

Mumps is an acute viral illness. Parotitis and orchitis were described by Hippocrates in the 5th century BCE. In 1934, Claud Johnson and Ernest Goodpasture showed that mumps could be transmitted from infected patients to rhesus monkeys and demonstrated that mumps was caused by a filterable agent present in saliva. This agent was shown to be a virus in 1935. Mumps was one of the most common causes of aseptic meningitis and sensorineural hearing loss in childhood in the United States until the introduction of a vaccine in 1967. In 1971, mumps vaccine was licensed in the United States as a combined measles, mumps, and rubella (MMR) vaccine. In 2005, a combination measles, mumps, rubella, and varicella (MMRV) vaccine was licensed.

During World War I, only influenza and gonorrhea were more common than mumps as causes of hospitalization among soldiers. A successful 2-dose vaccination program in the United States led to a greater than 99% reduction in the number of mumps cases reported annually. However, starting in 2006, there has been an increase in mumps cases and outbreaks, particularly in close-contact settings, with many occurring among fully vaccinated persons.

Mumps Virus

Mumps virus is a paramyxovirus in the same group as parainfluenza and Newcastle disease viruses, which produce antibodies that cross-react with mumps virus. The virus has a single-stranded RNA genome.

The virus can be isolated or propagated in cultures of various human and monkey tissues and in embryonated eggs. It has been recovered from the saliva, cerebrospinal fluid, urine, blood, semen, breastmilk, and infected tissues of patients with mumps.

Mumps virus is rapidly inactivated by formalin, ether, chloroform, heat, and ultraviolet light.

Pathogenesis

The virus is acquired by respiratory droplet transmission. It replicates in the nasopharynx and regional lymph nodes. During viremia, the virus spreads to multiple tissues, including the meninges, salivary glands, pancreas, testes, and ovaries. Inflammation in infected tissues leads to characteristic symptoms of parotitis and other complications such as orchitis and aseptic meningitis.

Mumps

- Acute viral illness
- Parotitis and orchitis described by Hippocrates in 5th century BCE
- Viral etiology described by Johnson and Goodpasture in 1934
- Before vaccine, one of the most common causes of aseptic meningitis and hearing loss among children and hospitalization among military
- Vaccination led to over 99% reduction in mumps cases

Mumps Virus

- Paramyxovirus (RNA)
- Rapidly inactivated by chemical agents, heat, and ultraviolet light

Mumps Pathogenesis

- Respiratory transmission of virus
- Replication in nasopharynx and regional lymph nodes
- Multiple tissues infected during viremia

Mumps Clinical Features

- Incubation period usually 16 to 18 days (range, 12 to 25 days)
- Nonspecific prodrome of myalgia, malaise, headache, low-grade fever
- Typically presents as parotitis
- May presents with respiratory symptoms or be subclinical

Clinical Features

The incubation period of mumps is usually 16 to 18 days but can range from 12 to 25 days. The prodromal symptoms are nonspecific and include myalgia, anorexia, malaise, headache, and low-grade fever.

Mumps typically presents as parotitis (i.e., swelling of the parotid gland) or other salivary gland swelling lasting about 5 days. Parotitis may be unilateral or bilateral, and swelling of any combination of single or multiple salivary glands may be present. Parotitis may first be noted as earache and tenderness on palpation of the angle of the jaw. Emergence of contralateral or same side parotitis within weeks to months after apparent recovery has been described. Mumps infection may present only with nonspecific or primarily respiratory symptoms or may be a subclinical infection. Before the introduction of the mumps vaccine, approximately 15% to 24% of infections were asymptomatic. The frequency of asymptomatic infection in vaccinated persons is unknown, but mumps is generally milder among vaccinated persons.

Mumps virus is the only infectious agent known to cause epidemic parotitis. Cases of mumps reinfection have been reported.

Complications

Complications of mumps occur with or without parotitis or other salivary gland swelling and generally include orchitis, oophoritis, mastitis, pancreatitis, hearing loss, meningitis, and encephalitis. Nephritis, myocarditis and other sequelae, including paralysis, seizures, cranial nerve palsies, and hydrocephalus, in mumps patients have also been reported but are rare. Complications associated with mumps infection are usually more common among adults than children. Vaccinated persons are less likely to have mumps complications than unvaccinated persons.

Orchitis is the most common complication in post-pubertal males, occurring in approximately 30% of unvaccinated and 6% of vaccinated post-pubertal males. With mumps-associated orchitis, there is usually abrupt onset of testicular swelling, tenderness, nausea, vomiting, and fever. Pain and swelling may subside in 1 week, but tenderness may last for multiple weeks. About half of patients with mumps orchitis develop testicular atrophy of the affected testis. While there is a theoretical risk for sterility based on the pathogenesis of the disease, no study has demonstrated a risk for sterility in men with mumps orchitis compared to those without mumps orchitis.

In the prevaccine era, oophoritis and mastitis had been reported in 7% and 30%, respectively, of post-pubertal women with mumps. Among vaccinated post-pubertal women, oophoritis

Mumps Complications

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

and mastitis are reported in 1% or fewer of mumps patients. Oophoritis may mimic appendicitis. Among unvaccinated patients, clinical aseptic meningitis occurred in up to 10%, pancreatitis in up to 4%, and sensorineural hearing loss in up to 4%. Meningitis is usually mild. Hearing loss is usually transient but may be permanent.

In the postvaccine era, among all persons infected with mumps, reported rates of meningitis, encephalitis, pancreatitis, and hearing loss (either transient or permanent) have all been 1% or less.

Permanent sequelae and death are very rare in both vaccinated and unvaccinated patients.

Laboratory Testing

The diagnosis of mumps is usually suspected based on clinical presentation, in particular the presence of parotitis. However, if mumps is suspected, laboratory testing should be performed. Other infectious causes of parotitis that may also be tested as part of the differential diagnosis include Epstein-Barr virus, cytomegalovirus, parainfluenza virus types 1 and 3, influenza A virus (most commonly H3N2), enteroviruses, lymphocytic choriomeningitis virus, human immunodeficiency virus (HIV), and non-tuberculous mycobacterium.

Mumps is confirmed by reverse transcriptase-polymerase chain reaction (RT-PCR) or viral culture from buccal/oral or urine specimens. A negative RT-PCR or viral culture in a person with clinically compatible mumps symptoms does not rule out mumps as a diagnosis.

Acute mumps infection can be detected by the presence of serum mumps IgM. However, this test cannot be used to confirm a diagnosis of mumps. IgM response may be transient, delayed, or not detected. This may be because of previous contact with mumps virus either through vaccination or natural infection. A negative IgM in a person with clinically compatible mumps symptoms does not rule out mumps as a diagnosis. False negatives are common so results should be interpreted with caution. Collection of serum 3 to 10 days after parotitis onset improves the ability to detect IgM.

Acute mumps infection can also be detected by a significant rise in IgG antibody titer between acute and convalescent-phase serum specimens, also known as IgG seroconversion. However, this test cannot be used to confirm a diagnosis of mumps. False positive results can occur in both unvaccinated and vaccinated persons because assays may be affected by other diagnostic entities that cause parotitis. In addition, false negative results can occur in vaccinated and unvaccinated persons. By the onset of symptoms, in

Mumps Epidemiology

- Reservoir
 - Human
- Transmission
 - Infectious respiratory droplet secretions
 - Saliva
- Temporal pattern
 - No temporal pattern
- Communicability
 - 2 days before through 5 days after onset of parotitis

Mumps Secular Trends in the United States

- About 152,000 cases reported in 1968
- Rapid decrease in cases after introduction of vaccine, but resurgence in mid-1980s among persons age 10 through 19 years
- Measles occurrence among vaccinated school-aged children in the 1980s led to recommendations for a second dose
- After 2-dose recommendation was introduced, mumps cases steadily declined from 1989 until 2004
- Increase in mumps cases since 2006 with most cases in persons fully vaccinated

someone who is vaccinated or had previous infection, the acute-phase IgG may already be elevated, and therefore a 4-fold rise cannot be detected when compared to the convalescent-phase serum sample.

Laboratory testing can confirm the presence of mumps vaccine virus in a recently vaccinated and potentially exposed individual.

Epidemiology

Occurrence

Mumps occurs worldwide, with 500,000 cases reported on average annually.

Reservoir

Mumps is a human disease. Although persons with asymptomatic or nonclassical infection can transmit the virus, no carrier state is known to exist. No animal or insect reservoir exists.

Transmission

Mumps is spread through infectious respiratory droplet secretions and saliva.

Temporal Pattern

Mumps is reported throughout the year.

Communicability

Mumps contagiousness is similar to that of influenza and rubella but is less than that for measles or varicella. Although mumps virus has been isolated from 7 days before to 9 days after parotitis onset, the highest percentage of positive isolations and the highest virus loads occur closest to parotitis onset and decrease rapidly thereafter. Mumps is therefore most infectious, and most transmission likely occurs, in the several days before and after parotitis onset. Mumps is considered infectious from 2 days before through 5 days after onset of parotitis. Transmission also likely occurs from persons with asymptomatic infections and from persons with prodromal symptoms.

Secular Trends in the United States

Mumps became nationally notifiable in 1968 with about 152,000 cases reported. After the use of the mumps vaccine, cases began to decrease rapidly. By 1985, fewer than 3,000 cases were reported annually.

In the mid-1980s there was a relative resurgence of mumps with approximately 13,000 cases reported in 1987. The highest incidence of mumps during the resurgence was among older school-age and college-age youth (age 10 through 19 years), who were born before routine mumps vaccination was recommended. Several mumps outbreaks among highly vaccinated school populations were reported, indicating that high coverage with a single dose of mumps vaccine did not always prevent disease transmission.

After two doses of measles, mumps, and rubella vaccine were recommended in 1989 for school-age children for improved measles control, the number of reported mumps cases steadily declined, from approximately 5,700 cases in 1989 to fewer than 300 cases in 2004.

Since 2006, there has been an increase in the number of reported mumps cases. Most cases reported in 2006 and 2009–2010 were associated with a few large, localized outbreaks. However, since 2014, more than 1,000 mumps cases have been reported each year, and in 2019 nearly every state reported mumps cases. During January 2016 through June 2017, 150 outbreaks were reported in 37 states, accounting for more than 9,000 cases. Since 2006, most cases have been in persons who previously received 2 doses of MMR vaccine. Most outbreaks involved close-contact settings, such as households, schools, universities, athletics teams and facilities, church groups, workplaces, large parties, and other events.

Among children born during 2016–2017, 90.7% received measles, mumps, and rubella-containing vaccine by age 24 months; this was not statistically significantly different from the coverage of 90.3% for children born during 2014–2015.

Mumps Vaccines

The live, attenuated mumps vaccine (Jeryl Lynn strain) was licensed for use in the United States in 1967. Jeryl Lynn strain is the only mumps virus strain that has been used in mumps vaccines in the United States. In 1971, mumps vaccine was licensed as a combined measles, mumps, and rubella (MMR) vaccine. In 2005, a combination measles, mumps, rubella, and varicella (MMRV) vaccine was licensed.

Mumps vaccine is available as measles, mumps, and rubella vaccine (MMR [MMR-II]) and measles, mumps, rubella, and varicella vaccine (MMRV [ProQuad]). Both MMR and MMRV vaccine contain live, attenuated viruses. Single-antigen mumps vaccine is not available in the United States. The Advisory Committee on Immunization Practices (ACIP) recommends that MMR or MMRV vaccine be used when any of the individual components is indicated.

Mumps Vaccines

- MMR (MMR-II)
- MMRV (ProQuad)

Mumps Vaccine Characteristics

- Live, attenuated vaccine
- Available as lyophilized powder and reconstituted with sterile, preservative-free water
- Administered by subcutaneous injection
- Contains gelatin
- Contains neomycin

Mumps Vaccination Schedule

- 2 dose series at age 12 through 15 months and at age 4 through 6 years
- Minimum age for dose 1 is 12 months
- Minimum interval from dose 1 to 2 is 4 weeks for MMR and 3 months for MMRV (although a 4-week interval is valid)
- Discuss risks and benefits of MMRV versus separate MMR and VAR
 - Separate MMR and VAR vaccines preferred for dose 1 in ages 12 through 47 months
 - MMRV preferred for dose 2 and dose 1 at age 48 months or older

Characteristics

MMR vaccine is a lyophilized preparation of measles virus vaccine live, an attenuated line of measles virus, derived from Enders' attenuated Edmonston strain and propagated in chick embryo cell culture; mumps virus vaccine live, the Jeryl Lynn strain of mumps virus propagated in chick embryo cell culture; and rubella virus vaccine live, the Wistar RA 27/3 strain of live attenuated rubella virus propagated in WI-38 human diploid lung fibroblasts. MMRV vaccine contains measles, mumps, and rubella virus of equal titer and identical to those in the MMR vaccine. The titer of Oka varicella zoster virus is higher in MMRV vaccine than in single-antigen varicella vaccine, a minimum of 9,772 plaque-forming units (PFU) versus 1,350 PFU, respectively. MMR and MMRV vaccines are supplied as a lyophilized (freeze-dried) powder and are reconstituted with sterile, preservative-free water. Both vaccines contain gelatin. MMR and MMRV vaccines are administered by the subcutaneous route. Each dose of MMR and MMRV vaccine contains neomycin as an antibiotic. It contains no adjuvant or preservative.

Vaccination Schedule and Use

MMR vaccine or MMRV vaccine can be used to implement the vaccination recommendations for prevention of measles, mumps, and rubella. MMR vaccine is licensed for use in persons age 12 months or older. MMRV vaccine is licensed for use in persons age 12 months through 12 years; MMRV vaccine should not be administered to persons age 13 years or older.

Two doses of MMR vaccine, separated by at least 4 weeks, are routinely recommended for children age 12 months or older. Dose 1 of MMR vaccine should be given at age 12 through 15 months. A second dose of MMR vaccine is recommended based on previous observations of the failure of some to generate an immune response to measles following dose 1. Dose 2 is routinely given at age 4 through 6 years, before a child enters kindergarten or first grade. All students entering school should receive 2 doses of MMR vaccine (with the first dose administered at age 12 months or older) before enrollment. Dose 2 of MMR vaccine may be administered as soon as 4 weeks after dose 1.

The minimum interval between doses of MMRV vaccine is 3 months, although when dose 2 is administered 4 weeks following dose 1, it can be considered valid. For the first dose of measles, mumps, rubella, and varicella vaccines at age 12 through 47 months, either separate MMR and varicella (VAR) vaccines, or MMRV vaccine, may be used. However, the risk of febrile seizures is about twice as high for children receiving MMRV vaccine versus separate MMR and VAR vaccines. Providers who are considering administering MMRV should discuss the benefits and risks of both vaccination options with the parents.

Unless the parent or caregiver expresses a preference for MMRV, separate MMR vaccine and VAR vaccine should be administered for the first dose in this age group. For the second dose of measles, mumps, rubella, and varicella vaccines at any age and for the first dose at age 48 months or older, the use of MMRV generally is preferred over separate injections of its equivalent component vaccines (i.e., MMR vaccine and VAR vaccine).

Vaccination of Adults

Adults born in 1957 or later should receive at least 1 dose of MMR vaccine unless they have documentation of vaccination with at least 1 dose of measles, mumps, and rubella-containing vaccine or other acceptable presumptive evidence of immunity to these three diseases. Except for health care personnel, who should have documented immunity, birth before 1957 generally can be considered acceptable evidence of immunity to measles, mumps, and rubella.

Colleges and other post-high-school educational institutions are potential high-risk areas for measles, mumps, and rubella transmission because of large concentrations of persons. Prematriculation vaccination requirements for measles immunity have been shown to significantly decrease the risk of measles outbreaks on college campuses where such requirements are implemented and enforced. All students entering colleges, universities, technical and vocational schools, and other institutions for post-high-school education should receive 2 doses of MMR vaccine or have other acceptable evidence of measles, mumps, and rubella immunity before entry.

For unvaccinated health care personnel born before 1957 who lack laboratory evidence of measles, mumps, or rubella immunity or laboratory confirmation of disease, health care facilities should have policies that offer 2 doses of MMR vaccine at the appropriate interval for measles and mumps and 1 dose of MMR vaccine for rubella, respectively. Health care facilities should also have policies for such personnel that recommend 2 doses of MMR vaccine during an outbreak of measles or mumps and 1 dose during an outbreak of rubella. This recommendation is based on serologic studies indicating that among hospital personnel born before 1957, 5% to 10% had no detectable measles, mumps, or rubella antibody. Adequate vaccination for health care personnel born during or after 1957 consists of 2 appropriately spaced MMR doses for measles and mumps, and at least 1 dose of MMR for rubella.

Revaccination

Measles-, mumps-, or rubella- virus-containing vaccine administered prior to age 12 months (e.g., for international travel) should not be counted as part of the 2-dose series. Children vaccinated before age 12 months should be

MMR Vaccination of Adults

- Certain persons without acceptable presumptive immunity:
 - At least 1 dose MMR for unvaccinated adults
 - 2 doses MMR for students entering colleges, universities, technical and vocational schools, and other post-high-school educational institutions
 - 2 doses MMR for measles and mumps and at least 1 dose MMR for rubella for healthcare personnel
- Healthcare personnel during an outbreak
 - 2 doses MMR for measles or mumps outbreak and 1 dose MMR for rubella outbreak

Mumps Immunity

- Born before 1957
- Serologic evidence of mumps immunity (equivocal tests are considered negative)
 - Mumps IgG antibody does not necessarily predict protection; during an outbreak, close contacts of mumps patient(s) should not be tested for serologic evidence of immunity
- Laboratory confirmation of disease
- Documentation of adequate vaccination for mumps

Mumps Vaccine Efficacy

- Antibodies develop in approximately 94% of recipients of a single dose
- One dose produced 78% effectiveness and two doses 88% effectiveness

revaccinated with 2 doses of appropriately spaced MMR or MMRV vaccine, the first dose administered when the child is age 12 through 15 months (12 months if the child remains in an area where disease risk is high) and the second dose at least 4 weeks later.

Persons who experienced perinatal HIV infection who may have received MMR vaccine prior to the establishment of effective combined antiretroviral therapy (cART), should be revaccinated with 2 appropriately spaced doses of MMR (i.e., the dose does not count) unless they have other acceptable current evidence of immunity. MMR series should be administered once effective cART has been established for at least 6 months and there is no evidence of severe immunosuppression.

Vaccination during Mumps Outbreaks

During an outbreak, a third dose of MMR vaccine is recommended for groups determined by public health authorities to be at increased risk for acquiring mumps to improve protection against mumps disease and related complications. Public health authorities will communicate to providers which groups are at increased risk and should receive an MMR dose. Everyone who is determined to be part of the group at increased risk and does not have contraindications should receive a dose of MMR vaccine. This includes people who do not have vaccine records that prove they received two doses of MMR vaccine in the past, and people who have evidence of presumptive immunity. No additional dose is recommended for people who already received three or more doses before the outbreak.

Mumps Immunity

Generally, persons can be considered immune to mumps if they were born before 1957, have serologic evidence of mumps immunity (equivocal test results should be considered negative), or laboratory confirmation of disease, or have documentation of adequate vaccination for mumps.

Demonstration of mumps IgG antibody by any commonly used serologic assay is acceptable evidence of mumps immunity but does not necessarily predict protection against mumps disease. During an outbreak, close contacts of mumps patient(s) should not be tested for laboratory evidence of immunity since a positive IgG titer may indicate acute infection.

Immunogenicity and Vaccine Efficacy

Mumps vaccine produces an inapparent, or mild, noncommunicable infection. Approximately 94% of recipients of a single dose develop measurable mumps antibody. Seroconversion rates are similar for single antigen mumps

vaccine, MMR vaccine, and MMRV vaccine. Postlicensure studies determined that vaccine effectiveness of one dose of mumps or MMR vaccine was 78% and two dose mumps vaccine effectiveness is 88%.

Contraindications and Precautions to Vaccination

As with other vaccines, a history of a severe allergic reaction (anaphylaxis) to a vaccine component or following a prior dose is a contraindication to further doses. Moderate or severe acute illness (with or without fever) in a patient is considered a precaution to vaccination, although persons with minor illness may be vaccinated.

MMR and MMRV vaccines both contain minute amounts of neomycin and gelatin. Persons with alpha-gal allergy may wish to consult their physician before receiving a vaccine that contains gelatin.

Severe immunocompromise (e.g., from hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy or patients with HIV infection who are severely immunocompromised) is a contraindication for MMR and MMRV vaccination. If the person's level of immunocompetence is uncertain, the decision to vaccinate should be made by the health care provider that prescribed the immunosuppressive medication for those patients whom immunocompromise is due to medication. Patients who have not received chemotherapy for at least 3 months, whose disease remains in remission, and who have restored immunocompetence, may receive MMR or MMRV vaccine. Healthy, susceptible close contacts of severely immunocompromised persons should be vaccinated.

Persons receiving systemic high-dose corticosteroid therapy (2 milligrams per kilogram of body weight or more per day or 20 milligrams or more per day of prednisone) for 14 days or more should not receive MMR or MMRV vaccine because of concern about vaccine safety. MMR or MMRV should not be administered for at least 1 month after cessation of systemic high-dose corticosteroid therapy. Although persons receiving high doses of systemic corticosteroids daily or on alternate days for less than 14 days generally can receive MMR or MMRV immediately after cessation of treatment, some experts prefer waiting until 2 weeks after completion of therapy.

Available data indicate that vaccination with MMR has not been associated with severe or unusual adverse reactions in HIV-infected persons who are not severely immunosuppressed, although antibody responses have been variable. MMR vaccine is recommended for susceptible HIV-infected persons age 12 months or older with no evidence of current

Mumps Vaccine Contraindications and Precautions

- Contraindication
 - Severe allergic reaction to vaccine component or following a prior dose
 - Severe immunocompromise
 - Systemic high-dose corticosteroid therapy for 14 days or more
 - HIV infection, regardless of immunocompetence status*
 - Family history of congenital or heredity immunodeficiency in first-degree relatives
 - Pregnancy
- Precaution
 - Moderate or severe acute illness
 - Alpha-gal allergy (consult with physician)
 - Receipt of antibody-containing blood products (wait 3 to 11 months to vaccinate)
 - History of thrombocytopenic purpura or thrombocytopenia
 - Need for tuberculin skin testing or interferon-gamma release assay testing
 - Simultaneous use of aspirin or aspirin-containing products*
 - Personal or family history of seizures of any etiology*
 - Receipt of specific antiviral drugs 24 hours before vaccination*

*MMRV only

severe immunosuppression (“no evidence of current severe immunosuppression” is defined as CD4 percentages greater than or equal to 15% for 6 months or longer for persons age 5 years or younger; and CD4 percentages greater than or equal to 15% and CD4 count greater than or equal to 200 cells/mm³ for 6 months or longer for persons older than age 5 years). MMR vaccine is not recommended for HIV-infected persons with evidence of severe immunosuppression.

MMRV is not approved for and should not be administered to a person known to be infected with HIV.

A family history of congenital or hereditary immunodeficiency in first-degree relatives (e.g., parents and siblings) is a contraindication for MMR or MMRV vaccine unless the immune competence of the potential vaccine recipient has been substantiated clinically or verified by a laboratory.

A history of thrombocytopenic purpura or thrombocytopenia is a precaution for MMR and MMRV vaccine. Such persons may be at increased risk for developing clinically significant thrombocytopenia after MMR or MMRV vaccination.

Simultaneous use of aspirin or aspirin-containing products is a precaution for MMRV vaccine due to the varicella component. The manufacturer recommends that vaccine recipients avoid the use of salicylates for 6 weeks after receiving MMRV vaccine because of the association between aspirin use and Reye syndrome following chickenpox.

A personal or family (i.e., sibling or parent) history of seizures of any etiology is a precaution for MMRV vaccine but not MMR. Children with a personal or family history of seizures of any etiology should ideally be vaccinated with separate MMR and VAR vaccines because the risks for using MMRV vaccine in this group of children generally outweigh the benefits.

MMR vaccine may be administered to egg-allergic persons without prior routine skin testing or the use of special protocols.

Spacing Considerations

The effect of the administration of antibody-containing blood products (e.g., immune globulin, whole blood or packed red blood cells, or intravenous immune globulin) on the response to MMR or MMRV vaccine is unknown. Because of the potential inhibition of the response to vaccination by passively transferred antibodies, neither MMR vaccine nor MMRV vaccine (nor VAR vaccine) should be administered for 3 to 11 months after receipt of antibody-containing blood products. The interval between the antibody-containing blood product and receipt of MMR or MMRV vaccine is determined by the type of product administered. Antibody-containing products should not be given for 2 weeks following vaccination unless

the benefits exceed those of the vaccine. In such cases, vaccine recipients should either be revaccinated later at the appropriate intervals (ranging 3 to 11 months) or tested for immunity and revaccinated if seronegative.

Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing is a precaution for MMR and MMRV vaccine. Measles vaccine (and possibly mumps, rubella, and varicella vaccines) may transiently suppress the response to tuberculin skin test (TST) in a person infected with *Mycobacterium tuberculosis*. TST and measles-containing vaccine may be administered at the same visit if necessary. Simultaneously administering TST and measles-containing vaccine does not interfere with reading the TST result at 48 to 72 hours and ensures that the person has received measles vaccine. If the measles-containing vaccine has been administered recently, TST screening should be delayed for at least 4 weeks after vaccination.

Receipt of specific antiviral drugs (e.g., acyclovir, famciclovir, or valacyclovir) 24 hours before vaccination is a precaution for MMRV vaccine due to the varicella component. These drugs should be avoided for 14 days after vaccination.

Vaccination in Pregnancy

Pregnancy is a contraindication for MMR or MMRV vaccine. Pregnancy should be avoided for 4 weeks following MMR or MMRV vaccine. Close contact with a pregnant woman is not a contraindication to MMR or MMRV vaccination of the contact.

If a pregnant woman inadvertently receives MMR or MMRV vaccine, termination of pregnancy is not recommended because the risk to the fetus appears to be extremely low. Instead, individual counseling for these women is recommended.

Vaccine Safety

Studies have shown MMR and MMRV vaccines are safe and well-tolerated. The National Academy of Medicine, formerly called the Institute of Medicine, reviewed the evidence between MMR vaccination and certain adverse events. The experts determined that evidence supports a causal relation between MMR vaccination and anaphylaxis, febrile seizures, thrombocytopenic purpura, transient arthralgia, and measles inclusion body encephalitis in persons with demonstrated immunodeficiencies.

Most adverse events reported following MMR vaccination (such as fever and rash) are attributable to the measles component. After MMR vaccination, 5% to 15% of susceptible persons develop a temperature of 103°F (39.4°C) or higher, usually occurring 7 to 12 days after vaccination and generally lasting 1 or 2 days. Most persons with fever do not have other symptoms. MMR vaccine is associated with a very small risk

Mumps Vaccine Safety

MMR

- Fever of 103°F (39.4°C) or higher
 - 5%–15%
- Rash
 - 5%
- Febrile seizures
 - 1 in every 3,000 to 4,000 doses
- Anaphylactic reactions
 - 1.8 to 14.4 cases per million doses
- Arthralgias and other joint symptoms
 - 25% (adult women)

MMRV

- Fever of 102°F or higher
 - 21.5%
- Febrile seizures
 - 1 additional per 2,300 to 2,600 children age 12 through 23 months

of febrile seizures; approximately one case for every 3,000 to 4,000 doses of MMR vaccine administered. The febrile seizures typically occur 6 to 14 days after vaccination and do not appear to be associated with any long-term sequelae. Children with a personal or family history of febrile seizures or family history of epilepsy might be at increased risk for febrile seizures after MMR vaccination.

MMR vaccine may cause a transient rash in approximately 5% of vaccine recipients, usually appearing 7 to 10 days after vaccination. Laboratory testing can confirm the presence of measles or mumps vaccine virus in a recently vaccinated and potentially exposed individual.

Allergic reactions following the administration of MMR vaccine are rare. Most of these are minor and consist of a wheal and flare or urticaria at the injection site. Immediate, anaphylactic reactions to MMR vaccine occur in 1.8 to 14.4 cases per million doses.

Arthralgias and other joint symptoms are reported in up to 25% of adult women following MMR vaccination and are associated with the rubella component. Transient lymphadenopathy sometimes occurs following receipt of MMR or other rubella-containing vaccine, and parotitis has been reported rarely (less than 1%) following receipt of MMR or other mumps-containing vaccine.

Rarely, MMR vaccine may cause thrombocytopenia within two months after vaccination. The clinical course of these cases is usually transient and benign, although hemorrhage occurs rarely. Based on case reports, the risk for MMR vaccine-associated thrombocytopenia may be higher for persons who have previously had immune thrombocytopenic purpura, particularly for those who had thrombocytopenic purpura after an earlier dose of MMR vaccine.

Measles inclusion body encephalitis has been documented after measles vaccination in persons with immune deficiencies. The illness is also known to occur within 1 year after initial infection with wild-type measles virus and has a high death rate. In the cases after MMR vaccination, the time from vaccination to development of measles inclusion body encephalitis was 4–9 months, consistent with development of measles inclusion body encephalitis after infection with wild-type measles virus.

In MMRV vaccine prelicensure studies conducted among children age 12 to 23 months, fever (reported as abnormal or elevated greater than or equal to 102°F oral equivalent) was observed 5 to 12 days after vaccination in 21.5% of MMRV vaccine recipients compared with 14.9% of MMR vaccine and VAR vaccine recipients. Two postlicensure studies indicated that one additional febrile seizure per 2,300 to 2,600 children age 12 through 23 months occurred 5 to 12 days after the first dose of

