



Measles, Mumps, and Rubella Vaccines

Pink Book Web-on-Demand Series

August 30, 2022

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LCDR, U.S. Public Health Service

NCIRD, CDC

Learning Objectives

- **Describe the Advisory Committee on Immunization Practices General Best Practice Guidelines on Immunization.**
- **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.**
- **Implement disease detection and prevention health care services (e.g., smoking cessation, weight reduction, diabetes screening, blood pressure screening, immunization services) to prevent health problems and maintain health.**

Continuing Education Information

- CE credit, go to: <https://tceols.cdc.gov/>
- Search course number: **WD4564-083022**
-
- CE credit expires: **July 1, 2024**
- CE instructions are available on the **Pink Book Web-on-Demand Series** web page
- Questions and additional help with the online CE system, e-mail CE@cdc.gov

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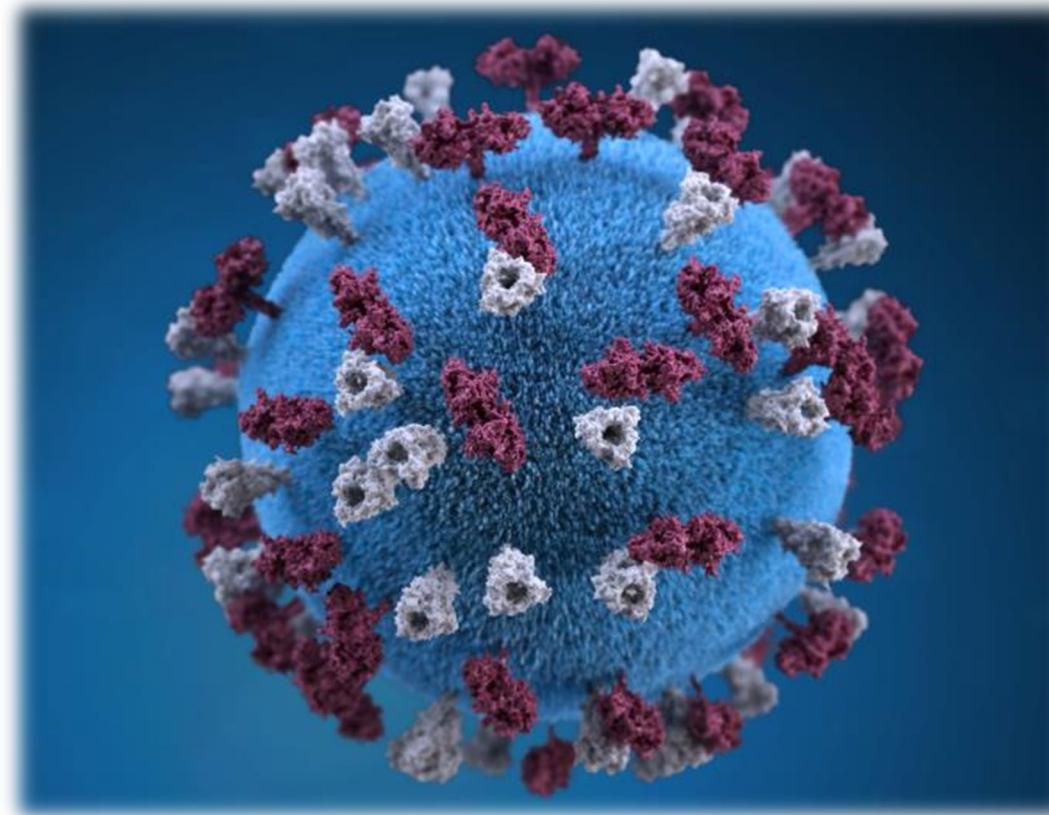
Disclosure Statements

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.

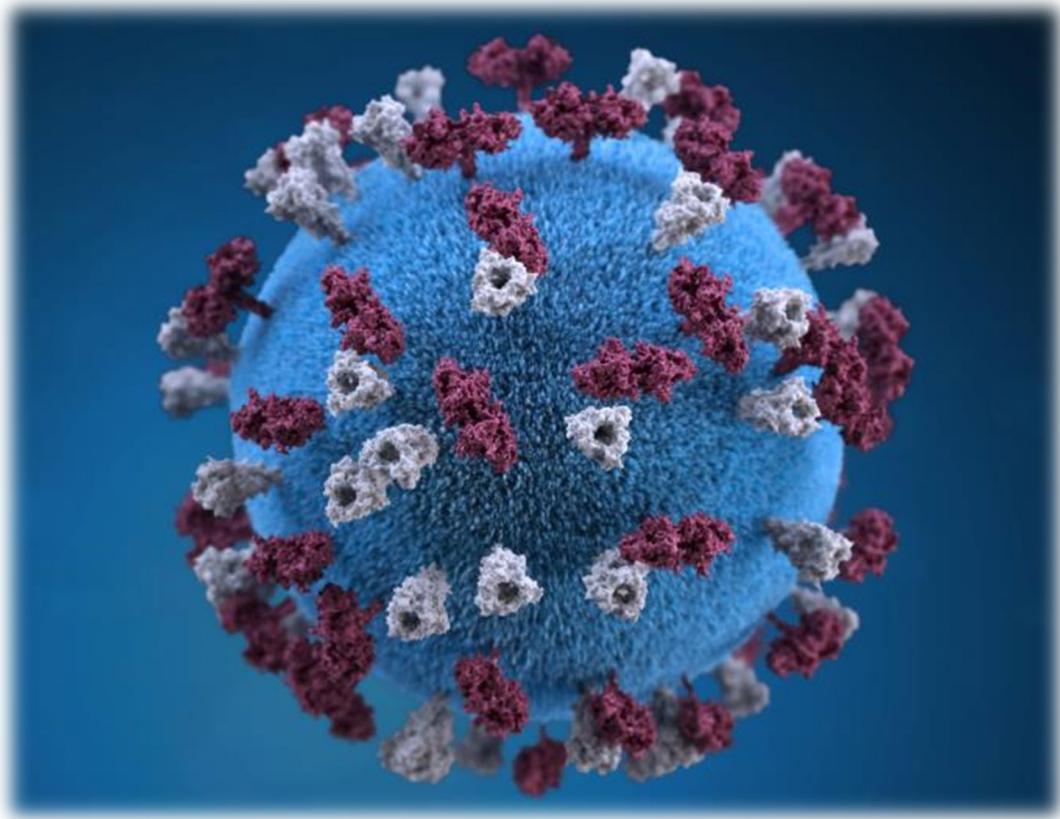
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Measles Disease

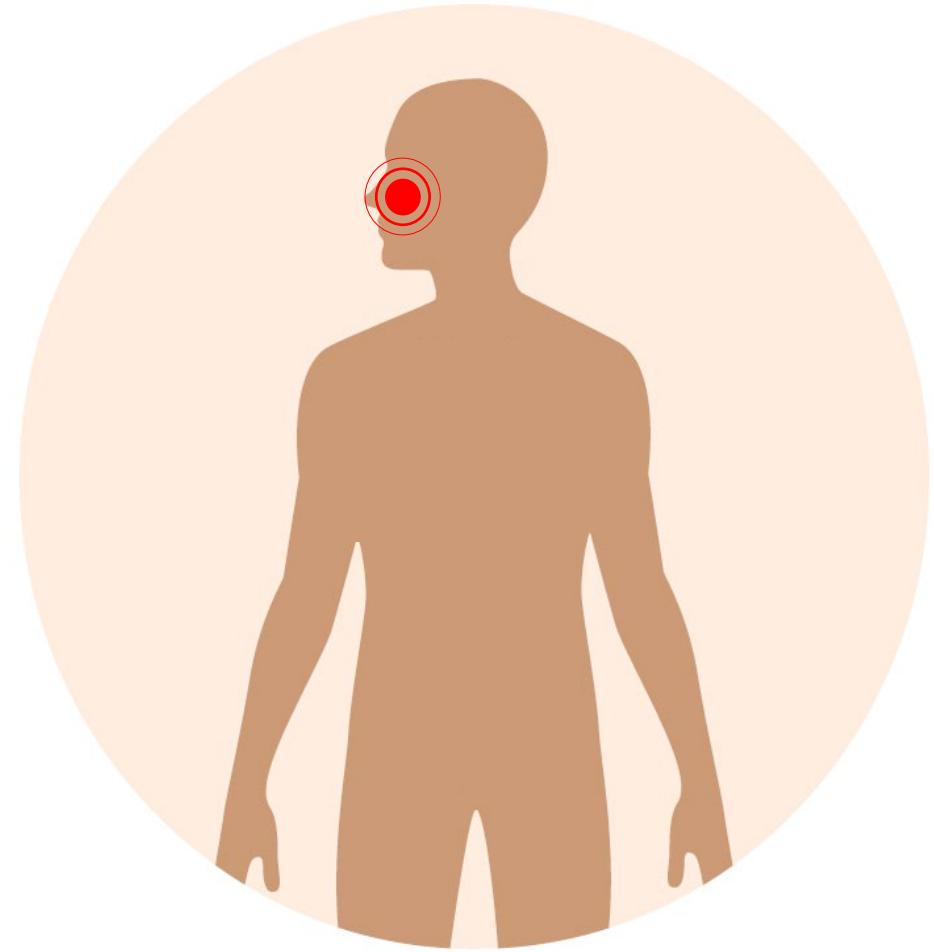
Measles



Measles



Paramyxovirus



Measles



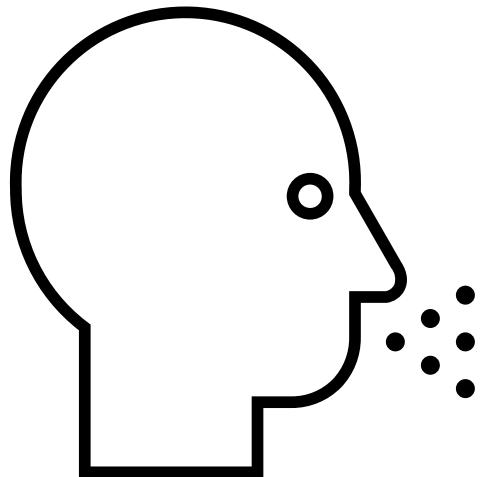
Measles

- Incubation period: 10–12 days



Measles

- Prodrome is 2–4 days – characterized by the 3 Cs:



Cough



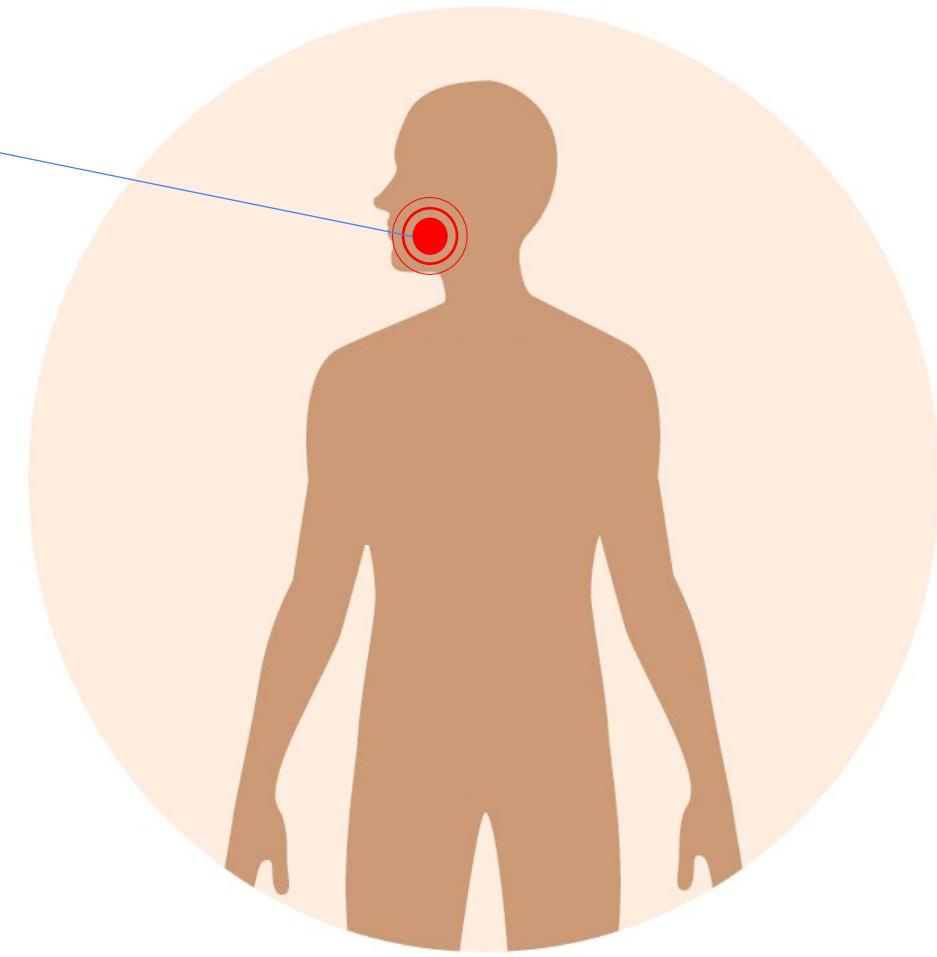
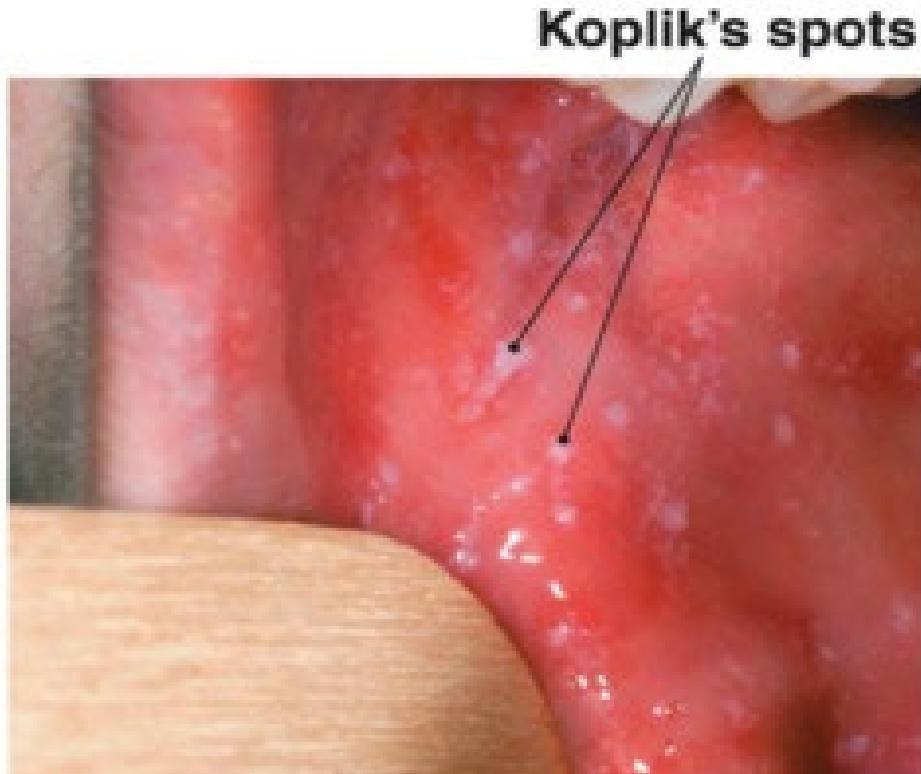
Coryza



Conjunctivitis

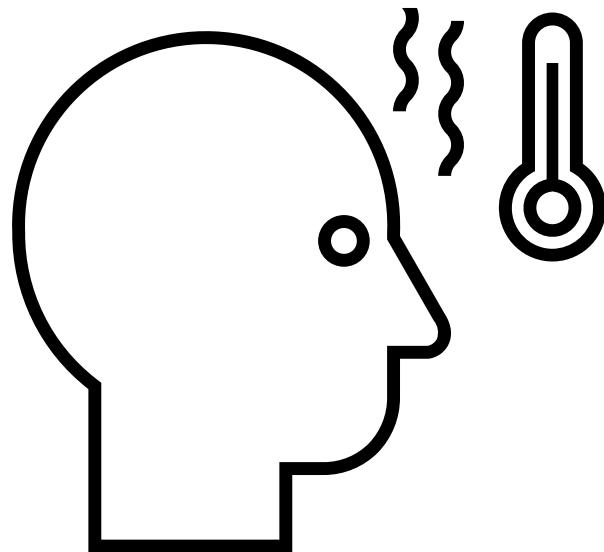
Measles

- Prodrome is 2–4 days



Measles

- Prodrome is 2–4 days



103°F to 105°F



Measles

■ Rash

- Occurs 2–4 days after prodrome
- 14 days after exposure
- Persists 5–6 days
- Maculopapular, becomes confluent



Measles

■ Rash

- Begins on face and upper neck
- Fades in order of appearance



Measles Complications

Complication	Rate
Diarrhea	8%
Otitis media	7%
Pneumonia	6%
Encephalitis	0.1%
Seizures	0.6%–0.7%
Death	0.2%

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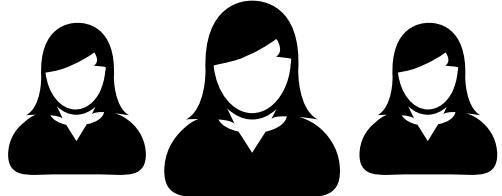
Measles Risk for Complications



Infants and Children



Pregnant women



Adults



Immunocompromised

Measles Risk for Complications



Infants and Children



Pregnant women



Adults



Immunocompromised

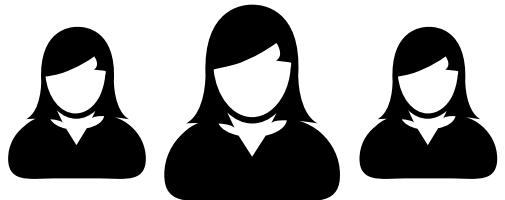
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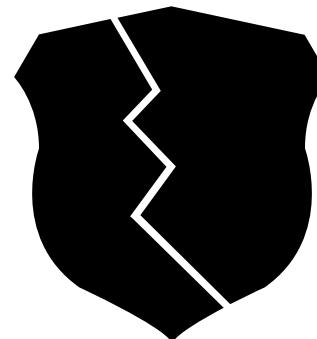
Infants and Children



Pregnant women



Adults



Immunocompromised

Measles



10M Cases
110,000 Deaths

Epidemiology

Measles	
Reservoir	Human
Transmission	Direct contact with infectious droplets or by airborne spread
Temporal Pattern	Peaks in late winter/spring
Communicability	4 days before to 4 days after rash onset

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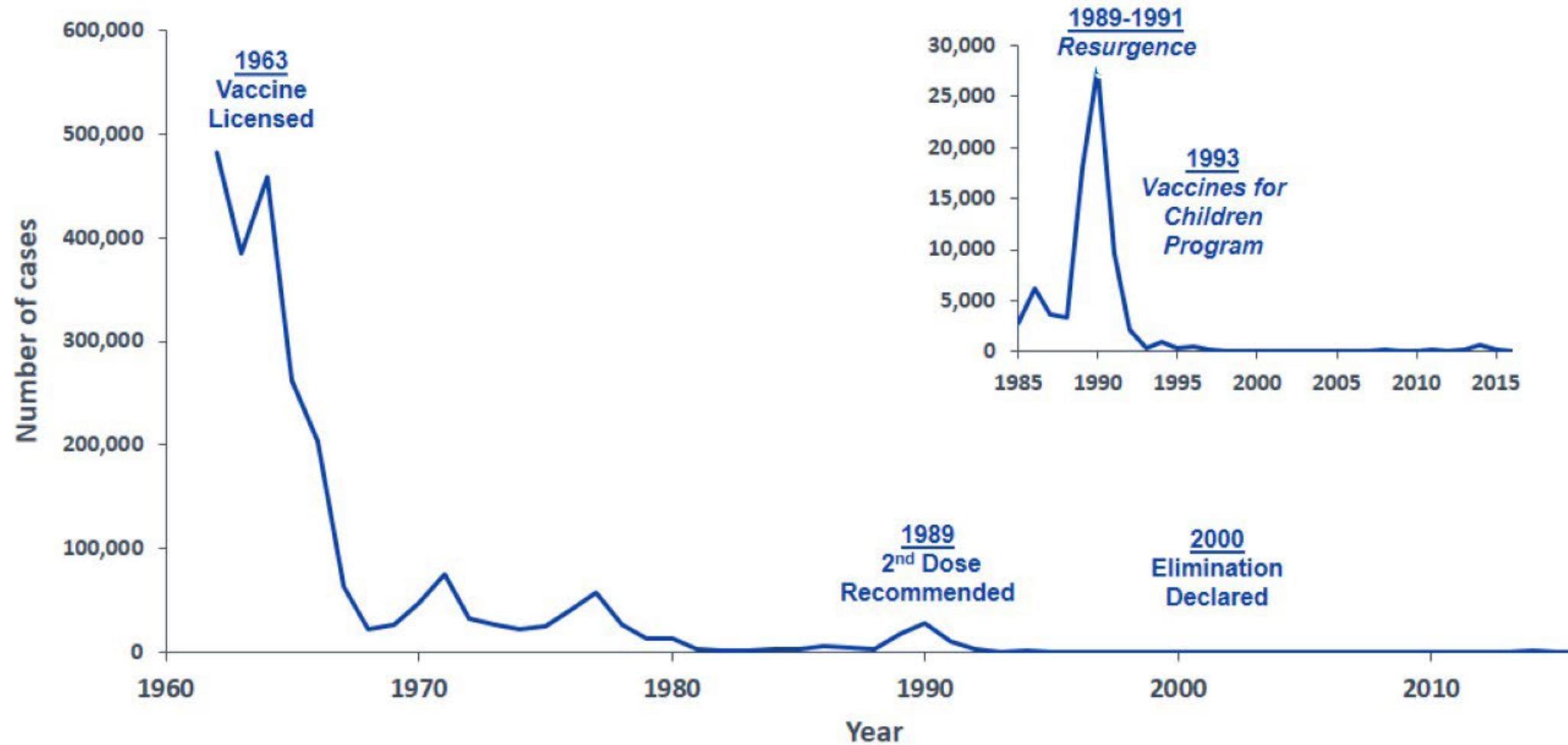
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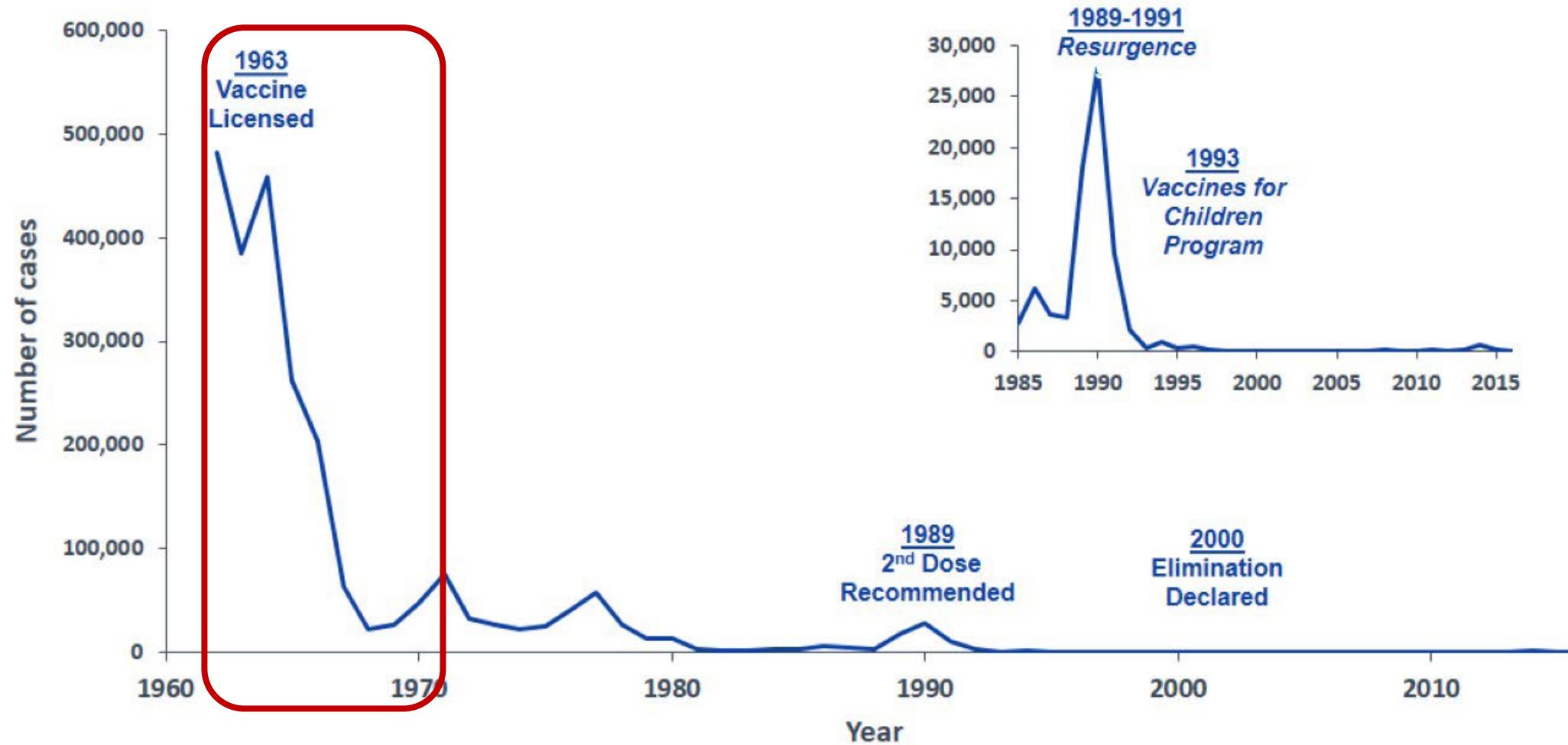
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Measles Cases, United States, 1962-2016*



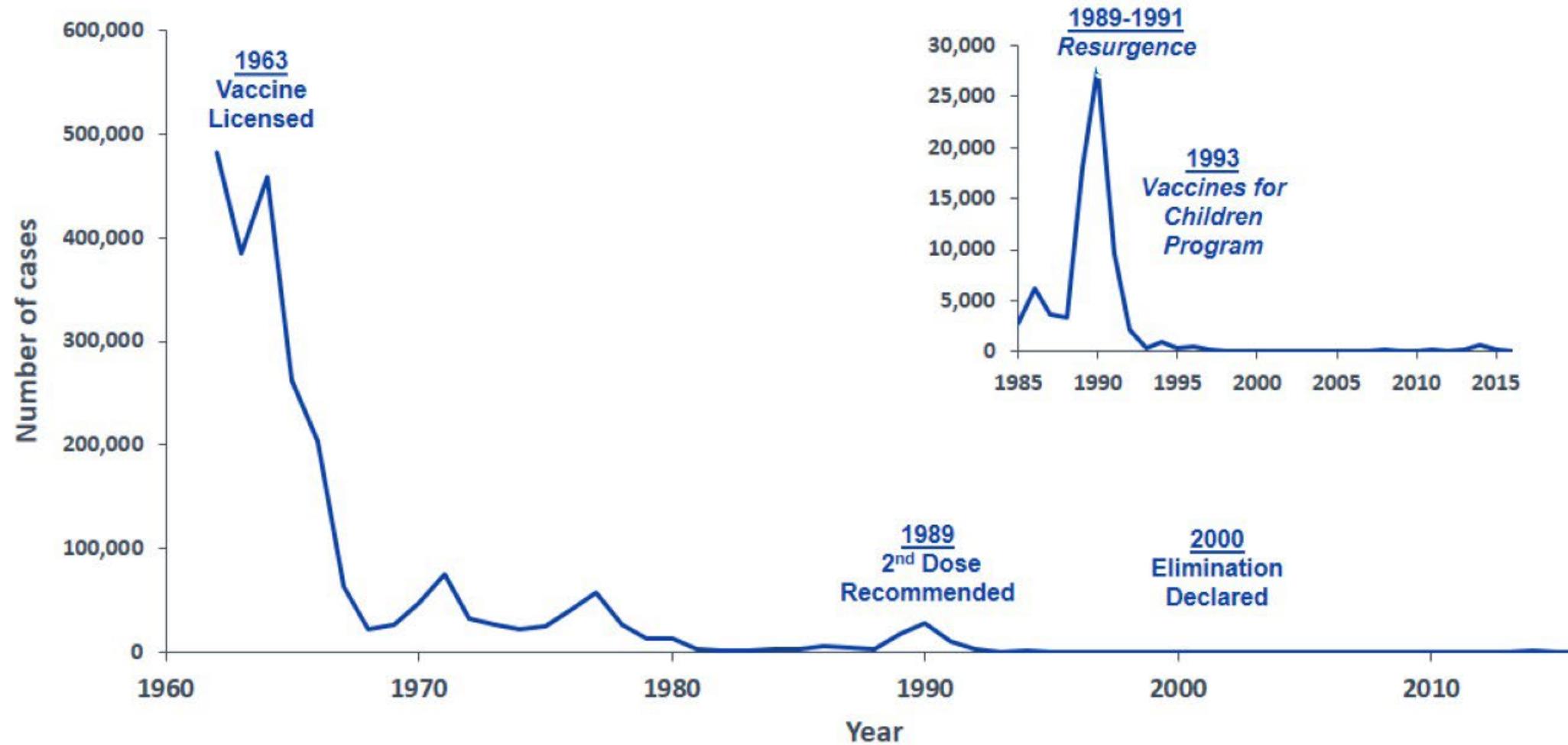
*2016 data is preliminary and subject to change

Measles Cases, United States, 1962-2016*



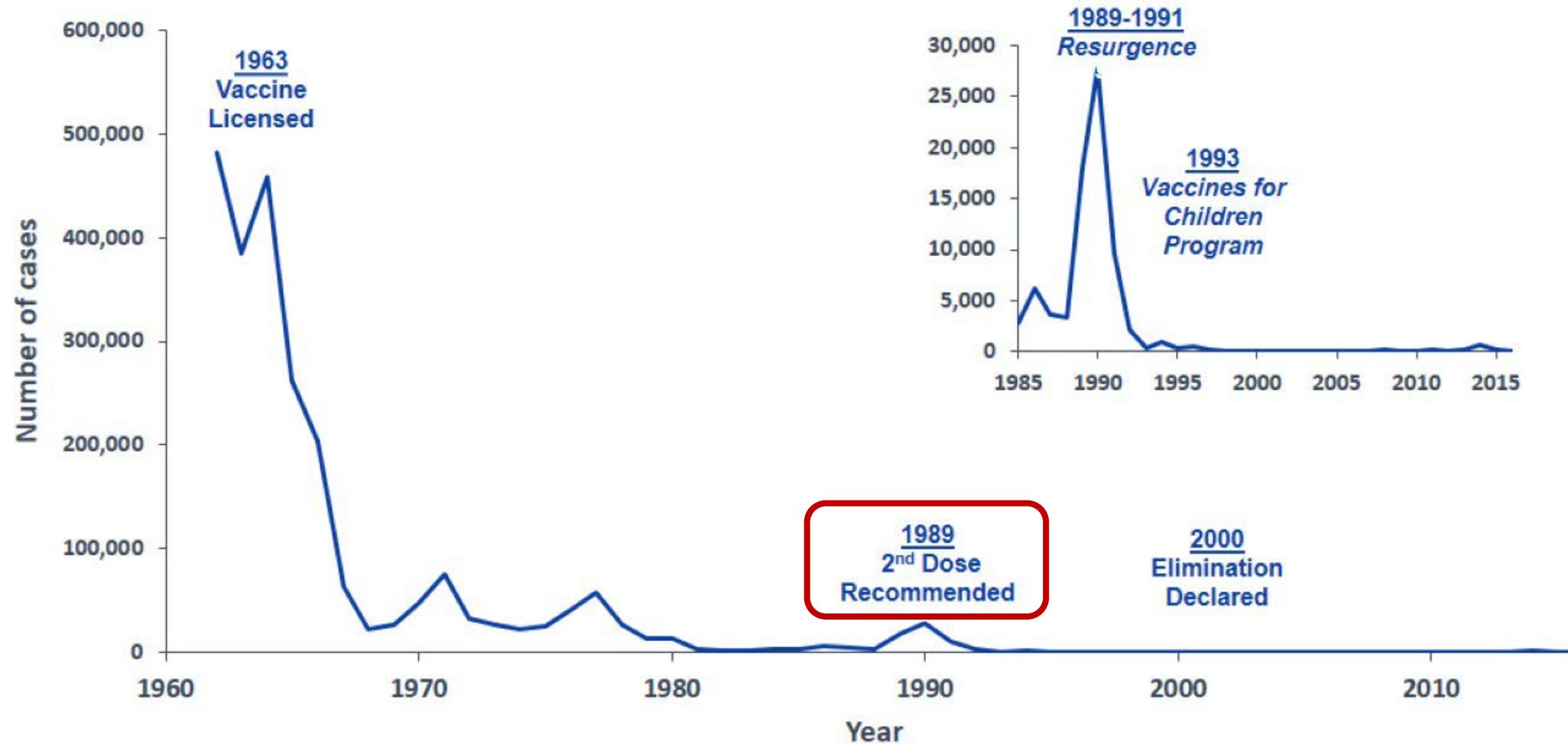
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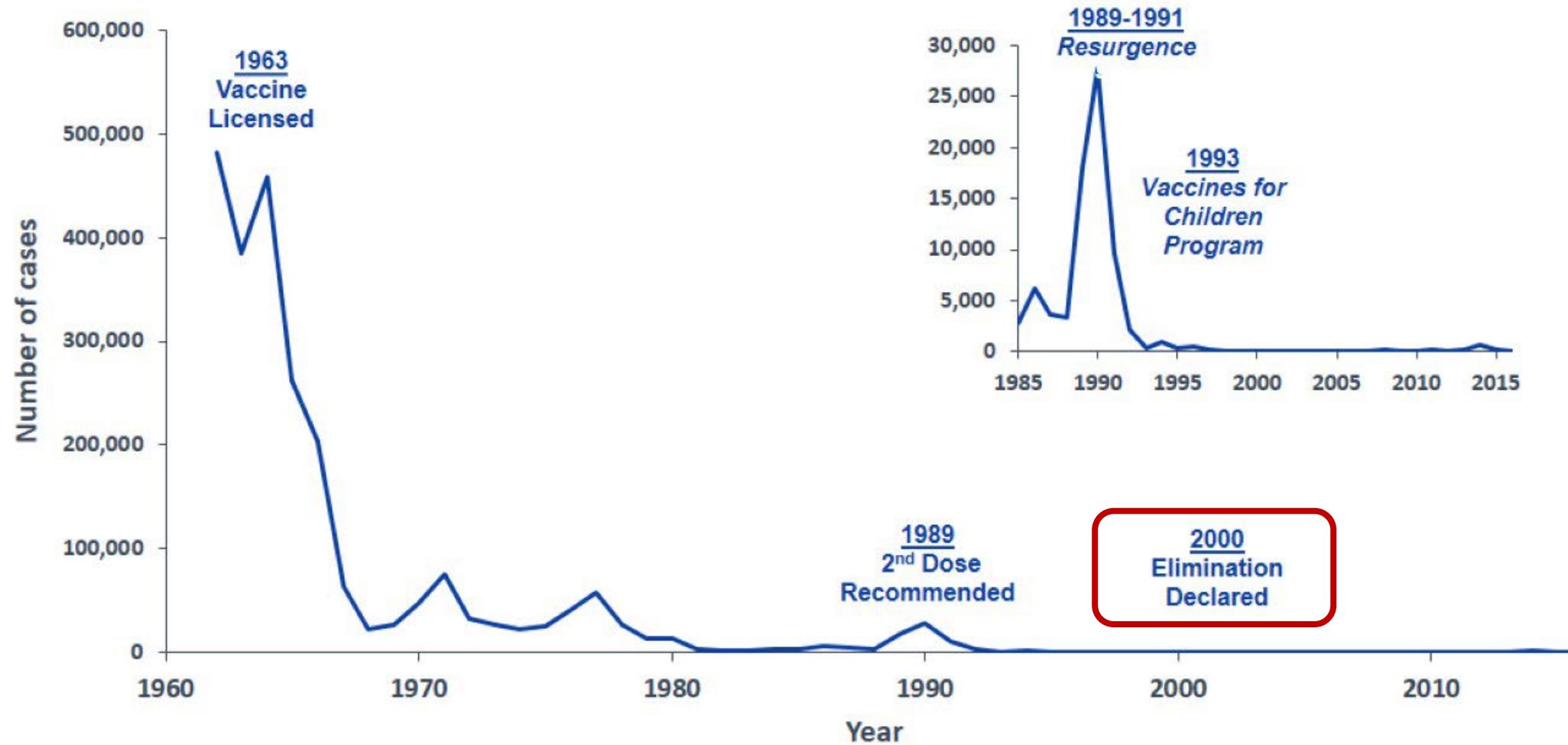
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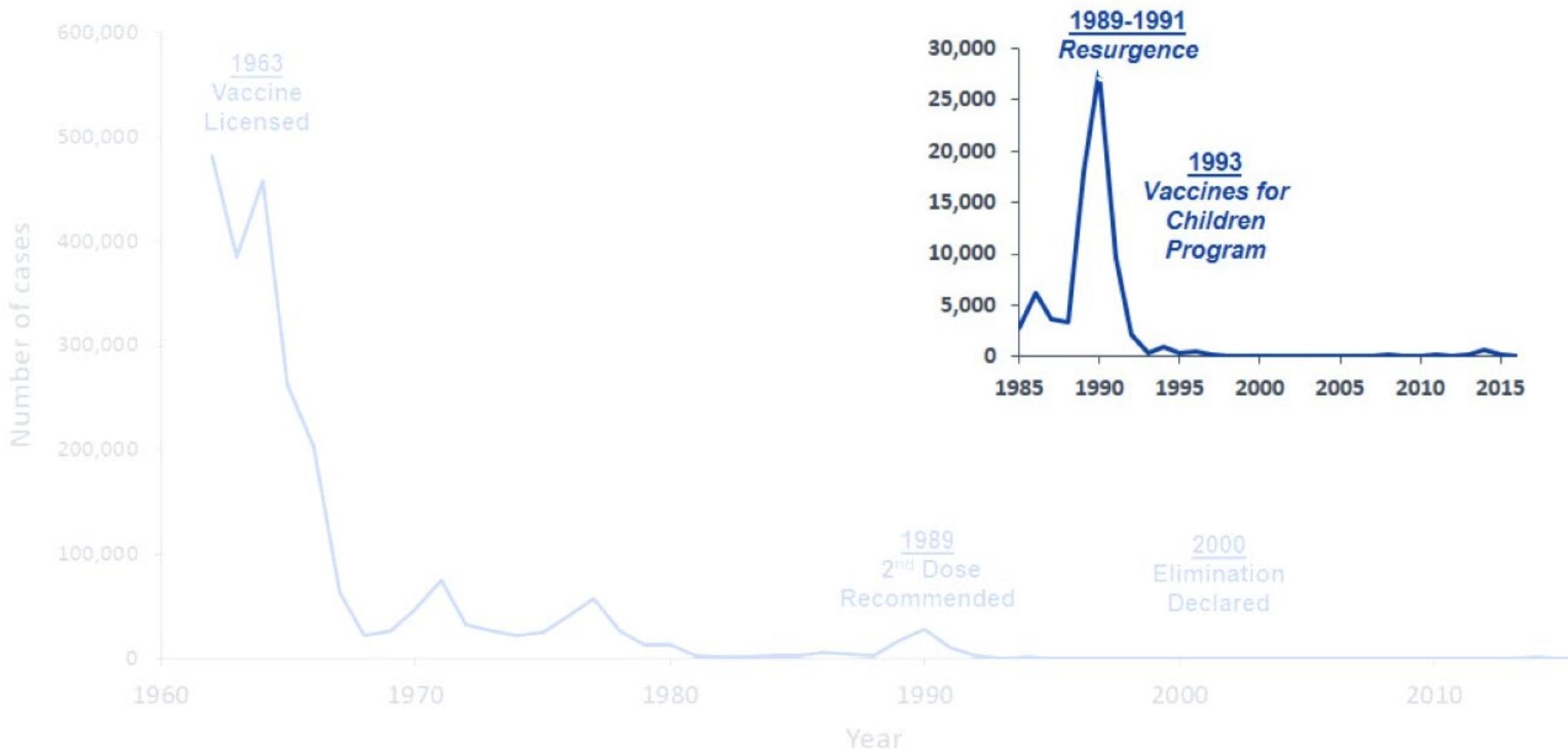
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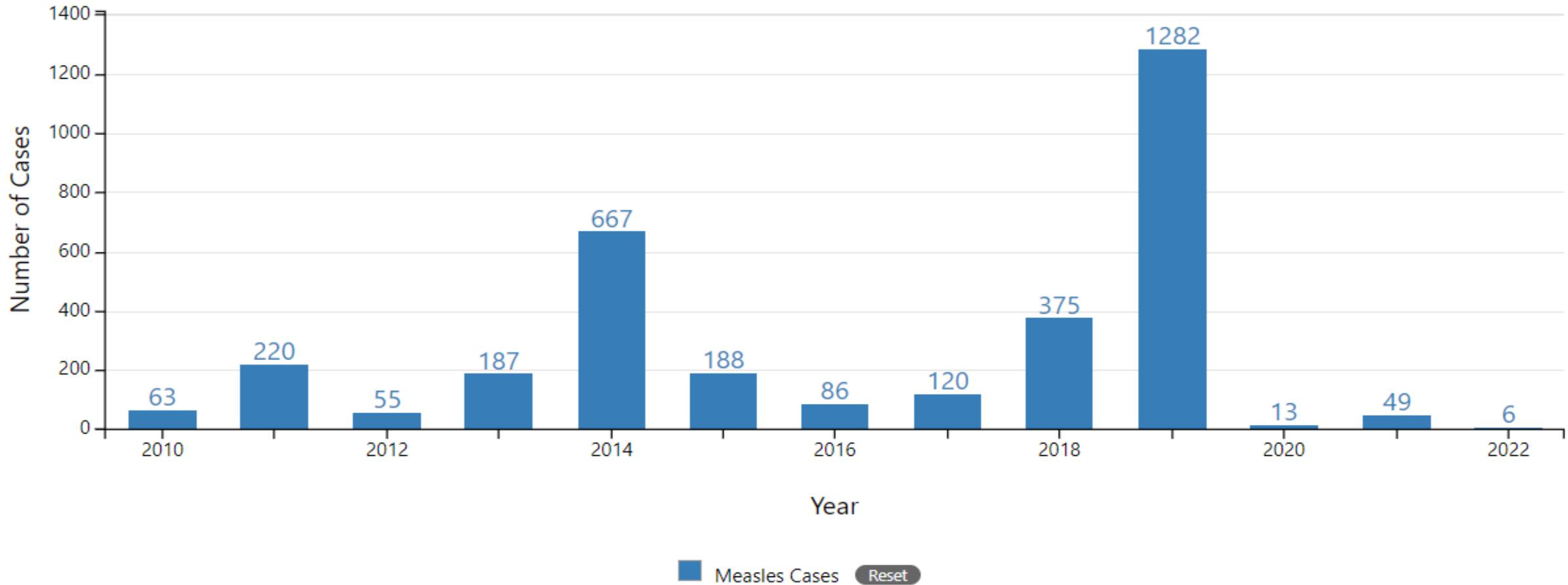
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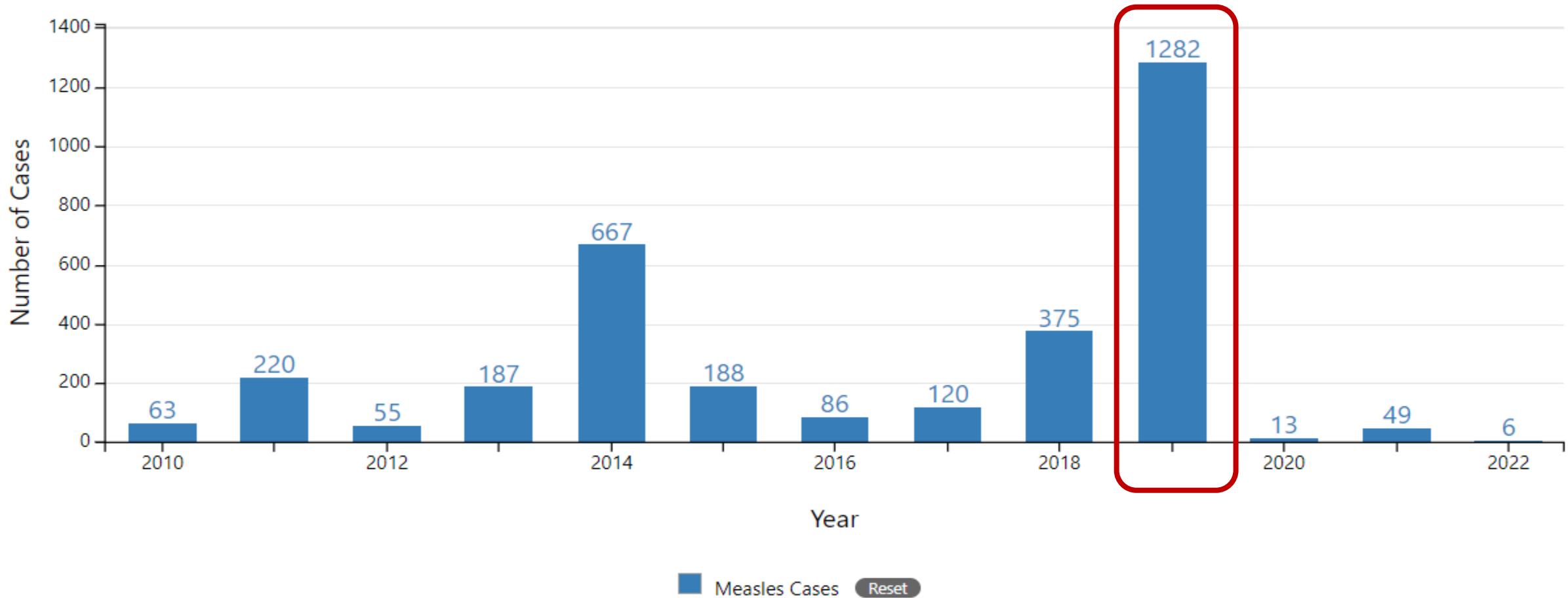
Number of Measles Cases Reported by Year

2010-2022 (as of July, 1 2022)



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2010-2022 (as of July, 1 2022)



National Update on Measles Cases and Outbreaks — United States, January 1–October 1, 2019

Weekly / October 11, 2019 / 68(40);893-896

On October 4, 2019, this report was posted online as an MMWR Early Release.

Manisha Patel, MD¹; Adria D. Lee, MSPH¹; Nakia S. Clemons, MPH¹; Susan B. Redd¹; Sarah Poser¹; Debra Blog, MD²; Jane R. Zucker, MD^{3,4}; Jessica Leung, MPH¹; Ruth Link-Gelles, PhD¹; Huong Pham, MPH¹; Robert J. Arciuolo, MPH³; Elizabeth Rausch-Phung, MD²; Bettina Bankamp, PhD¹; Paul A. Rota, PhD¹; Cindy M. Weinbaum, MD⁴; Paul A. Gastañaduy, MD¹ ([View author affiliations](#))

Measles Resources

Measles (Rubeola)



Prevent Measles

Make sure you and your loved ones are up to date with the measles vaccine.

[Measles Vaccines](#)



Planning a Trip Outside the U.S.?

[Check if you need measles vaccine](#)



Signs and Symptoms



Cases and Outbreaks



Transmission



Questions About Measles



Things Parents Need to Know

Measles Outbreak Toolkits



OUTBREAK RESPONSE communications toolkit

CS269662

CDC would like to support communities being affected by measles outbreaks by providing them with accurate, science-based information to counter misinformation. Click below to find resources designed for you:



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cdc.gov/measles

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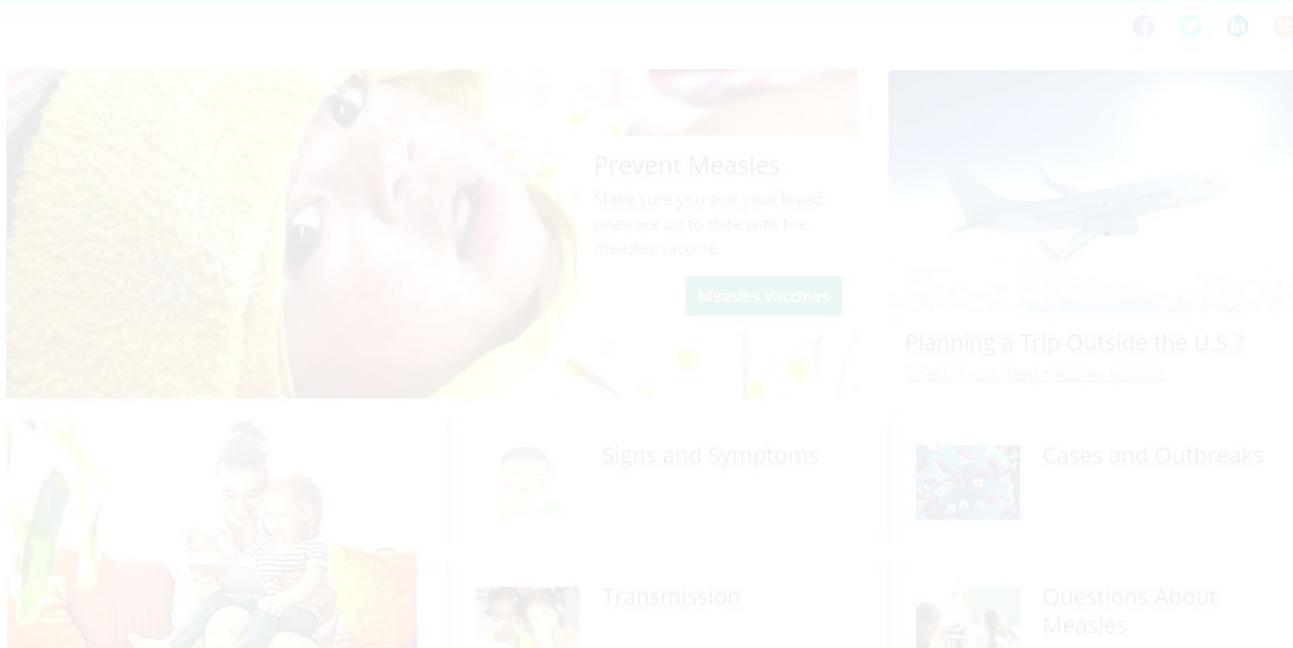


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Measles Resources

Measles (Rubeola)



This screenshot of the CDC's Measles (Rubeola) resources page features a large image of a smiling child on the left. The page is organized into several sections with images and text:

- Prevent Measles:** Make sure you and your loved ones are up to date with the measles vaccine. [Measles Vaccines](#)
- Planning a Trip Outside the U.S.:** [Check for travel requirements](#)
- Signs and Symptoms:**
- Transmission:**
- Cases and Outbreaks:**
- Questions About Measles:**

Things Parents Need to Know

Measles Outbreak Toolkits



This screenshot of the CDC's Outbreak Response toolkit page features a header with a collage of medical and scientific icons. The main title is "OUTBREAK RESPONSE communications toolkit". Below the title are four colored icons: a blue one with a person and a child, a green one with a grid, a purple one with a hospital building, and a dark blue one with a person and a child. The page includes the identifier "CS269662" and a text block: "CDC would like to support communities being affected by measles outbreaks by providing them with accurate, science-based information to counter misinformation. Click below to find resources designed for you:



[cdc.gov/measles/toolkit/index.html](https://www.cdc.gov/measles/toolkit/index.html)

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Measles (Rubeola)



Prevent Measles

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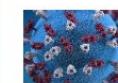


Planning a Trip Outside the U.S.?

[Check if you need measles vaccine](#)



Signs and Symptoms



Cases and Outbreaks



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[Things Parents Need to Know](#)

Measles Outbreak Toolkits



OUTBREAK RESPONSE

communications toolkit

CS269662

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Measles Resources

Measles Multimedia

Videos

Get vaccinated and prevent measles



[cdc.gov/measles/resources/multimedia.html](https://www.cdc.gov/measles/resources/multimedia.html)

Guidance for Health Care Personnel

- **Be vigilant about measles**
- **Ensure *EVERYONE* is up to date on MMR vaccination**
 - Staff and patients—children, adolescents, and adults
- **Consider measles in patients with febrile rash illness and clinically compatible measles symptoms (cough, coryza, and conjunctivitis)**
- **Ask patients about:**
 - Recent travel internationally
 - Recent travel to domestic venues frequented by international travelers
 - Recent contact with international travelers
 - History of measles in the community
- **Promptly isolate patients with suspected measles**

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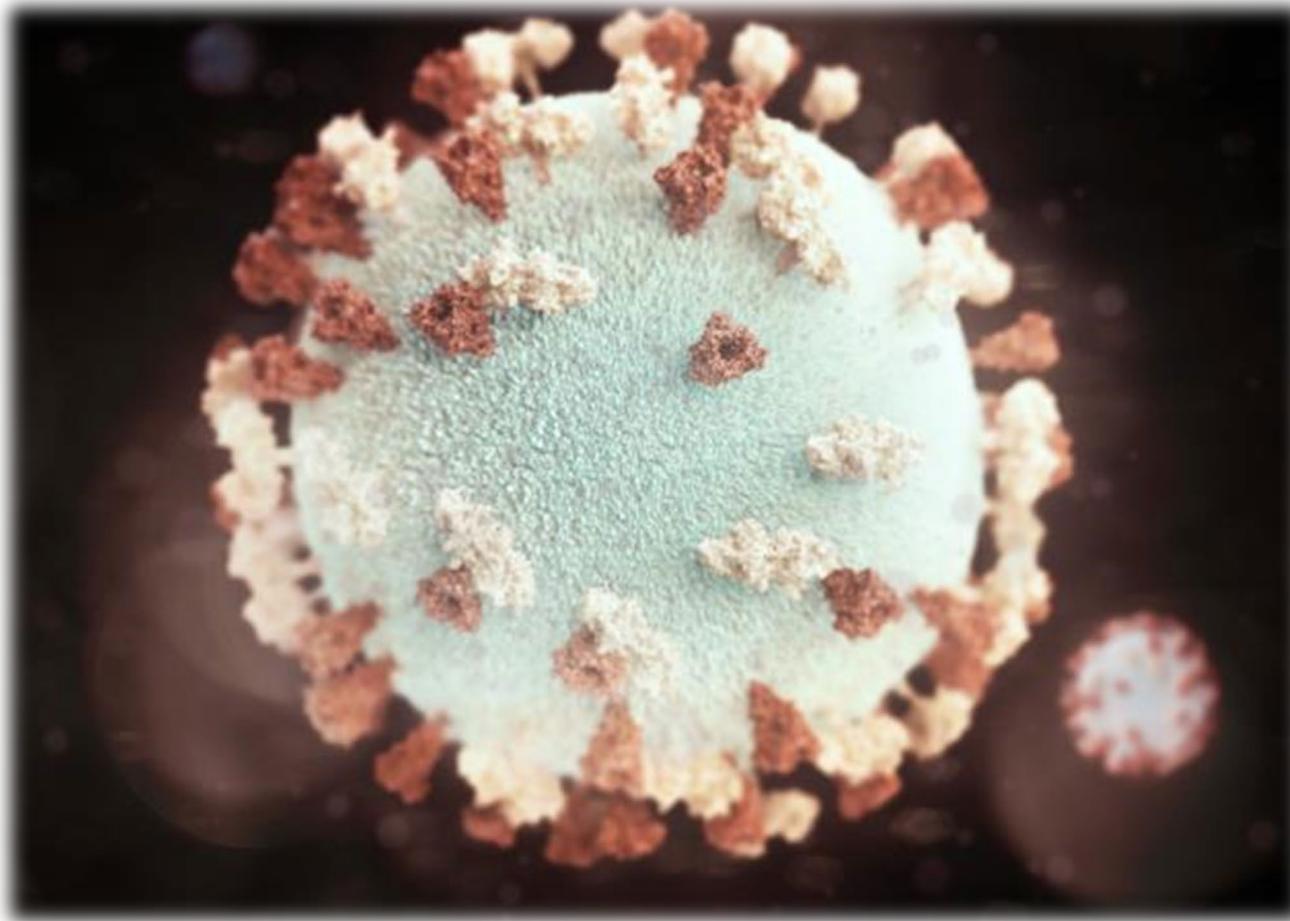
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2

Mumps Disease

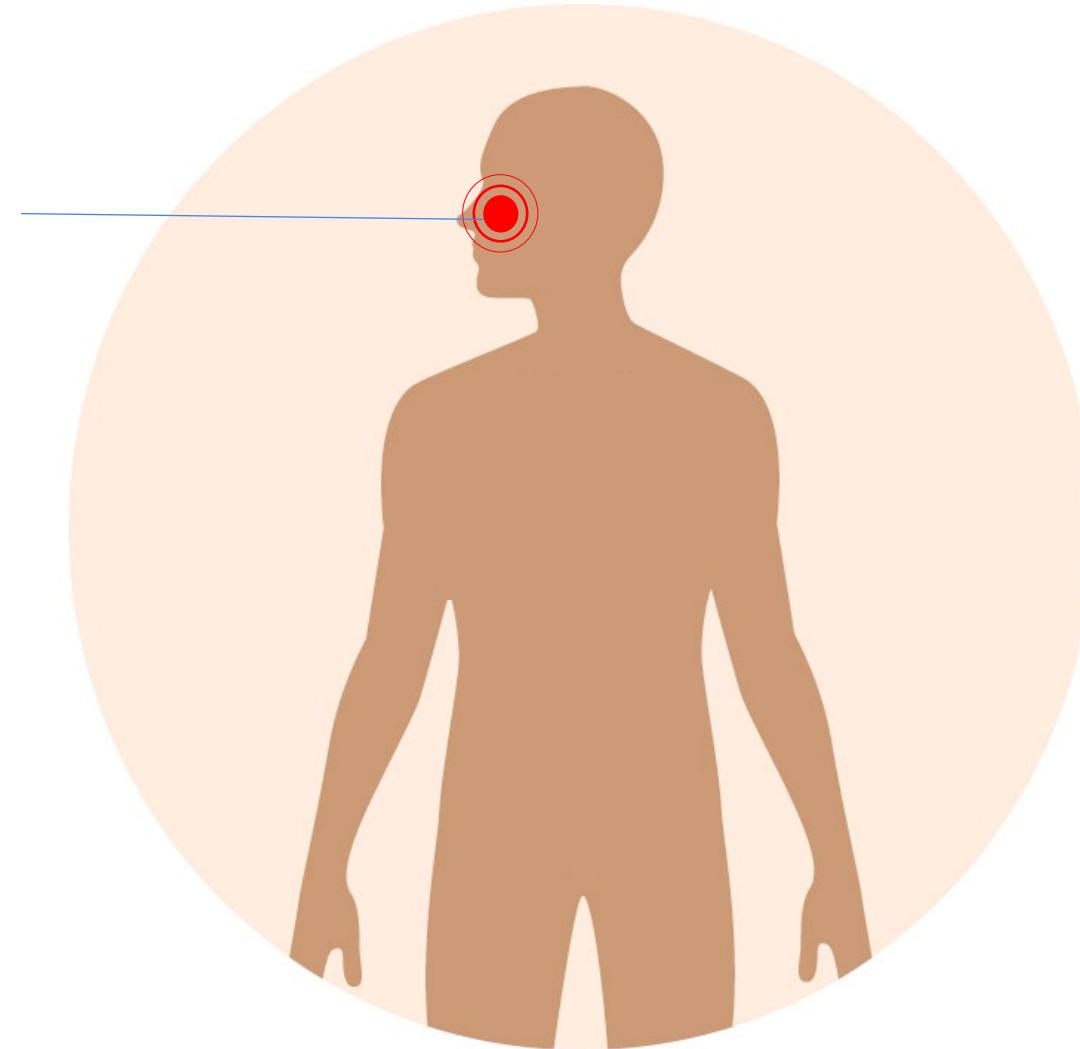
Mumps



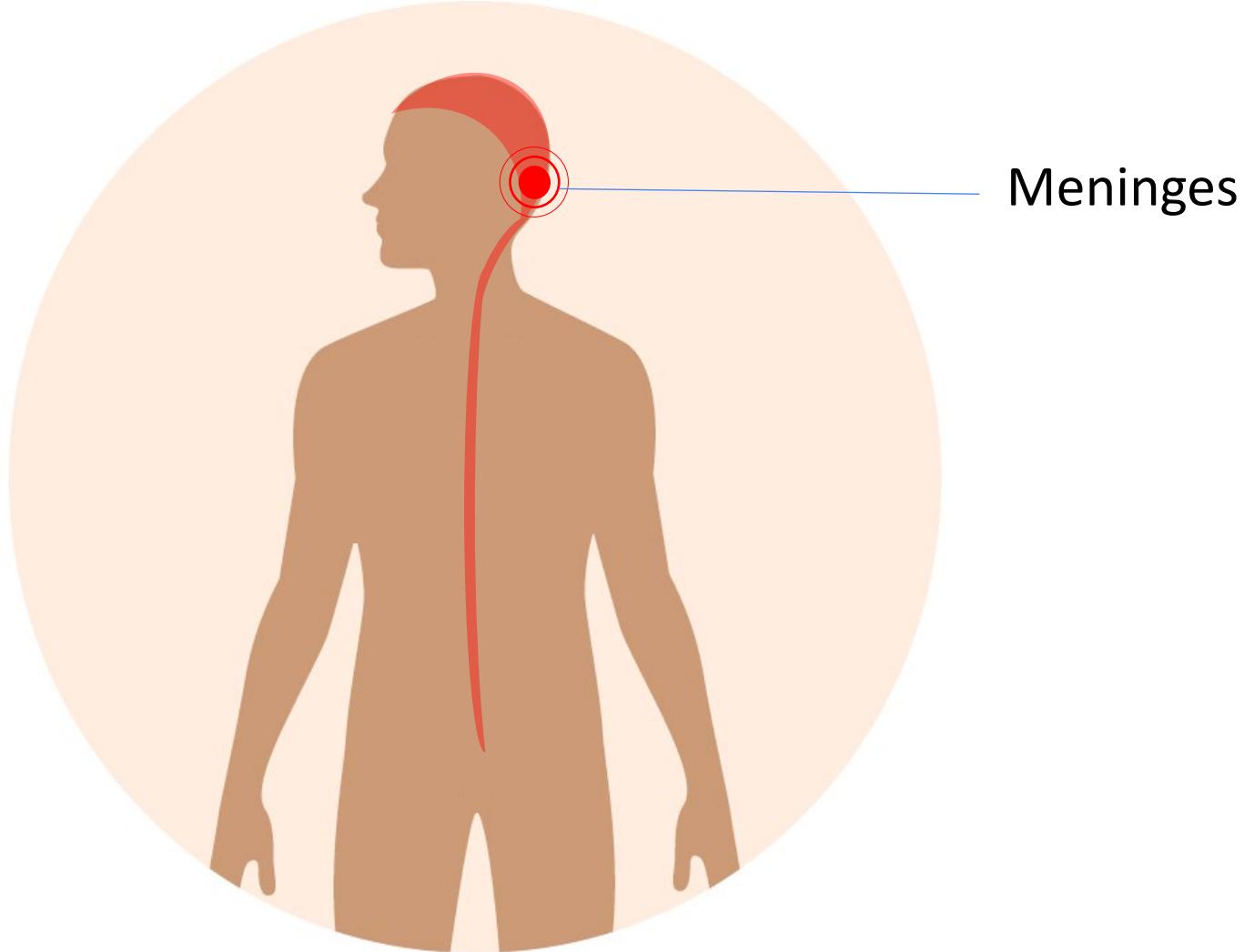
Paramyxovirus

Mumps

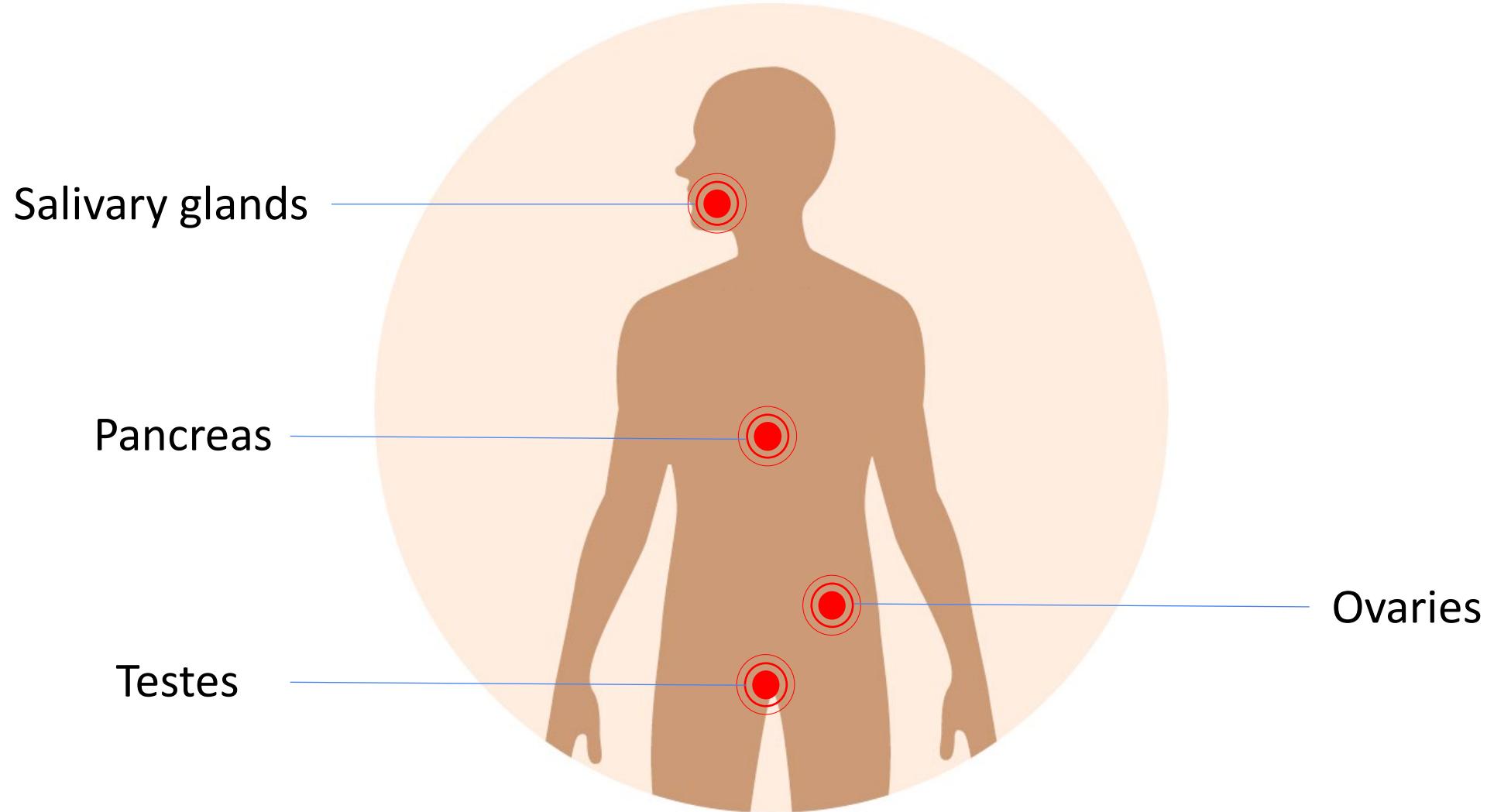
Nasopharynx



Mumps



Mumps



Mumps

- Incubation period: 12–25 days



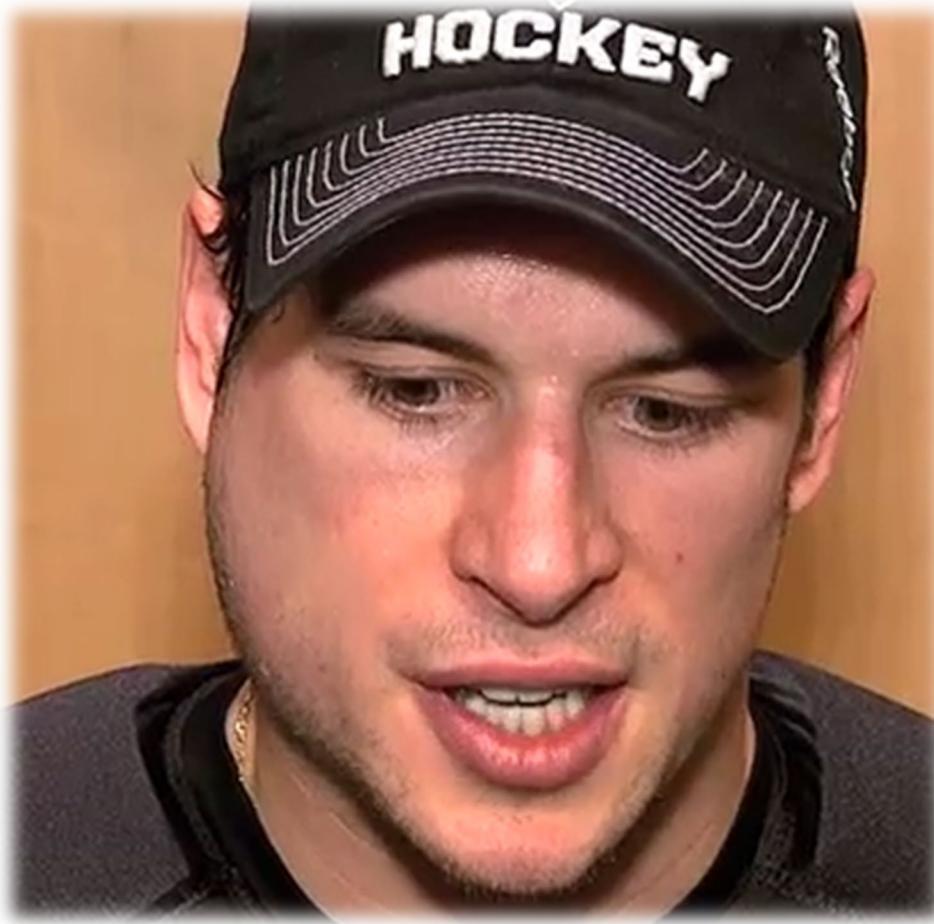
Mumps

- **Prodrome is nonspecific**

- Myalgia
- Anorexia
- Malaise
- Headache
- Low-grade fever

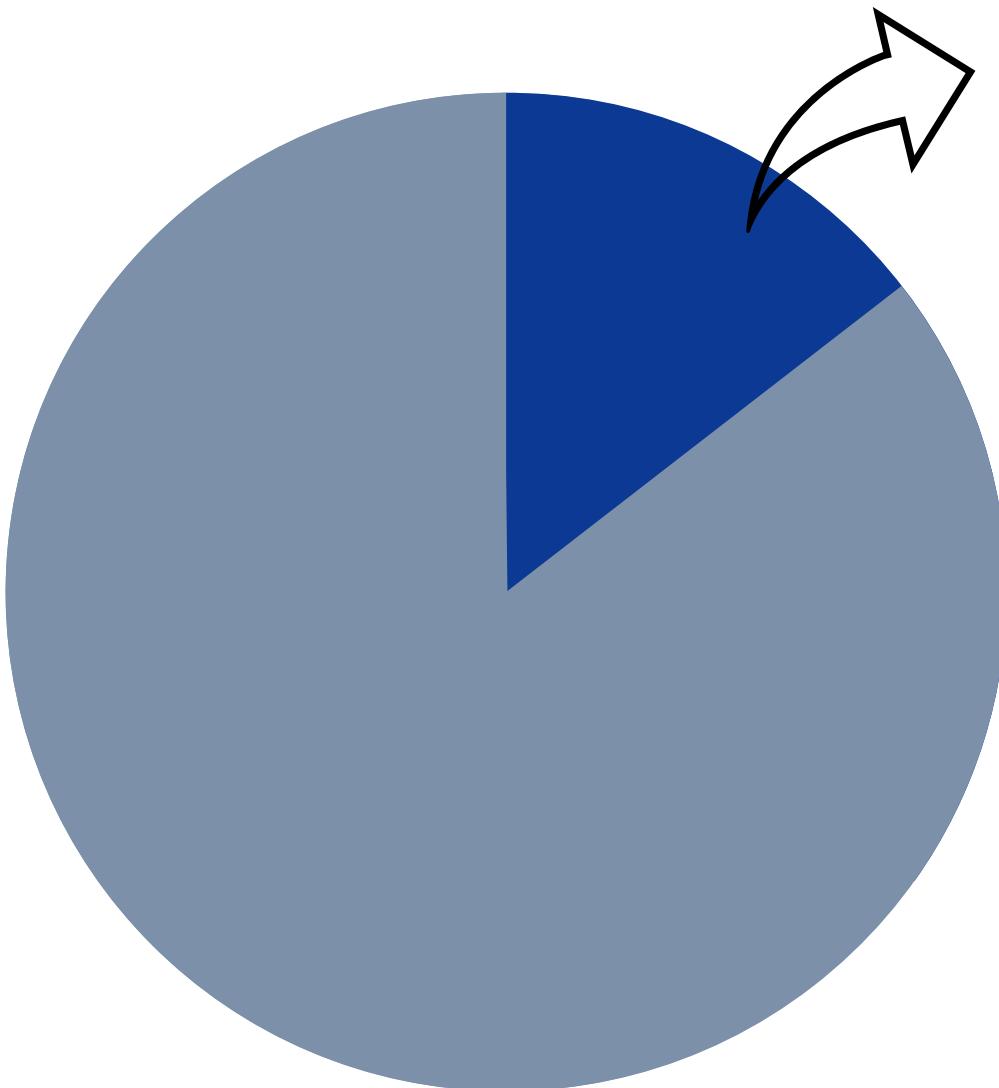


Mumps Parotitis



Parotitis in 9% –94% of cases, typically occurs within 16 –18 days

Mumps



Pre-vaccine era:
15%–24% of
infections were
asymptomatic

Mumps Complications

Complication	Est. frequency among unvaccinated (%)	Est. frequency among vaccinated (%)
Orchitis	30	6
Oophoritis	7	≤1
Mastitis	30	≤1
Pancreatitis	4	<1
Hearing loss	4	<1
Meningitis	<1–10	≤1
Encephalitis	≤1	≤1

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During 1962–1967, there were **3 deaths** per 10,000 reported mumps cases.

Epidemiology

Mumps	
Reservoir	Human
Transmission	Direct contact with saliva or respiratory droplets
Temporal Pattern	Peaks in late winter/spring
Communicability	Several days before and after onset of parotitis

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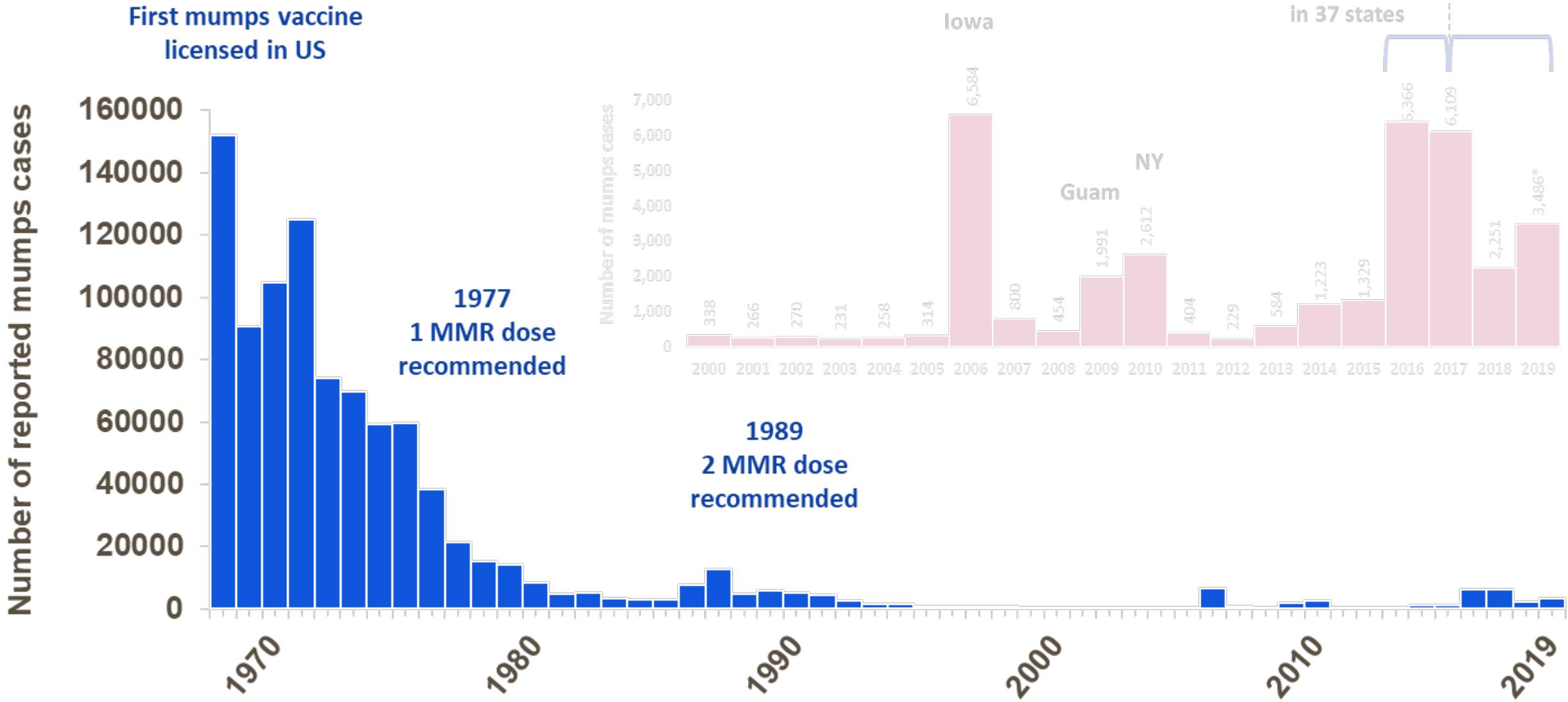
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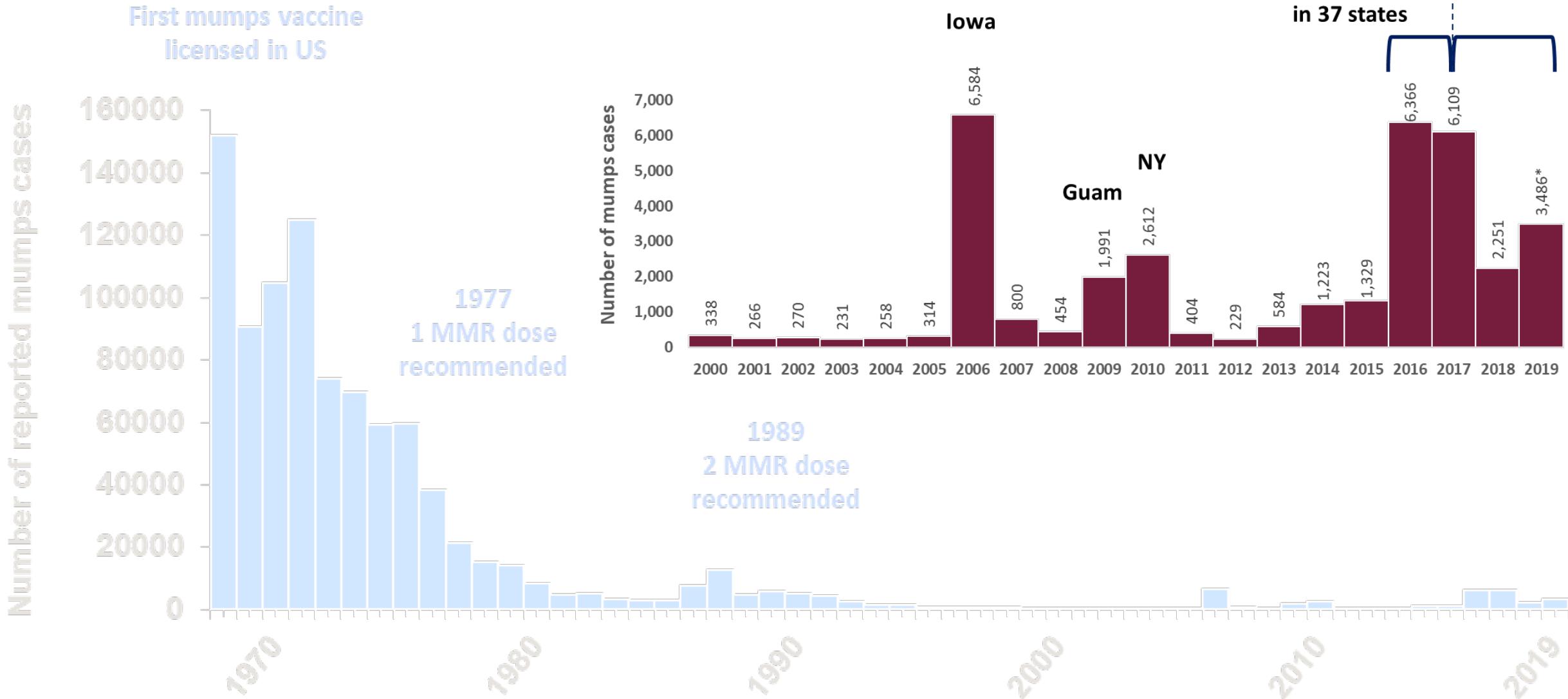
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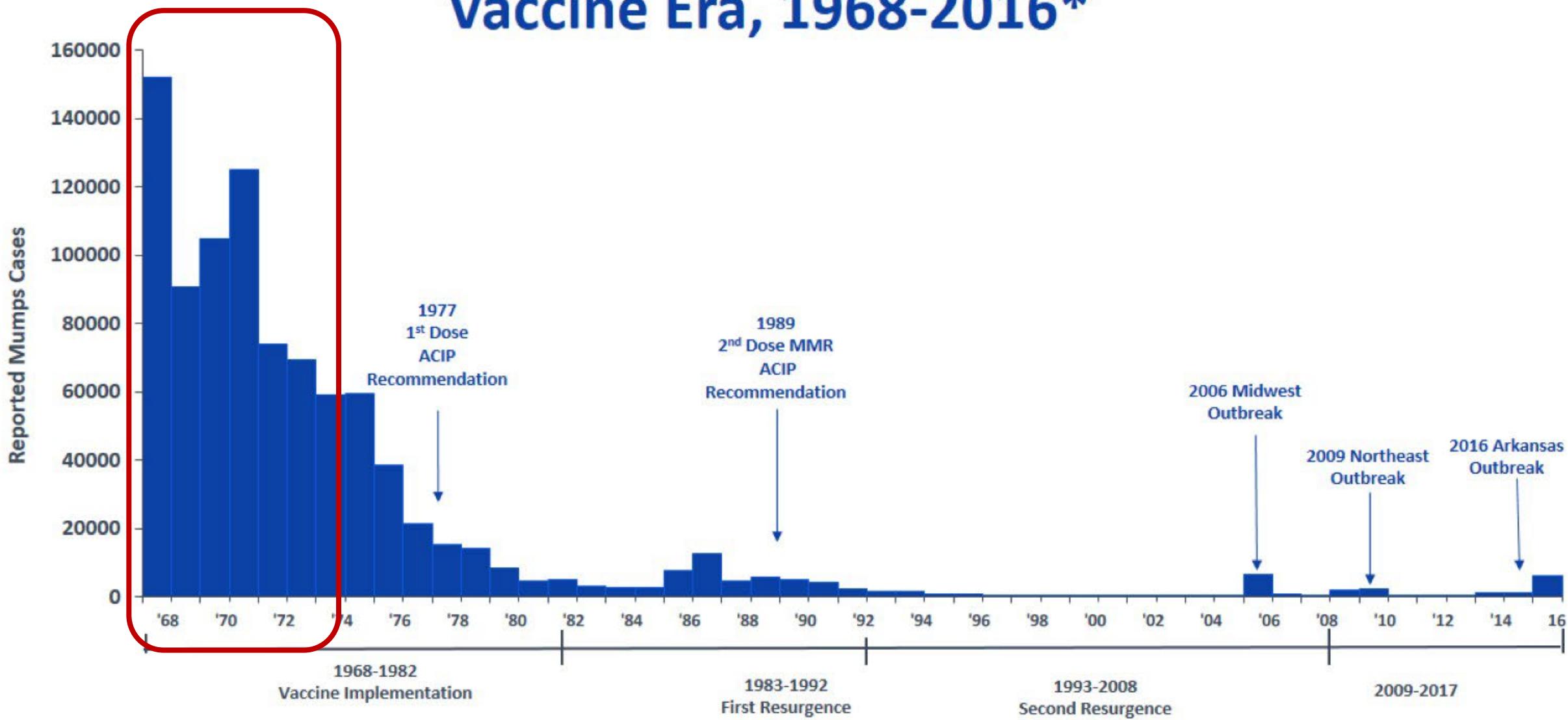
Reported Mumps Cases, United States, Vaccine Era, 1968-2019



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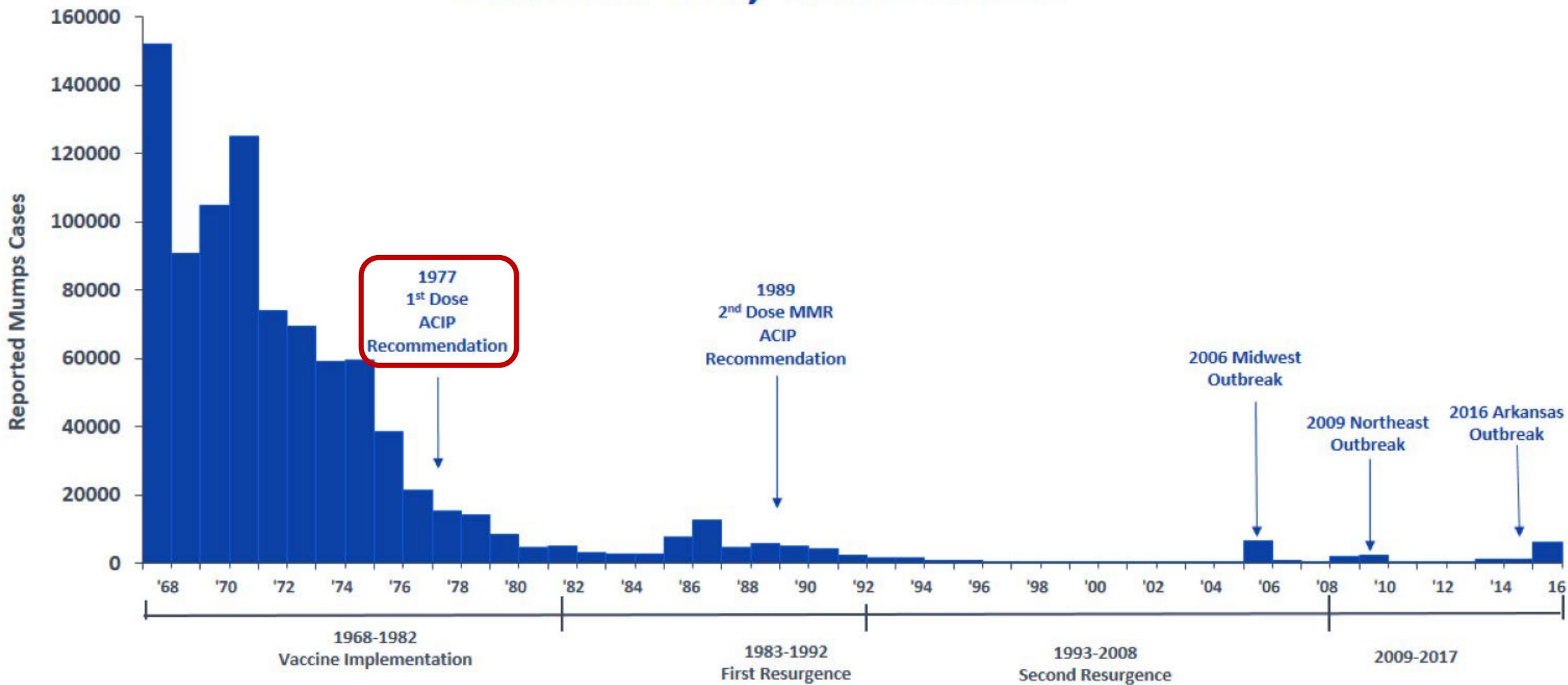


Reported Mumps Cases, United States, Vaccine Era, 1968-2016*



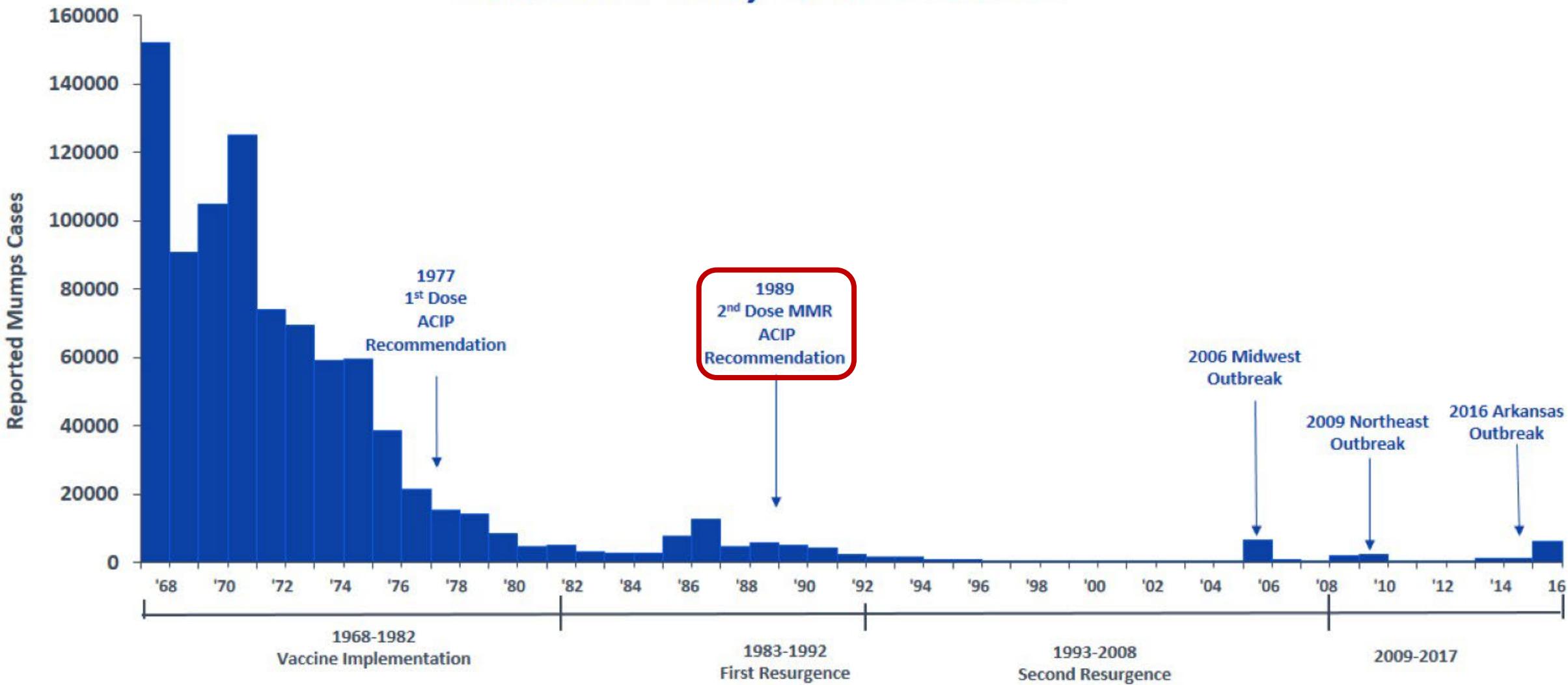
Source: National Notifiable Disease Surveillance System (passive surveillance); 2016 data is preliminary and subject to change

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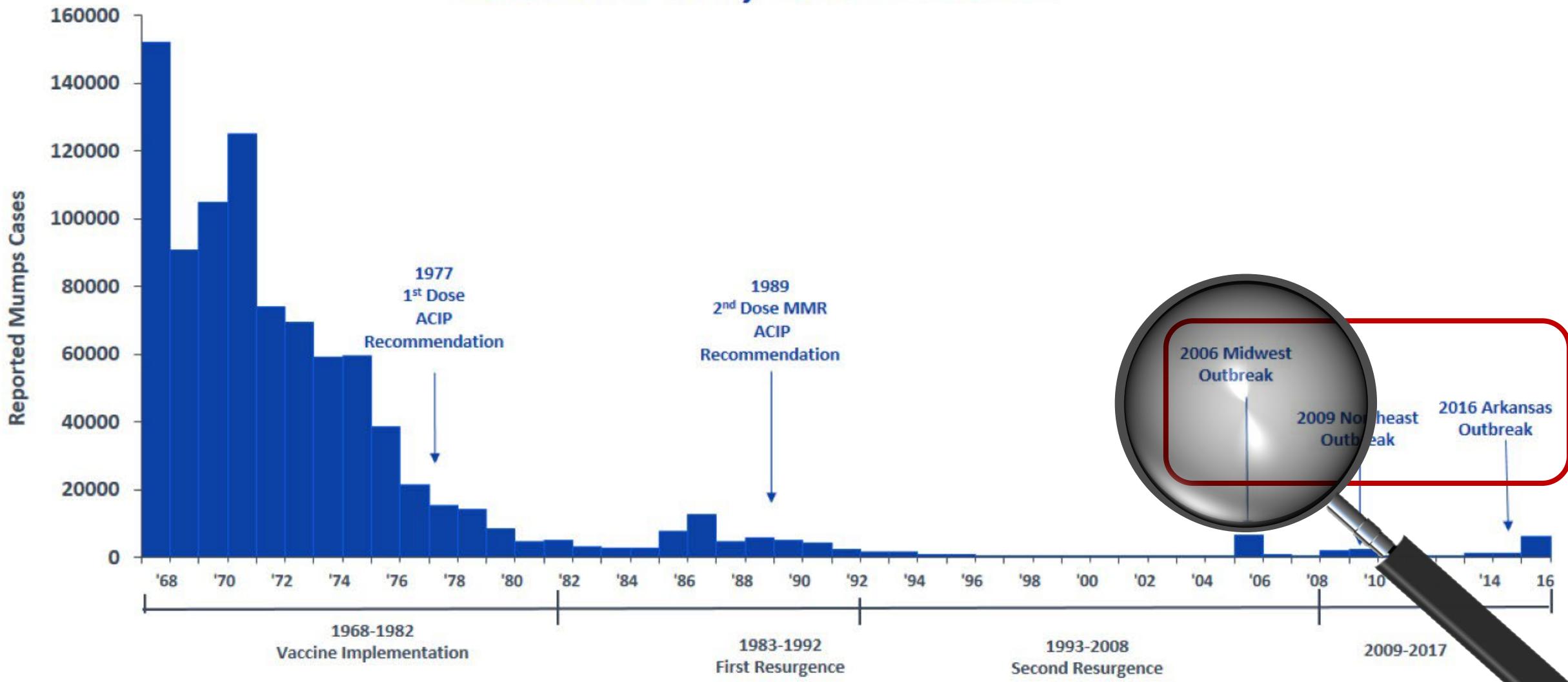
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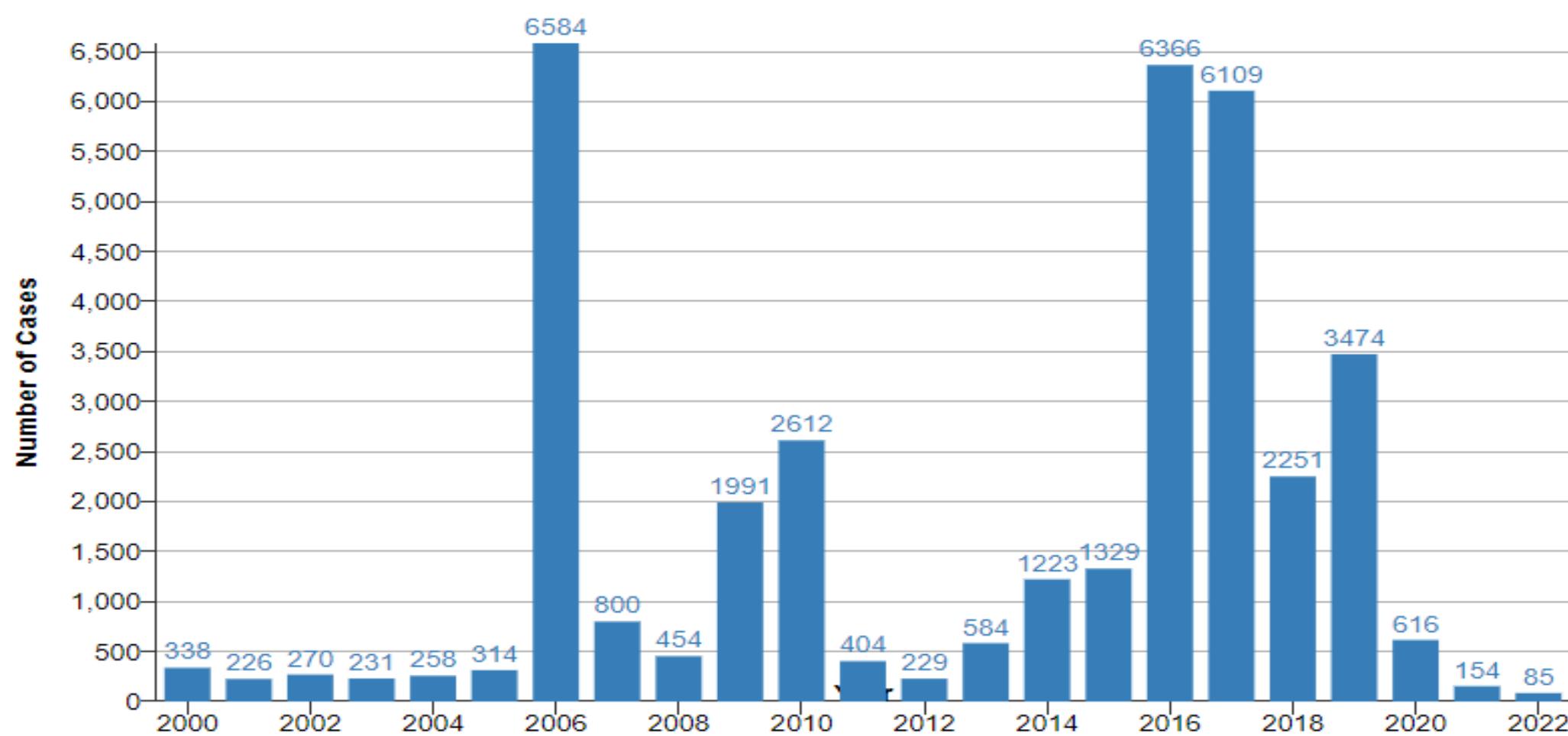
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Reported Mumps Cases by Year: United States, 2000-2022**

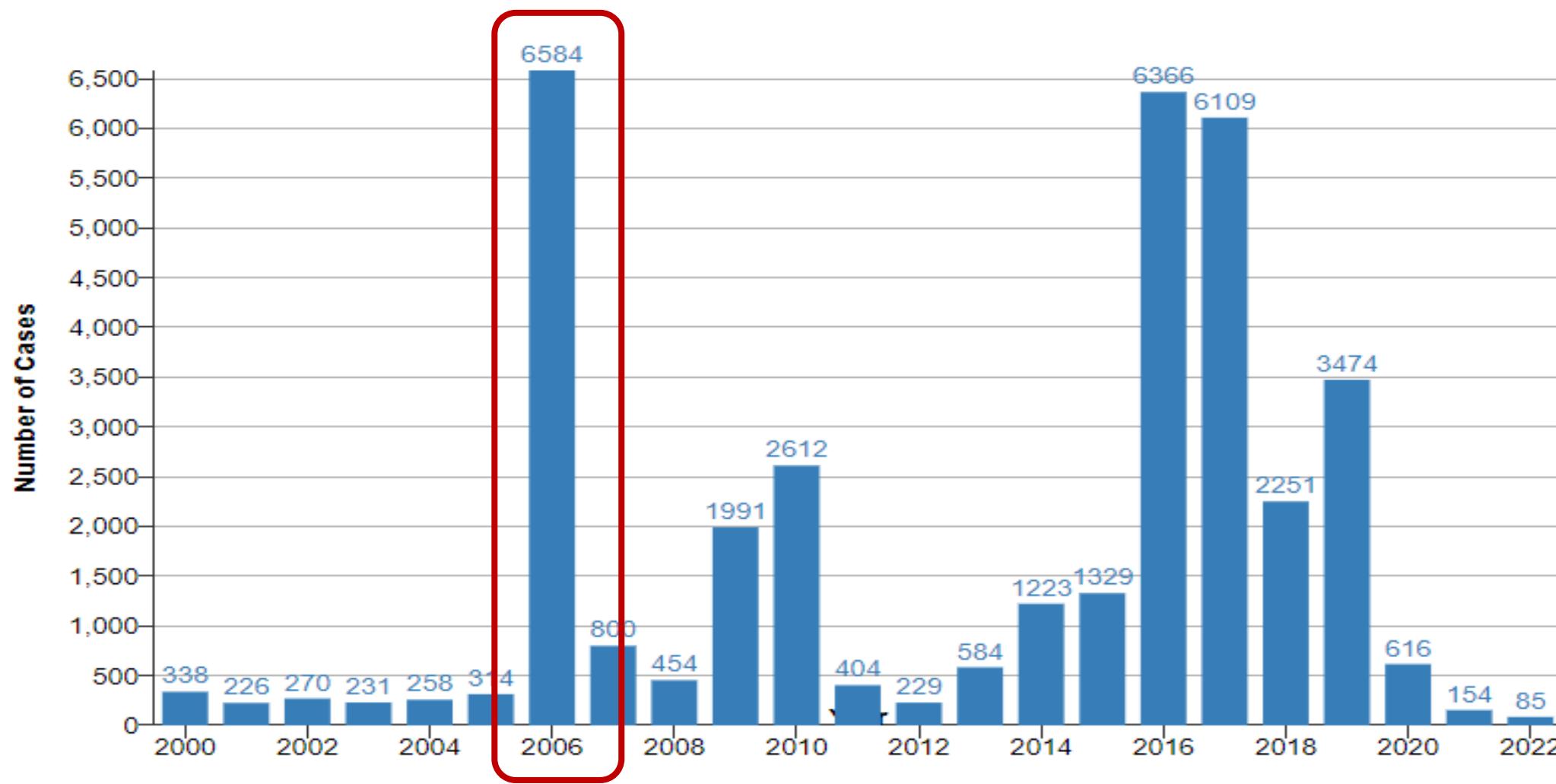


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**Cases as of January 31, 2019. Case count is preliminary and subject to change.

<https://www.cdc.gov/mumps/outbreaks.html>

Reported Mumps Cases by Year: United States, 2000-2022**

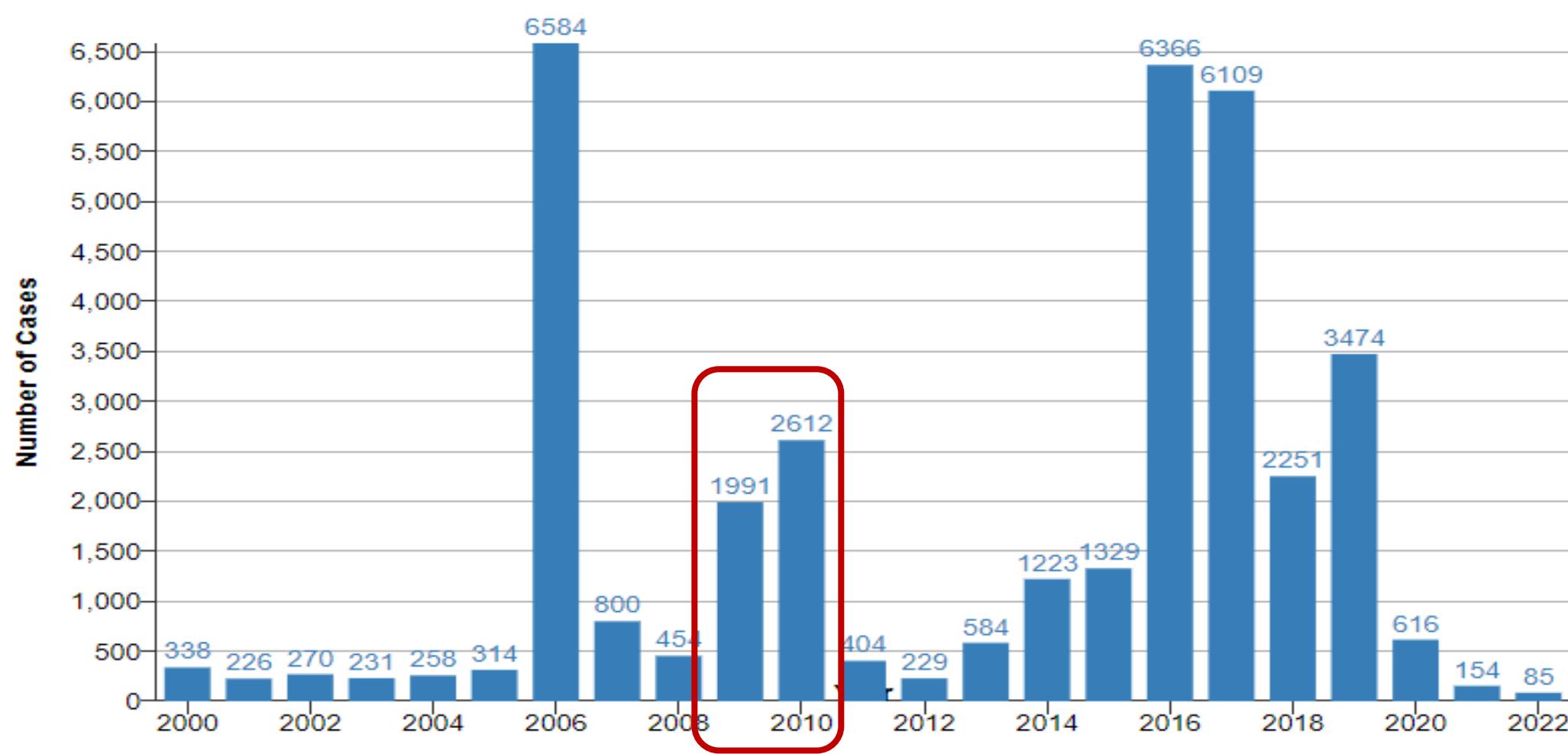


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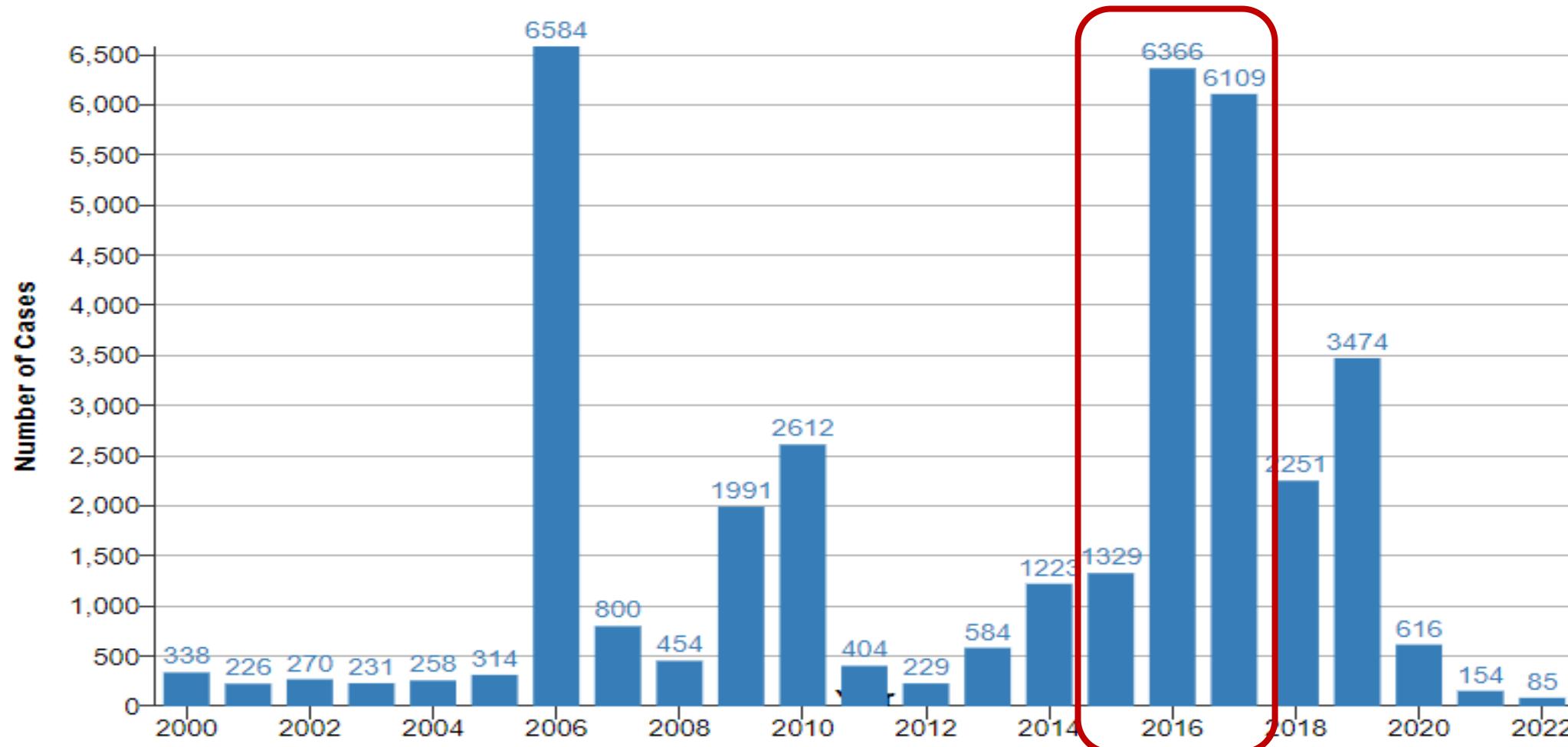


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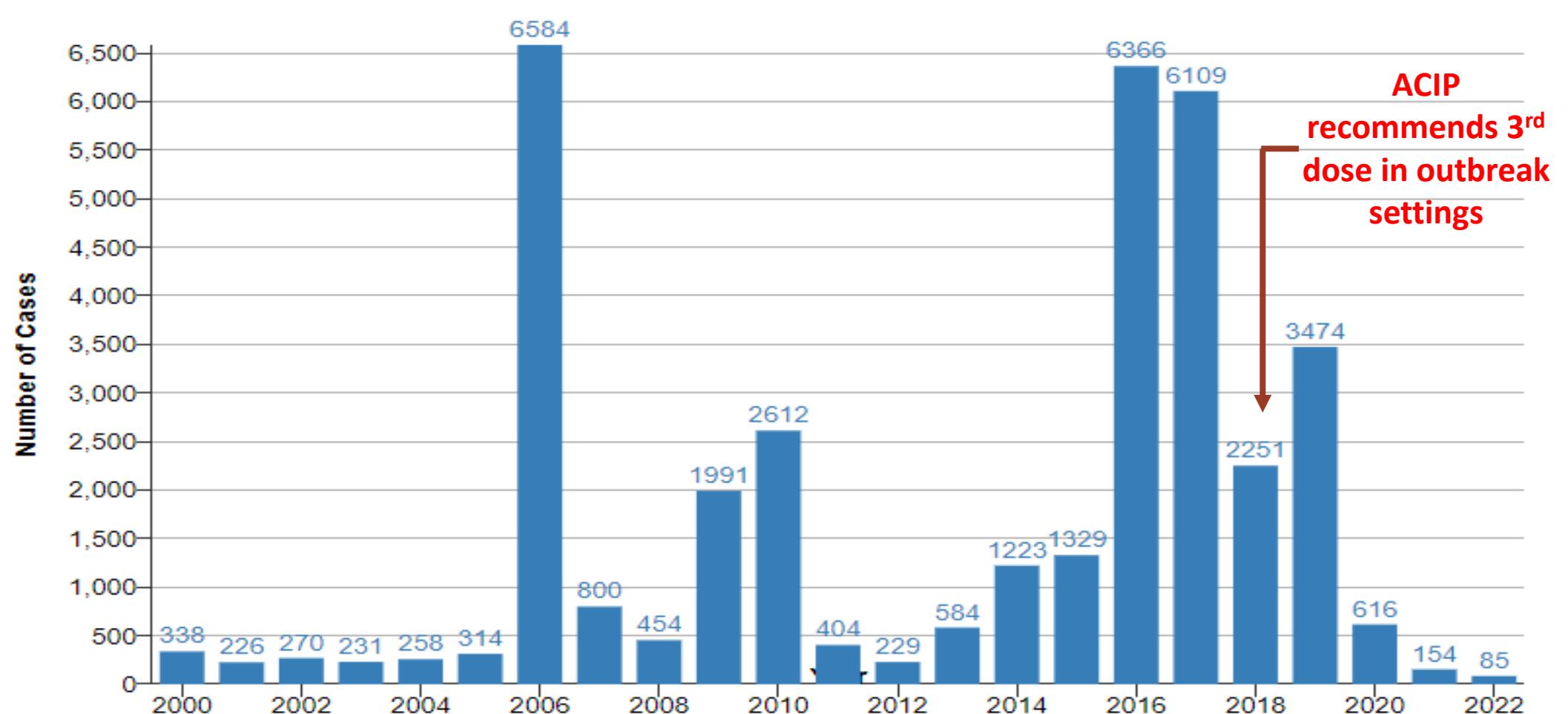


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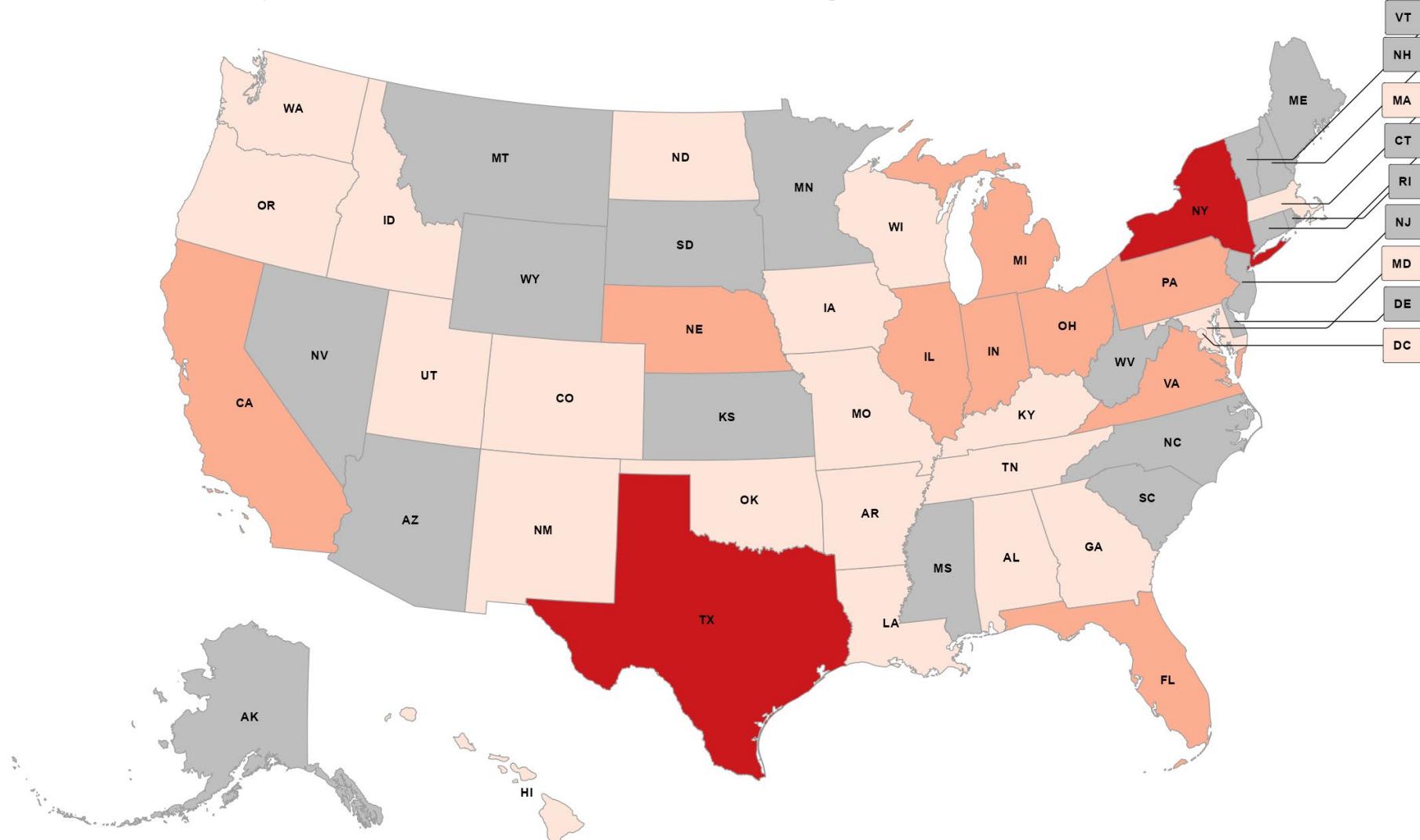


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U.S. Mumps Cases as of August 5, 2022**



*Jurisdictions refer to any of the 50 states, New York City, and the District of Columbia.

**2022 map represents cases reported to CDC as of July 1, 2022; 2021 and 2022 case counts are preliminary and subject to change.

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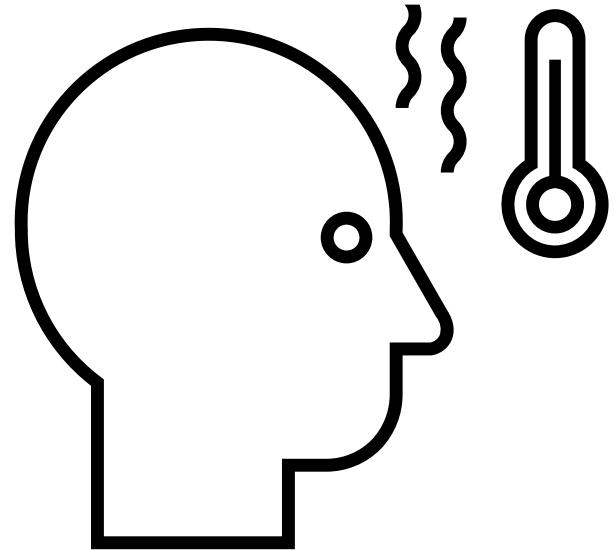
Suspect Mumps?

- **Health care professionals should be vigilant about mumps:**
 - Consider mumps in patients presenting with fever and parotitis regardless of age, vaccination status or travel history
 - Promptly isolate patients for 5 days after the glands begin to swell
 - Immediately report the suspect mumps case to the health department
 - Obtain specimens for testing from patients with suspected mumps, including a blood specimen and a buccal or oral swab specimen, which confirms the diagnosis



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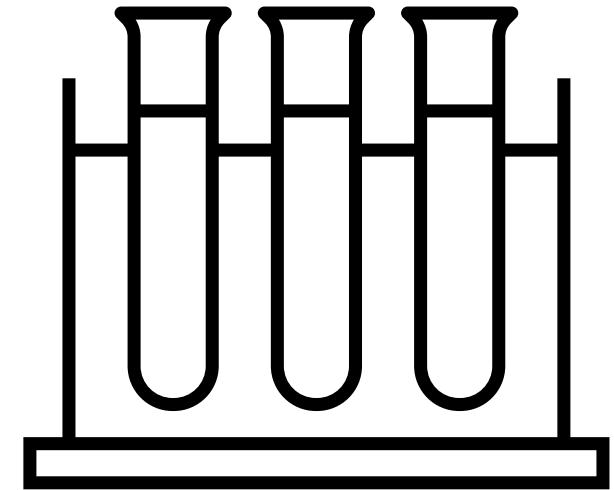
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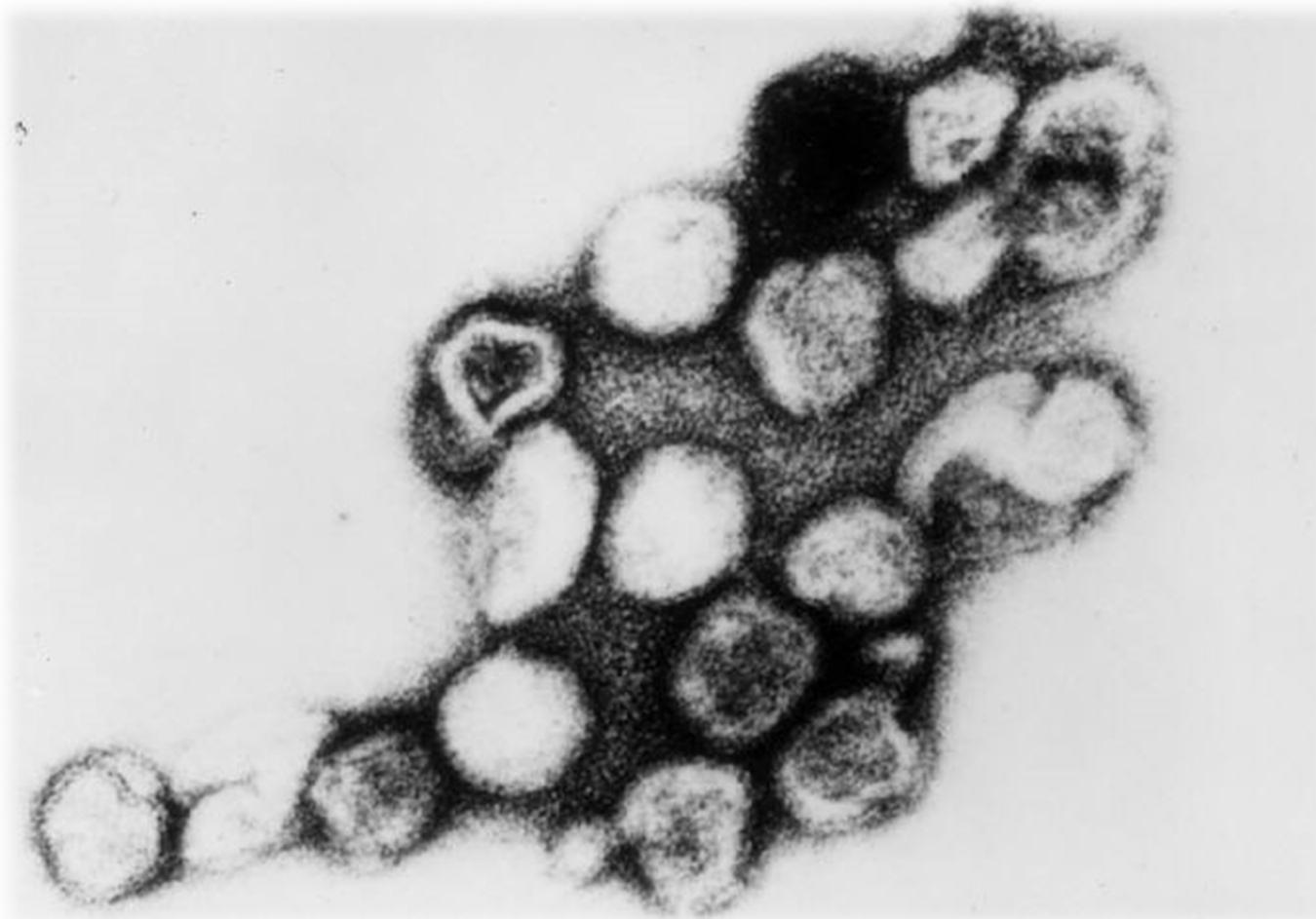
- **Health care personnel should have documented evidence of immunity**
 - Refer to “Immunization of Health-Care Personnel: Recommendations of the Advisory Committee on Immunization Practices”
(<https://www.cdc.gov/mmwr/pdf/rr/rr6007.pdf>)



4

Rubella Disease

Rubella



Togavirus

Rubella

- Incubation period: 12–23 days; average 14 days



Rubella

- **Prodrome is nonspecific**
 - Malaise
 - Fever



Rubella



Maculopapular rash **14-17 days** after exposure

Rubella Complications

Complication	Rate
Arthritis or arthralgia	May occur in up to 70% of adult women, but is rare in children and adult males
Encephalitis	1/6,000 cases
Hemorrhagic manifestations (e.g., thrombocytopenic purpura)	1/3,000 cases
Orchitis, neuritis, progressive panencephalitis	Rare

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Congenital Rubella Syndrome

- Rubella is associated with many birth defects



Congenital Rubella Syndrome

- Rubella is associated with many birth defects



Hearing impairment



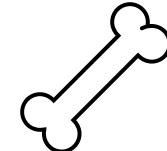
Eye Defects



Cardiac Defects



Microcephaly & Intellectual disabilities



Bone Alterations



Liver & Spleen Damage



Congenital Rubella Syndrome

- Rubella is associated with many birth defects



Hearing impairment



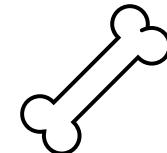
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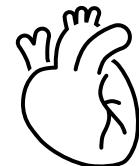
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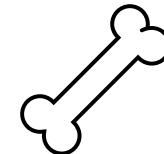
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- Rubella is associated with many birth defects
- The earlier the infection in pregnancy, the more serious the outcomes for the baby



Congenital Rubella Syndrome

- Rubella is associated with many birth defects
- The earlier the infection in pregnancy, the more serious the outcomes for the baby
- May lead to fetal death or preterm delivery



Congenital Rubella Syndrome



Epidemiology

Rubella	
Reservoir	Human
Transmission	Direct or droplet contact from nasopharyngeal secretions
Temporal Pattern	Peaks in late winter/spring
Communicability	7 days before to 5–7 days after rash onset

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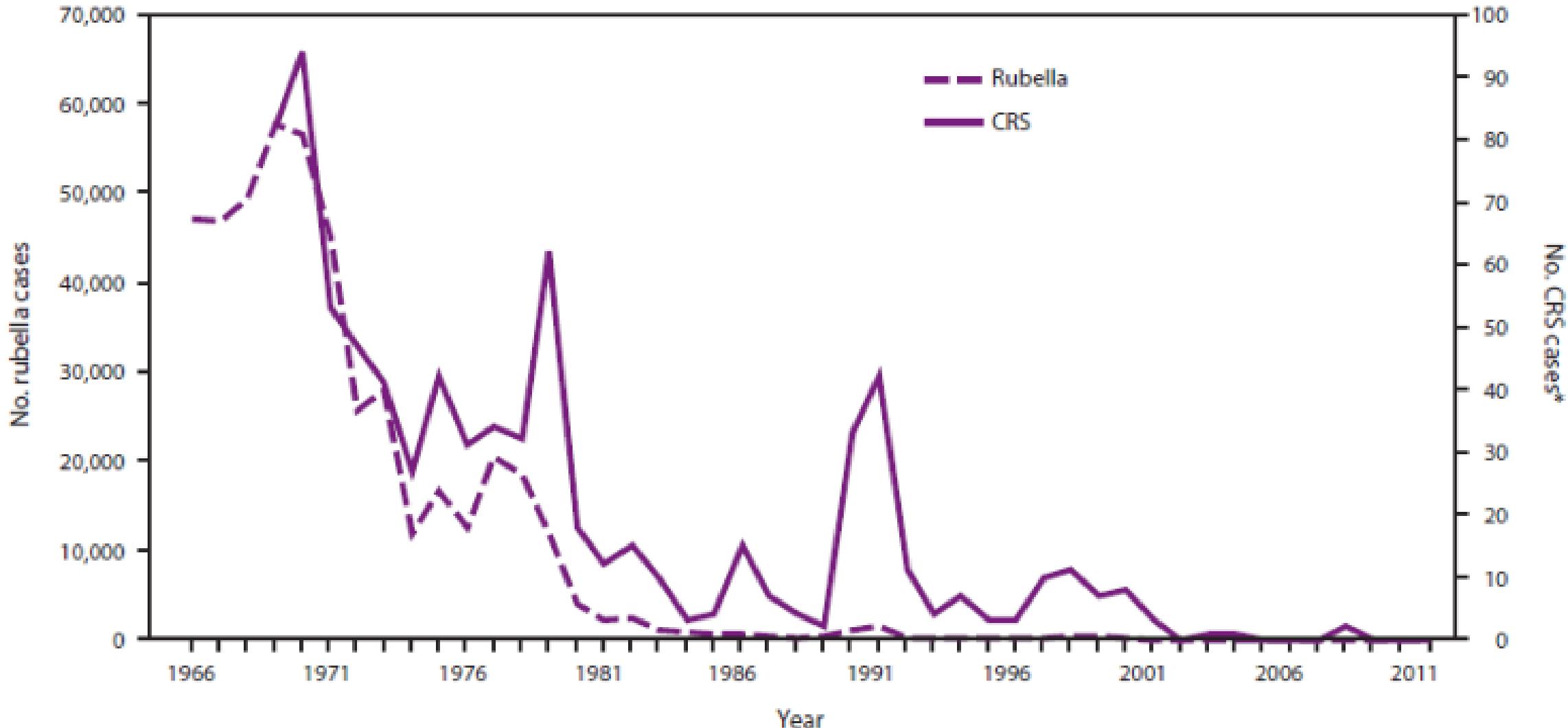
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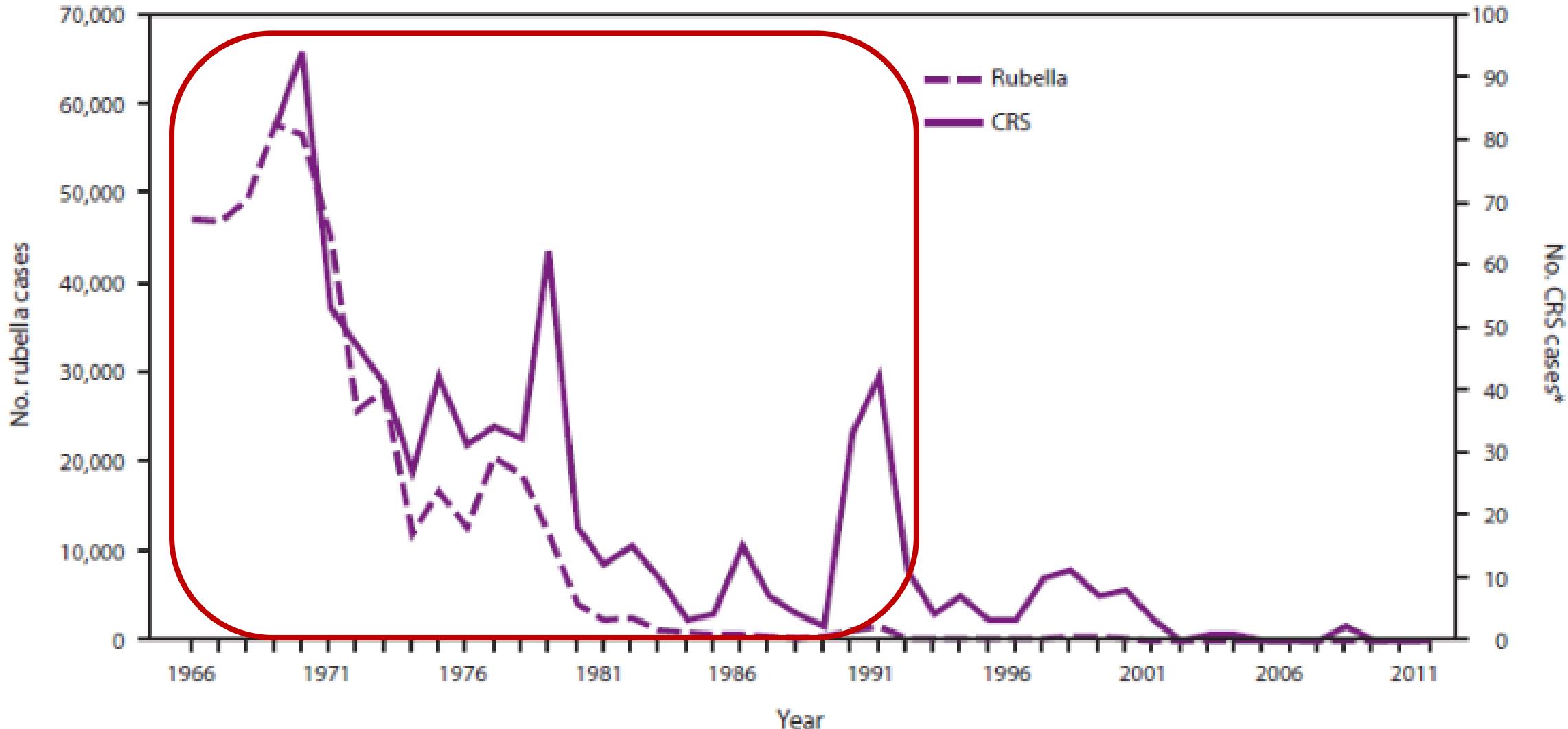
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Reported Rubella and CRS Cases – United States, 1966 - 2011



Reported Rubella and CRS Cases – United States, 1966 - 2011



Reported in the United States



Rubella

PAHO

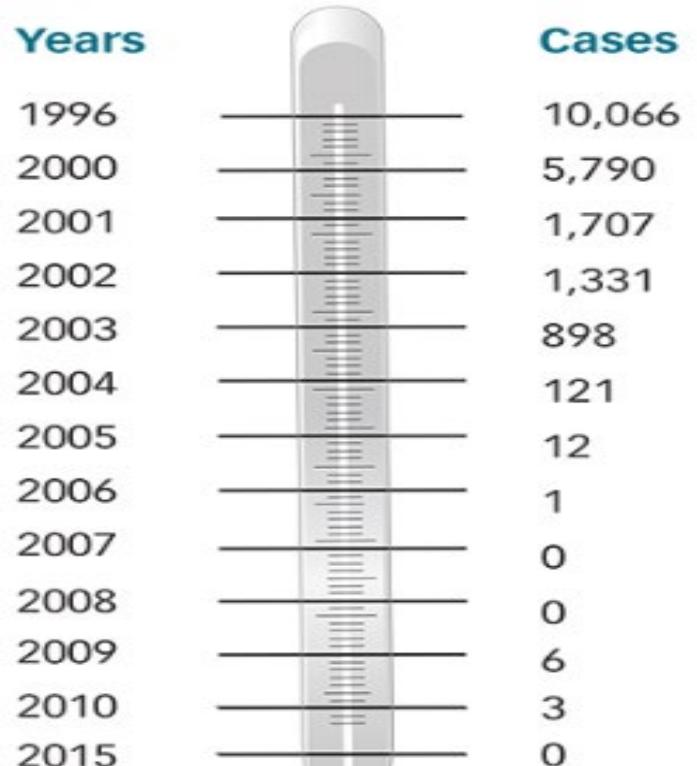


Pan American
Health
Organization



World Health
Organization
REGIONAL OFFICE FOR THE Americas

Thanks to vaccines,
the **Americas** were declared
rubella free in 2015



5

**MMR
Vaccine**

MMR Vaccines

- **Two products:**
 - M-M-R II
 - Priorix
- Live, attenuated vaccines
- Administered by SC (subcutaneous) injection
- Approved for pediatric and adult populations
- No single antigen vaccines in the United States



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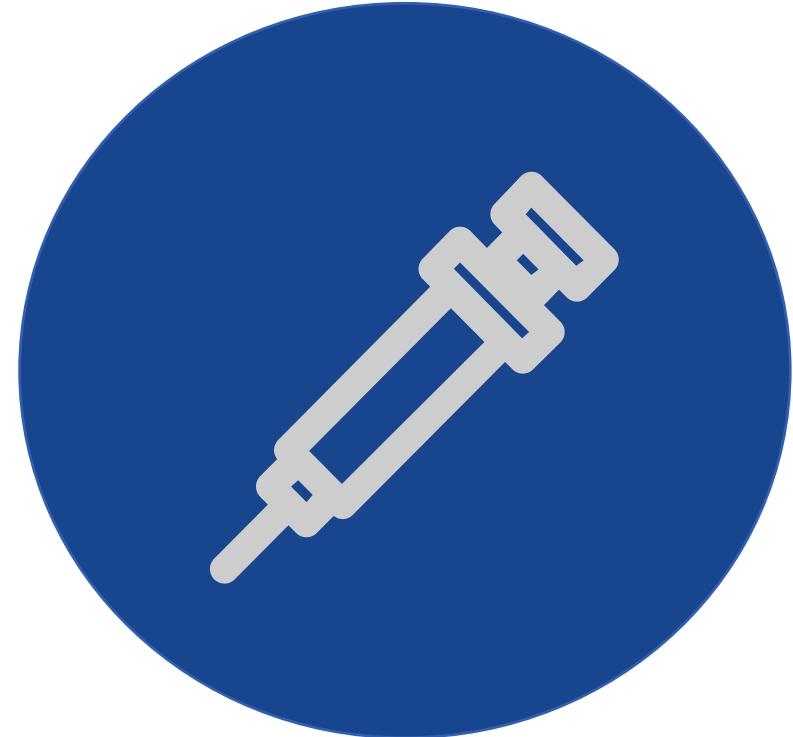
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M-M-R II Vaccine

- Licensed in 1971
- Highly effective
- Safe (over 50 years of use)
 - Low risk of febrile seizures in children 12–23 months (1 in 3,000 doses)
 - Temporary pain/stiffness in joints (teens or adult women)
 - Temporary low platelet count (1 in 30,000 doses)



M-M-R II Vaccine

■ Efficacy

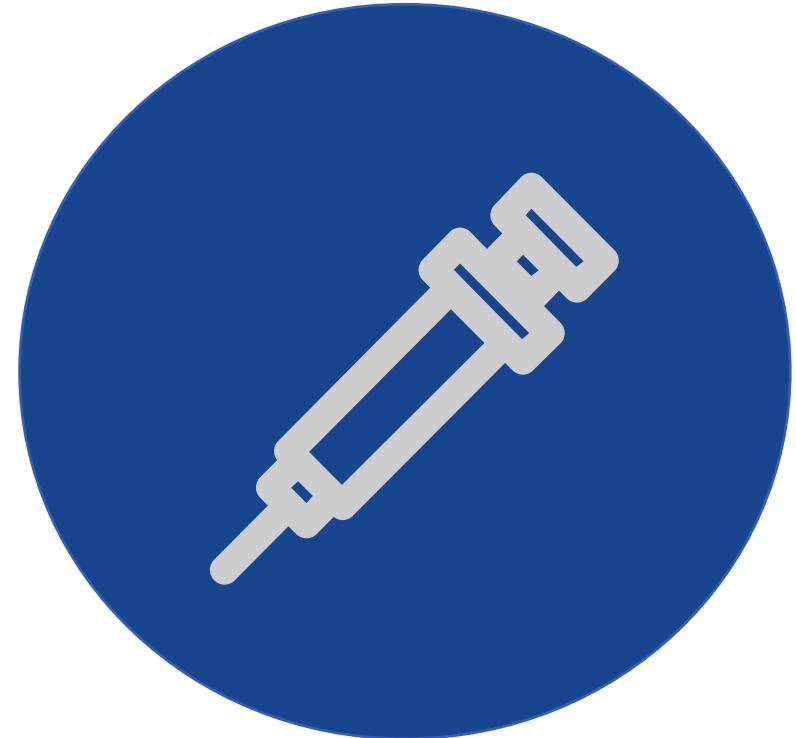
- Measles: 95% at 12 months; 98% at 15 months
- Mumps: 88% (range: 31%–95%) (2 doses)
- Rubella: 95% or more (1 dose)

■ Preparation

- Single dose vials
- Reconstitute with diluent

■ Administration

- Subcutaneously



Priorix Vaccine

- Licensed in 2022 in the United States
- Highly effective
- Similar safety profile as M-M-R II
 - Similar rates of febrile seizures
 - Similar rates of low platelet count



Priorix Vaccine

- **Immunogenicity**

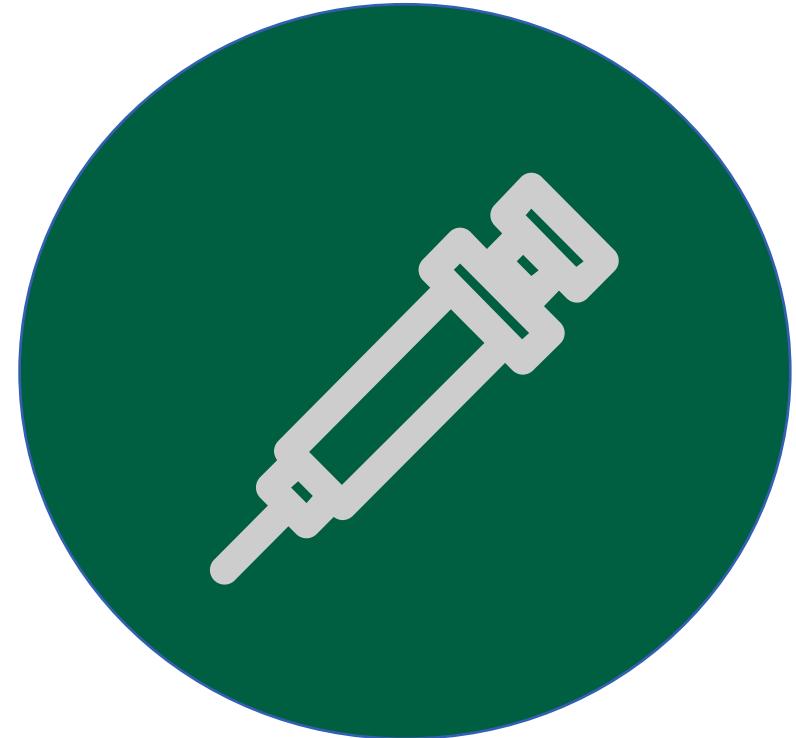
- No significant difference in geometric mean concentration for measles, mumps, or rubella between Priorix and M-M-R II

- **Preparation**

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 - Reconstitute with diluent

- **Administration**

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M-M-R II versus Priorix

	M-M-R II¹	Priorix²	Component Similarity
Measles	Enders' Edmonston strain	Schwarz strain	100% identical on a nucleotide level
Mumps	Jeryl Lynn™ (B level)	RIT4385	100% identical on a protein level³
Rubella	Wistar RA 27/3 strain	Wistar RA 27/3 strain	100% identical on a nucleotide level

- **Inactive ingredients: Priorix does not contain gelatin**

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MMR Vaccine Recommendations



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

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Immunization Schedules



For Healthcare Providers

Child and Adolescent Schedule

Recommended vaccination schedule for ages 18 years or younger

Table 1 Recommended Childhood and Adolescent Immunization Schedule for Ages 0-18 Years, United States, 2022	
Age	Vaccine
0-1 month	MMR
1-2 months	MMR
2-6 months	MMR
6-12 months	MMR
12-15 months	MMR
15-18 months	MMR
18-24 months	MMR
24-30 months	MMR
30-36 months	MMR
36-48 months	MMR
48-60 months	MMR
60-72 months	MMR
72-84 months	MMR
84-96 months	MMR
96-108 months	MMR
108-120 months	MMR
120-132 months	MMR
132-144 months	MMR
144-156 months	MMR
156-168 months	MMR
168-180 months	MMR
180-192 months	MMR
192-204 months	MMR
204-216 months	MMR
216-228 months	MMR
228-240 months	MMR
240-252 months	MMR
252-264 months	MMR
264-276 months	MMR
276-288 months	MMR
288-300 months	MMR
300-312 months	MMR
312-324 months	MMR
324-336 months	MMR
336-348 months	MMR
348-360 months	MMR
360-372 months	MMR
372-384 months	MMR
384-396 months	MMR
396-408 months	MMR
408-420 months	MMR
420-432 months	MMR
432-444 months	MMR
444-456 months	MMR
456-468 months	MMR
468-480 months	MMR
480-492 months	MMR
492-504 months	MMR
504-516 months	MMR
516-528 months	MMR
528-540 months	MMR
540-552 months	MMR
552-564 months	MMR
564-576 months	MMR
576-588 months	MMR
588-600 months	MMR
600-612 months	MMR
612-624 months	MMR
624-636 months	MMR
636-648 months	MMR
648-660 months	MMR
660-672 months	MMR
672-684 months	MMR
684-696 months	MMR
696-708 months	MMR
708-720 months	MMR
720-732 months	MMR
732-744 months	MMR
744-756 months	MMR
756-768 months	MMR
768-780 months	MMR
780-792 months	MMR
792-804 months	MMR
804-816 months	MMR
816-828 months	MMR
828-840 months	MMR
840-852 months	MMR
852-864 months	MMR
864-876 months	MMR
876-888 months	MMR
888-896 months	MMR
896-908 months	MMR
908-916 months	MMR
916-924 months	MMR
924-932 months	MMR
932-940 months	MMR
940-948 months	MMR
948-956 months	MMR
956-964 months	MMR
964-972 months	MMR
972-980 months	MMR
980-988 months	MMR
988-996 months	MMR
996-1004 months	MMR
1004-1012 months	MMR
1012-1020 months	MMR
1020-1028 months	MMR
1028-1036 months	MMR
1036-1044 months	MMR
1044-1052 months	MMR
1052-1060 months	MMR
1060-1068 months	MMR
1068-1076 months	MMR
1076-1084 months	MMR
1084-1092 months	MMR
1092-1100 months	MMR
1100-1108 months	MMR
1108-1116 months	MMR
1116-1124 months	MMR
1124-1132 months	MMR
1132-1140 months	MMR
1140-1148 months	MMR
1148-1156 months	MMR
1156-1164 months	MMR
1164-1172 months	MMR
1172-1180 months	MMR
1180-1188 months	MMR
1188-1196 months	MMR
1196-1204 months	MMR
1204-1212 months	MMR
1212-1220 months	MMR
1220-1228 months	MMR
1228-1236 months	MMR
1236-1244 months	MMR
1244-1252 months	MMR
1252-1260 months	MMR
1260-1268 months	MMR
1268-1276 months	MMR
1276-1284 months	MMR
1284-1292 months	MMR
1292-1300 months	MMR
1300-1308 months	MMR
1308-1316 months	MMR
1316-1324 months	MMR
1324-1332 months	MMR
1332-1340 months	MMR
1340-1348 months	MMR
1348-1356 months	MMR
1356-1364 months	MMR
1364-1372 months	MMR
1372-1380 months	MMR
1380-1388 months	MMR
1388-1396 months	MMR
1396-1404 months	MMR
1404-1412 months	MMR
1412-1420 months	MMR
1420-1428 months	MMR
1428-1436 months	MMR
1436-1444 months	MMR
1444-1452 months	MMR
1452-1460 months	MMR
1460-1468 months	MMR
1468-1476 months	MMR
1476-1484 months	MMR
1484-1492 months	MMR
1492-1500 months	MMR
1500-1508 months	MMR
1508-1516 months	MMR
1516-1524 months	MMR
1524-1532 months	MMR
1532-1540 months	MMR
1540-1548 months	MMR
1548-1556 months	MMR
1556-1564 months	MMR
1564-1572 months	MMR
1572-1580 months	MMR
1580-1588 months	MMR
1588-1596 months	MMR
1596-1604 months	MMR
1604-1612 months	MMR
1612-1620 months	MMR
1620-1628 months	MMR
1628-1636 months	MMR
1636-1644 months	MMR
1644-1652 months	MMR
1652-1660 months	MMR
1660-1668 months	MMR
1668-1676 months	MMR
1676-1684 months	MMR
1684-1692 months	MMR
1692-1700 months	MMR
1700-1708 months	MMR
1708-1716 months	MMR
1716-1724 months	MMR
1724-1732 months	MMR
1732-1740 months	MMR
1740-1748 months	MMR
1748-1756 months	MMR
1756-1764 months	MMR
1764-1772 months	MMR
1772-1780 months	MMR
1780-1788 months	MMR
1788-1796 months	MMR
1796-1804 months	MMR
1804-1812 months	MMR
1812-1820 months	MMR
1820-1828 months	MMR
1828-1836 months	MMR
1836-1844 months	MMR
1844-1852 months	MMR
1852-1860 months	MMR
1860-1868 months	MMR
1868-1876 months	MMR
1876-1884 months	MMR
1884-1892 months	MMR
1892-1900 months	MMR
1900-1908 months	MMR
1908-1916 months	MMR
1916-1924 months	MMR
1924-1932 months	MMR
1932-1940 months	MMR
1940-1948 months	MMR
1948-1956 months	MMR
1956-1964 months	MMR
1964-1972 months	MMR
1972-1980 months	MMR
1980-1988 months	MMR
1988-1996 months	MMR
1996-2004 months	MMR
2004-2012 months	MMR
2012-2020 months	MMR
2020-2028 months	MMR
2028-2036 months	MMR
2036-2044 months	MMR
2044-2052 months	MMR
2052-2060 months	MMR
2060-2068 months	MMR
2068-2076 months	MMR
2076-2084 months	MMR
2084-2092 months	MMR
2092-2100 months	MMR
2100-2108 months	MMR
2108-2116 months	MMR
2116-2124 months	MMR
2124-2132 months	MMR
2132-2140 months	MMR
2140-2148 months	MMR
2148-2156 months	MMR
2156-2164 months	MMR
2164-2172 months	MMR
2172-2180 months	MMR
2180-2188 months	MMR
2188-2196 months	MMR
2196-2204 months	MMR
2204-2212 months	MMR
2212-2220 months	MMR
2220-2228 months	MMR
2228-2236 months	MMR
2236-2244 months	MMR
2244-2252 months	MMR
2252-2260 months	MMR
2260-2268 months	MMR
2268-2276 months	MMR
2276-2284 months	MMR
2284-2292 months	MMR
2292-2300 months	MMR
2300-2308 months	MMR
2308-2316 months	MMR
2316-2324 months	MMR
2324-2332 months	MMR
2332-2340 months	MMR
2340-2348 months	MMR
2348-2356 months	MMR
2356-2364 months	MMR
2364-2372 months	MMR
2372-2380 months	MMR
2380-2388 months	MMR
2388-2396 months	MMR
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2404-2412 months	MMR
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2420-2428 months	MMR
2428-2436 months	MMR
2436-2444 months	MMR
2444-2452 months	MMR
2452-2460 months	MMR
2460-2468 months	MMR
2468-2476 months	MMR
2476-2484 months	MMR
2484-2492 months	MMR
2492-2500 months	MMR
2500-2508 months	MMR
2508-2516 months	MMR
2516-2524 months	MMR
2524-2532 months	MMR
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2548-2556 months	MMR
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2588-2596 months	MMR
2596-2604 months	MMR
2604-2612 months	MMR
2612-2620 months	MMR
2620-2628 months	MMR
2628-2636 months	MMR
2636-2644 months	MMR
2644-2652 months	MMR
2652-2660 months	MMR
2660-2668 months	MMR
2668-2676 months	MMR
2676-2684 months	MMR
2684-2692 months	MMR
2692-2700 months	MMR
2700-2708 months	MMR
2708-2716 months	MMR
2716-2724 months	MMR
2724-2732 months	MMR
2732-2740 months	MMR
2740-2748 months	MMR
2748-2756 months	MMR
2756-2764 months	MMR
2764-2772 months	MMR
2772-2780 months	MMR
2780-2788 months	MMR
2788-2796 months	MMR
2796-2804 months	MMR
2804-2812 months	MMR
2812-2820 months	MMR
2820-2828 months	MMR
2828-2836 months	MMR
2836-2844 months	MMR
2844-2852 months	MMR
2852-2860 months	MMR
2860-2868 months	MMR
2868-2876 months	MMR
2876-2884 months	MMR
2884-2892 months	MMR
2892-2900 months	MMR
2900-2908 months	MMR
2908-2916 months	MMR
2916-2924 months	MMR
2924-2932 months	MMR
2932-2940 months	MMR
2940-2948 months	MMR
2948-2956 months	MMR
2956-2964 months	MMR
2964-2972 months	MMR
2972-2980 months	MMR
2980-2988 months	MMR
2988-2996 months	MMR
2996-3004 months	MMR
3004-3012 months	MMR
3012-3020 months	MMR
3020-3028 months	MMR
3028-3036 months	MMR
3036-3044 months	MMR
3044-3052 months	MMR
3052-3060 months	MMR
3060-3068 months	MMR
3068-3076 months	MMR
3076-3084 months	MMR
3084-3092 months	MMR
3092-3100 months	MMR
3100-3108 months	MMR
3108-3116 months	MMR
3116-3124 months	MMR
3124-3132 months	MMR
3132-3140 months	MMR
3140-3148 months	MMR
3148-3156 months	MMR
3156-3164 months	MMR
3164-3172 months	MMR
3172-3180 months	MMR
3180-3188 months	MMR
3188-3196 months	MMR
3196-3204 months	MMR
3204-3212 months	MMR
3212-3220 months	MMR
3220-3228 months	MMR
3228-3236 months	MMR
3236-3244 months	MMR
3244-3252 months	MMR
3252-3260 months	MMR
3260-3268 months	MMR
3268-3276 months	MMR
3276-3284 months	MMR
3284-3292 months	MMR
3292-3300 months	MMR
3300-3308 months	MMR
3308-3316 months	MMR
3316-3324 months	MMR
3324-3332 months	MMR
3332-3340 months	MMR
3340-3348 months	MMR
3348-3356 months	MMR
3356-3364 months	MMR
3364-3372 months	MMR
3372-3380 months	MMR
3380-3388 months	MMR
3388-3396 months	MMR
3396-3404 months	MMR
3404-3412 months	MMR
3412-3420 months	MMR
3420-3428 months	MMR
3428-3436 months	MMR
3436-3444 months	MMR
3444-3452 months	MMR
3452-3460 months	MMR
3460-3468 months	MMR
3468-3476 months</td	

Child/Adolescent Schedule

Vaccine	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 all children



Range of recommended ages
for catch-up vaccination



Range of recommended ages
for certain high-risk groups

Child/Adolescent Schedule

Vaccine	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)																	

 Range of recommended ages for all children

 Range of recommended ages for catch-up vaccination

 Range of recommended ages for certain high-risk groups

See Notes

◀--- 1st dose ---►

2nd dose

Child/Adolescent Schedule

12 months



Vaccine	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

←--- 1st dose ---→

2nd dose



Range of recommended
ages for all children



Range of recommended ages
for catch-up vaccination



Range of recommended ages
for certain high-risk groups

Child/Adolescent Schedule

Vaccine	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 all children



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Child/Adolescent Schedule

Vaccine	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
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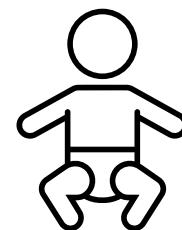
Range of recommended
ages for all children



Range of recommended ages
for catch-up vaccination



Range of recommended ages
for certain high-risk groups



6-11 months



International travel

Child/Adolescent Schedule

12 months



Vaccine	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

←--- 1st dose ---→

2nd dose



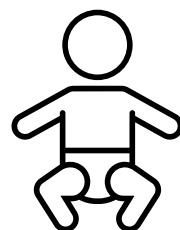
Range of recommended
ages for all children



Range of recommended ages
for catch-up vaccination



Range of recommended ages
for certain high-risk groups



Child/Adolescent Schedule

4-6 years



Vaccine	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 all children

 Range of recommended ages for catch-up vaccination

 Range of recommended ages for certain high-risk groups

Child/Adolescent Schedule



Second dose **produces immunity** in persons
who didn't respond to the first dose

Child/Adolescent Schedule

2nd dose may be given earlier



 Range of recommended ages for all children

 Range of recommended ages for catch-up vaccination

 Range of recommended ages for certain high-risk groups



<4 years old



International travel

Child/Adolescent Schedule



If school law requires a dose on or after 4th birthday,
then **another dose** should be administered

Child/Adolescent Schedule

Vaccine	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)																	



Range of recommended
ages for all children



Range of recommended ages
for catch-up vaccination



Range of recommended ages
for certain high-risk groups

See Notes

◀— 1st dose —▶

2nd dose

Child/Adolescent Schedule – Medical Indications

VACCINE	Pregnancy	Immunocompromised status (excluding HIV infection)	HIV infection CD4+ count ¹		Kidney failure, end-stage renal disease, or on hemodialysis	Heart disease or chronic lung disease	CSF leak or cochlear implant	Asplenia or persistent complement component deficiencies	Chronic liver disease	Diabetes
			<15% or total CD4 cell count of <200/mm ³	≥15% and total CD4 cell count of ≥200/mm ³						
Measles, mumps, rubella	*									

 Contraindicated or not recommended—vaccine should not be administered

*Vaccinate after pregnancy

 Vaccination according to the routine schedule recommended

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 Vaccination according to the routine schedule recommended

MMRV Vaccine

- **Composition** Live, attenuated measles, mumps, rubella, and varicella vaccines. 7 to 8 times as much vaccine virus as monovalent varicella vaccine
- **Age** 12 months through 12 years
- **Efficacy** Inferred from that of MMR vaccine and varicella vaccine on the basis of noninferior immunogenicity
- **Schedule** 2 administered
- **Route** Subcutaneous

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- **Schedule** 2 administered
- **Route** **Subcutaneous**

MMRV Vaccine

- **First dose at 12–47 months of age**

- Minimum age is 12 months
- Can be given as MMR and VAR separately or MMRV
- CDC recommends separate MMR and VAR

- **Second dose at 15 months–12 years of age**

- MMRV generally preferred
- May be given any time before 13th birthday at least 3 months (minimum interval) after the first dose
- Not approved for use in persons 13 years of age and older



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- May be given any time before 13th birthday at least 3 months (minimum interval) after the first dose
- Not approved for use in persons 13 years of age and older



Adult MMR Schedule

■ Routine administration

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)		

■ Medical Indications

Vaccine	Pregnancy	Immuno-compromised (excluding HIV infection)	HIV infection CD4 count	Asplenia, complement deficiencies	End-stage renal disease; or on hemodialysis	Heart or lung disease, alcoholism ¹	Chronic liver disease	Diabetes	Health care personnel ²	Men who have sex with men
MMR	NOT RECOMMENDED						1 or 2 doses depending on indication			

Adult Schedule

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)		



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



No recommendation/
Not applicable

Adult Schedule

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)	



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Need Two Doses: 2nd dose 28 days after 1st dose

Adult Schedule

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



No recommendation/
Not applicable

Healthcare Personnel

- Born before 1957, **CANNOT** presume immunity
- Must have documented evidence of immunity
- Healthcare personnel born before 1957 without acceptable evidence of immunity, consider:
 - 2 doses of MMR for measles or mumps
 - 1 dose for rubella



Adult Schedule – Medical Indications

Vaccine	Pregnancy	Immuno-compromised (excluding HIV infection)	HIV infection CD4 percentage and count		Asplenia, complement deficiencies	End-stage renal disease, or on hemodialysis	Heart or lung disease; alcoholism ¹	Chronic liver disease	Diabetes	Health care personnel ²	Men who have sex with men
			<15% or <200 mm ³	≥15% and ≥200 mm ³							
MMR	Contraindicated*	Contraindicated					1 or 2 doses depending on indication				



Contraindicated or not recommended—vaccine should not be administered.

*Vaccinate after pregnancy.



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

Adult Schedule – Medical Indications

Vaccine	Pregnancy	Immuno-compromised (excluding HIV infection)	HIV infection percentage $<15\%$ or $<200 \text{ mm}^3$	CD4 percentage $\geq 15\%$ and $\geq 200 \text{ mm}^3$	Asplenia, complement deficiencies	End-stage renal disease, or on hemodialysis	Heart or lung disease; alcoholism ¹	Chronic liver disease	Diabetes	Health care personnel ²	Men who have sex with men
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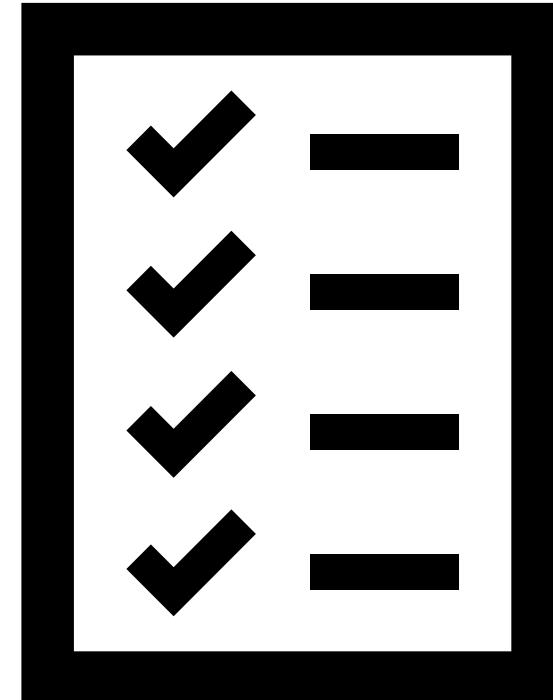
Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection

What counts as
acceptable evidence
of immunity?



Acceptable Evidence of Immunity

- Documented age-appropriate vaccination with live measles-, mumps-, and rubella-virus- containing vaccines
- Laboratory evidence of immunity
- Laboratory confirmation of disease
- Born before 1957
 - Except healthcare personnel
 - Except rubella for women of childbearing age who could become pregnant



Is serologic testing
necessary for
measles, mumps,
and rubella?



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
 - Exception for women of childbearing age

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6

Clinical Considerations

MMR Revaccination Indications

- Vaccinated before the first birthday
- Vaccinated with inactivated (killed) measles vaccine (KMV) or measles vaccine of unknown type from 1963–1967
- Vaccinated + immune globulin (IG) in addition to a further attenuated strain or vaccine of unknown type (revaccination not necessary if IG given with Edmonston B vaccine)
- Vaccinated before 1979 with either inactivated mumps vaccine or mumps vaccine of unknown type who are at high risk for mumps infection (e.g., work in a health care facility) should be considered for revaccination with 2 doses of MMR

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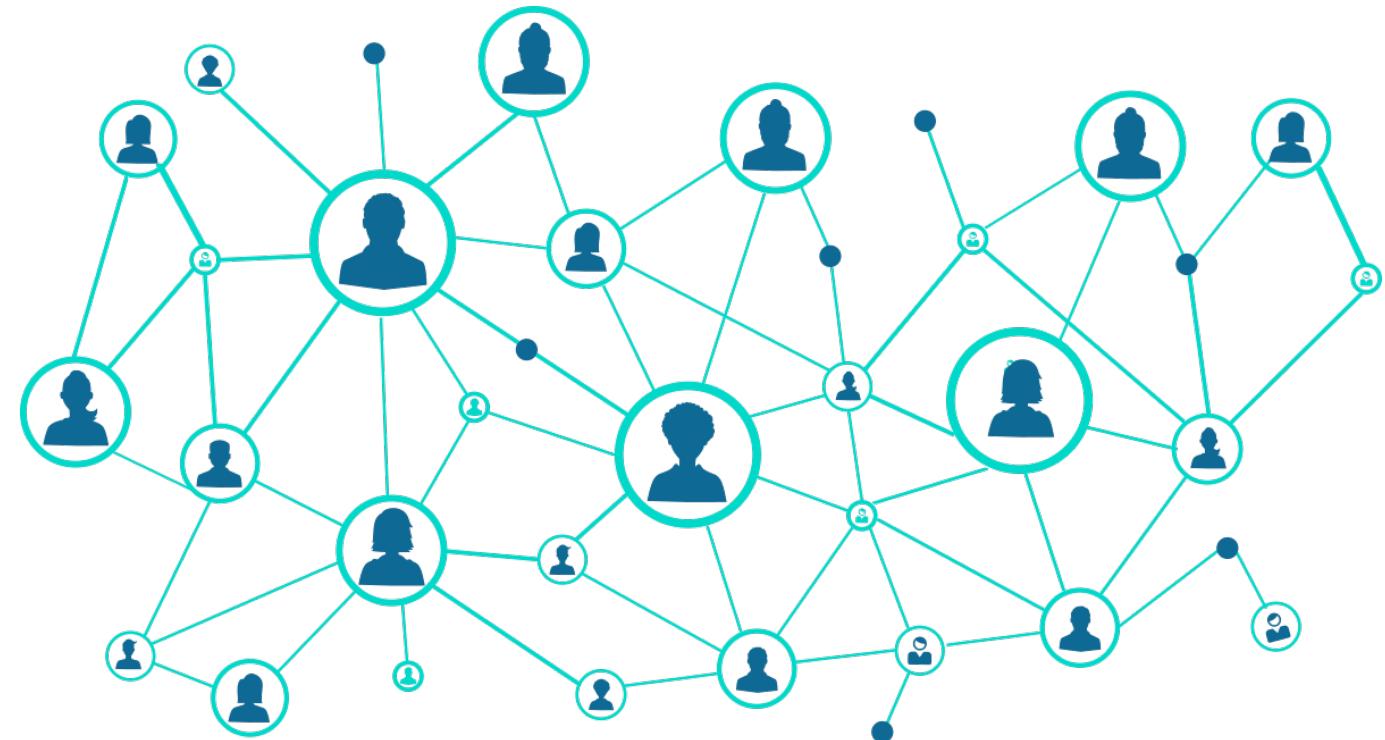
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Mumps Outbreaks

- **Third dose of MMR during Mumps outbreaks**
- **For persons identified by public health authorities as being at increased risk**
- **Third dose mitigates spread during outbreaks**



International Travel



- Routinely ask patients about plans for international travel
- Refer to vaccination guidance for international travelers

Health Care Personnel: MMR Vaccination and Serologic Testing

- HCP with 2 documented, appropriately spaced doses of MMR **do not** need to be serologically tested for immunity
- If they are tested and results are negative or equivocal **NO** additional MMR doses are needed
- Born before 1957 is **NOT** presumptive evidence of immunity. Healthcare workers need documented evidence of immunity



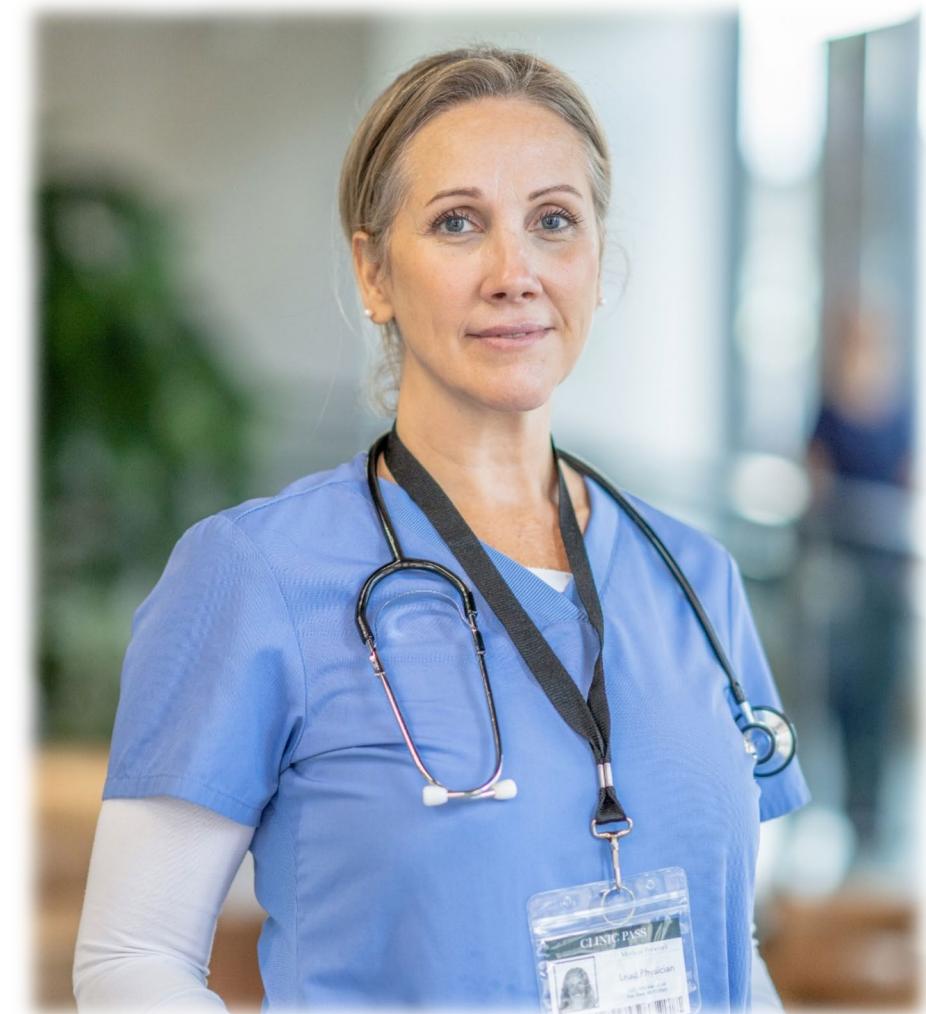
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Q&A

- **If a healthcare worker develops a rash and low-grade fever after MMR vaccination, is the healthcare worker infectious?**
 - A. Yes
 - B. No



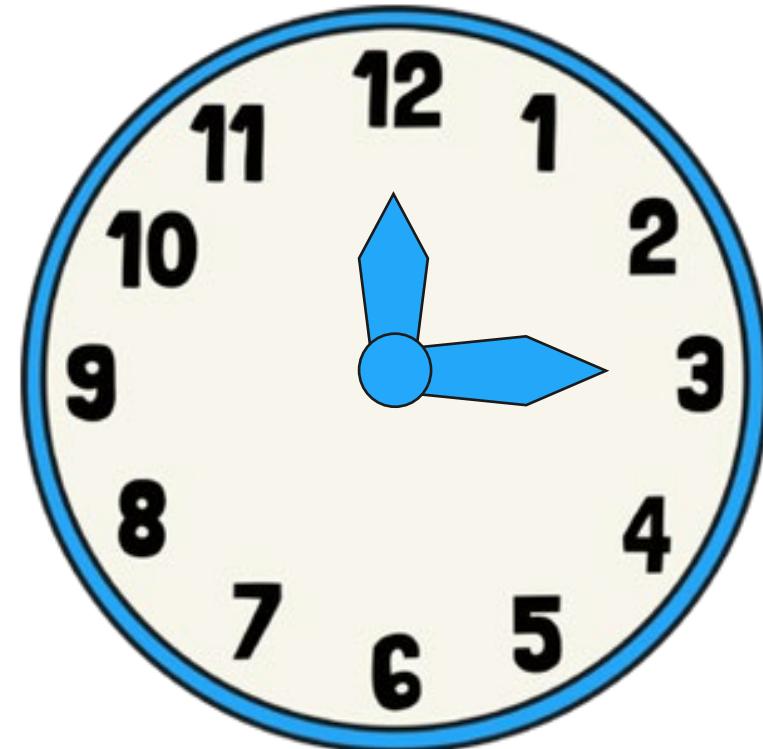
Q&A

- **If a healthcare worker develops a rash and low-grade fever after MMR vaccination, is the healthcare worker infectious?**
 - **B. No.** Approximately 5 to 15% will develop a low-grade fever and/or rash after vaccination. However, the person is not infectious, and no special precautions need to be taken.



Health Care Personnel and Outbreaks

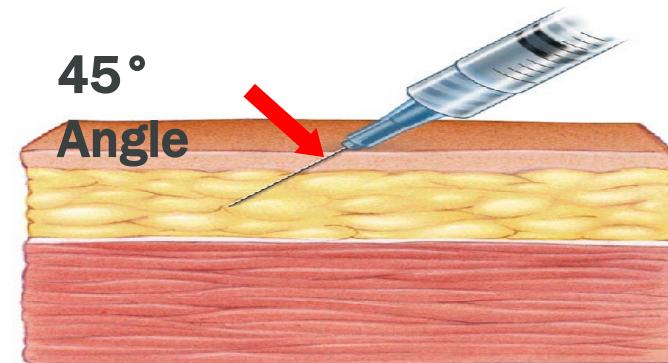
- Measles, mumps and rubella outbreaks spread **RAPIDLY**
- Healthcare facilities should routinely document adequate evidence of immunity among personnel **BEFORE** an outbreak occurs



MMR and MMRV Administration

■ Preparation

- MMR and MMRV vaccines must be reconstituted BEFORE administering
- Use ONLY the diluent supplied by the manufacturer

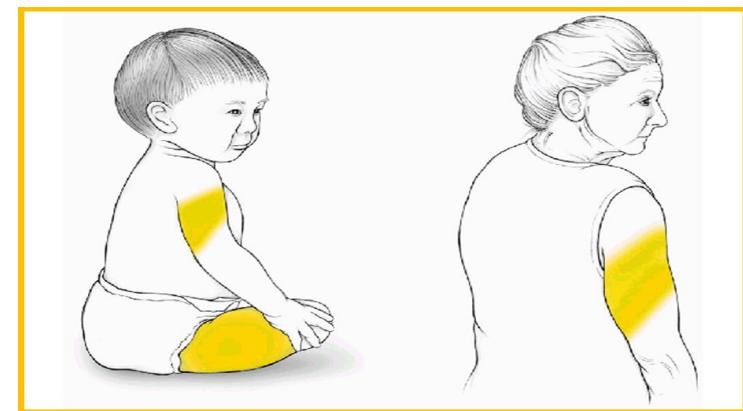


■ Route: Subcutaneous injection

- Needle gauge: 23–25 gauge
- Needle length: 5/8 inch

■ Site:

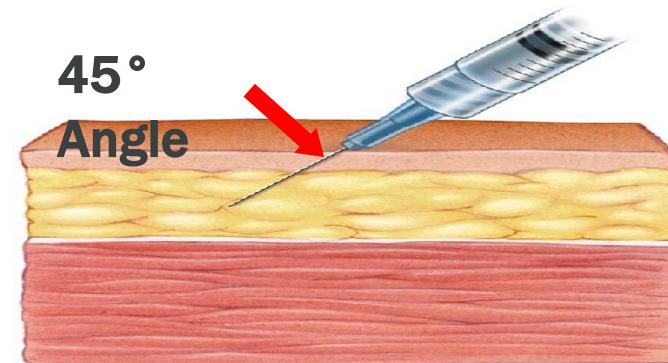
- Infants/toddlers: upper anterolateral thigh
- Older children/adults: upper outer triceps



MMR and MMRV Administration

■ Preparation

- MMR and MMRV vaccines must be reconstituted BEFORE administering
- Use ONLY the diluent supplied by the manufacturer

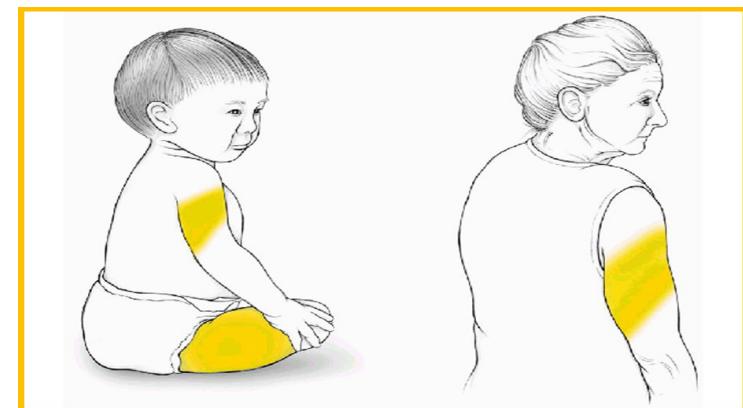


■ Route: Subcutaneous injection

- Needle gauge: 23–25 gauge
- Needle length: 5/8 inch

■ Site:

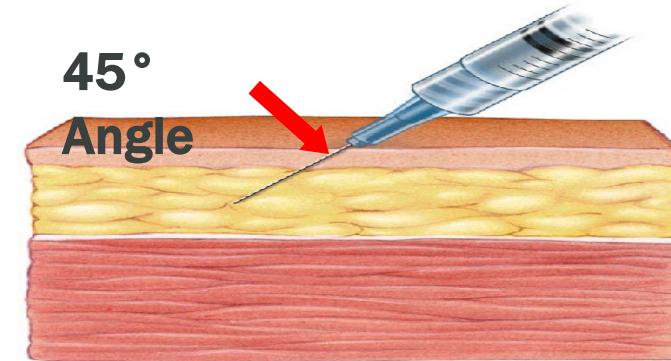
- Infants/toddlers: upper anterolateral thigh
- Older children/adults: upper outer triceps



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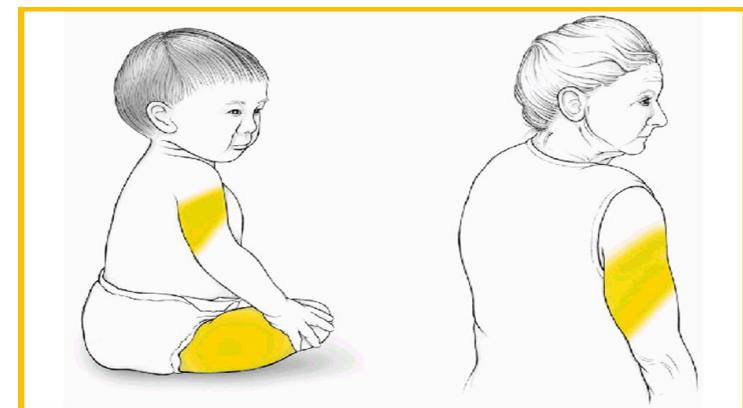


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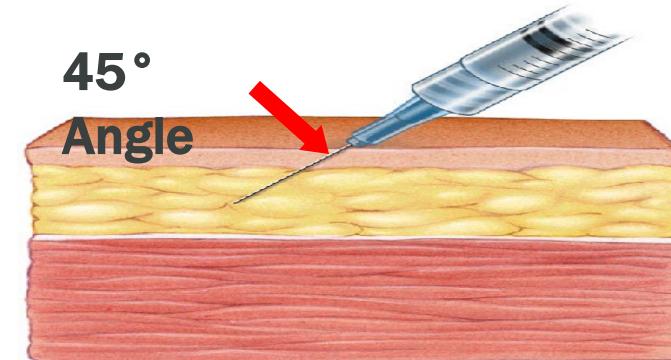
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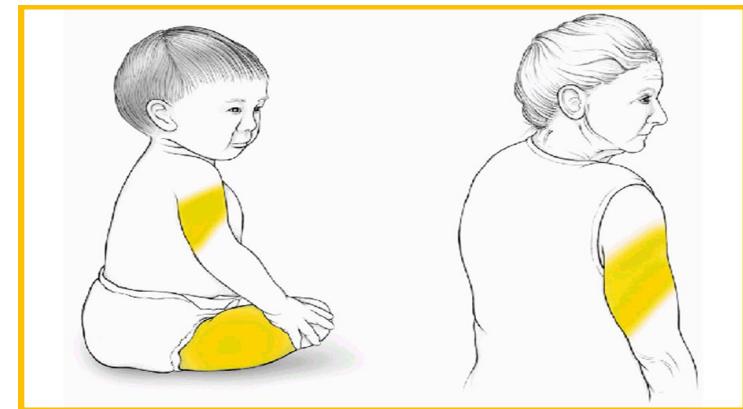


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MMR and MMRV Administration Errors

- **Wrong diluent used to reconstitute vaccine**
 - Dose does NOT count and should be repeated ASAP
- **Wrong route**
 - Administered intramuscularly instead of subcutaneously
- **MMRV administered after the age of 12 years**
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- **Always remember – store vaccine according to the manufacturer's recommendations and use a new needle and syringe for each patient**

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MMR and MMRV Administration Errors

VAERS

Vaccine Adverse Event Reporting System

www.vaers.hhs.gov

Measles Post-exposure Prophylaxis

Measles	Mumps & Rubella
Within 72 hours of exposure, MMR vaccine	
Within 6 days of exposure, immunoglobulin for non-immune persons*	Post-exposure MMR vaccination or immunoglobulin is NOT recommended

*Not indicated for persons who have received 1 dose of measles-containing vaccine at age 12 months or older, unless they are severely immunocompromised

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7

Safety

Contraindications

MMR	MMRV
<p>Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component</p> <ul style="list-style-type: none">• If someone is severely allergic to gelatin, do NOT administer M-M-R II	<p>Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component</p>
Pregnancy	Pregnancy
Known severe immunodeficiency (e.g., from hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy(c) or patients with HIV infection who are severely immunocompromised)	Known severe immunodeficiency (e.g., from hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy(c) or patients with HIV infection who are severely immunocompromised)
Family history of altered immunocompetence	Family history of altered immunocompetence

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Precautions

MMR	MMRV
Recent (≤ 11 months) receipt of antibody-containing blood product (specific interval depends on product)	Recent (≤ 11 months) receipt of antibody-containing blood product (specific interval depends on product)
History of thrombocytopenia or thrombocytopenic purpura	History of thrombocytopenia or thrombocytopenic purpura
Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing	Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing
Moderate or severe acute illness with or without fever	Moderate or severe acute illness with or without fever

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Tuberculin Skin Testing (TST)* or Tuberculosis Interferon-Gamma Release-Assay (IGRA) and MMR or MMRV Vaccines

- **TST or IGRA may be given at same visit as MMR or MMRV**
- If MMR/MMRV given first, delay TST or IGRA by at least 28 days
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MMR Vaccine Adverse Reactions

Adverse Reactions	
Fever	5%–15% (measles)
Rash, pruritis, purpura	5% (measles)
Thrombocytopenia	1/30,000–40,000 doses (measles)
Lymphadenopathy	Rare (rash, pruritis, purpura)
Allergic reactions	Rare
Parotitis	Rare (mumps)
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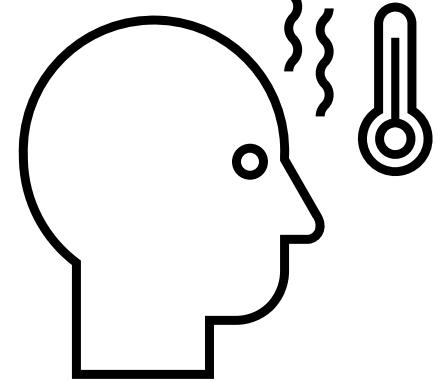
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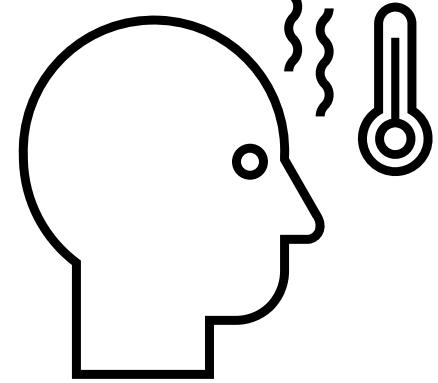
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MMRV Vaccine Adverse Reactions



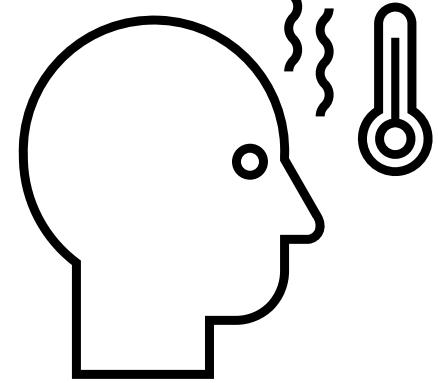
- Adverse reactions are similar to MMR
- Increased risk of fever and febrile seizures with MMRV when used as the first dose (children 12–23 months of age)
- 2X higher compared to MMR and varicella vaccines separately
- Occurs among 8 out of every 10,000 children vaccinated
- No increased risk of febrile seizures when MMRV used as the second dose in the MMR and varicella series
- Children with a personal or family history of seizures should be vaccinated with separate MMR and varicella vaccines

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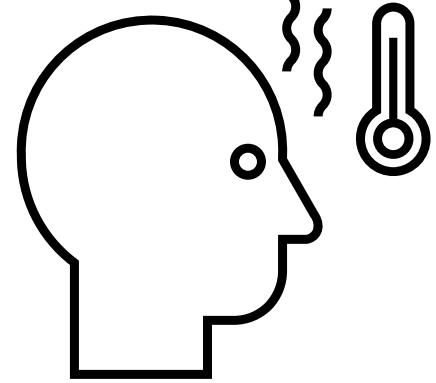
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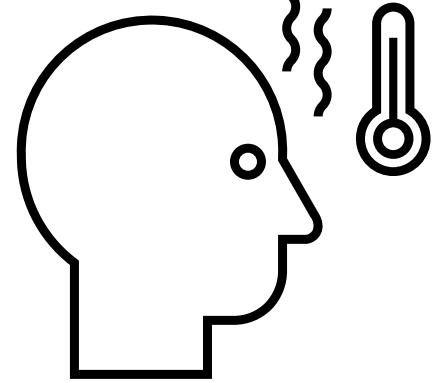
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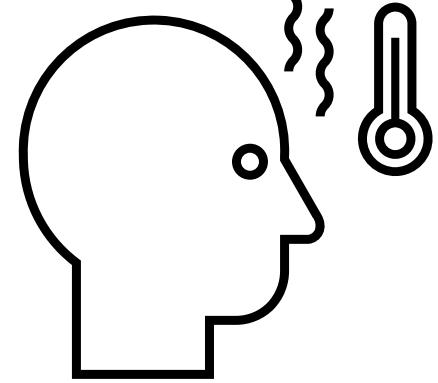
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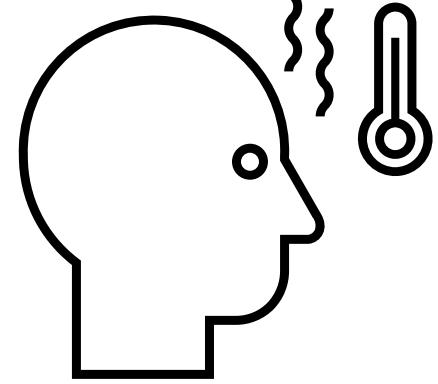
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MMRV Vaccine

Vaccines and Preventable Diseases

Vaccines & Preventable Diseases Home > Vaccines by Disease > Rubella > For Healthcare Professionals



[Vaccines & Preventable Diseases Home](#)

Vaccines by Disease

Chickenpox (Varicella)

Dengue

Diphtheria

Flu (Influenza)

Hepatitis A

Hepatitis B

Hib

Human Papillomavirus (HPV)

Measles

Meningococcal

Mumps

MMR & Varicella Vaccines or MMRV Vaccine: Discussing Options with Parents

For Healthcare Providers

Two Options for Protection

There are two options for protecting children who are 12 months-12 years old against measles, mumps, rubella, and varicella: using the varicella vaccine and the trivalent measles, mumps, and rubella (MMR) vaccine or using the quadrivalent measles, mumps, rubella, and varicella (MMRV) vaccine. This means that parents and caregivers have a decision to make, and they will rely on you as their child's healthcare provider for help in making that decision.

MMRV Vaccine as the First Dose at Ages 12–47 Months—The Necessary Conversation

As you know, questions or concerns about vaccines can be a source of stress for some parents during a well-child visit. As their child's healthcare provider, you remain parents' most trusted source of information about vaccines. For the first dose of measles, mumps, rubella, and varicella vaccines given at ages 12-47 months, either MMR and varicella vaccines or MMRV vaccine can be used.

On This Page

[Two Options for Protection](#)

[MMRV Vaccine as the First Dose at Ages 12-47 Months—The Necessary Conversation](#)

[Summary of Risks and Benefits](#)

[The Risk of Febrile Seizures](#)

[MMRV Vaccine as a First Dose at Ages 48 Months and Older or as a Second Dose at Any Age](#)

[Successful Communication about the Vaccination Options](#)

Vaccine Safety

CDC > Vaccine Safety > Safety Information by Vaccine > Measles, Mumps, Rubella, Varicella (MMRV) Vaccines



Vaccine Safety

Safety Information by Vaccine

[Chickenpox \(Varicella\) Vaccines](#)

[Diphtheria, Tetanus, and Pertussis Vaccines](#)

[Haemophilus influenza Type b \(Hib\) Vaccines](#)

[Hepatitis A Vaccines](#)

[Hepatitis B Vaccines](#)

[Human Papillomavirus \(HPV\) Vaccine](#)

[Influenza \(Flu\) Vaccines](#)

[Measles, Mumps, Rubella \(MMR\) Vaccines](#)

[Measles, Mumps, Rubella, Varicella \(MMRV\) Vaccines](#)

[VSD MMRV Safety Study](#)

MMRV Vaccine and Febrile Seizures

A study showing the risk levels for several health outcomes, including seizures, after measles, mumps, rubella, and varicella (MMRV) combination vaccine in children aged 12 to 23 months has been published in the July 2010 print issue of *Pediatrics* (published online June 28).

The study, "Measles-Mumps-Rubella-Varicella Combination Vaccine and the Risk of Febrile Seizures" uses computerized information from CDC's [Vaccine Safety Datalink \(VSD\) Project](#). VSD consists of managed care organizations which gather vaccination and demographic information, as well as health outcomes of their patients (more than 9.2 million across the U.S.).

Researchers examined VSD data on more than 83,000 children who received their first dose of MMRV vaccine and over 376,000 children who received their first doses of MMR and varicella vaccines given at the same visit from the year 2000 to the year 2008.



The Study's Main Findings Report:

For MMRV combination vaccine, there was 1 additional febrile seizure for every 2,300 doses given, compared to separate MMR plus varicella vaccines in the 7 to 10 days following vaccination.

Of the children identified as having seizures following the 7 to 10-day vaccination period, about 90% were found to be febrile seizures.

The rate of seizures in this timeframe was 85 per 1000 person-years in the MMRV vaccine group compared to 42 per 1000 in the MMR and varicella vaccine group. This risk was about 2 times higher in children who received the combination shot (MMRV) versus the single shots (MMR and varicella).

www.cdc.gov/vaccines/vpd/mmr/hcp/vacopt-factsheet-hcp.html

www.cdc.gov/vaccinesafety/vaccines/mmr/mmr-fbrile-seizures.html

MMR Vaccine Safety



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Vaccine Safety

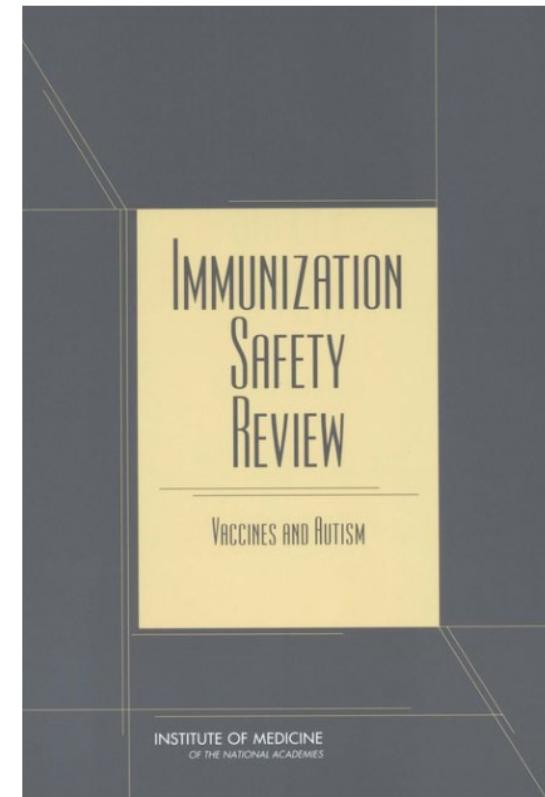


[Vaccine safety information: <https://www.cdc.gov/vaccinesafety/index.html>](https://www.cdc.gov/vaccinesafety/index.html)

<https://nap.nationalacademies.org/catalog/10997/immunization-safety-review-vaccines-and-autism>

<https://www.cdc.gov/measles/cases-outbreaks.html>

“The committee concludes that the evidence favors **rejection** of a causal relationship between MMR vaccine and autism.” Institute of Medicine, 2004

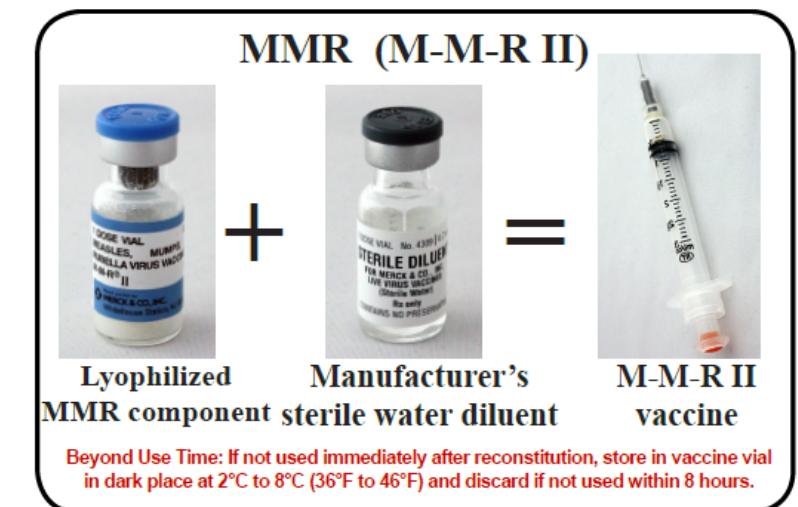
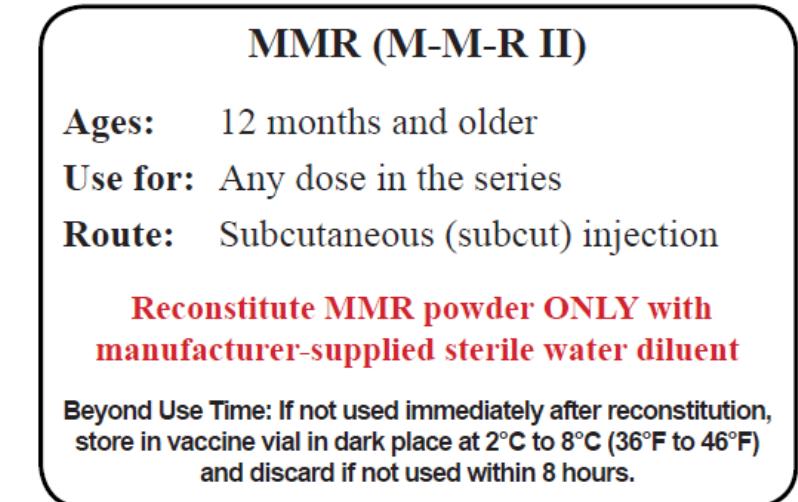


8

Storage and Handling

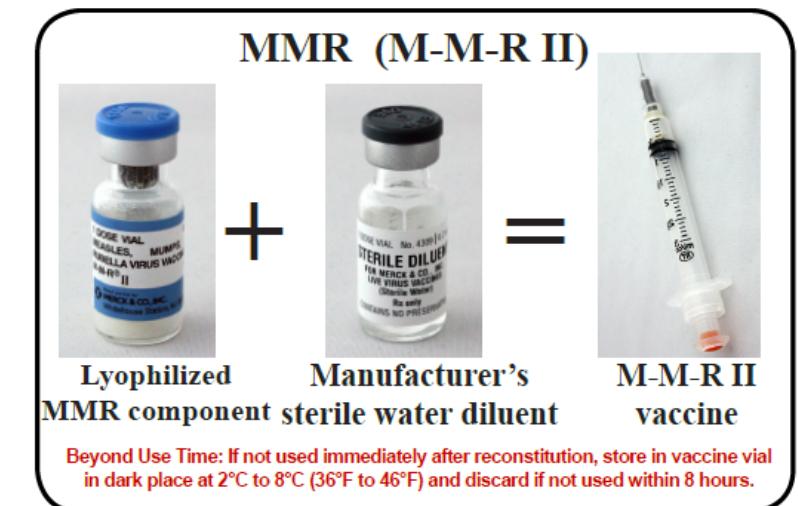
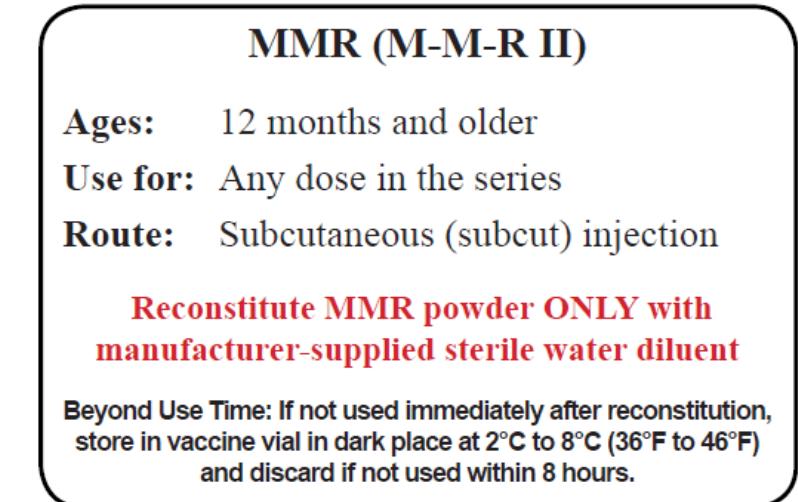
MMR Storage and Handling

- **Store in the refrigerator between 2°C and 8°C (36°F and 46°F)**
 - M-M-R II may also be stored in the freezer
 - Protect vaccine from light by keeping in the original packaging with the lid closed
- **Store diluent at room temperature or refrigerate**
- **Discard if not used within 8 hours after reconstitution**
 - Do not fill syringe with reconstituted vaccine until ready to administer



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 - Do not fill syringe with reconstituted vaccine until ready to administer

MMR (M-M-R II)

Ages: 12 months and older

Use for: Any dose in the series

Route: Subcutaneous (subcut) injection

Reconstitute MMR powder ONLY with manufacturer-supplied sterile water diluent

Beyond Use Time: If not used immediately after reconstitution, store in vaccine vial in dark place at 2°C to 8°C (36°F to 46°F) and discard if not used within 8 hours.

MMR (M-M-R II)



Lyophilized MMR component + Manufacturer's sterile water diluent = M-M-R II vaccine

Beyond Use Time: If not used immediately after reconstitution, store in vaccine vial in dark place at 2°C to 8°C (36°F to 46°F) and discard if not used within 8 hours.

MMR Storage and Handling

- Store in the refrigerator between 2°C and 8°C (36°F and 46°F)
 - M-M-R II may also be stored in the freezer
 - Protect vaccine from light by keeping in the original packaging with the lid closed
- Store diluent at room temperature or refrigerate
- Discard if not used within 8 hours after reconstitution
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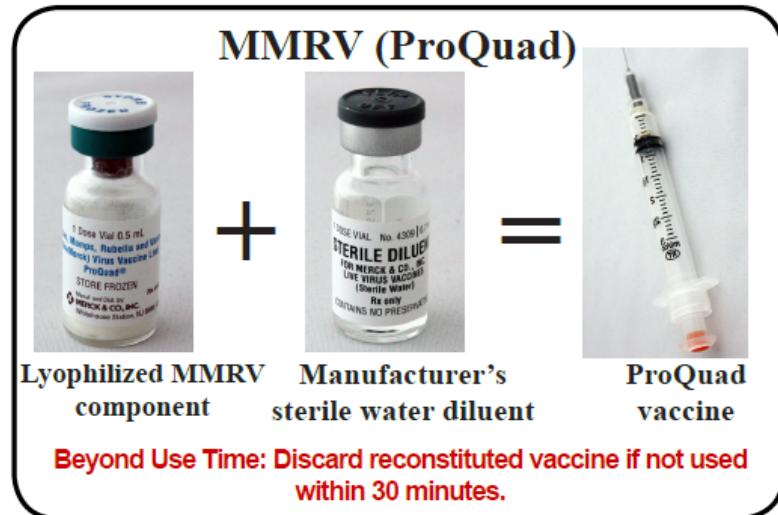
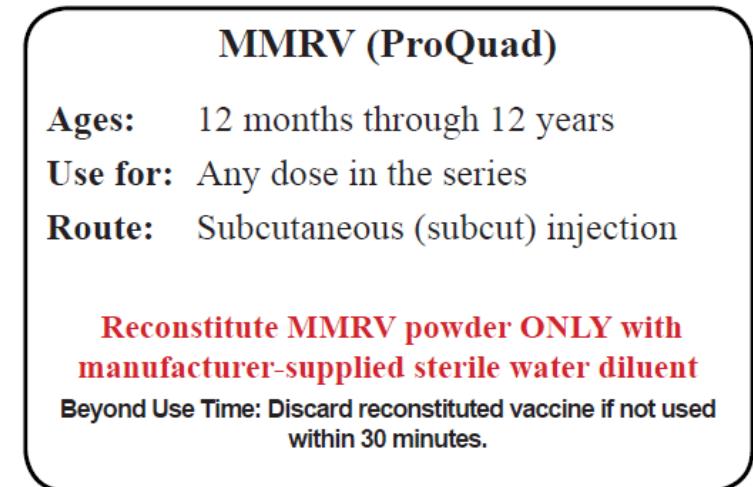


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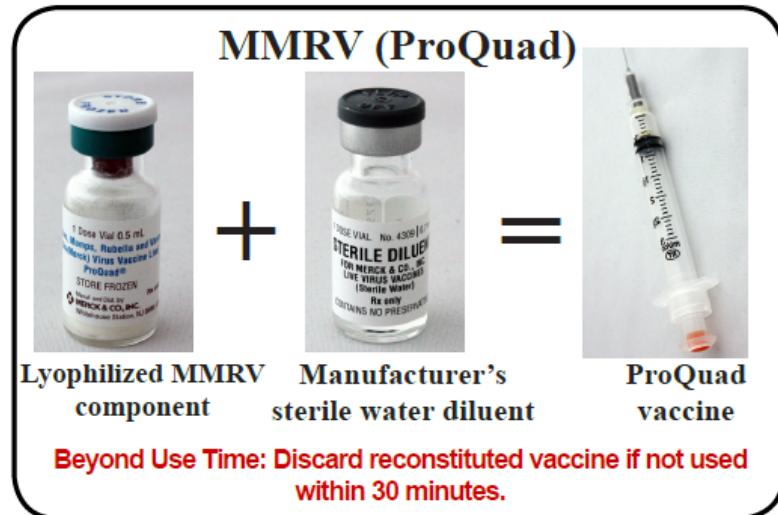
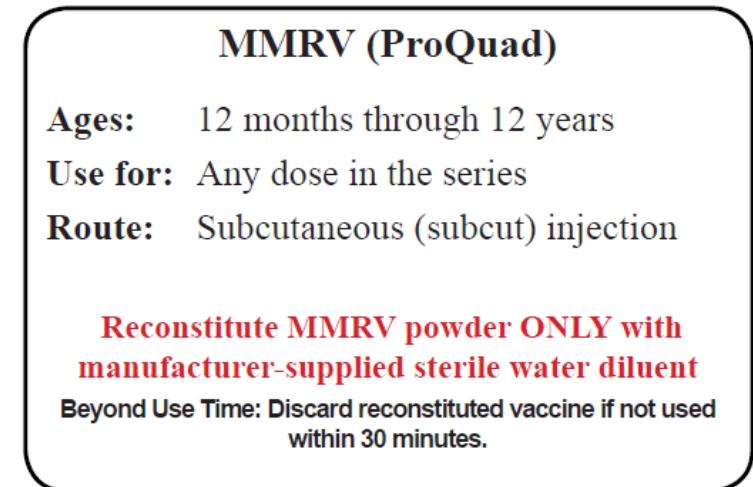
MMRV Storage and Handling

- **Store in the freezer between -50°C and -15°C (-58°F and +5°F)**
 - Do NOT use dry ice
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- **Store diluent at room temperature or refrigerate**
- **Use MMRV within 30 minutes of reconstitution or discard it**
 - Do not fill syringe with reconstituted vaccine until ready to administer
 - Do not freeze reconstituted vaccine



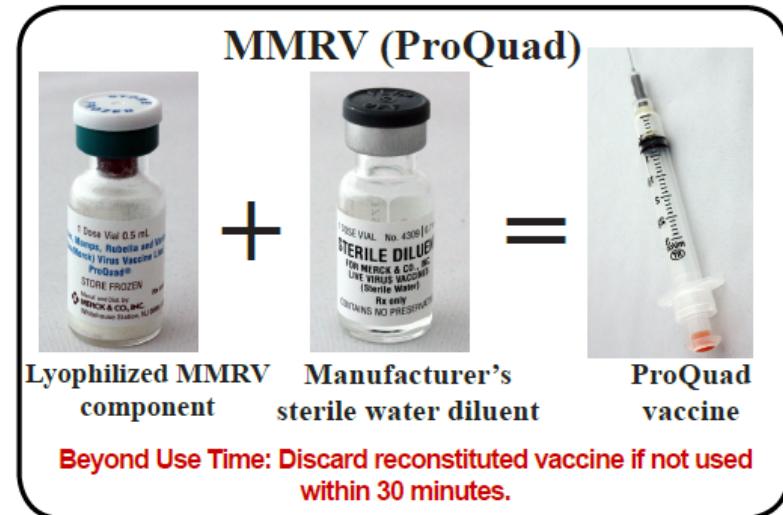
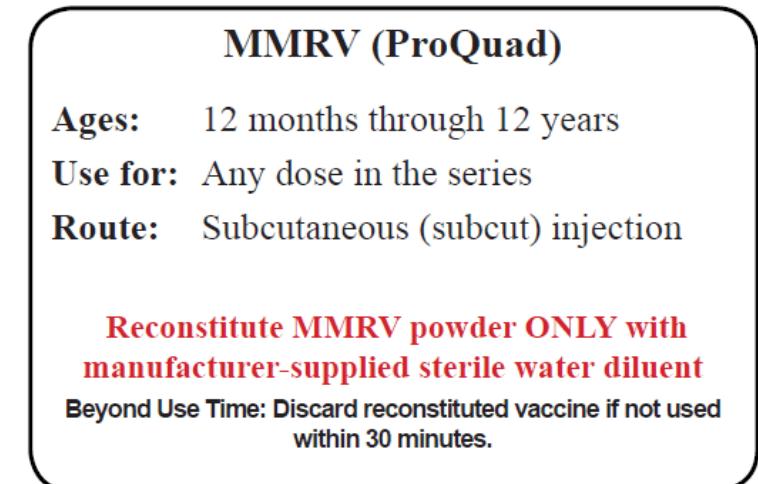
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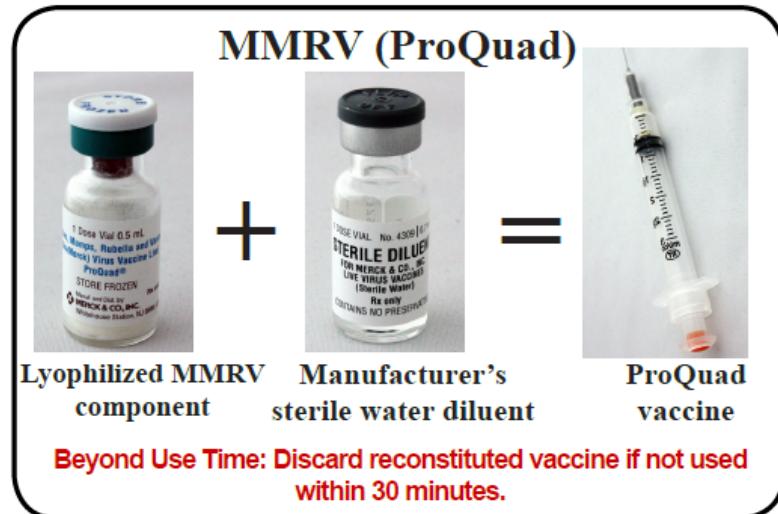
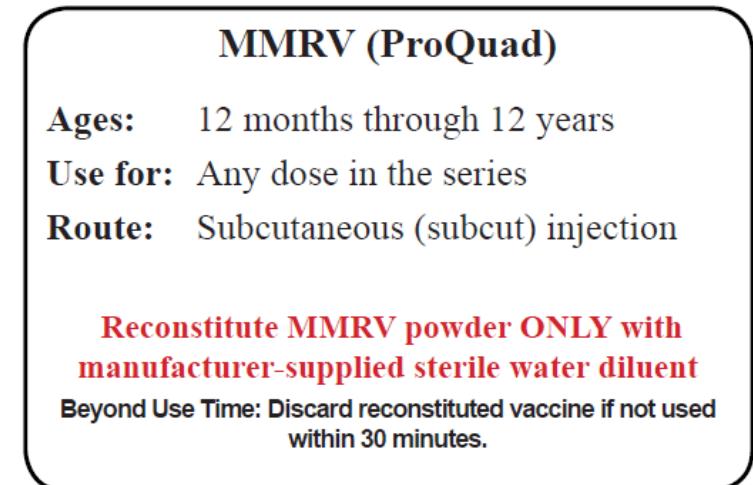
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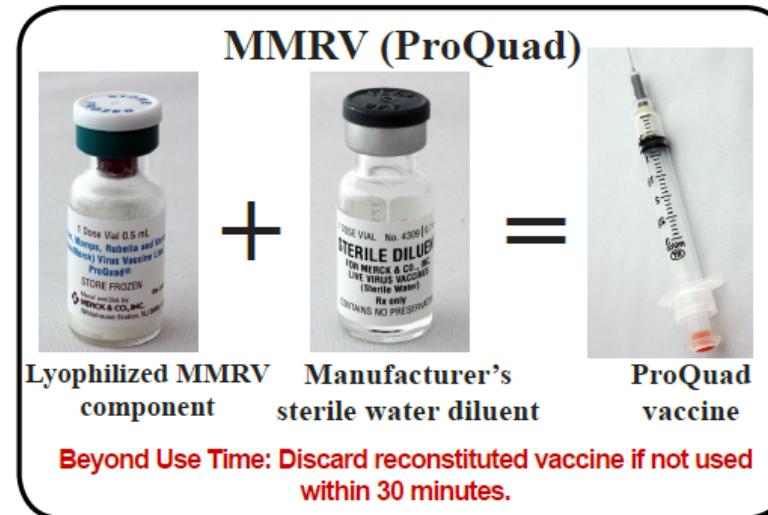
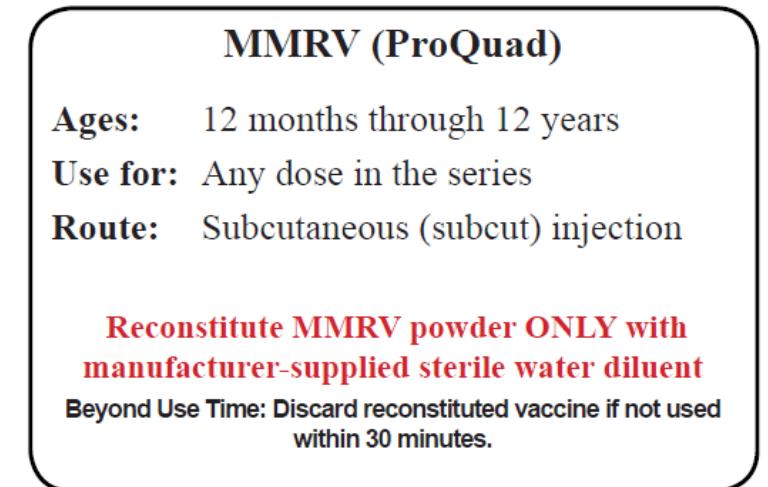
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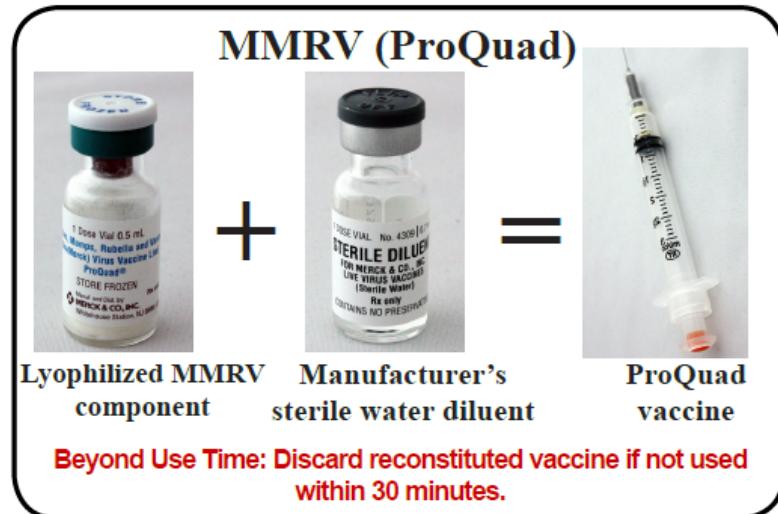
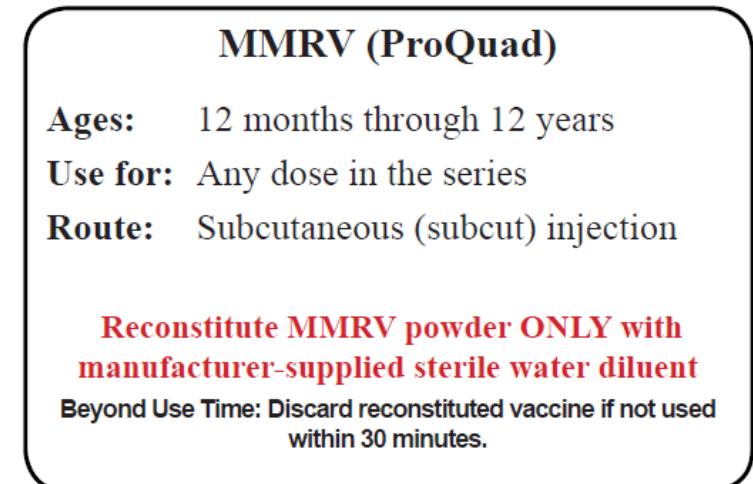
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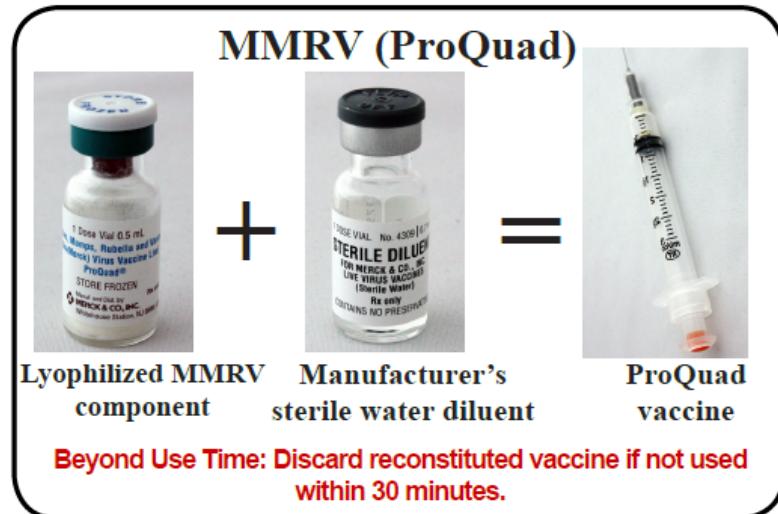
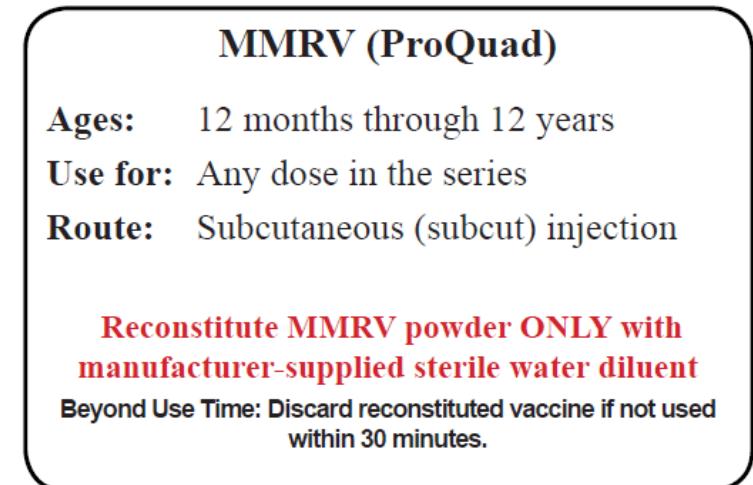
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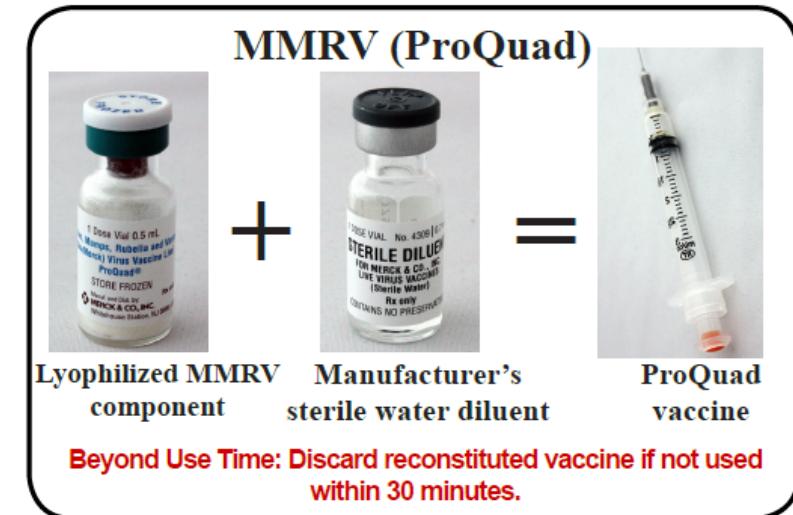
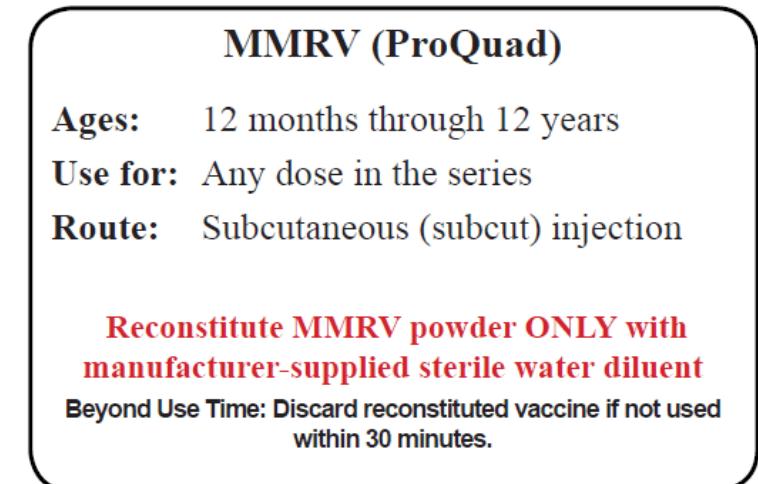
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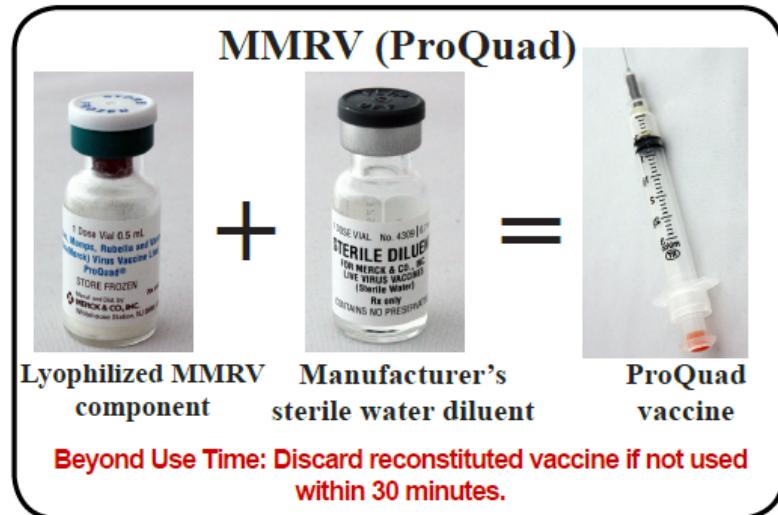
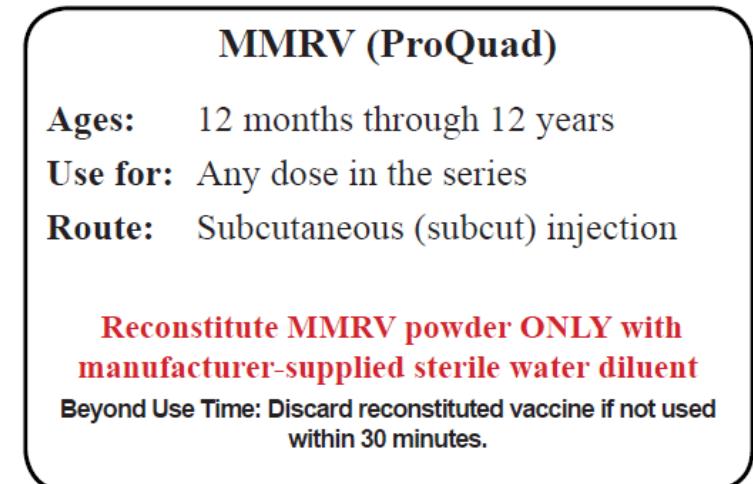
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Q&A

■ 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



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 - C. None



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