April 2024

Measles (Rubeola)

Surveillance and Investigation Protocol

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Division of Infectious Disease Epidemiology
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Measles (Rubeola)

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I. ABOUT THE DISEASE

A. Clinical Presentation

Measles, also known as Rubeola, is an acute viral infection characterized by prodromal symptoms of slowly increasing fever (peak to 105^{0}F), followed by cough, coryza (runny nose), or conjunctivitis, and rash.

Koplik spots are punctate blue-white spots on the bright red background of the oral buccal (cheek) mucosa (see Fig. 1) that occur 1-2 days before, to 1-2 days after, the skin rash. Their presence is pathognomonic for measles.

The measles rash is a maculopapular eruption that occurs 2-6 days after the onset of prodrome and about 14 days after exposure (range: 7-21 days). The rash lasts 5-6 days and begins at the hairline and spreads downward from the head to the trunk and lower extremities (see Fig. 2).

Figure 1. Koplik spots on the buccal mucosa

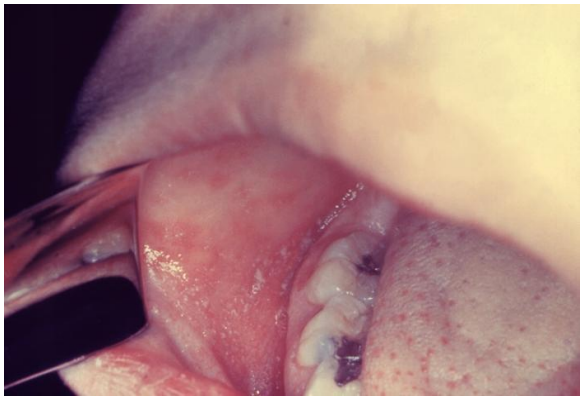
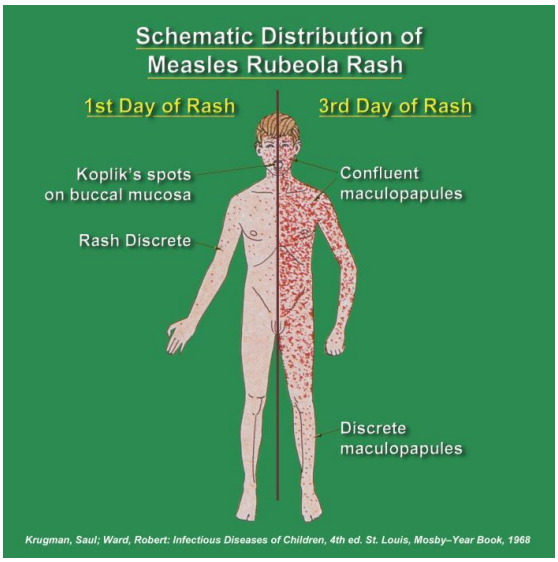


Image retrieved from http://phil.cdc.gov/phil/home.asp

Figure 2. Distribution of measles rash



B. Etiologic Agent

Measles virus is an enveloped RNA virus of the genus Morbillivirus in the Paramyxoviridae family. The wild-type measles virus has one serotype and 24 genotypes.

C. Reservoir

Humans are the only known natural reservoir; there is no known animal reservoir. Asymptomatic carrier state has not been documented.

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D. Incubation Period

The incubation period of measles from exposure to onset of prodromal symptoms is 8 to 12 days. The average interval from exposure to onset of rash is 14 days (range: 7-21 days).

E. Mode of Transmission

Measles is primarily transmitted from person-to-person via respiratory droplets. Airborne transmission via aerosolized droplet nuclei has been documented in closed areas for up to 2 hours after a person with measles occupied the room. In temperate areas, the peak incidence of infection usually occurs during late winter and spring.

F. Period of Communicability

Measles is one of the most highly contagious infections. It is estimated that 90% of susceptible individuals will become infected with measles after exposure. Population immunity of 95% is needed to stop ongoing transmission.

Patients are most infectious from 4 days before the onset of rash through 4 days after appearance of the rash. Maximum infectiousness occurs between 1-2 days before onset of prodromal symptoms (3-5 days before the rash) to 4 days after onset of rash. This coincides with peak levels of viremia when cough and coryza are most intense, thus facilitating transmission. Immunocompromised patients may have prolonged excretion of the virus in respiratory tract secretions.

II. DISEASE INVESTIGATION

A. **Case Definition and Case Classification**

Clinical Case Definition (2013)

An acute illness characterized by:

- Generalized, maculopapular rash lasting ≥ 3 days; **and**
- Temperature ≥ 101.0°F (greater than or equal to 38.3°C); **and**
- Cough, coryza, or conjunctivitis.

Case Classification

PROBABLE:

In the absence of a more likely diagnosis, an illness that meets the clinical description with:

- No epidemiological linkage to a laboratory-confirmed measles case; **and**
- Noncontributory or no measles laboratory testing.

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CONFIRMED:
An acute febrile rash illness† with:

- Isolation of measles virus‡ from a clinical specimen; **OR**
- Detection of measles-virus specific nucleic acid from a clinical specimen using polymerase chain reaction; **OR**
- IgG seroconversion‡ or a significant rise in measles immunoglobulin G antibody‡ using any evaluated and validated method; **OR**
- A positive serologic test for measles immunoglobulin M antibody‡§; **OR**
- Direct epidemiological linkage to a case confirmed by one of the methods above.

†Temperature does not need to reach ≥ 101°F/38.3°C and rash does not need to last ≥3 days.
‡Not explained by MMR vaccination during the previous 6-45 days.
§Not otherwise ruled out by other confirmatory testing or more specific measles testing in a public health laboratory.

B. Epidemiologic Classification of Internationally Imported and U.S.-Acquired Cases

INTERNATIONALLY IMPORTED CASE: An internationally imported case is defined as a case in which measles results from exposure to measles virus outside the U.S. as evidenced by at least some of the exposure period (7–21 days before rash onset) occurring outside the U.S. and rash onset occurring within 21 days of entering the U.S. and there is no known exposure to measles in the U.S. during that time. All other cases are considered U.S.-acquired.

U.S.-ACQUIRED CASE: A U.S.-acquired case is defined as a case in which the patient had not been outside the U.S. during the 21 days before rash onset or was known to have been exposed to measles within the U.S. These cases are subclassified into four distinct groups:

- **Import-linked case:** any case in a chain of transmission that is epidemiologically linked to an internationally imported case.
- **Imported-virus case:** a case for which an epidemiologic link to an internationally imported case was not identified, but for which viral genetic evidence indicates an imported measles genotype, *i.e.,* a genotype that is not occurring within the U.S. in a pattern indicative of endemic transmission.
- **Endemic case:** a case for which epidemiological or virologic evidence indicates an endemic chain of transmission. Endemic transmission is a chain of measles virus transmission that is continuous for ≥12 months within the U.S.
- **Unknown source case:** a case for which an epidemiological or virologic link to importation or to endemic transmission within the U.S. cannot be established after a thorough investigation. These cases must be carefully assessed epidemiologically to assure that they do not represent a sustained U.S.-acquired chain of transmission or an endemic chain of transmission within the U.S.

Note: Internationally imported, import-linked, and imported-virus cases are considered collectively to be import-associated cases.

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Jurisdictions may also choose to classify cases as "out-of-state-imported" when imported from another state in the U.S. For national reporting, however, cases will be classified as either internationally imported or U.S.-acquired.

C. Reporting Timeframe to Public Health

Immediately report to the local health department.

D. Outbreak Recognition

One case of measles in West Virginia is an outbreak. The last measles case reported in the state was in 2009. For measles outbreak response, see CDC's Measles Outbreak Toolkit .

E. Healthcare Provider (HCP) Responsibilities

1. Consider measles as a diagnosis in anyone with a febrile rash illness and clinically compatible symptoms (cough, coryza, and/or conjunctivitis) who has recently traveled abroad or who has had contact with or exposure to someone with a febrile rash illness. Immunocompromised patients may not exhibit rash or may exhibit an atypical rash. The incubation period for measles from exposure to fever is usually about 10 days (range: 8-12 days) and from exposure to rash onset is usually 14 days (range: 7-21 days).

2. Immediately notify the local health department.

3. Persons suspected of measles should be immediately placed in ISOLATION with airborne transmission precautions for 4 days after the onset of rash in otherwise healthy individuals and for the duration of illness in immunocompromised patients.

4. Assure that HCP who care for patients have evidence of immunity by **any** of the following:
   - Documented administration of 2 doses of live-virus measles vaccine at least 28 days apart on or after their first birthday;
   - Laboratory evidence of immunity;
   - Laboratory confirmation of disease; or
   - Birth before 1957. Although birth before 1957 is considered presumptive immunity for the general population, unvaccinated HCP born before 1957 should have additional evidence of immunity (*e.g.* lab evidence of immunity or confirmation of disease). Healthcare facilities should consider providing 2 doses of MMR at appropriate intervals to unvaccinated HCP born before 1957 who do not have additional evidence of immunity, particularly during a measles outbreak.

For more information, see CDC's Interim Infection Prevention and Control Recommendations for Measles in Health Care Settings.

5. If transferring a measles patient to another facility, notify the infection preventionist of the receiving healthcare facility **BEFORE** transferring the patient.

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6. Collect throat and/or nasopharyngeal secretions and urine for measles testing. The West Virginia Office of Laboratory Services (OLS) will assist with measles laboratory testing. If you have a suspect case of measles, notify your local health department or DIDE at 304-558-5358, ext. 2. Measles serology done by commercial laboratories may result in a false positive IgM, for this reason it should be paired with measles PCR testing. Please contact the local health department to coordinate measles testing at WV OLS free-of-charge.

7. Laboratory diagnosis of measles is done by any of the following:
   - Isolation of measles virus from a clinical specimen – Collect specimens as soon as possible after rash onset (ideally within 3 days of rash onset, but up to 10 days post rash onset). Specimens for virus isolation should be taken at the same time that serum is obtained, since a delay in collection will reduce the chance of isolating the virus. Throat (oropharyngeal) swabs and/or nasopharyngeal (NP) swabs collected in viral transport media are the preferred clinical samples for measles virus. Urine samples can also be collected in a sterile urine cup. While throat swabs are generally easily collected, processed and transported, urine samples provide an additional opportunity for successful isolation of virus. For measles testing through WV OLS, see WV Office of Laboratory Services VPD Referral Testing Guidance. Complete the Referral Testing Specimen Submission (RTSS) Form and make sure the specimen is correctly labelled. Mail the completed RTSS Form and the specimen to WV OLS. WV OLS will send the specimen to referral testing laboratory. Please notify WV OLS at (304) 558-3530 prior to shipping specimens.

   - Serology:
     a. Measles IgM – obtain specimen for single serum testing at first encounter with suspect case of measles. Sensitivity of test is affected by timing of specimen collection and immunization status and may diminish during the first 72 hours following rash onset. (Note: If IgM negative but patient has generalized rash lasting >72 hours, repeat measles IgM testing.)
     b. Measles IgG – paired acute and convalescent measles serology specimens; the acute specimen should be collected 72 hours after rash onset and convalescent specimen should be collected 14 to 30 days after the acute sample.

     Serological testing can be performed at a commercial or hospital laboratory.

8. Assist the LHD with the investigation by providing information about the suspect case of measles and contacts in a timely manner. Initial notification should be done by telephone as soon as possible. Anticipate the need to provide information on clinical history, clinical findings, laboratory findings, vaccination history, and history of travel or other exposures to support the investigation.

9. Measles is highly contagious and can be transmitted from 4 days before through 4 days after the rash onset. Healthcare personnel who become ill should be excluded from work until 4 days after rash develops.

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10. Susceptible HCP (no evidence of immunity) who have been exposed should be offered the 1st dose of MMR vaccine and should be relieved of direct patient contact from day 5 to day 21 following exposure, regardless of whether they received vaccine or IG after exposure.
    - HCP without evidence of immunity who are not vaccinated after exposure should be removed from all patient contact and excluded from the facility from day 5 after their first exposure to day 21 after their last exposure.
    - HCP with 1 documented vaccine dose prior to exposure may remain at work and should receive the second dose.

11. Inadvertent measles exposure in a healthcare setting requires **urgent action** to prevent spread to susceptible persons (patients, family members, visitors, and staff).
    a. List all persons who were in the same clinical area (emergency room, clinic, ward, waiting area, etc.) with an infectious measles patient for up to two hours after the patient left or was isolated.
    b. Review their records for immunization status and underlying disease.
    c. Post-exposure prophylaxis should be offered to anyone who cannot show proof of immunity, absent contraindications. Susceptible persons who can receive vaccine should receive a dose of MMR vaccine within 72 hours of initial exposure.
    d. Susceptible persons who cannot receive vaccine, especially infants less than 6 months of age, pregnant women, and immunocompromised persons can receive a dose of immune globulin within 6 days of exposure.

F. Laboratory Responsibilities

1. Immediately notify the healthcare provider and the infection preventionist of a positive laboratory result for measles.

2. Immediately notify the local health department and DIDE (at 304-558-5358 ext. 2) of a positive measles test result.

3. In addition to a telephone call, send the positive laboratory report via electronic laboratory report (ELR) or fax a copy to the local health department.

The West Virginia Office of Laboratory Services (OLS) accepts nasopharyngeal or throat swabs and urine for measles testing, see WV Office of Laboratory Services VPD Referral Testing Guidance for instructions. Specimens submitted to WV OLS will be sent to the Wisconsin State Laboratory of Hygiene (WSLH) for PCR testing. Complete the Referral Testing Specimen Submission Form and send to WV OLS along with the specimens. Although the WSLH does not accept serum specimens, if the provider wishes to have serology testing performed, serum should be collected at the same time as specimens for viral PCR and submitted to a reference lab.

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Measles viral RNA by PCR:
Specimens should be collected as soon as possible after rash onset and should not be delayed until any pending laboratory confirmation is obtained. While throat swabs are generally more easily collected, processed and transported, urine samples provide an additional opportunity for successful isolation of virus and may prove superior to throat swabs if collection is delayed beyond about 5 days after rash onset.

Nasopharyngeal or throat swab: Sterile swabs (Dacron or synthetic) can be used to obtain throat and/or nasopharyngeal specimens. A throat swab is taken by rubbing the posterior nasal passages with a dry sterile Dacron swab. Place swab in a tube containing 2-3 ml of viral transport medium (VTM). The swab can be broken off into the tube. Store swab in viral transport media (Remel M4 RT or equivalent) at 4°C if shipping within 24 hours; ship on cold packs. If immediate cold shipment (within 48 hours) cannot be arranged, or is not convenient, nose and throat swabs should be removed from the VTM. Gently vortex or swirl the swab in the fluid and ream the swab against the side of the tube. These samples should be frozen and shipped at -70° C on dry ice.

Urine: Collect 10-50mL of urine in sterile container. Do not add virus transport medium. If shipping within 24 hours, ship on cold packs. If shipping is delayed, freeze at -70°C and ship frozen on dry ice.

Shipping instructions:
After collection, make sure that the specimen collection vessel is labeled with the patient's name and date of collection. Complete WSLH's Referral Testing Specimen Submission Form and include it in the shipment.

For packaging and shipping instructions to WV OLS, see WV Office of Laboratory Services VPD Referral Testing Guidance. Packages must be properly labeled as **UN3373 Biological Substances** and shipped per current Department of Transportation regulations.

Send specimens to:
WV Office of Laboratory Services
ATTN: VPD Referral/Micro
167 11th Avenue
South Charleston, WV 25303
Telephone: 304-558-3530

NOTE: If shipping on dry ice, the package must be labeled with a **UN1845 label**, with the weight of the dry ice in the shipping container stated on the label. If a frozen specimen needs to be shipped directly to WSLH, OLS must be contacted before the shipment is made.

Measles serology
Acute measles serology specimens should be collected 72 hours after rash onset and convalescent measles serology should be collected 14 to 30 days after the acute sample. Since neither the OLS or WSLH performs serological testing, the serum will have to be submitted to a reference laboratory for this testing at the

patient's expense. Please consult your reference laboratory for specimen shipping requirements. CDC can perform serological testing only in special circumstances with pre-approval.

Detection of specific IgM antibodies in a serum sample collected within the first few days of rash onset can provide presumptive evidence of a current or recent measles virus infection. However, because no assay is 100% specific, serologic testing of non-measles cases using any assay will occasionally produce false positive IgM results.

Blood for serologic testing is collected by venipuncture or by finger/heel stick. Use tubes without additives—either a plain, red–top tube or a serum separator tube. Collect at least 300 µl of serum. Refrigerate at 4°C. Do not freeze. Ship the serum on cold packs.

G. Local Health Responsibilities

PREPARATION for MEASLES

1. Educate HCP and laboratories to immediately report a suspected case of measles to the health department. Notification of a suspected case should be done by telephone to ensure the report is received.

2. Educate HCP about measles infection, testing, and prevention and control measures.

3. Employees who will investigate a case of measles via face-to-face contact should have:
   - Documented administration of 2 doses of live-virus measles vaccine at least 28 days apart on or after the first birthday; or
   - Laboratory evidence of immunity; or
   - Laboratory confirmation of disease.
   - Birth before 1957. Although birth before 1957 is considered presumptive immunity for the general population, unvaccinated HCP born before 1957 should have additional evidence of immunity (*e.g.* lab evidence of immunity or confirmation of disease). Healthcare facilities should consider providing 2 doses of MMR at appropriate intervals to unvaccinated HCP born before 1957 who do not have additional evidence of immunity, particularly during a measles outbreak.

MEASLES CASE INVESTIGATION

1. When a case of measles (suspect or confirmed) is reported:
   - Make sure the case is isolated using airborne precautions.
   - Immediately investigate any reported suspect case of measles. You can use the Measles Case Report Form to collect all data and transfer the information into WVEDSS.
   - Ascertain the case and immediately initiate control measures. Provide guidance to facility where case was present while contagious. Determine where a case may have been exposed. Obtain

accurate and complete immunization history and document any doses of measles-containing vaccine. Vaccination histories may be obtained from WVSIIS, schools, medical providers, or on immunization records provided by the case-patient. Verbal history of receipt of measles vaccine is not considered adequate proof of vaccination.

2. Immediately notify DIDE at (304) 558-5358 ext. 2 about a suspected case of measles.

3. Advise HCP to collect appropriate specimens *(*blood, throat, nasopharyngeal secretions, and urine) for measles serology and PCR testing for all suspected measles cases. See **Laboratory Testing** section for detailed laboratory testing information. If sending specimens to WV OLS, facilitate transport of specimens to WV OLS. See WV Office of Laboratory Services VPD Referral Testing Guidance for instructions. Specimens submitted to WV OLS will be sent to the Wisconsin State Laboratory of Hygiene (WSLH) for PCR testing. Complete the Referral Testing Specimen Submission Form.

4. For confirmed or highly suspected cases, consider notifying local providers through a health alert or other activities to enhance reporting of other cases of measles. See CDC's Measles Outbreak Toolkit for Local/State Health Departments for notification templates.

5. Identify the source of infection for every case of measles. Case-patients should be asked about contact with other known cases. When no history of contact with a known case can be elicited, opportunities for exposure to unknown cases should be sought through a thorough interview covering travel history and activities and events to include dates attended. For cases involving multi-state or international travel, consult with the regional epidemiologist and the DIDE. After determining when and where transmission likely occurred, investigative efforts should be directed to locations visited.

6. Assess potential transmission and identify contacts of the case-patient during the infectious period (4 days before and 4 days after the onset of rash).

For the purpose of case investigation, ***lost to follow-up*** **(LTF)** is defined as a disease investigation outcome reported by a local health department staff in WVEDSS after:

- All avenues (e.g. phone call, text messaging, visit, mailed letter, email, etc.) of obtaining patient information, on at least 3 separate occasions (different days and times) have been exhausted, **AND**

- Attempts to collect patient medical information from the healthcare provider on at least 3 separate occasions have been exhausted, **AND**

- Attempts to contact patient or obtain information has been clearly documented in WVEDSS *General Comments* section, **AND**

- Documentation has been completed within 30 days of the patient's laboratory report.

MEASLES CONTACT TRACING

Conduct contact tracing and implement control measures **as soon as** a case is suspected.

1. Identify all contacts of measles case and sites of exposure during the period of communicability.

2. Exclude (quarantine) people who have not been vaccinated with measles-containing vaccine within 72 hours of exposure and people who have medical exemption against receiving measles vaccine from school, childcare, and healthcare settings until 21 days after the onset of rash in the last case of measles. Measles vaccine given within 72 hours of exposure may provide some protection against the disease. People receiving their second dose as well as unimmunized people receiving their first dose as part of the outbreak-control program may be readmitted immediately to the school, childcare facility, or non-healthcare related workplace.

3. Monitor/track exposed susceptible individuals for symptoms suggestive of measles until 21 days after the onset of rash in the last case of measles using the Measles Contact Monitoring Form and Measles Contact Tracing form.

4. In a congregate setting such as a school or workplace: Exclude persons without evidence of immunity to measles until they have received one dose of measles-containing vaccine. Evidence of immunity for students and adults is defined as:
   - Documented age-appropriate vaccination with a live measles virus-containing vaccine:
     - Preschool-aged children: 1 dose administered after the first birthday;
     - School-aged children (grades K-12): 2 doses; the first dose administered after the 1st birthday and the 2nd dose administered at least 28 days after the 1st dose;
   - Laboratory confirmation of disease; or
   - Laboratory evidence of immunity; or
   - Person born before 1957.

5. Vaccination is the intervention of choice for measles outbreak control. Absent contraindications, all susceptible persons should be immunized with the first dose of measles-containing vaccine within 72 hours of exposure to a case. A second dose of measles-containing vaccine may be given at any time at least 28 days after the 1st dose of measles-containing vaccine. Infants 6-12 months of age should have the 1st dose repeated at age 12-15 months, and the 2nd dose given at 4-6 years of age.

6. In schools, colleges, and other educational institutions (i.e., daycare) where close contact may exist, and where there may be high rates of vaccine exemptions, exclude and isolate cases until 4 days after rash onset, unless they are immunocompromised. Offer age-appropriate vaccination (first dose to the unvaccinated, second dose to those with one documented dose can be given at least 28 days after the

first dose). Persons who refuse vaccination should be excluded until 21 days after rash onset in the last case of measles.

7. In healthcare settings, all susceptible persons (patients, family, visitors, staff) who were in the same clinical care area (emergency room, clinic, ward, waiting area, etc.) should be evaluated for immunity. A 1st or 2nd dose of measles-containing vaccine should be given to:
   - Infants as young as 6 months of age (repeat the first dose of measles-containing vaccine at 12 to 15 months of age and second dose of measles-containing vaccine at 4-6 years of age)
   - Children
   - Adults should have one dose (birth before 1957 is NOT considered evidence of immunity during an outbreak).
   - Healthcare personnel without evidence of immunity (birth before 1957 is NOT considered evidence of immunity during an outbreak). Healthcare personnel without evidence of immunity should receive the first dose of vaccine and be excluded from work from day 5 after the first exposure to day 21 following the last exposure. All healthcare personnel caring for a suspect or confirmed measles case should use respiratory protection consistent with airborne infection control precautions, regardless of immune status**.**

   See **Healthcare Provider (HCP) Responsibilities** section for more information.

8. Individuals who are at risk for severe disease and complications from measles, particularly contacts younger than 6 months of age, pregnant women, and immunocompromised people for whom the risk of complications is highest, should receive immune globulin (IG). IG can be given within 6 days of exposure.

9. Children who received IG for post-exposure prophylaxis should be given the first dose of measles-containing vaccine at age 12-15 months, and the second dose at age 4-6 years, assuming there is no contraindication.

10. HIV-infected children who have serologic evidence of immunity or who received 2 doses of measles vaccine after initiation of combination antiretroviral therapy (cART) with no or moderate immunosuppression should be considered immune and will not require additional measures to prevent measles.

11. Asymptomatic mildly or moderately immunocompromised HIV-infected patients without evidence of immunity should receive IG (0.5 mL/kg, maximum of 15 mL) regardless of immunization status. Severely immunocompromised patients should receive IG intravenous (IGIV) prophylaxis, 400 mg/kg, after exposure, regardless of vaccination status, because they may not be protected by the vaccine. HIV-infected children who have received IGIV within 3 weeks of exposure do not require additional passive immunization. People with perinatally-acquired HIV who were vaccinated before initiation of cART should be considered unvaccinated and should receive 2 doses of MMR vaccine once effective

cART has been administered.

12. Conduct active (enhanced) surveillance for measles for at least 2 incubation periods (42 days after rash onset in last case) after the last confirmed case is reported, in all affected areas for persons with measles.

H. State Health Responsibilities

1. Promptly report case/s of measles to the CDC within 24 hours of notification.
2. Assist local health jurisdictions in responding to measles.
3. Provide technical support on surveillance, investigation, case ascertainment, laboratory testing, and control and prevention of measles.
4. Maintain measles awareness among public health partners and the public.
5. Develop guidance documents, protocols, alerts, and information sheets for public health and health care providers.
6. Review measles reports in WVEDSS for completeness prior to submission to CDC.

No Public Health Action is defined as incomplete disease investigation and no activity occurring at the local level for at least 60 days since the date of the patient's laboratory report. The state health department staff should document "no public health action" in WVEDSS *General Comments* section before administratively closing the investigation.

I. Occupational Health

Employees who will investigate a case or a suspected case of measles via face-to-face contact should have:

- Documented administration of 2 doses of live-virus measles vaccine at least 28 days apart on or after the first birthday; or
- Laboratory evidence of immunity; or
- Laboratory confirmation of disease; or
- Birth before 1957. Although birth before 1957 is considered presumptive immunity for the general population, unvaccinated HCP born before 1957 should have additional evidence of immunity (*e.g.* lab evidence of immunity or confirmation of disease). Healthcare facilities should consider providing 2 doses of MMR at appropriate intervals to unvaccinated HCP born before 1957 who do not have additional evidence of immunity, particularly during a measles outbreak. HCP and health departments should not accept verbal reports of vaccination without written documentation as presumptive evidence of immunity.

For more information, see **Healthcare Provider (HCP) Responsibilities** section.

III. DISEASE CONTROL AND PREVENTION

A. Disease Control Objectives

When a case is identified, prevent additional cases by:

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1. Assuring the case is placed in airborne isolation until 4 days after the rash onset.
2. Early identification and vaccination of close contacts.

B. Disease Prevention Objectives

Prevent cases of measles by encouraging measles vaccination of all susceptible individuals according to *Advisory Council on Immunization Practices* (ACIP) Recommendations.

C. Disease Prevention and Control Intervention

1. Measles can be prevented with measles-containing vaccine. Two doses of vaccine are 97% effective at preventing measles. The CDC recommends:
   a. Vaccinate children at age 12-15 months with a first dose of MMR vaccine.
   b. Ensure that school-age children receive a second dose of MMR vaccine.
   c. Vaccinate high risk groups, such as healthcare personnel, and international travelers including infants aged 6 to 11 months.
   d. Students at post-high school education institutions without evidence of immunity should receive two doses of MMR vaccine 28 days apart. Students with one documented dose of MMR vaccine should receive a 2nd dose.
   e. People born on or after 1957 who do not have evidence of immunity should receive at least one dose of MMR vaccine.

2. There is no specific antiviral therapy for measles.

3. Persons who do not meet the criteria for evidence of immunity (below) are considered susceptible and should be vaccinated against measles unless there is a contraindication.

EVIDENCE OF IMMUNITY

Acceptable presumptive evidence of immunity against measles includes at least **one** of the following:

- Written documentation of **one or more doses** of a measles-containing vaccine administered on or after the first birthday for preschool-age children and adults not considered high risk.
- Written documentation of **two doses** of measles-containing vaccine administered at least 28 days apart for school-age children and adults at high risk, including students at post-high school secondary educational institutions, healthcare personnel, and international travelers.
- Laboratory evidence of immunity.
- Laboratory confirmation of measles.
- Birth before 1957. HCP and health departments should not accept verbal reports of vaccination without written documentation as presumptive evidence of immunity.

IV. DISEASE SURVEILLANCE

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A. Public Health Significance

Measles is a highly infectious, acute viral illness that can be complicated by severe pneumonia, diarrhea, and encephalitis and can result in death. The secondary attack rate of measles among susceptible individuals is greater than 90%. In the pre-vaccine era, approximately 500,000 cases of measles occurred annually in the United States.

In 2019, the CDC reported 1,274 cases of measles from 31 jurisdictions; the highest number of cases in the U.S. since 1992. Most of the cases were not vaccinated against measles. In the post-elimination era, measles outbreaks in the U.S. can be attributed to travelers acquiring measles abroad and exposing susceptible individuals upon return, potentially resulting in further spread in communities with unvaccinated people.

Measles complications include otitis media, bronchopneumonia, laryngotracheobronchitis (croup), and diarrhea. Acute encephalitis, which often results in permanent brain damage, occurs in approximately 1 out of every 1000 cases. Subacute sclerosing panencephalitis (SSPE) is a rare degenerative central nervous system disease believed to be due to persistent measles virus infection of the brain. Onset occurs an average of 7 years after measles (range: 1 month-27 years) and occurs in 5-10 cases per one million reported measles cases. The onset is insidious, with progressive deterioration of behavior and intellect, followed by ataxia, myoclonic seizures, and eventually death. Death results from respiratory and neurologic complications.

B. Disease Surveillance Objectives

1. To rapidly detect and confirm a case of measles in West Virginia.
2. If measles occurs in West Virginia:
   a. Characterize the complications of measles.
   b. Determine whether cases are due to failure to vaccinate or vaccine failure.
   c. Identify sources and sites of transmission.
   d. Monitor the effectiveness of outbreak control strategies.
   e. Identify risk factors for infection.

C. Surveillance Indicators

1. The proportion of confirmed cases reported to CDC (NNDSS) with complete information (clinical case definition, hospitalization, laboratory testing, vaccination history, date reported to health department, transmission setting, outbreak related, epidemiologic linkage, date of birth, and onset date).
2. The interval between date of symptom onset and date of public health notification.
3. The proportion of confirmed cases that are laboratory confirmed.
4. The proportion of cases that have an imported source.
5. The proportion of cases for which at least one clinical specimen for virus isolation was submitted to CDC.

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Measles (Rubeola)

Surveillance and Investigation Protocol

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