
Measles Outbreak Control Guidelines

Infectious agent

Virus: paramyxovirus, genus *Morbillivirus*. There is only one antigenic type of this RNA virus.

Clinical manifestations

Measles is an acute disease characterized by fever, cough, coryza, conjunctivitis, erythematous maculopapular rash and Koplik spots.

Symptoms

Prodromal symptoms

- Begins 10-12 days after exposure.
- Duration 2-4 days with a range of 1-7 days.
- Fever increases gradually to 103° to 105° F.
- Symptoms include: cough, coryza, conjunctivitis, malaise, diarrhea, anorexia, and lymphadenopathy.
- Koplik spots:
 - Pathognomonic for measles
 - White enanthem (rash) on mucous membranes, usually the buccal membrane.
 - Appears as scattered blue-white spots on a bright red background.
 - Occurs 1-2 days before rash to 1-2 days after rash.

Rash

- Maculopapular eruption that lasts 5-6 days.
- Occurs 2-4 days after prodrome.
- From exposure to rash onset averages 14 days (range, 7-21 days)
- Rash usually begins on face/head and spreads downward and outward, reaching the hands and feet.
- Lesions are generally discrete, but may become confluent, particularly on the upper body.
- The rash fades in the same order that it appears--from head to extremities.

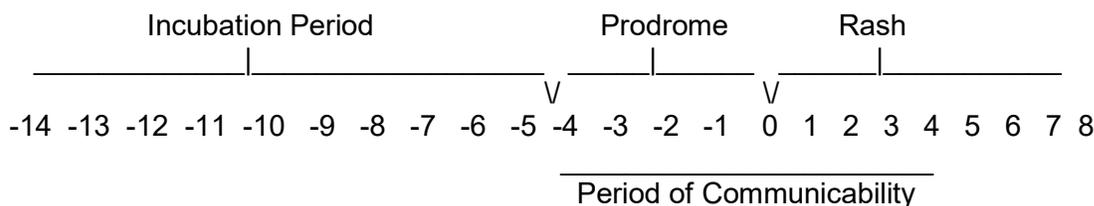
Differential Diagnosis

- Measles may be considered in the differential diagnosis of parvovirus, dengue, Kawasaki disease, and scarlet fever.
- Have a high index of suspicion for clinically compatible cases in unvaccinated persons and those who have recently travelled abroad or had recent contact with international travelers or visitors.

ILLUSTRATION OF AVERAGE MEASLES ILLNESS TIMELINE (in days)

Begins at time of exposure (-14 days).

Day 0 is day of rash onset. Infectious 4 days before to 4 days after rash onset



Complications

Occur in 30% of cases and are more common in children younger than 5 years, adults older than 20 years, pregnant women, and immunocompromised persons.

Diarrhea

- ◆ Diarrhea is reported in 8% of measles cases and is the most common complication of measles.

Otitis media

- ◆ Otitis media is reported in 7% of cases and occurs almost exclusively in children.

Pneumonia

- ◆ Pneumonia is reported in 6% of cases and may be identified as viral or superimposed bacterial.
- ◆ Most common cause of death.

Acute encephalitis

- ◆ Occurs in 0.1% of reported cases.
- ◆ Onset generally occurs 6 days after rash onset (range 1-15 days).
- ◆ Characterized by fever, headache, vomiting, stiff neck, meningeal irritation, drowsiness, convulsions, and coma.
- ◆ Case fatality rate is approximately 15%.
- ◆ Some form of residual neurologic damage occurs in as many as 25% of cases.
- ◆ Seizures are reported in 0.6% - 0.7% of cases.

Complications during pregnancy

- ◆ Measles infections during pregnancy have been associated with an increase in low-birth weight infants, premature labor, spontaneous abortion, and birth defects.

Congenital measles

- ◆ Measles infection of the neonate during pregnancy or with rash onset between 0-14 days of life is a rare occurrence that has not been well described in the medical literature.
- ◆ The clinical presentation of congenital measles may be variable, including asymptomatic, skin rash, pneumonia, keratitis, gastroenteritis and with an increased risk of mortality if not treated.
- ◆ Newborns born to women who were infected with measles less than 21 days prior to delivery should be considered to have congenital measles until determined otherwise by PCR and culture testing.

Death

- ◆ 0.2 - 0.3% of reported measles cases in the United States (U.S.) are fatal.

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- ◆ Pneumonia in children and acute encephalitis in adults are the most common causes of death.
- ◆ Measles mortality rates are much higher in developing countries due to nutritional deficiencies and the lack of medical case management.

Subacute sclerosing panencephalitis (SSPE)

- ◆ Symptoms include progressive deterioration of intellect and behavior followed by ataxia, seizures and death caused by persistent measles infection of the brain.
- ◆ Incidence is highest in those infected in early childhood.
- ◆ Average onset is 7-10 years after acute infection (range: 1 month-27 years).
- ◆ Persons with SSPE cannot transmit measles.

Treatment

- ◆ There is no specific antiviral therapy for measles
- ◆ Medical care is supportive and to address complications
- ◆ Treat severe measles cases among children (e.g. hospitalized) with vitamin A
 - Give vitamin A immediately upon diagnosis and repeat the next day
 - Plays a role in preserving epithelial cell integrity and immune modulation
 - Has been associated with reductions in morbidity and mortality
 - Age-specific daily doses
 - 50,000 IU for infants age <6m including those with congenital measles
 - 100,000 IU for infants age 6-11m
 - 200,000 IU for children age >12m

Note: Even in developed countries such as the U.S. (where measles usually is not severe), vitamin A should be given to all children with severe measles (e.g. requiring hospitalization).

Incubation period

- ◆ From exposure to prodrome averages 10-12 days.
- ◆ From exposure to rash onset averages 14 days (range 7-21 days).
- ◆ Individuals prophylaxed with immunoglobulin (IG) may have extended incubation periods up to 28 days and mild disease presentation.

Period of communicability

- ◆ Highly communicable disease with greater than 90% secondary attack rate among susceptible individuals.
- ◆ Communicable from 4 days before to 4 days after rash onset.

Transmission

- ◆ Transmitted by respiratory droplets and airborne route.
- ◆ Airborne transmission in a closed area has been reported for up to 2 hours after a person with measles occupied the area.

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Basic epidemiology

- ◆ Humans are the only reservoir.
- ◆ Measles is a leading cause of vaccine-preventable disease mortality in children worldwide.
- ◆ The remaining burden is primarily attributable to vaccine underutilization.
- ◆ Endemic measles was declared eliminated in the U.S. in 2000.
 - Most measles cases occur in U.S. citizens returning from travel who do not have measles vaccine protection.
 - Consider international importation if rash onset is within 21 days of return from foreign travel.

Case definition

Case definition and classification published by CSTE January 2013

Clinical description

An acute illness characterized by:

- ◆ Generalized maculopapular rash lasting ≥ 3 days; AND
- ◆ Fever of $\geq 101^{\circ}\text{F}$; AND
- ◆ Cough, coryza or conjunctivitis.

Case classification

Probable case

In absence of a more likely diagnosis, an illness that meets the clinical description with:

- ◆ No epidemiologic linkage to a laboratory-confirmed measles case; AND
- ◆ Noncontributory or no measles laboratory testing.

Confirmed case

An acute febrile rash illness with:

- ◆ Isolation of measles virus from a clinical specimen not explained by MMR vaccination in the previous 6-45 days; OR
- ◆ Detection of measles virus-specific nucleic acid from a clinical specimen using PCR not explained by MMR vaccination in the previous 6-45 days; OR
- ◆ IgG seroconversion from negative to positive (as documented in this illness) or a significant (4-fold) rise in measles IgG antibody not explained by MMR vaccination in the previous 6-45 days; OR
- ◆ A positive serologic test for measles IgM antibody performed at the public health laboratory and not explained by MMR vaccination in the previous 6-45 days; OR
- ◆ Direct epidemiologic linkage to a case confirmed by one of the methods above.

Note: Temperature does not need to reach $\geq 101^{\circ}\text{F}$ and rash does not need to last ≥ 3 days if laboratory criteria are met.

Outbreak

- ◆ For national reporting, an outbreak is defined as a chain of transmission including 3 or more cases linked in time and space.

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Case classification for Import Status

Internationally Imported case

- ◆ A case that has its source outside of the U.S. as evidenced by at least some of the exposure period (7-21 days before rash onset) occurring outside the U.S. with a rash onset within 21 days of entering the U.S. and there is no known exposure to measles in the U.S. during that time.

U.S. – acquired case

- ◆ A case in which the patient had not been outside the U.S. during the 21 days before the rash onset or was known to have been exposed to measles within the U.S.

U.S. – acquired cases sub-classifications

- ◆ **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.
- ◆ **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.

Note: Internationally imported, import-linked, and imported-virus cases are considered collectively to be import-associated cases.

Note: States may also choose to classify cases as “out-of-state-imported” when imported from another state in the U.S. However, for national reporting, cases will be classified as either internationally imported or U.S. acquired.

Reporting

- ◆ The LHD must be notified immediately by telephone as soon as a diagnosis of measles is suspected.
- ◆ A Confidential Case Report Form (DOH-389) must be submitted. The DOH-389 is located at <https://www.health.ny.gov/forms/doh-389.pdf>.
- ◆ The LHD must notify the NYSDOH Bureau of Immunization, preferably when the case is reported to them and no later than 24 hours after they are notified. The NYSDOH can be reached at 518-473-4437 during normal business hours. The Duty Officer system is available to LHDs and providers for consultation nights, holidays and weekends at 1-866-881-2809.

Laboratory testing and diagnosis

Laboratory confirmation of measles

- ◆ Laboratory confirmation is essential for all sporadic measles cases and outbreaks.
- ◆ Laboratory tests that confirm measles:

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- Isolation of measles virus in cell culture* from a clinical specimen
- Detection of measles virus nucleic acid (RNA)* from a clinical specimen using real-time reverse transcriptase polymerase chain reaction (RT-PCR)
 - RT-PCR testing for measles virus is available only at the Wadsworth Center
- Detection of measles IgM antibody* in serum
 - All positive IgM results from commercial laboratories must be forwarded to the Wadsworth Center for confirmation
- Four-fold rise in measles IgG antibody titer* by standard serologic assay
- IgG seroconversion* from negative to positive (documented during this illness)

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

Recommended clinical specimens and tests

- ◆ Collection of virologic and serologic specimens is recommended **for every case**.
- ◆ Both virologic and serologic specimens should be collected **at the first contact** with the suspected measles case.
- ◆ Clinical specimens for detecting measles virus (culture and RT-PCR) include a nasopharyngeal swab throat swab **or** oropharyngeal (throat) swab **and** a urine sample.
 - Nasopharyngeal swab is the preferred respiratory specimen type for RT-PCR. Throat swab is acceptable if nasopharyngeal swab cannot be collected.
 - Collection of both respiratory and urine samples can increase the likelihood of detecting virus.
- ◆ A serum specimen for measles IgM and IgG should be collected.
- ◆ If a suspect measles case has negative tests for acute measles infection, additional testing for rubella can be considered.

Culture and RT-PCR

- ◆ Virus isolation and detection is more likely within 3 days of rash onset.
 - Obtain viral specimens within 72 hours of rash onset for best results.
 - Do not collect viral specimens more than 10 days after rash onset.
- ◆ A negative culture or RT-PCR does not rule out measles.
 - Test results are affected by the timing, quality and handling of the specimens.
- ◆ Isolation of measles virus or detection of measles RNA by RT-PCR from clinical specimens is particularly helpful when serology results are inconclusive.
- ◆ Isolation of measles virus or detection of measles RNA is also extremely important for molecular epidemiologic surveillance (genotyping).

IgM antibody

- ◆ IgM antibodies appear within the first few days (1-4 days) of rash onset, peak within the first week post rash onset and are detected in samples for at least 30 days after rash onset.
- ◆ IgM antibodies are rarely detected after 6-8 weeks post rash onset
- ◆ A proportion of specimens (up to 23% in a CDC study) collected within 72 hours of rash onset may give false negative results. If a negative result is obtained from serum collected within 72 hours after rash onset, a second serum should be collected \geq 72 hours after rash onset.

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- ◆ False positive IgM: Because no assay is 100% specific, serologic testing of non-measles cases will occasionally produce false positive IgM results, such as in the presence of rheumatoid factor or another rash-causing viral illness such as parvovirus B19, enteroviruses, or human herpesvirus-6 (roseola). Positive IgMs for serology at commercial labs should always be submitted to the Wadsworth Center for confirmatory testing. If a diagnosis of measles is in doubt (for example, if the patient has atypical symptoms and/or lacks a history of exposure or travel to an endemic area) and a false positive IgM result is suspected, a second serum specimen should be collected.
 - If the acute serum was IgG negative, collect a second specimen ≥ 10 days after the acute specimen. If the IgG remains negative, measles can be ruled out.
 - If the acute serum was IgG positive, collect a second specimen ≥ 2 weeks after the acute specimen and test for a significant rise in IgG titer between paired serum samples.

IgG antibody

- ◆ IgG antibodies should be detectable 7 days post rash onset (range, 1-10 days). Titers peak around 2 weeks post rash onset and typically persist for a lifetime.
- ◆ If classification of a case cannot be made by detecting IgM antibodies in a serum sample collected ≥ 72 hours after rash onset or detection of measles virus, a convalescent serum sample can be collected 10 – 30 days after the acute serum specimen.
 - A 4-fold rise in measles IgG antibody titer between acute and convalescent specimens by standard serological assay confirms measles.
 - For comparison of acute and convalescent serum samples (“paired sera”), assays must be run on both samples in one laboratory at the same time and with the same test (“run in parallel”).

Vaccinated persons

- ◆ **Previously vaccinated persons** may not have an IgM response, or it may be transient and not detected depending on the timing of specimen collection.
 - RT-PCR may be the best method to confirm such cases.
 - If viral testing is not helpful, additional serologic testing may be needed. The Bureau of Immunization should be consulted for complete recommendations.
- ◆ **Recently vaccinated persons (6-45 days prior to rash onset):** Neither IgM nor IgG antibody responses can distinguish measles disease from the response to vaccination. A viral specimen with determination of the measles genotype (wild type virus versus vaccine virus) is needed.
 - Fever and rash may occur 7-12 days post-vaccination in about 5% of vaccinated persons

Specimen collection

Collection for viral testing and serology

- ◆ Providers should contact the LHD to report suspicion of measles and for directions on specimen collection and shipment.
- ◆ To expedite testing and to receive results in a timely manner, viral specimens and acute measles serology can be shipped directly to the Wadsworth Center.

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- Notify the LHD prior to sending any specimens to the Wadsworth Center.
- ◆ Carefully complete the history form, including the clinical information, test results, provider name and phone number; patient name, DOB and county of residence.
- ◆ The same types of swabs and media used for influenza PCR testing may also be used for measles nasopharyngeal or throat swabs. Providers in areas experiencing measles outbreaks should have viral test kits available.
 - LHDs should contact the NYSDOH Order Desk at the Wadsworth Center at 518-474-4175 for information on ordering viral test kits.
- ◆ Serology specimen kits are not routinely available from the Wadsworth Center. For questions about blood specimen tubes that should be used when collecting serum or for special requests, please contact Diagnostic Immunology at (518) 474-4177.

Specimen source

- ◆ For measles RT-PCR and culture: clinical specimen from nasopharynx or pharynx and urine.
- ◆ For measles IgM and IgG: serum.

Procedure

- ◆ Measles virus RT-PCR and culture
 - Use separate specimen containers for each sample.
 - Carefully complete the history form as described above.
 - Label specimen containers with patient's name, DOB and collection date; collect 2 specimens: NP or throat specimen **AND** urine specimen.
 - Nasopharyngeal (NP) swab or throat swab – use LIQUID viral transport or universal transport medium
 - Flocked swabs are preferred as they provide better specimen recovery. Sterile dacron or rayon swabs with plastic or flexible metal handles may also be used. Do NOT use cotton or calcium alginate swabs or swabs with wooden sticks as they contain substances that inactivate some viruses and inhibit PCR. Dry swabs not in media or other transport media are NOT acceptable for virus testing.
 - Rub the 2 dry sterile swabs on the appropriate area.
 - Immerse swab tips in 5ml of liquid viral transport or universal transport medium in the screw cap specimen tube.
 - Break the swabs to fit and seal tightly.
 - Urine
 - Collect 5-10 mL of urine in a sterile container. Urine does not need to be obtained via sterile methods, should not include preservatives, and should not be added to viral transport medium.
 - Insert specimen cup into plastic zip-lock bag or package specimen tube as for other samples.
- ◆ Measles IgG and IgM serology
 - Collect 7-10 mL of blood in a red top or serum separator tube (red-speckled or gold topped tubes).
 - Acute specimen: collect serum within 3-28 days of onset of symptoms.

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- Convalescent specimen: collect serum 14-30 days after the first (acute) specimen.
- Separate acute and convalescent serum specimens need to be collected using serum separator tube.
- Carefully complete the history form as described above.
- Label specimen tube with patient's name and collection date.
- When possible, centrifuge serum separator tube 20–30 minutes after collection.
- When testing for a four-fold rise in titer, acute and convalescent specimens are run simultaneously, so results will not be available until the convalescent specimen is collected, sent and tested.

Packaging and Shipping

- ◆ Refer to NYSDOH Wadsworth Center Measles Virus Testing Collection, Packaging and Shipping Instructions, located at https://www.health.ny.gov/prevention/immunization/providers/measles/docs/testing_collection.pdf.

Mailing instructions for the Wadsworth Center

- ◆ To ensure timely processing, please consult with the NYSDOH Bureau of Immunization at (518) 473-4437 prior to specimen shipment. Outside of routine business hours, call the Public Health Duty Officer Helpline at 1-866-881-2809.
- ◆ Complete and include the [Wadsworth Infectious Disease Requisition \(IDR\) Form](#) with specimen(s).
 - Access form at:
https://www.wadsworth.org/sites/default/files/WebDoc/1065760803/infectious_diseases_requisition_DOH_4463.pdf
- ◆ Ship measles viral specimens by overnight priority mail
 - Put specimen kit into Styrofoam mailing box
 - Include 2-3 frozen gel packs to keep specimen refrigerated
 - Specimens should be delivered on Tuesday through Friday, not on weekends or holidays.

Overnight delivery should be mailed to:

*Virus Isolation Laboratory
David Axelrod Institute
Wadsworth Center, NYSDOH
120 New Scotland Ave
Albany, NY 12208*

Questions? Call the Wadsworth Center at (518) 474-4177.

- ◆ Ship measles IgG and IgM serology by overnight priority mail
 - Put specimen kit into Styrofoam mailing box.
 - Include 1-2 cold packs to keep specimen refrigerated.
 - Specimens should be delivered on Tuesday through Friday, not on weekends or holidays.

Overnight delivery should be mailed to:

Diagnostic Immunology

**New York State Department of Health
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*David Axelrod Institute
Wadsworth Center, NYSDOH*

*120 New Scotland Ave
Albany, NY 12208*

Questions? Call the Wadsworth Center at (518) 474-4177.

- ◆ Weekend or holiday specimen submission may be considered in consultation with the NYSDOH Bureau of Immunization. Decisions are made on a case-by-case basis. Recommendations are based on clinical compatibility, risk to community or facility exposure, and the availability of laboratory staff. Due to financial constraints and limited staffing, only the highest risk cases will be tested on the weekend.

Case investigation

- ◆ All reports of suspected measles cases should be investigated immediately.
- ◆ Obtain necessary clinical information to determine whether a reported case is clinically compatible with measles.
 - Is any other diagnosis being considered or is any other testing being done?
- ◆ Obtain appropriate epidemiologic information, including immunization history, history of recent travel abroad or contact with international travelers/visitors, and history of exposure to a person with measles or similar symptoms.
- ◆ Suspect cases need laboratory confirmation (see above).
- ◆ The following information should be collected in the course of a case investigation:

Demographics

- ◆ Name
- ◆ Address
- ◆ DOB/age
- ◆ Race
- ◆ Ethnicity
- ◆ Gender
- ◆ Occupation/Setting
- ◆ Country of Birth
- ◆ Residency (United States or foreign visitor?)

Reporting source

- ◆ Date Reported
- ◆ Source
- ◆ Provider
- ◆ County

Clinical Information

- ◆ Rash (describe)
- ◆ Rash duration
- ◆ Fever

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- ◆ Cough
- ◆ Coryza
- ◆ Conjunctivitis
- ◆ Koplik spots
- ◆ Dates of onset of all symptoms

Complications

- ◆ Diarrhea
- ◆ Otitis media
- ◆ Pneumonia
- ◆ Acute encephalitis
- ◆ Seizures
- ◆ Respiratory distress
- ◆ Dehydration
- ◆ Preterm birth
- ◆ Hospitalization
- ◆ ICU admission

Laboratory results

- ◆ Lab name
- ◆ Date of specimen collection
- ◆ Type of tests
- ◆ Results/Confirmation

Vaccine history (Written or electronic records)

- ◆ Type
- ◆ Manufacturer
- ◆ Number of doses
- ◆ Vaccination dates
- ◆ Lot number
- ◆ Reason if not vaccinated

Outcome

- ◆ Case survived or died
- ◆ Date of death

Epidemiology

- ◆ Date investigation started
- ◆ Transmission setting
- ◆ Travel history (21 days prior to rash onset)
- ◆ Date of return to U.S.
- ◆ Contact with known case
- ◆ Outbreak related

Control measures

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This chapter serves as general measles control guidance; however, local and state health departments may recommend additional measures upon consideration of patient- and outbreak-specific factors such as, but not limited to, evidence of transmission, presence of high-risk populations, and immunization coverage in the exposed population.

- ◆ Case patients should be isolated for four days post rash onset.
- ◆ Initial preparation for major control activities may need to be started before the laboratory results are known.
- ◆ Identify all the locations the case patient visited while infectious. To the extent possible, identify any individuals who had contact with the case during the infectious period.
 - High priority groups for contact investigations include:
 - Household contacts
 - Close contacts other than household (i.e., persons who shared the same room or airspace in various settings)
 - Healthcare settings
 - Schools/child care centers, colleges, and other close settings where a defined number of people congregate (i.e., church)
 - Individuals at high risk for severe disease including infants who are not vaccinated, immunocompromised individuals, and pregnant women.
 - For locations that are not conducive to individual contact tracing (i.e., malls, stadiums, restaurants, etc.), communication with the general public, such as a press release, may be used to reach potentially exposed individuals.
- ◆ Review immunization and clinical status of all identified contacts.
- ◆ Exposed contacts lacking evidence of immunity should be excluded from public settings immediately upon confirmation of a case of measles and through 21 days after the last date of exposure. This time period may be extended through 28 days after the last date of exposure if IG is administered as PEP.
- ◆ See further guidance below regarding exclusion in specific settings.
- ◆ Presumptive evidence of measles immunity is defined as any of the following:
 - Born prior to 1957; or
 - Written or electronic documentation of acceptable vaccination, including dates administered:
 - 2 doses of measles-containing vaccine for children \geq 4 years and adults at high risk for exposure transmission (i.e. healthcare personnel, international travelers and students at post-high school educational institutions) with a minimum interval of 28 days from the first dose to the second dose;
 - One or more doses of a measles-containing vaccine administered on or after the first birthday for children aged 1 - 4 years and adults not at high risk; or
 - Laboratory evidence of immunity (positive serum measles IgG; equivocal results should be considered negative); or
 - Laboratory confirmation of disease, as defined above.
 - Verbal reports of vaccination without documentation should not be accepted.
- ◆ Persons who do not have presumptive evidence of immunity are considered susceptible.
- ◆ Postexposure prophylaxis (PEP) for susceptible contacts
 - Exposed persons who cannot readily document presumptive evidence of measles immunity should be offered PEP. A stat IgG measles immunity test may be considered to inform decision-making for persons with unknown measles immunity,

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- provided that PEP and other control measures are not delayed beyond appropriate windows.
- Vaccination within 72 hours of initial exposure, or immunoglobulin (IG) administered within six days of initial exposure, may provide some protection or modify the clinical course of disease.
 - In an ongoing outbreak, susceptible contacts who are not vaccinated within 72 hours, and who are not candidates for IG should still be immunized to provide protection against infection from future exposure. Individuals offered MMR vaccine more than 72 hours after exposure should be excluded for 21 days following their last exposure to measles and educated that they may still become ill from their recent exposure and to notify the LHD and their primary care provider of any signs and symptoms of measles infection.
 - People born after 1/1/1957 (who are 1 year of age or older) with no recorded measles vaccination should:
 - Receive one dose of MMR vaccine.
 - Be excluded from childcare, school and healthcare settings for 21 days after the last known exposure.
 - Be allowed to return to work (excluding healthcare settings) and general activities once vaccinated. However, LHDs should consider exclusion for 21 days after the last known exposure in an active outbreak and in individuals with prolonged or intense exposure to confirmed cases of measles.
 - Receive a second dose of vaccine not less than 28 days later.
 - People born after 1/1/1957 with only one recorded dose of measles vaccine should:
 - Receive a second dose.
 - Be allowed to return to childcare/school/work once vaccinated.
 - Healthy children 6 through 11 months of age:
 - Should receive MMR vaccine if administered within 72 hours of exposure.
 - This vaccination does NOT count as part of the routine 2-dose MMR series. These children will receive a total of 3 doses of MMR.
 - The following groups should **not** receive MMR vaccine, but can receive IG:
 - Pregnant women, or women planning to become pregnant within the next month,
 - Severely immunocompromised persons,
 - Infants under 6 months of age, or
 - Persons with a history of severe allergic reaction (e.g., anaphylaxis), after a previous dose or to a vaccine component.
 - ◆ Postexposure immunoglobulin (IG)
 - IG can be administered intramuscularly (IGIM) or intravenously (IGIV)
 - Indications:
 - Individuals at risk for severe disease and complications from measles should receive IG. This includes:
 - Infants under 6 months of age, including those with congenital measles. IGIM recommended.
 - Infants aged 6-11 months not vaccinated within 72 hours of initial exposure. IGIM recommended.
 - Susceptible household contacts or persons in settings with intense, prolonged close contact not vaccinated within 72 hours of initial exposure. IGIM recommended.

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- Postexposure use of IGIM in healthy adults might be limited because of volume limitations; persons who weigh > 30 kg will receive less than the recommended dose and will have lower titers than recommended. Careful consideration should be given to the potential advantages and disadvantages of IGIM use in persons who weigh > 30 kg. Consultation with NYSDOH is available if needed.
 - Susceptible pregnant women. IVIG recommended.
 - Severely immunocompromised persons, regardless of immunization status. IVIG recommended.
 - IG should not be used to control measles outbreaks, but rather to reduce the risk for infection and complications in the person receiving it.
 - Timing:
 - IG should be given within 6 days of initial exposure to prevent or modify disease.
 - Dosage:
 - IGIM: 0.5 ml/kg of body weight (maximum dose 15 ml).
 - IGIV: 400 mg/kg.
- Note: Persons receiving intravenous immunoglobulin (IVIG) at regular intervals for other reasons do not need additional IG if their last dose of IVIG was within three weeks of exposure and the dose was greater than 400 mg/kg.
- Individuals who receive IG within 6 days of exposure cannot return to healthcare, childcare or school settings for 28 days following their last exposure to measles since IG can prolong the incubation period.
 - The LHD should provide enhanced surveillance and a plan for follow-up should symptoms develop.
 - Regional and Central office staff are available for consultation on any special situations.
 - ◆ Immunization after IG administration
 - Blood and other antibody-containing blood products such as IG can inhibit the immune response to MMR and varicella-containing vaccines.
 - MMR and varicella-containing vaccines should not be administered sooner than 6 months after IGIM administration or 8 months after IGIV administration.
 - Any nonimmune person who received IG as PEP should receive MMR vaccine after the recommended interval from receipt of IGIM or IGIV, provided that the person is then at least 12 months old and the vaccine is not otherwise contraindicated.
 - ◆ Voluntary restrictions of movement and premises (VR)
 - Local health departments should refer to the NYSDOH Guidance on Measles Outbreak PEP, VR and Monitoring, dated August 29, 2019. Many nuanced circumstances exist; consult with the NYSDOH with questions about VR guidance.
 - Key points of information to be relayed to individuals for whom VR is recommended include:
 - Stay home.
 - Restrict visitors and other residents of the home to those with immunity to measles.
 - Monitor for signs and symptoms of measles. Call the healthcare provider as soon as possible if symptoms occur.

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- Alert the healthcare provider's office of the measles exposure before a visit (or in the case of emergency, alert the transporting EMT staff as soon as possible about the measles exposure).
- Persons who agree to VR must be treated with compassion and respect. LHDs should attempt to help meet these individuals' social, cultural, medical, and mental health needs and consider options to address financial hardships arising as a result of VR. Examples of the types of issues that may need to be addressed include but are not limited to:
 - Provision of basic needs like food, shelter, and medications.
 - Mental health and social service needs.
 - Telephone counseling.
 - Assistance in accessing culturally appropriate resources to help pass the time.
 - Communication needs (e.g. working telephone, cellular phone, email, internet).
 - Provision of supplies needed for personal hygiene.
 - Education of employer, referral for financial assistance through public programs, or referral to any other local resources that might be helpful to address financial hardships as a result of the restrictions (e.g. if not able to go to work).
 - Support needs, including but not limited to, family members, friends, and pets.
- ◆ **Monitoring of persons lacking evidence of immunity**
 - Monitor individuals lacking evidence of immunity, including those who receive PEP, for signs and symptoms of measles.
 - Monitor those who received MMR or who declined PEP for 21 days from the last day of exposure – one incubation period.
 - Monitor those who received IG for 28 days from the last day of exposure because IG may prolong the incubation period.
 - Any susceptible contact who develops any measles-like symptoms, including fever, cough, runny nose, conjunctivitis, or rash should be:
 - Immediately excluded from daycare/school/work for at least 5 days.
 - Offered appropriate diagnostic testing if a rash develops.
 - Advised to call ahead before visiting a clinic or emergency department to ensure appropriate infection control precautions are in place prior to the medical encounter.
 - Excluded for at least another 4 days after the onset of a rash.

Control measures for schools, daycares and other educational institutions

- ◆ Review immunization records of all students and school personnel born on or after 1/1/1957.
- ◆ Persons who cannot readily provide documentation of measles immunity as described above must be excluded from the school or institution.
- ◆ Persons with documentation of one dose of measles-containing vaccine who are subsequently vaccinated with a second dose may be immediately readmitted to the school or institution.
 - These individuals should be monitored for signs and symptoms of measles.

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- ◆ Persons who continue to be exempted from, or who refuse measles vaccination must be excluded from the school, childcare or other institution until 21 days after the onset of rash in the last case of measles.
- ◆ School activity restrictions during an outbreak:
 - For extracurricular activities, all participating individuals must be in compliance with the standards of measles immunity, be properly vaccinated or excluded as defined above.
 - The LHD should be notified of the planned event in order to review the activity plans and the measles immunity status of the participating persons. The LHD, in consultation with the NYSDOH, may advise cancellation of travel events based on the nature of the outbreak.
 - To reduce potential spread of measles disease, no spectators should be present at any indoor sporting or extracurricular activity involving students from the affected school. Outdoor activities may be permitted to have spectators only if the ability exists to restrict the spectators to those with evidence of measles immunity.
 - LHDs where the school resides, as well as the LHD receiving the participants, will insure that all participants are properly protected and provide enhanced surveillance for measles during the outbreak period or 21 days after the last exposure to the last reported case of measles.
- ◆ For school and post-secondary institutions, this guidance is in compliance with PHL 2164, PHL 2165 and NYCRR 66-1 and 66-2.

Control of outbreaks in summer camps:

- ◆ Case patients will need to be excluded or appropriately isolated while infectious.
- ◆ Review immunization records of all contacts born on or after 1/1/1957.
- ◆ List those who have not had 2 appropriately timed doses of measles vaccine or other proof of immunity to measles.
- ◆ Persons who cannot readily provide documentation of measles immunity as described above must be excluded or appropriately isolated in the camp setting. The LHD or NYSDOH can provide guidance for isolation recommendations.
- ◆ Persons with documentation of one dose of measles-containing vaccine who are subsequently vaccinated with a second dose may be immediately readmitted to the camp setting.
- ◆ For offsite or intercamp activities, all participating individuals must be in compliance with the standards of measles immunity, be properly vaccinated or excluded.
 - The LHD should be notified of the planned event to review the activity plans and the measles immunity status of the participating persons. The LHD, in consultation with the NYSDOH, may advise cancellation of travel events based on the nature of the outbreak.
 - Also, based on the nature of the measles outbreak, camp activities may be confined to the camp grounds with no other groups attending until 21 days after the date of onset of the last case.

Control measures for healthcare settings

- ◆ Implement airborne and standard precautions for patients in whom measles is suspected or confirmed.
 - Airborne precautions include isolation in a negative pressure isolation room, also known as an airborne infection isolation room (AIIR).

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- In clinic settings, where an AIIR may not be available, a single room with the door closed and away from susceptible contacts may be used when evaluating suspect measles patients.
- Suspect or confirmed measles patients should be asked to wear a surgical mask.
- ◆ **NOTE: Regardless of presumptive immune status, all healthcare staff entering a room with a patient who is potentially ill with measles should use respiratory protection consistent with airborne infection control precautions** (use of an N95 respirator or a respirator with similar effectiveness in preventing airborne transmission). Because of the possibility, albeit low, of MMR vaccine failure in healthcare providers exposed to infected patients, they should all observe airborne precautions in caring for patients with measles.
- ◆ Review the evidence of measles immunity for all exposed personnel.
 - Title 10 of NYS PHL requires all personnel born on or after 1/1/1957 working in certain healthcare facilities and home care agencies to have documented immunity to measles, or to be properly vaccinated with **two** measles-containing vaccines (unless a licensed physician, physician assistant, specialist assistant, licensed midwife or nurse practitioner certifies that immunization with measles vaccine may be detrimental to the person's health).
- ◆ If a measles outbreak occurs within or in the area served by a hospital, clinic/medical office, or other medical or nursing facility, all personnel regardless of birth year, that do not have written documentation of measles immunity (either serology or 2 doses of measles-containing vaccine) should receive a dose of MMR vaccine (and a second MMR dose 28 days after the first) unless vaccination is contraindicated. **Birth before 1957 is not acceptable presumptive evidence of immunity for personnel in a healthcare setting during an outbreak.**
- ◆ Serologic screening of healthcare personnel during an outbreak to determine measles immunity is not recommended. Results from serologic testing, if performed, should not delay the administration of MMR vaccine while waiting for the results of testing; however, the results can inform the need for the second MMR vaccine dose.
- ◆ Susceptible personnel who have been exposed to measles should be relieved from patient contact and excluded from the facility from the 5th day after their first exposure to the 21st day after their last exposure, regardless of whether they received postexposure prophylaxis.
 - Personnel with documentation of one measles-containing vaccine may remain at work and should receive their second dose.
- ◆ Exposed personnel should monitor for signs and symptoms of measles for 21 days after their last exposure.
- ◆ Exposed personnel who become ill should be relieved from all patient contact and excluded from the facility for 4 days after they develop rash.
- ◆ Hospital patient contacts of a case, who do not have presumptive evidence of measles immunity, should be vaccinated or offered IG (as discussed above) or placed on airborne precautions for 21 days after their last exposure to the case patient or four days after the onset of rash should they develop measles.
 - If IG is administered to an exposed person, observation should continue for 28 days after exposure.

Additional clinical information

- ◆ **Atypical Measles**
 - Occurs only in persons who received inactivated (killed) measles vaccine (KMV) and are subsequently exposed to wild-type measles virus.
 - Approximately 600,000-900,000 persons received KMV in the U.S. from 1963-67.
 - Illness is characterized by fever, pneumonia, pleural effusions and edema.
 - Rash is usually maculopapular, petechial, but may have urticarial, purpuric, or vesicular components. It appears first on wrist and ankles.
 - Atypical measles may be prevented by revaccinating with live measles vaccine.
 - Moderate to severe local reactions with or without fever may follow vaccination. However, these reactions are less severe than with wild type measles infection.
- ◆ **Measles in vaccinated persons**
 - May have a modified disease presentation and is usually detected during an outbreak or after known exposure to a confirmed case of measles
 - See testing and diagnosis section for recommended laboratory testing guidance.
 - Also has been described as secondary immune response (SIR).
- ◆ **Measles vaccine reaction**
 - Reactions following measles vaccine represent replication of measles vaccine virus with subsequent mild illness.
 - These events occur 6-12 days post-vaccination only in persons who are susceptible to infection.
 - Reactions include fever, transient rash and lymphadenopathy.