

# Measles

(Measles is also known as Rubeola)



## REPORT IMMEDIATELY

### Section 1: ABOUT THE DISEASE

#### A. Etiologic Agent

Measles is caused by the measles virus (genus *Morbillivirus*, family *Paramyxoviridae*).

#### B. Clinical Description

Measles is an acute disease characterized by fever, cough, runny nose, conjunctivitis, erythematous maculopapular rash, and characteristic mouth lesions (Koplik spots). Pictures of individuals with measles can be found at the following website: <http://www.cdc.gov/measles/about/photos.html>.

The prodrome, which lasts 2–4 days (range 1–7 days), is characterized by a fever that increases in stepwise fashion, often peaking as high as 103–105°F. This is followed by the onset of cough, runny nose, and/or conjunctivitis. The measles rash is a maculopapular eruption that usually lasts 4–7 days. Typically (though not always), it begins at the hairline, then involves the face and upper neck. Koplik's spots, an enanthem present on mucous membranes, is considered to be definitive for measles in the presence of other signs and symptoms. Koplik's spots occur 1–2 days before to 1–2 days after the measles rash, and appear as small blue-white spots on the bright red background of the buccal mucosa.

During the next 3 days, the measles rash gradually proceeds downward, reaching the hands and feet. The maculopapular lesions are generally discrete, but may become confluent, particularly on the upper body. Initially, lesions blanch with pressure. Fine, scaly desquamation may occur over more severely involved areas. The rash fades in the same order that it appears, from head to the extremities. Other symptoms of measles include loss of appetite, diarrhea (especially in infants), and generalized lymphadenopathy.

Approximately 30% of reported measles cases have one or more complications. Complications are more common among children less than 5 years old and adults 20 years of age and older. Complications of measles include diarrhea, otitis media, pneumonia, laryngotracheobronchitis (croup), encephalitis (approximately 1 of every 1,000 cases), seizures with or without fever (6–7 per 1,000 reported cases), and death (approximately 1–3 per 1,000 reported cases, mostly from pneumonia and occasionally from encephalitis). The risk of death from complications of measles is higher in younger children, older adults, and individuals with immunosuppression. The most common cause of death is pneumonia in children and encephalitis in adults. Pneumonia complicates 6% of measles cases in the U.S., and 19% of measles cases are hospitalized.

Measles in an immunocompromised person may be severe, with a prolonged course, particularly in those with T-cell deficiencies (certain leukemia, lymphomas, and HIV/AIDS). It may occur without the typical rash, and the patient may shed the virus for several weeks after the acute illness.

Measles during pregnancy results in a higher risk of premature labor, spontaneous abortion, and low-birth-weight infants. Birth defects (with no definable pattern of malformation) have been reported rarely, without confirmation that measles was the cause.

### **C. Reservoirs**

Humans are the only host for measles.

### **D. Modes of Transmission**

Measles is transmitted from person to person by airborne droplet spread or direct contact with nasal or throat secretions of an infected person. Less commonly, transmission may occur by articles freshly soiled with nose and throat secretions.

Measles is highly infectious. Infectious particles may remain suspended in air for up to 2 hours. Asymptomatic carriage has not been documented.

### **E. Incubation Period**

The incubation period of measles, from exposure to prodrome, averages 10–12 days (range 7-21 days). The period from exposure to rash onset averages 14 days.

### **F. Period of Communicability or Infectious Period**

The infectious period is from 4 days before to 4 days after rash onset (counting the day of rash onset as day zero). Immunocompromised patients may have prolonged excretion of virus in their secretions and can be infectious for the duration of their illness.

### **G. Epidemiology**

Measles occurs worldwide. In the temperate zones, peak incidence is in late winter and early spring. One dose of measles, mumps, rubella (MMR) vaccine induces measles immunity in about 95% of vaccinees; however, due to measles' extreme infectiousness, two doses are necessary to prevent outbreaks in the 5% that remain susceptible after one dose of vaccine. Vaccine failure after two doses, both administered at  $\geq 12$  months of age, is uncommon.

Measles is the leading vaccine-preventable killer of children worldwide. In developing countries, case-fatality rates average 3–5%, but can range as high as 10–30% in some localities. Indigenous transmission has been interrupted and an increasing proportion of U.S. cases are imported, often from Europe and Asia, and they occur among U.S. citizens traveling abroad, persons visiting the U.S., and adoptees from other countries. All individuals may be at risk for measles, but those most at risk are generally limited to five groups:

1. Children <12 months of age (those who are too young for routine immunization);
2. Unimmunized individuals;
3. Adults who may have received an earlier ineffective measles vaccine prior to 1968 or who are unimmunized because they graduated from school prior to mandatory measles vaccination (school and daycare requirements in Wisconsin began in July 1975);
4. Children and adults with only one dose of measles-containing vaccine; and
5. Those who are foreign-born and have never been vaccinated or did not have measles as a child in their country of origin.

Adults born prior to 1957 are generally considered immune. (The exception to this is in health care settings, where year of birth does not constitute acceptable proof of immunity.)

## H. Prevention Measures

### *Personal Preventive Measures/Education*

In addition to good personal hygiene (which consists of proper handwashing, disposal of used tissues, not sharing eating utensils, etc.), vaccination, including routine childhood vaccination, catch-up vaccination of adolescents, and targeted vaccination of high-risk adult groups (including international travelers), is the best preventive measure against measles. Vaccination is recommended for individuals without acceptable proof of immunity (referred to in this document as “susceptibles”), as defined below.

### **Proof of Immunity to Measles**

- Birth before January 1, 1957 (the exception to this is in the health care setting, where year of birth does not constitute acceptable proof of immunity).
- OR
- For preschool-age children and adults not at high risk: documentation<sup>1</sup> of receipt of one or more doses<sup>2</sup> of a measles-containing vaccine given on or after the first birthday.
- OR
- For school-age children and adults at high risk, including health care personnel, international travelers, and students at post-high school educational institutions: documentation of receipt of two doses of measles-containing vaccine. The second dose should be administered at least 4 weeks after the first dose.
- OR
- Serologic proof<sup>3</sup> of immunity.
- OR
- Laboratory confirmation of disease.

**Note:** Physician-diagnosed disease alone is not acceptable proof of immunity.

<sup>1</sup> Acceptable documentation is written documentation that includes the vaccine administered and the month, day and year of vaccination.

<sup>2</sup> In most situations, individuals who receive their first dose within 72 hours of exposure will be considered immune.

<sup>3</sup> If receipt of two valid doses of measles-containing vaccine has been documented, serologic testing for immunity is not necessary.

The Advisory Committee on Immunization Practices (ACIP) and the Centers for Disease Control and Prevention (CDC) recommend routine vaccination against measles virus using MMR (measles, mumps, rubella) vaccine. Recommendations for vaccination with MMR vaccine are detailed below. Please note that “MMR” will be used throughout this document to indicate vaccination with MMR, MMRV (measles, mumps, rubella, varicella), or any other approved measles-containing vaccine.

### **Recommendations for Routine Vaccination with MMR (Measles, Mumps, Rubella) Vaccine**

- **Children** should routinely receive two doses of MMR vaccine. The first dose should be administered at age 12-15 months and the second dose should be administered at age 4-6 years (at the time of school entry). The minimum recommended interval between doses is 28 days.
- **Adults** who do not have proof of immunity, as defined above, should receive one or two doses of MMR vaccine depending on their risk of infection. The minimum recommended interval between doses is 28 days.
  - Adults at high risk of infection (including health care personnel, college students and international travelers) should receive two doses of MMR vaccine.

- Adults not at high risk of infection should receive at least one dose of MMR vaccine.
- Adults who received an inactivated or unknown type of measles vaccine before 1968, or further attenuated measles vaccine accompanied by IG or high-titer measles immune globulin should be considered unvaccinated and should be re-vaccinated with one or two doses of MMR.

**Table 1. Assessing Immunity to Measles among Exposed Persons, by Age**

Age	Special Status	Acceptable Evidence of Immunity
Under 12 months	Any	Only laboratory evidence of immunity
1 to 4 years <sup>1</sup>	Any	1 valid MMR or laboratory evidence of immunity
5 to 18 years	Any	2 valid MMRs or laboratory evidence of immunity
Older than 18 years, born during or after 1957	Health care personnel College students International travelers	2 valid MMRs <sup>2</sup> or laboratory evidence of immunity
	Others	1 valid MMR or laboratory evidence of immunity
Born before 1957	Health care personnel	2 valid MMRs <sup>2</sup> or laboratory evidence of immunity
	Others	No evidence needed; all are considered immune

<sup>1</sup>In certain circumstances two doses may be recommended.

<sup>2</sup>Health care personnel should have two doses of MMR pre-exposure in order to avoid exclusion following an exposure.

More information on MMR vaccination:

- Spacing of MMR vaccination: See Table 5, “Recommended intervals between administration of antibody-containing products and measles or varicella-containing vaccine, by product and indication for vaccination”, in the General Recommendations on Immunization: [http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6002a1.htm?s\\_cid=rr6002a1\\_e](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6002a1.htm?s_cid=rr6002a1_e)
- The most current version of the Advisory Committee on Immunization Practices (ACIP) statement on measles, rubella, and mumps: See citation listed in the References section.
- Frequently asked questions about the MMR vaccine: <http://www.cdc.gov/vaccines/vpd-vac/combo-vaccines/mmr/vacopt-faqs-hcp.htm>
- MMR Vaccine Information Statement (VIS): <http://www.cdc.gov/vaccines/hcp/vis/index.html> .

A Measles Public Health Fact Sheet for the general public can be obtained from the WDPH website at: <http://www.dhs.wisconsin.gov/immunization/measles.htm>.

## Section 2: REPORTING CRITERIA AND LABORATORY TESTING

### A. What to Report to the Wisconsin Division of Public Health (WDPH)

Report any of the following:

- A case of rash illness accompanied by fever;
- A suspect case of measles (with or without fever), as diagnosed by a health care provider;
- Positive serologic test for measles immunoglobulin M (IgM);

- Significant rise between acute- and convalescent-phase titers in serum measles immunoglobulin G (IgG), or total antibody level by any standard serologic assay; or
- Detection or isolation (by PCR or culture) of measles virus from a clinical specimen.

*Note: See Sections 3B and 3C for information on how to report a case.*

## B. Specimen Collection and Laboratory Testing

What specimens should be collected for testing on a symptomatic individual?

- **Combined Throat and Nasopharyngeal Swabs:**  
As soon as measles is suspected (preferably within the first 3 days of illness, but no later than 10 days after rash onset), collect a throat swab AND a nasopharyngeal swab, combined in the same vial of virus transport medium. Synthetic swabs (e.g., Dacron) are required for specimen collection. Do not use cotton or calcium alginate swabs as they may be inhibitory to enzymes used in PCR. Place both swabs in a single tube of virus transport medium; any commercially available virus transport medium is acceptable. Maintain specimen at refrigerator temperature prior to and during transport.

Test to order: PCR (**Note:** All specimens that test positive by PCR are automatically sent to CDC for measles culture testing.)

- **Acute Serum:**  
As soon after onset as possible, collect 7-10 ml of blood in a red top or serum separator tube (SST). Store specimens at refrigerator temperature. Transport at refrigerator temperatures using cool-packs. A repeat serum specimen should be collected and tested if IgM serology testing is negative for specimens collected within 72 hours of rash onset.

Test to order: IgM and IgG serology

- **Convalescent Serum:**  
Paired (acute and convalescent) sera can be of value for patients with no history of vaccination or with seronegative acute specimens. Collect the convalescent serum 2-3 weeks after collection of acute sera to determine if a significant change in IgG antibody titer has occurred.

Test to order: IgM and IgG serology

- **Urine:**  
Virus can be present in the urine a few days before rash appears and begins to diminish a few days following rash onset. Collect 10-50 ml of first-voided morning urine in an empty container; do not add virus transport medium. Maintain the urine specimen at refrigerator temperature prior to and during transport. Note that urine is **not** the optimal specimen.

Test to order: PCR.

Additional information:

- Only symptomatic individuals should be tested for measles.
- If testing an asymptomatic individual for proof of immunity, request **only** the IgG test.
- Isolation of measles virus by culture is not recommended as the primary method to diagnose measles due to the time it takes for results to be available, but virus isolates are extremely important for molecular epidemiologic surveillance to help determine the geographic origin of the virus and the viral strains circulating in the U.S.
- See the Wisconsin State Laboratory of Hygiene website for additional information:  
<http://www.slh.wisc.edu/>

Where should specimens be sent for testing?

- If the patient is suspected of having measles, the specimens should be sent to the Wisconsin State Laboratory of Hygiene (WSLH) for testing. Note: Specimens submitted to the WSLH for measles testing will also be tested for rubella.
  - More details about specimen collection, transport, and testing can be found at the WSLH website: <http://www.slh.wisc.edu/>
  - Contact your local health department for details on fee-exempt testing (<http://www.dhs.wisconsin.gov/localhealth/counties/countyalphalist.htm>).
- If serum specimens were collected for immunity testing only, they should be sent to a commercial laboratory. Only the IgG test should be requested.

Negative results do not rule out measles infection due to the following:

- The amount of virus shed at the time of sample collection may have been too low to be detected.
- Inadequate specimen collection, processing, shipping or storage can significantly reduce the likelihood of detecting measles virus or measles RNA.
- Previously vaccinated individuals may not have a detectable IgM response.
- The full clinical and epidemiologic picture should be taken into consideration when interpreting test results.

## Section 3: REPORTING RESPONSIBILITIES AND CASE INVESTIGATION

### A. Purpose of Surveillance and Reporting

- To identify all cases and susceptible exposed persons rapidly, and to prevent further spread of this highly contagious disease.
- To identify the source of infection. Genotyping (performed at CDC) of viral isolates allows for determination of patterns of importation and transmission.
- To help in the international effort to eradicate measles.

### B. Laboratory and Health Care Provider Reporting Requirements

Measles is a Category I Reportable Disease according to WDPH regulations (DHS 145.04). Health care providers should immediately report to the local health department (LHD), by telephone, all confirmed or suspect cases of measles, as defined by the reporting criteria in Section 2A. Within 24 hours, health care providers should submit a case report online through the Wisconsin Electronic Disease Surveillance System (WEDSS) or by fax using an Acute and Communicable Disease Case Report ([F44151](#)).

Laboratories performing examinations on any specimens derived from Wisconsin residents that yield evidence of measles infection should report the case to the LHD online through WEDSS or by fax using an Acute and Communicable Disease Case Report ([F44151](#)).

LHD contact information can be found here:

<http://www.dhs.wisconsin.gov/localhealth/counties/countyalphalist.htm>.

## **C. Local Health Department (LHD) Reporting and Follow-Up Responsibilities**

### *Reporting Requirements*

Each LHD must report any case of measles or suspected case of measles, as defined by the reporting criteria in Section 2A, to both of the following entities:

- WDPH regional immunization contact person immediately by phone <http://www.dhs.wisconsin.gov/immunization/CentralStaff.htm>
- WDPH, using the appropriate case report form in WEDSS.

### *Case Investigation*

Below are questions that the LHDs should ask the health care provider and patient at the start of the case investigation. LHDs should also gather all of the information necessary to complete the WEDSS case report form.

- Clinical presentation;
- Measles immunization history;
- Country of origin and length of residence in the U.S. (those in the U.S. for a short time are more likely to be susceptible);
- History of travel in the last 42 days (to where, method of travel (e.g., airplane) and dates);
- Whether there were any recent out-of-town or out-of-country visitors (from where and dates);
- Whether there was any recent contact with anyone with similar symptoms;
- Risk factors for disease (e.g., <12 months of age, pregnancy, immunosuppression);
- Exposure and transmission settings (e.g., health care, childcare, school, institutional/residential settings [e.g., correctional, shelter, group home, military, college]—any setting where large numbers of foreign-born individuals are employed or live); and
- Laboratory information, including viral isolation and serologic test results.

Implementation of disease control measures is an integral part of case investigation. It is the responsibility of the LHD to understand and, if necessary, implement the control guidelines listed in Section 4.

## **Section 4: CONTROLLING FURTHER SPREAD**

This section provides detailed control guidelines regarding how to control disease in a case-patient and protect contacts of a case-patient from becoming infected. The LHD will take the lead on implementing control measures, in collaboration with the WDPH (including the Regional Immunization Representative).

### **A. Control of Disease in a Case**

1. Implement control measures before laboratory confirmation. If the laboratory results are negative, the decision to continue control measures should be made in consultation with the treating physician, the LHD, and the WDPH.
2. Exclude and isolate the case-patient during his/her infectious period as described in section 1F (from 4 days before through 4 days after rash onset, counting the day of rash onset as day zero). He/she may return to normal activities on the fifth day after rash onset.
3. Gather information from the case-patient about possible sources of his/her infection, such as
  - a. Contact with a known or suspect case of measles, and
  - b. Travel during the 21 days prior to disease onset.
4. Investigate by asking the case-patient other questions as outlined in Section 3C.

## **B. Protection of Contacts of a Case**

1. Define the dates during which the case-patient was infectious, using the standard measles infectious period described in Section 1F. (Persons with measles are usually considered infectious from 4 days before to 4 days after rash onset. The day of rash onset is considered day zero.)
2. Identify all individuals who were exposed to the case-patient during the case-patient's infectious period. Measles is so contagious that everyone at an entire institution is often considered exposed. A review of institutional floor plans and air flow patterns may be necessary to determine which individuals are considered exposed. To identify the exposed individuals, hereafter referred to as "contacts" of the case-patient, consider members of the following groups: household members; classmates; coworkers; staff and patients at the medical facility where patient was seen; religious/social groups; sports teams and other extracurricular groups; bus/carpool mates; close friends; etc.
3. Identify contacts who are at high risk of measles infection and ensure they are properly referred:
  - a. Pregnant women should be referred to their obstetricians for screening and management. (Particularly in childcare or school settings, remember to determine whether any teachers, student teachers, staff, or students are pregnant.)
  - b. Immunosuppressed individuals should be referred to their health care providers.
  - c. Infants <12 months of age should be referred to their pediatricians.
4. Identify contacts who are susceptible to measles infection. These are individuals without proof of immunity, including those with medical or religious exemptions to immunization. Proof of immunity is defined in Section 1. H. on page 3.
5. Immunize all who do not have proof of immunity to measles, are  $\geq 12$  months of age and do not have a contraindication for measles vaccination, with attention to the following:
  - a. **Measles vaccine given within 72 hours of exposure may prevent disease.**
  - b. Vaccinating an exposed individual who may be incubating measles virus is not harmful.
  - c. Vaccinate even if it is >72 hours post-exposure. It will protect against exposure to the next potential generation of cases. In addition, the situation should be viewed as an opportunity to vaccinate.



- d. The minimum recommended interval between doses of MMR is 28 days.
  - e. For more information on spacing of MMR vaccination, see Table 5, "Recommended intervals between administration of antibody-containing products and measles or varicella-containing vaccine, by product and indication for vaccination," in the General Recommendations on Immunization: [http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6002a1.htm?s\\_cid=rr6002a1\\_e](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6002a1.htm?s_cid=rr6002a1_e)
6. Recommend that individuals who are exposed to measles and at risk for severe disease and complications from measles (as defined below) receive immune globulin (IG) as soon as possible. If administered within 6 days of exposure, IG can prevent or modify measles in persons who are non-immune. This includes individuals in the following groups:
- a. Infants <12 months of age: Immunoglobulin administered intramuscularly (IGIM) should be administered to all infants <12 months of age who have been exposed to measles. For infants aged 6 through 11 months, MMR vaccine can be administered in place of IG if administered within 72 hours of exposure. If beyond the 72 hours of exposure, IGIM should be administered.
  - b. Pregnant women without evidence of measles immunity: Immunoglobulin administered intravenously (IGIV) should be administered. IGIV (rather than IGIM) is recommended to administer doses high enough to achieve estimated protective levels of measles antibody.
  - c. Immunocompromised patients: Severely immunocompromised patients should receive IGIV prophylaxis regardless of immunologic or vaccination status because they might not be protected by the vaccine. Severely immunocompromised patients include: patients with severe primary immunodeficiency; patients who have received a bone marrow transplant until at least 12 months after finishing all immunosuppressive treatment, or longer in patients who have developed graft-versus-host disease; patients on treatment for Acute Lymphocytic Leukemia (ALL) within and until at least 6 months after completion of immunosuppressive chemotherapy; and patients with a diagnosis of AIDS or HIV-infected persons with severe immunosuppression defined as CD4 percent <15% (all ages) or CD4 count <200 lymphocytes/mm<sup>3</sup> (aged >5 years) and those who have not received MMR vaccine since receiving effective anti-retroviral therapy (ART). Some experts include HIV-infected persons who lack recent confirmation of immunologic status or measles immunity.

The recommended dose of IGIM is 0.5mL/kg of body weight (maximum dose=15 mL) and the recommended dose of IGIV is 400 mg/kg.

For persons already receiving IGIV therapy, administration of at least 400 mg/kg body weight within 3 weeks before measles exposure should be sufficient to prevent measles. For patients receiving subcutaneous immunoglobulin (IGSC) therapy, administration of at least 200 mg/kg body weight for 2 consecutive weeks before measles exposure should be sufficient.

IGIM can be administered to other persons who do not have evidence of measles immunity, but this should be reserved for people who cannot be vaccinated with MMR (e.g., individuals who are immunocompromised or have a contraindication to vaccination, such as history of anaphylactic reaction to neomycin) and who were exposed in settings with intense, prolonged, close contact (e.g., household, daycare, and classroom).

Because immunoglobulin might prolong the incubation period, individuals who have received IG should be observed for signs and symptoms for 28 days after exposure.

7. Exclude and quarantine (enforced exclusion from public activities and other susceptible persons) contacts according to the following guidelines and after consultation with the local health department and the Wisconsin Immunization Program. (Requirements for health care and school settings may be more rigorous. See Section 4C for more details on quarantine in health care and school settings.)

- a. In most situations, individuals receiving their first or second dose of MMR within 72 hours of exposure will be considered immune and may return to work/school. Individuals without proof of immunity to measles (as defined in Section 4B) who do not receive MMR vaccination within 72 hours of exposure should be excluded on days 7–21 post-exposure. Several criteria are used to determine when to exclude susceptible contacts, and when they can return to normal activities, as outlined below.
    - i. If there was a discrete (one-time) exposure: Exclude the susceptible contact on days 7–21 from that exposure. The susceptible contact may return to normal activities on the 22nd day after the one-time exposure.
    - ii. If there was continuous or multiple dates of exposure: Exclude the susceptible contact beginning on day 7 following the first exposure through day –21 from the day of the last exposure.
    - iii. If there is more than one case of measles: The susceptible contact will need to be excluded until 21 days after the onset of rash in the last reported case in the outbreak setting. The susceptible contact may return to normal activities on the 22nd day after rash onset in the last reported case in the outbreak setting.
  - b. Individuals who have received IG more than 6 days after their first exposure should be excluded from public activities from days 7 through 21 after first exposure. These individuals may return to normal activities on the 22<sup>nd</sup> day.
8. Conduct surveillance for two incubation periods (42 days) after rash onset in the last case or the last exposure in the setting, whichever is later.

### **C. Managing Special Situations**

In some special situations, additional control measures are needed. Use the guidelines below for school and health care settings to augment the control procedures outlined above.

#### ***School and Licensed Daycare Settings***

Identify all individuals in the building during the infectious period, including students, staff, volunteers and other visitors. Determine if there are any:

- Pregnant individuals among the students, teachers, volunteers and staff anywhere in the school or daycare.
- Immunocompromised individuals among the students, teachers, and staff anywhere in the school or daycare.
- Medical/religious exemptions anywhere in the school or daycare, among both students and staff. It is particularly important to identify these individuals in the classroom and grade of case patient. Remember, these susceptible individuals (who do not get vaccinated) must also be excluded for the appropriate time period. However, the local health department and the Wisconsin Immunization Program should be consulted before exclusion is implemented.
- Extracurricular or sporting events or field trips that occurred during the infectious period.

#### **Exclusion and Quarantine of Susceptible Contacts**

- Individuals exposed in the school and daycare setting and born before 1957 are considered immune. However, administering a dose of MMR is recommended, if possible.
- Please consult with the local health department and the Wisconsin Immunization Program prior to implementing exclusion.

- If multiple cases occur, guidelines may be revised.
- In some rare settings where very high-risk susceptible individuals are present, the WDPH may recommend that susceptible students and staff be excluded, even if they have been immunized within 72 hours.

**School Setting**

Students, and adults born during or after 1957:

Previously unvaccinated exposed persons must be quarantined from day 7 through day 21 after exposure to the last case of measles, unless a dose of MMR vaccine was received within 72 hours of first exposure or IG was given within 6 days of first exposure (according to Wis. Stat. 252). Susceptible contacts who have already received one dose of MMR and received a second dose of MMR within 72 hours of exposure can be readmitted.

**Table 2. Exclusion Criteria in the School Setting for Students (grades K-12) and Adults Born During or After 1957 who are Exposed to Measles:**

Number of Pre-Exposure Doses of Measles-Containing Vaccine	Number of Doses of Measles-Containing Vaccine Received Within 72 Hours After Exposure	Total Number of Doses of Measles-Containing Vaccine Received	Exclude from School from Day 7 Through Day 21 Following Exposure?
0	0	0	Yes
0	1	1	No
1	0	1	Students Yes Adults <sup>1</sup> No
1	1	2	No
2	0	2	No

<sup>1</sup>A second dose is recommended for adults.

*Licensed Daycare Setting*

- In the daycare setting, adults and school-aged children (aged 5 and older) should be managed in accordance with Table 2.
- Children aged 0 to 5 months cannot be vaccinated and must be excluded if they do not receive IG within 6 days of exposure.
- Children aged 6 to 11 months must be excluded if they do not receive MMR vaccine within 72 hours of exposure or IG within 6 days of exposure. See Section B.6.a. for further information.
- All other children should be managed as indicated in Table 3.

**Table 3. Exclusion Criteria in the Daycare Setting for Infants and Children who are Exposed to Measles:**

Age of Child	Number of Pre-Exposure Doses of Measles-Containing Vaccine	Number of Doses of Measles-Containing Vaccine Received Within 72 Hours after Exposure	Total Number of Doses of Measles-Containing Vaccine Received	Exclude from daycare from day 7 through day 21 following exposure?
6-11 months	0	1	1	No
6-11 months	0	0	0	Yes
1 to 4 years	0	1	1	No
1 to 4 years	1	0	1	No <sup>1</sup>
1 to 4 years	1	1	2	No

<sup>1</sup>In certain circumstances, a second dose may be recommended.

**Notification**

- Notify groups or schools exposed during the infectious period (e.g., school sports teams).
- Surveillance and control measures will need to be instituted in these settings.

**Health Care Settings**

**Proof of Immunity among Health Care Personnel**

Health care personnel have contributed to the spread of measles in medical settings. Therefore, documentation of immunity among health care personnel is extremely important.

- All staff, regardless of year of birth, should have proof of two doses of measles vaccine or serologic proof of immunity.
- Staff who have not received two doses of MMR vaccine and do not have serologic proof of immunity should:
  - Receive a dose of MMR vaccine if one or more cases of measles occur in the facility.
  - Receive a second dose of MMR vaccine 28 days after receipt of the first dose, if receipt of two doses has not already been documented.

**Table 4. Assessing Immunity/Susceptibility to Measles among Exposed Health Care Personnel, by Number of Doses Received of Measles-Containing Vaccine**

Number of Pre-Exposure Doses of Measles-Containing Vaccine	Number of Doses of Measles-Containing Vaccine Received Within 72 Hours after Exposure	Total Number of Doses of Measles-Containing Vaccine Received	Considered Immune/Susceptible to Measles
0	0	0	Susceptible
0	1	1	Susceptible
1	0	1	Susceptible
1	1	2	Immune
2	0	2	Immune

**Initial Management of Patients with Febrile Rash Illness**

- 1) Assess and screen all patients with febrile rash illness, either prior to or immediately on arrival at the intake area.
- 2) Escort patients to a separate waiting area or place immediately in a negative pressure room, if available.
- 3) Both patients and staff should wear appropriate masks/respirators (masks for patients to prevent generation of droplets, and respirators for staff, if possible, to filter airborne particles).
- 4) If the patient is not admitted, maintain standard and airborne infection isolation (including while patient is exiting the facility; e.g., separate exit). Patients should receive instructions to remain in isolation at home through 4 days after rash onset.
- 5) Identify areas of the facility that may be contaminated based on all the patient's movements within the facility and the airflow within the facility. Measles virus can remain suspended in the air for up to 2 hours. Therefore, we recommend that susceptible patients NOT be placed in a room that has been occupied by a suspect case for 2 hours following the case's exit from that room.
- 6) Identify all contacts within the facility. This includes:
  - a. Patients, family, and friends in the waiting and examination rooms up to 2 hours after the index case was present; and
  - b. Other individuals in the affected area(s), such as emergency transport staff, law enforcement, delivery persons or maintenance staff; and
  - c. All staff both with and without direct patient contact; and
  - d. Possibly everyone at the facility, due to airborne route of transmission.
- 7) Identify contacts without immunity to measles (particularly high-risk contacts without proof of immunity) and offer:
  - a. MMR within 72 hours of exposure (will most likely prevent illness if given in this time period); or
  - b. For high-risk contacts and those ineligible for vaccination, IG within 6 days of exposure (may reduce the risk for measles or modify disease if administered within 6 days of exposure, but a recipient can still be infectious).
- 8) Notify infection control, employee health, department heads, and the health care providers of exposed patients. The local health department should also be notified.
- 9) Isolate cases and exclude susceptible contacts according to the guidelines below.

### **Infectious Period**

- Immunocompetent individuals:
  - Immunocompetent case-patients are considered to be infectious from 4 days before rash onset through 4 days after rash onset, counting the day of rash onset as day zero. Therefore, cases are considered infectious for a total of 9 days.
- Immunocompromised individuals:

- Immunocompromised case-patients may have prolonged excretion of virus in their secretions. They should be considered infectious from 4 days before rash onset through 4 days after rash onset (counting the day of rash onset as day zero) or for the duration of their illness, whichever is longer.

### **Exclusion and Isolation of Cases**

- Health care personnel suspected of having measles:
  - Should be excluded from work from the moment they are suspected of having measles through 4 days after they develop a rash consistent with measles. They may return to work on the fifth day after rash onset.
- Patients suspected of having measles:
  - If admitted, should be on airborne infection isolation (in addition to standard precautions) while infectious (4 days before rash onset through 4 days after rash onset) in a negative pressure room. They may be taken off isolation on the fifth day after rash onset.
  - If not admitted, should maintain respiratory isolation while exiting the facility (e.g., mask, separate exit) and should remain at home through 4 days after rash onset. They may return to normal activities on the fifth day after rash onset.

### **Exclusion and Quarantine of Susceptible Contacts**

- Contacts without proof of immunity:
  - If a patient, the individual should be placed in isolation from day 5 after the earliest exposure through day 21 after the last exposure to the case during his/her potential infectious period (as defined above). He/she may be taken off isolation on the 22nd day after last exposure.
  - If a health care staff member, the individual should be excluded from day 5 after the earliest exposure through day 21 after the last exposure to the case during his/her potential infectious period (as defined above) (according to Wis. Stat. 252). He/she may return on the 22nd day after last exposure. Note that the exclusion period for health care personnel is different from that for other settings.
- In the health care setting, infection control personnel should exclude all susceptible health care personnel, including those who have been vaccinated with their first dose of MMR within 72 hours of exposure. However, those who receive their second dose of MMR within 72 hours of exposure do not need to be excluded.

### ***HIV-Infected Individuals and Their Contacts***

Management of HIV-infected individuals exposed to measles and their contacts are outlined in the Red Book and the 2013 ACIP MMWR (see References Section).

## **ADDITIONAL INFORMATION**

The following is the formal CDC surveillance case definition for measles. It is provided for your information only and should not affect the investigation and reporting of a case that fulfills the criteria in Section 2A of this chapter. (The CDC and the WDPH use the CDC case definitions to maintain uniform standards for reporting on a national basis.) For reporting to the WDPH, always use the criteria outlined in Section 2A.

Note: The most up-to-date CDC case definitions are available on the CDC website at:  
<http://www.cdc.gov/vaccines/pubs/surv-manual/chpt07-measles.html#case>

## Case Definition for Measles

### *Clinical Case Definition*

An illness characterized by all the following:

- A generalized, maculopapular rash lasting  $\geq 3$  days;
- A temperature  $\geq 101^\circ\text{F}$  ( $38.3^\circ\text{C}$ ); and
- Cough, coryza, or conjunctivitis.

### *Laboratory Criteria for Diagnosis*

- Positive serologic test for measles IgM antibody;
- Detection of measles virus-specific nucleic acid\* from a clinical specimen using polymerase chain reaction; or
- Significant (generally a 4-fold) rise in measles antibody (IgG) level by any standard serologic assay; or
- Isolation of measles virus from a clinical specimen.

\* Not explained by MMR vaccination during the previous 6-45 days.

### *Case Classification*

#### **Confirmed**

An acute febrile rash illness with either laboratory confirmation OR a direct epidemiologic link to a laboratory confirmed case. Note: temperature does not need to reach  $\geq 101^\circ\text{F}$  and rash does not need to last  $\geq 3$  days.

#### **Probable**

A case that meets the clinical case definition, has noncontributory or no serologic or virologic testing, and is not epidemiologically linked to a confirmed case.

**Comment:** All confirmed cases will be classified by WDPH as one of the following:

- **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 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:** 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 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 U.S. 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 U.S.
- **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 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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# Measles

## Local Health Department (LHD) Action Steps

*This page does not need to be submitted to the WDPH with the case report form. It is for LHD use and is meant as a quick-reference guide to measles case investigation activities.*

LHD staff should follow these steps when measles is suspected or confirmed in the community. For more detailed information, including disease epidemiology, reporting, case investigation, and follow-up, refer to the preceding chapter.

### Reporting

- Immediately notify, by telephone, the WDPH Regional Immunization Representative, <http://www.dhs.wisconsin.gov/immunization/CentralStaff.htm> of any suspected case of measles or febrile rash illness.
- Enter all known information on the case into the Wisconsin Electronic Disease Surveillance System (WEDSS).

### Case Investigation

- Work with WDPH to ensure that appropriate clinical specimens are collected and submitted to the WSLH for confirmation.
- Obtain the information necessary for completion of the case report form, including source of exposure, clinical information, vaccination history, laboratory results, and source of infection.

### Prevention and Control

- Institute isolation and quarantine requirements and other control measures, as they apply to a particular case.
- Identify high-risk (e.g., pregnant women) or susceptible individuals, including those with medical or religious exemptions.
- Vaccinate susceptible individuals with MMR within 72 hours of exposure, if possible (if not contraindicated). Remember, measles vaccination within this time period most likely will prevent illness in susceptible individuals.
- Recommend IG for non-immune, high-risk susceptible individuals (who cannot receive vaccine) as soon as possible (preferably within 6 days).
- Conduct surveillance for two incubation periods (42 days).

### Managing Measles in Schools and Non-Health Care Settings

In addition to the prevention and control measures described above:

- Notify and educate staff/students.
- Test and exclude symptomatic individuals.

- Isolate remaining susceptible contacts. (In most settings, individuals vaccinated within 72 hours of exposure can be readmitted to a facility.)

**Managing Measles in Health Care Settings**

In addition to the prevention and control measures described above:

- Notify infection control or employee health of confirmed or suspect case(s) in institution.
- Ensure all health care personnel have proof of immunity appropriate for health care settings. (See Table 1 below.)

**Table 5. Assessing Immunity/Susceptibility to Measles among Exposed Health Care Personnel, by Number of Doses Received of Measles-Containing Vaccine**

Number of Pre-Exposure Doses of Measles-Containing Vaccine	Number of Doses of Measles-Containing Vaccine Received Within 72 hrs after Exposure	Total Number of Doses of Measles-Containing Vaccine Received	Considered Immune/Susceptible to Measles
0	0	0	Susceptible
0	1	1	Susceptible
1	0	1	Susceptible
1	1	2	Immune
2	0	2	Immune

Use more rigorous criteria for exclusion/isolation of susceptible individuals in the health care setting, as described in the chapter.