Wake County Health and Human Services
Public Health Division, Communicable Disease Program

Measles Guide

Adapted with permission from California Department of Public Health

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INTRODUCTION

Measles is highly contagious, with a 90% secondary attack rate in susceptible populations. Transmission of airborne measles virus has occurred up to 2 hours after a case occupied a room. Up to 9 out of 10 susceptible people with close contact to a measles patient will develop measles. Measles is a public health emergency.

Endemic transmission of measles no longer occurs in the United States. Rapid identification of travel-related cases is key to preventing spread. Contact investigations should proceed immediately for all cases of measles. When measles is strongly suspected, attempts to identify and provide prophylaxis to close contacts should proceed without delay. Prophylaxis (MMR given within 72 hours of exposure or IG given within 6 days) may prevent disease.

BASICS

Mode of transmission

Measles virus is transmitted from person to person via respiratory droplets. Although transmission occurs primarily through direct contact with infectious droplets, airborne transmission in a closed area has been documented for up to 2 hours after a person with measles was in the area.

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Incubation period

The average incubation period for measles is 11–12 days, and the average interval between exposure and rash onset is 14 days, with a range of 7–21 days.

Clinical signs and symptoms*

- Prodrome (7-14 days after infection)
    - Fever
    - Cough
    - Coryza (runny nose)
    - Conjunctivitis (red, watery eyes)
    - Some cases also report diarrhea, nausea, and vomiting.
- Koplik spots (tiny white spots), a characteristic sign of measles, may appear inside the mouth (2-3 days after symptoms begin) and last 5-6 days.
- Maculopapular rash (both flat and raised skin lesions; 3-5 days after symptoms begin) appears on the face at the hairline, then spreads downward to the neck, trunk, arms, legs and feet. Fevers may spike at this time, often to >104°F. In approximately one week, the rash fades in the same sequence that it appeared. Atypical rashes have been reported.

* Previously vaccinated individuals may have a modified disease presentation.

Complications

Common:

- Otitis media
- Broncho pneumonia
- Laryngotracheobronchitis (croup)
- Diarrhea

Serious:

- Encephalitis
- Respiratory and neurologic complications
- Subacute sclerosing panencephalitis (SSPE; rare degenerative disease of central nervous system)

People who are at high risk for complications include:

- Infants and children under age 5
- Adults over 20 years old
- Pregnant women
- People with weakened immune systems

Infectious period

People with measles are considered infectious from 4 days before until 4 days after onset of rash, with the rash onset being considered as day 0.

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Exposure

The following are considered exposure to measles:

- Sharing the same airspace with a person infectious with measles e.g., same classroom, home, clinic waiting room, etc.
- Being in these areas up to 1 hour after the infectious person left the area

This applies even if the infectious person was masked. Exposures that are longer in duration and/or face to face are more likely to result in measles transmission.

Wake County Communicable Disease Program may notify local health care providers when exposures have occurred in venues in which it is not possible to identify exposed individuals. They can then be on alert for possible cases.

Case definition

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

Case classification

- **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
  - Noncontributory 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.

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Outbreak

- Three or more epi linked cases of measles where at least one is laboratory confirmed within 42 days of each other.
- Active surveillance is maintained for at least two incubation periods (42 days) after the last reported confirmed case to ensure that all cases are identified before an outbreak investigation closes.

TREATMENT

No specific antiviral therapy is available for measles, treatment and management are supportive.

- CDC updated recommendation on vitamin A

PREVENTION

Vaccination (MMR or MMRV) is the most effective way to prevent measles infection.

- Children should routinely get two doses of MMR vaccine: one at age 12-15 months and a second at 4-6 years.
- Children can receive the second dose of MMR vaccine earlier than 4-6 years of age if it is at least 28 days after the first dose.
- A second dose of MMRV vaccine can be given 3 months after the first dose, up to 12 years of age. CDC recommends that separate MMR and varicella vaccines be given for the first dose in children aged 12-47 months; however, MMRV may be used if parents or caregivers express a preference.
- Adults and teens should be up to date on MMR vaccinations with either one or two doses (depending on risk factors) unless they have other presumptive evidence of immunity (see "Presumption of Immunity" Criteria for Low-Risk Contacts)
    - MMR vaccination (or other evidence of immunity) is especially important for healthcare professionals, international travelers, college students, close contacts of immunocompromised people, people with HIV infection, adults who got inactivated measles vaccine, and groups at increased risk during measles outbreaks.
- Any clinically significant events, unexpected events following vaccination, and/or events listed on the vaccine manufacturer's package insert should be reported to the Vaccine Adverse Event Reporting System (VAERS).
- See CDC Measles Vaccine Recommendations for more information about measles vaccination.

LABORATORY TESTING

Commercial laboratories

Some commercial laboratories offer serology and PCR testing for measles.

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North Carolina State Laboratory of Public Health (NC SLPH).
*Testing through NC SLPH is available only with prior approval from the Communicable Disease Branch, but in most circumstances is much faster than commercial testing***.** Discuss testing at NC SLPH by contacting the:

- Communicable Disease Branch (919-733-3419; available 24/7) or
- Wake County Communicable Disease Program* (919-250-4462)

NCSLPH can test nasopharyngeal (NP) specimens in viral transport medium (VTM) and will forward other specimens to a vaccine preventable disease center or the CDC. Contact the Virology/Serology Unit at NC SLPH (919-733-3937) for any questions related to specimen collection, storage, and shipment.

- Specimen Collection and Shipment to NC SLPH
- NCSLPH SCOPE Guide to Laboratory Services (additional information about submission criteria and shipping)

ASSESSING SUSPECT CASES

Consider measles in patients of any age, regardless of vaccination history, who have:

- A fever ≥101° F, **plus**
- At least one of the 3 "Cs" (cough, coryza or conjunctivitis) **and**
- A descending rash that starts on the face (rash typically follows the onset of illness within 4 days).
- Any of the following epidemiological risk factors in the past 21 days:
    - Known contact with a measles case or an ill person with fever and a rash
    - Contact with an international visitor who arrived in the U.S.
    - Travel outside the U.S.
    - Domestic travel through an international airport
    - Visit to a U.S. venue popular with international visitors such as a large theme park
    - Lives in or visited a U.S. community where there are measles cases

Still consider measles if the clinical presentation is highly suggestive of measles but no epidemiologic risk factor can be elicited. Immediately mask suspect cases and follow guidelines for infection control.

Collect the following information if a suspect measles case reports air travel during their infectious period:

- Departure and arrival cities
- Flight number, date, and time
- Terminal and/or gate number

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- Seat number
- Information on any traveling companions.

Contact Wake County Communicable Disease Program* (919-250-4462) immediately.

- Measles resource for Heath Care Providers

*Providers outside Wake County should call their local health department.

ISOLATION AND QUARANTINE

Isolation and quarantine are public health practices used to prevent exposure to people who have or may have a contagious disease.

Isolation

Isolation separates those with suspected or confirmed illness from those who are not ill. Those with suspected or confirmed illness should self-isolate at home, away from non-household and unimmunized contacts.

- Confirmed measles cases
  - Isolate during their infectious period, from 4 days before rash onset through 4 days after rash onset (the day of rash onset is considered day 0).
  - Exclude from school, daycare, healthcare facilities, workplaces and other places where people gather. Cases should remain at home and limit exposure to others (see Tables 1-3).
  - Use airborne** and standard precautions in healthcare settings. Ask patient to wear an N95 mask.
  - Notify health care facilities prior to arrival of confirmed cases requiring medical attention so appropriate precautions can be taken.

- Suspect measles cases
  - Isolate until measles is ruled out or until their presumed infectious period is over.
  - Use airborne** and standard precautions in healthcare facilities. Ask patient to wear an N-95 mask.
  - Notify health care facilities prior to arrival of suspect cases requiring medical attention so appropriate precautions can be taken.

**Airborne precautions include isolation in a negative air pressure room. Use a single room with the door closed and away from susceptible contacts to evaluate suspect measles cases when a negative air pressure room is not available.

Quarantine

Quarantine separates and limits the movement of people exposed to a contagious disease.

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They may
- Have been exposed to the disease and not know it or
- Have the disease and not show symptoms.

Wake County Communicable Disease Program determines when quarantine for measles is implemented and for how long.

LOW-RISK CONTACTS AND SETTINGS

Low-risk contact
A person who:
- Is not at high risk of experiencing severe measles illness, or
- To/from whom the transmission potential is not high

Examples of low-risk contacts include those who are:
- Immunocompetent
- ≥12 months of age
- Not pregnant
- Not a healthcare worker
- Not a household contact

Low risk setting
A low-risk setting is one in which transmission risk is low and multiple high-risk contacts are **not** present.

"Presumption of Immunity" Criteria for Low-Risk Contacts
Low-risk contacts can be presumed to be immune to measles for the purposes of measles case investigations if they meet one of the following criteria:
- Were born in the U.S. prior to 1957
- Were born outside the U.S. prior to 1970 **AND** moved to the U.S. in 1970 or later***
- Were born in any country in 1976 or later **AND** attended a U.S. primary or secondary school***
- Have written documentation with date of receipt of **at least one dose** of measles-containing vaccine given on or after their first birthday in 1968 or later
- Have a documented IgG positive test for measles
- Have laboratory confirmation of previous measles disease
- Served in the U.S. armed forces
- Entered the U.S. as a permanent U.S. resident or became one in 1996 or later (i.e., have a "green card)

***Unless known to be unvaccinated for measles, e.g., having a medical contraindication to vaccination or being philosophically or religiously opposed to vaccinations

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HIGH-RISK CONTACTS AND SETTINGS

High-risk contact

A person:

- Who may experience severe illness if they become infected with measles or
- To whom the transmission potential is high

Examples of high-risk contacts include:

- Infants up to 11 months of age
- Immunocompromised persons
- Pregnant persons
- Household contacts
- Contacts with prolonged exposure
- Healthcare workers or persons in settings with known unvaccinated persons (e.g., infant care settings)

High-risk setting

A high-risk setting is one:

- In which transmission risk is high (e.g., setting with a large number of measles-susceptible persons, or an infant care setting), or
- Where there are multiple high-risk contacts, particularly persons who could experience severe disease if infected with measles

Healthcare settings are considered high-risk settings for the purpose of exclusion of potentially infectious people. (Healthcare contacts without prolonged exposure who are not healthcare workers and are otherwise not high-risk can be followed up as low-risk contacts.)

Additional evidence of immunity is required for high-risk contacts and settings and may also be required during an outbreak. Acceptable evidence of immunity includes:

- Documentation of **two doses** of measles vaccine given in 1968 or later, separated by at least 28 days, with the first dose on or after the first birthday
- If no documentation of two doses of measles vaccine, a documented IgG positive test for measles
- Laboratory confirmation of previous disease

POST EXPOSURE PROPHYLAXIS (PEP)

Prophylaxis of susceptible household contacts should occur immediately and should not be delayed because of pending laboratory results.

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Waiting for laboratory confirmation of measles infection prior to prophylaxis of non-household contacts (e.g., schoolmates) may be reasonable in some situations; however, this should be evaluated on a case-by-case basis.

MMR and immune globulin as PEP

The administration of MMR versus immune globulin (IG) as PEP to exposed contacts depends primarily upon:

- Time since exposure
- Age of the contact and
- Risk status of the contact (e.g., pregnant or immunocompromised)

Please contact Wake County Communicable Disease Program at 919-250-4462* if you have questions about which type of PEP is appropriate.

*Providers outside Wake County should call their local health department.

- **MMR vaccine for PEP**
  - Susceptible persons ≥6 months of age with 1 or no documented doses of MMR may receive MMR vaccine to decrease their risk of developing disease if not contraindicated.
  - Give MMR vaccine as soon as possible after first exposure and up to 72 hours of the last exposure to measles.

- **Immune globulin (IG) for PEP**
  - IG may be given to eligible exposed susceptible persons (and severely immunocompromised persons regardless of immune status) ≤6 days from date of **last exposure** to prevent infection. However, only IG administered ≤6 days after **first exposure** to the case while the case is infectious is considered adequate PEP for public health contact management.
  - Persons who receive IG >6 days after the **first exposure** to the case while the case is infectious should be placed in quarantine.
  - Because the effectiveness of IG PEP at preventing measles varies, it is recommended that persons who receive IG PEP be excluded from high-risk settings during their potential incubation period (see Table 2).

EXCLUSION OF CONTACTS

Asymptomatic contacts who demonstrate presumptive evidence of immunity do not need to be excluded.

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For all others:

- Contacts lacking presumptive evidence of immunity who do not receive appropriate postexposure prophylaxis within the appropriate time must be excluded from school, childcare, healthcare facilities, and workplaces until at least 21 days after the last exposure to a case during the infectious period. Exclude:
  - From schools and childcare until at least 21 days after the onset of rash in the last case identified
  - From medical settings from the 5th day after first exposure through the 21st day after last exposure
- For contacts who are healthcare providers and lack presumptive evidence of immunity:
  - Offer healthcare providers with no prior documented doses of MMR, the first dose of MMR vaccine. Exclude from work from day 5 after their first measles exposure through day 21 following their last exposure.
  - Healthcare providers who received a single dose of MMR vaccine prior to exposure may remain at work and should receive the second dose of MMR vaccine at least 28 days after the first dose.
  - Exclude healthcare providers who receive IG as PEP from work from the 5th day after their first exposure through the 21st day after their last exposure.
- If exclusion of those other than healthcare workers is implemented, it should begin on day 7 after the date of first exposure through day 21 after the date of last exposure (day of exposure is day 0)
- Contacts who lack presumptive evidence of immunity and who receive MMR PEP within 72 hours of exposure can be immediately readmitted to childcare, school, or non-healthcare work.
- Exclude contacts who lack presumptive evidence of immunity and receive IG PEP from settings where transmission risk is high (e.g., settings with a large number of susceptible persons or infant care settings). Exclusion should last at least 21 days, and ideally 28 days, following the last exposure to a case during the infectious period.
- Exclude contacts who develop signs or symptoms of measles, regardless of evidence of immunity or receipt of PEP, from school, childcare, healthcare facilities, and workplaces, until evaluated further.

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FOLLOW UP OF MEASLES CONTACTS

High Risk Contacts

Table 1. Recommended Follow-Up of High-risk Measles Contacts
(persons with potential for severe illness if infected **or** to whom the transmission potential is high)

High-risk contacts	IgG testing	PEP†	Quarantine if no PEP‡	Exclusion	Monitoring§
Unvaccinated infants <6 months of age	No	IG only	Yes	Yes**	Active
Unvaccinated infants 6-11 months of age ††	No	MMR or IG‡‡	Yes	Yes**	Active
Pregnant persons without 2 documented MMR vaccine doses or serologic evidence of immunity‡‡	Yes	IG only	Yes	Yes**	Active
Severely immunocompromised	No	IG only	Yes	Yes**	Active
Household contact or contact with prolonged exposure **without** 2 documented MMR vaccine doses or serologic evidence of immunity	Yes	MMR or IG***	Yes	Yes**	Active
Immunocompetent contact **with** 2 documented MMR vaccine doses or serologic evidence of immunity	No	No	No	No	Passive

† Contacts at high risk of severe infection (severely immunocompromised people, unvaccinated infants, and susceptible pregnant persons) should receive IG PEP within 6 days or less from the date of last exposure to measles.

‡ Implement quarantine from day 7 after first exposure through day 21 after last exposure. If symptoms consistent with measles develop, the exposed person should be isolated and tested.

§ Persons who receive IG should be actively monitored for 21 days. They should then passively monitor (symptom watch) during days 22-28.

** Exclude from high-risk settings (e.g., childcare facilities with infants and healthcare facilities; see definition above) from day 7 (day 5 for healthcare workers in healthcare settings) after first exposure through day 21 after last exposure. Those who have received IG should exclude through day 28 after last exposure.

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†† MMR vaccine can be given as PEP within 72 hours or less from the time of exposure to persons >6 months of age who do not have contraindications for MMR vaccine. Intramuscular immune globulin (IMIG) can be given as PEP for exposed infants <12 months of age <6 days from exposure. Persons >12 months of age who may have been vaccinated or had disease and receive MMR vaccine as PEP should have blood drawn and tested for measles IgG if measles IgG status is unknown at the time of MMR administration.

‡‡ If it can be done rapidly, it is recommended that pregnant persons be tested for measles IgG prior to administering IGIV if it is likely that they have received vaccine or had disease. If an exposed pregnant person is IgG negative or IgG equivocal or has unknown status and IgG test results will not be known by day 6 after exposure, administer IGIV.

*** IGIM can be considered for susceptible persons in this category weighing <30 kg (<66 pounds). There is no recommendation for IGIM in susceptible persons >30 kg (≥66 pounds). MMR PEP is preferred if <72 hours of exposure. IGIV is not recommended for low-risk contacts weighing ≥30 kg (≥66 pounds).

Contacts in Healthcare or Other High-Risk Setting

Table 2. Recommended Follow-Up of Measles Contacts Who Work in a Healthcare Setting or Other High-Risk Setting

Contacts who work in a healthcare setting or other high-risk setting	IgG testing	PEP	Quarantine if no PEP‡	Exclusion	Monitoring
High-risk for severe disease due to personal medical history and without 2 documented MMR vaccine doses or serologic evidence of immunity	See Table 1				
Low risk for severe disease and with 1 documented MMR vaccine dose and no serologic evidence of immunity	Yes	MMR	No	Yes**	Active
Low risk for severe disease and with no documented MMR vaccine doses and no serologic evidence of immunity	Yes	MMR	Yes	Yes**	Active
With 2 documented MMR vaccine doses or serologic evidence of immunity	No	No	No	No	Passive

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‡ Implement quarantine from day 7 after first exposure through day 21 after last exposure. If symptoms consistent with measles develop, the exposed person should be isolated and tested.

** Exclude from high-risk settings (e.g., childcare facilities with infants and healthcare facilities; see definition above) from day 7 (day 5 for healthcare workers in healthcare settings) after first exposure through day 21 after last exposure. Those who have received IG should exclude through day 28 after last exposure

Low Risk Contacts

Table 3. Recommended Follow-Up of Low-Risk Measles Contacts
(immunocompetent persons, persons ≥12 months of age, not pregnant, not a healthcare worker, not a household contact)

Low-risk contacts	IgG testing	PEP	Quarantine if no PEP‡	Exclusion	Monitoring§
Two documented doses of MMR vaccine (3% will be susceptible)	No	No	No	No	Passive
Known to be measles IgG positive (<1% will be susceptible)					
Meets presumption of immunity criteria (including 1 documented MMR dose)	If desired	MMR if desired	No	Yes**	Passive
Unknown or no documentation of vaccination or immune status, **without** presumption of immunity†††	Yes	MMR	Yes	Yes**	Active
Prior measles IgG negative test result†††					
Known to be unvaccinated†††	No	MMR	Yes	Yes**	Active

‡ Implement quarantine from day 7 after first exposure through day 21 after last exposure. If symptoms consistent with measles develop, the exposed person should be isolated and tested.

§ Persons who receive IG should be actively monitored for 21 days. They should then passively monitor (symptom watch) during days 22-28.

** Exclude from high-risk settings (e.g., childcare facilities with infants and healthcare facilities; see definition above) from day 7 (day 5 for healthcare workers in healthcare settings) after first exposure through day 21 after last exposure. Those who have received IG should exclude through day 28 after last exposure.

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††† See page 7 for "Presumption of Immunity Criteria for Low-Risk Contacts". A self-reported history of measles disease without documentation is **not** acceptable as a presumption of immunity. If a low-risk contact has a measles IgG negative or IgG equivocal result and subsequently provides documentation of two doses of MMR vaccine, base public health decisions on the two documented doses of MMR vaccine, i.e., presume immunity.

RESOURCES

Interim Infection Prevention and Control Recommendations for Measles in Healthcare Settings Centers for Disease Control and Prevention. cdc.gov/infection-control/hcp/measles/index.html. April 2024.

Measles (Rubeola) Resources for Health Care Providers Division of Public Health, NC Department of Health and Human Services. dph.ncdhhs.gov/programs/epidemiology/communicable-disease/measles/providers#Tab-Diagnosisresources-5581

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