

# MEASLES

Report Immediately  
by phone

**Also known as: Rubeola, Hard measles, Red measles, Morbilli**

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## Responsibilities:

**Hospital:** Report by phone immediately

**Lab:** Report by phone immediately

**Physician:** Report by phone immediately

**Local Public Health (LPHA): Report by phone immediately. Follow-up required**

**Iowa Department of Public Health**

**Disease Reporting Hotline: (800) 362-2736**

**Secure Fax: (515) 281-5698**

## 1) THE DISEASE AND ITS EPIDEMIOLOGY

### A. Agent

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

### B. Clinical Description

Measles is an acute, highly communicable viral disease characterized by fever (as high as 103°-105°F), cough, coryza, conjunctivitis, and maculopapular rash (the 3 C's plus rash). Koplik spots (small spots with white or bluish-white centers on an erythematous base) may be present on the buccal mucosa. The rash is red and blotchy and appears on the third to the seventh day after the onset of initial symptoms; the rash begins on the face (hairline) proceeding downward and outward, reaching the hands and feet. Complications can include diarrhea, otitis media, pneumonia, encephalitis (1 per 1,000 cases), and death (1–2 per 1,000 cases). Immunocompromised individuals are at increased risk for pneumonitis, encephalitis, and death. These complications can occur in 20–80% of people with compromised immune systems, such as HIV-infection and patients receiving chemotherapy.

### C. Reservoirs

Humans are the only host.

### D. Modes of Transmission

Measles is transmitted airborne by droplet spread and direct contact with nasal or throat secretions of an infected person. Measles is one of the most highly infectious diseases. Measles virus can remain infectious in the air for up to 2 hours after an infectious person leaves an area.

### E. Incubation Period

The time from exposure to symptom onset is about 10 days with a usual range of 7 - 21 days. The rash usually appears about 14 days after exposure. Immune globulin given later than the third day of the incubation period, may extend the incubation period.

### F. Period of Communicability or Infectious Period

From 4 days before to 4 days after the first appearance of the rash (this is calculated by counting the day of rash onset as day zero). Measles virus is highly infectious and may remain suspended in the air (thus someone may contract the disease without ever being in the same room with an infected person) and viable on surfaces for up to 2 hours. More than 90% of susceptible people who are exposed to measles will be infected.

## **G. Epidemiology**

From 2001 through 2008, 38 outbreaks of measles were reported. From 2009 through 2014, 66 outbreaks of measles were reported. Outbreaks of measles in the United States mostly involve individuals who are directly exposed to imported measles cases or who are infected during a resulting chain of transmission, and who are either unvaccinated or had unknown vaccine status. The settings of measles transmission have included households, educational institutions (e.g., schools, day care), churches, healthcare facilities, homeless shelters, and other congregate settings. Lack of adherence to existing recommendations for measles prevention among groups at high risk (for example, individuals who travel internationally), can spread measles to susceptible populations, including infants too young to be vaccinated and unvaccinated persons by choice. Because of high population immunity, high measles vaccine effectiveness, and the immediate implementation of control measures, generally the sizes of measles outbreaks in the United States are limited. However, recent large outbreaks emphasize the importance of maintaining high levels of measles immunity across the population through routine measles vaccine coverage. The largest measles outbreak documented in the United States in more than two decades (383 cases) occurred in an under-immunized Amish community in Ohio over 4 months (March–July) in 2014. From December 2014 through March 2015, a measles outbreak consisting of 147 cases that originated in Disney theme parks in California spread to seven other U.S. states and two neighboring countries.

Responding to measles cases and outbreaks is time consuming and costly for local and state health departments. The overall costs to health departments to contain 16 outbreaks during 2011 amounted to an estimated \$2.7 million to \$5.3 million U.S. dollars. The economic burden of controlling measles spread in healthcare settings amounts to an estimated \$19,000 to \$114,286 U.S. dollars per case.

One dose of MMR vaccine induces measles immunity in about 95% of people who receive it; a second dose results in 99% immunity. Two doses, administered one month apart with the first dose being after 12 months of age, are recommended.

## **H. Bioterrorism Potential**

None.

## **2) DISEASE REPORTING AND CASE INVESTIGATION**

### **A. Purpose of Surveillance and Reporting**

- To identify all cases and susceptible exposed people rapidly and to prevent additional cases and further transmission of this highly contagious disease.
- To identify the source of infection so as to better understand how and why the case(s) occurred.
- To help in the international effort to eliminate indigenous transmission of measles from the Western Hemisphere.

### **B. Laboratory and Healthcare Provider Reporting Requirements**

Iowa Administrative Code 641-1.3(139) stipulates that the laboratory and the healthcare provider immediately report any suspected or confirmed case. The reporting number for IDPH Center for Acute Disease Epidemiology (CADE) is (800) 362-2736. After business hours, call the Iowa State Patrol Office at (515) 323-4360 and they will page a member of the on-call CADE staff.

#### **What to Report to the Iowa Department of Public Health**

- A suspect case of measles, as diagnosed by a healthcare provider, or
- Positive IgM serologic test or PCR test for measles

### **Case investigation**

Iowa Administrative Code 641-1.3(139) stipulates that the laboratory and the healthcare provider report. Measles is an immediately reportable disease. Call the reporting number for IDPH Center for Acute Disease Epidemiology (CADE) at (800) 362-2736 immediately upon identifying a suspect measles case.

After completing the investigation and gathering case information, enter the information into the Iowa Disease Surveillance System (IDSS), or FAX the report form with supporting laboratory documentation to (515) 281-5698 or mail (in an envelope marked "Confidential") to the IDPH/CADE, mailing address:

IDPH, CADE  
Lucas State Office Building, 5<sup>th</sup> Floor  
321 E. 12<sup>th</sup> St.  
Des Moines, IA 50319-0075

### **Laboratory Testing Services Available**

Suspect measles cases should be reported immediately to the Iowa Department of Public Health, Center for Acute Disease Epidemiology (CADE) at (800) 362-2736 or after hours, 515-323-4360. At that time, CADE will consult on appropriate testing to be ordered and specimen transport to the State Hygienic Laboratory (SHL). Public health response should not be delayed pending the return of laboratory results.

By using the Iowa SHL, transport time is significantly less, and results can be obtained more quickly. When submitting specimens to SHL, check the box in the demographics section of the order form directly below the clinician's phone number and signature. This indicates the testing is being completed because of an imminent public health threat and the test will be performed without charge to the patient. CADE Epidemiologists will provide a test request form.

#### **1. Blood Specimen for SHL IgG Testing**

- Prefer serum (min 500ul) or can send 4-6ml whole blood in a red top or serum separator tube, for infants 2-3ml acceptable and fill out Serology test request form

#### **2. Throat Swab for PCR:**

Specimens for measles PCR should ideally be obtained within five days of rash onset. A throat swab should not be collected any more than 9 days from rash onset. Viral RNA is more likely to be detected when the specimen is collected as soon as possible after rash onset.

Specimen Types Vary:

- On day 0-5 of rash, collect a throat swab\*

\*If a throat swab cannot be collected, a nasopharyngeal specimen can be sent instead; however, a throat swab is the preferred specimen.

\*\*If date of specimen collection is already more than nine days past rash onset, PCR is not valid.

### **Collection instructions for PCR**

A throat swab is preferred. Nasal/NP swabs or washes are acceptable but not preferred.

**Throat swab:** Swab tonsillar areas and posterior nasopharynx. Use tongue blade to depress tongue to prevent contamination of swab with saliva. Place swab into 2-3 ml of transport media.

### **Appropriate swabs and media:**

- Dacron swabs, flocked swabs
- Viral transport medium (VTM)

**Inappropriate swabs:**

- Wood-tipped applicators, Cotton-tipped swabs, Calcium-alginate tipped swabs, Charcoal swabs, Gel swabs
- **Dry swabs are not acceptable**

**Shipment of specimens**— Store/ship specimens at refrigeration temperature (2-8° C). IDPH will arrange specimen transport from your facility to SHL.

### **C. Initial Questions to Ask Healthcare Provider and Patient**

Public health investigating suspect cases should ask about:

- 1) symptoms (rash onset, rash characteristics, rash progression, other clinical findings cough, coryza, conjunctivitis and fever),
- 2) measles immunization history,
- 3) country of origin and length of residence in the US,
- 4) recent history of travel (date and location of travel),
- 5) recent out-of-town visitors (from where and visit dates), and
- 6) recent contact with anyone with similar symptoms (who and date of contact).

## **3) CONTROLLING FURTHER SPREAD**

### **Minimum Period of Isolation of Patient**

Through the 4<sup>th</sup> day after the onset of rash (counting the day of rash onset as day zero).

### **Minimum Period of Quarantine of Contacts**

Contacts born in or after 1957 (persons born before 1957 have presumed immunity), who are not appropriately immunized and do not have serologic evidence of immunity, will be quarantined from the 5 days after their earliest exposure through 21 days after their last exposure.

### **A. Isolate case to prevent further exposures**

Isolate the case through the 4<sup>th</sup> day after the onset of rash (counting the day of rash onset as day zero).

### **B. Identify all persons exposed to the case during his/her infectious period**

Consider the following:

- Household members
- School/child care contacts (students and staff)
- Staff and patients at the medical facility where patient was seen (including staff with and without direct patient contact)
- Individuals at workplace of case (especially child care centers, schools, and medical settings)
- Members of the same religious/social groups
- Members of sports teams, or other extracurricular groups
- Bus or carpool associates
- Close friends
- Persons potentially exposed at social events, travel sites, etc.

*Note:* Measles is so contagious that sometimes everyone at an *entire* institution is considered exposed.

### C. Determine whether exposed persons are immune

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

- written documentation of adequate vaccination— receipt of one or more doses of a measles-containing vaccine administered on or after the first birthday for preschool-age children and adults not at high risk, and two doses of measles-containing vaccine for school-age children and adults at high risk for exposure transmission (i.e., healthcare personnel, international travelers, and students at post-high school educational institutions); or
- laboratory evidence of immunity; or
- birth before 1957\*\*; or
- laboratory confirmation of disease.

Persons who do not meet the above criteria are considered susceptible and should be vaccinated unless contraindicated.

Note:

- Foreign-born individuals must have documentation of immunization or serologic proof of immunity. "Born before 1957" is not acceptable (see below for explanation).\*
- Non-immune persons include those with medical and religious exemptions to immunization.

**\*Year of Birth as Proof of Immunity**—Epidemiologic data indicate that most individuals born in the United States before January 1, 1957 are immune to measles. This has not been found to apply to those born in other countries, where the epidemiology of measles is not well known and where measles immunization may not have been routine.

**\*\*Exceptions to the "1957 Rule"**

The majority of persons born before 1957 are likely to have been infected naturally and may be presumed immune, depending on current state or local requirements. For unvaccinated personnel born before 1957 who lack laboratory evidence of measles immunity or laboratory confirmation of disease, healthcare facilities should consider vaccinating personnel with 2 doses of MMR vaccine at the appropriate interval. For unvaccinated personnel born before 1957 who lack laboratory evidence of measles immunity or laboratory confirmation of disease, healthcare facilities should recommend 2 doses of MMR vaccine during an outbreak of measles.

**Immunize or administer immune globulin to all non-immune exposed persons in accordance with the protocol below.** Presumptive evidence of measles immunity should be assessed for all identified contacts.

The MMR vaccine, if administered within 72 hours of initial measles exposure, and immunoglobulin (IG), if administered within six days of exposure, may provide some protection or modify the clinical course of disease among susceptible persons.

However, vaccination should be offered at any interval following exposure in order to offer protection from future exposures.

There is limited data regarding the effectiveness of MMR vaccine and IG PEP against disease prevention. Thus, individuals who receive MMR vaccine or IG as PEP should be monitored for signs and symptoms consistent with measles for at least one incubation period. IG may prolong the incubation period so extending the monitoring period for individuals who received IG as PEP may be considered (see Prevention and control strategies in medical settings).

Infectious or potentially infectious persons requiring medical attention (e.g., a susceptible contact in quarantine who develops measles-like symptoms), should be advised to call ahead before visiting a clinic or emergency department to ensure appropriate precautions are in place prior to the medical encounter.

Except in healthcare settings, unvaccinated persons who receive their first dose of MMR vaccine within 72 hours post exposure may return to child care, school, or work.

Individuals who are at risk for severe disease and complications from measles (e.g., infants <12 months of age, pregnant women without evidence of measles immunity, and severely immunocompromised persons regardless of vaccination status because they might not be protected by the vaccine) should receive IG.

IG administered intramuscularly (IGIM) is recommended for infants <12 months of age, and IG administered intravenously (IGIV) for severely immunocompromised persons and pregnant women who are exposed to measles. For infants 6 through 11 months of age, MMR vaccine can be given in place of IG, if administered within 72 hours of exposure. IGIM can be given to other persons who do not have evidence of measles immunity, but priority should be given to persons exposed in settings with intense, prolonged, close contact (e.g., household, daycare, classroom). However, postexposure use of IGIM might be limited because of volume limitations; persons who weigh >30 kg will receive less than the recommended dose and will have lower titers than recommended. For exposed persons without evidence of measles immunity, a rapid IgG antibody test can be used to inform immune status, provided that administration of IG is not delayed.

After receipt of IG, individuals cannot return to healthcare settings. In other settings such as childcare, school, or work, factors such as immune status, intense or prolonged contact, and presence of populations at risk, should be taken into consideration before allowing these individuals to return. These factors may decrease the effectiveness of IG or increase the risk of disease and complications depending on the setting to which they are returning.

The recommended dose of IG given intramuscularly is 0.5 mL/kg of body weight (maximum dose = 15 mL) and the recommended dose of IG given intravenously is 400 mg/kg.

Note that children vaccinated before their first birthday should be revaccinated when they are 12–15 months old and again when they are 4–6 years of age. Also, any non-immune person exposed to measles who received IG should subsequently receive MMR vaccine, which should be administered no earlier than 6 months after IGIM administration or 8 months after IGIV administration, provided the person is then ≥12 months of age and the vaccine is not otherwise contraindicated.

If many cases are occurring among infants <12 months of age, measles vaccination of infants as young as six months of age may be undertaken as an outbreak control measure. IG should not be used to control measles outbreaks, but rather to reduce the risk for infection and complications in the person receiving it.

### **Quarantine non-immune exposed persons**

Quarantine must begin 5 days after the *earliest* exposure and extend through 21 days from the *latest* exposure. They may return to normal activities on the 22<sup>nd</sup> day.

## **D. Managing Special Situations**

### **1. School Settings**

Identify students and staff with medical or religious exemptions anywhere in the school. These individuals must be quarantined until 21 days after the last case of measles was in the school during their infectious period.

Students and staff who received one dose of MMR and are exposed to a confirmed measles case should receive a second dose of MMR as soon as possible. Student and staff exclusions will be determined on a case by case basis in consultation with IDPH.

## 2. Healthcare Settings

Persons who work in healthcare settings (including volunteers, trainees, nurses, physicians, technicians, receptionists, and other clerical and support staff) are at increased risk of exposure to measles and at increased risk of transmission to persons at high risk of severe measles. All persons who work in such settings and have the potential for exposure to potentially infectious patients or materials (e.g., contaminated air) should have presumptive evidence of immunity to measles to prevent any potential outbreak.

Presumptive evidence of immunity to measles for healthcare personnel includes any of the following.

- Written documentation of vaccination with 2 doses of live measles or MMR vaccine administered at least 28 days apart,
- Laboratory evidence of immunity (measles IgG in the serum; equivocal results will be considered negative),
- Laboratory confirmation of disease, or
- Birth before 1957\*.

\*Although birth before 1957 is considered as presumptive evidence of immunity, for unvaccinated HCP born before 1957 that lack laboratory evidence of measles immunity or laboratory confirmation of disease, healthcare facilities should consider vaccinating personnel with two doses of MMR vaccine at the appropriate interval.

If a measles case or an outbreak occurs within or in the areas served by a hospital, clinic, or other medical or nursing facility, all personnel regardless of birth year, should receive two doses of MMR vaccine, unless they have other documentation of measles immunity. Birth year before 1957 is not acceptable presumptive evidence of immunity during an outbreak. Healthcare facilities should provide MMR vaccine to all personnel without presumptive evidence of measles immunity at no charge. Recently vaccinated HCP (i.e., prior to exposure or the outbreak) do not require any restriction in their work activities. Those with documentations of 1 vaccine dose may remain at work and should receive the second dose. Because of the possibility, albeit low, of measles vaccine failure in HCP, all staff entering the room of a person with suspect or confirmed measles should use respiratory protection consistent with airborne infection control precautions (i.e., use of an N95 respirator), regardless of presumptive immunity status.

**Initial management of patients with febrile rash illness**—Assess and screen all patients with febrile rash illness. If measles is suspected the following steps should be performed:

- Escort patients to a separate waiting area or place immediately in an exam room or negative pressure room, if available.
- If the patient exposed public areas, including the waiting room, those areas should be closed off for 2 hours after the patient left that area.
- Both patients and staff should wear appropriate masks/respirators (masks for patients to prevent generation of particles, and respirators for staff, if possible, to filter airborne particles).
- If not admitted, maintain airborne precautions. Upon exiting, the patient should be masked and escorted out through a non-public exit. Patients should be instructed to remain in isolation at home, through 4 days after rash onset (with onset of rash being day zero) or until cleared by IDPH after measles is ruled out via laboratory testing.

- 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 which has been occupied by a suspect case for 2 hours following the case's exit from that room.

**a. Infectious period**

- **Cases** 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 patients** may have prolonged excretion of viral particles in their secretions and should be **considered infectious for the duration of their illness.**

**b. Exclusion/isolation of cases**

- **Personnel** who develop symptoms consistent with measles should be excluded from work and immediately tested. Contact public health to coordinate testing.
- If **admitted, patients** should be on airborne precautions while infectious (through 4 days after rash onset) in a negative pressure room.
- If **not admitted, patients** should be masked and escorted from the facility through a non-public exit, instructed to go straight home, and remain in isolation at home through 4 days after rash onset. They may return to normal activities on the 5<sup>th</sup> day.

**c. Exclusion/isolation of contacts**

- **Susceptible staff** contacts should be excluded from the 5<sup>th</sup> day after the earliest exposure through the 21<sup>st</sup> day after the last exposure to the case during his/her potential infectious period (as defined above). They may return on the 22<sup>nd</sup> day.
- **Susceptible hospitalized patient contacts** should be placed in airborne infection isolation, includes negative pressure room, 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). They may be taken off isolation on the 22<sup>nd</sup> day.

The above recommendations are summarized in the table below, "Measles Control in Medical Settings."

**Iowa Department of Public Health  
Measles Control in Medical Settings**

This table summarizes additional control measures to decrease nosocomial measles transmission.

1. Assess and screen all patients with rash illness or with other potential airborne diseases, prior to arrival at intake area, i.e. outside.
2. Escort suspect measles patients to a negative pressure (if possible) room.
3. Both patients and staff should wear appropriate masks/respirators (masks for patients to prevent generation of particles, and respirators for staff, if possible, to filter airborne particles).
4. If admitted: maintain on airborne precautions (in addition to standard precautions) while infectious in a negative pressure room. (Patients are considered infectious for 4 days before through 4 days after rash onset, counting the day of rash onset as day zero.)
5. If not admitted: maintain respiratory isolation, including while patient is exiting the facility, (*e.g.*, mask, separate exit). Ideally the patient would be assessed outside of the healthcare facility. Patient should remain in isolation at home through 4 days after rash onset, counting the day of rash onset as day zero. The patient may resume normal activities on the 5<sup>th</sup> day. The patient may be removed from isolation earlier by IDPH if measles is ruled out via laboratory testing.



6. Avoid placing non-immune persons in a room which has been occupied by a suspect case for 2 hours following the case's exit.
7. Identify all exposed individuals among patients and staff:
  - This includes patients and families in the waiting and examination rooms up to 2 hours after index case was present;
  - Includes all staff both with and without direct patient contact;
  - Due to airborne route of transmission, those exposed often include everyone at the entire facility.
8. Identify non-immune persons (particularly high-risk non-immune persons) and offer:
  - MMR as soon as possible but within 72 hours of exposure (will most likely prevent illness if given in this window), or
  - For high-risk non-immune persons and those ineligible for vaccination, IG as soon as possible but within  $\leq 6$  days after exposure (may modify or prevent illness, but the recipient can still be considered infectious)
9. Notify infection prevention, employee health, department heads and the healthcare providers of exposed patients.
10. Exclusion of non-immune persons:
  - All staff born in or after 1957, who have not received a second dose of measles vaccine  $\leq 72$  hours post exposure, must be **excluded from 5 days after their earliest exposure through 21 days after their last exposure to the case during his/her potential infectious period.**
  - All staff born before 1957 that have not received 1 dose of MMR  $\leq 72$  hours post exposure must be excluded 5 through 21 days post exposure.
  - Staff who contract measles should be excluded for 4 days after their first day of rash onset.
  - In special high-risk healthcare settings such as transplant, oncology, neonatal units, etc., exclusion criteria should be even more rigorous. Infection prevention personnel may wish to exclude all susceptible personnel even if they have been immunized within 72 hours.

#### d. Personal Preventive Measures/Education

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. It is particularly important to vaccinate susceptible household contacts of high-risk non-immune persons who cannot themselves be vaccinated, such as immunocompromised individuals, pregnant women, and infants.

Please refer to the most current versions of the Advisory Committee on Immunization Practices (ACIP) statement on measles, rubella, and mumps.

## 4) ADDITIONAL INFORMATION

The Council of State and Territorial Epidemiologists (CSTE) surveillance case definitions for Measles can be found at: [www.cdc.gov/osels/ph\\_surveillance/nndss/phs/infdis.htm#top](http://www.cdc.gov/osels/ph_surveillance/nndss/phs/infdis.htm#top)

CSTE case definitions should not affect the investigation or reporting of a case that fulfills the criteria in this chapter. (CSTE case definitions are used by the state health department and the CDC to maintain uniform standards for national reporting.)

## References

1. Pinkbook | Measles | Epidemiology of Vaccine Preventable Diseases | CDC. (2018, May 16). Retrieved April 17, 2019, from <https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html>

2. Surveillance Manual | Measles | Vaccine Preventable Diseases | CDC. (2018, March). Retrieved April 17, 2019, from <https://www.cdc.gov/vaccines/pubs/surv-manual/chpt07-measles.html>
3. Heymann, D.L., ed. *Control of Communicable Diseases Manual, 20<sup>th</sup> Edition*. Washington, DC, American Public Health Association, 2015.