by Airborne Route

- Very infectious
- Patients infectious from 4 days before rash starting until 4 days after rash starts
- Virus can remain in air after infected person leaves
  - CDC: 2 hours
  - California Department of Public Health: 1 hour
- No minimal period of exposure exists
Measles Infection Control

- Airborne precautions necessary in clinical settings
- Facilities without negative pressure room can see patient:
  - Outside
  - At end of day
- N-95 masking recommended for healthcare workers
- Masking of measles case in facility is of uncertain benefit
  - Science would say that airborne virus not prevented from spread by mask
  - Significantly ill patients don’t keep the mask on
  - Public health recommendation would still be to conduct a contact investigation
  - Masking case when going to and from isolation room is recommended
Measles Cluster 1, Orange County, 2014

- 16 yo
- 45 yo Mom
- 3 yo
- 3 yo sib
- 38 yo Father
- 41 yo MD
- 37 yo MD
- 48 yo Father
- 40 yo HCW

Timeline:
- 2/10
- 2/20
- 2/28
- 3/10
- 3/20
- 3/30
Measles Cluster 2, Orange County, 2014

- 28 yo M
- 18 yo Pt.
- 38 yo F
- 32 yo Nurse
- 36 yo Nurse
- 41 yo M
- 45 yo M
- 45 yo Mom
- 25 yo sib
- 21 yo F

Initial cases: 28 yo M, 18 yo Pt., 38 yo F, 32 yo Nurse, 36 yo Nurse, 41 yo M, 45 yo M.
Secondary cases: 25 yo sib, 21 yo F, 45 yo Mom.

Timeline:
- 1/30
- 2/10
- 2/20
- 3/1
- 3/10
- 3/20
- 3/30
Orange County Cases and Their Connections, 2015

Disney visitors
Disney staff
Mall exposure
Household
Healthcare
Work site
Unknown

12/30

1/7 1/14 1/21 1/28 2/4
Measles Follow Up of Exposed

Exposure

- Vaccine w/in 72h
- Rash onset

Time in days
- 0
- 7
- 14
- 21

Incubation periods
- shortest
- longest

- IG w/in 6 days
- Exclusion from work d5-21 post exposure

Exposure

Vaccine w/in 72h

Rash onset

0     7     14     21

IG w/in 6 days

Exclusion from work d5-21 post exposure
Potential Exposure Venues

• Household
• Sharing the same airspace in:
  – Work
  – School/daycare
• Community exposures
  – Malls
  – Restaurants
  – Public transportation
  – Healthcare facility
  – Etc.
Number of Community Measles Exposures, 2015

• 1955 community contacts identified
• 1858 were healthcare facility contacts
  – These are significant underestimations
  – Approximately 20% of identified contacts cannot be reached
• 828 contacts attempted by OCHCA
  – Majority of non-high risk healthcare contacts in 2015 contacted by the facility
Healthcare Facility Transmission, 2014 and 2015

• 57 cases
• 91 healthcare facility exposure events
• >3000 patients and staff exposed
• 10 total transmissions
• 7 healthcare workers
  – 1 additional healthcare worker developed disease-likely patient exposure, though no source identified
• 3 patients
2014-2015 Healthcare Workers Developing Measles

Of 10 healthcare facility transmissions:

- 5 of 7 healthcare cases had a history of face-to-face exposure to case of measles
- 1 was custodial worker who cleaned room after patient left
- 1 was healthcare worker who denied face to face exposure to patient
- 3 were patients in same waiting room at same time as cases:
  - 9 month old
  - 18 yo with history of two MMRs
  - 19 yo with unknown immunization history
# Healthcare Workers with Measles Clinical and Epidemiologic Features, 2014

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Measles Immunity Prior to Exposure</th>
<th>Exposure</th>
<th>Illness Onset</th>
<th>Fever</th>
<th>Cough</th>
<th>Coryza</th>
<th>Rash</th>
<th>Days Considered infectious while asymptomatic</th>
<th>Days working during active symptoms</th>
<th>Number of patients exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>IgG⁺</td>
<td>3/3/2014</td>
<td>3/17/2014</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>3/18/14</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>36</td>
<td>IgG⁺</td>
<td>3/3/2014</td>
<td>3/14/2014</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>3/18/14</td>
<td>0</td>
<td>4</td>
<td>850</td>
</tr>
<tr>
<td>41</td>
<td>2 MMR</td>
<td>3/7/2014</td>
<td>3/18/2014</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>3/20/14</td>
<td>2</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>37</td>
<td>4 MMR IgG⁺</td>
<td>3/7/2014</td>
<td>3/16/2014</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>3/20/14</td>
<td>0</td>
<td>4</td>
<td>72</td>
</tr>
<tr>
<td>40</td>
<td>Unknown vaccine history, IgG equivocal</td>
<td>3/7/2014</td>
<td>3/19/2014</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>3/21/14</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
OCHCA Healthcare Facility Response, 2015

- Emphasize that facilities assure that exposed staff have evidence of immunity
- Exclude from days 5-21 exposed staff without proof of immunity
- Emphasize that staff with evidence of immunity still have a small risk of developing disease
- Facilities (in general) contacted low risk patients by phone or letter to inform them of exposure:
  - Over 1 year of age
  - Immunocompetent
  - Not pregnant
  - Not healthcare worker
- **OCHCA’s response was predicated on a large outbreak**
OCPH Followed Up on High Risk Persons

• Under one year of age generally
  – Pediatric practices and area pediatric children’s hospital followed up with this group with their exposures

• Pregnant women

• Immunocompromised
  – Immune globulin or IVIG given to these groups

• Health care workers
MMR Vaccination

• Recommended in two doses:
  – 12-15 months of age
  – 4-6 years of age
• 95% are immune after first dose
• 97-99% immune after second dose
• No need for “booster”
• No downside to extra dose of MMR
MMR Vaccination in an Outbreak: Variation Options

• Second dose can be given anytime 28 days after the first dose
  – Not formally recommended, though offered as an option for OC providers

• Vaccine can be given from 6-11 mos of age if travel or outbreak setting, though dose will need to be repeated
  – Seems that titers reached with revaccination are lower
  – Not recommended by OCHCA unless infants are traveling

• OCHCA’s main emphases:
  – Vaccinate kids and vaccinate them on time!
  – MMR can be given to anyone who are not sure that they were vaccinated or had disease previously
Measles Immunity Recommendations for Health Care Workers

• Proof of immunity as evidenced by:
  – Two doses of MMR
  – Serologic measles IgG +

• Wear N-95 mask even if you think you are immune

• If you are exposed and develop respiratory illness, stop working and get tested
Summary Points

• Measles disease in Orange County was weighted toward unvaccinated cases
• Measles transmission was rare due to high immunization rates
• Healthcare providers who care for measles patients are at particular risk of disease
Acknowledgments

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