Vaccine Preventable Diseases

Session 2
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Communicable Disease Branch
Contents

• Viral Vaccine Preventable Diseases
  – Varicella
  – Measles, Mumps, Rubella
  – Polio
• Bacterial Vaccine Preventable Diseases
  – Diphtheria and Tetanus
• VPDs in NC EDSS
Learning Objectives

• Locate control measures for less commonly seen VPDs

• Identify appropriate clinical specimens for VPD testing

• List key data elements for reporting VPDs in NC EDSS
Using VPD Resources

• Read case definition for each disease
• Review relevant chapters
  – CDC Pink Book
  – CDC VPD Surveillance Manual
• Refer to NC SLPH Guide to Services
• Check for CDC MMWR for recent VPD updates
• Epi on call 24/7: 919-733-3419
VARICELLA
Varicella Reporting

• Single cases - not reportable in NC EDSS
• Still warrant public health response to
  • Prevent an outbreak
  • Protect high risk contacts

• Outbreaks (≥5 cases) - report to CD Branch

• Refer to CDC Varicella Outbreak Manual
Varicella

Highly infectious febrile rash illness; mild prodrome

Progressive rash
  – Starts on head, chest, back; spreads to extremities
  – Highest concentration on chest and back
  – Maculopapular lesions, vesicles, and crusts present at same time

Complications – bacterial skin infections, sepsis, pneumonia, CNS (encephalitis, cerebellar ataxia), Reye syndrome, death

Immunocompromised and neonates at higher risk of severe disease
Varicella Epidemiology

Causative agent: varicella-zoster virus (VZV)
  – *Primary*: chickenpox
  – *Recurrent*: shingles

Mode of transmission: airborne, direct contact with secretions, lesion fluid

Incubation period: 14-16 days (range 10-21)

Infectious period: 1-2 days prior to rash until crusting
Varicella Cases and 1-Dose Vaccine Coverage
Varicella Active Surveillance Project Sites, 1995-2005

Antelope Valley, California

West Philadelphia

90% decline in varicella incidence in both sites

Guris J Infect Dis 2008
Breakthrough Varicella Infection

Photo: CDC Public Health Image Library
# Varicella-Containing Vaccines

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Use and Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varicella vaccine (Varivax®)</td>
<td>• Approved for persons 12 months and older</td>
</tr>
<tr>
<td></td>
<td>• 70-90% effective against any varicella disease</td>
</tr>
<tr>
<td>Measles/mumps/rubella/varicella vaccine</td>
<td>• Approved for persons 12 months through 12 years</td>
</tr>
<tr>
<td>(Proquad®)</td>
<td>• Efficacy inferred from that of MMR vaccine and varicella vaccine</td>
</tr>
<tr>
<td>Herpes zoster vaccine (Zostavax®)</td>
<td>• Recommended for adults 60 years of age and older</td>
</tr>
<tr>
<td></td>
<td>• 51% reduction in shingles risk; 67% reduction in post-herpetic neuralgia</td>
</tr>
</tbody>
</table>
# Varicella Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Purpose</th>
<th>Specimen</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue culture/DFA</td>
<td>Disease Confirmation</td>
<td>• Vesicular fluid-lesion • Biopsy tissue</td>
<td>• SLPH • Culture: 4 wks • DFA: 1-2 days</td>
</tr>
<tr>
<td>PCR</td>
<td>Disease Confirmation/Strain Differentiation</td>
<td>• Vesicular swabs • Lesion scrapings • Scabs-crusted lesions • Biopsy tissue, CSF</td>
<td>• CDC VPD Reference Lab; reliable, fast</td>
</tr>
<tr>
<td>Serology-IgG</td>
<td>Varicella Immunity/Disease Confirmation</td>
<td>• Serum</td>
<td>• SLPH-7 day turn around; • Routine testing following vaccination not recommended</td>
</tr>
</tbody>
</table>
# Evidence of Varicella Immunity

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Documentation of age-appropriate vaccination  | • Preschool children aged >12 months: 1 dose  
• School aged children, adolescents, adults: 2 doses |
| Lab evidence of immunity or disease confirmation | • Commercial assays may yield false negative results                                                                                   |
| U.S. born before 1980                         | • Not sufficient evidence for healthcare personnel, pregnant women or immunocompromised persons                                         |
| Clinician diagnosis of disease or history of disease | • Assess mild, atypical disease for lab-confirmed epi link or perform lab work for confirmation                                         |
| History of clinician diagnosed herpes zoster   |                                                                                                                                           |
Varicella Treatment

• Antivirals not considered clinically beneficial for otherwise healthy children

• Consider use for otherwise healthy persons at risk for moderate-severe varicella

• If treating, start early for maximum benefit
## Varicella Control Measures

<table>
<thead>
<tr>
<th>Control Measure</th>
<th>Indication</th>
</tr>
</thead>
</table>
| Vaccination         | *Post Exposure Prophylaxis (PEP)*: within 3-5 days  
*Outbreak Control*: 2 dose vaccination policy  
*Postpartum*: upon completion of pregnancy if non-immune |
| Antivirals (acyclovir) | *PEP*: persons at increased risk for moderate-severe disease;  
*Treatment*: Secondary cases in same household as infected child |
| VZ Immune globulin VariZIG® | *PEP*: for exposed persons at high risk of severe disease w/o evidence of immunity and ineligible for vaccine: administer up to 10 days after exposure |
| Isolation           | *Active Disease*: until rash is crusted. Vaccinated person: no new lesions for 24 hours. Healthcare: airborne, contact precautions |
| Quarantine          | *Unvaccinated, non-immune*: School exclusion-until 21 days after rash onset in last case. Healthcare exclusion-furlough from days 8 to 21 after exposure |
MEASLES, MUMPS AND RUBELLA
Measles

- Prodrome
  - High fever
  - Cough, coryza, conjunctivitis
- Koplik spots
  - Blue-white spots on buccal mucosa
- Maculopapular Rash
  - Begins at hairline, involves face and neck
  - Spreads down and out
  - Fades in order it appeared

Complications
- Mostly in children <5 and adults 20+
- Severe complications can occur

Photo: CDC Public Health Image Library
Measles Epidemiology

Endemic transmission no longer occurs in U.S.

Rapid identification of travel-related cases is key to prevent spread

NC 2013 outbreak:
23 cases, 30 isolation orders, >1000 exposures, 2200 local public health hours
# Measles Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles virus isolation‡</td>
<td>Throat*, NP swab, urine</td>
<td>CDC VPD Reference Lab/SLPH *Collect within 3 days of rash onset</td>
</tr>
<tr>
<td>Measles virus-specific PCR‡</td>
<td>Throat*, NP swab, urine</td>
<td>CDC VPD Reference Lab/SLPH-2 days *Collect within 3 days of rash onset</td>
</tr>
<tr>
<td>IgM antibody‡</td>
<td>Serology</td>
<td>SLPH: 3 day turnaround Collect ASAP &amp; &gt;72 h after rash onset</td>
</tr>
<tr>
<td>IgG antibody‡</td>
<td>Paired sera</td>
<td>SLPH: 7 day turn around Collect ASAP and 14-30 days after acute Look for seroconversion‡ or significant rise in measles IgG antibody‡</td>
</tr>
</tbody>
</table>

‡ Not explained by MMR vaccination during the previous 6–45 days
# Measles Control Measures

<table>
<thead>
<tr>
<th>Control Measure</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMR Vaccine (PEP)</td>
<td>▪ Eligible contacts-Administer within 72 hours of initial exposure</td>
</tr>
<tr>
<td></td>
<td>▪ Monitor for signs/ symptoms for at least 1 incubation period</td>
</tr>
<tr>
<td></td>
<td>▪ Except for healthcare-persons may return to work if vaccinated within 72 hours of initial exposure</td>
</tr>
<tr>
<td>Immune globulin (PEP)</td>
<td>▪ Contacts ineligible for vaccine-Administer within 6 days of exposure</td>
</tr>
<tr>
<td></td>
<td>▪ Monitor for signs/ symptoms for at least 1 incubation period</td>
</tr>
<tr>
<td>Isolation</td>
<td>▪ Case patients should be isolated for 4 days post rash onset (day 0)</td>
</tr>
<tr>
<td></td>
<td>▪ Healthcare setting-use airborne precautions</td>
</tr>
<tr>
<td>Quarantine</td>
<td>▪ Exposed unvaccinated, non-immune persons should be excluded from affected facility until 21 days after rash onset in last case</td>
</tr>
</tbody>
</table>
Mumps

**Acute viral illness**
Prodrome
- Myalgia, malaise, low-grade fever, anorexia, headache

Manifestations
- Up to 20%: Asymptomatic
- 30-40%: Parotitis
- 40-50%: Non-specific, respiratory

**Complications**
- Aseptic meningitis (50-60%)
- Symptomatic meningitis (up to 15%)
- Orchitis (up to 50% post pubertal males)
- 1 death per year (1980 – 1999)
# Mumps Lab Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCR</td>
<td>Fluid-parotid duct swab, salivary gland, CSF, throat</td>
<td>SLPH: 1-3 days; Collect within 3 days of parotitis/meningitis onset Refer to SLPH Guide for details</td>
</tr>
<tr>
<td>Mumps virus culture</td>
<td>Fluid-parotid duct swab, salivary gland, CSF, throat</td>
<td>SLPH: 3 weeks; Confirmed by IF, PCR Refer to SLPH Guide for details</td>
</tr>
<tr>
<td>IgM capture serology</td>
<td>Serology</td>
<td>Available at most commercial labs Unvaccinated: Collect after 3 days from onset Vaccinated: IgM response may be transient or absent</td>
</tr>
<tr>
<td>IgG serology</td>
<td>Acute/convalescent sera</td>
<td>SLPH: Paired sera- conversion from (-) to (+) Unvaccinated: rapid long lasting rise Vaccinated: elevated result in acute sera may prevent detection of 4 fold titer rise</td>
</tr>
</tbody>
</table>
## Mumps Control Measures

<table>
<thead>
<tr>
<th>Control Measure</th>
<th>Indication</th>
</tr>
</thead>
</table>
| MMR Vaccine             | Not indicated for PEP  
Vaccinate those without evidence of immunity                                  |
| Immune globulin (IG)    | Not indicated for PEP                                                     |
| Isolation               | Case-patient: isolate/ exclude for 5 days after parotitis onset  
Healthcare setting: use droplet and standard precautions                  |
| Quarantine              | Exposed non-immune contacts-  
*Healthcare setting*: exclude from 12th day after 1st unprotected exposure through 25th day after last exposure  
*School setting*: exclude until 26th day after onset in last case |
Rubella

- Prodrome
  - Low-grade fever
  - Malaise
  - Lymphadenopathy
  - Upper respiratory symptoms
- Maculopapular Rash
  - Begins on face
  - Progresses from head to foot
  - Can be itchy
- Other symptoms
  - Arthralgia & arthritis in adults
- Complications
  - Not common
  - Mostly seen in adults

Photo: CDC Public Health Image Library
Congenital Rubella Syndrome

Infection early in pregnancy is most severe
- Up to 85% infected in 1\textsuperscript{st} trimester will be affected
- Defects rare after 20\textsuperscript{th} week of gestation

Various congenital defects
- Deafness, eye defects
- Cardiac, neurological abnormalities

Prevention of CRS is main objective of the rubella vaccination program
# Rubella Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubella virus detection-PCR</td>
<td>Nasal, throat, urine, blood, CSF</td>
<td>CDC VPD Reference Lab /SLPH-2 days; Best results from throat swabs; maximum viral shedding up to day 4 after rash onset</td>
</tr>
<tr>
<td>IgM capture EIA</td>
<td>Serology</td>
<td>SLPH-2 days; May not be detectable before day 5 after rash onset; false + likely due to low incidence</td>
</tr>
</tbody>
</table>
| IgG                           | Paired sera               | SLPH-2 days; Acute: within 7-10 days of illness onset  
Convalescent: 2-3 weeks after acute |


# Rubella Control Measures

<table>
<thead>
<tr>
<th>Control Measure</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMR vaccine</td>
<td>Not recommended; may give to non-immune contacts but post exposure vaccination has not been shown to prevent rubella</td>
</tr>
<tr>
<td>IG</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Isolation</td>
<td>Cases should be isolated for 7 days after rash onset.</td>
</tr>
</tbody>
</table>
| Quarantine      | **Healthcare setting**: Exclude non-immune for 7 days after exposure and continuing through either 23 days after last exposure or 7 days after rash appears. Exclude exposed healthcare personnel who are vaccinated as part of control measures from direct patient care for 23 days after the last exposure to rubella.  
**School setting**: Exclude until 23 days after the onset of rash of the last reported case-patient in the outbreak setting. |
## Disease Facts Summary – Measles, Mumps, Rubella

<table>
<thead>
<tr>
<th></th>
<th>Measles</th>
<th>Mumps</th>
<th>Rubella</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transmission</strong></td>
<td>Airborne</td>
<td>Respiratory droplets</td>
<td>Respiratory droplets</td>
</tr>
<tr>
<td><strong>Incubation Period</strong></td>
<td>14 days Range: 7-21 days</td>
<td>16-18 days Range: 12-25 days</td>
<td>17 days Range: 12-23 days</td>
</tr>
<tr>
<td><strong>Infectious Period</strong></td>
<td>4 days before to 4 days after rash onset</td>
<td>2 days before to 5 days after parotitis onset</td>
<td>7 days before to 7 days after rash onset</td>
</tr>
<tr>
<td><strong>Communicability</strong></td>
<td>Highly contagious</td>
<td>Moderately contagious</td>
<td>Moderately contagious</td>
</tr>
<tr>
<td><strong>Exposure</strong></td>
<td>Sharing same airspace (up to 2 hours after case present)</td>
<td>Contact within 3 feet</td>
<td>Any direct contact</td>
</tr>
</tbody>
</table>
MMR Vaccine

• Live, attenuated vaccine

• 2 dose series
  – 12-15 months
  – 4-6 years

• Effectiveness
  • Measles 95-99%
  • Mumps 81-91%
  • Rubella 94-100%

• Lifelong immunity

Photo: Immunization Action Coalition
Vaccine Preventable Diseases

POLIO
Polio

1979-last U.S. case

In U.S.-4 dose IPV immunization schedule

Endemic in Pakistan, Afghanistan, Nigeria

Potential for importation remains
## Polio Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>Stool, pharyngeal swab,</td>
<td>SLPH- 3 weeks turnaround; at least 2 stool specimens obtained 24 hours</td>
</tr>
<tr>
<td></td>
<td>CSF</td>
<td>apart within 14 days after onset</td>
</tr>
<tr>
<td>Intratypic differentiation</td>
<td>Isolate from culture</td>
<td>CDC Reference Lab</td>
</tr>
<tr>
<td>Serology</td>
<td>Paired sera</td>
<td>3 weeks apart</td>
</tr>
</tbody>
</table>
Vaccine Preventable Diseases

DIPHTHERIA AND TETANUS
Diphtheria

**Respiratory disease**
- Sore throat, malaise, low grade fever
- Pseudomembrane over tonsils, pharynx, larynx
- Inflammation of cervical lymph nodes
- Soft tissue swelling

**Complications**
- Most attributable to toxin
- Myocarditis, neuritis
- Extent of local disease determines severity
- Death in 5%-10%
Diphtheria Epidemiology

- Less than 5 U.S. cases in past 10 years
- Ongoing circulation of toxigenic *C. diptheriae*
- Human carriers-reservoir; usually asymptomatic
# Diphtheria Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>Nose, throat, membrane swab</td>
<td>Call CD Branch/ SLPH prior to sending; special media required containing tellurite; send 2 swabs; Thrush, other diseases can mimic signs of diphtheria; perform routine culture initially</td>
</tr>
<tr>
<td>Toxigenicity testing</td>
<td>Isolate from culture</td>
<td>CDC VPD lab via SLPH</td>
</tr>
<tr>
<td>PCR</td>
<td>Nose, throat, membrane swab</td>
<td>CDC VPD lab via SLPH</td>
</tr>
</tbody>
</table>
Treatment and Control Measures

- Diphtheria Antitoxin (DAT) – Investigational New Drug (IND) protocol PLUS
- Parenteral antibiotics until patient can swallow
- Age-appropriate vaccination (DTaP, Tdap)
- Contact investigation - test, treat, vaccinate, monitor
Tetanus

Generalized tetanus:
- trismus (lockjaw),
- difficulty swallowing,
- muscle rigidity,
- spasms

Spasms continue for 3-4 weeks

Complete recovery may take months

Source: National Notifiable Disease Surveillance System, CDC
Tetanus Testing and Treatment

• Diagnosis is clinical; no confirmatory lab tests

• Immediate treatment with tetanus toxoid and tetanus immune globulin (TIG) may decrease disease severity

• Requires hospitalization, emergency care
VPD Testing Approval

Except for pertussis, all suspect or probable cases of vaccine preventable diseases must be reported to the Communicable Disease Branch at (919) 733-3419 for prior approval of laboratory testing.
## Key VPD Data for NC EDSS

<table>
<thead>
<tr>
<th>Package</th>
<th>Vaccine Preventable Disease Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative</td>
<td>Initial source and date of report to public health, county of residence, investigation trail</td>
</tr>
<tr>
<td>Clinical</td>
<td>Symptom onset date, all case definition symptom data, treatment, hospitalization, outcome</td>
</tr>
<tr>
<td>Lab</td>
<td>Specimen date, type, result, ordering provider, facility</td>
</tr>
<tr>
<td>Risk History</td>
<td>Exposure information, travel history, knowledge of other symptomatic contacts, epidemiological links</td>
</tr>
<tr>
<td>Vaccination</td>
<td>Shot history dates, reason for refusal</td>
</tr>
</tbody>
</table>
CDC Resources

CDC Pink Book –
http://www.cdc.gov/vaccines/pubs/pinkbook/index.html

CDC VPD Surveillance Manual -

ACIP Recommendations -
http://www.cdc.gov/vaccines/hcp/acip-recs/index.html
CDC References

• CDC Yellow Book-

• CDC Varicella Outbreak Manual-
  http://www.cdc.gov/chickenpox/outbreaks/control-investigation.html
NC Resources

• Case definitions –  

• NC SCOPE Guide to Services -  
  http://slph.state.nc.us/doc/administration/SCOPE-2013.pdf

• NC SCOPE Index to Services -  
  http://slph.state.nc.us/doc/administration/SCOPE-2013-Index.pdf