



Measles FAQ for the ID Provider

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Objectives

- Manage recognizing measles early in disease course and next steps
- Prepare for appropriate infection prevention strategies/scenarios
- Characterize appropriate steps to assess immunity in various patients



Misinformation and Its Correction: Continued Influence and Successful Debiasing

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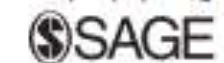
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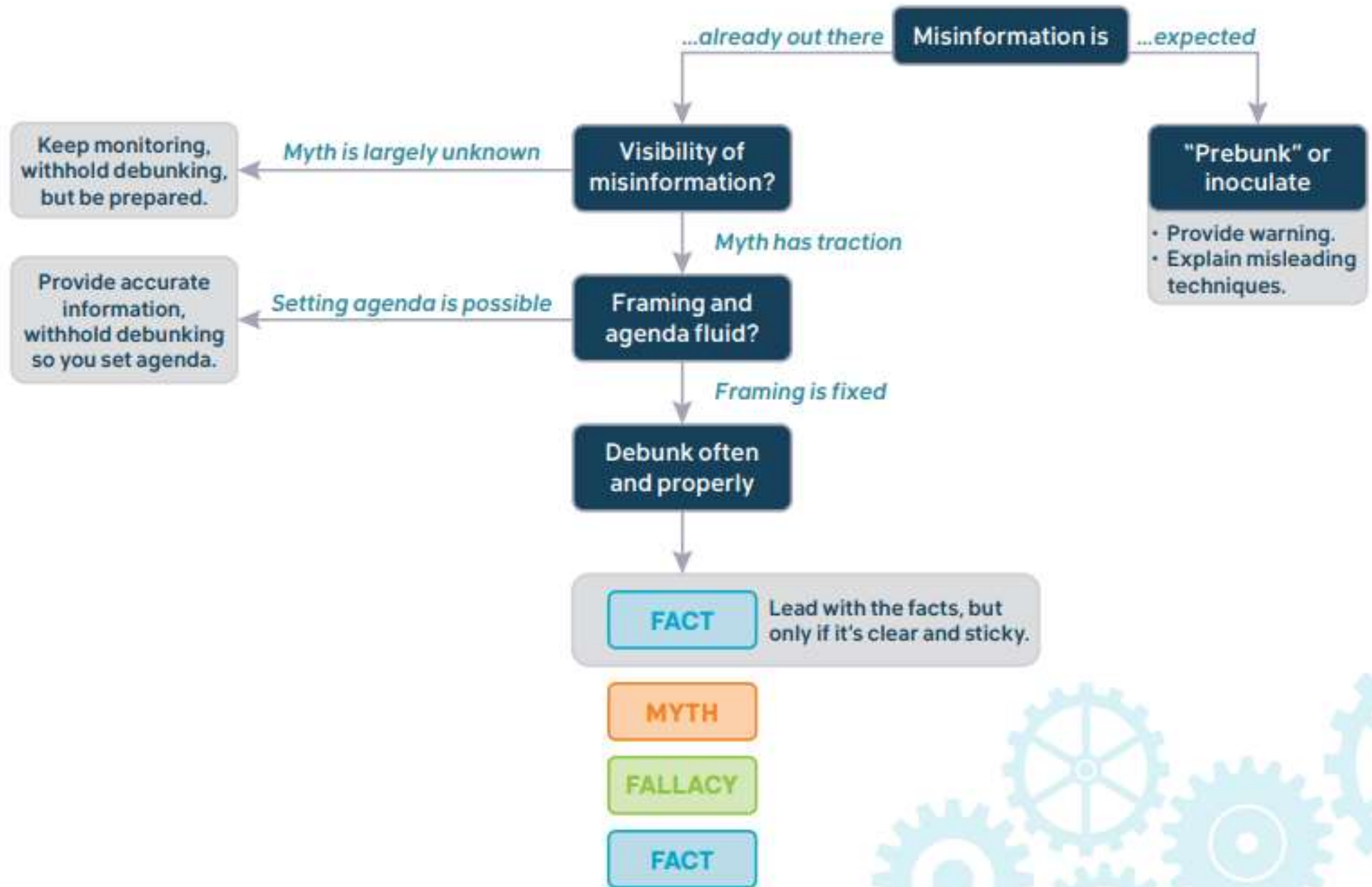
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Americans' Ethics Ratings of 23 Professions Are at or Below Recent Levels

Please tell me how you would rate the honesty and ethical standards of people in these different fields -- very high, high, average, low or very low?

% Very high/High

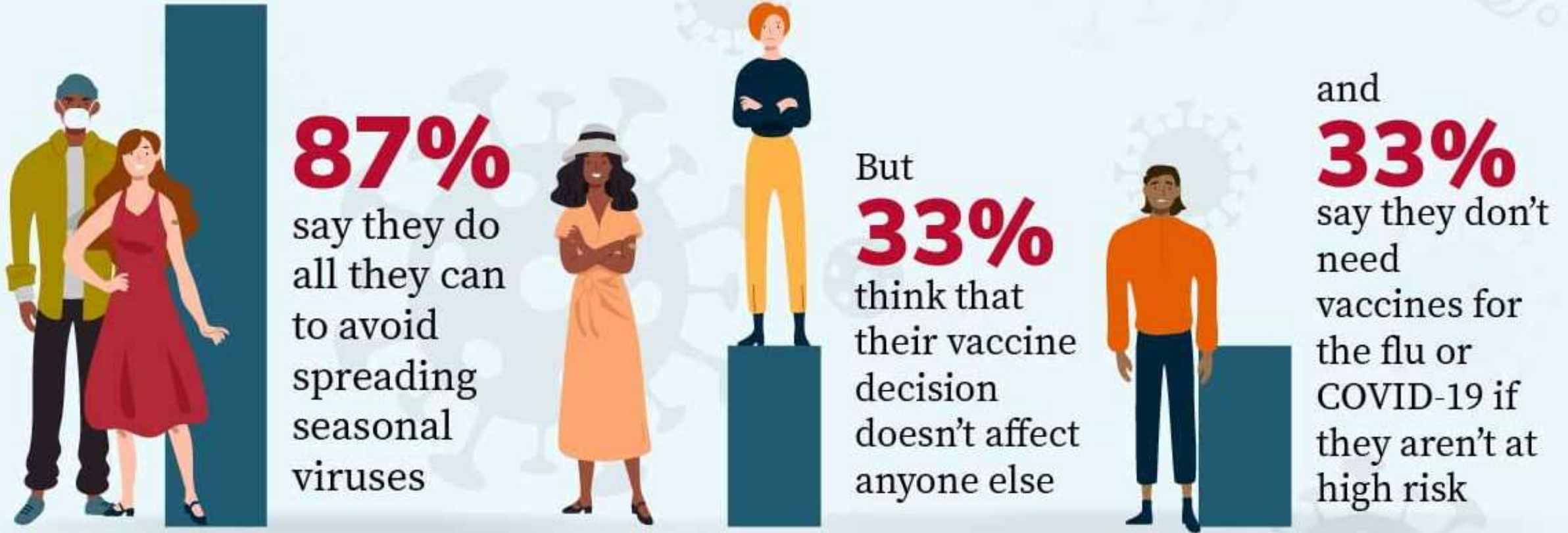
	2019	2022	2023	2023-2019
	%	%	%	pct. pts.
Nurses	85	79	78	-7
Veterinarians*	--	--	65	N/A
Engineers	66	--	60	-6
Dentists	61	--	59	-2
Medical doctors	65	62	56	-9
Pharmacists	64	58	55	-9
Police officers	54	50	45	-9
College teachers	49	--	42	-7
Psychiatrists	43	--	36	-7
Chiropractors	41	--	33	-8
Clergy	40	34	32	-8
Labor union leaders	24	24	25	1

WASHINGTON, D.C. -- Americans' ratings of nearly all 23 professions measured in Gallup's 2023 Honesty and Ethics poll are lower than they have been in recent years. Only one profession -- labor union leaders -- has not declined since 2019, yet a relatively low 25% rate their honesty and ethics as "very high" or "high."

Nurses remain the most trusted profession, with 78% of U.S. adults currently believing nurses have high honesty and ethical standards. However, that is down seven percentage points from 2019 and 11 points from its peak in 2020.

At the other end of the spectrum, members of Congress, senators, car salespeople and advertising practitioners are viewed as the least ethical, with ratings in the single digits that have worsened or remained flat.

Nearly all respondents in a national survey say they're doing everything they can to prevent spread, but for many, their actions tell a different story.





WHO calls immunization a
“global health and
development success story,”
responsible for preventing 3.5-5
million deaths each year.

“Memory can be dangerously short.”

In the 1950s, 400-500 individuals in the US died of measles annually, with 3-4 million infected. The number of deaths plummeted to 110000 globally in 2017, and it was eliminated from the US in 2000.

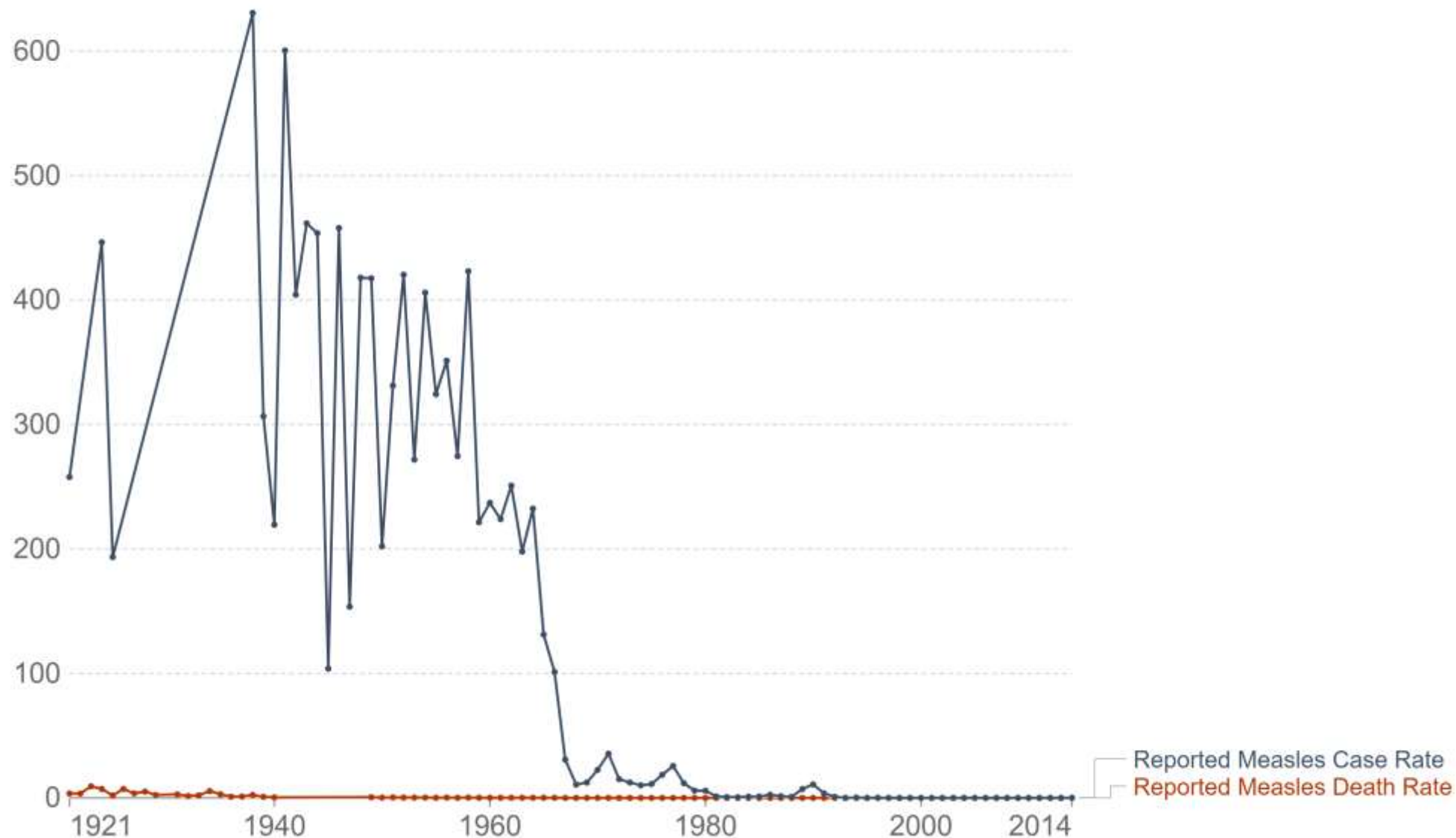
1/3 of measles cases are complicated by pneumonia, encephalitis

1994-2001: childhood immunizations prevented an estimated 381 million illnesses, 855,000 deaths, and saved \$1.65 trillion in societal costs



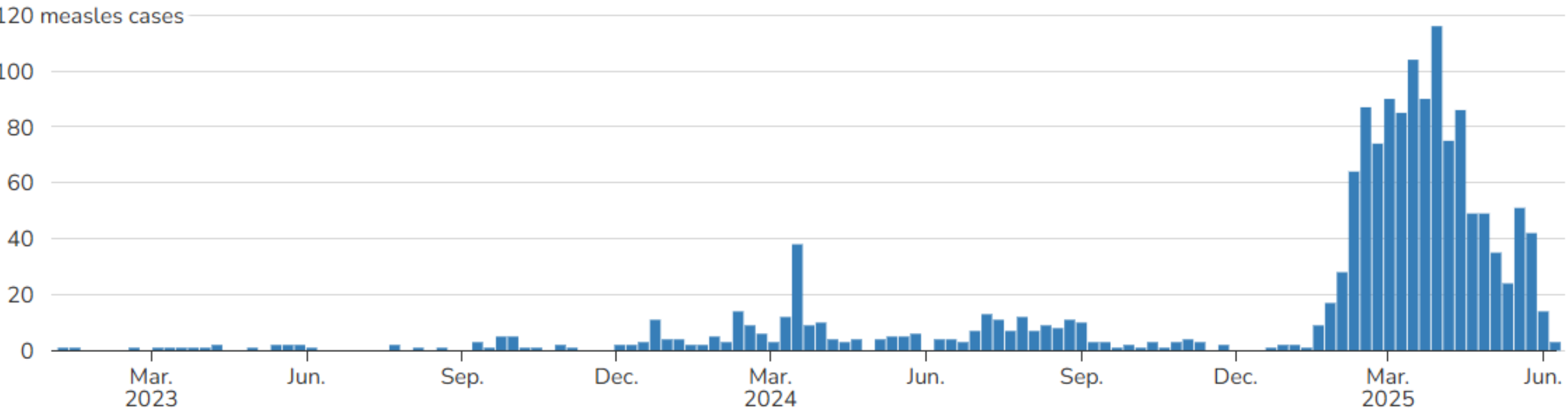
Rate of reported cases and deaths from measles in the USA

The reported rates are per 100,000 US population.



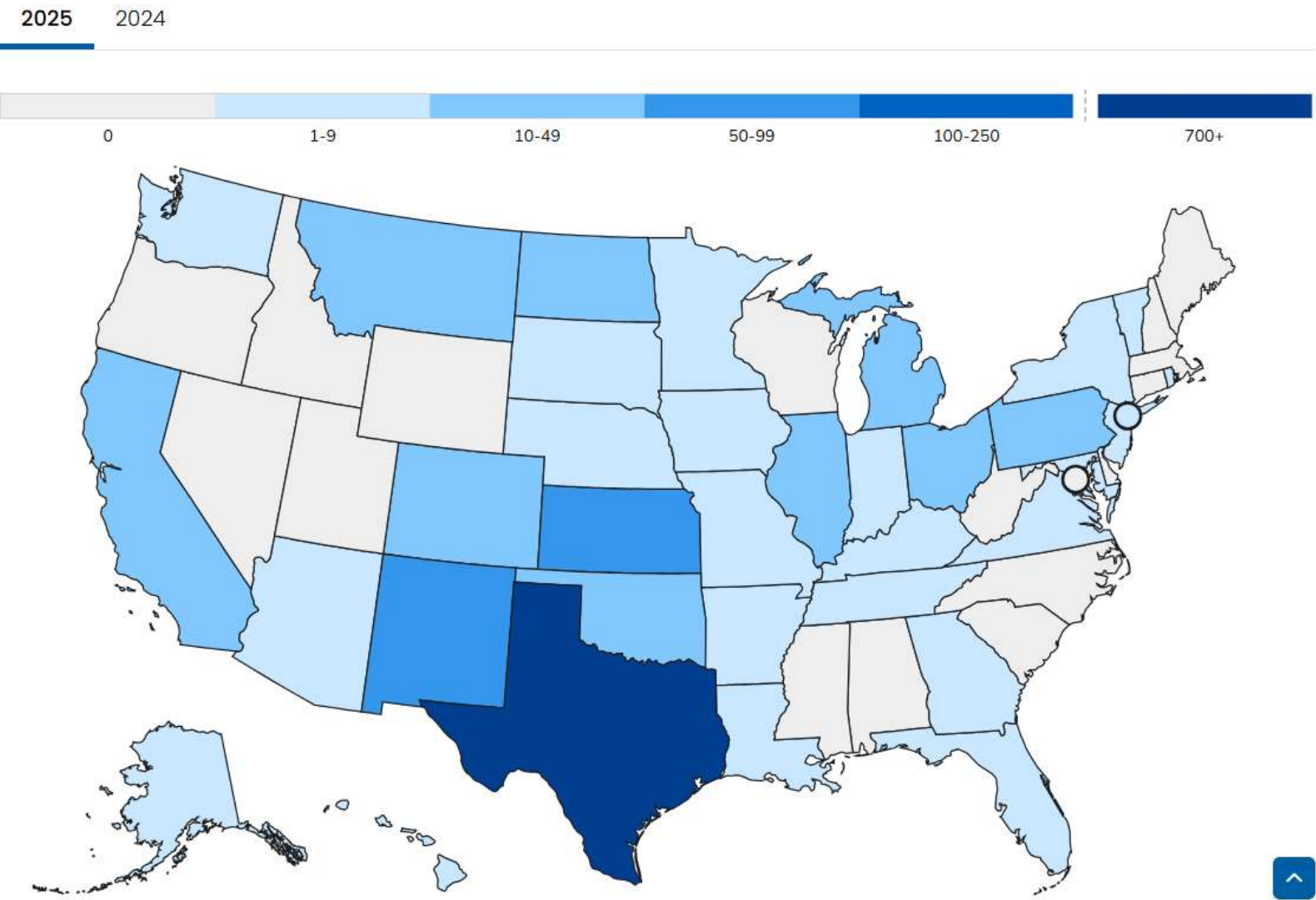
Weekly measles cases by rash onset date

2023–2025* (as of June 12, 2025)



Measles Cases and Outbreaks | Measles (Rubeola) | CDC

as of June 12, 2025





Disease	Transmission	Basic reproduction number	Herd Immunity Threshold
Measles	Airborne	12-18	92-95%
Pertussis	Airborne droplet	12-17	92-94%
Diphtheria	Saliva	6-7	83-86%
Rubella	Airborne droplet	6-7	83-86%
Smallpox	Airborne droplet	5-7	80-86%
Polio	Fecal-oral route	5-7	80-86%
Mumps	Airborne droplet	4-7	75-86%
SARS	Airborne droplet	2-5	50-80%
Ebola	Bodily fluids	1.5-2.5	33-60%
Influenza	Airborne droplet	1.5-1.8	33-44%



FAQ#1: When
should we suspect
measles?



Incubation and Exposure

Prodrome

Incubation 11-12
days

Fever, cough,
coryza, conjunctiv

Koplik spots 2-3
days after symptoms
start



Rash

Usually 2-4 days
after prodrome

Lasts 5-6 days

Infectivity

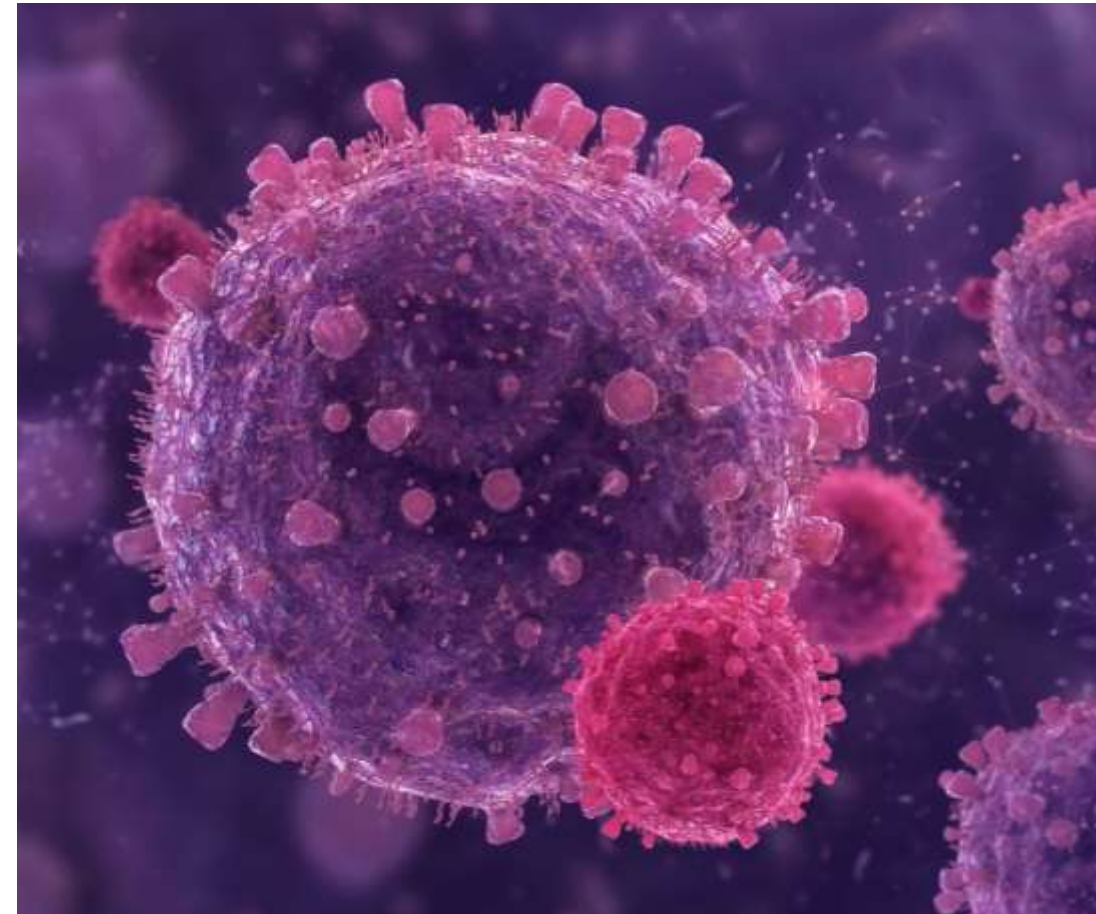
4 days before and 4
days after rash

Complications:
diarrhea, otitis
media; pneumonitis,
encephalitis, death

Pathophysiology



- Inhaled virus infects the respiratory tract's lymphocytes, dendritic cells, and alveolar macrophages.
- Then spreads to adjacent lymphoid tissue and disseminates throughout the bloodstream resulting in viremia and spread to distant organs.
- Virus transfers from lymphs and dendritic cells to epithelial cells of the respiratory tract
 - Virus shed and expelled as respiratory droplets during coughing, sneezing
- Appearance of fever coincides with viremia
- Rash occurs after dissemination and is due to perivascular and lymphocytic infiltrates
- **Measles is known to induce immunosuppression for weeks to months, even years.**
 - Causes increased susceptibility to secondary bacterial infection



MEASLES

IT ISN'T JUST A LITTLE RASH



Measles can be dangerous, especially for babies and young children.

Measles symptoms typically include:



High fever
(may spike to more than 104°F)



Cough



Runny nose



Red and/or watery eyes



Rash
(breaks out 3-5 days after symptoms begin)

Measles can be serious.

Measles can cause severe health complications, including pneumonia, swelling of the brain (encephalitis) and death.



1 out of 5 people who get measles will be hospitalized.



1 out of every 20 children with measles will get pneumonia, the most common cause of death from measles in young children.



1 out of every 1,000 people with measles will develop brain swelling, which may lead to brain damage.



1 to 3 out of 1,000 people with measles will die.

Long-term complications

A very rare, but deadly disease called subacute sclerosing panencephalitis can develop 7 to 10 years after a person has recovered from measles.



You have the power to protect your child.

Provide your children with safe and long-lasting protection against measles by making sure they get the measles-mumps-rubella (MMR) vaccine. Talk to your healthcare provider.



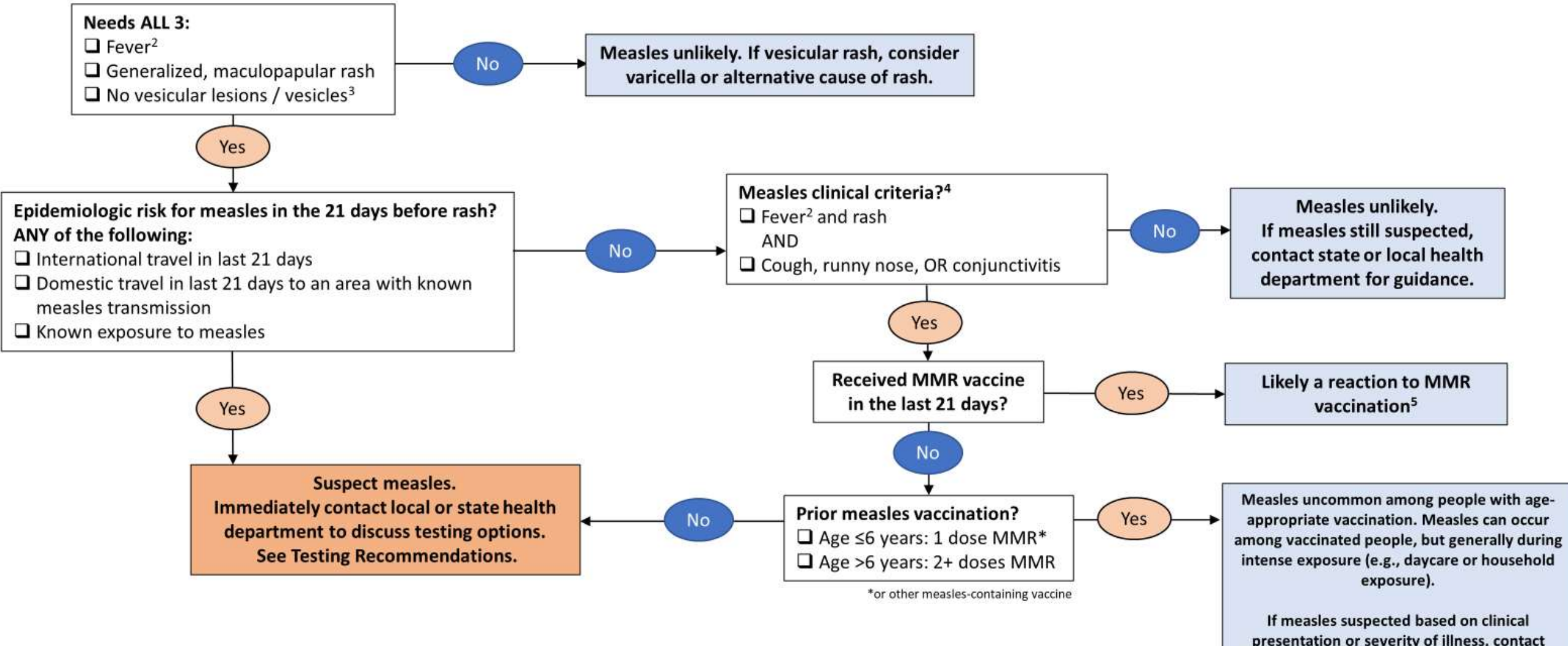
- Subacute sclerosing panencephalitis
 - Vaccine protection: Bellini WJ et al. Journal of Infectious Diseases. 2005; 192(10):1686-1693.
- Immune amnesia
 - Mina MJ et al. Science. 2019; 366(6465): 599-606.



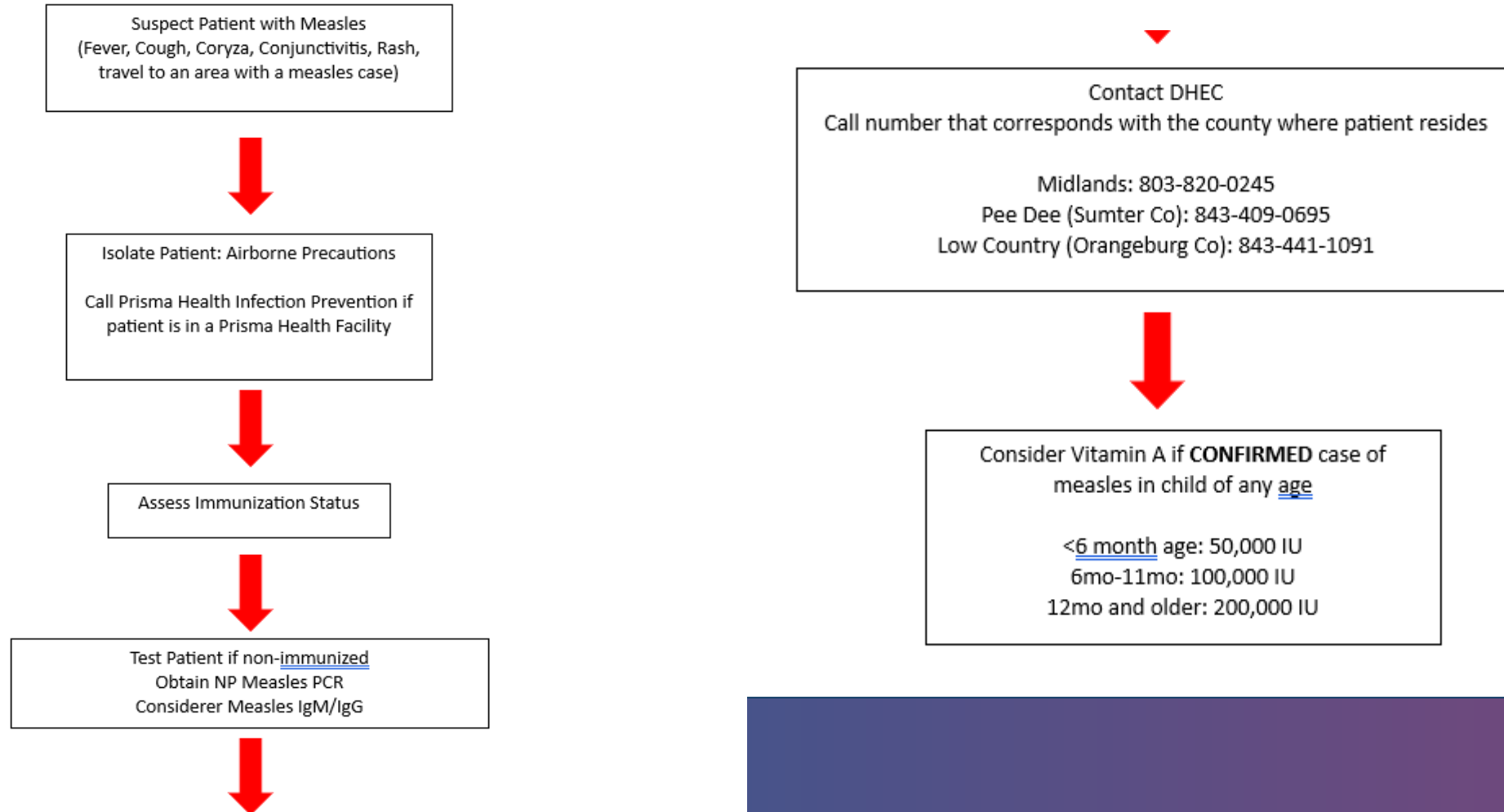
www.cdc.gov/measles

Evaluating a patient presenting with rash when there is no local measles transmission¹

START HERE



What to do if you suspect measles (Prisma Health)



Measles Testing Options



- State lab
 - Once DPH evaluates and takes it on as a case
- LabCorp
 - ~4 day turnaround

Measles – Recommendations for Testing for Clinicians

Measles is a mandatory, immediately notifiable disease. Please report confirmed and probable cases of measles to your local health department.						
	Preference	Test	Specimen	Indication	Timing	Notes
ACUTE DISEASE	Preferred Test	RT-PCR	Nasopharyngeal (NP) or throat (OP) swab (preferred) Urine can be collected in addition to an NP/OP swab	Acute Disease	- A specimen for detection of virus should be collected as soon as possible upon suspicion of measles. - Specimen should be ideally collected within 3 days after rash onset but can be collected up to 10 days. - If >10 days since rash onset, PCR testing is generally not recommended.	- NP/OP swab collected <3 days after rash onset is the preferred specimen. Ideally, RT-PCR should be performed for all suspect measles cases identified within 10 days of rash onset. - Collecting a urine specimen along with an NP/OP swab may improve test sensitivity, especially if at the end of the RT-PCR detection window. - Contact your health department regarding where to send specimens for testing and genotyping, if appropriate.
	Preferred Test	IgM (with IgG)	Serum	Acute Disease	- Ideally, serology will be obtained for suspect measles cases, in addition to RT-PCR. - IgM is most sensitive 3+ days after rash onset and may be negative days 0–3 after rash onset. IgM can be detected for 6–8 weeks after acute measles.	- Detection of measles IgM can aid in the diagnosis of measles and can increase the detection window for acute cases. - Testing IgG for acute cases can provide evidence of pre-existing immunity, which can be helpful to differentiate rare instances of vaccine failure. - People with a history of measles vaccination may not have detectable IgM during an acute measles illness.
IMMUNITY	Only test for immunity	IgG only	Serum	Evidence of Immunity	IgG can be detected approximately 2 weeks after measles vaccination.	- The presence of measles-specific IgG indicates a recent or prior exposure to measles virus or measles vaccine. IgM is <u>not</u> an appropriate test for immunity.

* Viral culture is a valid way to confirm cases of acute measles disease; however, is not generally recommended as it takes longer to receive results than RT-PCR, which is widely available. Specimen collection and timing is similar to that for RT-PCR.

** Acute and convalescent phase serum specimen collection (separated by at least 2 weeks) to demonstrate a 4-fold increase in IgG titer can confirm measles infection but is generally not required to confirm measles infection.

Measles PCR Testing



- Preferred method of testing for measles
- Must use Viral Transport Media
 - pink
- Appropriate specimens:
 - NP
 - Throat
 - Urine
- Most sensitive within 3 days of rash onset
 - Can be performed up to 10 days after rash onset



Measles IgM Testing

Should only be used in conjunction with PCR

Most sensitive when rash has been present at least 3 days

- Can have false negatives when performed too early in disease state
- Can have false positives with other viral infections
 - Parvovirus

South Carolina 2024 List of Reportable Conditions

REPORT UPON RECOGNITION OF A SUSPECTED CASE, OUTBREAK, DIAGNOSIS, OR POSITIVE LABORATORY EVIDENCE (SEE "HOW TO REPORT" BELOW)

Suspected means clinical suspicion and/or initial laboratory detection, isolation, identification, or presence of supportive laboratory results.

Potential agent of bioterrorism

! Immediately reportable by phone call to a live person at the regional public health office, 24/7

* Urgently reportable within 24 hours by phone or electronic notification (email: SCIONHelp@dhcc.sc.gov for details. The SCIONHelp email address may not be used for case reporting.)

All other conditions except lead are reportable within 3 business days

 **! Any case that may be caused by chemical, biological, or radiological threat, novel infectious agent, or any cluster of cases, or outbreak of a disease or condition that might pose a substantial risk of human morbidity or mortality (1) (2)**

* Anaplasmosis (*Anaplasma phagocytophilum*)

* Animal (mammal) bites

 **! Anthrax (*Bacillus anthracis*) (2)**

* Babesiosis (*Babesia* spp.)

 **! Botulism (*Clostridium botulinum* or *Botulinum* toxin)**

* Brucellosis (*Brucella* spp.) (2)

 * Campylobacteriosis (2)

* *Candida auris* or suspected (2) (3)

* Carbapenem-resistant *Enterobacterales* (CRE) and *Acinetobacter* species (2) (4) (5)

* Carbapenem-resistant *Pseudomonas* spp. (CRPA) (2) (4) (6)

* Chancroid (*Haemophilus ducreyi*)

* Chikungunya (2)

* *Chlamydia trachomatis*

* Ciguatera

* Coronavirus Disease 2019 (COVID-19), (SARS CoV-2) (7)

* Cryptosporidiosis (*Cryptosporidium* spp.)

* Cyclosporiasis (*Cyclospora cayetanensis*) (2)

* Dengue (2)

* Diphtheria (*Corynebacterium diphtheriae*) (2)

* Eastern Equine Encephalitis (EEE) (2)

* Ehrlichiosis (*Ehrlichia*)

* *Escherichia coli*, Shiga toxin – producing (STEC) (2)

* Giardiasis (*Giardia* spp.)

* Gonorrhea (*Neisseria gonorrhoeae*) (4)

* *Haemophilus influenzae*, all types, invasive disease (H flu) (2) (4) (8)

* Hantavirus (2)

* Hemolytic uremic syndrome (HUS), post-diarrheal

* Hepatitis (acute) A, B, C, D, & E (9)

* Hepatitis (chronic) B, C, & D (9)

* Hepatitis B surface antigen + with each pregnancy

* HIV and AIDS clinical diagnosis

* HIV CD4 test (all CD4 T- lymphocyte results) (L)

* HIV exposed infants (all results, positive and negative)

* HIV subtype, genotype, and phenotype (L)

* HIV 1/2 Antibody and Antigen (rapid)

* HIV 1/2 AB/AG (confirmatory, all positive and negative) (L)

* HIV 1/2 AB/AG+ and/or detectable viral load with each pregnancy

* HIV viral load (all results, detectable and undetectable) (L)

! Influenza, avian or other novel strain

* Influenza associated deaths (all ages)

* Influenza

* Lab-confirmed cases (eg. culture, RT-PCR, DFA, Molecular assay) (10)

* Influenza associated hospitalizations (10)

* La Crosse Encephalitis (LACV) (2)

Lead tests, all results - indicate venous or capillary specimen (11)

* Legionellosis

* Leprosy (*Mycobacterium leprae*) (Hansen's Disease)

* Leptospirosis

* Listeriosis (2)

* Lyme disease (*Borrelia burgdorferi*)

* Lymphogranuloma venereum

* Malaria (*Plasmodium* spp.) (2)

! Measles (*Rubeola*)

! Meningococcal disease (*Neisseria meningitidis*) (2) (4) (8) (12)

* Mpox (positive, negative, and all other results)

* Mumps

* Pertussis (*Bordetella pertussis*)

 **! Plague (*Yersinia pestis*) (2)**

! Poliomyelitis

 * Psittacosis (*Chlamydia psittaci*)

 * Q fever (*Coxiella burnetii*)

! Rabies (human)

* Rubella (includes congenital)

* Salmonellosis (2) (4)

* Shiga toxin positive (2)

* Shigellosis (2) (4)

 **! Smallpox (*Variola*)**

* Spotted Fever Rickettsiosis (*Rickettsia* spp.)

* *Staphylococcus aureus*, vancomycin-resistant or intermediate with a VA >8 MIC (VRSA/VISA) (2) (4) (13)

* *Streptococcus* group A, invasive disease (GAS) (4) (8) (14)

* *Streptococcus pneumoniae*, invasive (pneumococcal) (4) (8) (15)

* St. Louis Encephalitis (SLEV) (2)

* Syphilis: congenital, primary, or secondary (lesion or rash) or Darkfield positive (16)

* Syphilis: early latent, latent, tertiary, or positive serological test (17)

* Tetanus (*Clostridium tetani*)

* Toxic Shock (specify staphylococcal or streptococcal)

* Tuberculosis (*Mycobacterium tuberculosis*) (2) (18)

* Tuberculosis test - Positive Interferon Gamma Release Assays (IGRAs):

QuantIFERON-TB Gold Plus (QFT-Plus) and T-SPOT.TB (18) (L)

 * Tularemia (*Francisella tularensis*) (2)

* Typhoid fever (*Salmonella typhi*) (2) (4)

 * Typhus, epidemic (*Rickettsia prowazekii*)

* Varicella

* Vibrio, all types, including *Vibrio cholerae* O1 and O139 (2)

 **! Viral Hemorrhagic Fevers (e.g. Ebola, Lassa, Marburg viruses)**

* West Nile Virus (2)

* Yellow Fever

* Yersiniosis (*Yersinia*, not *pestis*)

* Zika (2)

Report to Region where patient lives,
not where the facility is located



How to Report Other Conditions

Report **Immediate** conditions by phone and **Urgent** conditions within 24 hours by phone or by electronic notification. Report all other conditions electronically* or by mail within 3 days to the appropriate public health office in the region in which the patient resides. *Email **SCIONHelp@dhec.sc.gov** for details on electronic notification. The **SCIONHelp** email may not be used for case reporting.

Immediate and Urgent Reporting (TELEPHONE)

Lowcountry

Allendale, Bamberg, Beaufort,
Berkeley, Calhoun, Charleston,
Colleton, Dorchester, Hampton, Jasper,
Orangeburg

3685 Rivers Avenue, Suite 201
North Charleston, SC 29405

Office: (843) 441-1091
Fax: (843) 953-0051
Nights/Weekends: (843) 441-1091

Midlands

Aiken, Barnwell, Chester, Edgefield,
Fairfield, Lancaster, Lexington,
Kershaw, Newberry, Richland, Saluda,
York

2000 Hampton Street
Columbia, SC 29204

Office: (888) 801-1046
Fax: (803) 251-3170
Nights/Weekends: (888) 801-1046

Pee Dee

Clarendon, Chesterfield, Darlington,
Dillon, Florence, Georgetown, Horry,
Lee, Marion, Marlboro, **Sumter**,
Williamsburg

1931 Industrial Park Road
Conway, SC 29526

Office: (843) 915-8886
Fax: (843) 915-6506
Nights/Weekends: (843) 409-0695

Upstate

Abbeville, Anderson, Cherokee,
Greenville, Greenwood, Laurens,
McCormick, Oconee, Pickens,
Spartanburg, Union

352 Halton Road
Greenville, SC 29607

Office: (864) 372-3133
Fax: (864) 282-4373
Nights/Weekends: (864) 423-6648



FAQ#2: Isolation
precautions? An answer in
two parts: pre and post

Before the first measles cases...

(at hire, really)

- Check with employee health to ensure your HCW have documented immunity to measles
 - Written documentation with 2 doses of measles virus containing vaccine (the first dose administered at age ≥ 12 months; the second dose no earlier than 28d after the first dose)
 - OR
 - Laboratory evidence of immunity (IgG)
 - OR
 - Laboratory confirmation of disease
 - OR birth before 1957

Infection Prevention



- Healthcare Workers (HCW) are **paid/unpaid** persons working in healthcare settings who have the potential for exposure to patients and/or to infectious materials, including body substances, contaminated medical supplies and equipment, contaminated environmental surfaces, or contaminated air
- HCW are at risk for exposure to/transmission of vaccine-preventable diseases
- Employers/HCW had shared responsibility to prevent occupationally acquired infections and avoid causing harm to patients by taking reasonable precautions to prevent transmission of vaccine-preventable diseases

Recommendations



The recommendations for vaccination (2 categories)

1) those diseases for which routine vaccination or documentation of immunity is recommended for HCP because of risks to HCP in their work settings and, should HCP become infected, to the patients they serve

- Vaccines recommended in the first category are hepatitis B, seasonal influenza, measles, mumps, and rubella, pertussis, and varicella vaccines.

2) those diseases for which vaccination of HCP might be indicated in certain circumstances.

- Vaccines in the second category are meningococcal, typhoid, and polio vaccines.

Occupational Safety and Health Administration (OSHA)



- Section 5(a)(1): imposes general duty to employers to provide a **safe and healthy workspace** and protect employees against workplace hazards that could cause an accident or illness that would most likely result in death or serious physical harm
 - Employees are protected by vaccines
 - ...employee can claim serious consequences from vaccination makes it UNSAFE

TABLE 1. Recommendations for immunization practices and use of immunobiologics applicable to disease prevention among health-care personnel* --- Advisory Committee on Immunization Practices (ACIP), June 9, 1989--August 26, 2011

Subject	Publication in <i>MMWR</i>
General recommendations on immunization	2011;60(No. RR-2)
Diphtheria, tetanus, and pertussis	1991;40(No. RR-10) 1997;46(No. RR-7)
Hepatitis B	1991;40(No. RR-8) [†] 1991;40(No. RR-13) 2001;50(No. RR-11) [†] 2006;55(No. RR-16) 2008;57(No. RR-8) [†]
Influenza [§]	2010;59(No. RR-8) 2011;60:1128--32
Measles, mumps, rubella (MMR)	1998;47(No. RR-8)
Meningococcal disease and outbreaks	2005;54(No. RR-7) 2011;60:72--6
Mumps (see also MMR and Measles)	1989;38:388--92, 397--400 2006;55:629--630
Pertussis, acellular (see also Diphtheria, tetanus, and pertussis)	2006;55(No. RR-3) 2006;55(No. RR-17) 2008;57(No. RR-4) 2011;60:13--15
Poliomyelitis	2000;49(No. RR-5) 2009;58:829--30
Rubella (see also MMR, Measles, and Mumps)	2001;50:1117
Typhoid	1994;43(No. RR-14)
Varicella	2007;56(No. RR-4)
* Persons who provide health care to patients or work in institutions that provide patient care (e.g., physicians, nurses, emergency medical personnel, dental professionals and students, medical and nursing students, laboratory technicians, hospital volunteers, and administrative and support staff in health-care institutions). Source: U.S. Department of Health and Human Services. Definition of health-care personnel (HCP). Available at http://www.hhs.gov/ask/initiatives/vacc toolkit/definition.html &D. [†] This report provides guidance from CDC and is not an ACIP statement. [§] Each year influenza vaccine recommendations are reviewed and amended to reflect updated information concerning influenza activity in the United States for the preceding influenza season and to provide information on the vaccine available for the upcoming influenza season. These recommendations are published periodically in <i>MMWR</i>. The most current published recommendations should be consulted (available at http://www.cdc.gov/vaccines/pubs/acip-list.htm).	





If patient is in office/at home, call prior to sending to hospital/ER etc to limit exposures!

When Suspecting Measles:



1. Immediately mask and isolate the patient in a room with a closed door.
2. Only allow healthcare workers with presumptive evidence of measles immunity to attend to the patient, and they must use N95.
3. Evaluate the patient and order measles confirmatory testing (throat/NP swab for RT-PCR and serum for IgM measles testing).
4. Contact infection prevention at your facility.
5. Immediately report this suspected case to your local/state health department.

Definitions

- “Healthcare settings” refers to places where healthcare is delivered and includes, but is not limited to, acute care facilities, long-term acute care facilities, inpatient rehabilitation facilities, nursing homes and assisted living facilities, home healthcare, vehicles where healthcare is delivered (e.g. mobile clinics), and outpatient facilities, such as dialysis centers, physician offices, and others
- Definition of exposure to measles for HCP in healthcare settings: HCP exposures to measles in healthcare setting include spending any time while unprotected:
 - In a shared air space with an infectious measles patient at the same time
 - In a shared air space vacated by an infectious measles patient within the prior 2 hours

Minimizing potential exposures

If scheduling appointments, provide instructions over the phone for arrival

- Including: which entrance to use, precautions including droplet mask

Upon arrival

- Provide droplet mask and separate from other patients

Transfer into airborne infection isolation room (AIIR, i.e. negative pressure, 6-12 air exchanges/hour with exhaust outside) as soon as possible

- Patient can then remove face mask once in the AIIR
- If AIIR is not available, put into a room with a HEPA filter, keep the mask on, and once out of the room, let it sit for 2 hours before terminal clean

Considerations: shared air space



Keep in mind what is a shared air space or shared air handling system



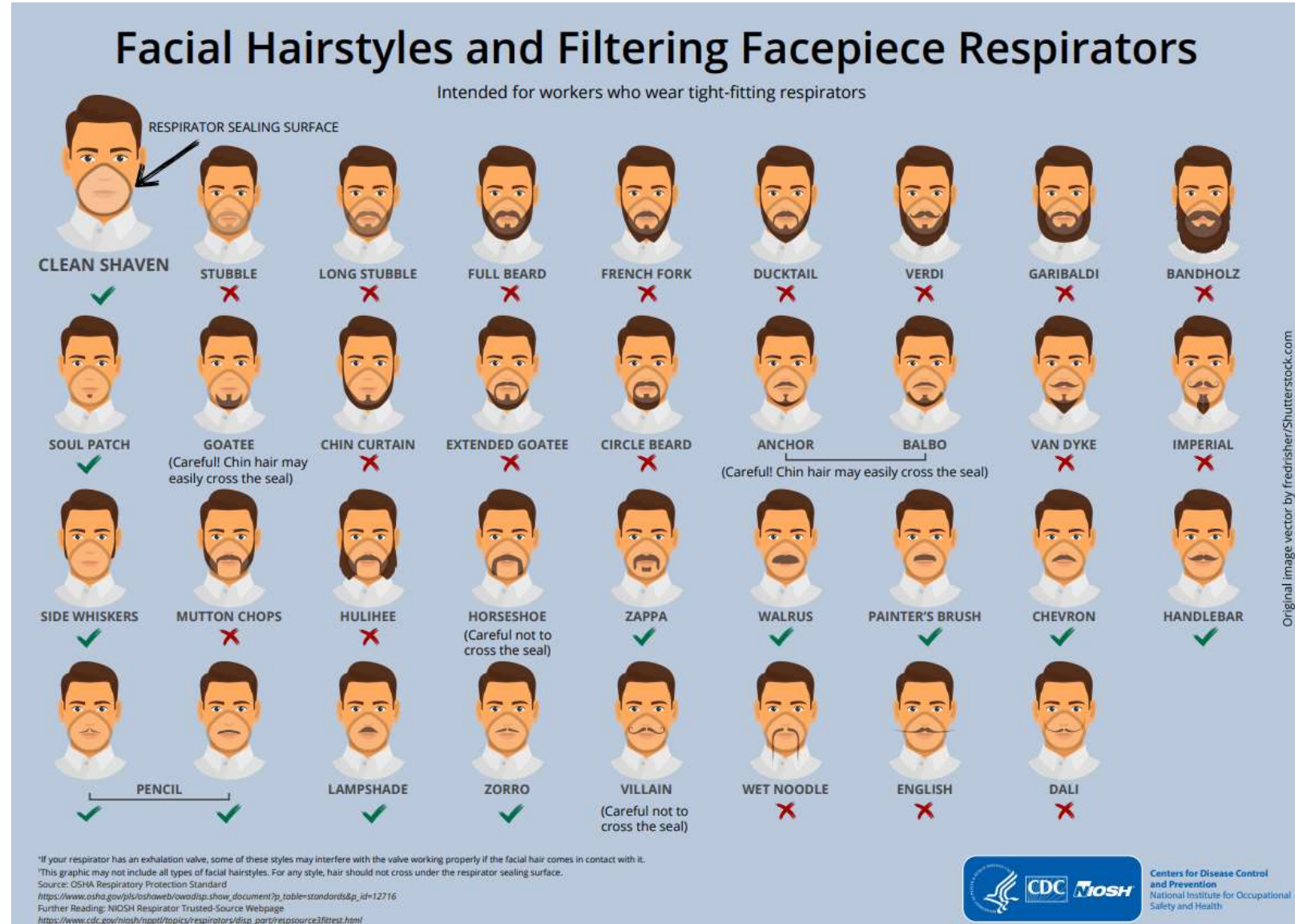
Emergency department: patient waiting space, triage, HCP work areas, multiple individual rooms



Humidity, air flow dynamics also important
Distance from source patient

Healthcare Personnel

- N95
- As certified by NIOSH and fit tested by OSHA standards
- If patient is transported, they wear droplet mask with shortest route/limited exposure to non-essential personnel.



Duration of Isolation

- Duration:
 - Rash onset is considered Day 0
 - Patient should be isolated (airborne in hospital, individual room at home) for 4 days after rash onset
 - Immunocompromised patients should remain in isolation the entire duration of illness
 - No visitors unless they are necessary for the patient's well being and care
 - Should have presumptive evidence of immunity as well

Post-Exposure Prophylaxis



- Measles vaccine if given within 72 hours of exposure will provide protection
- In measles outbreak, you can give MMR to children 6-11 months of age but will not count toward 2 dose series
- Immune globulin (IG) can be given IM to prevent or modify measles in a susceptible person within 6 days of exposure.
 - IG is indicated for susceptible household or other close contacts of patients with measles
 - contacts < 1 year of age
 - pregnant women
 - immunocompromised hosts
 - other people for whom measles vaccine is contraindicated
- If IG not available you can give IVIG 400 mg/kg



FAQ#3a: Immunity in HCW

Born before 1957...?

(and not just them!)

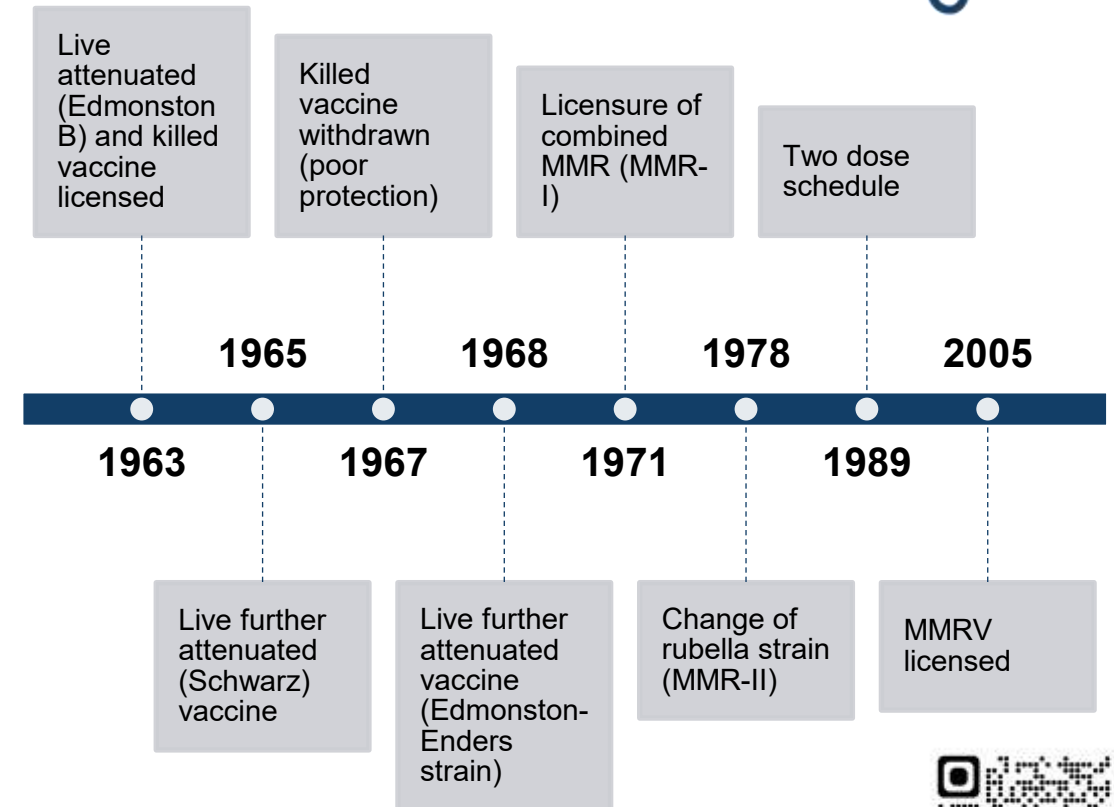
- Consider vaccinating HCP born before 1957 who do not have other evidence of immunity to measles
- During a measles outbreak, 2 doses of measles virus-containing vaccine are recommended for all HCP, regardless of year of birth



FAQ#3b: Immunity in Patients

Measles Vaccines

- Composition: Live virus
- Efficacy: 95% (range 90-98%)
- Duration of immunity: lifelong
- Schedule: 2 doses
 - 12 -15 months
 - 4-6 years
- Co-administered with mumps and rubella (MMR)



1989



- Significant resurgence (18,193 cases) with 40% being in vaccinated
- Blame placed on:
 - Failure of vaccine programs
 - Vaccine failure
 - Continued to report 95% effectiveness of vaccine
- Experimental vaccine used in CDC studies in Los Angeles in minority children
 - Unlicensed and parents were not made aware
 - Meant to have high dose to overcome maternal antibodies leading to vaccine failure
 - Halted study in 1991
- ACIP updated recommends for two doses prior to school entry
 - First dose at 15 months, second dose at 4-6yo
 - 1st dose subsequently updated to be 12-15 months

Immunity/Indications for revaccination



- Measles Immunity

- Born before 1957
- Documentation of physician-diagnosed measles
- Serologic evidence of immunity
- Documentation of receipt of measles containing vaccine (2 doses)

- Revaccination

- Vaccinated before the first birthday
- Vaccinated with killed measles vaccine
- Vaccinated prior to 1968 with an unknown type of vaccine
- Vaccinated with IG in addition to a further attenuated strain or vaccine of unknown type
- Receipt of chemotherapy/CAR-T at >6mo from completion of therapy

ORIGINAL ARTICLE

Duration of Humoral Immunity to Common Viral and Vaccine Antigens

Ian J. Amanna, Ph.D., Nichole E. Carlson, Ph.D., and Mark K. Slifka, Ph.D.



- Longitudinal analysis for viral antigens vaccinia, measles, mumps, VZV, EBV
- 45 subjects for period up to 26 years (blood was banked annually)
- Measured antigen-specific memory B cells by means of limiting-dilution analysis and compared memory B cell frequencies to their corresponding serum antibody levels
- Majority of patients had recovered from viral infections
- 96% were seropositive
- None had significant decline in measles-specific antibodies and is estimated that protective levels would be maintained for life (estimated half-life 3014 years [95% CI: 104-infinity])

Serologies



- 2-7% children who receive only one dose fail to respond to it
 - A single dose is effective at reducing measles transmission, two dose strategy necessary for elimination of indigenous transmission
- Per the CDC, >99% persons receiving 2 doses of measles vaccine (1st dose after 1st birthday) develop serologic evidence of immunity
- Titer is lower in vaccine induced immunity than natural disease
- *Both serologic and epidemiologic evidence indicated that vaccine-induced immunity appears to be long-term and probably lifelong in most persons.*
- *Most vaccinated persons who appear to lose antibody show an anamnestic immune response upon revaccination, indicating that they are probably still immune.*
 - Studies show annual loss of seroprevalence 0.009
 - Persons with no detectable antibody manifest secondary immune response on revaccination or exposure

Diving deeper

Haralambieva IH, Ovsyannikova IG. The genetic basis for interindividual immune response variation to measles vaccine: new understanding and new vaccine approaches. Expert Rev Vaccines 2013; 12(1): 57-70.

- *Estimates of the immunogenicity of the current, live-attenuated measles vaccines vary substantially. Our laboratory found only 81% to be seropositive in a sample of 1490 school-aged children all having had a single dose of measles-containing vaccine received at 12 months or later in life; of the remaining 19% who were seronegative, one in five who received a second dose remained seronegative*
- *Various studies estimate anywhere from 2 to 10% of those vaccinated with two doses fail to develop protective humoral immunity, and those antibody levels wane over time, which can result in infection*
- *In our evaluation of 763 healthy school-aged children in Rochester (MN, USA), all previously vaccinated with two doses of MMR, only 91.1% demonstrated protective humoral immunity*

“Immunogenetics”



- Polymorphisms in the HLA genes are a possible explanation for inter-individual variations in vaccine-inducated adaptive immune responses
- Twin studies estimate heritability for antibody responses to measles vaccine ~89%
 - SNPs and HLA alleles explain approximately 30% interindividual variability in measles-specific humoral immune responses
- Population based studies have identified key HLA haplotypes
 - B*8, B*13, B*44, DRB1*03, DQA1*0201 alleles have lower vaccine antibody responses
 - Class I B*7 and class II DQA1*0101 and DPA1*0202 alleles have high measles vaccine antibody responses
 - HLA homozygosity may contribute to decrease in antibody responses
 - Obviously multifactorial influences and more studies are necessary
- *All of these findings are evidence that measles vaccine immune response is subject to regulation by multiple inter-related genes, genetic variants and gene networks, as is expected for complex biological processes such as infectious disease and immune response.*

Immunogenetics and other concerns



- Genetic ancestry may also play a significant role in measles vaccine responses. One cohort study found that Caucasians and most Hispanics, ethnic groups which represent nearly 80 percent of the U.S. population, showed significantly lower humoral and cellular responses to MMR vaccination than African Americans.
- Measles virus (MeV) has eight clades (A-H) and the clades are further divided into 23 genotypes
 - Sera from vaccinated individuals neutralize all the clades, the efficacy varies from clade to clade
 - Newer strains show epitopes that are not shared by vaccine strains
- 1999, Europe: Highly vaccinated population shows decay of antibodies without exposure to wild virus (which prompts mild to no symptoms); estimated protection of vaccine induced protection in the absence of re-exposure is 25 years
 - Confirmed in 2002 in Japan: “asymptomatic measles infections occur even in the adult population with unexpectedly high frequency”

Voight EA, Ovsyannikova IG. [Genetically defined race, but not sex, is associated with higher humoral and cellular immune responses to measles vaccination](#). *Vaccine* Sept. 22, 2016; 34(41): 4913-4919.

Kulkarni RD, Ajantha GS. [Global eradication of measles: Are we poised?](#). *Indian J Med Microbiol* 2017; 35(1): 10-16.

Mossong J, Nokes DJ. [Modeling the impact of subclinical measles transmission in vaccinated populations with waning immunity](#). *Am J Epidemiol* Dec. 1999; 150(11): 1238-1249.

Sonoda S, Kitahara M, Nakayama T. [Detection of measles virus genome in bone-marrow aspirates from adults](#). *J Gen Virol* Oct. 1, 2002; 83: 2485-2488.



There is not enough information about what drives a vaccine response, a vaccine non-response, adverse events following vaccination and the many complex interactions between immune function-related components known at this time.

This finding confirmed the scientific evidence from Germany in April 2019 which reported:

“Although measles cases have gradually declined globally since the 1980s together with an increase in vaccination coverage, there has been a resurgence of measles in the European Union and European Economic Area starting in 2017 with adults aged over 20 years comprising more than a third of all cases.”³⁸

“The impact of waning immunity to measles will likely become more apparent over the coming years and may increase in the future, as the vaccinated population (with hardly any exposure to measles) will grow older and the time since vaccination increases. It is worth noting that the median age of measles cases has been increasing over the past 15 years in Berlin and the extent of waning immunity may increase further. Vaccinated cases have a lower viraemia and have rarely been observed to contribute to transmission. However, with the vaccinated population turning older and titres possibly decreasing further, this observation has to be re-evaluated.”³⁹

In the past decade, outbreaks of measles in highly vaccinated populations have been documented in medical literature.

In 2011, a fully vaccinated person transmitted measles to four contacts, of which two contacts had documentation of receiving two prior MMR doses and two had confirmed blood antibody results considered protective against measles.⁴⁰

In 2014, an outbreak of measles occurred among vaccinated health care workers in the Netherlands. Of the eight confirmed cases, six had received two measles vaccines, one had received a single dose, and one worker was unvaccinated. Study authors concluded that among the 106 potentially exposed health care workers, the effectiveness of two doses of measles vaccine were approximately 52 percent.⁴¹

In 2017, an outbreak of measles occurred among young soldiers in Israel. The primary patient involved in the outbreak had documentation of having received three doses of measles vaccine and the additional eight cases of measles were found to have occurred in persons who reported having, or provided documentation of having, at least two doses of a measles containing vaccine.⁴²



Measles in Healthcare Facilities in the United States During the Postelimination Era, 2001–2014

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Between 2001 and 2014, 78 reported measles cases resulted from transmission in US healthcare facilities, and 29 healthcare personnel were infected from occupational exposure, 1 of whom transmitted measles to a patient. The economic impact of preventing and controlling measles transmission in healthcare facilities was \$19 000–\$114 286 per case.



- Of the non-imported cases—5.9% were transmitted in US healthcare facilities.
- 29 measles infections in HCP due to occupational exposures, 1 of whom transmitted measles to a patient
- Of the 29, 65.5% had adequate presumptive immunity
- 5 measles cases in HCP with non-occupational exposures who had the potential to pass it on to their patients
- Expenses: furlough, time spent reviewing for immunity, time spent conducting serologic testing and administering vaccines

At least 3% of measles cases this year were in people who were fully vaccinated, CDC says



By Alexander Tin

Edited By Sarah Lynch Baldwin

Updated on: June 18, 2025 / 8:04 AM EDT / CBS News



[CBS News](#) (6/17, Tin) reports the CDC said in its weekly update Friday that “at least 3% of measles cases confirmed so far this year have been in people who received two doses of the measles vaccine.” According to the agency, “about three dozen of the nearly 1,200 measles infections in 2025 have been in people with two vaccine doses,” and an “additional 2% of cases were in people who received at least one dose of the measles vaccine. Many of the cases were in Texas, which on Tuesday counted a 21st confirmed measles case in someone with at least two doses of the vaccine.”

None of the confirmed measles cases that led to hospitalizations this year had documented evidence of receiving two doses of vaccine, the CDC spokesperson said. More than 8 in 10 of the cases have been in people 20 years old or older.

Six cases of measles in people who received at least two doses of the vaccine were in Colorado, that state's health department [says](#).

“None of the six cases with 2+ doses were seniors or required hospitalization,” Hope Shuler, a spokesperson for the Colorado Department of Public Health and Environment, said in an email.

[At least 3% of measles cases this year were in people who were fully vaccinated, CDC says - CBS News](#)

The Journal of Infectious Diseases

EDITORIAL COMMENTARY



Is There a Correlate of Protection for Measles Vaccine?

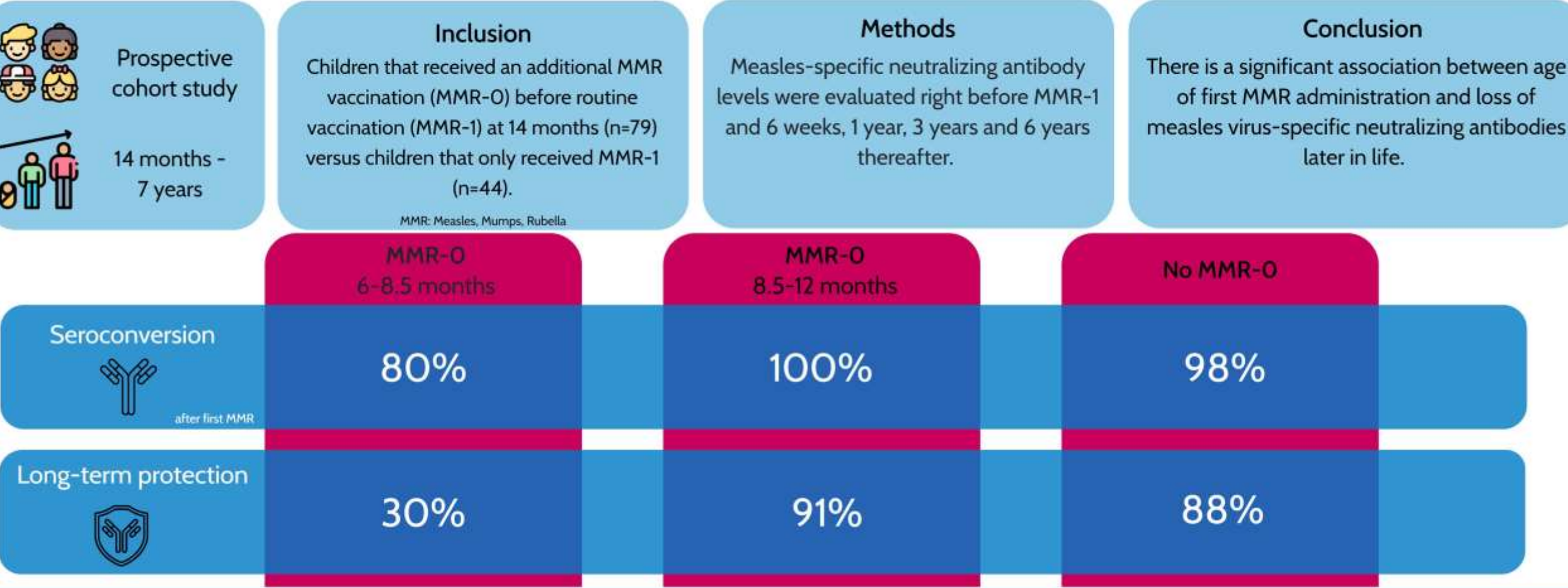
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Long-term dynamics of measles virus-specific neutralizing antibodies in children vaccinated before 12 months of age

van der Staak et al., 2024 | *Clinical Infectious Diseases*





FAQ#4: Any
treatment?

Treatment of Measles

- No specific anti-viral therapy available
- Measles is susceptible in vitro to ribavirin
 - severely affected and immunocompromised children with measles
- Vitamin A treatment in children with resource-limited countries has been associated with decreased morbidity/mortality
- WHO recommends vitamin A therapy (once daily x 2 days) for all children with acute measles. Give once daily x 2 days at the following doses:
 - 200,000 IU for children $\geq$ 12 months
 - 100,000 IU for infants 6-11 months of age
 - 50,000 IU for infants younger than 6 months of age
 - An additional dose should be given 2-4 weeks later for children with Vitamin A deficiency

February 1992

Vitamin A Levels and Severity of Measles

New York City

Thomas R. Frieden, MD, MPH; Anne L. Sowell, PhD; Kelly J. Henning, MD; [et al](#)

» [Author Affiliations](#)

Am J Dis Child. 1992;146(2):182-186. doi:10.1001/archpedi.1992.02160140048019

Abstract

• Recent studies show that vitamin A levels decrease during measles and that vitamin A therapy can improve measles outcome in children in the developing world. Vitamin A levels of children with measles have not been studied in developed countries. We therefore measured vitamin A levels in 89 children with measles younger than 2 years and in a reference group in New York City, NY. Vitamin A levels in children with measles ranged from 0.42 to 3.0 $\mu\text{mol/L}$; 20 (22%) were low. Children with low levels were more likely to have fever at a temperature of 40°C or higher (68% vs 44%), to have fever for 7 days or more (54% vs 23%), and to be hospitalized (55% vs 30%). Children with low vitamin A levels had lower measles-specific antibody levels. No child in the reference group had a low vitamin A level. Our data show that many children younger than 2 years in New York City have low vitamin A levels when ill with measles, and that such children seem to have lower measles-specific antibody levels and increased morbidity. Clinicians may wish to consider vitamin A therapy for children younger than 2 years with severe measles. Additional studies of vitamin A in measles and other infectious diseases, and in vaccine efficacy trials, should be done.

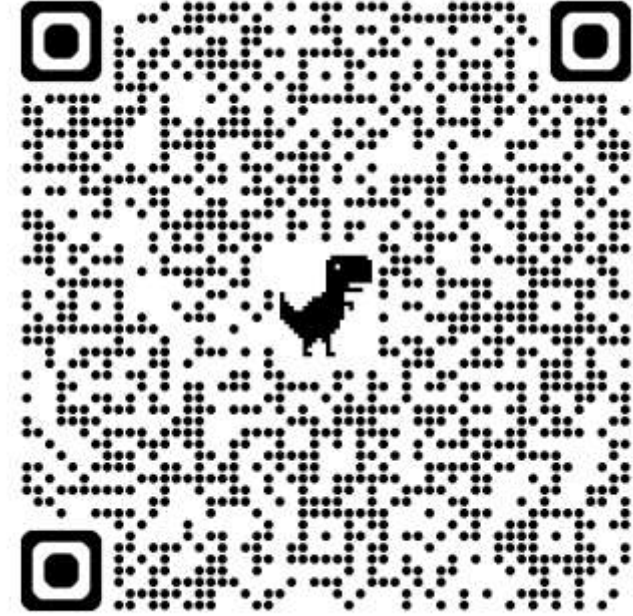
(*AJDC.* 1992;146:182-186)

Ribavirin



- Broad spectrum antiviral
- Works *in vitro*
- Clinical data lacking
 - Forni et al reported 6 adult cases in NYC in 1991 on mechanical ventilation with 5 patients improving
 - Confounded by HIV status (1 or 2 of them presumed positive)
 - “Therapy with IV ribavirin was well tolerated by our patients and was associated with reversal of respiratory compromise”
- It is NOT approved in the US by the FDA, but can be used IV through EIND or orally (commercial preparation)

Be Ready for Measles Toolkit



PROJECT
FIRSTLINE

CDC's National Training Collaborative
for Healthcare Infection Prevention & Control





Transitioning...
AHEC modules

Immunization and Vaccine Information for Healthcare Professionals

<https://www.scahec.net/learn/programs>

Basic discussions about vaccine technology and safety, but additional content on pediatrics, pregnancy, travel, immunocompromised patients and more

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