Measles and Measles Vaccine
Epidemiology and Prevention of Vaccine-Preventable Diseases
National Immunization Program
Centers for Disease Control and Prevention
Revised January 2006

Note to presenters:
Images of vaccine-preventable diseases are available from the Immunization Action Coalition website at http://www.vaccineinformation.org/photos/index.asp

Measles
- Highly contagious viral illness
- First described in 7th century
- Near universal infection of childhood in prevaccination era
- Common and often fatal in developing areas

Measles Virus
- Paramyxovirus (RNA)
- Hemagglutinin important surface antigen
- One antigenic type
- Rapidly inactivated by heat and light

Measles Pathogenesis
- Respiratory transmission of virus
- Replication in nasopharynx and regional lymph nodes
- Primary viremia 2-3 days after exposure
- Secondary viremia 5-7 days after exposure with spread to tissues

Measles Clinical Features
- Incubation period 10-12 days

Prodrome
- Stepwise increase in fever to 103°F or higher
- Cough, coryza, conjunctivitis
- Koplik spots
Measles Clinical Features

Rash
• 2-4 days after prodrome, 14 days after exposure
• Maculopapular, becomes confluent
• Begins on face and head
• Persists 5-6 days
• Fades in order of appearance

Measles Complications

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>8</td>
</tr>
<tr>
<td>Otitis media</td>
<td>7</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>6</td>
</tr>
<tr>
<td>Encephalitis</td>
<td>0.1</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>18</td>
</tr>
<tr>
<td>Death</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Based on 1985-1992 surveillance data

Measles Complications by Age Group

Measles Laboratory Diagnosis

• Isolation of measles virus from a clinical specimen (e.g., nasopharynx, urine)
• Significant rise in measles IgG by any standard serologic assay (e.g., EIA, HA)
• Positive serologic test for measles IgM antibody

Measles Epidemiology

• Reservoir: Human
• Transmission: Respiratory, Airborne
• Temporal pattern: Peak in late winter–spring
• Communicability: 4 days before to 4 days after rash onset

Measles—United States, 1950-2005

*2005 provisional total
Measles—United States, 1980-2005*

Age Distribution of Reported Measles, 1975-2002


- Cases 55,622
- Age group affected Children <5 yrs
- Hospitalizations >11,000
- Deaths 123
- Direct medical costs >$150 million

Measles 1993-2004

- Endemic transmission interrupted
- Record low annual total in 2004 (37 total cases)
- Many cases among adults
- Most cases imported or linked to importation

Measles Clinical Case Definition

- Generalized rash lasting >3 days, and
- Temperature 101°F (>38.3°C), and
- Cough or coryza or conjunctivitis

Measles Vaccines

1963  Live attenuated and killed vaccines
1965  Live further attenuated vaccine
1967  Killed vaccine withdrawn
1968  Live further attenuated vaccine (Edmonston-Enders strain)
1971  Licensure of combined measles-mumps-rubella vaccine
1989  Two dose schedule
2005  Licensure of MMRV
<table>
<thead>
<tr>
<th><strong>Measles Vaccine</strong></th>
<th><strong>MMRV (ProQuad)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Composition</td>
<td>• Combination measles, mumps, rubella and varicella vaccine</td>
</tr>
<tr>
<td>Live virus</td>
<td>• Approved children 12 months through 12 years of age (up to age 13 years)</td>
</tr>
<tr>
<td>• Efficacy</td>
<td>• Titer of varicella vaccine virus in MMRV is more than 7 times higher than standard varicella vaccine</td>
</tr>
<tr>
<td>95% (range, 90%-98%)</td>
<td></td>
</tr>
<tr>
<td>• Duration of</td>
<td></td>
</tr>
<tr>
<td>Immunity</td>
<td></td>
</tr>
<tr>
<td>Lifelong</td>
<td></td>
</tr>
<tr>
<td>• Schedule</td>
<td></td>
</tr>
<tr>
<td>2 doses</td>
<td></td>
</tr>
<tr>
<td>• Should be</td>
<td></td>
</tr>
<tr>
<td>administered with</td>
<td></td>
</tr>
<tr>
<td>mumps and rubella</td>
<td></td>
</tr>
<tr>
<td>as MMR</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>MMR Vaccine Failure</strong></th>
<th><strong>Measles (MMR) Vaccine Indications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Measles, mumps, or</td>
<td>• All infants ≥12 months of age</td>
</tr>
<tr>
<td>rubella disease (or</td>
<td>• Susceptible adolescents and</td>
</tr>
<tr>
<td>lack of immunity) in a</td>
<td>adults without documented</td>
</tr>
<tr>
<td>previously vaccinated</td>
<td>evidence of immunity</td>
</tr>
<tr>
<td>person</td>
<td></td>
</tr>
<tr>
<td>• 2%-5% of recipients</td>
<td></td>
</tr>
<tr>
<td>do not respond to the</td>
<td></td>
</tr>
<tr>
<td>first dose</td>
<td></td>
</tr>
<tr>
<td>• Caused by antibody,</td>
<td></td>
</tr>
<tr>
<td>damaged vaccine, record</td>
<td></td>
</tr>
<tr>
<td>errors</td>
<td></td>
</tr>
<tr>
<td>• Most persons with</td>
<td></td>
</tr>
<tr>
<td>vaccine failure will</td>
<td></td>
</tr>
<tr>
<td>respond to second dose</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Measles Mumps Rubella Vaccine</strong></th>
<th><strong>Second Dose of Measles Vaccine</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 12 months is the recommended</td>
<td>• Intended to produce measles</td>
</tr>
<tr>
<td>and minimum age</td>
<td>immunity in persons who failed to</td>
</tr>
<tr>
<td>• MMR given before 12 months</td>
<td>respond to the first dose (primary</td>
</tr>
<tr>
<td>should not be counted as a valid</td>
<td>vaccine failure)</td>
</tr>
<tr>
<td>dose</td>
<td>• May boost antibody titers in</td>
</tr>
<tr>
<td>• Revaccinate at ≥12 months of age</td>
<td>some persons</td>
</tr>
</tbody>
</table>
Second Dose Recommendation
- First dose of MMR at 12-15 months
- Second dose of MMR at 4-6 years
- Second dose may be given any time ≥4 weeks after the first dose

Adults at Increased Risk of Measles
- College students
- International travelers
- Healthcare personnel

Measles Immunity in Healthcare Personnel
- All persons who work in medical facilities should be immune to measles

Measles Immunity
- Born before 1957
- Documentation of physician-diagnosed measles
- Serologic evidence of immunity
- Documentation of receipt of measles-containing vaccine

Measles Vaccine Indications for Revaccination
- Vaccinated before the first birthday
- Vaccinated with killed measles vaccine
- Vaccinated prior to 1968 with an unknown type of vaccine
- Vaccinated with IG in addition to a further attenuated strain or vaccine of unknown type

MMR Adverse Reactions
- Fever 5%-15%
- Rash 5%
- Joint symptoms 25%
- Thrombocytopenia <1/30,000 doses
- Parotitis rare
- Deafness rare
- Encephalopathy <1/1,000,000 doses
MMR Vaccine and Autism

• Measles vaccine connection first suggested by British gastroenterologist
• Diagnosis of autism often made in second year of life
• Multiple studies have shown no association

MMR Vaccine and Autism

“The evidence favors a rejection of a causal relationship at the population level between MMR vaccine and autism spectrum disorders (ASD).”

- Institute of Medicine, April 2001

MMR Vaccine Contraindications and Precautions

• Severe allergic reaction to vaccine component or following prior dose
• Pregnancy
• Immunosuppression
• Moderate or severe acute illness
• Recent blood product

Measles and Mumps Vaccines and Egg Allergy

• Measles and mumps viruses grown in chick embryo fibroblast culture
• Studies have demonstrated safety of MMR in egg allergic children
• Vaccinate without testing

Measles Vaccine and HIV Infection

• MMR recommended for persons with asymptomatic and mildly symptomatic HIV infection
• NOT recommended for those with evidence of severe immunosuppression
• Prevaccination HIV testing not recommended
• MMRV not approved for use in persons with HIV infection

PPD and Measles Vaccine

• Apply PPD at same visit as MMR
• Delay PPD >4 weeks if MMR given first
• Apply PPD first—give MMR when skin test read
Vaccine Storage and Handling
MMR Vaccine

• Store 35° - 46°F (2° - 8°C) (may be stored in the freezer)
• Store diluent at room temperature or refrigerate
• Protect vaccine from light
• Discard if not used within 8 hours reconstitution

Vaccine Storage and Handling
MMR Vaccine

• Must be shipped to maintain a temperature of ≤ -4°F (-20°C) at all times
• Must be stored at an average temperature of ≤ 5°F (-15°C) at all times
• May NOT be stored at refrigerator temperature at any time
• Must be administered within 30 minutes of reconstitution

National Immunization Program
Contact Information

• Telephone 800.CDC.INFO
• Email nipinfo@cdc.gov
• Website www.cdc.gov/nip