

Measles: Rapid Evidence Review

David S. Gregory, MD; Shefali S. Shah, MD; and Brittany L. England, MD

Measles is one of the most contagious, vaccine-preventable viral infections, capable of infecting up to 90% of exposed nonimmune people. Respiratory droplets and aerosols from people infected with measles remain infectious for up to 2 hours. Infection in unvaccinated people can lead to hospitalization and death. Approximately 1 to 3 of every 1,000 children with measles will die from complications. Measles-mumps-rubella vaccination is highly safe and effective at reducing infection risk and preventing community spread. Population-based studies have found no association between vaccination and autism spectrum disorder or other neurodevelopmental disorders. Although measles has been considered eliminated in the United States since 2000, outbreaks have recently become larger and more common because vaccination rates in many states and counties have fallen below herd immunity thresholds. Symptoms include cough, coryza, conjunctivitis, and fever, followed by erythematous maculopapular exanthem. Family physicians play a key role in increasing vaccination rates and reducing risk of community spread through appropriate suspicion, early diagnostic testing, and isolation of people who are infected. Vitamin A supplementation may reduce mortality rates in hospitalized children with severe or complicated measles but should be used only under medical supervision to avoid toxicity; it should be avoided during pregnancy. Management of measles outbreaks requires isolating people who have been exposed or infected, discerning which people who were exposed have presumed immunity, and providing postexposure prophylaxis to nonimmune people with vaccination or immunoglobulin infusion.

Am Fam Physician. 2026;online. Copyright © 2026 American Academy of Family Physicians.

Published online October 15, 2026.

Measles is caused by rubeola, a virus capable of infecting up to 90% of nonimmune people who have been exposed. Respiratory droplets and aerosols suspended in the air remain infectious for up to 2 hours.¹ Infection rates have increased in recent years, and family physicians play a pivotal role in increasing vaccination rates and managing measles

outbreaks. This review summarizes the epidemiologic trends and evidence for diagnosis, prevention, and treatment of measles.

EPIDEMIOLOGY

- Before the vaccine was introduced in 1963, hundreds of measles deaths were reported annually in the United States, but by 2000, measles was considered eliminated nationwide.^{2,3} Measles outbreaks have been associated with international travel but since 2023 have become more common and widespread because of decreasing vaccination rates in many states and counties.^{2,4}
- eFigure A shows numbers of confirmed infections by state, and Figure 1 shows vaccination rates for kindergartners by county.⁴ The number of measles cases in the United States increased from 285 in 2024 to 2,288 (with three confirmed deaths) in 2025.² There have been 4,080 confirmed cases in 2026 as of October 9.²
- Approximately 1 to 3 of every 1,000 children with measles will die from complications.⁵
- The Centers for Disease Control and Prevention website and Johns Hopkins University measles tracker have the most up-to-date data on cases and vaccination rates.^{2,6} Table 1 lists online resources for tracking and managing outbreaks.

PREVENTION

- Measles-mumps-rubella vaccination is the only effective way to prevent measles infection.⁷
- Vaccination uses a live-attenuated virus to induce immunity, which is contraindicated in children younger than 6 months, pregnant people, and people with immunodeficiency.⁸

DAVID S. GREGORY, MD, FAAFP, is the regional medical director of the Virginia Tech Carilion Family Medicine Residency Program, and a professor in the Department of Family and Community Medicine at Virginia Tech Carilion School of Medicine, Roanoke.

SHEFALI S. SHAH, MD, is a core faculty member at the Virginia Tech Carilion Family Medicine Residency Program, and an assistant professor in the Department of Family and Community Medicine at Virginia Tech Carilion School of Medicine, Roanoke.

BRITTANY L. ENGLAND, MD, is a clinical faculty member at Virginia Tech Carilion Family Medicine Residency Program, and an assistant professor in the Department of Family and Community Medicine at Virginia Tech Carilion School of Medicine, Roanoke.

Author Disclosure: No relevant financial relationships.

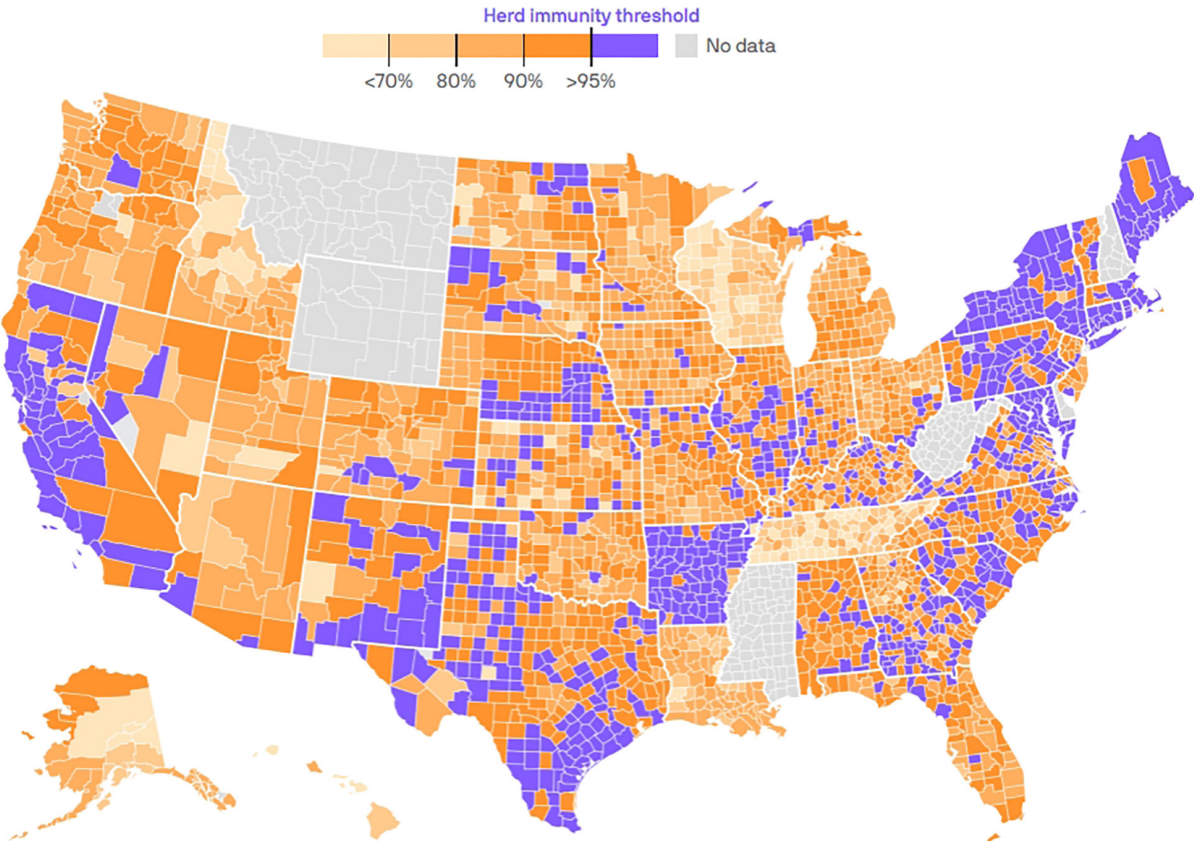
Address correspondence to David S. Gregory, MD, at dgregory2@carilionclinic.org.

SORT: KEY RECOMMENDATIONS FOR PRACTICE

Clinical recommendation	Evidence rating	Comments
Measles-mumps-rubella vaccination is highly safe and the only effective way to prevent measles infections and complications in people 1 year and older who are not pregnant and are immunocompetent. ^{7,9-14}	A	Large population-based outcome trials
Population-based studies have found no association between measles-mumps-rubella vaccination and autism spectrum disorder. ⁹⁻¹⁴	A	Large population-based outcome trials
Real-time polymerase chain reaction testing should be used to diagnose suspected measles infection and define outbreaks. ²³	C	Small diagnostic accuracy studies
Appropriately dosed and medically supervised vitamin A supplementation may be used to reduce mortality risk in hospitalized children with severe or complicated measles. Unsupervised supplementation should be discouraged to avoid potential toxicity. ^{24,29-32,34}	B	Meta-analysis of multiple studies performed outside the United States

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to <https://www.aafp.org/afpsort>.

FIGURE 1



Measles vaccination rates for kindergartners, by county. Measles-mumps-rubella or overall vaccination rates for either 2023 or 2024 depending on data availability.

Note: A rate of 92%-94% immunity confers herd immunity. Counties with < 90%-95% vaccination rates may not have herd immunity.

Reprinted with permission from Axios. Where vaccination rates declined the most, by county. December 31, 2025. Accessed August 30, 2026. <https://www.axios.com/2025/12/31/measles-flu-vaccine-mmr-rates-2026>

• Extensive studies have repeatedly confirmed that vaccination is highly safe in people 1 year and older who are not pregnant and are immunocompetent.⁷ Population-based studies have found no association between vaccination and autism spectrum disorder or other neurodevelopmental disorders.⁹⁻¹⁴

• Immunity following vaccination is 93% to 95% after the first dose and 97% to 99% after the second dose.⁸ Measles infection confers long-lasting immunity in only 15% to 20% of cases.⁸

• Spread of measles can be further reduced when 92% to 94% of the population is vaccinated, reaching a community immunity threshold or herd immunity.¹⁵

• Family physicians' recommendations for vaccination play a pivotal role in increasing vaccination rates and developing herd immunity.¹⁶

• Vitamin A supplementation does not reduce risk of measles infection and should not be used as a substitute for vaccination.³

• To prevent transmission in health care settings, people with suspected measles should wear masks, ideally N95-grade; avoid gathering areas (eg, waiting rooms, hallways); and be placed directly in isolation rooms as far away from others as possible, ideally in an airborne infection isolation room. Clinicians should follow standard and airborne precautions by wearing N95-grade masks, eye protection, gowns, and gloves.

CLINICAL PRESENTATION AND DIAGNOSIS

• Fever and rash should prompt suspicion for measles, especially if the patient has not received the measles-mumps-rubella vaccine, has recently traveled internationally, or is from a community with a low vaccination rate.

• Differential diagnosis varies by clinical stage, making diagnosis challenging before eruption of the characteristic exanthem.^{5,7}

• During the prodromal phase, the differential includes other common viruses (eg, rhinovirus, parainfluenza, influenza, adenovirus, respiratory syncytial virus).

• Onset of an exanthem helps narrow the diagnosis to exanthem-causing viruses, summarized in Table 2.¹⁷⁻²⁰

Signs and Symptoms

• Following exposure and a typical incubation period of 7 to 21 days, symptoms begin with a prodromal phase, including fever and any of the three Cs (cough, coryza, conjunctivitis).^{5,7}

• Early symptoms such as diarrhea, nausea, malaise, and myalgias occur 1 to 2 days after the prodromal phase begins.^{5,7}

• An erythematous maculopapular exanthem appears 2 to 4 days following the nonspecific prodromal phase.^{5,7}

TABLE 1

Resources for Tracking and Managing Measles

Resource	Website
Be Ready for Measles Toolkit	https://www.cdc.gov/measles/php/toolkit/index.html
24/7 Phone Numbers	https://libraries.cste.org/24-7-table
Johns Hopkins University US Measles Tracker	https://publichealth.jhu.edu/ivac/resources/us-measles-tracker
Laboratory Testing for Measles	https://www.cdc.gov/measles/php/laboratories/index.html
Measles Cases and Outbreaks	https://www.cdc.gov/measles/data-research/index.html
Measles Prevention and Treatment Overview	https://www.cdc.gov/measles/media/pdfs/2026/05/measles-prevention-and-treatment-overview.pdf
VaxView Vaccination Coverage	https://www.cdc.gov/vaccines/data-reporting

• The exanthem is the most characteristic symptom, with several key features unique to measles^{5,7} (Figure 2²¹):

- Onset on the face, hairline, or behind the ears, spreading to the neck, trunk, and extremities
- Maculopapular coalescing as the rash spreads
- Nonpruritic
- Koplik spots (small blueish-white plaques on an erythematous base, present on the buccal mucosa and pathognomonic for measles)
- Hyperpigmentation and/or purple macules and papules in dark skin tones
- Progression to scarring, hypopigmentation, and desquamation
- Fading in the order of presentation

Diagnostic Testing

• Suspected measles requires laboratory confirmation using measles serology and real-time polymerase chain reaction testing, which is primarily available through state and local health departments in many jurisdictions.³

• Nasopharyngeal or oropharyngeal samples are preferred for real-time polymerase chain reaction testing, although it can also be performed on urine samples. Serology for measles immunoglobulin M- and immunoglobulin G-specific antibodies is performed from blood samples.³

• Real-time polymerase chain reaction testing can detect measles with a sensitivity of 94% and a specificity of 99% (positive likelihood ratio = 94; negative likelihood ratio = 0.06), even

TABLE 2

Differential Diagnosis of Measles Exanthem by Signs and Symptoms

Disease	Timing of onset	Symptoms	Description	Characteristics
Drug eruption from antibiotic sensitivity or allergies	Usually 1-4 weeks after initiating drug	Nonspecific, flulike symptoms can occur before rash	Many patterns, most commonly maculopapular diffuse rash Often pruritic	Common in patients taking beta-lactam antibiotics, sulfonamides, nonsteroidal anti-inflammatory drugs Can occur with almost any drug
Human herpesvirus 6 (roseola)	5-15 days after exposure	3-5 days of high fever ($> 102.2^{\circ}\text{F}$ [39°C]) that resolves, followed by rash Upper respiratory infection symptoms, diarrhea, irritability, and/or posterior cervical lymphadenopathy	2- to 3-mm blanching macules and papules spreading from trunk to neck and extremities	Abrupt appearance of rash concurrent with defervescence
Kawasaki disease	Noninfectious inflammatory process	High fever ($> 102.2^{\circ}\text{F}$) ≥ 5 days	Erythematous, morbilliform, or maculopapular rash with central distribution	Diagnostic criteria: fever for ≥ 5 days and at least four of the following clinical signs: Oral mucosal changes Rash Bilateral conjunctival injection Cervical lymphadenopathy Swelling and redness of palms and soles
B19 virus (fifth disease)	4-21 days after exposure	Mild symptoms including fever, coryza, headache, and diarrhea, followed by rash	Erythematous rash spreading from cheeks (slapped cheek rash) to arms, legs, and trunk May resolve and recur during the week of presentation	Skin lesions in reticular pattern can persist for weeks and occasionally recur for months after exposure to heat, exercise, or other triggers
Rubella	14-21 days after exposure	Low-grade fever, conjunctivitis, rhinitis, cough, and/or lymphadenopathy	Maculopapular rash that begins on face and spreads caudally without coalescence	Most classic mimic of measles Lesions do not coalesce and are fainter than measles lesions Exposure during early pregnancy increases risk of congenital rubella syndrome

Example



Reprinted with permission from Lew S, Lau J, Al-Hashimi N. Descending maculopapular rash in a child. *Am Fam Physician*. 2022;106(1):83-84.



Copyright © 2016. Reused with the permission of NHS Digital. All rights reserved. <http://www.nhs.uk/conditions/roseola>



Reprinted with permission from Kawasaki Disease Foundation. Kawasaki disease 101. Accessed August 30, 2026. <https://kdfoundation.org/kd101>



Reprinted from Centers for Disease Control and Prevention. About parvovirus B19. December 17, 2025. Accessed August 30, 2026. Source material freely available at www.cdc.gov/parvovirus-b19/about/index.html. Use does not constitute endorsement.



Adapted from Centers for Disease Control and Prevention. Public health image library. ID# 22147. Accessed August 30, 2026. Source material freely available at <https://www.cdc.gov/phil/details.aspx?pid=22147>. Use does not constitute endorsement.

continues ►

before measles immunoglobulin G antibodies from serology are detectable.^{22,23}

- Measles-specific immunoglobulin G is detectable 1 to 3 days after rash onset, supporting an acute infection. These antibodies also indicate past infection or immunity from vaccination.³

TREATMENT

Drug Therapy

- Most patients can be treated at home with antipyretics (acetaminophen or ibuprofen) to improve comfort and reduce dehydration risk from fever.
- Aspirin and other salicylates should be avoided due to the risk of Reye syndrome.
- No specific antiviral treatment for measles infection is approved by the US Food and Drug Administration.²⁴⁻²⁷
- Although ribavirin has been used off-label to treat severe and complicated measles, no controlled clinical studies support its use, it has considerable risk of adverse effects, and it is only available from the manufacturer through an Emergency Investigational New Drug application.^{24,27,28}
- Low vitamin A levels are common in hospitalized children with severe or complicated measles.²⁴
- A Cochrane review demonstrated reduced all-cause mortality and diarrhea-related deaths in children with measles who received vitamin A supplementation. However, this meta-analysis included studies from low-income countries where vitamin A deficiency is more common than in the United States.²⁹
- Vitamin A deficiency is uncommon in the United States; therefore, the American Academy of Pediatrics recommends supplementation selectively for hospitalized children with severe or complicated measles²⁴ (Table 3^{3,24,30-32}).
- Internationally, the World Health Organization and the National Foundation for Infectious Diseases recommend vitamin A supplementation for all children with measles.^{24,30,31}
- Excessive vitamin A supplementation can be toxic, causing nausea and vomiting, headache and fatigue, joint and bone pain, blurry vision, and skin and hair problems. Toxicity can eventually lead to intracranial hypertension and hepatitis, risking permanent brain injury, liver failure, and death.^{29,32-34} Vitamin A supplementation is also associated with severe birth defects and is not advised during pregnancy.^{33,34}
- Cod liver oil contains vitamins A and D in unregulated and sometimes dangerous concentrations, risking toxicity, and should not be used to treat or prevent measles.
- The American Academy of Pediatrics suggests that vitamin A supplementation should be used only under the supervision of a prescribing clinician, regardless of severity or hospitalization status, because of toxicity risks.²⁴

Postexposure Prophylaxis

- Postexposure prophylaxis should be offered to people without presumptive evidence of immunity after a known exposure to a person with measles (Table 4).⁸
- Two types of postexposure prophylaxis provide some protection and modify the disease course: measles-mumps-rubella

TABLE 2 (continued)**Differential Diagnosis of Measles Exanthem by Signs and Symptoms**

Disease	Timing of exanthem onset	Symptoms	Exanthem description	Characteristics
Scarlet fever	1-7 days after exposure	Flulike symptoms, sore throat, and/or lymphadenopathy	Blanchable, papular rash with sandpaper skin that begins on face and spreads caudally	Associated with exudate pharyngitis and strawberry tongue Group A streptococcus infection; requires treatment with antibiotics

Information from references 17-20.

vaccination within 72 hours of exposure, or immunoglobulin administered within 6 days of exposure.⁸

- Immunoglobulin is recommended for people with a contraindication to receiving the vaccination, including pregnant patients, people with severe immunocompromise, and infants younger than 6 months.⁸

Managing Outbreaks

- During an outbreak, the local health department can assist with isolating suspected cases and identifying confirmed cases (Figure 3³⁵⁻⁴⁰). For confirmed cases, focus should shift to treatment of the person with measles and surveillance of others who were exposed.

PROGNOSIS AND COMPLICATIONS

- Although many patients fully recover from the infection, approximately 30% of patients with measles experience complications following the prodromal phase and rash (Table 5⁹), often occurring up to 1 month after infection.⁷
- Vaccinated individuals have lower rates of complications and hospitalization.^{41,42}
- Patients with weakened immune systems, malnutrition, and vitamin A deficiency are at high risk of severe illness, complications, and mortality.⁷
- Encephalitis is a serious complication with high rates of mortality. Acute post-infectious measles encephalitis can occur within 1 week of measles symptom onset,

FIGURE 2

Maculopapular rash on face



Maculopapular rash on face and trunk with signs of coalescence



Rash on trunk with signs of hyperpigmentation, purple macules



Koplik spots on buccal mucosa

Presentations of measles exanthem and enanthem.

Adapted from Centers for Disease Control and Prevention. Photos of measles. May 23, 2024. Accessed August 30, 2026. Source material freely available at <https://www.cdc.gov/measles/signs-symptoms/photos.html>. Use does not constitute endorsement.

Example



Reprinted with permission from National Health Service. Scarlet fever. December 23, 2024. Accessed August 30, 2026. <https://www.nhs.uk/conditions/scarlet-fever>. Information from NHS website is licensed under the Open Government License v3.0.

TABLE 3

Vitamin A Supplementation for Measles

Age (months)	Dosing (once daily for 2 days*)
< 6	50,000 IU (15,000 mcg RAE)
6-11	100,000 IU (30,000 mcg RAE)
≥ 12	200,000 IU (60,000 mcg RAE)

RAE = retinol activity equivalents.
*—Children with clinical signs or symptoms of vitamin A deficiency (eg, Bitot spots) should receive a third age-specific dose of vitamin A 2-4 weeks later.
Information from references 3, 24, and 30-32.

TABLE 4

Acceptable Presumptive Evidence of Measles Immunity

Routine patients	Students at post-high school educational institutions	Health care professionals*	International travelers
Documentation of age-appropriate vaccination with vaccine containing live measles virus†:	Documentation of vaccination with two doses of vaccine containing live measles virus†	Documentation of vaccination with two doses of vaccine containing live measles virus†	Documentation of age-appropriate vaccination with vaccine containing live measles virus†:
Preschool: one dose	or	or	Infants 6-11 months of age¶: one dose
School-aged (kindergarten through grade 12): two doses	Laboratory evidence of immunity§	Laboratory evidence of immunity§	People ≥ 12 months of age‡: two doses
Adults not at high risk‡: one dose	or	or	or
Laboratory evidence of immunity§	Laboratory confirmation of disease	Laboratory confirmation of disease	Laboratory evidence of immunity§
or	or	or	or
Laboratory confirmation of disease	Born before 1957	Born before 1957	Laboratory confirmation of disease
or			or
Born before 1957			Born before 1957

*—Health care professionals include all paid and unpaid people working in health care settings who could be exposed to patients who are infected or infectious materials, including body substances or contaminated medical supplies and equipment, environmental surfaces, or air.
†—First dose of vaccine containing live measles virus should be administered at ≥ 12 months. Second dose should be administered ≥ 28 days after the first dose.
‡—Adults at high risk include students at post-high school educational institutions, health care professionals, and international travelers.
§—Measles, mumps, or rubella immunoglobulin G in serum; equivocal results should be considered negative.
||—Health care facilities should consider vaccinating professionals born before 1957 who are unvaccinated and lack laboratory evidence of measles, mumps, or rubella immunity or laboratory confirmation of disease. Vaccination should include two doses of measles-mumps-rubella vaccine at the appropriate interval (for measles and mumps) and one dose (for rubella).
¶—Children who receive a dose of measles-mumps-rubella vaccine at < 12 months should receive two additional doses, administered when the child is 12-15 months of age and again ≥ 28 days later. If the child remains in a high-risk area, the first dose should be administered at 12 months of age.
Adapted from McLean HQ, et al.; Centers for Disease Control and Prevention. Prevention of measles, rubella, congenital rubella syndrome, and mumps, 2013: summary recommendations of the Advisory Committee on Immunization Practices. *MMWR Recomm Rep*. 2013;62(RR-04):19.

FIGURE 3

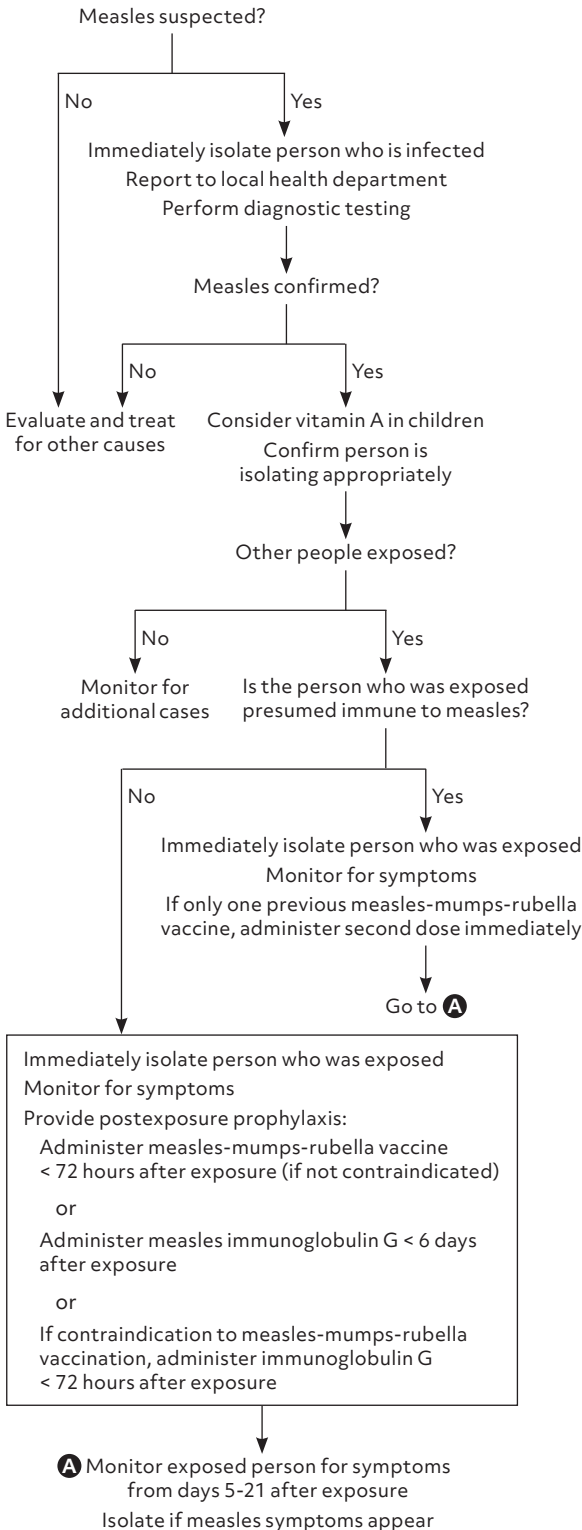


TABLE 5

Complications Associated With Measles

Acute complications	Incidence in high-income countries
Diarrhea	1 out of 10 people
Otitis media	1 out of 10 people
Pneumonia	1 out of 20 people
Hospitalization	1 out of 5 unvaccinated people
Encephalitis	1 out of 1,000 people
Death (typically from respiratory or neurologic complications)	1 out of 1,000 people

Long-term complication	Incidence in high-income countries
Subacute sclerosing panencephalitis (progressive disease of the central nervous system that can develop 7-10 years after measles infection)	7-11 out of 100,000 people

Adapted from Centers for Disease Control and Prevention. Measles symptoms and complications. April 29, 2026. Accessed August 30, 2026. Source material freely available at <https://www.cdc.gov/measles/signs-symptoms/index.html>. Use does not constitute endorsement.

with a 20% mortality rate.⁴³ Measles inclusion-body encephalitis can occur within 6 months of infection and is uniformly fatal.

- Subacute sclerosing panencephalitis is a rare, progressive, and fatal neurologic complication that can present 7 to 10 years after measles infection.⁷

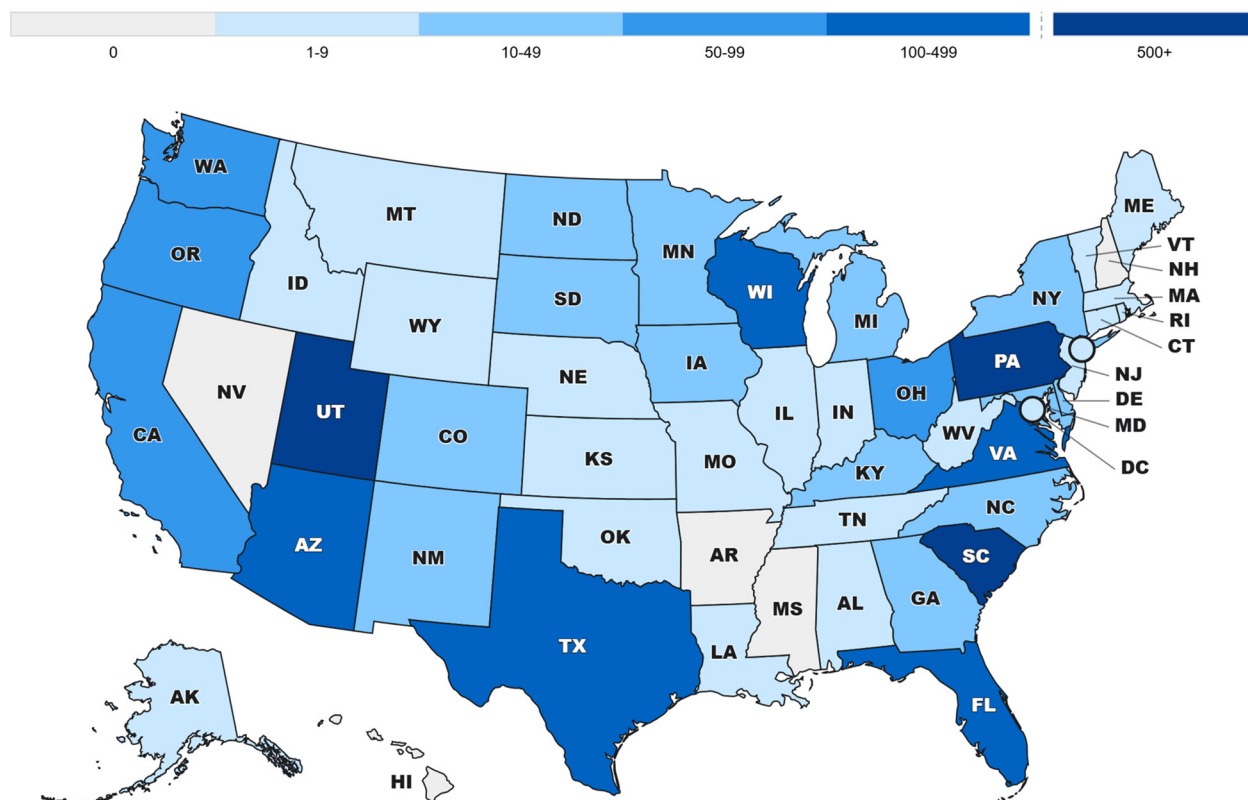
Data Sources: A PubMed search was conducted using key words autism, cod liver oil, measles, rubeola, complications, differential diagnosis, epidemiology, exanthem, rash, therapy, treatment, vaccination, ribavirin, vaccine safety, and vitamin A, filtering for epidemiologic reports, meta-analyses, and systematic reviews. The Ovid database, Trip Medical Database, and Cochrane Database of Systematic Reviews were also searched. Search dates: August through October 2025, April 2026, and August 2026.

REFERENCES

1. Iwamura N, et al. Predicting the airborne transmission of measles: impact of indoor carbon dioxide (CO2) levels and mitigation strategies. *Cureus*. 2024;16(7):e64882.

2. Centers for Disease Control and Prevention. Measles cases and outbreaks. Updated October 9, 2026. Accessed October 14, 2026. <https://www.cdc.gov/measles/data-research/index.html>
3. Centers for Disease Control and Prevention. Clinical overview of measles. August 5, 2026. Accessed August 30, 2026. https://www.cdc.gov/measles/hcp/clinical-overview/index.html#cdc_clinical_overview_test_dia-diagnosis-and-laboratory-testing
4. Axios. Where vaccination rates declined the most, by county. December 31, 2025. Accessed August 30, 2026. <https://www.axios.com/2025/12/31/measles-flu-vaccine-mmr-rates-2026>
5. Centers for Disease Control and Prevention. Measles symptoms and complications. August 5, 2026. Accessed August 30, 2026. <https://www.cdc.gov/measles/signs-symptoms/index.html>
6. Johns Hopkins University. U.S. measles tracker. Updated October 9, 2026. Accessed October 14, 2026. <https://publichealth.jhu.edu/ivac/resources/us-measles-tracker>
7. Do LAH, et al. Measles 2025. *N Engl J Med*. 2025;393(24):2447-2458.
8. McLean HQ, et al.; Centers for Disease Control and Prevention. Prevention of measles, rubella, congenital rubella syndrome, and mumps, 2013. *MMWR Recomm Rep*. 2013;62(RR-04):1-34.
9. Madsen KM, et al. A population-based study of measles, mumps, and rubella vaccination and autism. *N Engl J Med*. 2002;347(19):1477-1482.
10. Çatlı NE, et al. The relationship between autism and autism spectrum disorders and vaccination. *Trends Pediatr*. 2025;6(2):76-81.
11. Wilson K, et al. Association of autistic spectrum disorder and the measles, mumps, and rubella vaccine. *Arch Pediatr Adolesc Med*. 2003;157(7):628-634.
12. Zerbo O, et al. Safety of measles and pertussis-containing vaccines in children with autism spectrum disorders. *Vaccine*. 2022;40(18):2568-2573.
13. DeStefano F, et al. The MMR vaccine and autism. *Annu Rev Virol*. 2019;6(1):585-600.
14. Gulati S, et al. The vaccine-autism connection: no link, still debate, and we are failing to learn the lessons. *Autism*. 2025;29(7):1639-1645.
15. Minta AA, et al. Progress toward measles elimination — worldwide, 2000–2023. *MMWR Morb Mortal Wkly Rep*. 2024;73(45):1036-1042.
16. Bester JC. Measles and measles vaccination: a review. *JAMA Pediatr*. 2016;170(12):1209-1215.
17. Gangar P, et al. Viral exanthems. In: Hoeger PH, et al., eds. *Harper's Textbook of Pediatric Dermatology*, 4th ed. John Wiley & Sons, Inc. 2019;660-680.
18. Newburger JW, et al. Diagnosis, treatment, and long-term management of Kawasaki disease: a statement for health professionals from the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease in the Young, American Heart Association. *Pediatrics*. 2004;114(6):1708-1733.
19. Bigby M. Rates of cutaneous reactions to drugs. *Arch Dermatol*. 2001;137(6):765-770.
20. National Health Service. Scarlet fever. December 23, 2024. Accessed August 30, 2026. www.nhs.uk/conditions/scarlet-fever
21. Centers for Disease Control and Prevention. Photos of measles. May 23, 2024. Accessed August 30, 2026. <https://www.cdc.gov/measles/signs-symptoms/photos.html>
22. Hübschen JM, et al. Measles. *Lancet*. 2022;399(10325):678-690.
23. Roy F, et al. Rapid identification of measles virus vaccine genotype by real-time PCR. *J Clin Microbiol*. 2017;55(3):735-743.
24. Committee on Infectious Diseases. Kimberlin DW, ed. *Red Book: 2024–2027 Report of the Committee on Infectious Diseases*, 33rd ed. American Academy of Pediatrics; 2024.
25. Centers for Disease Control and Prevention. CDC Stacks: measles prevention and treatment overview. May 1, 2026. Accessed August 30, 2026. <https://stacks.cdc.gov/view/cdc/257236>
26. Moss WJ. Measles. *Lancet*. 2017;390(10111):2490-2502.
27. Papanikolopoulou A, et al. Measles: a narrative review of current therapeutic options and implications for the future. *Viruses*. 2026;18(8):816.
28. Bichon A, et al. Case report: ribavirin and vitamin A in a severe case of measles. *Medicine (Baltimore)*. 2017;96(50):e9154.
29. Imdad A, et al. Vitamin A supplementation for preventing morbidity and mortality in children from six months to five years of age. *Cochrane Database Syst Rev*. 2022;(3):CD008524.
30. Vitamin A supplements: a guide to their use in the treatment and prevention of vitamin A deficiency and xerophthalmia, 2nd ed. World Health Organization; 1997. Accessed August 30, 2026. <https://iris.who.int/bitstream/handle/10665/41947/9241545062.pdf>
31. National Foundation for Infectious Diseases. Call to action: vitamin A for the management of measles in the United States. March 2020. Accessed August 30, 2026. <https://www.nfid.org/wp-content/uploads/2023/04/Call-to-Action-Vitamin-A-for-the-Management-of-Measles-in-the-US-FINAL.pdf>
32. Bastos Maia S, et al. Vitamin A and pregnancy: a narrative review. *Nutrients*. 2019;11(3):681.
33. Olson JM, et al. Vitamin A toxicity. *StatPearls*. Updated September 2, 2023. Accessed May 8, 2026. <http://www.ncbi.nlm.nih.gov/books/NBK532916>
34. Suchdev PS, et al. Reevaluating vitamin A for measles management in high-income settings. *Lancet Reg Health Am*. 2025;48:101168.
35. Centers for Disease Control and Prevention. Expanding measles outbreak in the United States and guidance for the upcoming travel season. March 7, 2025. Accessed May 8, 2026. <https://www.cdc.gov/han/php/notices/han00522.html>
36. Centers for Disease Control and Prevention. Healthcare providers: stay alert for measles cases. January 26, 2026. Accessed May 8, 2026. <https://www.cdc.gov/measles/hcp/clinical-overview/stay-alert-for-measles-cases.html>
37. Council of State and Territorial Epidemiologists. 24/7 table. Accessed August 30, 2026. <https://libraries.cste.org/24-7-table>
38. Centers for Disease Control and Prevention. Interim infection prevention and control recommendations for measles in healthcare settings. August 19, 2025. Accessed August 30, 2026. <https://www.cdc.gov/infection-control/hcp/measles/index.html>
39. Campos-Outcalt D. Practice alert: measles continues to be a threat to health in the United States. *Am Fam Physician*. 2024;110(2):120-121.
40. Centers for Disease Control and Prevention. Measles. April 5, 2024. Accessed September 8, 2026. <https://www.cdc.gov/infection-control/hcp/healthcare-personnel-epidemiology-control/measles.html>
41. Stein-Zamir C, et al. Measles clinical presentation, hospitalization and vaccination status among children in a community-wide outbreak. *Vaccine*. 2023;41(17):2764-2768.
42. van Dam ASG, et al. Effect of vaccination on severity and infectiousness of measles during an outbreak in the Netherlands, 2013–2014. *Epidemiol Infect*. 2020;148:e81.
43. Au S, et al. Measles: an updated literature review of the host response, pathogenesis, complications, prevention measures, and recent outbreaks. *Curr Issues Mol Biol*. 2026;48(2):206.

eFIGURE A

**Map of measles cases in 2026 among US residents.**

Reprinted from Centers for Disease Control and Prevention. Measles cases and outbreaks. Updated October 9, 2026. Accessed October 14, 2026. Source material freely available at <https://www.cdc.gov/measles/data-research/index.html>. Use does not constitute endorsement.