

# Measles

## 1. DISEASE REPORTING

### 1.1 Purpose of Reporting and Surveillance

1. To identify measles cases.
2. To prevent the spread of measles.
3. To identify groups of unimmunized children and adults.

### 1.2 Laboratory and Physician Reporting Requirements

Physicians are required to report all cases (including suspected cases) within 24 hours. Labs are required to report all measles IgM antibody-positive test results within one working day.

### 1.3 Local Health Department Reporting and Follow-Up Responsibilities

1. Report all confirmed and presumptive cases (see definitions below) to the Immunization Program by telephone or fax within 24 hours of initial report. Send the Measles Case Investigation Form to the Communicable Disease section by the end of the calendar week.
2. Begin follow-up investigation within 24 hours. Use the Measles Case Investigation Form. Send a copy of the completed form to the Communicable Disease section within 7 days of initial report.
3. Initiate special control measures within 24 hours of initial report (see §5, Controlling Further Spread).
  - a. Identify contacts of the case during the period of communicability.
  - b. Alert physicians, hospital emergency rooms, and other sites visited by the case during the period of communicability.
  - c. Alert physicians, hospital emergency rooms, student infirmaries, and local officials of the potential for additional cases; encourage them to consider measles in persons with a rash illness. This includes making special arrangements for patient flow to minimize contact between cases and susceptibles. Health care workers should be advised to immediately report any suspected case.
  - d. Set up special clinics as needed to immunize susceptible persons at risk of infection.
  - e. If indicated, prepare and distribute a press release in conjunction with the Immunization Program staff.
  - f. Identify and exclude susceptibles when measles has been identified in a school or day care facility (see §§5 and 6).

## 2. EPIDEMIOLOGY

### 2.1. Etiologic Agent

The measles virus—a single-stranded, RNA-encoded paramyxovirus.

### 2.2 Description of Illness

Measles is characterized by a generalized maculopapular rash, fever, and one or more of the following: cough, coryza, conjunctivitis, or Koplik's spots. There are three stages of illness.

#### 1. Prodrome

Measles has a distinct prodromal stage that begins with a mild to moderate fever and malaise. Usually within 24 hours there is an onset of conjunctivitis, photophobia, coryza (sneezing, nasal congestion, and nasal discharge), an increasingly severe cough, swollen lymph nodes (occipital, postauricular and cervical at the angle of the jaw), and Koplik's spots (seen only for a day or two before and after onset of rash). These

## Measles

spots are seen as bluish-white specks on a rose-red background appearing on the buccal and labial mucosa usually opposite the molars.

### 2. Rash

The rash begins with flat, faint eruptions of upper lateral parts of the neck, behind the ears, along the hairline and on the posterior parts of the cheeks. The rash may appear from 1–7 days after the onset of the prodromal symptoms, but usually appears within 3–4 days. Individual lesions become more raised as the rash rapidly spreads over the entire face, neck, upper arms and chest. In severe cases, the lesions may become confluent. In mild cases, the rash may be macular and more nearly pinpoint, resembling that of scarlet fever.

### 3. Fever

Fever is mild to moderate early in the prodrome, and goes up when the rash appears. Temperatures may exceed 40°C (104°F), and usually fall 2–3 days after rash onset. High fever persisting beyond the third day of the rash suggests that a complication (e.g., otitis media) may have occurred.

#### 2.3 Reservoirs

Other acutely infected humans.

#### 2.4 Modes of Transmission

Virus is spread directly from person to person by inhalation of suspended droplet nuclei or by contact with infective nasopharyngeal secretions. It can also be transmitted indirectly by objects (fomites) contaminated with nasopharyngeal secretions. Measles virus is labile. Half the infectivity is lost every 2 hr at 37 C. So it depends on the initial number of viral particles in the droplet. It does not survive drying on a surface, so it has a short survival time on contaminated fomites. It is effectively spread as an aerosol. The virus survives drying in microdroplets in the air relatively well, as opposed to drying on a flat surface. Measles is one of the most contagious of all infectious diseases, with >90% attack rates among susceptible close contacts.

#### 2.5 Incubation Period

The incubation period ranges from 7–18 days (average 10–12 days) from exposure to the onset of prodromal symptoms. The interval from exposure to rash onset is usually 14 days (range 10–18 days). The administration of IG later than the third day of the incubation period may extend the incubation period to 21 days.

#### 2.6 Period of Communicability

Measles is most communicable during the 3–4 days preceding rash onset. Persons with measles have been shown to shed virus between 4–5 days prior to rash onset (1–2 days prior to onset of prodromal symptoms) and for 4 days after the rash has appeared.

#### 2.7 Treatment

No specific treatment.

## 3. CASE DEFINITIONS, DIAGNOSIS, AND LABORATORY SERVICES

### 3.1 Confirmed Case Definition

Absent measles immunization or receipt of antibody-containing blood products within the previous 45 days:

- Positive “confirmatory” lab results (measles virus isolation, detection of virus by PCR, or >4-fold rise in antibody titer), or
- Positive IgM serology with compatible illness, defined as:
  - acute onset generalized maculopapular rash lasting  $\geq 3$  days and
  - temperature  $\geq 38.3^\circ\text{C}$  (101°F) and
  - cough, coryza, or conjunctivitis

## Measles

### 3.2 Presumptive Case Definition

A person who is epi-linked to a confirmed case and who has all of the following:

1. acute onset generalized maculopapular rash lasting  $\geq 3$  days and
2. temperature  $\geq 38.3^{\circ}\text{C}$  ( $101^{\circ}\text{F}$ ) and
3. cough, coryza, or conjunctivitis

### 3.3 Suspected (Clinical Diagnosis)

Any person with a generalized rash and fever of unknown etiology.

### 3.4 Services Available (or not) at the Oregon State Public Health Laboratory

Currently OSPHL performs no test for measles, but both IgM and IgG antibodies are available commercially.

For test results to be reliably positive or negative, blood for IgM testing should be drawn no sooner than three days after rash onset, but can be done earlier if it is uncertain whether the patient will return (or be returned) for testing. However, in the first 72 hours after rash onset, up to 30% of tests for IgM may give false negative results. Patients with negative IgM results from blood drawn sooner than three days after rash onset will need to be retested, but not patients with positive IgM results. IgM is detectable for at least 28 days after rash onset and frequently longer. False positive IgM results for measles may be due to the presence of rheumatoid factor in serum specimens. Serum specimens from patients with other rash illness, such as parvovirus B19, rubella, and roseola have been observed to result in false positive reactions in some IgM tests for measles. In these situations, confirmatory tests may be done at CDC. Because tests for IgG require two specimens and because a confirmed diagnosis can not be made until the second specimen is obtained, IgM tests are generally preferred. However, if the IgM tests remain inconclusive, a second (convalescent) serum specimen, collected 14-30 days after the first (acute) specimen, can be used to test for an increase in the IgG titer.

Specimens (urine or throat swabs) for virus culture obtained from clinically suspected cases of measles should be shipped to the OSPHL and then to CDC as soon as measles is confirmed. Clinical specimens for virus isolation should be collected at the same time as samples taken for serologic testing. Specimens should be properly collected and stored while waiting for case confirmation; see the guidelines available at [www.cdc.gov/ncidod/dvrd/revb/measles/viral\\_isolation.htm](http://www.cdc.gov/ncidod/dvrd/revb/measles/viral_isolation.htm).

## 4. ROUTINE INVESTIGATION

### 4.1 Identify the Source of Infection

Identify people who may have been exposed to the case during the 7–18 days prior to onset of fever (especially the 3-day window that is 13-15 days before rash onset). Ask about:

1. names, addresses and phone numbers of any householder, playmate, or other contact who was sick or had a rash;
2. any indoor group activities attended, such as churches, theaters, tourist locations, air travel, parties, athletic events, family gatherings, and the like;
3. any visit to a doctor's office, clinic, or hospital (find out exact time and date);
4. any health care employment;
5. attendance or work at a school, day care, college, prison, etc.;
6. any travel outside of Oregon; and
7. any visitors from outside the U.S.

### 4.2 Identify Potentially Exposed Persons (Contacts)

Identify persons who may have been exposed to the case during the period from 4 days before through 4 days after onset of rash.

Measles is spread by the airborne route and is potentially transmissible after only brief exposure and at distances as great as 30 meters. The virus can remain airborne for up to 2 hours. That said, the fact is that transmission of measles in the United States is now the exception, rather than the rule, because of high levels of vaccine-induced immunity in the population. Therefore, an attempt to identify and interview

## Measles

every person who was within 30 meters of a case at any time during the case's 8-day period of potential contagion could represent an enormous amount of work for minimal public-health benefit.

There is no accepted, data-based definition of measles "exposure" that demands public-health follow-up. For practical reasons during a case investigation, some lines must nonetheless be drawn. In typical circumstances, "exposure" may be defined as

- any period of time spent indoors
- within 10 meters of a case's location
- within 20 minutes of the case's having been there.

These are operational guidelines only, and a more aggressive definition may be called for in some circumstances — e.g., a case who is coughing vigorously, a case in an under immunized population or in a school with high exemption rates. Conversely, cases are less contagious after the rash breaks out — which is when most of them seek medical attention — lessening the risk of transmission in health care settings.

Of those exposed, determine which have no evidence of immunity (as in §4.C) and implement appropriate prevention measures (§5.D).

### 4.3 Determine Measles Immune Status of Exposed Contacts

Acceptable evidence of immunity is as follows.

1. Born before 1957 (except for health care workers who should consider at least 1 measles-containing dose)
2. Healthcare provider-diagnosed measles
3. Laboratory evidence of immunity to measles
4. Documentation of adequate vaccination, as follows.
  - a. Pre-school children: **1** MMR given after 12 months of age.
  - b. K - 12 and adults at high risk (i.e., post-high school educational and college students, healthcare personnel, and international travelers): **2** MMR, with the first given after 12 months of age and with a minimum of 28 days between the first and second dose.
  - c. All other adults born during or after 1957: **1** MMR

### 4.4 Environmental Evaluation

None.

## 5. CONTROLLING FURTHER SPREAD

### 5.1 General Comments

In Oregon, two doses of measles vaccination have been required since 1998. In 2006, >96% of school-age children had received two doses of measles-containing vaccine. Such high vaccination rates have interrupted the endemic transmission of measles in the United States. Despite repeated introduction of measles into Oregon, we have seen no more than 14 cases in any given year since 1991. As long as vaccination rates remain high, aggressive measures are not needed to control measles.

### 5.2 Education

Advise cases to avoid contact with susceptible children (particularly infants), pregnant women, and immunosuppressed individuals for 4 days after the rash appears. Instruct contacts or parents to look for the symptoms and signs of measles beginning 8 days after the first day of contact with a person during the period of communicability. If suggestive symptoms develop, they must call the local health department ASAP. It is important to avoid exposing people who may coincidentally be present at a health care facility or doctor's office. Persons with possible measles should call ahead first to alert staff at such facilities so that special arrangements can be made to prevent contact with other patients or employees, pending an evaluation.

### 5.3 Isolation of cases

1. Keep hospitalized patients under airborne precautions for 4 days after rash onset.

## Measles

- Exclude cases with confirmed and presumptive measles from day care, school or work as long as they could be contagious (ORS 433.106; OAR 333 019 0010). Advise cases to stay home and avoid contact with others.

### Suggested intervals between administration of antibody-containing products for different indications and measles-containing vaccine and varicella-containing vaccine\*

Product/indication	Dose, including mg immunoglobulin G (IgG)/kg body weight*	Recommended interval before measles or varicella-containing vaccine administration (months)
Respiratory syncytial virus immune globulin (IG) monoclonal antibody (Synagis™)†	15 mg/kg intramuscularly (IM)	None
Tetanus IG	250 units (10 mg IgG/kg) IM	3
Hepatitis A IG		
Contact prophylaxis	0.02 mL/kg (3.3 mg IgG/kg) IM	3
International travel	0.06 mL/kg (10 mg IgG/kg) IM	3
Hepatitis B IG	0.06 mL/kg (10 mg IgG/kg) IM	3
Rabies IG	20 IU/kg (22 mg IgG/kg) IM	4
Measles prophylaxis IG		
Standard (i.e., nonimmunocompromised) contact	0.25 mL/kg (40 mg IgG/kg) IM	5
Immunocompromised contact	0.50 mL/kg (80 mg IgG/kg) IM	6
Blood transfusion		
Red blood cells (RBCs), washed	10 mL/kg negligible IgG/kg intravenously (IV)	None
RBCs, adenine-saline added	10 mL/kg (10 mg IgG/kg) IV	3
Packed RBCs (hematocrit 65%)§	10 mL/kg (60 mg IgG/kg) IV	6
Whole blood (hematocrit 35%–50%)§	10 mL/kg (80–100 mg IgG/kg) IV	6
Plasma/platelet products	10 mL/kg (160 mg IgG/kg) IV	7
Cytomegalovirus intravenous immune globulin (IGIV)	150 mg/kg maximum	6
IGIV		
Replacement therapy for immune deficiencies¶	300–400 mg/kg IV¶	8
Immune thrombocytopenic purpura	400 mg/kg IV	8
Postexposure varicella prophylaxis**	400 mg/kg IV	8
Immune thrombocytopenic purpura	1000 mg/kg IV	10
Kawasaki disease	2 g/kg IV	11

\* This table is not intended for determining the correct indications and dosages for using antibody-containing products. Unvaccinated persons might not be fully protected against measles during the entire recommended interval, and additional doses of immune globulin or measles vaccine might be indicated after measles exposure. Concentrations of measles antibody in an immune globulin preparation can vary by manufacturer's lot. Rates of antibody clearance after receipt of an immune globulin preparation also might vary. Recommended intervals are extrapolated from an estimated half-life of 30 days for passively acquired antibody and an observed interference with the immune response to measles vaccine for 5 months after a dose of 80 mg IgG/kg.

† Contains antibody only to respiratory syncytial virus

§ Assumes a serum IgG concentration of 16 mg/mL.

¶ Measles and varicella vaccinations are recommended for children with asymptomatic or mildly symptomatic human immunodeficiency virus (HIV) infection but are contraindicated for persons with severe immunosuppression from HIV or any other immunosuppressive disorder.

\*\* The investigational product VariZIG, similar to licensed VZIG, is a purified human immune globulin preparation made from plasma containing high levels of anti-varicella antibodies (immunoglobulin class G [IgG]). When indicated, health-care providers should make every effort to obtain and administer VariZIG.

Source: ACIP Recommendations: MMWR 2006;55-RR15.

## 5.4 Protection of Contacts

### 1. Active Immunization with Measles Vaccine

Vaccinating susceptible contacts within 72 hours of exposure may prevent disease. Because disease prevention is uncertain, however, school and work restrictions (see §6 below) still apply. Contraindications include: pregnancy; anaphylactic allergy to neomycin or gelatin; untreated active TB; or compromised immunity (including HIV infection). Immune globulin may interfere with the desired response to measles vaccine if given less than 3 months before or 2 weeks after the measles vaccine. Any measles immunization given in that window should be repeated at least 3 months after the IG was given (see table 4 above). If repeating the vaccine is not practical, serologic testing to determine if antibodies were produced is indicated.

### 2. Passive Immunization with Immune Globulin

IG can prevent or attenuate infection with measles, and should be considered for susceptible persons at increased risk of severe infection (e.g. pregnant women and children <1 year old) and those for whom vaccine is contraindicated. Patients should be warned that IG may only modify measles infection and may increase the incubation period to 21 days. IG should never be used as an outbreak control measure. To be effective, IG (0.25 ml/kg [0.5 ml/kg for immunocompromised persons]; maximum dose 15 ml) must be

## Measles

administered ASAP but not more than 6 days after exposure.

### 3. Follow-up for Contacts

Susceptible contacts who received high-dose IG for measles prophylaxis should be immunized against measles 5 or 6 months after IG was given (see table for details) if the vaccine is no longer contraindicated.

### 5.5 Quarantine

Quarantine is not generally indicated to control measles outbreaks. Susceptible persons who have been exposed to measles should be advised to stay home during days 5–21 after exposure. Under special circumstances, such as during outbreaks in schools attended by large numbers of persons who refuse vaccination, restriction of an event or other quarantine measures might be warranted.

## 6. MANAGING SPECIAL SITUATIONS

### 6.1 Case Among Employees or Attendees at School/Day Care Facility

1. Maintain daily active surveillance of school or day care contacts for prodromal signs and symptoms or rash illnesses compatible with measles for 21 days from the last date of attendance of any measles case.
2. Encourage those with suspected infections to stay home while symptomatic so as not to expose susceptibles. To prevent nosocomial transmission, parents should tell their children's health care providers about the possibility of measles prior to arriving at the doctor's office.
3. Exclude all unimmunized children and staff without evidence of natural immunity (including susceptible siblings of a case attending other schools). Those susceptible students attending school at the time the case was communicable should be excluded for at least 21 days after the last date of attendance of the last measles case. Once vaccinated, these persons can be readmitted.

### 6.2 Case in a Medical Setting

Control efforts in medical settings should focus on reviewing existing immunization policies, employee immunization records and patient isolation practices.

Health care workers (volunteers, trainees, nurses, physicians, technicians, receptionists and other clinical support staff) should be immunized before exposure, ideally as a condition of employment. Documentation of immunity should be easily and readily available.

If a case with measles in any stage of communicability was treated at health care facility, identify potentially exposed health care workers (see §4.B above) and assess their documented immune status to confirm that they are immune. As harsh as this is, susceptible personnel who have been exposed to measles should be relieved from patient contact and excluded from the facility from the 5th to the 21st day after exposure, regardless of whether they have received vaccine or immune globulin after the exposure. Personnel who become ill should be relieved from all patient contact and excluded from the facility for 7 days after they develop rash. This means physicians, too. The desirability of a priori immunity is obvious. Exposed patients should likewise have their immune status assessed and be given vaccine if they are not immune; school and work restrictions of exposed contacts apply.

### 6.3 Case on an Aircraft

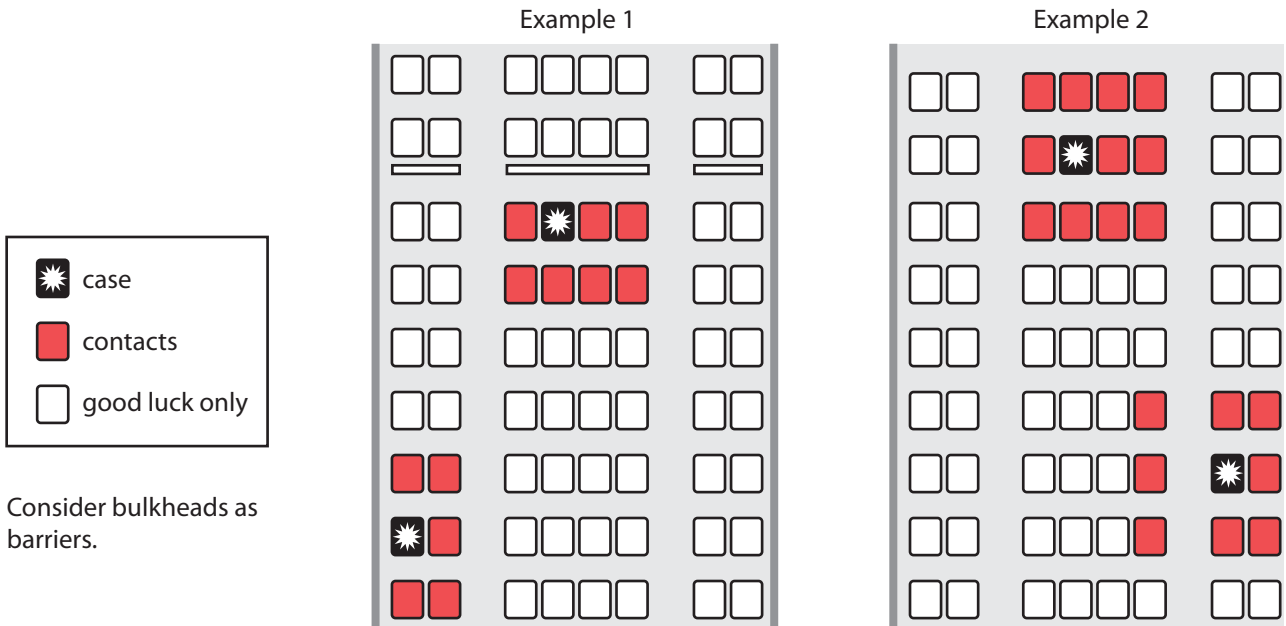
Although measles transmission has been documented during air travel, it is rare.

Accordingly, an admittedly arbitrary definition has been devised to cover who may have been sufficiently exposed to warrant notification. The figures show 4 examples on a hypothetically configured jumbo jet. Unfortunately, not all planes are configured this way, and sometimes we are not given the seat assignment information for a given event. So this is only a general indication of what we would likely recommend; this is not an exact science.

Passengers who are contacted should be informed of their exposure, queried about their age and immune status, and offered post-exposure immunoprophylaxis with vaccine or IG as appropriate. A second dose of measles vaccine is recommended for people who travel internationally and were born in 1957 or later (absent a history of measles infection).

# Measles

## Potential Exposures on Airplanes



### UPDATE LOG

July 2006. The confirmed case definition was modified from "IgM antibody to measles virus" to "positive IgM serology to measles." Several people had misinterpreted the older language to mean that the presence of any IgM antibody was indicative of a confirmed case. Recommendations concerning follow-up to potential airborne exposures were revised to recommend a 2-hour cutoff (down from 4 hours). Longer periods are certainly possible, but the risk beyond 2 hours is apparently low enough that the juice isn't worth the squeeze. Not coincidentally this makes our recommendations more consistent with CDC's. (Juventila Liko)

October 2007. Case definitions revised to require symptoms. This is more in line with the national definition, and acknowledges the fact that with our incidence of disease being so low, IgM has a poor positive predictive value. (Juventila Liko)

April 2008. Revised 2D, 3D, 4B, 4C, 5A, 5D, 5E, 6B, 6C to reflect a concerted approach to the control of measles in Oregon based on high levels of measles vaccination in the community, national recommendations, and a focused attack on measles outbreak. (Paul Cieslak, Juventila Liko)