Measles, Mumps, and Rubella

Chapters 13, 15, and 20
Measles

- **Paramyxovirus**
  - Nasopharynx is primary site of infection

- **Incubation period is 10–12 days**

- **Prodrome is 2–4 days**
  - 3 Cs – cough, coryza, and conjunctivitis
  - Stepwise increase in fever up to 103°F–105°F
  - Koplik spots

- **Rash occurs 2–4 days after prodrome, 14 days after exposure, and persists 5–6 days**
  - Begins on face and upper neck
  - Maculopapular, becomes confluent
  - Fades in order of appearance
Measles Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Rate</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>Seizures</td>
<td>0.6–0.7%</td>
</tr>
<tr>
<td>Death</td>
<td>0.2%</td>
</tr>
</tbody>
</table>
Mumps

- **Paramyxovirus**
  - Nasopharynx and regional lymph nodes are primary sites of infection

- **Incubation period is 12–25 days**

- **Prodrome is nonspecific**
  - Myalgia
  - Anorexia
  - Malaise
  - Headache
  - Low-grade fever

- **Parotitis in 9%–94%, typically occurs within 16–18 days**

- **Prevaccine era: 15%–27% of infections were asymptomatic**
# Mumps Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchitis</td>
<td>12%–66% in postpubertal males (prevaccine)</td>
</tr>
<tr>
<td></td>
<td>3%–10% (postvaccine)</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>3.5% (prevaccine)</td>
</tr>
<tr>
<td>Unilateral deafness</td>
<td>1/20,000 (prevaccine)</td>
</tr>
<tr>
<td>Death</td>
<td>2/10,000 from 1966–1971</td>
</tr>
</tbody>
</table>
Rubella

- Togavirus
- Incubation period is 14 days (range: 12–23 days)
- Prodrome
  - Rare in children
  - Low-grade fever in adults
- Maculopapular rash 14–17 days after exposure
- Lymphadenopathy occurs before rash and lasts for several weeks
# Rubella Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthritis or arthralgia</td>
<td>May occur in up to 70% of adult women, but is rare in children and adult males</td>
</tr>
<tr>
<td>Encephalitis</td>
<td>1/6,000 cases</td>
</tr>
<tr>
<td>Hemorrhagic manifestations (e.g., thrombocytopenic purpura)</td>
<td>1/3,000 cases</td>
</tr>
<tr>
<td>Orchitis, neuritis, progressive panencephalitis</td>
<td>Rare</td>
</tr>
</tbody>
</table>
Rubella infection may affect fetal organs, causing:
- Hearing impairment
- Eye defects
- Cardiac defects
- Microcephaly
- Intellectual disabilities
- Bone alterations
- Liver and spleen damage

May lead to fetal death or preterm delivery

Severity of damage to fetus depends on gestational age
## Epidemiology

<table>
<thead>
<tr>
<th></th>
<th>Measles</th>
<th>Mumps</th>
<th>Rubella</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reservoir</strong></td>
<td>Human</td>
<td>Human</td>
<td>Human</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>Direct contact with infectious droplets or by airborne spread</td>
<td>Direct contact with saliva or respiratory droplets</td>
<td>Direct or droplet contact from nasopharyngeal secretions</td>
</tr>
<tr>
<td><strong>Temporal Pattern</strong></td>
<td>Peaks in late winter/spring</td>
<td>Peaks in late winter/spring</td>
<td>Peaks in late winter/spring</td>
</tr>
<tr>
<td><strong>Communicability</strong></td>
<td>4 days before to 4 days after rash onset</td>
<td>Several days before and after onset of parotitis</td>
<td>7 days before to 5–7 days after rash onset</td>
</tr>
</tbody>
</table>
Measles Cases, United States, 1962-2016*

*2016 data is preliminary and subject to change
States with Reported Measles Cases (as of 8/1/2019)

The states that have reported cases to CDC are Alaska, Arizona, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Mexico, Nevada, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, Tennessee, Virginia, and Washington.

www.cdc.gov/measles/cases-outbreaks.html
Number of Measles Cases Reported by Year

2010-2019** (as of August 1, 2019)

<table>
<thead>
<tr>
<th>Year</th>
<th>Measles Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>63</td>
</tr>
<tr>
<td>2011</td>
<td>220</td>
</tr>
<tr>
<td>2012</td>
<td>55</td>
</tr>
<tr>
<td>2013</td>
<td>187</td>
</tr>
<tr>
<td>2014</td>
<td>667</td>
</tr>
<tr>
<td>2015</td>
<td>188</td>
</tr>
<tr>
<td>2016</td>
<td>86</td>
</tr>
<tr>
<td>2017</td>
<td>120</td>
</tr>
<tr>
<td>2018</td>
<td>372</td>
</tr>
<tr>
<td>2019</td>
<td>1172</td>
</tr>
</tbody>
</table>

Measles cases and outbreaks: https://www.cdc.gov/measles/cases-outbreaks.html
Be vigilant about measles

Ensure EVERYONE is up to date on MMR vaccination
  - Staff and patients—children, adolescents, and adults

Consider measles in patients with febrile rash illness and clinically compatible measles symptoms (cough, coryza, and conjunctivitis)

Ask patients about:
  - Recent travel internationally
  - Recent travel to domestic venues frequented by international travelers
  - Recent contact with international travelers
  - History of measles in the community

Promptly isolate patients with suspected measles

www.cdc.gov/measles/hcp/index.html
Measles Resources

Reported Mumps Cases, United States, Vaccine Era, 1968-2016*

Source: National Notifiable Disease Surveillance System (passive surveillance); 2016 data is preliminary and subject to change
U.S. Mumps Cases as of July 19, 2019

*AL, AK, AR, AZ, CA, CO, CT, DE, FL, GA, HI, IA, IL, IN, KS, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV

**Preliminary data reported to CDC. Mumps outbreaks are not reportable.
* Case count is preliminary and subject to change.
**Cases as of July 19, 2019. Case count is preliminary and subject to change.
https://www.cdc.gov/mumps/outbreaks.html
Suspect Mumps?

- Health care professionals should be vigilant about mumps:
  - Consider mumps in patients presenting with fever and parotitis
  - **Promptly isolate patients** for 5 days after the glands begin to swell
  - **Immediately report the suspect mumps case to the health department**
  - Obtain specimens for testing from patients with suspected mumps, including a blood specimen and a buccal or oral swab specimen, which confirms the diagnosis

- Health care personnel should have documented evidence of immunity
  - Refer to “Immunization of Health-Care Personnel: Recommendations of the Advisory Committee on Immunization Practices” (www.cdc.gov/mmwr/pdf/rr/rr6007.pdf)
Rubella

Congenital Rubella Syndrome (CRS) and Birth Defects

www.cdc.gov/globalhealth/immunization/infographic/stop_rubella.htm
www.cdc.gov/rubella/index.html
## Acceptable Presumptive Evidence of Immunity

<table>
<thead>
<tr>
<th>Routine</th>
<th>Students (College/Post High School)</th>
<th>Health Care Personnel</th>
<th>International Travelers</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Documented age-appropriate vaccination with live measles-, mumps-, and rubella-virus-containing vaccines, or</td>
<td>(1) Documented doses of live measles and mumps virus-containing vaccines; dose of rubella-virus-containing vaccine, or</td>
<td>(1) Documented doses of live measles and mumps virus-containing vaccines; dose of rubella-virus-containing vaccine, or</td>
<td>(1) Documented age-appropriate vaccination with live measles-, mumps-, and rubella-virus-containing vaccines, or</td>
</tr>
<tr>
<td>(2) Laboratory evidence of immunity, or</td>
<td>(2) Laboratory evidence of immunity, or</td>
<td>(2) Laboratory evidence of immunity, or</td>
<td>(2) Laboratory evidence of immunity, or</td>
</tr>
<tr>
<td>(3) Laboratory confirmation of disease</td>
<td>(3) Laboratory confirmation of disease</td>
<td>(3) Laboratory confirmation of disease</td>
<td>(3) Laboratory confirmation of disease</td>
</tr>
<tr>
<td>(4) Born before 1957 (except rubella for women of childbearing age who could become pregnant)</td>
<td>(4) Born before 1957 (except rubella for women of childbearing age who could become pregnant)</td>
<td>(4) Born before 1957 (except rubella for women of childbearing age who could become pregnant)</td>
<td>(4) Born before 1957 (except rubella for women of childbearing age who could become pregnant)</td>
</tr>
</tbody>
</table>
Serologic screening before vaccination is not necessary unless the health care facility considers it cost-effective.

Postvaccination serologic testing to verify immunity is not recommended:
- Documented, age-appropriate vaccination supersedes the results of subsequent serologic testing.
- MMR vaccination for persons with 2 documented doses of measles- or mumps-containing vaccine or 1 dose of rubella-containing vaccine with a negative or equivocal measles titer is not recommended.
- Exception for women of childbearing age.

www.cdc.gov/mmwr/pdf/rr/rr6204.pdf
MMR Vaccine

- MMR (combination vaccine) licensed in 1971
- Highly effective
- Safe (over 50 years of use)
  - Low risk of febrile seizures in children 12 to 23 months (1 in 3,000 doses)
  - Temporary pain/stiffness in joints (teens or adult women)
  - Temporary low platelet count (1 in 30,000 doses)
MMR Vaccine

- **Composition**: Live, attenuated viruses
- **Efficacy**
  - Measles: 95% at 12 months; 98% at 15 months
  - Mumps: 88% (range: 31%–95%) (2 doses)
  - Rubella: 95% or more (1 dose)
- **Schedule**: 2 doses given subcutaneously

MMRV Vaccine

- **Composition**: Live, attenuated measles, mumps, rubella, and varicella vaccines
  7 to 8 times as much vaccine virus as monovalent varicella vaccine

- **Efficacy**: Inferred from that of MMR vaccine and varicella vaccine on the basis of noninferior immunogenicity

- **Schedule**: 2 doses given subcutaneously
### Child/Adolescent Schedule

#### Routine administration

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth</th>
<th>1 mo</th>
<th>2 mos</th>
<th>4 mos</th>
<th>6 mos</th>
<th>9 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>19-23 mos</th>
<th>2-3 yrs</th>
<th>4-6 yrs</th>
<th>7-10 yrs</th>
<th>11-12 yrs</th>
<th>13-15 yrs</th>
<th>16 yrs</th>
<th>17-18 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles, mumps, rubella (MMR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
MMR Recommendations for Children and Adolescents (Birth through 18 Years)

- **First dose at 12–15 months of age**
  - Minimum age is 12 months
  - Doses given before 12 months of age are not counted as valid
    - Infants as young as 6 months should receive MMR before international travel*
    - Revaccinate at 12 months of age or older

- **Second dose at 4–6 years of age**
  - May be administered before age 4 years (observe 4-week minimum interval)
  - Intended to produce measles and/or mumps immunity in persons who failed to respond to the first dose
  - People who received 2 doses of MMR vaccine as children according to the U.S. vaccination schedule are considered protected for life

*ACIP off-label recommendation [www.cdc.gov/mmwr/pdf/rr/rr6204.pdf](http://www.cdc.gov/mmwr/pdf/rr/rr6204.pdf)
MMRV Vaccine

- **First dose at 12–47 months of age**
  - Minimum age is 12 months
  - Can be given as MMR and VAR separately or MMRV

- **Second dose at 15 months–12 years of age**
  - MMRV generally preferred
  - May be given any time before 13th birthday at least 3 months (minimum interval) after the first dose
  - Not approved for use in persons 13 years of age and older

## Adult Schedule

### Routine administration

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>19–21 years</th>
<th>22–26 years</th>
<th>27–49 years</th>
<th>50–64 years</th>
<th>≥65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles, mumps, rubella (MMR)</td>
<td>1 or 2 doses depending on indication (if born in 1957 or later)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Medical Indications

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Pregnancy</th>
<th>Immuno-compromised (excluding HIV infection)</th>
<th>HIV infection CD4 count</th>
<th>Asplenia, complement deficiencies</th>
<th>End-stage renal disease, on hemodialysis</th>
<th>Heart or lung disease, alcoholism[^1]</th>
<th>Chronic liver disease</th>
<th>Diabetes</th>
<th>Health care personnel[^2]</th>
<th>Men who have sex with men</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMR</td>
<td>CONTRAINDICATED</td>
<td></td>
<td>&lt;200</td>
<td>≥200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACIP Immunization Recommendations: Adults

- Adults born in 1957 or later without acceptable evidence of immunity to measles, mumps, or rubella should receive 1 dose of MMR.

- A routine second dose of MMR vaccine at least 28 days after the first dose is recommended for adults who are:
  - College and post-high-school students
  - Working in medical facilities
  - International travelers

- Adults born before 1957 are generally presumed immune to measles, mumps, and rubella.
MMR Recommendations: Adults

- Adults without acceptable evidence of immunity to measles, mumps, or rubella who work in a health care facility should receive 2 doses of MMR
  - Personnel born before 1957 without acceptable evidence of immunity to measles, mumps, or rubella should be considered for vaccination with 2 doses of MMR for measles or mumps, or 1 dose for rubella
Clinical Considerations
MMR Revaccination Indications

- Vaccinated before the first birthday
- Vaccinated with inactivated (killed) measles vaccine (KMV) or measles vaccine of unknown type from 1963 through 1967
- Vaccinated with immune globulin (IG) in addition to a further attenuated strain or vaccine of unknown type (revaccination not necessary if IG given with Edmonston B vaccine)
- Vaccinated before 1979 with either inactivated mumps vaccine or mumps vaccine of unknown type who are at high risk for mumps infection (e.g., work in a health care facility) should be considered for revaccination with 2 doses of MMR
Mumps: January 2018 ACIP Recommendation

https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mmr.html

*Off-label recommendation
International Travel

- Infants 6 through 11 months of age should receive one dose of MMR vaccine
- Children 12 months of age or older should have documentation of two doses of MMR vaccine
- Teenagers and adults born during or after 1957 without evidence of immunity against measles should have documentation of two doses of MMR vaccine
- Ask patients about plans for international travel as part of your routine screening process
Health Care Personnel: 
MMR Vaccination and Serologic Testing

- HCP with 2 documented, appropriately spaced doses of MMR are not recommended to be serologically tested for immunity

- IF they are tested and results are negative or equivocal for measles, mumps, and/or rubella, NO additional MMR doses are recommended

- Do NOT test persons with documented history of MMR vaccination
HCP Born Before 1957

- 2 doses of MMR vaccine should be considered for unvaccinated HCP born before 1957 who do not have laboratory evidence of disease or immunity to measles and/or mumps
- 1 dose of MMR vaccine should be considered for HCP with no laboratory evidence of disease or immunity to rubella
HCP and Outbreaks

- Health care facilities should recommend 2 doses of MMR vaccine at the appropriate interval for unvaccinated health care personnel regardless of birth year who lack laboratory evidence of measles or mumps immunity or laboratory confirmation of disease.

- A third dose of MMR can be administered to adults who previously received 2 or more doses of mumps-containing vaccine and are identified by public health authority to be at increased risk for mumps in an outbreak.
What Do You Think?

- If a health care worker develops a rash and low-grade fever after MMR vaccination, is s/he infectious?

- Approximately 5 to 15% of susceptible people who receive MMR vaccine will develop a low-grade fever and/or mild rash 7 to 12 days after vaccination. However, the person is not infectious, and no special precautions (such as exclusion from work) need to be taken.
MMR and MMRV Administration

- **Preparation**
  - MMR-containing vaccines must be reconstituted BEFORE administering
  - Use ONLY the diluent supplied by the manufacturer

- **Route: Subcutaneous injection**
  - Needle gauge: 23–25 gauge
  - Needle length: 5/8 inch

- **Site: Upper outer triceps of the arm or the thigh**
MMR and MMRV Administration Errors

- **Wrong diluent used to reconstitute vaccine**
  - Dose does NOT count and should be repeated ASAP

- **Wrong route**
  - Administered intramuscularly instead of subcutaneously

- **MMRV administered after the age of 12 years**
  - Dose counts if the minimum interval has been met

- **Always remember – store vaccine according to the manufacturer’s recommendations and use a new needle and syringe for each patient**
Measles, Mumps, Rubella Postexposure Prophylaxis

- If given within 72 hours of exposure, MMR vaccine might protect or modify clinical course of measles (preferable to IG for persons >12 months if given within 72 hours of exposure)

- If administered within 6 days of exposure, IG can prevent or modify measles in persons who are nonimmune
  - Not indicated for persons who have received 1 dose of measles-containing vaccine at age ≥12 months, unless they are severely immunocompromised

- Postexposure MMR vaccination or IG not shown to prevent or alter the clinical severity of rubella or mumps and is not recommended
MMR and MMRV Contraindications and Precautions

- History of anaphylactic reaction to neomycin
- History of severe allergic reaction to any component of the vaccine
- Pregnancy
- Moderate or severe acute illness
- Recent blood product
- Personal or family (i.e., sibling or parent) history of seizures of any etiology
  - Should be vaccinated with separate MMR and varicella vaccines, not MMRV

*ACIP off-label recommendation; Vaccine package insert states 3 months
MMR Vaccine Contraindications and Precautions

- **Immunosuppression**
  - HIV
    - Prevaccination HIV testing not recommended
    - MMR recommended for persons who do not have evidence of current severe immunosuppression
    - Revaccination recommended for persons with perinatal HIV infection who were vaccinated before establishment of effective antiretroviral therapy (ART) with 2 appropriately spaced doses of MMR vaccine once effective ART has been established
    - MMRV not for use in persons with HIV infection
  - Low-dose steroids – vaccinate anytime
  - Leukemia in remission without chemotherapy for 3 months – vaccinate
  - Hematopoietic cell transplant (HCT) recipient who is immunocompetent

General Best Practice Guidelines for Immunization: www.cdc.gov/vaccines/hcp/acip-recs/general-recs/index.html
Tuberculin Skin Testing (TST)* or Tuberculosis Interferon-Gamma Release-Assay (IGRA) and MMR or MMRV Vaccines

- Apply TST or IGRA at same visit as MMR or MMRV
- Delay TST or IGRA at least 4 weeks (28 days) if MMR or MMRV given first
- Apply TST first and administer MMR or MMRV when skin test read (least favored option because receipt of MMR or MMRV is delayed)

*Previously called PPD
MMR Vaccine Adverse Reactions

- Fever 5%–15% (measles)
- Rash, pruritis, purpura 5% (measles)
- Thrombocytopenia 1/30,000–40,000 doses (measles)
- Lymphadenopathy Rare (rash, pruritis, purpura)
- Allergic reactions Rare
- Parotitis Rare (mumps)
- Hearing loss Rare (mumps)
MMRV Vaccine Adverse Reactions

- Similar to MMR

- Higher risk for fever and febrile seizures 5–12 days after the first dose among children 12–23 months of age
  - 1 additional febrile seizure occurred 5–12 days after vaccination per 2,300–2,600 children compared with children who received first dose as MMR and varicella vaccine separately

- Fever of 102°F or higher
  - 22% of MMRV recipients
  - 15% with separate injections

- Increased risk of febrile seizures has not been observed following use of MMRV as the second dose in the MMR and varicella series
MMR Vaccine Safety

“The committee concludes that the evidence favors rejection of a causal relationship between MMR vaccine and autism.” Institute of Medicine, 2004

Vaccine safety information: https://www.cdc.gov/vaccinesafety/index.html
www.nap.edu/catalog/10997/immunization-safety-review-vaccines-and-autism
www.cdc.gov/measles/cases-outbreaks.html
MMR Storage and Handling

- Store in the refrigerator between 2°C and 8°C (36°F and 46°F)
  - May also be stored in the freezer
  - Protect vaccine from light by keeping in the original packaging with the lid closed
- Store diluent at room temperature or refrigerate
- Discard if not used within 8 hours after reconstitution
  - Do not fill syringe with reconstituted vaccine until ready to administer
MMRV Storage and Handling

- Store in the freezer between -50°C and -15°C (-58°F and +5°F)
  - Do NOT use dry ice
  - Protect vaccine from light
  - Vaccine may be stored at refrigerator temperature (2°C and 8°C or between 36°F and 46°F) for up to 72 continuous hours after removal from freezer

- Store diluent at room temperature or refrigerate

- If not used immediately, the reconstituted vaccine may be stored at room temperature, protected from light, for up to 30 minutes
  - Do not freeze reconstituted vaccine

- Discard if not used within 30 minutes after reconstitution
  - Do not fill syringe with reconstituted vaccine until ready to administer
A nursing student had MMR titers done before he started school. His titers came back negative. He has 2 documented doses of MMR after 1 year of age, separated by more than 4 weeks. How many doses of MMR should we administer?

- One
- Two
- None