

# Measles (Rubeola)

## Surveillance Protocol

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### Healthcare Provider Responsibilities

1. Assure that health care personnel (HCP) who care for patients are immune to the disease by any of the following criteria (CDC):
  - a. Documented administration of 2 doses of live-virus measles vaccine at least 28 days apart on or after their first birthday;
  - b. Laboratory evidence of immunity;
  - c. Laboratory confirmation of disease; or
  - d. 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. laboratory evidence of immunity or confirmation of disease). Health care facilities should consider providing two doses of MMR vaccine at the appropriate intervals to unvaccinated HCP born before 1957 who do not have additional evidence of immunity, particularly during a measles outbreak.
2. 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 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, 7 to 12 days) and from exposure to rash onset is usually 14 days (range, 7 to 21 days).
3. Notify the infection preventionist BEFORE referring a suspect or confirmed measles case to a health facility.
4. Suspect measles patients should be immediately placed in isolation with airborne transmission precautions for 4 days after the onset of rash in otherwise healthy children and for the duration of illness in immunocompromised patients.
5. Collect blood, urine, throat or nasopharyngeal secretions for measles diagnosis. West Virginia Office of Laboratory Services (OLS) and the Division of Infectious Disease Epidemiology (DIDE) will assist with measles laboratory testing. If you have a suspect case of measles, notify your local health department or DIDE immediately at 304-558-5358 extension 1. Because of the high false positive measles IgM results done by commercial laboratories, DIDE and OLS recommend calling 304-558-5358, extension 1 to obtain measles testing free-of-charge.
6. Laboratory diagnosis of measles is done by any of the following:
  - a. Isolation of measles virus from a clinical specimen – Specimens should be collected as soon as possible after rash onset (ideally within three days of rash onset, but up to ten 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

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### **Division of Infectious Disease Epidemiology**

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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 more easily collected, processed and transported, urine samples provide an additional opportunity for successful isolation of virus. For more information about specimen collection and shipping, contact the WV Office of Laboratory Services at 304-558-3530.

- b. Serology:
  - i. 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.)
  - ii. 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.
7. Immediately report all suspected cases of measles to your local health department by phone. 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.
8. Susceptible HCP who have been exposed should be offered the first dose of MMR vaccine and should be relieved of direct patient contact from the 5<sup>th</sup> to the 21<sup>st</sup> day following exposure, regardless of whether they received vaccine or IG after exposure.
  - a. 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.
  - b. HCP with documentation of 1 vaccine dose may remain at work and should receive the second dose.
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 not have direct patient contact for 4 days after rash develops.
10. Inadvertent measles exposures in a healthcare setting require *urgent action* to prevent spread to susceptible persons (patients, family members, visitors and staff). List all persons who were in the same clinical area (emergency room, clinic, ward) with an infectious measles patient for up to two hours after the patient left or was isolated. Review their records for immunization status and underlying disease. Susceptible persons who can

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receive vaccine should receive a dose of MMR vaccine within 72 hours of exposure. Susceptible persons who cannot receive vaccine, especially infants less than one year of age, pregnant women and immunocompromised persons can receive a dose of immune globulin within 6 days of exposure. For immunization recommendation and postexposure prophylaxis recommendation with immune globulin, see Immunization Recommendations (p. 4 & 5).

### Laboratory Responsibilities

1. Immediately notify the healthcare provider and the infection preventionist of a positive laboratory result for measles.
2. Immediately report a positive laboratory result of measles to your local health department via fax and by phone or to DIDE via fax 304-558-8736 and by phone 304-558-5358, extension 1.

### Local Health Responsibilities

1. Employees who will investigate (including face-to-face contact with) a case of measles should have:
  - a. Documented administration of 2 doses of live-virus measles vaccine at least one month apart on or after the first birthday;
  - b. Laboratory evidence of immunity;
  - c. Laboratory confirmation of disease
2. Educate laboratories and providers to immediately report a suspected case of measles to public health.
3. Educate providers and the general public about vaccination for measles and the disease.
4. When a case of measles (suspect or confirmed) is reported:
  - a. Immediately assure the case is isolated using airborne precautions
  - b. Investigate any reported suspected case of measles **immediately** by using the measles WVEDSS form:  
<http://www.wvDIDE.org/Portals/31/PDFs/DIDE/measles/measles.pdf>.
5. Consult DIDE immediately about case ascertainment, laboratory confirmation and control measures. Obtain accurate and complete immunization histories documenting any doses of measles -containing vaccine. Vaccination histories may be obtained from 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.
6. Assure that serology and measles viral isolation (blood, throat and/or nasopharyngeal secretions) are performed for all suspected measles cases. See Laboratory Testing for detailed laboratory testing information.

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7. 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.
8. Identify the source of infection for every confirmed 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. After determining when and where transmission likely occurred, investigative efforts should be directed to locations visited.
9. 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).
10. Implement control measures:
  - a. One case of measles constitutes an outbreak.
  - b. Exclude people who have not been vaccinated with measles-containing vaccine within 72 hours of exposure or people who have medical exemption from measles vaccine from school, childcare, and health care 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 or childcare facility.
  - c. 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:
    - Documentation of 2 doses of live measles-containing vaccine, or
    - Laboratory confirmation of disease, or
    - Positive measles IgG, or
    - Person who were born before 1957.
  - d. Vaccination is the intervention of choice for measles outbreak control in schools and child care centers. Absent contraindications, all persons in attendance should be immunized with the first dose of measles-containing vaccine within 72 hours of exposure to a patient with measles. A second dose of measles-containing vaccine may be given at any time at least 28 days after the first dose of measles-containing vaccine. In healthcare settings all susceptible persons (patients, family, visitors, staff) who were in the same clinical care area (emergency room, clinic, ward, etc.) should be evaluated for immunity. A first or second dose of measles-containing vaccine should be given to:
    - i. 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-

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- containing vaccine at 4-6 years of age)
  - ii. Children
  - iii. Persons in college or other training after high school
  - iv. Health care personnel (birth before 1957 is NOT considered evidence of immunity during an outbreak)
  - v. Other adults should have one dose (birth before 1957 is NOT considered evidence of immunity during an outbreak).
  - e. Immune globulin (IG) can be given within 6 days of exposure to susceptible household or other close contacts of patients with measles, particularly contacts younger than 1 year of age, pregnant women, and immunocompromised people for whom the risk of complications is highest.
  - f. Children who received IG for postexposure prophylaxis should be given measles-containing vaccine 5 months (if the dose of IG was 0.25 mL/kg) or 6 months (if the dose of IG was 0.5 mL/kg) after IG administration, assuming there is no contraindication.
  - g. All children and adolescents with **HIV infection** and children of unknown HIV infection status born to HIV-infected women who are exposed to wild-type measles (regardless of their measles vaccination status) should receive IG prophylaxis, regardless of their measles immunization status with an exception of patients who receive IG Intravenous (IGIV) 400 mg/kg at regular intervals whose last dose was received within 3 weeks of exposure. Some experts recommend an additional dose of IGIV if measles exposure occurs 2 or more weeks after the last regular dose of IGIV.
11. In outbreak settings, conduct active (enhanced) surveillance for measles for at least two incubation periods (24 days or two times the maximum incubation period) following onset of rash in the last case, in all affected areas for persons with measles.

### State Health Responsibilities

1. Prompt and complete reporting of measles cases to the CDC through WVEDSS.
2. Report cases of measles to the CDC within 24 hours of notification (“Immediate, Urgent”).
3. Provide technical expertise and consultation regarding surveillance, investigation, laboratory confirmation, case ascertainment, control measures and prevention of measles.
4. Notify the CDC of suspected outbreaks identified in West Virginia and assist local health jurisdictions during investigation of a measles outbreak.
5. Maintain measles awareness among public health partners and the public.

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### Disease Control Objectives

1. When a case is identified, prevent additional cases by:
  - a. Assuring the case is placed in airborne isolation until 4 days after the rash onset.
  - b. Early identification and vaccination of close contacts.

### Disease Prevention Objectives

Prevent cases of measles by encouraging measles vaccination of all susceptible individuals per the CDC Advisory Council on Immunization Practices (ACIP) recommendations.

### Disease Surveillance Objectives

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

### 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 prevaccine era, approximately 500,000 cases of measles occurred annually in the United States.

From 1989 to 1991, the incidence of measles in the United States increased because of low immunization rates ('failure to vaccinate') in preschool-aged children, especially in urban areas. During this time outbreaks were also reported in school-age children who had received the recommended one-dose measles-containing vaccine ('failure of vaccine'). In 1989, a two-dose vaccination schedule was recommended by the CDC Advisory Council on Immunization Practices (ACIP) and in 1998 they recommended that all school age children in all grades receive both doses by 2001. Implementation of the two-dose schedule in school-age children and improved timely administration of the first dose of MMR vaccine resulted in a dramatic decline in measles cases.

In 2000, endemic measles was declared eliminated in the United States. However, measles remains endemic in many parts of the world and international travelers infected with measles have been a source of outbreaks in the U.S. Since 2000, the annual number of cases of measles in the U.S. has ranged from a low of 37 in 2004 to a high of 644 in 2014. The rise in the number of cases in recent

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years is due to greater spread from imported cases to unvaccinated individuals. Beginning in late 2014, a nationwide outbreak of measles was linked to a California amusement park. Over half the cases to date have been unvaccinated.

The need to maintain the highest possible measles vaccination coverage in West Virginia and the United States and to adhere to recommendations regarding measles vaccination plays a major role in the prevention of measles.

### Clinical Description

#### **Prodrome**

Measles is characterized by prodromal symptoms of slowly increasing fever (peaking up to 105<sup>0</sup>F), followed by cough, coryza (runny nose), or conjunctivitis. The prodrome lasts for 2-4 days (range 1-7 days). Koplik spots occur 1-2 days before to 1-2 days after the skin rash. Their presence is considered to be pathognomonic for measles, and appear as punctate blue-white spots on the bright red background of the oral buccal (cheek) mucosa (see figure 1).

#### **Rash**

The measles rash is a maculopapular eruption that usually appears 14 days after exposure (range 7-21 days). The rash begins at the hairline and spreads from head to trunk to lower extremities and lasts 5-6 days (see figure 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

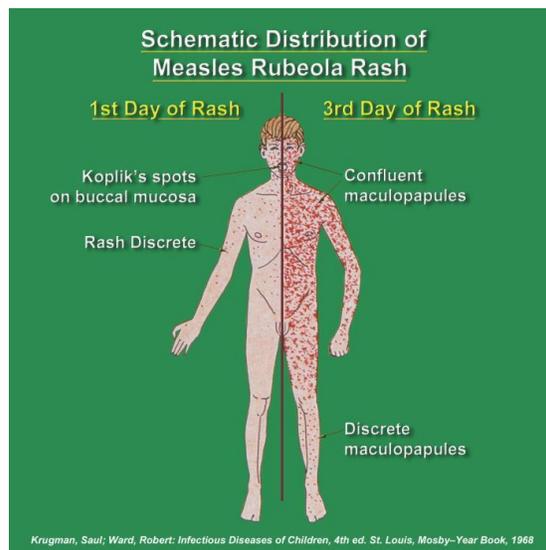


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### Complications

Complications include otitis media, bronchopneumonia, laryngotracheobronchitis (croup) and diarrhea that occur commonly in young children. Acute encephalitis, which often results in permanent brain damage, occurs in approximately 1 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 five to ten cases per million reported measles cases. The onset is insidious, with progressive deterioration of behavior and intellect, followed by ataxia, myoclonic seizures, and eventually death. SSPE has been extremely rare since the early 1980s. Death, predominantly resulting from respiratory and neurologic complications, occurs in 1 to 3 of every 1000 cases reported in the United States. Case fatality rates are high in children under 5 years of age and immunocompromised children, including children with leukemia, HIV infection and severe malnutrition.

### Etiologic Agent

Measles is caused by an RNA virus with 1 serotype, classified as a member of the genus Morbillivirus in the Paramyxoviridae family.

### Reservoir

Humans are the only known natural reservoirs. There has been no documentation of asymptomatic carrier state.

### Mode of Transmission

Measles is primarily transmitted from person-to-person via large 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.

### Incubation Period

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

### Period of Communicability

Measles is one of the most contagious infectious diseases with the basic reproduction number,  $R_0$  estimated at 12-40. A case of measles introduced into a susceptible population can potentially infect 12-40 individuals.

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Patients are infectious from 4 days before the rash through 4 days after appearance of the rash. Maximum infectiousness occurs between 1-2 days before onset of symptoms (3-5 days before the rash) to 4 days after onset of rash.

Immunocompromised patients who may have prolonged excretion of the virus in respiratory tract secretions can be contagious for the duration of illness.

### Outbreak Recognition

An outbreak is defined as one or more cases in a county or one or more cases in a congregate setting (such as school or workplace). The last measles case reported in West Virginia was in 2009.

### Case Definition

#### **Measles (Rubeola) 2013 Case Definition**

##### **Clinical case definition**

- An acute illness characterized by:
- Generalized, maculopapular rash lasting  $\geq 3$  days; **and**
- Temperature  $\geq 101.0^{\circ}\text{F}$  (greater than or equal to  $38.3^{\circ}\text{C}$ ); **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.

##### **Confirmed:**

An acute febrile rash illness<sup>†</sup> with:

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

<sup>†</sup>Temperature does not need to reach  $\geq 101^{\circ}\text{F}/38.3^{\circ}\text{C}$  and rash does not need to last  $\geq 3$  days.

<sup>‡</sup>Not explained by MMR vaccination during the previous 6-45 days.

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§Not otherwise ruled out by other confirmatory testing or more specific measles testing in a public health laboratory.

### Epidemiologic Classification of Internationally-Imported and U.S.-Acquired

**Internationally imported case:** An internationally imported case is defined as a case in which measles results from exposure to measles virus outside the United States as evidenced by at least some of the exposure period (7–21 days before rash onset) occurring outside the United States and rash onset occurring within 21 days of entering the United States 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:** An U.S.-acquired case is defined as a case in which the patient had not been outside the United States during the 21 days before rash onset or was known to have been exposed to measles within the United States.

U.S.-acquired cases are subclassified into four mutually exclusive 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 United States in a pattern indicative of endemic transmission. An endemic genotype is the genotype of any measles virus that occurs in an endemic chain of transmission (i.e., lasting  $\geq 12$  months). Any genotype that is found repeatedly in U.S.-acquired cases should be thoroughly investigated as a potential endemic genotype, especially if the cases are closely related in time or location.
- **Endemic case:** a case for which epidemiological or virological evidence indicates an endemic chain of transmission. Endemic transmission is defined as a chain of measles virus transmission that is continuous for  $\geq 12$  months within the United States.
- **Unknown source case:** a case for which an epidemiological or virological 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.

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

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

### **Laboratory Testing**

The West Virginia Office of Laboratory Services requires serum specimens for measles serologic testing to be submitted simultaneously with a specimen type appropriate for measles PCR (throat swab, nasopharyngeal aspirate, nasopharyngeal swab, or urine). Genotyping will be performed on all PCR positive specimens unless otherwise indicated.

### ***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. Serum should be shipped on cold packs (do not freeze).

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°F. Do not freeze. Ship the serum on cold packs.

### ***Measles viral isolation:***

Specimens should be collected as soon as possible after rash onset and it 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.

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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 (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.

### ***Shipping instructions:***

After collection, make sure that the specimen collection vessel is labeled with the patient name and date of collection. Complete the WSLH VPD form found at [http://www.dhhr.wv.gov/oeps/disease/IBD\\_VPD/VPD/documents/vpd-submission-form.pdf](http://www.dhhr.wv.gov/oeps/disease/IBD_VPD/VPD/documents/vpd-submission-form.pdf) and include it in the shipment.

Ship the specimen(s) to OLS according to the recommendations in the chart.

[http://www.dhhr.wv.gov/oeps/disease/IBD\\_VPD/VPD/documents/vpd-reference-testing.pdf](http://www.dhhr.wv.gov/oeps/disease/IBD_VPD/VPD/documents/vpd-reference-testing.pdf)

Packages must be properly labeled as UN3373 Biological Substances and shipped per current DOT regulations.

Send specimens to:

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

### **Preventive Interventions**

1. Measles can be prevented with measles-containing vaccine. Two doses of vaccine is 97% effective at preventing measles. Vaccine recommendations (CDC):
  - 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 health care 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.
  - e. People born on or after 1957 who do not have evidence of immunity (See \*Evidence of immunity, page 4) should receive at least one dose of MMR vaccine.

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2. Ensure that all health care personnel have evidence of immunity to measles.
3. Measles is transmitted by direct contact with infectious droplets or by airborne spread when an infected person breathes, coughs, or sneezes. Infected people should be isolated for four days after they develop a rash.
4. Post-exposure prophylaxis should be offered to anyone who cannot show proof of immunity, absent contraindications.
  - a. MMR vaccine, if administered within 72 hours of initial exposure, or immunoglobulin (IG), if administered within six days of exposure, may provide some protection or modify the clinical course of disease (CDC).

### Treatment

There is no specific antiviral therapy for measles.

### Surveillance Indicators

1. Proportion of cases with complete demographic data.
2. Proportion of cases with adequate laboratory testing (serologic and PCR result).
3. Proportion of cases with complete vaccine information.
4. Proportion of cases with complete clinical information.
5. Proportion of cases with complete information on transmission setting.
6. Median days between rash onset date and the date reported to public health.

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