



Measles

Disease Plan

Quick Links

✓ WHY IS MEALES IMPORTANT TO PUBLIC HEALTH?	2
✓ DISEASE AND EPIDEMIOLOGY	2
✓ PUBLIC HEALTH CONTROL MEASURES	8
✓ CASE INVESTIGATION	12
✓ REFERENCES	19
✓ VERSION CONTROL	20
✓ UT-NEDSS Minimum/Required Fields by Tab	21

Last updated: March 24, 2015, by Jeff Eason, MPH

Questions about this disease plan?

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

✓ WHY IS MEALES 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 United States, the disease was declared eliminated in 2000. However, sporadic outbreaks have occurred with 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 is 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.

✓ DISEASE AND EPIDEMIOLOGY

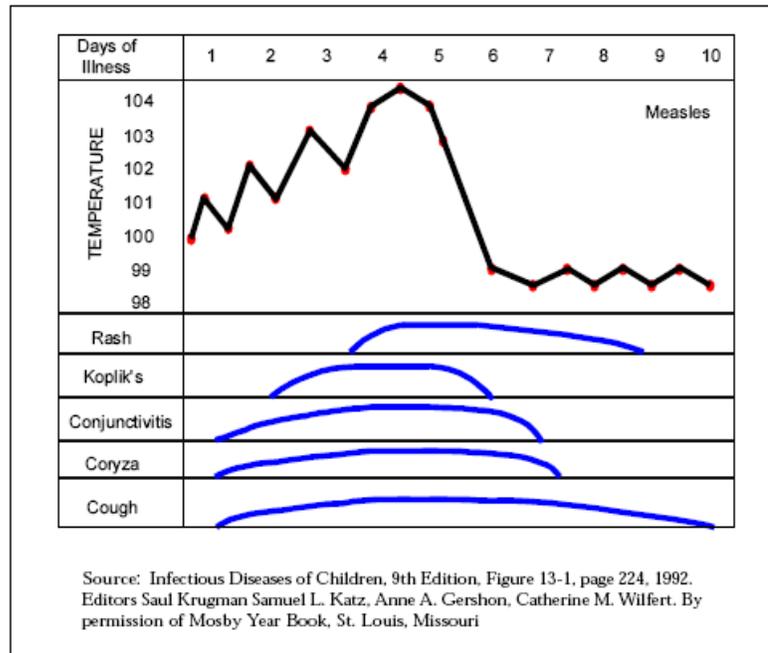
Clinical Description

Measles is an acute viral illness characterized by a prodrome followed by a maculopapular rash which may become confluent. Incubation period is 6-21 days (14 day median).¹⁰

- 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.²
- *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 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



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 United States 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 United States, 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 less than five years of age and adults over 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.²

Causative Agent

Measles is caused by a single-stranded RNA paramyxovirus of the genus *Morbillivirus*. Two envelope proteins, F (fusion) and H (hemagglutinin), play an important role in pathogenesis. The F protein is responsible for fusion of the virus to the host membrane, viral penetration, and hemolysis. The H protein is responsible for adsorption of the virus into the host cell. There is only one antigenic type of measles virus.⁴

Differential Diagnosis

The differential diagnosis includes, but is not limited to: the common cold, 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 United States 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.¹⁰

Timing

- Patient is 0-7 days after the onset of rash
 - Collect serum (for serology) and **Nasopharyngeal (NP) swab** or NP aspirate or throat swab (for PCR and genotyping)
 - Note: If serum is collected prior to three days post rash, and is negative, a second IgM should be drawn and tested to confirm result. Sensitivity of IgM testing is 70%.
- Patient is 3-10 days after onset of rash
 - Collect serum (for serology) and **Urine** (for PCR and genotyping)
- Patient is 10-28 days after the onset of rash
 - Collect serum (for serology).

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.
- If the patient is not insured, please call UDOH Bureau of Epidemiology (BOE) for other testing options.

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.

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).
- If the patient does not have private insurance, please call UDOH BOE for other testing options.

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

- Urine and 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. Urine specimens may be collected 3-10 days after 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.

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 United States 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:²

- 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 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 less than 1%.

Reservoir

Humans are the only known hosts of measles virus.⁸

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 areas for up to two hours *after* the infected person has left. Measles is considered one of the most contagious diseases in the world.¹

Susceptibility

Anyone can get measles. However, it is typically regarded as a childhood disease. Vaccination efforts have eradicated the virus in the US. All cases in the US 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 less than 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).¹⁰

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 United States 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 644 measles cases were reported in the United States, the largest number since 2011. The 2014 cases resulted from 23 outbreaks from across the country. Many of the cases were attributed to imported cases from the Philippines, which was experiencing a large outbreak at the time. One outbreak associated with the Philippines resulted in 383 cases in an unimmunized population. This outbreak began after unimmunized international travelers returned to their community in the United States.

Similar to the United States, 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.

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:¹⁰

- 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 less than one year of age), immunoglobulin (IG) 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 Prophylaxis⁶

The following patient groups are at risk for severe disease and complications from measles and should receive IG:

- Infants aged less than 12 months of age.
- Pregnant women without evidence of measles immunity.
- Severely immunocompromised persons.
- Vaccine contraindicated individuals.

IG can be administered to other persons who have not received one dose of MMR at 12 months or older, but priority should be given to persons exposed in settings with intense, prolonged, close contact (e.g., household, daycare, 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 aged <12 months

Because infants are at higher risk for severe measles and complications, intramuscular immunoglobulin (IGIM) should be administered to all infants aged less than 12 months 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 immunity⁶

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.²

Immunocompromised patients⁶

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 less than 15 percent (all ages) or CD4 count <200 lymphocytes/mm³ (age >5 years), 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.³

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 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.

Isolation and Quarantine Requirements

Isolation: Persons diagnosed with measles should voluntarily isolate themselves at home until four days after rash onset (unless they are a healthcare worker (HCW), in which case they should isolate themselves for seven days after rash onset).

Hospital: Any resident diagnosed with measles should be put into airborne isolation with respiratory droplet precautions for the duration of the illness. Transportation of the patient should be limited. Healthcare personnel should be limited and have evidence of immunity:

- Documentation of 2 MMR at least 28 days apart*
- Laboratory evidence of immunity
- Medical record with history of disease
- Birth before 1957 (not acceptable evidence in an outbreak situation)

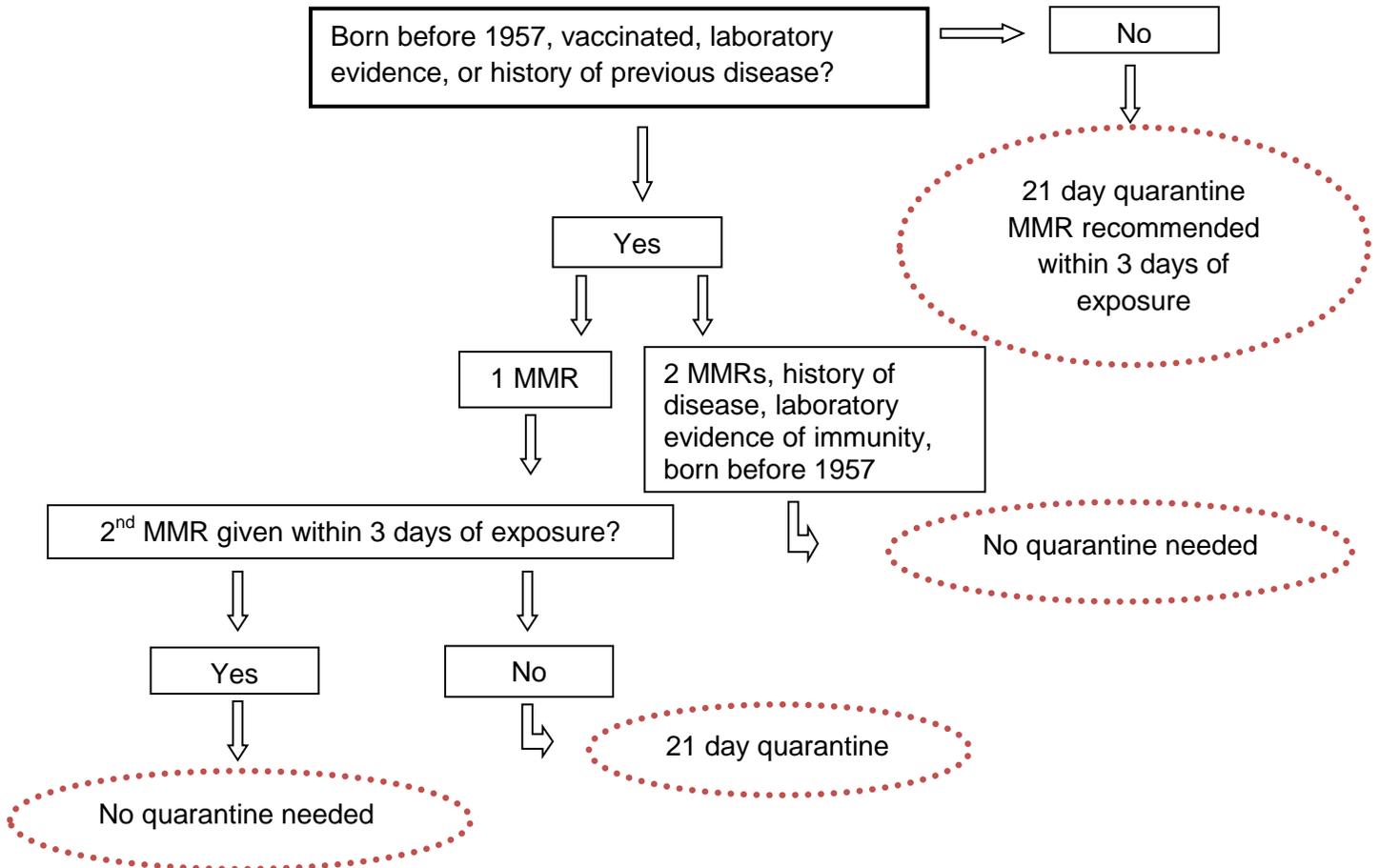
*Documentation of two appropriate doses of MMR supersedes laboratory evidence if an antibody titer indicates non-immune.

Quarantine: Close contacts should have their immunization records audited for appropriate immunity. The following would indicate appropriate immunity; persons with such evidence would not be subject to quarantine.

- Documentation of age-appropriate vaccination with a live measles virus-containing vaccine:
 - Preschool-aged children**: 1 dose
 - School-aged children (grades K-12): 2 doses
 - Adults not at high risk**: 1 dose, or
- Laboratory evidence of immunity
- Medical record of disease
- Birth before 1957

**May receive 2nd dose of MMR as post exposure prophylaxis (<72 hours) and be released from quarantine.

Voluntary Quarantine Algorithm



A verbal report of immunization is not considered adequate documentation. If adequate documentation cannot be provided, 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 less than 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.

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		
<i>Clinical Evidence</i>			
Fever (any)	N	N	
Rash (any)	N	N	
Temperature $\geq 101^{\circ}\text{F}/38.3^{\circ}\text{C}$			N
Generalized, maculopapular rash			N
Absence of a more likely diagnosis			N

<i>Laboratory Evidence</i>			
Culture measles virus		O*	
PCR test for measles-specific nucleic acid		O*	
Measles IgM antibody		O*	
Acute and convalescent anti-measles IgG antibodies		O*	
<i>Epidemiological Evidence</i>			
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 $\geq 101^\circ\text{F}$ 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 $\geq 101^{\circ}\text{F}/38.3^{\circ}\text{C}$ 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.

United States-acquired cases are subclassified into four mutually exclusive groups:

Import-linked case: Any case in a chain of transmission that is epidemiologically linked to an internationally imported case.

Imported-virus case: A case for which an epidemiologic link to an internationally imported case was not identified, but for which viral genetic evidence indicates an imported measles genotype, e.g., a genotype that is not occurring within the United States in a pattern indicative of endemic transmission. An endemic genotype is the genotype of any measles virus that occurs in an endemic chain of transmission (e.g., lasting ≥ 12 months). Any genotype that is found repeatedly in United States-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 United States.

Unknown source case: A case for which an epidemiological or virological link to importation or to endemic transmission within the United States cannot be established after a thorough investigation. These cases must be carefully assessed epidemiologically to assure that they do not represent a sustained United States-acquired chain of transmission or an endemic chain of transmission within the United States.

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

CSTE criteria for defining a case of measles

Criterion	Confirmed		Probable
<i>Clinical Evidence</i>			
Generalized, maculopapular rash lasting ≥ 3 days			N
Temperature $\geq 101^{\circ}\text{F}/38.3^{\circ}\text{C}$			N
Fever (any)	N	N	
Rash (any)	N	N	

Cough			O
Coryza			O
Conjunctivitis			O
Absence of a more likely diagnosis			N
<i>Laboratory Evidence</i>			
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		
<i>Epidemiological Evidence</i>			
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 (unless they are a HCW, in which case, they should be isolated for seven 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

Close contacts (high risk exposures) are people who have either been exposed to the case or exposed to the case's respiratory secretions during the case's infectious period (four days before rash onset to four days after rash onset). Consider members of the following groups:

- Household and family members
- Those who have direct contact with respiratory secretions
- Healthcare workers with face-to-face contact with a patient
- Core groups of close friends, social contacts, boyfriends, girlfriends
- School/daycare contacts
- Contacts at church activities and employment
- Participants in extracurricular activities (such as fieldtrips); and
- Persons exposed at social events.

NOTE: CDC Division of Global Migration and Quarantine (DGMQ) should be immediately notified 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.

Non-close contacts (low risk exposures) 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). The general public at an exposure event are considered members of the low risk exposures.

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. Susceptible contacts not fully immunized (explained in Isolation and Quarantine Requirements) within 72 hours after exposure should be quarantined in their home until 21 days after exposure to a measles case.
- Work with susceptible contacts' physicians to determine if administration of IG is necessary.
- Susceptible contacts that have received IG should be quarantined in their home until 21 days after exposure.
- 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 Risk Exposure	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*	NO	YES, until lab results	Passive
	>12 months, 0 MMRs documented, but reports immunization	YES, before MMR	YES	NO	YES, until lab results	Active
	>12 months, reports unimmunized	NO	YES	NO	YES	Active
	≤12 months, unvaccinated	NO	NO	YES**	YES	Active
	Laboratory evidence of immunity	NO	NO	NO	NO	None
	Born before 1957	NO	NO	NO	NO	Passive
	Medical record of measles	NO	NO	NO	NO	None
	Pregnant women without 2 MMRs documented	YES, before IG	NO	YES	YES	Active
	Immunocompromised individuals	NO	NO	YES	YES	Active
	Low Risk Exposures	Two appropriate MMRs documented	NO	NO	NO	NO
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*	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	Passive
≤12 months, unvaccinated		NO	NO	YES**	YES	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	Active
Immunocompromised individuals		NO	NO	YES	YES	Active

*MMR should be provided to protect from future exposures in the event that the contact does not develop disease.

**For infant 6-12 months, MMR may be substituted for IG.

High risk and low risk exposures are defined in the "Identify Case Contacts" section

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).

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).

✓ REFERENCES

Atkinson W, Hamborsky J, & Wolfe S, (Eds.). (2012). Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. (12th ed). Washington DC: Public Health Foundation.

Barinaga, J., & Skolnik, P. (2015, February 12). Clinical manifestations and diagnosis of measles. Retrieved March 12, 2015, from http://www.uptodate.com/contents/clinical-manifestations-and-diagnosis-of-measles?source=search_result&search=measles&selectedTitle=1~150.

Barinaga, J., & Skolnik, P. (2015, February 13). Prevention and treatment of measles. Retrieved March 11, 2015, from http://www.uptodate.com/contents/prevention-and-treatment-of-measles?source=search_result&search=measles&selectedTitle=2~150.

McLean, H., Fiebelkorn, A., Temte, J., & Wallace, G. (2013, June 14). Prevention of Measles, Rubella, Congenital Rubella Syndrome, and Mumps, 2013: Summary Recommendations of the Advisory Committee on Immunization Practices (ACIP). Retrieved March 11, 2015, from <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6204a1.htm>.

Centers for Disease Control and Prevention. Isolation and Identification of Measles Virus. Retrieved from: <http://www.cdc.gov/ncidod/dvrd/revb/measles/man.htm>.

Centers for Disease Control and Prevention. (1998). Measles, Mumps, and Rubella — Vaccine Use and Strategies for Elimination of Measles, Rubella, and Congenital Rubella Syndrome and Control of Mumps: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR* 1998;47(No. RR-8).

Centers for Disease Control and Prevention. (2013). Morbidity and Mortality Weekly Report (MMWR). Prevention of Measles, Rubella, Congenital Rubella Syndrome, and Mumps, 2013: Summary Recommendations of the Advisory Committee on Immunization Practices (ACIP). June 14, 2013/62(RR04);1-34. Retrieved from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6204a1.htm>.

Council for State and Territorial Epidemiologists. (2012). Measles position statement. Retrieved from: <http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/12-ID-07FINAL.pdf>.

Heymann, D.I. (Ed). (2015). *Control of Communicable Diseases Manual* (20th ed). Washington, D.C.: American Public Health Association.

Pickering, L.K. (Ed) (2012). *Red Book: 2012 report of the committee on infectious diseases* (26th ed.) Elk Grove Village, IL: American Academy of Pediatrics.

Wharton M., Hughes H., & Reilly M., (Eds) (2013). Centers for Disease Control and Prevention. *Manual for the Surveillance of Vaccine-Preventable Diseases*. (6th ed). Centers for Disease Control and Prevention.

✓ **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.

✓ 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 over 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: Import
- Is the case: U.S.-acquired
- Is the case: EPI-Link
- 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