Masqueraders of Vaccine-Preventable Diseases

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2018 KidStrong Conference
June 22, 2018
Objectives

1. Review the epidemiology of selected vaccine-preventable diseases (VPDs)

2. Identify diseases that masquerade as VPDs and differentiate these diseases from selected VPDs

3. Apply lessons learned to the management of disease masqueraders and selected VPDs
1. Which of the following diseases is NOT vaccine-preventable?

   a. Whooping Cough
   b. Strep throat
   c. Pneumococcal infection
   d. Meningococcal meningitis
   e. Chickenpox
1. Which of the following diseases is NOT vaccine-preventable?

a. Whooping Cough
b. Strep throat
c. Pneumococcal infection
d. Meningococcal meningitis
e. Chickenpox
2. Which of the following vaccine-preventable diseases need to be reported IMMEDIATELY?

a. Diphtheria
b. Mumps
c. Measles
d. Polio
e. Tetanus
2. Which of the following vaccine-preventable diseases need to be reported IMMEDIATELY?

a. Diphtheria  
b. Mumps  
c. Measles  
d. Polio  
e. Tetanus
Surveillance: monitor, control and prevent disease

Disease Reporting: WV Reportable Disease Rule (64 CSR-7)

• Report IMMEDIATELY to local health department (LHD):
  Measles       Rubella

• Report within 24 HOURS to LHD:
  Diphtheria    Pertussis    Invasive Meningococcal Disease
  Tetanus       Polio        Invasive *H. influenzae* Disease
  Mumps         Hepatitis A  Hepatitis B

• Report within 1 WEEK to LHD:
  Varicella - counts
  *S. pneumoniae*, Invasive Disease
  Influenza - counts, death of <18 years
MUMPS

Parent: Joey (11 years) will not be in school today. He woke up with a sore throat and swelling on the left side of his face. He felt a bit warm but is really feeling tired. He’ll be in school tomorrow for his test.

As a school nurse:

1. What do you think is going on?
2. What would you do?
Mumps

Etiology: Paramyxovirus, RNA virus

Reservoir: human, no carriers

Transmission:
- Airborne
- Direct contact with droplet nuclei or saliva

Temporal pattern peak in late winter and spring

Communicability:
- Several days before and after onset of parotitis
- Asymptomatic infections may transmit
Mumps S/S

1 in 3 children have no symptoms.

Fever, Headache, Swelling of Parotid Glands (hard to swallow, talk, chew)

Orchitis, Fever, Chills, Ab Pain Start. Parotid Swelling Gone

Introduction (Droplet)  3 days  16-18 days  26-28 days  29-35 days

4 days after symptoms start

5 days return to school

“Contagious,” stay at home

Harvard Medical School

HealthStory Productions, LLC
Mumps Presentations

Signs and Symptoms:

- Nonspecific prodrome:
  - Myalgia
  - Malaise
  - Headache
  - Low-grade fever

- Parotitis in 9%-94%
Laboratory Testing:

A. Viral detection: rRT-PCR, culture
   • Specimen sources
     • Swab of salivary gland, throat
     • Urine
     • CSF
   • Timing: within 3 - 8 days of parotitis

B. Serology
   • IgM - ASAP
   • Paired IgG - ASAP then 2 weeks later
U.S. Mumps Outbreak:

2006:
• Multi-state
• College students mostly in Midwest
• WV = 24 cases

2009-2010:
• Congregate settings
Parotitis Versus Lymphadenitis

Mumps parotitis
• Pain and tenderness
• 1 or both salivary glands swollen
• Swollen tissue pushes ear up and out

Lymph node swelling
• Well-defined borders
• Behind the angle of jaw bone
• Lack of ear protrusion
Acute Parotitis

**Viral pathologies**
- Coxsackie virus
- Influenza A virus
- Parainfluenza virus
- Cytomegalovirus
- Adenovirus
- Epstein-Barr virus
- Varicella-zoster virus

**Suppurative** (bacterial, especially Staphylococcus aureus) or recurrent parotitis

**Management**
- Supportive
- May need antibiotics

May need antibiotics
### Influenza-Associated Parotitis

#### Clinical Characteristics and Symptoms of Illness Among Cases and Controls, Multistate Investigation of Influenza-Associated Parotitis, U.S., 1 October 2014–31 March 2015

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cases (n = 50)</th>
<th>Controls (n = 124)</th>
<th>Odds Ratio [95% Confidence Interval]</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Respondents</td>
<td>n (%)</td>
<td>Respondents</td>
<td></td>
</tr>
<tr>
<td><strong>Influenza-like illness</strong></td>
<td>49</td>
<td>25 (51)</td>
<td>122</td>
<td>109 (89)</td>
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<tr>
<td><strong>Self-report of testing for influenza</strong></td>
<td>45</td>
<td>30 (67)</td>
<td>124</td>
<td>123 (99)</td>
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<tr>
<td><strong>Self-report of testing for strep throat</strong></td>
<td>43</td>
<td>18 (42)</td>
<td>113</td>
<td>50 (44)</td>
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<tr>
<td><strong>Self-reported symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fever/feverish</td>
<td>49</td>
<td>32 (65)</td>
<td>122</td>
<td>115 (94)</td>
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<tr>
<td>Chills</td>
<td>49</td>
<td>24 (49)</td>
<td>115</td>
<td>87 (76)</td>
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<td>Muscle ache</td>
<td>47</td>
<td>18 (38)</td>
<td>119</td>
<td>83 (70)</td>
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<tr>
<td>Headache</td>
<td>48</td>
<td>30 (63)</td>
<td>119</td>
<td>86 (72)</td>
</tr>
<tr>
<td>Cough</td>
<td>50</td>
<td>32 (64)</td>
<td>122</td>
<td>106 (87)</td>
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<tr>
<td>Wheezing</td>
<td>49</td>
<td>5 (10)</td>
<td>121</td>
<td>36 (30)</td>
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<tr>
<td>Shortness of breath</td>
<td>49</td>
<td>4 (8)</td>
<td>120</td>
<td>33 (28)</td>
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<tr>
<td>Sore throat/difficulty swallowing</td>
<td>49</td>
<td>27 (55)</td>
<td>121</td>
<td>79 (65)</td>
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<tr>
<td>Runny nose</td>
<td>46</td>
<td>23 (50)</td>
<td>121</td>
<td>75 (62)</td>
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<tr>
<td>Ear pain</td>
<td>48</td>
<td>19 (40)</td>
<td>119</td>
<td>26 (22)</td>
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<tr>
<td>Rash</td>
<td>49</td>
<td>5 (10)</td>
<td>122</td>
<td>10 (8)</td>
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<tr>
<td>Facial swelling</td>
<td>50</td>
<td>34 (68)</td>
<td>122</td>
<td>2 (2)</td>
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<tr>
<td>Gland swelling</td>
<td>50</td>
<td>36 (72)</td>
<td>113</td>
<td>29 (26)</td>
</tr>
<tr>
<td>Tongue swelling</td>
<td>47</td>
<td>1 (2)</td>
<td>121</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Discomfort with acidic foods</td>
<td>40</td>
<td>4 (10)</td>
<td>92</td>
<td>8 (9)</td>
</tr>
</tbody>
</table>

- Odds ratios (ORs), 95% confidence intervals, and P values from conditional logistic regression. Reference group for OR is absence of symptom or condition.
- Influenza-like illness defined as fever (≥100°F) or feeling feverish and cough and/or sore throat.
- Temperature ≥100°F or self-report of feeling feverish.

Case 1

Parent: Joey (11 years) will not be in school today. He woke up with a sore throat and swelling on the left side of his face. He felt a bit warm but is really feeling tired. He’ll be in school tomorrow for his test.

As a school nurse:

1. What do you think is going on?
   
   Mumps versus other viral parotitis

2. What would you do?
• Report suspect or confirmed case of mumps

• Isolate/exclude child for 5 days from onset of parotitis

• Standard and droplet precautions until 5 days after onset of parotitis
• Notify the school

• Educate the public

• Identify and monitor contacts (household, school) – document age-appropriate vaccination

• Exposed children in outbreak setting:
  • Vaccinate
  • If not vaccinated, exclude for 26 days after onset of parotitis from the last person
Parent: Joey (11 years) will not be in school today. He woke up with a sore throat and swelling on the left side of his face. He felt a bit warm but is really feeling tired. He’ll be in school tomorrow for his test.

As a school nurse:

1. What do you think is going on?  
Mumps versus other viral parotitis

2. What would you do?  
Recommend he see a doctor  
Notify LHD
Influenza

INFLUENZA (FLU)

Etiology: Orthomyxovirus, 3 types (A, B, C)

Reservoir: Animals

Transmission:
• Droplet
• Indirect transfer
• Airborne

Communicability: 24 hours before symptom onset to 1 week after symptom onset
Influenza Clinical Course

**Natural Course of Influenza**

- **Days after onset of illnesses**:
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8

- **Signs and Symptoms**:
  - Coryza
  - Sore throat
  - Myalgia
  - Headache
  - Cough
  - Anorexia
  - Malaise

- **Virus Shed**: log_{10} TCID_{50} per mL of blood
  - 3.0
  - 4.5
  - 5.0
  - 4.5
  - 3.0
  - 1.0

- **Serum Antibody (HI) Titer**
  - <4
  - 8f

*—Coryza is an acute inflammatory condition of the nasal mucous membranes with a profuse discharge from the nose.
1—Serum antibody titer was 64 at day 21.

**FIGURE 1.**

Clinical characteristics of naturally occurring influenza A in an otherwise healthy 28-year-old male patient. (TCID_{50} = median tissue culture infective dose; HI = hemagglutination inhibition)

WV ILI Cases During Influenza Seasons, 2013 - 2018
Influenza Test Results, WV, 2017 - 2018
Public Health Management of Influenza

- Report to LHD:
  - Weekly, number of cases – sporadic
  - Immediately, report cases – outbreak

- Standard and droplet precautions

- Outbreak at school:
  - Establish baseline absenteeism rate
  - Determine current/ongoing absenteeism rate
  - Notify school, educate students and personnel
# Influenza Versus Common Cold

## Comparison of Influenza and the Common Cold

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>INFLUENZA</th>
<th>COMMON COLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset*</td>
<td>Abrupt</td>
<td>More gradual</td>
</tr>
<tr>
<td>Fever*</td>
<td>Common: 37.7°C to 40.0°C (100°F to 104°F)</td>
<td>Uncommon or only 0.5°C (1°F) increase</td>
</tr>
<tr>
<td>Myalgia*</td>
<td>Severe, common</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>Severe, common</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Anorexia</td>
<td>Common</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Headache</td>
<td>Severe, common</td>
<td>Mild, uncommon</td>
</tr>
<tr>
<td>Cough (dry)*</td>
<td>Common, severe</td>
<td>Mild to moderate</td>
</tr>
<tr>
<td>Malaise</td>
<td>Severe</td>
<td>Mild</td>
</tr>
<tr>
<td>Fatigue, weakness</td>
<td>More common than with the common cold; lasts 2 to 3 weeks</td>
<td>Very mild, short lasting</td>
</tr>
<tr>
<td>Chest discomfort</td>
<td>Common, severe</td>
<td>Mild to moderate</td>
</tr>
<tr>
<td>Stuffy nose</td>
<td>Occasional</td>
<td>Common</td>
</tr>
<tr>
<td>Sneezing</td>
<td>Occasional</td>
<td>Common</td>
</tr>
<tr>
<td>Sore throat</td>
<td>Occasional</td>
<td>Common</td>
</tr>
</tbody>
</table>

*—Clusters of more severe or common features may be more likely to predict influenza. Information from references 1 and 2.*

[https://www.aafp.org/afp/2003/0101/p111.html](https://www.aafp.org/afp/2003/0101/p111.html)
Influenza Differential Diagnosis

Influenza
- Body aches and pain
- Headache, anorexia, chest discomfort

Other viral infections
- Congestion
- Runny nose
- Sneezing
- Headache

Infectious mononucleosis
- Swollen neck lymph nodes
- Sore throat
- Fever

Streptococcal Pharyngitis (“Strep Throat”)

**Etiology:** Group A Streptococcus

**Transmission:**
Contact with respiratory secretions

**Clinical Presentation:**
- Fever
- Cervical lymph node swelling
- Tonsils red and swollen
- Headache
- Vomiting

**Treatment:** Antibiotics
RUBEOLA (MEASLES)

**Etiology:** Paramyxovirus, RNA virus

**Reservoir:** Human, no carriers

**Transmission:**
- Respiratory route - airborne

**Communicability:**
- 4 days before to 4 days after rash onset

Measles virus particle studded with glycoprotein tubercles. Source: CDC
10 year old child was in class when the teacher notices the child’s face as ‘flushed’ and sends the child to the clinic. On examination, you found that she has low grade fever, was not feeling well, and has a bright red rash starting to develop on her face.

1. What is possibly causing this?

2. Next steps?
Measles Clinical Course

**Measles S/S**

- **Introduction (Droplet)**
  - 7-10 days

- **Hacking Cough**
  - 10-12 days

- **Runny Nose**
  - 14-19 days

- **High Fever**
  - Fever Ends (lasts 4-7 days)

- **RED EYES**

- **Full Body Rash**

- **Koplic Spots**

- **Natural Course**
  - 24-26 days

- **4 days before rash starts**

- **“Contagious,” stay at home**
  - 4 days after rash starts

Kidshealth.org

HealthStory Productions, LLC
Measles

Rash:
- Maculopapular $\rightarrow$ confluence $\rightarrow$ peel, fades
- Starts at hairline $\rightarrow$ trunk $\rightarrow$ hands, feet

Prodrome (3 C’s):
- Cough
- Coryza
- Conjunctivitis
Complications:
• Otitis media
• Pneumonia
• Acute encephalitis
• Seizures, neurologic damage
• Death
• SSPE
• Pregnant women – premature labor, abortion

Laboratory Testing:
• Viral detection: rRT-PCR, culture
• Serology
Measles Epidemiology

2015 Measles Cases in the U.S.
January 1, 2015 to January 2, 2016

WV: No cases of measles since 2009
• Immediately report suspect or confirmed case
  • 1 case of measles is an OUTBREAK!

• Isolate/exclude sick child for 4 days from onset of rash

• Standard and airborne transmission precautions until 4 days after onset of rash

• Inform health care provider (HCP) ahead of time if you are sending a suspect case of measles, so HCP can prepare and advise
• Notify the school

• Educate the public

• Identify contacts - household, school

• Develop list and monitor contacts

• Exposed children in outbreak setting:
  • Vaccinate
  • If not vaccinated, exclude for 21 days after onset of rash from the last person
Erythema Infectiosum

**Etiology:** Human Parvovirus B19

**Transmission:**
- Respiratory secretions
- Transplacental

**Clinical Presentation:**
- Fever, headache
- Tired, muscle aches
- Strawberry tongue, tonsillitis

**Rash:**
- ‘Slapped cheek’ rash
- Rash followed by lacelike appearing rash
Etiology: Herpesvirus 6

Clinical Presentation:
- Generally well
- Seizures (10%) due to high fever

Transmission:
- Respiratory secretions

Rash:
- High fever for 3 days then defervesce, then rash appears
- Morbilliform
- Spreads to neck and trunk
Scarlet Fever

Etiology:
Group A Streptococcus

Transmission:
Respiratory secretions

Clinical Presentation:
• Toxic (headache, nausea, vomiting)
• High fever
• Strawberry tongue, tonsillitis

Rash:
• Sandpaper feel
• Bright red skin in creases of the underarm, elbow, and groin

Treatment: Antibiotic
Enteroviral Infection

**Etiology:** Enterovirus, Coxsackie virus

**Clinical Presentation:** Respiratory or GI manifestations

**Rash:** Scattered, macule or maculopapular, rash appears during or after fever

**Treatment:** Supportive

*Hand-foot-and-mouth disease (HFMD)*
Kawasaki Disease

**Etiology:** unknown

**Clinical Presentation:**
- High fever
- Measles-like rash
- Skin peeling
- Swollen hands, feet, and cervical lymph nodes

**Complications:**
- Coronary disease, aneurysms

**Treatment:**
- IVIG
- Aspirin
Kawasaki Disease

Clinical manifestations of Kawasaki Disease

- **Fever**
  - Acute
  - Subacute
  - Convalescent

- **Arthritis**
  - Acute
  - Subacute
  - Convalescent

- **Cardiovascular**
  - Acute
  - Subacute
  - Convalescent
  - Myocarditis
  - Aneurysms

- **Skin**
  - Acute
  - Subacute
  - Convalescent
  - Red palms/soles
  - Desquamation
  - Nail changes

- **Lips & Conjunctiva**
  - Acute
  - Subacute
  - Convalescent

- **Cervical Lymphadenopathy**
  - Acute
  - Subacute

- **Thrombocytosis**
  - Acute
  - Subacute

- **Weeks**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
10 year old child was in class when the teacher notices the child’s face as ‘flushed’ and sends the child to the clinic. On examination, you found that she has low grade fever, was not feeling well, and has a bright red rash starting to develop on her face.

1. What is possibly causing this?
   Parvovirus

2. Next steps?
   Manage accordingly
VARICELLA (CHICKENPOX)

Etiology: VZV (Human herpesvirus 3)

Reservoir: Humans

Transmission:
• Direct contact with VZV lesions
• Airborne

Communicability:
• 1 - 2 days before rash onset until all lesions have crusted

Treatment: Supportive
Varicella Clinical Presentation

Varicella (Chicken Pox) S/S

Introduction (Droplet)

14-16 days

15-18 days

18-21 days

Vesicular Rash Abdomen, Back, Face Spreads Out
Mid-grade fever “Malaise”
Headache Sore Throat

“Contagious,” stay at home

Vesicles Crust Over, Natural Course

“Centers for Disease Control

HealthStory Productions, LLC
Varicella in Unvaccinated

Clinical Manifestations:
• Small red bumps → small fluid-filled sacs → scabs
• Crops of vesicles - several days
• Rash (mouth, ears, genitals)
• Itchy
• Fever, runny nose and cough

Complications:
• Bacterial infections
• Pneumonia
• Central Nervous System
• Reye syndrome

varicella lesions in various stages
Source: http://www.vaccineinformation.org/photos/variaap001.jpg
Breakthrough Varicella

Breakthrough varicella: Infection in a vaccinated person

Clinical Manifestations:
- Mild
- Low/no fever
- Fewer lesions
- Maculopapular rash
- Contagious

Source: CDC
Diagnosing Breakthrough Varicella (cont’d)

Poison Ivy

Folliculitis

Insect Bites

Herpes Simplex

Breakthrough Varicella

Scabies

“Hot Tub” Folliculitis

Etiology:
*Pseudomonas aeruginosa*

Clinical Presentation:
- Itchy red rash
- Resemble acne
- Rash → dark nodules
- Sore throat, earache, headache

Transmission: Direct contact

Treatment: Supportive, topical antibiotics
Etiology: Molluscum contagiosum virus

Clinical Presentation:
- Small, raised, firm
- Umbilicated papules
- Pink or flesh-colored
- Anywhere in body

Transmission: Person-to-person, autoinoculation

Treatment: May not be necessary
Varicella PCR Testing

Advantages:
• Preferred test for diagnosing varicella
• Easily implemented
• Less invasive than drawing blood
• Reliable

Technique:
• Collect within 5 days of rash onset
• Obtain samples from vesicles and crusts, but can also obtain from papule or macule by rubbing lesion
• Samples from ≥ 2 lesions

Source: Philadelphia Department of Public Health
Varicella Serologic Testing

IgM Testing
• False negatives, poor specificity
• Timing of collection

IgG Acute and Convalescent Titers
• Required second office visit

Source: Philadelphia Department of Public Health
Public Health Management of Varicella

• Report to HD:
  • Weekly, number of cases – sporadic
  • Immediately, report cases – outbreak (≥ 3 cases)

• Exclude infected until all lesions have crusted

• Standard and respiratory precautions

• Ventilate room

• Obtain evidence of immunity – vaccinate susceptible individuals
### Varicella Vaccine Effectiveness (VE)

#### Two-dose Varicella VE in Rash Severity in Outbreaks of Varicella Among Public School Students

*Pediatr Infect Dis J. 2014 November; 33(11): 1164–1168*

VE against ALL varicella

<table>
<thead>
<tr>
<th>Varicella vaccine</th>
<th>VE</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-dose</td>
<td>83.2%</td>
<td>69.2%</td>
</tr>
<tr>
<td>Two-dose</td>
<td>93.9%</td>
<td>86.9%</td>
</tr>
<tr>
<td>2 doses vs. 1-dose</td>
<td>63.6%</td>
<td>32.6%</td>
</tr>
</tbody>
</table>

VE in preventing moderate/severe varicella

<table>
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<th>VE</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-dose</td>
<td>88.2%</td>
<td>72.7%</td>
</tr>
<tr>
<td>Two-dose</td>
<td>97.5%</td>
<td>91.6%</td>
</tr>
<tr>
<td>2 doses vs. 1-dose</td>
<td>78.6%</td>
<td>40.9%</td>
</tr>
</tbody>
</table>
Enhanced Varicella Outbreak Surveillance

- All public schools in WV
- During the school year
- Report varicella cases monthly including zero cases
Conclusion

- Diagnosis of VPD can be challenging
- Report suspected cases of VPD
Contact

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