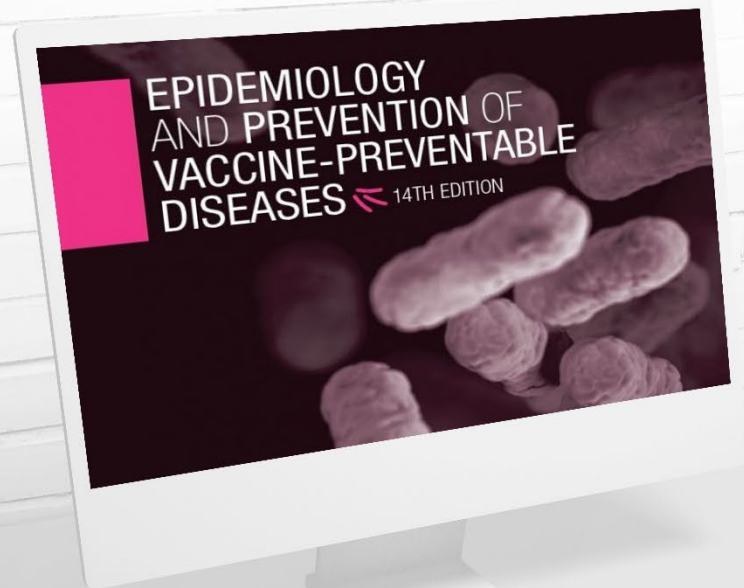


Measles, Mumps, and Rubella Vaccines

Pink Book Web-on-Demand Series

Andrew Kroger, MD, MPH
Medical Officer
Immunization Services Division





Learning Objectives

- Describe the fundamental principles of the immune response.
- Describe immunization best practices.
- Describe an emerging immunization issue.
- For each vaccine-preventable disease, identify those for whom routine immunization is recommended.
- For each vaccine-preventable disease, describe characteristics of the vaccine used to prevent the disease.
- Locate current immunization resources to increase knowledge of team's role in program implementation for improved team performance.

Continuing Education Information

- To claim continuing education (CE) for this course, please follow the steps below by July 1, 2026.
- Search and register for course **WD4810-080624** in **CDC TRAIN**.
- Pass the post-assessment at 80%.
- Complete the evaluation.
- Visit “Your Learning” to access your certificates and transcript.
- If you have any questions, contact **CDC TRAIN** at train@cdc.gov or CE Coordinator, Melissa Barnett, at MBarnett2@cdc.gov



Disclosure Statements

- In compliance with continuing education requirements, all planners and presenters must disclose all financial relationships, in any amount, with ineligible companies during the previous 24 months as well as any use of unlabeled product(s) or products under investigational use.
- CDC, our planners, and content experts, wish to disclose they have no financial relationship(s) with ineligible companies whose primary business is producing, marketing, selling, reselling, or distributing healthcare products used by or on patients.
- Content will not include any discussion of the unlabeled use of a product or a product under investigational use except for Dr. Kroger's discussion of the use of MMR vaccines in a manner recommended by the Advisory Committee on Immunization Practices, but not approved by the Food and Drug Administration.
- CDC did not accept financial or in-kind support from any ineligible company for this continuing education activity.

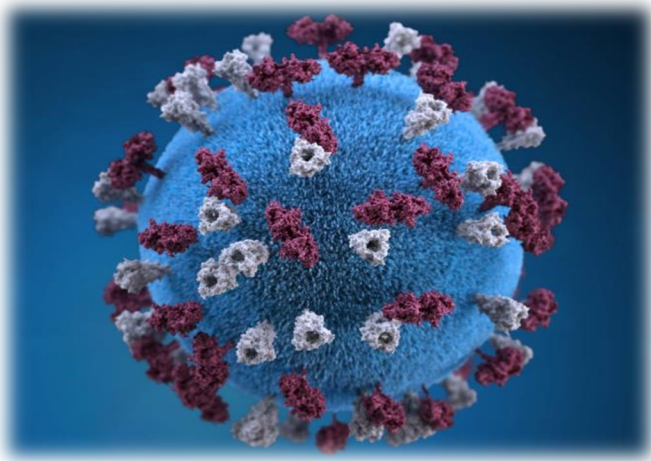
Disclosure Statements

The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

1

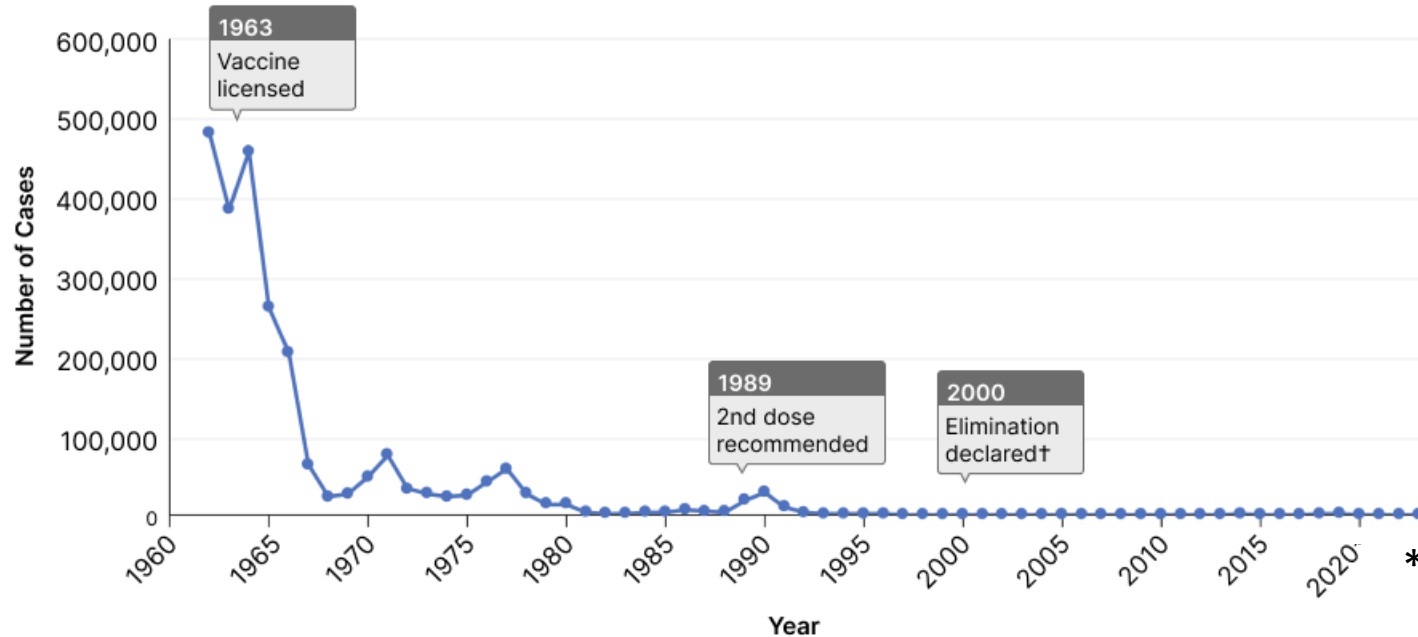
Measles Disease

Measles Virus



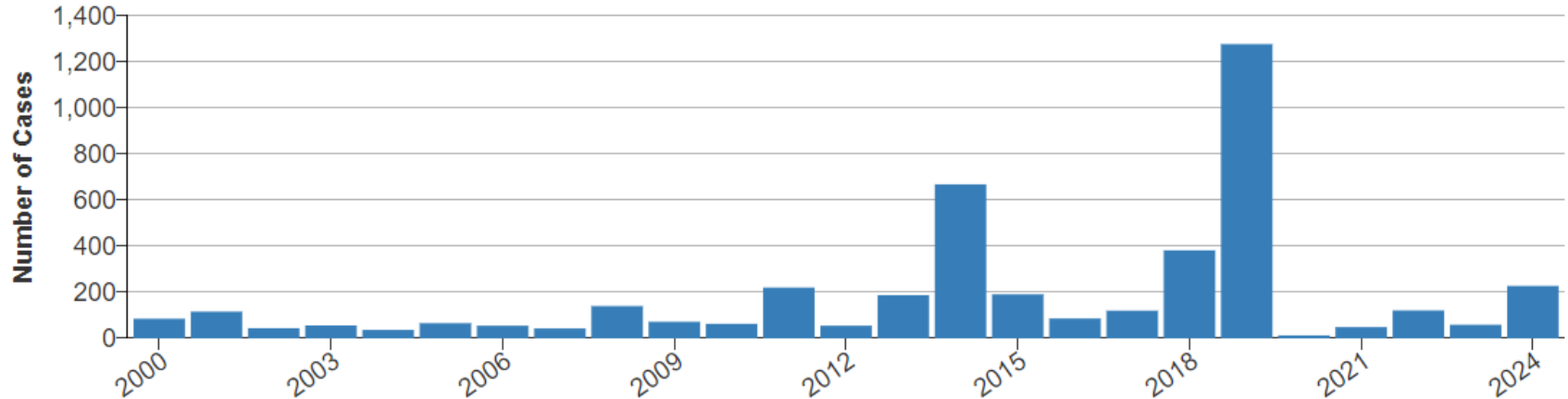
- Measles virus is RNA paramyxovirus
- Humans only reservoir
- Highly transmissible

Reported Measles Cases in the United States from 1962-2023*



*2023 data are preliminary and subject to change. †Elimination is defined as the absence of endemic measles transmission in a region for ≥ 12 months in the presence of a well-performing surveillance system.

Yearly Measles Cases in the United States from 2000-2024*



*2023-2024 data are preliminary and subject to change.

Declines in Measles Vaccination Rates Increase Risk of Outbreaks, Including in the United States

Measles remains a common disease in many parts of the world.
In 2022, an estimated 136,000 people (mostly children) died from measles.



Many countries and popular travel destinations are experiencing measles outbreaks in Spring/Summer 2024. These include the UK, India, Austria, the Philippines, and more.



In the United States, all measles cases originate from international travel. Importations often come from unvaccinated U.S. residents.

Clinical Overview of Measles

- Measles is one of the most contagious diseases.
- MMR vaccine provides the best protection.
- Isolate infected patients for 4 days after they develop a rash, and follow airborne precautions in healthcare settings.
- Report suspected measles cases to your local health department.
- Laboratory confirmation is essential for all sporadic measles cases and all outbreaks.

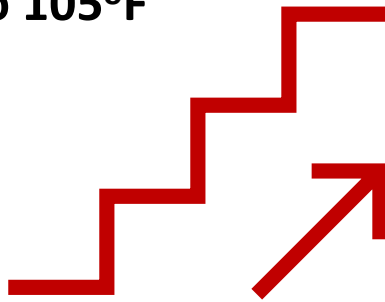


Measles Complications: Who Is at Risk?

- **Anyone who is not protected against measles is at risk for infection.**
- **Several groups are more likely to suffer from measles complications:**
 - Children younger than 5 years of age
 - Adults older than 20 years of age
 - Pregnant women
 - People with weakened immune systems, such as from leukemia or HIV infection

Measles Clinical Features (1)

- **The average incubation period for measles:**
 - 11 to 12 days from exposure to prodrome
 - 14 days from exposure to rash (range: 7–21 days)
- **Stepwise increase in fever to as high as 103°F to 105°F**



Measles Clinical Features (2)

- **Characterized by 3 C's**
 - Cough, coryza, conjunctivitis
- **Koplik spots on buccal mucosa or hard palate**



Cough



Coryza
runny nose



Conjunctivitis
red, watery eyes



Koplik spots

Measles Rash

- **Maculopapular eruption**
- **Occurs on average 14 days after exposure; persists 5–6 days**
 - Contagious 4 days before to 4 days after rash appears
- **Begins at the hairline, then involves face and upper neck**
- **Proceeds downward and outward to hands and feet**
- **Severe lesions peel or scale**
- **Fades in the same order that it appears**
- **In darker skin tones, rash appears violaceous or brown**



Measles Complications (1)

- **Common complications from measles include:**
 - Otitis media
 - Pneumonia
 - Diarrhea
- **Even in previously healthy children, measles can cause serious illness requiring hospitalization.**

Measles Complications (2)

- 1 out of every 1,000 people infected will develop acute encephalitis, which often results in permanent brain damage.
- 1 to 3 out of every 1,000 children who become infected will die from respiratory and neurologic complications.
- Subacute sclerosing panencephalitis (SSPE) is a rare but fatal degenerative disease of the central nervous system:
 - Characterized by behavioral and intellectual deterioration
 - Generally, develops 7 to 10 years after measles infection



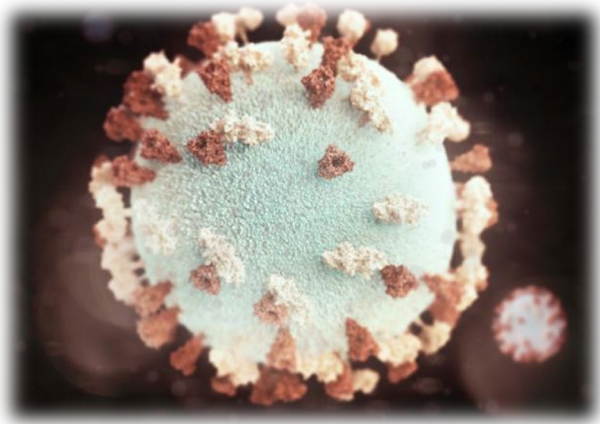
Be Vigilant About Measles - Recognize the Symptoms and Act!

- **Ask patients about:**
 - Vaccination history
 - Recent international travel
 - Recent contact with international travelers
 - History of measles in the community
- **Adhere to airborne precautions when caring for patients with known or suspected measles.**
- **Promptly isolate patients with suspected measles.**

2

Mumps Disease

Mumps Virus



- Mumps is RNA paramyxovirus
- Humans only reservoir

Mumps Clinical Features

- **Incubation period usually 16 to 18 days**
 - Range 12-25 days
- **Nonspecific prodrome of myalgia, malaise, headache, low-grade fever**
- **Typically presents as parotitis or other salivary gland swelling**
- **Up to 24% of mumps cases in the pre-vaccine era were asymptomatic; the prevalence of asymptomatic disease among vaccinated persons is unknown.**



Mumps Complications

- **Orchitis, oophoritis, mastitis, pancreatitis, hearing loss, meningitis, and encephalitis**
 - Meningitis, encephalitis, pancreatitis, and hearing loss among infected persons are rare (less than 1%) in the postvaccine era.
- **More common among adults than children**
- **Less likely in vaccinated persons compared to unvaccinated persons**



Impact of Mumps Vaccination Program

99% decrease in yearly cases

1968:

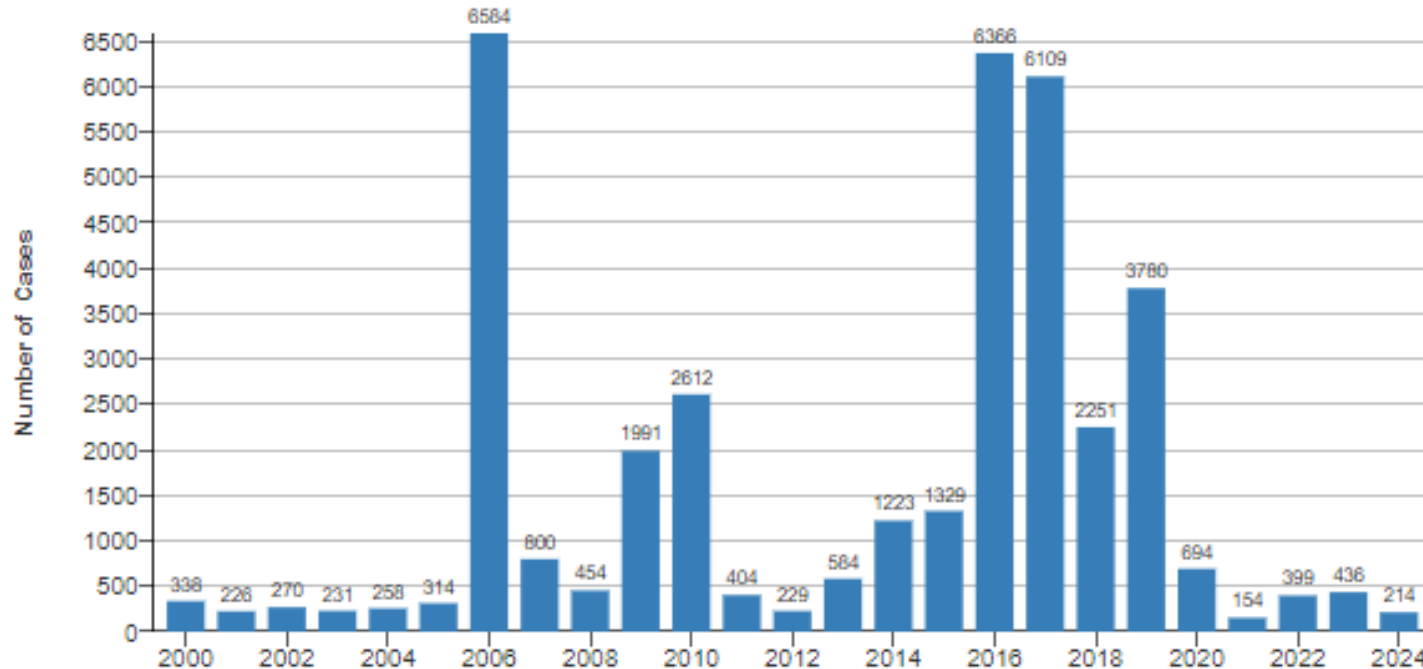
152,209 cases



2023:

436 cases

Reported Mumps Cases in the United States, 2000–2024*

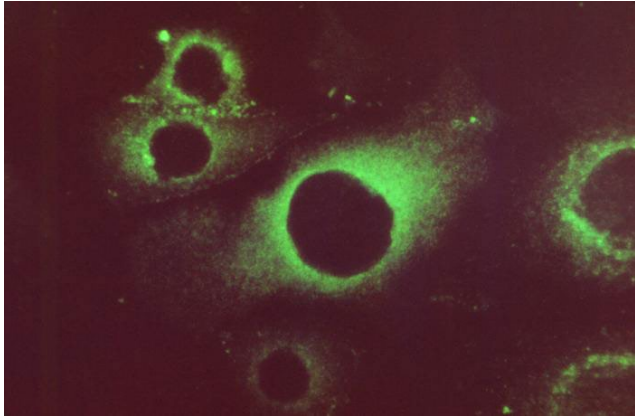


*2021–2024 case counts are preliminary and subject to change.

3

Rubella Disease

Rubella Virus



- Rubella virus is RNA rubivirus
- Humans only reservoir

About Rubella — German Measles, 3-Day Measles

- Spreads when an infected person coughs or sneezes
- Usually causes a rash that first appears on the face
- Rubella is very dangerous during pregnancy and for developing babies.
- Measles, mumps, and rubella (MMR) vaccine is the best protection against rubella.

Rubella Clinical Features

- **Incubation period - 14 days**
 - Range 12-23 days
- **Young children - Rash is first symptom**
- **Older children and adults - Prodrome with low-grade fever, malaise, lymphadenopathy, and upper respiratory symptoms before rash**
 - Maculopapular rash 14 to 17 days after exposure
 - Arthralgia common in adult women



Congenital Rubella Syndrome (CRS)

Rubella is associated with many birth defects



**Hearing
impairment**



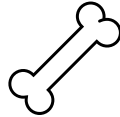
Eye abnormalities



**Congenital heart
disease**



**Microcephaly &
intellectual disabilities**



**Bone
alterations**



**Liver & spleen
damage**



Rubella and CRS in the U.S. – Before the Vaccine

12,500,000 People got rubella

20,000 Babies were born with CRS

11,000 Pregnant women lost their babies

2,100 Newborns died

Rubella and CRS Elimination — United States and the Americas

- **United States:**

- Since elimination in 2004, fewer than 10 rubella cases are reported annually.
- Most cases had evidence of infection while traveling outside the U.S.

- **Americas:**

- In 2015, PAHO determined rubella and CRS had been eliminated.



Global Rubella and CRS

- **Over half the world's countries have eliminated rubella, however transmission is still occurring widely in Africa, East Asia, and South Asia.**
 - Approximately 49,000 cases were reported worldwide in 2019, and 10,000 cases were reported in 2020.
- **Globally, rubella is still a leading vaccine-preventable cause of birth defects.**
 - In 2019, an estimated 32,000 children were born with CRS.

4

MMR Vaccine

MMR-containing Vaccines


Vaccine Product	Component(s)	Age Indication
M-M-R II	MMR	12 months and older
Priorix	MMR	12 months and older
ProQuad (MMRV)	MMR, Varicella	12 months through 12 years

MMR-containing Vaccines

Vaccine Product	Component(s)	Age Indication
➡ M-M-R II	MMR	12 months and older
➡ Priorix	MMR	12 months and older
ProQuad (MMRV)	MMR, Varicella	12 months through 12 years

- **Both vaccines (M-M-R II and Priorix) are interchangeable**

MMR-containing Vaccines

Vaccine Product	Component(s)	Age Indication
M-M-R II	MMR	12 months and older
Priorix	MMR	12 months and older
 ProQuad (MMRV)	MMR, Varicella	12 months through 12 years

MMR Vaccine Effectiveness

- **1 dose of MMR vaccine:**
 - 93% effective for measles
 - Range: 39%–100%
 - 72% effective for mumps
 - Range: 49%–92%
 - 97% effective for rubella
 - Range: 94%–100%
- **2 doses of MMR vaccine:**
 - 97% effective for measles
 - Range: 67%–100%
 - 86% effective for mumps
 - Range: 32%–95%

Prevention Strategies: Children

MMR vaccine is the best and safest protection against measles.

- **Ensure children are current on MMR vaccine.**
Routine vaccination schedule includes:
 - Dose 1: 12–15 months of age
 - Dose 2: 4–6 years of age
- **Assess vaccination status before international travel.**
 - Age 6–11 months: 1 dose of MMR
 - Age 12 months and older:
2 doses separated by at least 4 weeks



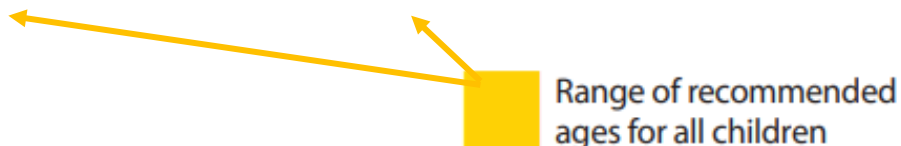
Child and Adolescent Immunization Schedule

Routine MMR Vaccination

Table 1 Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2024

These recommendations must be read with the notes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars. To determine minimum intervals between doses, see the catch-up schedule (Table 2).

Vaccine and other immunizing agents	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16 yrs	17–18 yrs
Measles, mumps, rubella (MMR)						See Notes	← 1 st dose →					2 nd dose					



Dose 1 in children 12 through 47 months of age: separate MMR and varicella vaccines recommended.

Child and Adolescent Immunization Schedule

Catch-up MMR Vaccination

Table 1 Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2024

These recommendations must be read with the notes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars. To determine minimum intervals between doses, see the catch-up schedule (Table 2).

Vaccine and other immunizing agents	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16 yrs	17–18 yrs
Measles, mumps, rubella (MMR)						See Notes	← 1 st dose →					2 nd dose					

Range of recommended ages for catch-up vaccination

- The minimum interval between dose 1 and dose 2 of MMR is 4 weeks.
- The minimum interval between dose 1 and dose 2 of MMRV is 3 months.

Child and Adolescent Immunization Schedule: MMR Vaccination Special Situations (1)

Table 1 Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2024

These recommendations must be read with the notes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars. To determine minimum intervals between doses, see the catch-up schedule (Table 2).

Vaccine and other immunizing agents	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16 yrs	17–18 yrs
Measles, mumps, rubella (MMR)					See Notes	← 1 st dose →						2 nd dose					

Range of recommended ages for certain high-risk groups

International travel

- Infants ages 6 through 11 months: 1 dose before departure; then 2-dose routine vaccination

Child and Adolescent Immunization Schedule: MMR Vaccination Special Situations (2)

Table 1 Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2024

These recommendations must be read with the notes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars. To determine minimum intervals between doses, see the catch-up schedule (Table 2).

Vaccine and other immunizing agents	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16 yrs	17–18 yrs
Measles, mumps, rubella (MMR)						See Notes	← 1 st dose →					2 nd dose					

International travel for 12 months or older

- Unvaccinated: 2 doses separated by at least 4 weeks
- Partially vaccinated: 2nd dose at least 4 weeks after dose 1
- Fully vaccinated: no additional doses

Child and Adolescent Immunization Schedule: MMR Vaccination Special Situations (3)

- In October 2017, ACIP recommended that people identified by public health authorities as being part of a group at increased risk for acquiring mumps in an outbreak should receive a third dose of MMR vaccine. This recommendation aims to improve protection of people in outbreak settings against mumps disease and mumps-related complications.
 - See www.cdc.gov/mmwr/volumes/67/wr/mm6701a7.htm for information about additional doses of MMR (including 3rd dose of MMR).

Prevention Strategies: Adults

MMR vaccine is the best and safest protection against measles.

- Ensure adults are up-to-date or have acceptable evidence of immunity.
 - Routine recommendations for adults:
 - Health care personnel
 - International travelers
 - College and other post-high school students
 - Household contacts of persons with altered immunocompetence


2 doses separated by at least 4 weeks
 - All other adults → 1 dose
- No serologic testing after vaccination is recommended.



Recommended Adult Immunization Schedule: MMR Vaccination

Table 1 Recommended Adult Immunization Schedule by Age Group, United States, 2024

Vaccine	19–26 years	27–49 years	50–64 years	≥65 years
Measles, mumps, rubella (MMR)	1 or 2 doses depending on indication (if born in 1957 or later)			For healthcare personnel, see notes

 Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of immunity

Presumptive Evidence of Measles Immunity

- **At least 1 of the following = Presumptive evidence of measles immunity:**
 - Written documentation of adequate vaccination:
 - 1 or more doses of a measles-containing vaccine administered on or after the first birthday for preschool-age children and adults not at high risk
 - 2 doses of measles-containing vaccine for school-age children and adults at high risk, including college and other post-high school students, health care personnel, and international travelers
 - Laboratory evidence of immunity*
 - Laboratory confirmation of measles
 - Birth before 1957[†]
- **No additional doses are indicated or recommended**

*Measles immunoglobulin (IgG) in serum, equivocal results should be considered negative.

[†]For unvaccinated health care personnel born before 1957 who lack laboratory evidence of measles immunity or laboratory confirmation of disease, health care facilities should consider vaccinating personnel with 2 doses of MMR vaccine at the appropriate interval.

Summary: Adult MMR Vaccination Special Situations

- Administer 2 doses separated by at least 4 weeks to previously unvaccinated



Students in postsecondary educational institutions



- International travelers
- Household or close contacts of immunocompromised persons with no evidence of immunity



Health care personnel with no evidence of immunity:

- Born before 1957 = **Consider**
- Born after 1957 = **Administer**

MMR in Women of Childbearing Age With No Evidence of Rubella Immunity

- **MMR is contraindicated during pregnancy** and should not be administered to a pregnant woman with no evidence of rubella immunity.
- If a pregnant woman does not have evidence of rubella immunity, administer 1 MMR dose **after** pregnancy (before discharge from health care facility).
- For nonpregnant women of childbearing age with no evidence of rubella immunity, administer 1 MMR dose.



Do NOT give
MMR during
pregnancy.

MMR in Women of Childbearing Age With No Evidence of Rubella Immunity

- **Vaccinated women of childbearing age who have:**
 - received 1 or 2 doses of rubella-containing vaccine*and*
 - have rubella serum IgG levels that are not clearly positive**should be administered 1 additional dose of MMR vaccine**
 - Maximum of 3 doses
 - They do not need to be retested for serologic evidence of rubella immunity.
- **Out of an abundance of caution, pregnancy should be avoided until one month after receiving the MMR vaccine.**



Do NOT give
MMR during
pregnancy.

Adult Immunization Schedule by Medical Condition Indication

Table 2 Recommended Adult Immunization Schedule by Medical Condition or Other Indication, United States, 2024

Always use this table in conjunction with Table 1 and the Notes that follow. Medical conditions or indications are often not mutually exclusive. If multiple medical conditions or indications are present, refer to guidance in all relevant columns. See Notes for medical conditions or indications not listed.

VACCINE	Pregnancy	Immunocompromised (excluding HIV infection)	HIV infection CD4 percentage and count		Men who have sex with men	Asplenia, complement deficiency	Heart or lung disease	Kidney failure, End-stage renal disease or on dialysis	Chronic liver disease; alcoholism ^a	Diabetes	Healthcare Personnel ^b
			<15% or <200mm ³	≥15% and ≥200mm ³							
MMR	*										

Contraindicated or not
recommended
*Vaccinate after pregnancy,
if indicated

Recommended for all adults
who lack documentation of
vaccination, **OR** lack evidence
of immunity



Knowledge Check

What counts as acceptable evidence of immunity?

- A. Documented age-appropriate vaccination with live measles-, mumps-, and rubella-virus- containing vaccines
- B. Laboratory evidence of immunity
- C. Laboratory confirmation of disease
- D. Born before 1957 (except healthcare personnel and except rubella for women of childbearing age who could become pregnant)
- E. All of the above



Answer

What counts as acceptable evidence of immunity?

- A. Documented age-appropriate vaccination with live measles-, mumps-, and rubella-virus- containing vaccines
- B. Laboratory evidence of immunity
- C. Laboratory confirmation of disease
- D. Born before 1957 (except health care personnel and except rubella for women of childbearing age who could become pregnant)
- E. **All of the above** ←



Knowledge Check

After completing the series, is serologic testing necessary for measles, mumps, and rubella, to document immunity based on vaccination?

- A. Yes
- B. No



Answer

After completing the series, is serologic testing necessary for measles, mumps, and rubella, to document immunity based on vaccination?

A. Yes

B. No ←

Measles, Mumps, Rubella Serologic Testing

- **Serologic screening before vaccination is not necessary unless the health care facility considers it cost-effective.**
- **Post-vaccination serologic testing to verify immunity is not recommended.**
 - Documented, age-appropriate vaccination supersedes the results of subsequent serologic testing.
 - MMR vaccination for persons with 2 documented doses of measles- or mumps-containing vaccine or 1 dose of rubella-containing vaccine with a negative or equivocal measles titer is not recommended.



5

Clinical Considerations

Postexposure Prophylaxis (PEP)

Measles

- **There are two types of PEP for measles:**
 - MMR vaccine, if administered within 72 hours of initial measles exposure, may provide some protection or modify the clinical course of disease.
 - Immunoglobulin (IG), if administered within 6 days of exposure, may also provide some protection or modify the clinical course of disease.

Mumps and Rubella

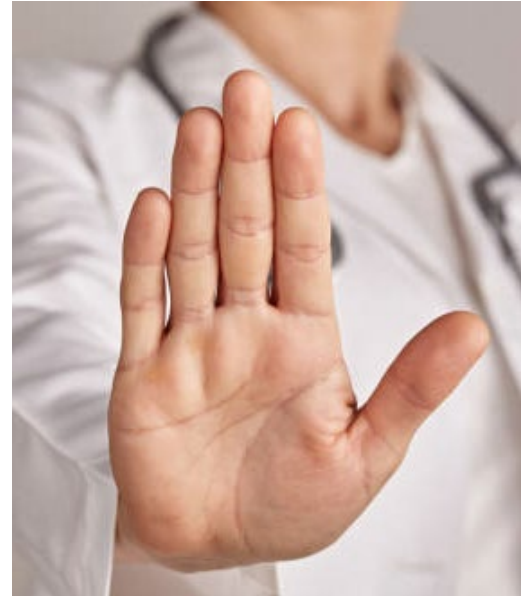
- **Unlike with measles, MMR vaccine is not effective for post-exposure prophylaxis.**

6

Safety

MMR and MMRV: Contraindications*

- Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[†]
- Severe immunodeficiency[‡]
- Pregnancy
- Family history of altered immunocompetence, unless verified clinically or by laboratory testing as immunocompetent



* When a contraindication is present, a vaccine should **not** be administered.

[†] Vaccination providers should check FDA-approved prescribing information for the most complete and updated information, including contraindications, warnings, and precautions.

[‡] Hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy or patients with HIV infection who are severely immunocompromised

MMR and MMRV: Precautions*

- Recent (≤ 11 months) receipt of antibody-containing blood product (specific interval depends on product)
- History of thrombocytopenia or thrombocytopenic purpura
- Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing
- Moderate or severe acute illness with or without fever
- MMRV only: Personal or family (sibling or parent) history of seizures of any etiology



* When a precaution is present, vaccination should generally be deferred but might be indicated if the benefit of protection from the vaccine outweighs the risk for an adverse reaction.

Adverse Reactions After MMR Vaccination

- **Fever (less than 15%)**
 - Febrile seizures (1 per 3,000 – 4,000 doses)
- **Transient rashes (5%)**
- **Transient lymphadenopathy (5% of children and 20% of adults)**
- **Parotitis (less than 1%)**
- **Coryza**
- **Cough**
- **Pharyngitis**
- **Headache**
- **Anaphylaxis (1.8-14.4 per million doses)**
- **Thrombocytopenic purpura (1 case per 40,000 doses)**
- **Arthralgia (25%)**
- **Arthritis (10%-30%)**
- **Measles inclusion body encephalitis (3 cases reported, 1 verified)**



Knowledge Check

If a health care worker develops a rash and low-grade fever after MMR vaccination, is the health care worker infectious?

- A. Yes
- B. No



Answer

If a health care worker develops a rash and low-grade fever after MMR vaccination, is the health care worker infectious?

A. Yes

B. No ←



7

Storage and Handling

MMR Vaccine Products

Product (Mfr)	MMR-II (Merck)	Priorix (GSK)
Type	Live, attenuated	
Age Indications	12 months and older	
Schedule	2 doses, separated by at least 4 weeks	
Storage	<p>Vaccine: Between -50°C and +8°C (-58°F and +46°F). Protect from light.</p> <p>Diluent: Between 2°C and 25°C (36°F and 77°F)</p>	<p>Vaccine: Between 2°C and 8°C (36°F and 46°F). Protect from light.</p> <p>Diluent: Between 2° and 25°C (36°F and 77°F)</p>
Preparation	Requires reconstitution	
Beyond Use Date/Time (BUD)	Reconstituted vaccine may be stored between 2°C and 8°C (36°F and 46°F), for up to 8 hours. Protect from light.	Reconstituted vaccine may be stored between 2°C and 8°C (36°F and 46°F), for up to 8 hours
Administration Route	IM or Subcut injection	Subcut injection



Knowledge Check

A nursing student had MMR titers done before he started school. His titers came back negative. He has 2 documented doses of MMR after 1 year of age, separated by more than 4 weeks. How many doses of MMR should we administer?

- A. One
- B. Two
- C. None



Answer

A nursing student had MMR titers done before he started school. His titers came back negative. He has 2 documented doses of MMR after 1 year of age, separated by more than 4 weeks. How many doses of MMR should we administer?

A. One

B. Two

C. None ←

CDC Clinical Resources

- **www.cdc.gov/vaccines**
 - Advisory Committee on Immunization Practices (ACIP) Vaccine Recommendations and Guidelines
 - Recommended Immunization Schedules
 - Vaccine Storage and Handling Toolkit
 - Vaccine Information Statements

Pink Book Training
Materials



Continuing Education Information

- To claim continuing education (CE) for this course, please follow the steps below by July 1, 2026.
- Search and register for course **WD4810-080624** in **CDC TRAIN**.
- Pass the post-assessment at 80%.
- Complete the evaluation.
- Visit “Your Learning” to access your certificates and transcript.
- If you have any questions, contact **CDC TRAIN** at train@cdc.gov or CE Coordinator, Melissa Barnett, at MBarnett2@cdc.gov



Email Us Your Immunization Questions



nipinfo@cdc.gov

Thank You From Atlanta!

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

