PUBLIC HEALTH REFERENCE SHEET
Measles (Rubeola)

Name	Measles virus, a member of the genus *Morbillivirus* in the Paramyxoviridae family.
Reservoir & Transmission	Humans are the only natural host. Airborne by droplet spread, direct contact with nasal or throat secretions; less commonly by articles freshly soiled with nose and throat secretions. The period of communicability extends from 4 days before rash to 4 days after rash appearance. It is minimal after the second day of rash.
Incubation Period	From exposure to rash onset averages 14 days, with a range of 7–21 days.
Common Symptoms	Begins with high fever, cough, runny nose (coryza), and red, watery eyes (conjunctivitis). Two to three days later, tiny white spots (Koplik spots) may appear inside the mouth. Three to five days after symptoms begin, a rash breaks out.
Gold Standard Diagnostic Test	A four-fold rise in titer as measured in a measles virus plaque reduction neutralization test (PRN or PRNT) between acute and convalescent serum samples.
Risk Groups	For serious illness and complications: infants and children aged <5 years, adults aged >20 years, pregnant women, and people with compromised immune systems.
Geographic Significance	Still common in many developed and developing countries and travel in densely populated areas.

What is measles?
Measles, also known as Rubeola, is a highly contagious acute viral respiratory illness that is caused by a single-stranded, enveloped RNA virus with 1 serotype. It is classified as a member of the genus Morbillivirus in the Paramyxoviridae family.

What is the occurrence of measles?
Measles remains a common disease in many parts of the world, including Europe, the Middle East, Asia, and Africa. Each year, an estimated 142,000 people die from measles. Outbreaks in countries to which people travel can directly contribute to an increase in measles cases. In the U.S., measles importations have come from countries, including the Philippines, Ukraine, Israel, Thailand, Vietnam, England, France, Germany, and India. In the decade before the live measles vaccine was licensed in 1963, an average of 549,000 measles cases and 495 measles deaths were reported annually in the U.S. In 2000, measles was declared eliminated from the U.S. based on the absence of endemic measles virus transmission in a defined geographic area, such as a country, for 12 months or longer in the presence of a well-performing surveillance system. Since 2000, the annual number of cases in the U.S. ranged from a low of 37 in 2004 to a high of 1,282 in 2019, and most cases have been among people who are not vaccinated against measles.

How is measles transmitted?
Measles is transmitted by direct contact with infectious droplets or spread airborne when an infected person breathes, coughs, or sneezes. Measles virus can remain infectious in the air for up to 2 hours after an infected person leaves an area. Measles is one of the most contagious of all infectious diseases; approximately 9 out of 10 susceptible persons with close contact to a

measles patient will develop measles. Patients are considered contagious from 4 days before to 4 days after the rash appears.

Who is at risk for measles?
Individuals who are not immunized are at risk for measles. People at high risk for severe illness and complications from measles include:

- Infants and children aged <5 years
- Adults aged >20 years
- Pregnant women
- People with compromised immune systems, such as from leukemia or HIV infection

What are the signs and symptoms of measles?
Measles is characterized by a prodrome of fever (up to 105°F), malaise, cough, coryza (acute inflammation of mucous membrane inside the nose), and conjunctivitis, a pathognomonic enanthema (Koplik spots), followed by a maculopapular rash. The rash usually appears about 14 days after a person is exposed. The rash spreads from the head to the trunk to the lower extremities. Immunocompromised patients may not develop the rash.

What are potential complications from measles?
Common complications from measles include otitis media (1 out of 10), diarrhea (1 out of 10). Even in previously healthy children, measles can cause serious illness requiring hospitalization.

- One out of every 20 children with measles will develop pneumonia
- One out of every 1,000 measles cases will develop acute encephalitis, that can lead to convulsions and leave the child deaf or with intellectual disability.
- One to three of every 1,000 children who become infected with measles will die from respiratory and neurologic complications.
- Pregnant women who have not had the MMR vaccine may give birth prematurely or have a low-birth-weight baby.
- Subacute sclerosing panencephalitis (SSPE) is a very rare, but fatal degenerative disease of the central nervous system characterized by behavioral and intellectual deterioration and seizures that generally develop 7 to 10 years after measles infection.

How is measles diagnosed?
Consider measles in patients presenting with febrile rash illness and clinically compatible measles symptoms, especially if the person recently traveled internationally or was exposed to a person with febrile rash illness.

Laboratory confirmation is essential for all sporadic measles cases and all outbreaks. Detection of measles-specific IgM antibody and measles RNA by real-time polymerase chain reaction (RT-PCR) are the most common methods for confirming measles infection. Obtain both a serum sample and a throat swab (or nasopharyngeal swab) from patients suspected to have measles. Collecting both respiratory and urine samples can increase the likelihood of detecting measles virus. Molecular analysis can also be conducted to determine the genotype of the measles virus. Genotyping is used to map the transmission pathways of measles virus and link or unlink cases. Genotyping is the only way to distinguish between wild-type measles virus infection and a rash caused by a recent measles vaccination.

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How is measles treated?

Isolate infected individuals for four days after they develop a rash. In healthcare settings, use airborne infection control precautions (N95 respirator and a single-patient isolation room). There is no specific antiviral therapy for measles. Medical care is supportive and to help relieve symptoms and address complications such as bacterial infections.

Severe measles cases among children, such as those who are hospitalized, should be treated with vitamin A. Vitamin A should be administered immediately upon diagnosis and repeated the next day. The recommended age-specific daily doses are:

- 50,000 IU for infants younger than 6 months of age
- 100,000 IU for infants 6–11 months of age
- 200,000 IU for children 12 months of age and older

Lifelong immunity to measles is typically attained after natural measles infection or completed vaccination. Acceptable presumptive evidence of immunity against measles includes at least one of the following:

- Written documentation of adequate vaccination:
    - One or more doses of a measles-containing vaccine administered on or after the first birthday for preschool-age children and adults not at high risk
    - Two doses of measles-containing vaccine for school-age children and adults at high risk, including college students, healthcare personnel, and international travelers
    - Some adults who received the measles vaccine between 1963 and 1967 may not be protected from the virus due to an ineffective version of the measles vaccine available at that time
- Laboratory evidence of immunity
- Laboratory confirmation of measles
- Birth before 1957

Do not accept verbal reports of vaccination without written documentation as presumptive evidence of immunity.

How can measles be prevented?

Measles can be prevented with measles-containing vaccine, which is primarily administered as the combination measles-mumps-rubella (MMR) vaccine. The combination measles-mumps-rubella-varicella (MMRV) vaccine can be used for children aged 12 months through 12 years for protection against measles, mumps, rubella, and varicella. Single-antigen measles vaccine is not available. One dose of MMR vaccine is approximately 93% effective at preventing measles; two doses are approximately 97% effective. Almost everyone who does not respond to the measles component of the first dose of MMR vaccine at age 12 months or older will respond to the second dose.

People exposed to measles who cannot readily show evidence of immunity against measles should be offered post-exposure prophylaxis (PEP) or be excluded from the setting (school, hospital, childcare). MMR vaccine, if administered within 72 hours of initial measles exposure, or immunoglobulin (IG), if administered within six days of exposure, may provide some protection, or modify the clinical course of disease. People who receive MMR vaccine or IG as PEP should be monitored for signs and symptoms consistent with measles for at least one incubation period.

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If MMR vaccine is not administered within 72 hours of exposure as PEP, MMR vaccine should still be offered at any interval following exposure to the disease to offer protection from future exposures.

If many measles cases are occurring amongst infants younger than 12 months of age, measles vaccination of infants as young as 6 months of age may be used as an outbreak control measures. Children vaccinated before their first birthday should be revaccinated when they are 12 through 15 months old and again when they are 4 through 6 years of age.

People who are at risk for severe illness and complications from measles, such as infants younger than 12 months of age, pregnant women without evidence of measles immunity, and people with severely compromised immune systems, should receive IG. Intramuscular IG (IMIG) should be given to all infants younger than 12 months of age who have been exposed to measles. For infants aged 6 through 11 months, MMR vaccine can be given in place of IG, if administered within 72 hours of exposure. Because pregnant women might be at higher risk for severe measles and complications, intravenous IG (IVIG) should be administered to pregnant women without evidence of measles immunity who have been exposed to measles. People with compromised immune systems who are exposed to measles should receive IVIG regardless of immunologic or vaccination status because they might not be protected by MMR vaccine.

IG should not be used to control measles outbreaks, but rather to reduce the risk for infection and complications in the people receiving it. IMIG can be given to those who do not have evidence of immunity against measles, but priority should be given to people exposed in settings with intense, prolonged, close contact, such as household, daycare, or classroom where the risk of transmission is highest.

Except in healthcare settings, unvaccinated people who receive their first dose of MMR vaccine within 72 hours after exposure may return to childcare, school, or work. After receipt of IG, people cannot return to healthcare settings. In other settings, such as childcare, school, or work, factors such as immune status, intense or prolonged contact, and presence of populations at risk, should be taken into consideration before allowing people to return. These factors may decrease the effectiveness of IG or increase the risk of disease and complications depending on the setting to which they are returning.

What are some public health considerations?

- Report suspected measles cases to their local health department within 24 hours.
- Document relevant travel and deployment history occurring within the incubation period.
- Note the patient's measles immunization history.
- Susceptible healthcare workers should be excluded from work beginning 5 days through the 21st day following exposure, regardless of post-exposure vaccine or IG.
- A healthcare worker who develops measles symptoms after exposure should be excluded from work until 4 days after rash onset, or until measles is ruled out.

References

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