Measles, Mumps, and Rubella Virus Vaccine Live

AHFS Class: 80:12 — Vaccines (tofc-80)

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Alert:

On January 5, 2026, the US Department of Health and Human Services (HHS) announced the approval of a revised US childhood and adolescent immunization schedule (https://www.cdc.gov/vaccines/hcp/imz-schedules/child-adolescent-age.html (https://www.cdc.gov/vaccines/hcp/imz-schedules/child-adolescent-age.html)). Under the revised recommendations, CDC continues to organize the childhood immunization schedule in three distinct categories (Immunizations Recommended for All Children, Immunizations Recommended for Certain High-Risk Groups or Populations, and Immunizations Based on Shared Clinical Decision-Making) but changes individual vaccine placement within those categories. For additional information, see https://www.hhs.gov/press-room/cdc-acts-presidential-memorandum-update-childhood-immunization-schedule.html (https://www.hhs.gov/press-room/cdc-acts-presidential-memorandum-update-childhood-immunization-schedule.html) .

Introduction

Measles, mumps, and rubella virus vaccine live (MMR) is a fixed-combination preparation containing live attenuated measles, mumps, and rubella viruses.[108,185,194,]

Uses

▪ Prevention of Measles, Mumps, and Rubella Infection

Measles, mumps, and rubella virus vaccine live (MMR) is used to stimulate active immunity to measles, mumps, and rubella infection in adults and pediatric patients 12 months of age or older.[108,190,] There are currently 2 preparations of the MMR vaccine in the US (M-M-R® II and Priorix®).[108,185,190,] The 3 live attenuated viruses contained in both vaccines are genetically similar or identical, and studies have shown similar seroresponse rates and geometric mean antibody concentrations to the measles, mumps, and rubella viruses after the first and second doses of the vaccines; therefore the 2 preparations are considered interchangeable.[99,185,190,] A fixed combination vaccine is also available containing measles, mumps, rubella, and varicella virus vaccine live (MMRV) for use when primary immunization with MMR and varicella vaccine is indicated in pediatric patients 12 months through 12 years of age.[99,194,] Previous monovalent vaccines for the measles virus (Attenuvax®), mumps virus (Mumpsvax®), and rubella virus (Meruvax® II) are no longer commercially available in the US.[109,110,111,]

Measles, mumps, and rubella are viral infections that can cause potentially serious complications and death.[105,203,] Measles is highly contagious and can cause symptoms such as otitis media, pneumonia, and diarrhea, with pneumonia being the most fatal complication.[203,] Rubella (sometimes called "German measles") is an acute viral disease that mostly affects school-aged children and young adults; serious complications of rubella infection can also occur in pregnant women, including miscarriage, fetal death, or congenital rubella syndrome.[115,118,203,] Mumps mostly affects children and can cause orchitis or more serious complications such as aseptic meningitis and deafness.[112,203,] The most effective method of protecting against measles, mumps, and rubella is immunization with the MMR vaccine (or MMRV vaccine in pediatric patients up to 12 years of age).[99,105,112,115,] Most people who are vaccinated with MMR or MMRV generally will be protected for life against measles and rubella; however, immunity against mumps may decrease over time.[99,]

During the late 1980s and early 1990s, the incidence of measles in the US increased because of low immunization rates in preschool children, particularly in urban areas, and primary vaccine failure (i.e., lack of response to the vaccine) in children who received only 1 dose of the vaccine.[105,116,124,145,196,] Implementation of vaccination programs and the addition of a routine second dose of the MMR vaccine for primary vaccination improved vaccine coverage in preschool children and subsequently decreased the incidence of measles to extremely low levels (less than 1 case per 1 million population) in the US to the point where endemic measles was declared eliminated in 2000.[99,105,106,124,] Following vaccination with 1 dose of MMR, the vaccine is approximately 93% effective against measles, 72% effective against mumps, and 97% effective against rubella; following 2 doses of MMR, the vaccine is 97% effective against measles and 86% effective against mumps.[99,] In recent years, increasing cases and outbreaks of measles have occurred in many states, the majority of which have been associated with importation of measles by nonvaccinated international travelers to the US from countries where measles is endemic and also with the spread of infection in communities with low measles vaccination rates.[124,106,]

Although mumps is a common disease in many countries, mumps cases in the US have decreased by more than 99% following implementation of a mumps vaccine program in 1967.[112,] Rubella disease is no longer endemic in the US, but is common in other parts of the world and can be imported into the US by people who become infected in other countries.[118,]

Primary Vaccination

The CDC's Advisory Committee on Immunization Practices (ACIP) and other organizationss (e.g., American Academy of Pediatrics [AAP]) provide recommendations for the prevention of measles, mumps, and rubella infection.[99,100,101,102,112,115,124,] Primary vaccination with a 2-dose series of MMR is recommended in all persons ≥12 months of age; the first dose should be administered at 12–15 months of age and the second dose at 4–6 years of age.[99,102,104,105,] ACIP states that use of the fixed-combination vaccine containing measles, mumps, and rubella virus vaccine live (MMR) and varicella virus vaccine live (MMRV; ProQuad®) is not recommended for

individuals 12–47 months of age or 13–18 years of age, and to administer the MMR and varicella vaccines separately for these age groups.[102,] AAP expresses no preference for use of the MMRV fixed-combination vaccine or use of the MMR and varicella vaccines separately for toddlers receiving their first immunization of this kind; patients should be counseled about the rare possibility of their child developing a febrile seizure 1–2 weeks after immunization with MMRV for the first immunizing dose.[310,] For the second dose given between 4–6 years of age, AAP states that use of the fixed-combination vaccine MMRV is generally preferred over the separate MMR and varicella vaccines to minimize the number of injections.[310,]

Vaccination with MMR is also recommended in older children, adolescents, and adults if they do not have evidence of immunity.[99,100,] Acceptable evidence of immunity includes at least one of the following: 1) written documentation of adequate vaccination, 2) laboratory evidence of immunity, 3) laboratory confirmation of disease, or 4) birth before 1957.[99,] Most individuals born before 1957 are likely to have been infected naturally with measles and generally can be considered immune; however, ACIP recommends that healthcare personnel born before 1957 without laboratory evidence of immunity or disease should consider receiving 2 doses of the MMR vaccine.[99,]

For catch-up vaccination in unvaccinated children and adolescents, ACIP recommends a 2-dose series with the MMR vaccine administered at least 4 weeks apart; the fixed-combination MMRV vaccine is not recommended for individuals 12–47 months of age or 13–18 years of age..[102,124,]

In adults 19 years of age or older who do not have evidence of immunity to measles, mumps, or rubella, 1 dose of MMR vaccine should be given.[100,] Adults at high risk for exposure and transmission such as students in postsecondary educational institutions, international travelers, and household or close personal contacts of immunocompromised persons who do not have evidence of immunity to measles, mumps, or rubella should complete a 2-dose series with MMR vaccine at least 4 weeks apart if they did not previously receive any doses of MMR; for those who previously received 1 dose of MMR, a second dose should be given to complete the series.[100,105,]

In healthcare professionals born before 1957 with no evidence of immunity to measles, mumps, or rubella, ACIP states to consider a 2-dose series of MMR vaccine at least 4 weeks apart for protection against measles or mumps, or 1 dose for protection against rubella.[100,] For healthcare professionals born in 1957 or later, a 2-dose MMR series should be completed at least 4 weeks apart for protection against measles or mumps, or at least 1 dose should be given for protection against rubella.[100,]

The MMR vaccine is contraindicated during pregnancy; however, 1 dose of the vaccine is recommended after pregnancy (before discharge from the healthcare facility) in individuals who do not have evidence of immunity to rubella.[100,]

Individuals with human immunodeficiency virus (HIV) infection are at increased risk for severe complications if infected with measles.[108,170,171,207,] Vaccination with MMR (2-dose series at least 4 weeks apart) is recommended in HIV-infected children, adolescents, or adults who do not have evidence of immunity to measles, mumps, or rubella and who do not have *severe* immunosuppression; the vaccine is contraindicated in individuals who are immunodeficient or immunosuppressed due to disease or medical therapy.[100,108,124,207,] Severe immunosuppression has been defined as a CD4+ T-lymphocyte percentage <15% in individuals ≤5 years of age, and a CD4+ T-lymphocyte percentage <15% or a CD4+ T-lymphocyte count <200 lymphocytes/mm^3 in individuals >5 years of age.[124,]

Because an increasing proportion of measles cases in the US results from exposure to the disease in foreign countries, ACIP recommends that all international travelers ≥12 months of age should have documented receipt of 2 appropriately spaced doses of MMR vaccine, and**infants 6–11 months of age [off-label]**† should receive 1 dose of the vaccine prior to travel.[106,]

Both the MMR and MMRV vaccines may be administered at the same time, at different anatomic sites, as other routine childhood vaccines.[99,104,105,185,] In general, simultaneous administration (on the same day) of the most widely used vaccines, including diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed (DTaP), hepatitis B vaccine, haemophilus b (Hib) conjugate vaccine, MMR vaccine, poliovirus vaccine, and varicella virus vaccine live, has resulted in seroconversion rates and adverse effects similar to those observed when the vaccines were administered separately.[103,107,] Additional live virus vaccines that are not administered on the same day should be separated by at least 4 weeks.[185,]

Postexposure Prophylaxis

MMR vaccine has been used for postexposure prophylaxis in individuals who do not have evidence of immunity.[99,124,207,] Available data suggest that administration of MMR vaccine within 72 hours of exposure to the measles virus will provide protection or lessen disease severity and may also prevent later disease.[99,124,196,] There is no harm in receiving another dose of MMR vaccine if an individual is already immune to measles, mumps, or rubella.[99,] Postexposure prophylaxis is only indicated in exposed individuals who do not have documented immunity.[124,] For such individuals 12 months of age or older who are exposed to measles, a dose of MMR vaccine may be indicated depending on the time after initial exposure.[124,207,] The use of a measles virus-containing vaccine (MMR) within 72 hours of exposure is generally recommended and immunoglobulin is principally indicated when the vaccine is contraindicated or more than 72 hours since initial exposure has elapsed.[124,] The American Academy of Pediatrics (AAP) recommends that individuals who are severely immunocompromised who are exposed to measles should receive IV immune globulin (IGIV) prophylaxis (400 mg/kg) after exposure, regardless of their vaccination status.[124,]

MMR vaccine is not effective for postexposure prophylaxis of rubella; however, vaccination after exposure is not harmful and may possibly prevent later disease if re-exposed.[111,]

Outbreak Control

If a measles outbreak occurs in child-care facilities, schools, colleges, and other institutions of higher education, AAP recommends that all exposed individuals including students (and their siblings) and all school personnel born in 1957 or later be vaccinated against measles, unless they can provide documentation of immunity (i.e., previous vaccination with 2 doses of a measles virus-containing vaccine at 12 months of age or older or other evidence of immunity).[124,] AAP states that immunization is the intervention of choice for control of measles outbreaks in schools and daycare centers and has been used in **children as young as 6 months of age [off-label]**† in previous measles epidemics in the US.[124,] Individuals who are revaccinated and unvaccinated individuals receiving their first dose of MMR vaccine as part of the outbreak control program may be immediately readmitted to school.[124,] If an outbreak occurs in a hospital or area served by the hospital, all employees and volunteers who cannot provide evidence of immunity to measles should receive 2 doses of the MMR vaccine and should not have direct patient contact starting on the 5th day after the first exposure to 21 days after the last exposure, regardless of whether they have received vaccine or immune globulin after the exposure.[124,] Individuals who have been

exempted from measles immunization for medical, religious, or other reasons should be excluded from the outbreak area until at least 21 days after the onset of rash in the last case of measles.[124] During measles outbreaks, AAP states that children as young as 6 months of age also should be vaccinated if exposure to natural measles is considered likely.[124]

An additional dose of MMR vaccine may be recommended during a mumps outbreak.[99,101] Outbreaks of mumps primarily have occurred in institutional settings with close contact or in close-knit communities; waning of vaccine immunity over time after receipt of the second dose of MMR vaccine can also contribute to an increased risk of mumps in this setting.[101] ACIP recommends that persons previously vaccinated with 2 doses of a mumps-containing vaccine who are identified by public health authorities as being part of a group or population at increased risk of acquiring mumps during an outbreak should receive a third dose of a mumps virus-containing vaccine.[101] Public health authorities will notify individuals at increased risk who are candidates for this additional dose.[99]

Dosage and Administration

▪ General

Dispensing and Administration Precautions

Appropriate medical treatment used to manage immediate allergic reactions must be available in the event an acute anaphylactic reaction occurs following administration of measles, mumps, and rubella virus vaccine live (MMR).[190]

▪ Administration

Fixed-combination vaccines containing measles, mumps, and rubella vaccine live (MMR) are administered by IM injection or subcutaneous injection depending on the preparation.[108,190] There are currently 2 preparations of the MMR vaccine in the US (M-M-R® II and Priorix®).[108,185,190] A fixed-combination vaccine preparation containing measles, mumps, rubella, and varicella vaccine live (ProQuad®) is also commercially available for use when such vaccines are indicated in children 12 months through 12 years of age; consult the prescribing information for ProQuad® for additional details.[194]

MMR vaccines are supplied as single-dose vials of lyophilized antigen component that must be reconstituted with the accompanying sterile diluent (supplied in a vial or prefilled syringe) prior to administration.[108,190] If the diluent is supplied in a vial, withdraw the entire volume of diluent from the vial and inject into the lyophilized vaccine vial.[108] If the diluent is supplied as a prefilled syringe, transfer the entire contents of the prefilled syringe into the vial containing the lyophilized antigen component.[108,190] A single dose of MMR vaccine after reconstitution is approximately 0.5 mL.[108,190] See the manufacturer's prescribing information for additional details on preparation of individual vaccine preparations.[108,190] After reconstitution, withdraw and administer the entire volume immediately.[108,190]

M-M-R II

The fixed-combination measles, mumps, and rubella vaccine labeled as M-M-R® II is administered by IM or subcutaneous injection.[108]

Store the lyophilized antigen component at -50 to 8°C prior to use.[108] Before reconstitution, store the vaccine at 2–8°C.[108] Store the supplied diluent in the refrigerator (2–8°C) or at room temperature (20–25°C); do not freeze.[108]

Administer immediately after reconstitution.[108] If not administered immediately, may store the reconstituted vaccine at 2–8°C for up to 8 hours; protect from light.[108]

Priorix

The fixed-combination measles, mumps, and rubella vaccine labeled as Priorix® is administered by subcutaneous injection only.[190]

Store the lyophilized antigen component at 2–8°C; protect from light.[190] Store the supplied diluent syringes in the refrigerator (2–8°C) or at room temperature (up to 25°C).[190] Do not freeze the lyophilized antigen component or sterile water diluent.[190]

Administer immediately after reconstitution.[190] If not administered immediately, may store the reconstituted vaccine at 2–8°C for up to 8 hours; do not freeze.[190]

▪ Dosage

Prevention of Measles, Mumps, and Rubella Infection (Primary Vaccination)

A single dose of measles, mumps, and rubella virus vaccine live (MMR) is approximately 0.5 mL.[108,190]

Infants and Children 12 Months through 6 Years of Age.

For primary immunization in infants and children, a 2-dose regimen of MMR vaccine is recommended.[99,102,105,108] For routine childhood immunization, the first dose of MMR should be administered at 12–15 months of age and the second dose should be administered at 4 to 6 years of age.[99,102,105,108] The second dose may be given earlier during any routine visit, provided there is a minimum interval of 1 month between the first and second doses.[102,108] Alternatively, a 2-dose series with the fixed combination vaccine containing measles, mumps, rubella, and varicella vaccine live (MMRV) may be used in children 12 months through 6 years of age.[194] ACIP states that use of MMRV is not recommended for individuals 12–47 months of age.[102] (See Primary Vaccination under Uses.)

Children who received an initial dose of MMR prior to their first birthday should receive additional doses of the vaccine at 12–15 months of age and at 4–6 years of age to complete the vaccination series.[108]

Children and Adolescents 7 through 18 Years of Age.

A 2-dose primary series of MMR is recommended in previously unvaccinated children and adolescents 7 through 18 years of age who do not have evidence of immunity.[99] The first and second doses should be administered at least 4 weeks apart; alternatively, a 2-dose series with MMRV may be administered (in children through 12 years of age) with a minimum interval between doses of 3 months.[102,124] ACIP states that use of the fixed combination MMRV vaccine is not recommended for

individuals 13–18 years of age.[102,] (See Primary Vaccination under Uses.)

Adults.

For previously unvaccinated adults 19 years of age and older, primary immunization consists of 1 or 2 doses of MMR vaccine.[100,105,]

In adults who do not have evidence of immunity to measles, mumps, or rubella and are not considered to be a high risk of exposure and transmission, 1 dose of MMR should be given.[100,]

In adults at high risk for exposure and transmission (e.g., students in postsecondary educational institutions, international travelers, healthcare professionals, household or close personal contacts of immunocompromised persons) who do not have evidence of immunity to measles, mumps, or rubella, a 2-dose series with MMR is recommended if they did not previously receive any doses of MMR; for those who previously received 1 dose of MMR, a second dose should be given to complete the series.[100,105,] The minimum interval between doses is 4 weeks.[100,105,]

Most adults born before 1957 are likely to have been infected naturally with measles and generally can be considered immune; however, ACIP recommends that healthcare personnel born before 1957 without laboratory evidence of immunity or disease should consider receiving 2 doses of the MMR vaccine.[99,]

Postexposure Prophylaxis Against Measles

When used for postexposure prophylaxis of measles in individuals 12 months of age or older, a single dose of MMR should be given within 72 hours of exposure.[108,]

When protection against measles is considered necessary for postexposure prophylaxis in **infants 6 through 11 months of age [off-label]**†, who are considered too young to receive routine primary immunization, AAP recommends that a single 0.5-mL dose of MMR be given.[124,]

Outbreak Control

Additional 1 or 2 doses may be necessary during an outbreak situation depending on evidence of immunity.[99,101,124,]

When protection against measles is considered necessary for outbreak control in **infants 6 through 11 months of age [off-label]**† who are considered too young to receive routine primary immunization, a single 0.5-mL dose of MMR should be given.[124,]

▪ Special Populations

Hepatic Impairment

The manufacturers make no specific dosage recommendations for patients with hepatic impairment.[108,190,]

Renal Impairment

The manufacturers make no specific dosage recommendations for patients with renal impairment.[108,190,]

Geriatric Patients

The manufacturers make no specific dosage recommendations for geriatric patients.[108,190,]

Cautions

▪ Contraindications

Individuals with a history of hypersensitivity to any component of the MMR vaccine (including gelatin) or after a previous dose of any measles, mumps, and rubella virus-containing vaccine.[108,190,194,]

Individuals with a history of anaphylaxis to neomycin.[108,194,]

Individuals who are immunodeficient or immunosuppressed due to disease or medical therapy.[108,190,194,] Disseminated measles, mumps, and rubella virus infection have been reported in such individuals.[108,190,194,]

Individuals with an active febrile illness with fever (>38.5°C).[108,194,]

Individuals with active untreated tuberculosis.[108,194,]

Individuals who are pregnant or who are planning on becoming pregnant within the next month.[108,190,194,]

▪ Warnings/Precautions

Febrile Seizures

Febrile seizures have occurred rarely in children following administration of measles-containing virus vaccines.[108,109,114,144,170,190,] Children with a personal or family (i.e., in first-degree family members [siblings or parents]) history of seizures may be at increased risk of seizures following vaccination.[108,114,124,170,]

There is some evidence suggesting higher rates of fever and febrile seizures 5 to 12 days after administration of the first dose of the fixed-combination vaccine containing measles, mumps, rubella, and varicella virus live (ProQuad®) in children 12 to 23 months of age who have not been previously vaccinated against measles, mumps, rubella, or varicella, or do not have a history of wild-type infections compared to children vaccinated with a first dose of MMR and monovalent varicella vaccine live as separate injections.[104,194,] Exercise caution when administering ProQuad® to persons with an individual or family history of febrile seizures.[104,194,]

Prior to vaccination, parents and guardians of children with a personal or family history of seizures should be advised of the risk of seizures after measles immunization.[124] Children receiving anticonvulsants should continue such therapy after vaccination.[124]

Hypersensitivity

Allergic or immediate hypersensitivity reactions (e.g., urticaria, angioedema, anaphylaxis) have been reported rarely following vaccination with MMR.[108,190] MMR should not be administered to individuals who have had a severe allergic reaction to a previous dose of measles-containing vaccine or to any vaccine component.[124] Appropriate medical treatment used to manage immediate allergic reactions must be available in the event an acute anaphylactic reaction occurs following administration of MMR.[190]

Egg Hypersensitivity.

MMR is produced in chick embryo cell culture;[108,124] individuals with a history of anaphylactic, anaphylactoid, or other immediate reaction (e.g., hives, swelling of the mouth or throat, difficulty breathing, hypotension, shock) to egg ingestion may be at increased risk of immediate-type hypersensitivity reactions after receiving vaccines containing traces of chick embryo antigen.[108,194] The manufacturer states that the potential benefits and risks should be carefully evaluated before considering administration of MMR to individuals with a history of immediate hypersensitivity reactions to egg ingestion.[108]

Immediate allergic reactions (i.e., breathing difficulty, hypotension) have occurred following administration of monovalent measles virus vaccine live (no longer commercially available in the US) in several children with a history of anaphylactoid reactions to egg ingestion.[109] However, current preparations of measles-containing virus vaccine live do not contain enough egg protein to cause a severe reaction in most egg-allergic children,[124,156,159,161,162,165] and evidence from studies and reports of anaphylactic reactions to the vaccine in individuals who had no evidence of egg allergy suggest that hypersensitivity reactions may be related to other components.[159,160,161,162,163,165,170] Measles virus vaccine live generally has been administered safely to children with egg allergies that were not anaphylactoid in nature and also has been administered safely to children with a history of immediate reactions to eggs.[156,157,158,159,160,161,162,163,164,165,170] The American Academy of Pediatrics (AAP) states that children with egg allergy are at low risk of anaphylactic reactions to measles-containing vaccines (including MMR and MMRV); skin testing for egg allergy is not predictive of such reactions and therefore is not recommended.[124] Measles-containing vaccines should not be administered to patients who have had a severe allergic reaction to a previous dose of measles-containing vaccine or to a vaccine component.[124]

Neomycin Hypersensitivity.

Because MMR (the vaccine labeled as M-M-R® II) contains trace amounts of neomycin, the vaccine is contraindicated in individuals who have had an anaphylactic reaction to neomycin.[108] The American Academy of Pediatrics (AAP) states that the MMR vaccine may be used in individuals with a non-anaphylactic neomycin allergy.[124]

Latex.

Some preparations of the MMR vaccine (e.g., tip caps of prefilled syringes of diluent supplied with Priorix®) contain natural rubber latex, which may cause allergic reactions.[190]

Thrombocytopenia

Measles virus-containing vaccines (e.g., MMR) rarely can cause clinically evident thrombocytopenia (e.g., purpura) within 2 months after vaccination; the risk of thrombocytopenia is higher after the first dose of the vaccine than after the second dose.[108,124,170,175,176,177,178,179,181,182,190] Carefully evaluate the potential risks and benefits of vaccination in children with thrombocytopenia or in those who experienced thrombocytopenia after vaccination with a previous dose of MMR.[108]

In prospective studies, the reported incidence of clinically evident thrombocytopenia after MMR vaccination ranged from 1 per 30,000 to 1 per 40,000 vaccinated children, with a temporal clustering of cases occurring 2–3 weeks after vaccination.[170,175,176,177] With passive surveillance, the reported incidence ranged from 1 per 100,000 to 1 per million distributed doses.[170,178,179] Results of one retrospective study confirmed that a causal relation exists between receipt of MMR and idiopathic thrombocytopenic purpura and indicated that the absolute risk within 6 weeks of vaccination was 1 in 22,300 doses with 2 out of 3 cases occurring in the 6-week post-vaccination period being caused by MMR.[191] However, the incidence of thrombocytopenia with natural measles or rubella infection is substantially greater than that with vaccination, being reported as 1 per 3000 children during one measles epidemic.[170,180] Evidence from case reports suggests that the risk of vaccine-induced thrombocytopenia may be increased in individuals with a history of idiopathic (immune) thrombocytopenic purpura, particularly for those who developed it with a previous dose of the vaccine;[170,179,181,182] however, results of one retrospective study indicate that children with a history of idiopathic thrombocytopenic purpura prior to the first dose of MMR are not at increased risk of vaccine-associated idiopathic thrombocytopenic purpura.[191] In most cases, vaccine-associated thrombocytopenic purpura usually has been transient and benign, resolving within 1 week.[170,179]

Individuals with a history of thrombocytopenic purpura or thrombocytopenia may be at increased risk of developing clinically apparent thrombocytopenia after vaccination.[108,170,179,181,182] Thrombocytopenia has worsened in those with preexisting thrombocytopenia and may worsen with subsequent doses.[108] The decision to vaccinate such individuals should depend on the benefits of immunity and the risks of recurrence or exacerbation of thrombocytopenia after vaccination or during natural infection with viruses.[108]

Individuals with Altered Immunocompetence

MMR is contraindicated in individuals who are immunodeficient or immunosuppressed due to disease or medical therapy.[108] Immunocompromised patients with disorders associated with increased severity of viral infections should not receive live virus measles vaccine with the exception of people with HIV infection, unless they have evidence of severe immunosuppression.[124] Vaccination with MMR should be deferred in individuals with a family history of congenital or hereditary immunodeficiency until the individual's immune status has been evaluated and the individual has been found to be immunocompetent.[108]

Because replication of measles vaccine virus may be potentiated in individuals with primary immunodeficiencies (e.g., cellular immune deficiency, hypogammaglobulinemia, dysgammaglobulinemia) or with suppressed immune response resulting from leukemia, lymphoma, other malignancies affecting the bone marrow or lymphatic system, or blood dyscrasias, concern exists about the potential risk of administering any live virus vaccine to such individuals.[170] Evidence based on case reports has linked measles virus-containing vaccine and measles infection to subsequent death in some severely immunocompromised children.[170,171,183] Of the more than 200 million doses of measles virus-containing vaccine administered in the US, fewer than 5 such deaths have been reported.[170]

Immune Globulins and Transfusions

Immune globulin and other blood products should not be given concurrently with MMR.[108,124] These products may contain antibodies that interfere with the serologic response to measles vaccines.[108,124] Specific recommendations for intervals between administration of immune globulin or blood products and live virus vaccines are provided in guidelines.[124]

MMR vaccine should be administered at least 2 weeks before planned administration of immune globulin, blood transfusion, or other blood products because of the theoretical possibility that antibody in those products could neutralize vaccine virus and interfere with successful immunization.[124] If immune globulin must be administered within 14 days after administration of MMR or MMRV, these vaccines should be administered again after the specified interval.[124]

Syncope

Syncope can occur in association with administration of injectable vaccines, including MMR.[190]

Risk of Virus Transmission

Live attenuated rubella vaccine virus has been detected in the nose and throat of individuals 7 to 28 days after vaccination with a rubella virus-containing vaccine; however, no documented confirmed cases of transmitted rubella vaccine virus have been reported.[190]

Limitation of Vaccine Effectiveness

Vaccination with MMR may not protect all susceptible individuals from measles, mumps, or rubella infection.[190]

Specific Populations

Pregnancy.

MMR and MMRV vaccines are contraindicated in pregnant women; infection during pregnancy with the wild-type viruses has been associated with adverse maternal and fetal outcomes such as spontaneous abortion, stillbirth, premature delivery, and congenital defects.[108,190,194] In pregnant women with no evidence of immunity to rubella, ACIP recommends that a dose of MMR be administered after pregnancy, but before discharge from the healthcare facility.[99]

Lactation.

It is not known whether measles, mumps, or varicella vaccine virus is secreted in human milk.[108,190,194] Studies have shown that lactating postpartum women vaccinated with live attenuated rubella vaccine may secrete the virus in breast milk and transmit it to breast-fed infants.[108] In breastfed infants with serological evidence of rubella virus vaccine strain antibodies, none exhibited severe disease; however, one infant exhibited mild clinical illness typical of acquired rubella.[108]

ACIP states that it is safe for breastfeeding women to receive MMR vaccination.[99] Breastfeeding does not interfere with the response to MMR vaccine and the nursing infant will not be affected by vaccine present in breastmilk.[99]

The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for these vaccines, and any potential adverse effects on the breastfed child from the vaccine or from the underlying maternal condition.[108,190] For preventive vaccines, the underlying maternal condition is susceptibility to disease prevented by the vaccine.[108,190]

Pediatric Use.

Measles, mumps, and rubella virus vaccine live is not approved for use in individuals less than 12 months of age; however, the vaccine has been used for postexposure prophylaxis and outbreak control in **infants as young as 6 months of age [off-label]**†.[108,124,190] Safety and efficacy of MMR in infants younger than 6 months of age have not been established.[108,190]

Geriatric Use.

Clinical studies of MMR did not include sufficient numbers of individuals 65 years of age or older to determine whether these individuals respond differently than younger individuals.[108,190]

▪ Common Adverse Effects

Common adverse effects reported in individuals receiving M-M-R® II: injection site reactions (erythema, pain, and swelling), fever.[108]

Common adverse effects reported in individuals 12 through 15 months of age receiving Priorix®: local reactions including pain and redness, and systemic reactions including irritability, loss of appetite, drowsiness, and fever.[190]

Common adverse effects reported in individuals 4 through 6 years of age receiving Priorix®: local reactions including pain, redness, and swelling, and systemic reactions including loss of appetite, drowsiness, and fever.[190]

Common adverse effects reported in individuals 7 years of age and older receiving Priorix®: local reactions including pain and redness.[190]

Drug Interactions

▪ Corticosteroids and Immununosuppressive Drugs

Individuals receiving immunosuppressive agents (e.g., alkylating agents, antimetabolites, corticotropin, corticosteroids [at immunosuppressive dosages], radiation therapy) may have a diminished response to measles virus-containing vaccine and replication of the virus may be potentiated.[108] The American Academy of Pediatrics (AAP) states that for patients who have received high doses of corticosteroids (≥2 mg/kg of body weight or ≥20 mg/day of prednisone or its equivalent for people who weigh ≥10 kg) for 14 days or more and who otherwise are not immunocompromised, the recommended interval between stopping the corticosteroids and immunization is at least 4 weeks.[124] In general, inhaled steroids do not cause immunosuppression and are not a contraindication to immunization.[124]

▪ Immune Globulins and Blood Products

Antibodies contained in immune globulin preparations (e.g., immune globulin IM [IGIM], immune globulin IV [IGIV], hepatitis B immune globulin [HBIG], rabies immune globulin [RIG], tetanus immune globulin [TIG], varicella-zoster immune globulin [VZIG]) may interfere with the immune response to certain live virus vaccines, including measles virus-containing vaccines.[108,124,170] Similarly, blood products (e.g., whole blood, packed red blood cells, plasma) may interfere with the immune response to certain live virus vaccines, including MMR; therefore, MMR should not be administered simultaneously with or for specified intervals before or after administration of blood products.[124]

Specific recommendations for intervals between administration of immune globulin or blood products and live virus vaccines are provided in guidelines.[124] MMR vaccine should be administered at least 2 weeks before planned administration of immune globulin, blood transfusion, or other blood products because of the theoretical possibility that antibody in those products could neutralize vaccine virus and interfere with successful immunization.[124] If immune globulin must be administered within 14 days after administration of MMR or MMRV, these vaccines should be administered again after the specified interval.[124]

▪ Tuberculin Skin Testing

MMR vaccines may interfere with results of tuberculin skin testing by suppressing tuberculin skin test reactivity and also possibly affect testing with interferon gamma release assay (IGRA).[108,124] If a tuberculin skin test with tuberculin purified protein derivative (PPD) is necessary, the test should be performed before, simultaneously with, or at least 4 to 6 weeks after vaccination with MMR.[108]

▪ Vaccines

Both the MMR and MMRV vaccines may be administered at the same time, at different anatomic sites, as other routine nonlive or live attenuated childhood vaccines.[99,108,135,185] In general, simultaneous administration (on the same day) of the most widely used vaccines, including diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed (DTaP), hepatitis B vaccine, Hib conjugate vaccine, MMR, poliovirus vaccine, and varicella virus vaccine live, has resulted in seroconversion rates and adverse effects similar to those observed when the vaccines were administered separately.[103,107] Additional live virus vaccines that are not administered simultaneously (on the same day) should be separated by at least 4 weeks to avoid the potential for immune interference.[108,135,185]

MMR may be administered concurrently with monovalent varicella virus vaccine live (Varivax®) at a different site using a separate syringe.[103,107,108,124,209] Results of studies in healthy children 12–36 months of age indicate that seroconversion rates, antibody responses, and adverse effects reported with simultaneous administration of the vaccines are similar to those reported when the vaccines are administered 6 weeks apart.[209] Because there is a theoretical concern that the immune response to one live viral vaccine may be impaired if administered within 1 month of another, if MMR and varicella virus vaccine live are not administered simultaneously, then they should be administered at least 1 month apart.[103,124] There is some evidence that administration of varicella virus vaccine live less than 30 days after MMR decreases the effectiveness of the varicella vaccine.[103] Results of a retrospective cohort study that used data from the Vaccine Safety Datalink (VSD) project and included children 12 months of age or older who were vaccinated during January 1995 to December 1999 indicate that administration of varicella virus vaccine live less than 30 days after MMR results in a 2.5-fold increase in the incidence of breakthrough varicella infections.[103] However, when the vaccines were administered concurrently, there was no increase in the risk for breakthrough infections.[103] Studies using MMRV (ProQuad®) in healthy children 1–6 years of age indicate that the antibody response to measles, mumps, rubella, and varicella antigens following a single dose of the fixed-combination vaccine are similar to those obtained after a single dose of MMR and a single dose of varicella virus vaccine live (Varivax®).[194,195] However, there is some evidence that the relative risk for febrile seizures in infants may be higher with the fixed-combination vaccine MMRV than that reported when a dose of single-antigen varicella virus vaccine live (Varivax®) and a dose of MMR are given concomitantly.[194]

In a study evaluating the antibody responses to the measles, mumps, and rubella virus vaccine live in children 12–15 years of age who received either the M-M-R® II or Priorix® preparations of the vaccine, all study participants also received Havrix® (hepatitis A virus vaccine) and Varivax® (varicella virus vaccine).[190] Children enrolled in the US also received a pneumococcal conjugate vaccine (Prevnar®) concomitantly.[190] There was no evidence of interference with the antibody responses to these vaccines when administered concomitantly.[190]

In a study evaluating the antibody responses to the measles, mumps, and rubella virus vaccine live in children 4–6 years of age who received either the M-M-R® II or Priorix® preparations of the vaccine, a subset of study participants also received Kinrix® (diphtheria and tetanus toxoids and acellular pertussis adsorbed and inactivated poliovirus vaccine) and Varivax® (varicella virus vaccine).[190] There was no evidence of interference with the antibody responses to these vaccines when administered concomitantly.[190]

Description

The fixed-combination vaccine containing measles, mumps, and rubella antigens (measles, mumps, and rubella virus vaccine live [MMR; M-M-R® II]) stimulates active immunity to measles by inducing production of measles-specific immunoglobulin G (IgG) and M (IgM) antibodies (humoral immunity) and also induces a cell-mediated immune response.[108,196] Studies using monovalent measles virus vaccine live indicate that the antibody response to initial vaccination (primary response) resembles that caused by primary natural measles infection, with an initial transient increase in serum IgM titers and a subsequent increase in serum IgG titers,[136,137] although the titers achieved with vaccination are lower. As with natural infection, IgG antibody titers decline slowly over time,[113,117,136] but immunity is thought to persist for many years and possibly lifelong in most vaccinees.[113,136] Individuals who experience initial antigenic stimulation from either natural infection or vaccine generally exhibit an anamnestic (secondary) response to subsequent revaccination or exposure to natural measles.[136,138,139] This anamnestic response generally is characterized by a rapid but often transient increase in serum IgG titers but little or no detectable IgM production;[136,138,139] however, with more sensitive assays, IgM titers may be detected more frequently, albeit still in low proportion to IgG.[138]

The duration of immunity following vaccination with measles virus-containing vaccine has not yet been established and can only be determined by continued long-term observation.[108] There is serologic and epidemiologic evidence that vaccine-induced immunity to measles persists at least 13–23 years.[113,136] and probably life-long in most vaccinees.[136] Titers of vaccine-induced antibodies as measured by the hemagglutination-inhibition (HI) assay have been shown to slowly decline and are lower than

those following natural measles infection.[113,117,]

The rubella vaccine component induces both humoral and cellular immunity; studies indicate that 1 dose of the vaccine can provide long lasting immunity.[105,] Although antibodies induced by the rubella vaccine may decrease over time, data suggest that waning immunity with increasing susceptibility to rubella disease does not occur.[105,]

The mumps vaccine component produces a subclinical, noncommunicable infection with few adverse effects, probably involving both the humoral and cellular immune responses.[105,]

Advice to Patients

The following information contains important points for the clinician to discuss with patients during counseling. For more comprehensive monographs suitable for distribution to the patient, please refer to the *AHFS Patient Medication Information* monographs available from MedlinePlus (https://vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v:project=medlineplus) (in English and Spanish; written at a 6th- to 8th-grade reading level).

Advise the patient to read the FDA-approved patient labeling.[108,]

Provide the required vaccine information to the patient, parent, or guardian.[108,190,]

Inform the patient, parent, or guardian of the benefits and risks associated with vaccination.[108,190,]

Question the patient, parent, or guardian about reactions to any previous doses of MMR vaccine.[108,]

Inform the patient, parent, or guardian that vaccination with MMR vaccine may not offer 100% protection from measles, mumps, and rubella infection. [108,]

Instruct patients, parents, or guardians to report any adverse reactions to their healthcare provider.[108,]

Advise patients that the U.S. Department of Health and Human Services has established a Vaccine Adverse Event Reporting System (VAERS) to accept all reports of suspected adverse events after the administration of any vaccine.[108,] For information or a copy of the vaccine reporting form, call the VAERS toll-free number at 1-800-822-7967, or report online at https://vaers.hhs.gov (https://vaers.hhs.gov) .[108,]

Advise patients to inform their clinician of existing or contemplated concomitant therapy, including prescription and OTC drugs and dietary or herbal supplements, as well as any concomitant illnesses.[108,190,]

Advise patients to inform their clinician if they are or plan to become pregnant or plan to breast-feed.[108,190,] Question females of reproductive potential regarding the possibility of pregnancy.[108,190,] Inform patients to avoid pregnancy for 1 month following vaccination.[108,190,]

Inform patients of other important precautionary information.[108,190,]

Additional Information

The American Society of Health-System Pharmacists, Inc. represents that the information provided in the accompanying monograph was formulated with a reasonable standard of care, and in conformity with professional standards in the field. Readers are advised that decisions regarding use of drugs are complex medical decisions requiring the independent, informed decision of an appropriate health care professional, and that the information contained in the monograph is provided for informational purposes only. The manufacturer's labeling should be consulted for more detailed information. The American Society of Health-System Pharmacists, Inc. does not endorse or recommend the use of any drug. The information contained in the monograph is not a substitute for medical care.

Preparations

Excipients in commercially available drug preparations may have clinically important effects in some individuals; consult specific product labeling for details.

Measles, Mumps, and Rubella Virus Vaccine Live (MMR) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Measles%2C+Mumps%2C+and+Rubella+Virus+Vaccine+Live+%28MMR%29&collapse=1)

Parenteral

For injection, for intramuscular or subcutaneous use

No less than 3.0 $\log_{10}$ Tissue Culture Infective Dose $(TCID)_{50}$ of measles virus live (Enders' attenuated Edmonston strain), 4.1 $\log_{10}$ $TCID_{50}$ of mumps virus live (Jeryl Lynn live attenuated strain), and 3.0 $\log_{10}$ $TCID_{50}$ of rubella virus live (Wistar RA 27/3 live attenuated strain) per 0.5 mL dose after reconstitution

M-M-R® II *(supplied with sterile diluent in a vial or prefilled syringe)*, Merck Sharp and Dohme (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Merck+Sharp+and+Dohme&collapse=1)

Suspension, for subcutaneous injection

No less than 3.4 $\log_{10}$ Cell Culture Infective Dose 50% $(CCID_{50})$ of measles virus live (Schwarz live attenuated strain), 4.2 $\log_{10}$ $CCID_{50}$ of mumps virus live (RIT 4385 live attenuated strain derived from Jeryl Lynn strain), and 3.3 $\log_{10}$ $CCID_{50}$ of rubella virus live (Wistar RA 27/3 live attenuated strain) per 0.5 mL dose after reconstitution

Priorix®, GlaxoSmithKline (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=GlaxoSmithKline&collapse=1)

Measles, Mumps, Rubella and Varicella Virus Vaccine Live (MMRV) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Measles%2C+Mumps%2C+Rubella+and+Varicella+Virus+Vaccine+Live+%28MMRV%29&collapse=1)

Parenteral

For injection, for subcutaneous use

Measles Virus Vaccine Live (More Attenuated Enders' Line) ≥3 log $_{10}$ tissue culture infective dose 50% ($TCID_{50}$), Mumps Virus Vaccine Live (Jeryl Lynn [B level] Strain) ≥4.3 log $_{10}$ $TCID_{50}$, Rubella Virus Vaccine Live (Wistar RA 27/3 Strain) ≥3 log $_{10}$ $TCID_{50}$, and Varicella Virus Vaccine Live (Oka/Merck Strain) ≥3.99 log $_{10}$ plaque-forming units (PFU) per 0.5 mL

ProQuad®, Merck (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Merck&collapse=1)

Related Resources

AHFS Patient Medication Information (https://vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v:project=medlineplus&query=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20) and other related patient health topics (MedlinePlus)
ASHP Drug Shortages Resource Center (https://www.ashp.org/Drug-Shortages)
CCRIS (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+ccris:%%22Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%22) (Chemical Carcinogenesis Research Information System)
ChemID*plus* (https://chem.nlm.nih.gov/chemidplus/name/Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20)
Biochemical Data Summary (http://www.drugbank.ca/unearth/q?utf8=%%E2%%9C%%93&query=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20&searcher=drugs&approved=1&vet_approved=1& (US and Canada)
Clinical Trials (https://www.clinicaltrials.gov/ct/search?submit=Search&term=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20)
DailyMed (https://dailymed.nlm.nih.gov/dailymed/search.cfm?query=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20) (drug labels)
DART (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+dart:%%22Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%22) (Developmental and Reproductive Toxicology Database)
Drugs@FDA (https://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm?fuseaction=Search.SearchAction&SearchType=BasicSearch&SearchTerm=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20) (approval information)
European Medicines Agency (https://www.ema.europa.eu/en/search/search?search_api_views_fulltext=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20)
FDA National Drug Code Directory (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20&collapse=1)
FDA Recalls, Market Withdrawals, and Safety Alerts (https://www.fda.gov/Safety/Recalls/default.htm)
HSDB (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+hsdb:%%22Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%22) (Hazardous Substances Data Bank)
Inxight Drugs (https://drugs.ncats.io/substances?q=%%22Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%22) (National Center for Advancing Translational Sciences)
LactMed (drug effects on breastfeeding) (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+lactmed:@or+%%28@na+%%22Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%22+%%29)
New Drug Approvals (https://ahfs.ashp.org/drug-assignments.aspx)
Orange Book (https://www.accessdata.fda.gov/scripts/cder/ob/default.cfm?panel=0&drugname=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20) (therapeutic equivalence)
PharmGKB (https://www.pharmgkb.org/search?connections&gaSearch=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20&query=Measles,%20Mumps,%20and%20Rubella%20Virus (Pharmacogenomic data from PharmGKB)
Pillbox (*beta*) (https://pillbox.nlm.nih.gov/pillimage/search_results.php?submit=Search&splid=&getingredient=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20) (drug identification and images)
PubMed (https://www.ncbi.nlm.nih.gov/pubmed?DB=pubmed&term=Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%5BAll+Fields%%5D) (scientific journals)
Safety-related Labeling Changes (https://www.accessdata.fda.gov/scripts/cder/safetylabelingchanges) (FDA/CDER)
ToxLine (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+toxline:%%22Measles,%20Mumps,%20and%20Rubella%20Virus%20Vaccine%20Live%20%%22) (Toxicology Literature Online)

† Use is not currently included in the labeling approved by the US Food and Drug Administration.

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ASHP represents pharmacists who serve as patient care providers in acute and ambulatory settings. The organization's nearly 55,000 members include pharmacists, student pharmacists, and pharmacy technicians. For more than 75 years, ASHP has been at the forefront of efforts to improve medication use and enhance patient safety. For more information about the wide array of ASHP activities and the many ways in which pharmacists advance healthcare, visit ASHP's website (https://www.ashp.org), or its consumer website (https://www.safemedication.com).

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