UTAH DEPARTMENT OF HEALTH

Report Immediately

Measles

Disease Plan

Quick Links

Last updated: July 25, 2019 by Bree Barbeau, MPH

Questions about this disease plan?

Contact the Utah Department of Health (UDOH) Bureau of Epidemiology: 801-538-6191.

✓ CRITICAL CLINICIAN INFORMATION

Clinical Evidence

Signs/Symptoms

- First 2-4 days of symptoms
  - Fever
  - Malaise
  - Cough
  - Coryza
  - Red, watery eyes
- 3-5 days after symptoms begin
  - Koplik spots, tiny white spots in mouth, may appear before and after rash
  - Erythematous, maculopapular and blanching rash, blanching appears first on the face and hairline and spreads downward to the neck, trunk, arms, legs and feet.
  - Small raised bumps may also appear on top of the flat red spots
  - Fever may spike up to 104°F when rash appears
  - Pharyngitis
- Other symptoms may include:
  - Anorexia
  - Photophobia
  - Diarrhea, especially in infants
  - Generalized lymphadenopathy

Period of Communicability

- 4 days before rash onset to 4 days after rash onset
- 90% of susceptible contacts will develop disease (highly contagious)

Incubation Period

- Range of 7-21 days from exposure to appearance of rash (average of 14 days)
- Average 8-12 days from exposure to onset of symptoms

Mode of Transmission

- Primarily through respiratory droplet via coughing, sneezing or direct contact with respiratory secretions
- Airborne transmission in closed settings up to two hours after contagious person has left

Laboratory Testing

Type of Lab Test/Timing of Specimen Collection

- Serology – tested for both IgM and IgG to rule out false positive IgM tests
  - Serum specimen for IgM should be collected as soon as possible after rash onset. If acute serum specimen is collected within 72 hours after rash onset and is negative, a convalescent serum specimen should be collected ≥72 hours after rash onset.
  - A serum specimen for IgG testing should be collected in conjunction with IgM serum specimen collection.
- RT-PCR and Genotyping – Both tests use the same specimen
  - Nasopharyngeal swab or throat swab collected 0-7 days after onset of rash

Type of Specimens

- Serum
- Nasopharyngeal swab OR throat swab

Treatment Recommendations

Type of Treatment

- Severe measles cases among children, such as those who are hospitalized, should be treated with vitamin A. Vitamin A should be administered immediately on diagnosis and repeated the next day. The recommended age-specific daily doses are:50,000 IU for infants younger than 6 months of age
- 100,000 IU for infants 6-11 months of age
- 200,000 IU for children 12 months of age and older

Case and Contact Management

Isolation of Case

- Cases should voluntarily isolate at home until 4 days after rash onset and be excluded from work, school, and other public settings during that time

Quarantine of Contacts

- All persons in close contact with an infected individual should have their immunization records audited for appropriate immunity. Those with appropriate immunity do not need to be quarantined. Refer to the Isolation and Quarantine Requirements section of this disease plan for additional information.
- If appropriate immunity is not met, the individual is considered “susceptible.” These susceptible individuals should be vaccinated within 72 hours of exposure. If the individual is at high risk for severe disease, IG may be given instead of vaccine within six days of exposure.
  - If not vaccinated within 72 hours or given IG within 6 days, individual should be placed in voluntary quarantine until 21 days after the date of last exposure to the measles case.
  - If immune globulin is administered to an exposed person, observations should continue for signs and symptoms of measles for 28 days after exposure since immune globulin may prolong the incubation period.
- Exclude healthcare personnel without evidence of immunity from duty from day 5 after first exposure to day 21 after last exposure, regardless of post-exposure prophylaxis.
- Except in healthcare settings, unvaccinated contacts who receive their first dose of MMR vaccine within 72 hours after exposure may return to childcare, school, or work.

Prophylaxis

- MMR vaccine should be given within 72 hours of exposure as post exposure prophylaxis for individuals without evidence of immunity.
  - Immune globulin (IG) should be given within six days of exposure as post exposure prophylaxis for patient groups that are at high risk for severe disease and complications. Refer to the Recommendations for Use of Immune Globulin for Post-exposure Prophylaxis section in the disease plan for additional information.

Healthcare workers: Healthcare workers who have been exposed to measles and have no evidence of immunity should be given MMR vaccine within 72 hours or IG within six days.

Infection Control Procedures

- Follow Standard and Airborne Precautions for patients with measles. Airborne Precautions should be in place for 4 days after rash onset. For immunocompromised patients, these precautions should be in place for the duration of the illness.
- Limited patient transportation
- Limit healthcare personnel providing care and ensure that they have evidence of immunity

✓ WHY IS MEASLES IMPORTANT TO PUBLIC HEALTH?

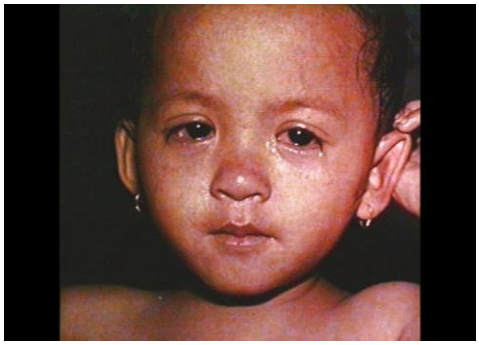
Measles is one of the most infectious of all diseases. It is a leading killer of unvaccinated children around the world. In the U.S., the disease was declared eliminated in 2000. However, sporadic outbreaks have occurred due to importation from other countries where measles is endemic. It is public health's responsibility to contain these outbreaks when they occur. To be successful, rapid diagnosis of measles cases must occur along with identification of contacts and implementation of other interventions. Paramount to the success of public health's efforts is a high immunization rate in the community. Community immunization rates correlate with the intensity of outbreaks. In a population with high immunity, there are less susceptible individuals to become infected with measles, and therefore the transmission of measles in disrupted. This was evident in the 2015 measles outbreak in Utah, when over 390 contacts were exposed to measles at 16 different events and only one secondary case of measles occurred. In 2017, an index case of measles resulted in over 500 contacts being potentially exposed to measles and only two secondary cases.

✓ DISEASE AND EPIDEMIOLOGY

Clinical Description

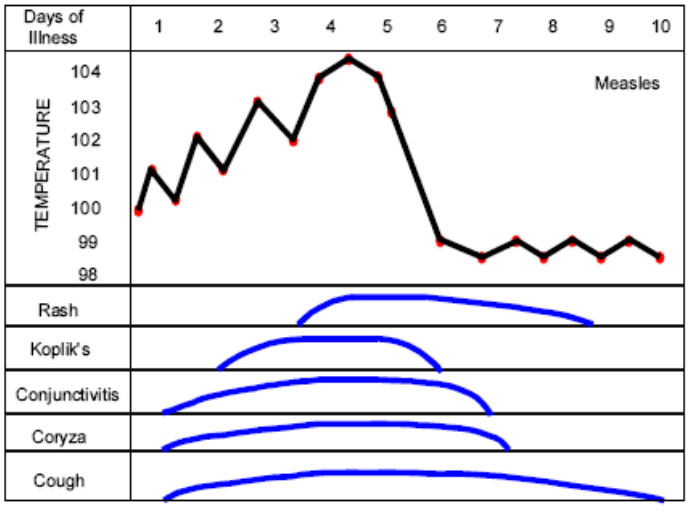
Measles is an acute viral illness characterized by a prodrome followed by a maculopapular rash which may become confluent. Incubation period is 7-21days (14 day median).

- The *prodrome* lasts 3-4 days (range 2-8 days). It is characterized by fever, often peaking as high as 103°-105°F, with malaise, cough, coryza, and conjunctivitis.[2]
- The *rash* is maculopapular and usually lasts 5-7 days. It begins on the face near the hairline, and over the next few days extends to the body and extremities. The lesions increase in size and may become confluent. Initially, lesions blanch with fingertip pressure. By day 3-4 of the rash, however, most do not blanch with pressure. The skin over the more severely affected areas may slough off. The rash fades first on the face and head, and then disappears from the body and extremities. The rash progression is characteristic of measles, but is not pathognomonic.



- *Koplik spots* are blue-white spots that generally develop on the mucosa of the mouth and are a characteristic sign of measles disease. Koplik spots may appear 1-2 days before the rash, to 1-2 days after the rash.
- Other symptoms associated with measles include anorexia, diarrhea (especially in infants), and generalized lymphadenopathy.

Time course of clinical events in measles infection



Source: Infectious Diseases of Children, 9th Edition, Figure 13-1, page 224, 1992. Editors Saul Krugman Samuel L. Katz, Anne A. Gershon, Catherine M. Wilfert. By permission of Mosby Year Book, St. Louis, Missouri

Persons with measles usually present with characteristic disease. However, two forms of measles infections that have abnormal presentations have been described, “Atypical” measles and “Modified” measles.

Atypical measles occurs only in persons who were vaccinated with inactivated measles vaccine and are subsequently exposed to wild-type measles virus. An estimated 600,000 to 900,000 persons received the inactivated measles vaccine in the U.S. from 1963 to 1967. The inactivated measles vaccine sensitized recipients to measles virus antigens without providing protection.

Atypical measles is characterized by fever, pneumonia, pleural effusions, and edema. The rash appears first on the wrists or ankles. It is usually maculopapular or petechial, but may have urticarial, purpuric, or vesicular components.

Individuals with atypical measles do not appear to effectively transmit disease. Atypical measles may be prevented by revaccinating with live measles vaccine. Moderate to severe local reactions, with or without fever, may follow vaccination; these reactions cause less severe illness than infection with wild measles virus.

Modified measles occurs primarily in persons who received immune globulin (IG) as post-exposure prophylaxis, individuals with history of disease, vaccinated individuals with an incomplete antibody response, and young infants who have some residual maternal antibody. It is characterized by a prolonged incubation period (17-21 days), mild prodrome and sparse, discrete rash of short duration. Similar mild illness has been reported among previously vaccinated persons.

Complications

Diarrhea, otitis media (ear infection), and pneumonia (viral or bacterial) are the most common complications. Subacute sclerosing panencephalitis (SSPE) is a very rare degenerative central nervous system disease believed to be due to persistent measles virus infection of the brain. Generally, SSPE appears around seven years after measles infection. Symptoms include progressive deterioration of behavior and intellect, followed by ataxia (loss of the ability to coordinate muscular movement), seizures, and eventually death. Hemorrhagic measles, which rarely occurs in the U.S., is characterized by high fever (105°-106°F), seizures, delirium, respiratory distress, and hemorrhage into the skin and mucous membranes. Encephalitis, seizures, and death can also occur, although rarely. Pneumonia is the most common cause of death in measles cases.

Complications are seen in roughly 30% of all measles cases, and generally occur more frequently in children <5 years of age and adults >20 years of age. Those at an increased risk of complications are the very young and very old, immunocompromised, vitamin A deficient or poor nutrition status, and pregnant women. Measles illness during pregnancy results in a higher risk of premature labor, spontaneous abortion (particularly in the first trimester), and low-birth weight of infants.

Causative Agent

Measles is caused by a single-stranded RNA paramyxovirus of the genus *Morbillivirus*.

Differential Diagnosis

The differential diagnosis includes, but is not limited to: the common cold, parvovirus, respiratory syncytial virus (RSV), influenza, rubella, fifth disease, enterovirus or adenovirus infection, mononucleosis, scarlet fever, roseola, Kawasaki disease, Rocky Mountain spotted fever, and drug reaction.

Laboratory Identification

Because of the rarity of measles in the U.S. and the fact that most clinicians have never seen a case, laboratory diagnosis is essential. However, laboratory testing alone should not be used to rule out measles. Only highly suspect cases that are clinically compatible should be recommended for testing. IgM and IgG serology, RT-PCR, and genotyping should *all* be performed for highly suspect cases.

Serology

All serum samples should be tested for both IgM and IgG to assist in identifying false positive IgM tests.

Availability

- The first option for all serology testing should be through the patient's physician and using a commercial laboratory. All commercial laboratories can arrange to have this testing performed.
- Utah Public Health Laboratory (UPHL) does not perform any serology testing for measles.

Limitations

- There are two methods for serological testing: direct capture and indirect capture. Many commercially available tests are indirect capture tests. Indirect capture requires that serum samples be processed prior to testing to remove IgG and rheumatoid factor. Incomplete removal or problems with processing the sample can lead to false positive results. The direct capture method, used by CDC, measures IgM directly from the serum sample, without any sample processing needed. Direct capture tests are considered confirmatory.
- In all measles serology tests, indirect and direct, rheumatoid factor and parvovirus, rubella, or roseola infections can cause false positive measles IgM because of cross-reactivity.

Specimen collection

- Serum specimen for IgM should be collected as soon as possible after rash onset. If acute serum specimen is collected within 72 hours after rash onset and is negative, a convalescent serum specimen should be collected ≥72 hours after rash onset.
- A serum specimen for IgG testing should be collected in conjunction with IgM serum specimen collection.

Interpretation

- Test interpretation should be supplemented by a good description of the clinical course of illness in the suspected case.
- Recent immunization and cross-reacting disease states should be considered during interpretation.
- Laboratories may use different methodologies with different ranges to differentiate positive and negative tests. Ensure that the reference range for the particular methodology is provided with each result to correctly classify cases.

RT-PCR and Genotyping

RT-PCR and genotyping are performed using the same specimen, and, therefore, are combined.

- UPHL does not perform the RT-PCR or genotyping test for measles.
- All PCR and genotyping must be preapproved by UDOH BOE and submitted to UPHL for shipment to the Vaccine Preventable Disease (VPD) Laboratory in California which is funded by the Centers for Disease Control and Prevention (CDC).

Availability

- CDC and CDC-funded VPD laboratories perform measles RT-PCR.

Limitations

- RT-PCR and genotyping should not be relied upon for diagnosis; specimens should only be tested after serological results come back positive for measles.
- Vaccine strain of measles is detected by the RT-PCR test. If a patient has been immunized within 65 days, the PCR test will likely be positive. Genotyping results will be able to differentiate between measles wild type and vaccine strain.

Specimen collection

- Throat or NP swabs are appropriate specimens for RT-PCR and genotyping. Throat or NP swabs may be collected within seven days of rash onset.
- If 10 or more days have passed since rash onset, specimens should not be collected.

Interpretation

- A positive result, along with clinical symptoms, confirms the diagnosis of measles.
- A negative result, when the specimen was collected and handled and performed correctly, excludes measles infection.

Serology Interpretation		
Vaccinated	**Lab Test**	**Specimen Collection Timing**
	IgM	Serum specimen should be collected as soon as possible after rash onset. If acute serum specimen is collected within 72 hours after rash onset and is negative, a convalescent serum specimen should be collected ≥72 hours after rash onset. Patients that mount a secondary immune response to measles, as seen in most previously vaccinated persons, may not have an IgM response or it may be transient and not detected depending on the timing of specimen collection.
	IgG	A serum specimen for IgG testing should be collected in conjunction with IgM serum specimen collection. Tests for IgG antibody may be used for measles diagnosis or measles immunity testing. In vaccinated persons, the IgG may already be quite elevated in the acute serum sample which frequently prevents detection of a four-fold rise in IgG titer in the convalescent serum specimen.
	PCR/Culture	NP or throat swab specimen should be collected within 3 days of rash onset; may be collected up to ten days post rash onset.
Unvaccinated	**Lab Test**	**Specimen Collection Timing**
	IgM	Serum specimen should be collected as soon as possible after rash onset. If acute serum specimen is collected within 72 hours after rash onset and is negative, a convalescent serum specimen should be collected ≥72 hours after rash onset. Detectable within 1-4 days after onset of rash; reaches a maximum level within a week after rash onset and remains elevated for 6-8 weeks.
	IgG	A serum specimen for IgG testing should be collected in conjunction with IgM serum specimen collection. Tests for IgG antibody may be used for measles diagnosis or measles immunity testing. IgG antibodies are detectable 7-10 days post rash onset, peak approximately two weeks post rash onset, and persist for life.
	PCR/Culture	NP or throat swab specimen should be collected within 3 days of rash onset; may be collected up to ten days post rash onset.

Treatment

There is no specific treatment for measles. In children that are immunocompromised or severely ill, the measles virus has demonstrated susceptibility to ribavirin in vitro, but this drug has not been approved by the U.S. Food and Drug Administration (FDA). The CDC recommends that severe measles cases among children, such as those who are hospitalized, should be treated with vitamin A. Vitamin A should be administered immediately on diagnosis and repeated the next day. The recommended age-specific daily doses are:

- 50,000 IU for infants <6 months of age
- 100,000 IU for infants 6-11 months of age
- 200,000 IU for children 12 months of age and older

Case Fatality

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; in developed countries, it is <1%.

Reservoir

Humans are the only known hosts of measles virus.

Transmission

Measles is primarily spread through respiratory droplets generated by coughing and sneezing, and by direct contact with nasal or throat secretions of infected persons. However, airborne transmission of much smaller particles has been documented in closed settings for up to two hours *after* the infected person has left. Measles is considered one of the most contagious diseases in the world.

Susceptibility

Anyone can get measles. However, it is typically regarded as a childhood disease. Vaccination efforts have eradicated the virus in the U.S. All cases in the U.S. are either imported from an area where the measles virus is still circulating, usually Europe or Asia, or are linked to a case with imported measles virus. Measles cases can occur throughout the year, but tend to peak in late winter and spring.

Those most at risk for developing measles are generally limited to five groups:

1. Children <12 months of age (those who are too young to be immunized);
2. Unimmunized individuals;
3. Adults who may have received an earlier ineffective measles vaccine prior to 1968;
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.

Incubation Period

The incubation period from exposure to prodrome averages 8-12 days; from exposure to rash onset averages 14 days (range 7-21 days).

Period of Communicability

A person with measles is contagious four days before rash onset to four days after rash onset; infectivity is minimal after the second day of rash. More than 90% of susceptible contacts will develop disease.

Epidemiology

From 2000-2010, the incidence of measles in the U.S. was very low, with fewer than 200 cases reported each year. In 2001, a record annual low of 44 cases was reported. In 2011, 222 cases were reported, followed by another low case year in 2012 with 55 cases. One hundred-ninety cases were identified in 2013, and in 2014 a total of 667 measles cases were reported in the U.S., the largest number since 2011. The 2014 cases resulted from 23 outbreaks from across the country. In 2015, the US experienced a large, multi-state measles outbreak linked to an amusement park in California; a total of 188 cases were reported. The outbreak likely started from a traveler who became infected overseas with measles, then visited the amusement park while infectious; however, no source was identified. In 2018, 372 cases of measles were reported in the U.S. From January to June, 2019, 1,022 individual cases of measles have been confirmed in 28 states. This is the greatest number of cases reported in the U.S. since 1992 and since measles was declared eliminated in 2000.

Measles rates have been low in Utah since 2000. In 2011, Utah experienced an outbreak resulting in 13 cases initiated by a measles importation from Eastern Europe. From December 2014 through February 2015, Utah identified three cases linked to a national outbreak associated with a popular theme park in California. In 2017, a case of measles was identified in an age-appropriately immunized child <5 years of age who traveled to an area where measles is endemic, but did not receive a second MMR as recommended by the CDC prior to travel to this region. Two unvaccinated contacts of the index case, a social contact and an individual from a public event, were subsequently identified as confirmed cases of measles.

A high immunization rate helps control the transmission of measles when the disease is brought into Utah. Utah is an international destination for visitors and a hub for international travelers. This reinforces the need for maintaining high immunization rates, and for public health to remain vigilant in measles surveillance.

✓ PUBLIC HEALTH CONTROL MEASURES

Public Health Responsibility

Promoting vaccination, awareness, and providing rapid interventions when cases are identified allow public health to control measles outbreaks. Public health's responsibilities include:

- Promotion of vaccination to prevent disease.
- Maintain measles awareness among clinicians and the public.
- Identify all cases and susceptible exposed people rapidly.
- Identify the source of infection through genotyping of viral isolates.
- Assist in the international effort to eradicate measles.

Prevention

Vaccination is the primary method of prevention. Vaccination within 72 hours of exposure in unimmunized persons can provide protection against measles in some cases. In persons for whom vaccination is contraindicated (immunocompromised, pregnant women, and infants <1 year of age), immunoglobulin (IG) administered within six days of exposure can provide some protection either by preventing or reducing the severity of disease. If immunization status is unknown, vaccination in an already immune person is not harmful, and may be preferred over laboratory evaluation of immunity depending on exposure risk.

Recommendations for Use of Immune Globulin for Post-exposure Prophylaxis

The following patient groups are at risk for severe disease and complications from measles and should receive IG within six days of exposure:

- Infants <12 months of age.
- Pregnant women without evidence of measles immunity.
- Severely immunocompromised persons (bone marrow transplant, leukemia, HIV, etc.)
- Vaccine contraindicated individuals.

IG can be administered to other persons who have not received one dose of MMR at 12 months of age or older, but priority should be given to persons exposed in settings with intense, prolonged, close contact (e.g., household, childcare, and classroom). For exposed persons without evidence of measles immunity, a rapid measles IgG antibody test or measles immunity verification test can be used to inform immune status, provided that administration of IG is not delayed. MMR vaccine can be administered in place of IG if administered within 72 hours of exposure and not contraindicated.

Infants <12 months of age

Because infants are at higher risk for severe measles and complications, intramuscular immunoglobulin (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 IGIM if administered within 72 hours of exposure. **Note:** This vaccine dose will not count towards routine childhood immunizations.

Pregnant women without evidence of measles immunity

Pregnant women may be at increased risk for severe measles and complications. Therefore, administration of intravenous immune globulin (IGIV 400 mg/kg) is appropriate for pregnant women without evidence of measles immunity who have been exposed to measles.

Severely Immunocompromised patients

Severely immunocompromised patients exposed to measles should receive post exposure prophylaxis with IGIV (400 mg/kg) regardless of immunologic or vaccination status. Such patients include individuals with severe primary immunodeficiency, bone marrow transplant recipients until at least 12 months after completing all immunosuppressive treatment (or longer in patients with graft-versus-host disease), patients on treatment for acute lymphoblastic leukemia until at least six months after completion of immunosuppressive chemotherapy,

patients with HIV infection and CD4 percent <15% (all ages) or CD4 count <200 lymphocytes/mm³ (>5 years of age), and patients who have not received MMR vaccine since receiving effective antiretroviral therapy (ART).

For patients already receiving IGIV therapy, administration of at least 400 mg/kg body weight within three weeks before measles exposure should be sufficient to prevent measles infection. For patients receiving subcutaneous immune globulin (IGSC) therapy, administration of at least 200 mg/kg body weight for two consecutive weeks before measles exposure should be sufficient.

Vaccine

Two doses of measles-containing vaccine (MMR) separated by at least 28 days are routinely recommended for all children. The first dose is given at 12-15 months of age; the second is given at 4-6 years of age. The immunity level among recipients of two doses of vaccine is approximately 99%.

MMR is a live, attenuated vaccine, and, therefore, pregnant women and persons with an impaired immune system should not receive the vaccine. Non-pregnant women should avoid becoming pregnant within 28 days after the last dose of vaccination. Breastfeeding is not a contraindication for MMR vaccination.

During an outbreak, infants between 6-12 months of age who have been exposed to measles may be vaccinated with the MMR vaccine. This dose will not be counted as the first dose of MMR -- typically given at 12-15 months of age. Vaccine is preferred over IG if prophylaxis is indicated as protection from future exposures.

Evidence of Immunity

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

- Written documentation of adequate vaccination*:
    - 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
    - Two doses of measles-containing vaccine for school-age children and adults at high risk, including college students, healthcare personnel, and international travelers
- Laboratory evidence of immunity
- Laboratory confirmation of measles
- Birth before 1957 (not acceptable evidence for healthcare personnel)

*****Documented age-appropriate vaccination supersedes the results of subsequent serologic testing.

Although birth before 1957 is considered as presumptive evidence of immunity, for unvaccinated healthcare workers 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.

Isolation and Quarantine Requirements

Isolation: Persons diagnosed with measles should voluntarily isolate themselves at home until four days after rash onset.

Quarantine: Close contacts should have their records audited for appropriate immunity as indicated in the Evidence of Immunity section above. Persons with such evidence will not be subject to quarantine. Preschool-aged children and adults not at high risk who have received only one documented dose of MMR, may receive a second dose of MMR as post exposure prophylaxis (<72 hours after exposure) and be released from quarantine.

A verbal report of immunization is not considered adequate documentation for high risk contacts. If adequate documentation cannot be provided and measles titer levels are unavailable, the person should be considered susceptible. Susceptible persons should be vaccinated immediately (if desired, collect specimens for immunity verification first), preferably within 72 hours after exposure. Contacts that have evidence of one dose of MMR vaccine prior to the post exposure dose (received <72 hours) are considered fully vaccinated, and may come out of quarantine immediately. Susceptible persons, if not immunized within 72 hours after exposure, should be placed on voluntary quarantine until 21 days after the date of last exposure to the measles case. If immunization status is unknown, vaccination in an already immune person is not harmful.

Healthcare Setting: When a measles case occurs in a healthcare setting the following measures should be undertaken:

- Implementation of airborne and standard precautions for patients in whom measles is suspected or confirmed;
- Airborne precautions include isolation in a negative air pressure isolation room, also known as airborne infection isolation (AII) or airborne infection isolation room (AIIR). In clinic settings where a negative air pressure isolation room may not be available, a single room with the door closed and away from susceptible contacts may be used when evaluating persons in whom measles is suspected. Airborne Precautions should be in place for four days after rash onset. For immunocompromised patients, these precautions should be in place for the duration of the illness;
- Suspect or confirmed measles patients should be asked to wear a mask;
- Immediate review of evidence of measles immunity in all exposed staff and patients;
- Vaccination of personnel without presumptive evidence of immunity; and/or
- Exclusion of HCWs with active measles illness for four days after the rash appears.
- HCWs without presumptive evidence of immunity should be offered the first dose of MMR vaccine and excluded from work from day five after the first exposure to day 21 following after their last exposure.
- Additional information about CDC's infection and control recommendations for measles in healthcare settings can be found here: https://www.cdc.gov/infectioncontrol/guidelines/measles/index.html.

Student Exclusion

In an outbreak, it may be necessary to exclude students with immunization exemptions. Administrative rule R396-100-8 (below) grants authority to public health to exclude students with vaccine exemptions in an affected school or when measles transmission is occurring in a population where it is likely that further spread of the disease may occur in a school.

R396-100-8. Exclusions of Students Who Are Under Exemption and Conditionally Enrolled Status

1. A local or state health department representative may exclude a student who has claimed an exemption or who is conditionally enrolled from school attendance if there is good cause to believe that the student has a vaccine preventable disease and:
    a. has been exposed to a vaccine-preventable disease; or
    b. will be exposed to a vaccine-preventable disease as a result of school attendance.
2. An excluded student may not attend school until the local health officer is satisfied that a student is no longer at risk of contracting or transmitting a vaccine-preventable disease.

✓ CASE INVESTIGATION

Reporting

If measles is at all suspected, it should be reported immediately to the local health department or the Utah Department of Health.

CSTE Reporting Criteria

Criterion	Reporting		
Clinical evidence			
Fever (any)	N	N	
Rash (any)	N	N	
Temperature ≥101°F/38.3°C			N
Generalized, maculopapular rash			N
Absence of a more likely diagnosis			N
Laboratory evidence			
Culture measles virus		O*	
PCR test for measles-specific nucleic acid		O*	
Measles IgM antibody		O*	
Acute and convalescent anti-measles IgG antibodies		O*	
Epidemiological evidence			
Contact of a confirmed measles case	O		
Belonging to a defined risk group during an outbreak	O		
Residence in a geographic area where measles is endemic or an outbreak of measles is occurring	O		

Travel during past 21 days to a geographic area where measles is endemic or an outbreak of measles is occurring	O		

Notes:
S = This criterion alone is Sufficient to report a case.
N = All "N" criteria in the same column are Necessary to report a case.
O = At least one of these "O" (Optional) criteria in each category (e.g., clinical evidence and laboratory evidence) in the same column—in conjunction with all "N" criteria in the same column—is required to report a case.
*A requisition or order for any of the "O" laboratory tests—in conjunction with all "N" criteria in the same column—is sufficient to meet the reporting criteria.

Case Definition
Measles (2013)

Clinical description

- An acute illness characterized by:
  - Generalized, maculopapular rash lasting ≥3 days; **and**
  - temperature ≥101°F or 38.3°C; **and**
  - cough, coryza, or conjunctivitis.

Probable

- In the absence of a more likely diagnosis, an illness that meets the clinical description with:
  - no epidemiologic linkage to a laboratory-confirmed measles case; **and**
  - non-contributory or no measles laboratory testing.

Confirmed

- An acute febrile rash illness[†] with:
  - isolation of measles virus[+] from a clinical specimen; **or**
  - detection of measles-virus specific nucleic acid[+] from a clinical specimen using polymerase chain reaction; **or**
  - IgG seroconversion[+] or a significant rise in measles immunoglobulin G antibody[+] using any evaluated and validated method; **or**
  - a positive serologic test for measles immunoglobulin M antibody[+§]; **or**
  - direct epidemiologic linkage to a case confirmed by one of the methods above.

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

U.S.-acquired cases are sub-classified 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, e.g., a genotype that is not occurring within the U.S. in a pattern indicative of endemic transmission. A n endemic genotype is the genotype of any measles virus that occurs in an endemic chain of transmission (e.g., lasting ≥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 ≥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 that they do not represent a sustained U.S.-acquired chain of transmission or an endemic chain of transmission within the U.S.

Note: Internationally imported, import-linked, and imported-virus cases are considered collectively to be import-associated cases. States may also choose to classify cases as out-of-state-imported when imported from another state in the U.S. For national reporting, however, cases will be classified as either internationally imported or U.S.-acquired.

2013 CSTE criteria for defining a case of measles

Criterion	Confirmed		Probable
Clinical evidence			
Generalized, maculopapular rash lasting ≥3 days			N
Temperature ≥101°F/38.3°C			N
Fever (any)	N	N	
Rash (any)	N	N	
Cough			O
Coryza			O
Conjunctivitis			O
Absence of a more likely diagnosis			N
Laboratory evidence			
Measles virus‡ from a clinical specimen	O		
PCR test for measles-specific nucleic acid‡	O		
Measles immunoglobulin G antibody seroconversion‡ **or** significant rise in measles immunoglobulin G antibody‡ using a validated method	O		
Measles IgM antibody positive	O		

Epidemiological evidence			
Direct epidemiologic linkage to a laboratory-confirmed case		N	A

Notes:
S = This criterion alone is Sufficient to classify a case.
N = All "N" criteria in the same column are Necessary to classify a case. A number following an "N" indicates that this criterion is only required for a specific disease/condition subtype (see below).
O = At least one of these "O" (Optional) criteria in each category (e.g., clinical evidence and laboratory evidence) in the same column—in conjunction with all "N" criteria in the same column—is required to classify a case.
A = This criterion must be absent (e.g., NOT present) for the case to meet the reporting criteria.
‡Not explained by MMR vaccination during the previous 6-45 days.
§Not otherwise ruled out by other confirmatory testing or more specific measles testing in a public health laboratory.

Case Investigation Process

All highly suspect cases of measles warrant immediate action. Cases of measles should be managed as follows:

- Local and state health departments should be immediately notified.
- Appropriate laboratory samples and preliminary clinical and epidemiologic information (including vaccine history and travel history) should be obtained.
- Strict isolation should be imposed until four days after rash onset
- All case contacts should be identified and appropriately managed (explained in detail below).
- The source of the exposure should be identified.

Outbreaks

A single case of measles is considered an outbreak.

Initially work to isolate the case, collect travel and contact exposure history, and rapidly identify all close contacts. Verify vaccination status of contacts and provide post exposure prophylaxis as indicated. Define population groups at specific risk and immunize. An epidemiologically linked case is one in which the patient has had contact with one or more persons who have or had the disease, and transmission of the agent by the usual modes of transmission is plausible. A case may be considered epidemiologically linked to a laboratory-confirmed case if at least one case in the chain of transmission is laboratory confirmed.

Public health resources should be concentrated on patients meeting the Confirmed and Probable case definitions. All local health departments are encouraged to follow the Confirmed and Probable case classification.

Due to the volume of coordinated public health partner activities required to initiate an effective measles response, Incident Command Structure (ICS) should be implemented as soon as possible. The ICS structure may expand or be stood down as needed to support the response efforts.

Identify Case Contacts

A measles exposure is defined as sharing the same airspace with a person infectious with measles (four days prior through the four days after their rash onset). Potential measles exposures might include persons in the same classroom, home, clinic waiting room, airplane, etc. or persons who were in these areas up to one hour after the infectious person left the area.

Although the CDC recommends using a two-hour window for contact investigations, there is only one report in the literature of measles transmission ≥60 minutes after an infectious person has left the setting. No minimum time period has been established for exposure, but it is presumed that certain types of exposures (longer in duration, face to face) are more likely to result in measles transmission than brief, transient exposures. UDOH recommends that public health investigators use a one-hour window for measles contact investigations, but this recommendation may be increased depending on the setting/situation and at the discretion of the local health department.

High priority groups for contact investigation**:**

1. Household contacts without presumptive evidence of immunity;
2. Close contacts other than household (e.g., persons who shared the same room or airspace in various settings);
3. Schools/childcare centers, colleges or other close settings where a defined number of persons have congregated (e.g., churches) because of high contact rates and transmission potential; and
4. Healthcare settings may be considered high priority depending on the health status of exposed persons.

In these settings, exposures usually result in an identified number of susceptible contacts to follow up on individually. However, efforts to identify the likelihood of exposure in larger settings such as hospitals (e.g., patients and healthcare personnel in ER) may be helpful. In particular, one should identify individuals at high risk for severe disease including infants who are not vaccinated, immunocompromised individuals, and pregnant women.

Low priority groups are people who have potentially been exposed to the case or case's respiratory secretions during the case's infectious period (four days before rash onset to four days after rash onset) and do not fall into one of the high priority groups outlined above.

NOTE: UDOH will immediately notify the CDC Division of Global Migration and Quarantine (DGMQ) regarding contacts exposed to a confirmed case that was in the contagious period during any flights. This will allow action to be taken to follow-up with exposed persons in time to assess them to identify any resulting cases and prevent further spread of disease.

Case Contact Management

Because of the contagiousness of the disease, active identification of all contacts of a measles case is warranted. When cases are identified, it is public health's responsibility to:

- Assess contacts' immunity by auditing immunization records. Contacts must be able to produce documentation of vaccination; a verbal history of vaccination is not sufficient.

- Vaccinate susceptible contacts (not fully vaccinated according to ACIP recommendations prior to exposure), unless contraindicated.
- Administer IG to susceptible contacts who are at risk for severe disease and complications from measles:
    - Infants <12 months of age.
    - Pregnant women without evidence of measles immunity.
    - Severely immunocompromised persons (bone marrow transplant, leukemia, HIV, etc.)
    - Vaccine contraindicated individuals.
    - Work with susceptible contacts' physicians to determine if administration of IG is necessary.
    - Susceptible contacts who received IG within six days of exposure should be quarantined in their home until 28 days after exposure since IG may prolong the incubation period of measles.
    - For additional information about recommendations for use of IG, please refer to the 'Recommendations for Use of Immune Globulin for Post-exposure Prophylaxis' section of this plan.
- Provide educational materials informing of exposure and recommending vaccination in the community.
- Assess the need for active monitoring or passive monitoring. Susceptible contacts with direct exposures should be placed on voluntary quarantine with active monitoring. Monitoring decisions can be made using the measles immunity assessment tool below.

In UT-NEDSS, for contacts, the "VPD Exposure Event" disease classification may be used for situations where individuals were exposed, but the specific case is unknown (such as an airline exposure).

In UT-NEDSS, for contacts, the "Measles Monitoring Event" disease classification may be used for situations where individuals were exposed, and the measles index case and exposure event is known.

Measles Immunity Assessment Tool

	Measles Immunity Status Prior to Exposure	**Immunity Testing**	**MMR as PEP**	**IG as PEP**	**Quarantine**	**Monitoring**
High Priority Groups	Two appropriate MMRs documented	NO	NO	NO	NO	None
	1 MMR documented and it has been ≤72 hours since exposure	NO	YES	NO	NO	None
	1 MMR documented and it has been >72 hours since exposure	YES	NO[1]	NO	YES, 21 days or until lab results	Passive
	≥12 months, 0 MMRs documented, but reports immunization	YES, before MMR	YES	NO	YES, 21 days or until lab results	Active
	≥12 months, reports unimmunized	NO	YES	NO	YES, 21 days	Active

	<12 months, unvaccinated	NO	NO[3]	YES	YES, 28 days[2]	Active
	6-12 months, unvaccinated and it has been ≤72 hours since exposure	NO	YES[3]	NO	YES, 21 days	Active
	Laboratory evidence of immunity	NO	NO	NO	NO	None
	Born before 1957	NO	NO	NO	NO	None
	Medical record of measles	NO	NO	NO	NO	None
	Pregnant women without 2 MMRs documented	YES, before IG	NO	YES	YES, 28 days[2] or until lab results	Active
	Immunocompromised individuals	NO	NO	YES	YES, 28 days[2]	Active
Low Priority Groups	Two appropriate MMRs documented	NO	NO	NO	NO	None
	1 MMR documented and it has been ≤72 hours since exposure	NO	YES	NO	NO	None
	1 MMR documented and it has been >72 hours since exposure	YES, if desired	NO[1]	NO	NO	None
	≥12 months, 0 MMRs documented but reports immunization	YES, before MMR if desired	YES	NO	NO	None
	≥12 months, reports unimmunized	NO	YES	NO	YES, 21 days[4]	Passive
	<12 months, unvaccinated	NO	NO[3]	YES	YES, 28 days[2,4]	Passive
	6-12 months, unvaccinated and it has been ≤72 hours since exposure	NO	YES[3]	NO	YES, 21 days[4]	Passive
	Laboratory evidence of immunity	NO	NO	NO	NO	None
	Born before 1957	NO	NO	NO	NO	None
	Medical record of measles	NO	NO	NO	NO	None
	Pregnant women without 2 MMRs documented	YES, before IG	NO	YES	YES, 28 days[2,4] or until lab results	Passive
	Immunocompromised individuals	NO	NO	YES	YES, 28 days[2,4]	Passive

Notes:

1. MMR should be provided to protect from future exposures in the event that the contact does not develop disease.
2. IG may prolong the incubation period of measles so extending the monitoring period for individuals who received IG as PEP is recommended.
3. For infants aged 6-12 months, MMR vaccine can be given in place of IG, if administered within 72 hours of exposure. MMR or IG may be used interchangeably for PEP for those infants

between 6-12 months. Decision on use of MMR versus IG should be made based on available resources and circumstance.

4. Quarantine should be recommended based on the above criteria; requirements for compliance with quarantine are at the discretion of the local health department.
5. High priority and low priority groups are defined in the “Identify Case Contacts” section.
6. Active Monitoring is defined as daily public health contact with an individual on voluntary quarantine to monitor them for symptoms. These individuals should be entered as Measles Monitoring Events (MME).
7. Passive Monitoring is defined as a contact that is either on voluntary quarantine or not on quarantine that contacts a public health representative if symptoms consistent with measles develop. These individuals should be entered as Measles Monitoring Events (MME).

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✓ VERSION CONTROL

V.03.15: Content within the disease plan was updated on 3/11/2015. Changes were made to incorporate the current public health control measures and surveillance guidelines. Specifically, CSTE case definition and swim lanes were added to assist in case classification. Clarification of the investigational process and contact management was also added with current processes.
V. 03.07.17: Added Critical Clinician Information section.

V. 03.05.18 Updated Critical Clinician Information, Causative Agent, Differential Diagnosis, Laboratory Identification, Epidemiology, Evidence of Immunity, and Isolation and Quarantine Requirements sections in conjunction with EAG VPD Disease Plan Workgroup. Added Rules for Entering Laboratory Results section.

V. 05.31.18: Updated Identify Case Contacts and Measles Immunity Assessment Tool sections in conjunction with EAG VPD Disease Plan Workgroup.

V. 07.25.19: Updated Infection Control Procedures/Healthcare Setting sections to reflect CDC release of Interim Infection Prevention and Control Recommendations for Measles in Healthcare Settings.

✓ UT-NEDSS MINIMUM/REQUIRED FIELDS BY TAB

Demographic

- City
- County
- State
- Date of Birth
- Birth Gender
- Ethnicity
- Race
- First Name
- Last Name
- Area Code

Clinical

- Clinician First Name
- Clinician Last name
- Clinician Middle Name
- Clinician Phone
- Date Diagnosed
- Date of Death
- Died
- Disease
- Onset Date
- Rash Onset Date
- Did the rash last at least 3 days?
- Did the patient have a fever >101°F?
- Did the patient have a cough?
- Did the patient have coryza (runny nose)?
- Did the patient have conjunctivitis?
- Has the patient ever received a measles-containing vaccine?

Laboratory

- Collection Date
- Organism
- Result Value
- Specimen Source
- Test Result
- Test Type

Epidemiological

- Imported From
- Is the case: Imported?
- Is the case: U.S.-acquired?
- Is the case: Epi-linked?
- Date 14 days prior to onset
- Date of onset
- Did the case travel out of state or out of country during the incubation period?
- List location and dates of travel

Investigation

- Is this case epi-linked to anyone?
- Date 14 days prior to onset
- Date of Onset
- Did the case travel out of state or out of country during the incubation period?
- List location and dates of travel

Contacts

No required fields

Reporting

- Date first reported to public health
- Comment

Administrative

- Outbreak Name
- State Case Status
- Outbreak-associated

✓ RULES FOR ENTERING LABORATORY TEST RESULTS

The following rules describe how laboratory results reported to public health should be added to new or existing events in UT-NEDSS. These rules have been developed for the automated processing of electronic laboratory reports, although they apply to manual data entry, as well.

Test-Specific Rules

Test specific rules describe what test type and test result combinations are allowed to create new morbidity events in UT-NEDSS, and what test type and test result combinations are allowed to update existing events (morbidity or contact) in UT-NEDSS.

Test Type	Test Result	Create a New Event	Update an Existing Event
Antigen by DFA/IF	Positive	Yes	Yes
	Negative	No	Yes
IgG Antibody	Positive	No	Yes
	Negative	No	Yes
	Equivocal	No	Yes
IgM Antibody	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes
PCR/Amplification	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes

Whitelist Rules

Whitelist rules describe how long an existing event can have new laboratory data appended to it. If a laboratory result falls outside the whitelist rules for an existing event, it should not be added to that event, and should be evaluated to determine if a new event (CMR) should be created.

Measles Morbidity Whitelist Rule: Never a new case.

Measles Contact Whitelist Rule: If the specimen collection date of the laboratory result is 21 days or less after the event date of the contact event, the laboratory result should be added to the contact event.

Graylist Rule

We often receive laboratory results through ELR that cannot create cases, but can be useful if a case is created in the future. These laboratory results go to the graylist. The graylist rule describes how long an existing event can have an old laboratory result appended to it.

Measles Graylist Rule: If the specimen collection date of the laboratory result is 30 days before to seven days after the event date of the morbidity event, the laboratory result should be added to the morbidity event.

Other Electronic Laboratory Processing Rules

- If an existing event has a state case status of “not a case,” ELR will never add additional test results to that case. New labs will be evaluated to determine if a new CMR should be created.