Centers for Disease Control and Prevention

Measles, Mumps, and Rubella Vaccines

Current as of 3/1/22

I will provide a discussion of the epidemiology of measles, mumps, and rubella as well as the vaccine recommendations for prevention of these three diseases.

About This Presentation

This presentation was designed to help prelicensure nursing faculty incorporate appropriate elements of the IRUN Curriculum Framework into their existing curricula. This content is also available in a PowerPoint file located on the IRUN web page.

Please submit questions or comments about this publication via the IRUN web page.

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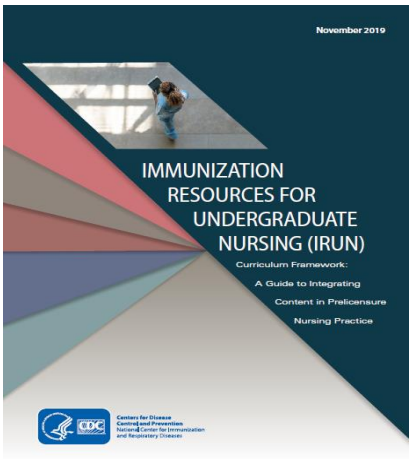
N/A—disclosures

Immunization Resources for Undergraduate Nursing (IRUN) Curriculum Framework Topics

- Public Health Perspective
- Immunization Strategies
- Immune System/Immunology
- Vaccine-Preventable Diseases
- Types of Vaccines
- Immunization Schedules
- Communications
- Legal/Ethical Issues
- Vaccine Storage and Handling
- Vaccine Administration
- Documentation
- Vaccine Safety



- The Immunization Resources for Undergraduate Nursing (IRUN) Curriculum Framework consists of 12 topic areas with corresponding learning objectives and suggested resources. In this slide deck, we will use these topic areas and framework to learn about measles, mumps, and rubella and their corresponding vaccine recommendations.
- For more information about the IRUN Curriculum Framework topics or resources, please visit the IRUN web page, which can be accessed by clicking on the graphic on this slide.

Learning Objectives

- Describe the etiologic agent, pathogenesis, clinical manifestations and epidemiology of measles, mumps and rubella diseases.
- Describe barriers to vaccination and strategies to increase vaccination coverage for measles, mumps and rubella diseases.
- Identify measles, mumps and rubella vaccine (MMR) indications, contraindications, and precautions.
- Discuss the importance of appropriate spacing and timing of MMR doses.
- Describe correct vaccine and diluent storage and handling.
- Define the steps for proper MMR vaccine administration.
- Describe proper MMR vaccine documentation and adverse event reporting practices.
- Explain the nurse's role in preventing measles, mumps and rubella transmission.
- Locate resources relevant to current MMR vaccine recommendations.

Following today's lecture, you will be able to meet these nine learning objectives. (READ SLIDE)

PUBLIC HEALTH PERSPECTIVE

Global Impact of Measles

- A leading cause of vaccine-preventable disease death among children
- Despite substantial decreasing global measles incidence during 2000–2016, a global measles resurgence commenced in 2017.
- Failure to vaccinate is the fundamental cause of the resurgence globally.

CDC: Stopping Global Measles Outbreaks [video]

Information from Patel MK, Goodson JL, Alexander JP Jr., et al. Progress Toward Regional Measles Elimination — Worldwide, 2000–2019. MMWR Morb Mortal Wkly Rep 2020;69:1700–1705. DOI: http://dx.doi.org/10.15585/mmwr.mm6945a6; https://www.cdc.gov/globalhealth/measles/data/global-measles-outbreaks.html; Video source https://youtu.be/LuPOVEJo-2o

- We will start by discussing the impact of Measles, globally.
- Measles is one of the most contagious diseases in the world and is a leading cause of vaccine-preventable death among children. Around 9 out of 10 people who are not protected will become infected following exposure to the measles virus.
- Despite substantial decreasing global measles incidence and measles-associated mortality during 2000–2016, a global measles resurgence commenced during 2017–2018 and continued into 2019. This marked a significant step backward in progress toward global measles elimination. Compared with the historic low in reported cases in 2016, reported measles cases increased 556% in 2019, with increases in numbers of reported cases and incidence in all WHO regions.
- The estimated global measles mortality increased nearly 50% since 2016.
- In all WHO regions, the fundamental cause of the resurgence was a failure to vaccinate, both in recent and past years, causing immunity gaps in both younger and some older age groups. Lessons can be learned from outbreaks in various countries, as well as from notable successes in countries such as China, Colombia, and India. Identifying and addressing gaps in population immunity will require additional strategies as outlined in the Immunization Agenda 2030 and the Measles-Rubella Strategic Framework 2021–2030.
- The video on the right discusses the importance of identifying and addressing measles immunization gaps.

Impact of Measles in the United States

- About 500,000 reported cases and 500 deaths annually before the vaccine.
  - Actual cases estimated at 3 to 4 million
- Following vaccine licensure in 1963, measles incidence decreased by over 95%.
- Measles occurrence among vaccinated school-aged children in the 1980s led to recommendations for a second dose.
- In 2019, a total of 1,282 cases of measles were confirmed in 31 states. Most cases were among people who were not vaccinated against measles.
- This is the greatest number of cases reported in the United States since 1992, keeping in mind measles was declared eliminated in 2000.

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Gastanaduy P, Haver P, Rota P, Patel M; Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html#secular

- Before 1963, approximately 500,000 cases and 500 measles deaths were reported annually, with epidemic cycles every 2 to 3 years. However, the actual number of cases was estimated at 3 to 4 million annually. More than 50% of persons had measles by age 6 years, and more than 90% by age 15 years. In the years following licensure of vaccine in 1963, the incidence of measles decreased by more than 95%, and 2- to 3-year epidemic cycles no longer occurred. From 1985 through 1988, 68% of cases in school-aged children (age 5 to 19 years) occurred among those who had been appropriately vaccinated – i.e., had received a single dose of measles vaccine as recommended. The occurrence of measles among previously vaccinated children (i.e., vaccine failure) led to a recommendation for a second dose in this age group in 1989.

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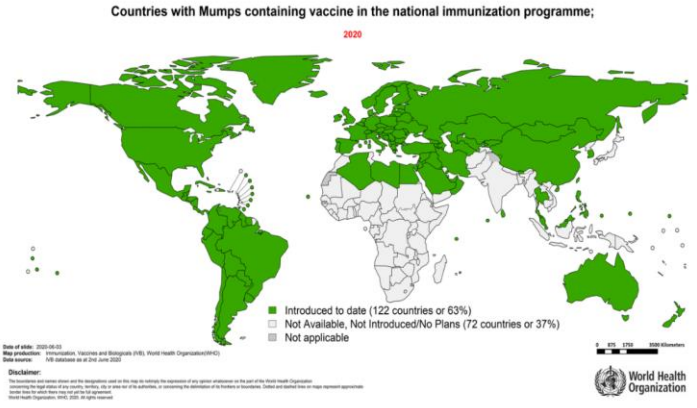
- This is the greatest number of cases reported in the United States since 1992, keeping in mind measles was declared eliminated in 2000.

Global Impact of Mumps

- "Except in countries with high coverage of mumps-containing vaccines, the annual mumps incidence in most parts of the world is in the range 100–1000 per 100 000 population, with epidemic peaks every 2–5 years" (World Health Organization, 2020).



Information from World Health Organization; https://www.who.int/ith/diseases/mumps/en; https://apps.who.int/iris/bitstream/handle/10665/267764/PMC2557572.pdf?sequence=1&isAllowed=y
Map from https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/passive/Mumps_VaccIntro.gif?ua=1

- According to the World Health Organization, "except in countries with high coverage of mumps-containing vaccines, the annual mumps incidence in most parts of the world is in the range of 100–1000 per 100 000 population, with epidemic peaks every 2–5 years. (World Health Organization, 2020)".
- The map here shows, in green, which countries have included Mumps in their national vaccine program as of 2020. To date, 63% of countries globally have introduced mumps into their national vaccine programs.

Impact of Mumps in the United States

- Mumps is endemic in the United States.
- Prior to the introduction of mumps vaccine in the United States, mumps was considered a universal childhood disease, with over 100,000 cases reported each year. Following a 1-dose mumps vaccination recommendation in the 1970s and subsequent 2-dose MMR policy in the late 80s, mumps cases were reduced by 99% by the early to mid-2000s.
- Since 2006, mumps cases increased in the United States. Most cases have been in persons who previously received 2 doses of MMR vaccine. Most outbreaks involved close-contact settings.
- In 2020, mumps continued to circulate during the pandemic. From April–December 2020, 31 states reported 96 cases.

Information from Centers for Disease Control and Prevention. *National Notifiable Disease Surveillance System*; https://www.cdc.gov/mmwr/publications/index.html; https://www.cdc.gov/vaccines/pubs/pinkbook/mumps.html#secular-trends-in-US ; For more recent case data Mumps | Cases and Outbreaks | CDC

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- However, since 2006, there has been an increase in the number of reported mumps cases. 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.
- In 2020, mumps continued to circulate during the COVID-19 pandemic. From April–December 2020, 31 states reported 96 cases.

Global Impact of Rubella

- Rubella is no longer endemic in the United States, but rubella remains a problem in other parts of the world.
- However, due to increased vaccination coverage for rubella, reported rubella cases declined 97%, from 670,894 cases in 102 countries in 2000 to 14,621 cases in 151 countries in 2018.
- Congenital rubella syndrome (CRS) rates are highest in the WHO African and South-East Asian regions where vaccination coverage is lowest.
- Travelers can get rubella abroad and bring it into the United States.

Information from https://www.cdc.gov/rubella/about/in-the-us.html; https://www.who.int/news-room/fact-sheets/detail/rubella; https://www.cdc.gov/vaccines/pubs/surv-manual/chpt15-crs.html

- Now we will shift our conversation to discuss rubella.
- Although rubella is no longer endemic (constantly present) in the United States, the disease remains a problem in other parts of the world.
- "The number of countries using rubella vaccines in their national program continues to steadily increase. As of December 2018, 168 out of 194 countries had introduced rubella vaccines and global coverage was estimated at 69%. Reported rubella cases declined 97%, from 670 894 cases in 102 countries in 2000 to 14 621 cases in 151 countries in 2018. Congenital rubella syndrome rates are highest in the WHO African and South-East Asian regions where vaccination coverage is lowest." (WHO, 2020)
- Congenital rubella syndrome (CRS) is an illness in infants that results from maternal infection with rubella virus during pregnancy.
- Rubella can be brought into the United States by people who get infected in other countries.

Impact of Rubella in the United States

- Rubella was eliminated from the United States in 2004.
- Before the rubella vaccination program began in 1969, rubella was a common, widespread infection.
- The last major rubella epidemic occurred from 1964–1965:
  - 12.5 million people infected
  - 20,000 babies born with congenital rubella syndrome (CRS)
  - 11,000 pregnant women lost their babies
  - 2,100 newborns died
- Today, fewer than 10 people in the United States are reported as having rubella each year.

Congenital Rubella Syndrome (CRS) and Birth Defects

Information from https://www.cdc.gov/rubella/about/in-the-us.html; Image source https://www.cdc.gov/rubella/index.html

- Rubella was eliminated from the United States in 2004.
- Before the rubella vaccination program began in 1969, rubella was a common, widespread infection in the United States. The last major rubella epidemic in the United States occurred from 1964–1965. During that epidemic:
  - 12.5 million people were infected.
  - 20,000 babies were born with congenital rubella syndrome (CRS).
  - 11,000 pregnant women lost their babies
  - 2,100 newborns died.
- Today, less than 10 people in the United States are reported as having rubella each year. Since 2012, all rubella cases had evidence that they were infected when they were living or traveling outside the United States. To maintain rubella elimination, it is important that children and women of childbearing age are vaccinated against rubella.

IMMUNIZATION STRATEGIES

Barriers to Routine Vaccination in the United States: Health Care Access

- **Barriers to health care access:**
  - Language barriers
  - Lack of trust in providers
  - Transportation problems
  - Inconvenient office hours
  - Patient/parent misinformation
  - Vaccine hesitancy
  - Competing provider priorities
  - Low awareness of vaccination benefits
  - Receipt of care from multiple providers
  - Complex vaccination schedule
  - Vaccine cost
  - Breaks in insurance coverage

- Vaccination coverage among children enrolled in Medicaid or with no health insurance was lower than that among children who were privately insured.

Information from Hill HA, Yankey D, Elam-Evans LD, Singleton JA, Pingali SC, Santibanez TA. Vaccination Coverage by Age 24 Months Among Children Born in 2016 and 2017 — National Immunization Survey-Child, United States, 2017–2019. MMWR Morb Mortal Wkly Rep 2020;69:1505–1511. DOI: http://dx.doi.org/10.15585/mmwr.mm6942a1external icon.; Walker TY, Elam-Evans LD, Yankey D, et al. National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13–17 Years—United States, 2018. *MMWR Morb Mortal Wkly Rep.* 2019;68:718–723; Escoffery C, et al. Facilitators and Barriers to the Implementation of the HPV VACs (Vaccinate Adolescents Against Cancers) Program: A Consolidated Framework for Implementation Research Analysis. *Prev Chronic Dis* . 2019;16:E85.

- Strategies to increase vaccination coverage in our communities cannot be developed without a thorough understanding of what barriers exist, preventing individuals from vaccination.

Barriers

- Barriers to health care access and use among the publicly insured include language barriers, lack of trust in providers, transportation problems, inconvenient office hours, patient/parent misinformation, vaccine hesitancy, competing provider priorities, low awareness of vaccination benefits, receipt of care from multiple providers, complex vaccination schedules, vaccine cost, breaks in coverage and other individual and systems level barriers.

- Health insurance and poverty status are interrelated factors associated with lower vaccination coverage in young children. Vaccination coverage among children enrolled in Medicaid or with no health insurance was lower than that among children who were privately insured. The prevalence of being completely unvaccinated was highest among uninsured children (4.1%), lower among those enrolled in Medicaid (1.3%), and lowest among those with private insurance (0.8%).

Strategies for High Vaccination Coverage: Vaccines for Children (VFC) Program

- Vaccines for Children program created in 1993
- Children through age 18 years of age who meet at least one of the following criteria are eligible to receive VFC vaccine:
  - Medicaid eligible
  - Uninsured
  - American Indian or Alaska Native
  - Underinsured

Information from: Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Kang Y. Vaccination Coverage Among Children Aged 19–35 Months — United States, 2016. MMWR Morb Mortal Wkly Rep 2017;66:1171–1177. DOI: https://www.cdc.gov/mmwr/volumes/67/wr/mm6740a4.htm; https://www.cdc.gov/vaccines/programs/vfc/about/index.html; https://www.cdc.gov/vaccines/programs/vfc/providers/eligibility.html;
Image from https://www.cdc.gov/vaccines/programs/vfc/index.

- Partially, in response to a U.S. based measles outbreak between 1989-1991, Congress passed the Omnibus Budget Reconciliation Act (OBRA) on August 10, 1993, creating the Vaccines for Children (VFC) Program. VFC became operational October 1, 1994. Known as section 1928 of the Social Security Act, the Vaccines for Children program is an entitlement program (a right granted by law) for eligible children, age 18 and younger.

- Children living below and up to a certain percentage above the poverty level are eligible for Medicaid and are entitled to vaccines through the Vaccines for Children, or VFC.

- Uninsured children, American Indians or Alaska natives are eligible for VFC benefits.

- And finally, a child who is insured, but doesn't have insurance that covers VFC program vaccines are eligible to receive VFC vaccine through federally qualified health center or rural health clinic.

- Although many children are eligible for VFC vaccine coverage, some families might not be aware of the VFC program, might be unable to afford fees for visits to a vaccine provider, or might need assistance locating a physician who participates in the VFC program. Thus, CDC has undertaken several activities designed to elucidate potential barriers to early childhood vaccination from the perspective of state immunization programs and health care providers enrolled in the VFC program. There are also plans to assess parental experience with and barriers to accessing vaccination services.

Strategies for High Vaccination Coverage

- Reduce barriers to immunization.
- Provide recommendation for vaccination and reinforcement.
- Reduce missed opportunities.
- Schedule next immunization visit before patient leaves the office.
- Utilize reminder and recall for patients.

Information from Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Hall E., Wodi A.P., Hamborsky J., et al., eds . 14th ed. Washington, D.C. Public Health Foundation, 2021.; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html; Vaccination Coverage by Age 24 Months Among Children Born in 2015 and 2016—National Immunization Survey-Child, United States, *MMWR*/ October 18, 2019 / 68(41);913–918.; https://www.cdc.gov/vaccines/programs/iqip/index.html; https://www.cdc.gov/vaccines/hcp/admin/reminder-sys.html

- As described in a previous slide, recognizing the barriers to immunization and implementing strategies minimize barriers is necessary to increase vaccination coverage.
- Recommending the vaccine is one of the most effective strategies for increasing vaccination coverage for patients of all. As the most trusted profession in the United States, nurses play a critical role in recommending vaccines to those in their communities. We will discuss more strategies for recommending vaccines in subsequent slides.
- "Reducing missed opportunities" means establishing a policy to vaccinate at every visit if vaccinations are indicated. To decrease missed opportunities, providers need to use every patient encounter to screen for, strongly recommend, and offer needed vaccinations to patients, taking advantage of tools, such as the ones shown later in this presentation, to support effective communication with patients and parents.
- Another strategy to increase vaccination coverage is scheduling the next immunization visit before the patient leaves the office.
- Reminder/recall systems are cost-effective methods to identify and notify families when children are due for vaccinations or are already behind. Reminders (for vaccines due soon) and recalls (for overdue vaccines) can be delivered by telephone, text message, letter, postcard, or other methods. Most reminder and recall notices are tailored for individuals, and many include educational messages about the importance of vaccination.

Strategies for High Vaccination Coverage

- Employ Immunization Quality Improvement For Providers (IQIP) Process and Strategies:
  - https://www.cdc.gov/vaccines/programs/iqip/at-a-glance.html
- Maintain thorough documentation in patient records.
- Utilize Immunization Information Systems (IISs)

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Bjork, A., Morelli, V., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/strat.html#quality; https://www.cdc.gov/vaccines/programs/iis/index.html

- The Immunization Quality Improvement for Providers process and strategies promotes and supports implementation of provider-level strategies designed to help increase on-time vaccination of children and adolescents. More information about the IQIP program can be found using the link on this slide.
- Other important strategies consist of good record-keeping through documentation in patient records and the use of immunization information systems to assess vaccination status and record vaccines administered.

Immunization Information Systems (IISs)

- IISs are confidential, computerized databases that record all vaccine doses administered by providers to persons residing within a given geopolitical area.
- IISs provide consolidated immunization histories that help in determining appropriate vaccinations.
- All immunization providers are encouraged to document all administered vaccines in an IIS.

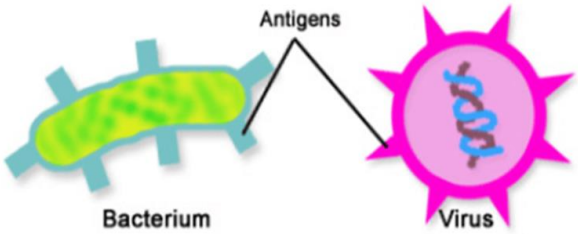
Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Bjork, A., Morelli, V., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/strat.html#quality; About Immunization Information Systems https://www.cdc.gov/vaccines/programs/iis/about.html;

- By 2 years of age, over 20% of children in the U.S. typically have seen more than one health care provider, resulting in scattered paper medical records. Immunization information systems (IISs) help providers and families by consolidating immunization information into one reliable source. IISs are confidential, population-based, computerized information systems that collect and consolidate vaccination data from multiple health care providers within a geographic area.
- Immunization providers are strongly encouraged to participate in an IIS. Laws governing use of IISs vary by state or region. Some states mandate use of an IIS to document vaccinations for certain patients. Providers should be aware of state and/or regional requirements for IIS reporting in their jurisdiction.

IMMUNE SYSTEM/IMMUNOLOGY

Human Immune System

- Complex network of interacting cells and proteins whose purpose is to identify, and elimination of foreign substances called antigen.
- Antigens can either be live or inactivated.

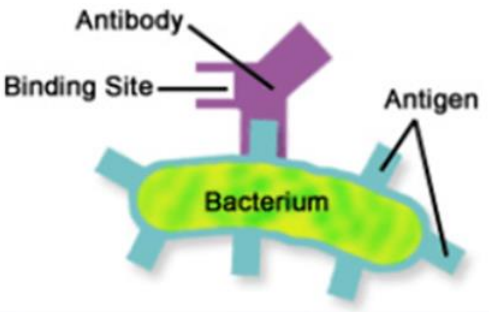


Information and graphic from Centers for Disease Control and Prevention. *You Call the Shots*. Dale Babcock, BS, Jennifer Hamborsky, MPH, MCHES, M. Suzanne Johnson-DeLeon MPH, Tina S. Objio, MSN, MHA, RN, ,Raymond Strikas, MD, MPH, https://www2.cdc.gov/nip/isd/ycts/mod1/courses/gbp/index.html; https://www2.cdc.gov/vaccines/ed/pinkbook/2020/downloads/pb1/PB1.pdf

- Immunology is a complicated subject, and a detailed discussion of it beyond the scope of this presentation. However, an understanding of the basic function of the immune system is useful in order to understand both how vaccines work and the basis of recommendations for their use.
- The immune system is a complex system of organs and infection-fighting cells that work to protect the body against disease. The primary purpose of the immune system's, infection fighting cells is to identify antigens. Antigens are substances that are foreign to the body. They can either by live (microorganisms such as bacteria and viruses) or inactivated.

Human Immune System

- When the immune system identifies antigens invading the body, it goes to work to defend the body against those antigens. This is called the immune response.
- Antibodies are protein molecules that help infection-fighting cells recognize and kill the microorganism.
  - Specific to a single organism or group of closely related organisms



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- When the immune system identifies antigens invading the body, it goes to work to defend the body against those antigens. This is called the immune response.
- The most effective immune responses are generally produced in a response to a live antigen. However, an antigen does not necessarily have to be alive, as occurs with infection with a virus or bacterium, to produce an immune response.
- Antibody production is part of the immune response. Antibodies are protein molecules that help infection-fights cells recognize and bind with antigens. When antibodies on the infection-fighting cells bind with antigens on the microorganism, the infection fighting cells help kill the microorganism.
- Antibodies are generally specific to a single organism or group of closely related organisms. That means that antibodies against one antigen will not protect the body against a different antigen. Each time a new antigen enters the body, the immune system makes a new antibody specifically for that antigen.

Active and Passive Immunity

- Mechanism for acquired immunity
  - Active immunity is protection that is produced by the person's own immune system. (e.g., natural infection, vaccine)
  - Passive immunity is protection produced by animal or human and transferred to another human, usually by injection. (e.g., immune globulin, newborn baby acquires passive immunity from mother through placenta).

Active Immunity [video]

Passive Immunity [video]

Information from Centers for Disease Control and Prevention. *You Call the Shots*. Dale Babcock, BS, Jennifer Hamborsky, MPH, MCHES, M. Suzanne Johnson-DeLeon MPH, Tina S. Objio, MSN, MHA, RN, ,Raymond Strikas, MD, MPH, https://www2.cdc.gov/nip/isd/ycts/mod1/courses/gbp/index.html; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html; https://www.cdc.gov/vaccines/vpd/mmr/public/index.html; https://www.immunize.org/askexperts/experts_mmr.asp. Media files from https://www2.cdc.gov/vaccines/ed/pinkbook/2020/downloads/pb1/PB1.pdf

(play videos)

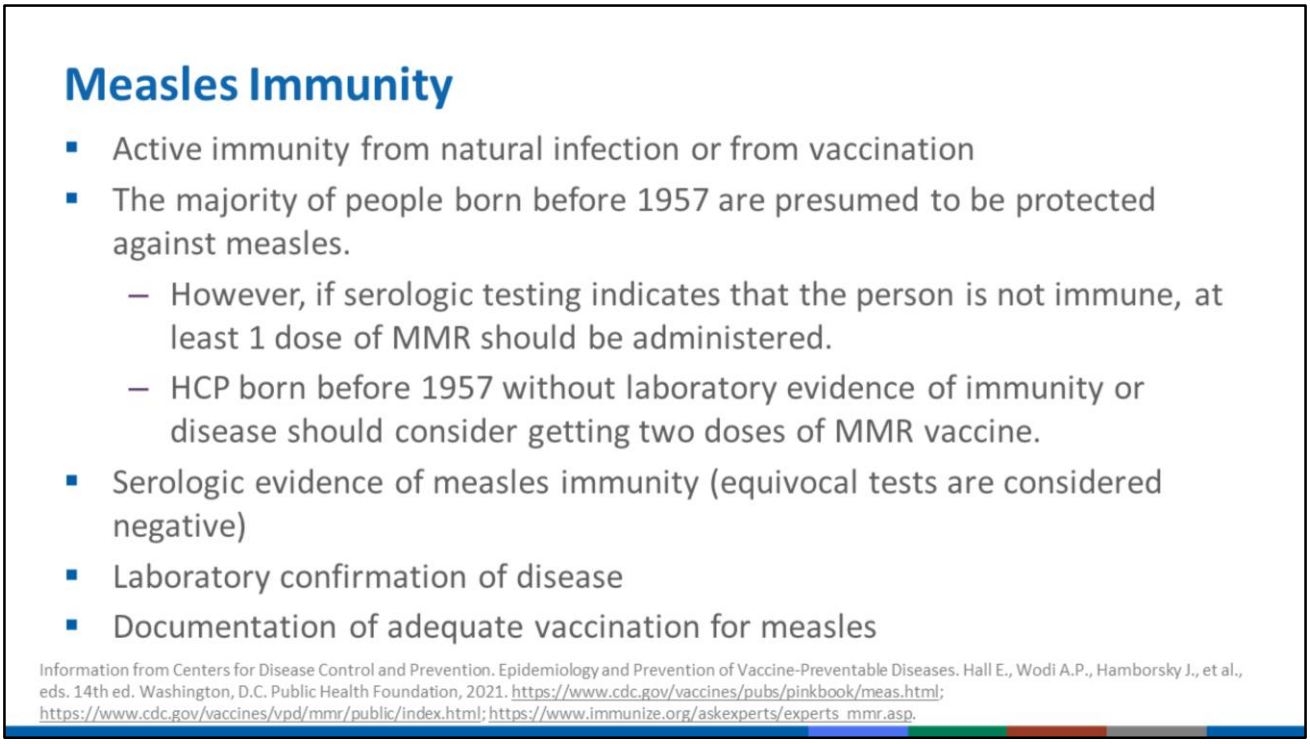
- There are two basic mechanisms for acquired immunity—active and passive.
- Active immunity is protection that is produced by the person's own immune system. This type of immunity usually lasts for many years, often throughout a lifetime.
- Active immunity results when exposure to a disease organism triggers the immune system to produce antibodies to that disease. Exposure to the disease organism can occur through infection with the actual disease (resulting in natural immunity), or introduction of a killed or weakened form of the disease organism through vaccination (vaccine-induced immunity).
- Passive immunity is protection produced by animal or human and transferred to another human, usually by injection. Passive immunity often provides effective protection, but this protection wanes with time, usually within a few weeks or months.
- The most common form of passive immunity is that which an infant receives from its mother. Antibodies are transported across the placenta during the last one to two months of pregnancy. As a result, a full-term infant will have the same antibodies as its mother. These antibodies will protect the infant from certain disease for up to a year. Protection is better against some disease (e.g., measles, rubella, tetanus) than others (e.g., polio, pertussis).
- The video clips on the right describe active and passive immunity in more detail.

Factors Affecting Immune Response to Vaccines

- Host factors
- Maternal antibody
- Nature and dose of antigen
- Route of administration
- Presence of an adjuvant

Information from: https://www.cdc.gov/vaccines/vpd/polio/public/index.html#immunity-against; https://www.cdc.gov/vaccines/vac-gen/immunity-types.htm; https://www.cdc.gov/vaccines/Pubs/pinkbook/downloads/prinvac.pdf

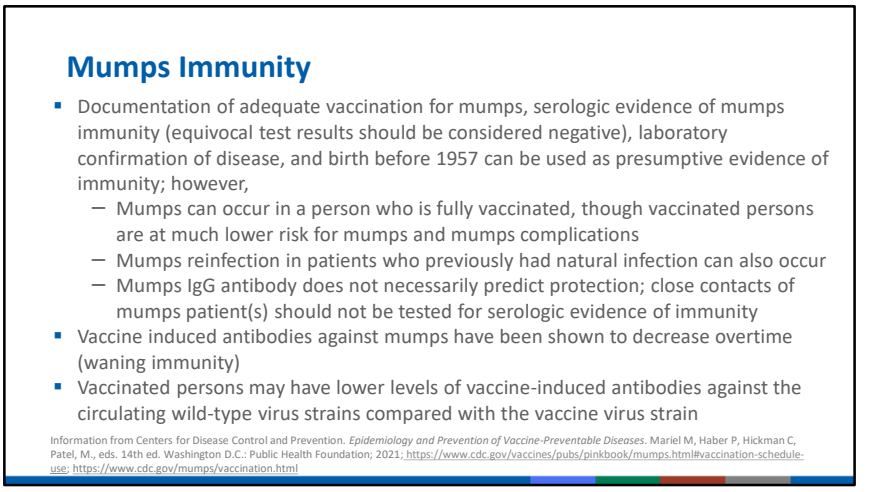
- Many factors may influence the immune response to vaccination. These include host factors such as age, nutritional factors, genetics, and coexisting disease.
- In addition, the presence of maternal antibody and vaccine-specific factors such as nature and dose of antigen, route of administration, and the presence of an adjuvant (e.g., aluminum-containing material added to improve the immunogenicity of the vaccine) can affect the immune response.



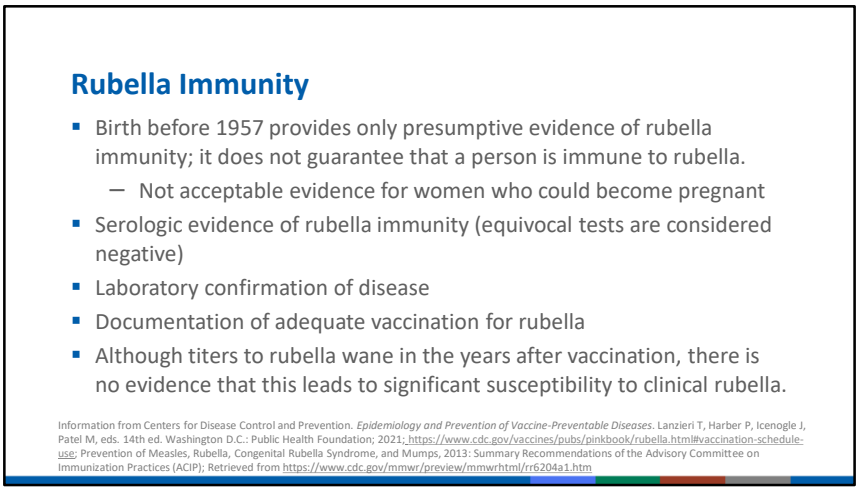
- Long-lasting immunity to measles can be conferred through natural infection or through vaccination.

- Birth before 1957 provides only presumptive evidence for measles, mumps, and rubella. Before vaccines were available, nearly everyone was infected with measles, mumps, and rubella viruses during childhood. The majority of people born before 1957 are likely to have been infected naturally and therefore are presumed to be protected against measles, mumps, and rubella. However, if serologic testing indicates that the person is not immune, at least 1 dose of MMR should be administered. Healthcare personnel born before 1957 without laboratory evidence of immunity or disease should consider getting two doses of MMR vaccine.

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



- Documentation of adequate vaccination for mumps, serologic evidence of mumps immunity (equivocal test results should be considered negative), laboratory confirmation of disease, and birth before 1957 can be used as presumptive evidence of immunity; however,
  - Mumps can occur in a person who is fully vaccinated, though vaccinated persons are at much lower risk for mumps and mumps complications
  - Mumps reinfection in patients who previously had natural infection can also occur
  - Mumps IgG antibody does not necessarily predict protection; close contacts of mumps patient(s) should not be tested for serologic evidence of immunity
- Vaccine induced antibodies against mumps have been shown to decrease overtime (waning immunity)
- Vaccinated persons may have lower levels of vaccine-induced antibodies against the circulating wild-type virus strains compared with the vaccine virus strain



- Generally, persons can be considered immune to rubella if they were born before 1957, have serologic evidence of rubella immunity (equivocal test results should be considered negative), or laboratory confirmation of disease, or have documentation of adequate vaccination for rubella. Birth before 1957 provides only presumptive evidence of rubella immunity; it does not guarantee that a person is immune to rubella. Birth before 1957 is not acceptable evidence of rubella immunity for women who could become pregnant.

- Although titers to rubella wane in the years after vaccination, there is no evidence that this leads to significant susceptibility to clinical rubella or CRS. Clinical rubella and CRS-affected pregnancies are extremely rare in vaccinated persons the United States.

- At least 95% of vaccinated persons age 12 months or older develop serologic evidence of rubella immunity after a single dose, and more than 90% have protection against clinical rubella for at least 15 years. Follow-up studies indicate that 1 dose of vaccine confers long-term, probably lifelong, protection. Seroconversion rates are similar for MMR and MMRV vaccines.

- Clinical diagnosis of rubella is unreliable and should not be considered in assessing immune status. Because many rash illnesses may mimic rubella infection and many rubella infections are unrecognized, the only reliable evidence of previous rubella infection is the presence of serum rubella IgG antibody. Laboratories that regularly perform antibody testing are generally the most reliable.

VACCINE-PREVENTABLE DISEASES

MEASLES

Pathogenesis

- Paramyxovirus causes measles
  - F and H membrane proteins responsible for viral penetration and adsorption of virus to cells
- Primary site of infection is alveolar macrophages or dendritic cells
- Primary viremia 2–3 days after exposure
- Secondary viremia 5–7 days after exposure with spread to tissues

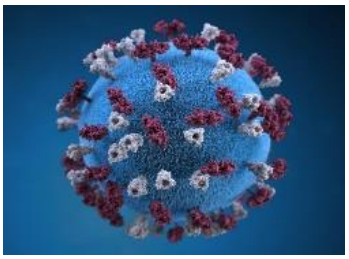


Illustration of measles virus particle

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Gastanaduy P, Haver P, Rota P, Patel M. eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html#pathogenesis; Image source https://phil.cdc.gov/Details.aspx?pid=21074

- The measles virus is a paramyxovirus, genus *Morbillivirus*. It is 120–250 nm in diameter, with a core of single-stranded RNA.
- Two membrane envelope proteins are important in pathogenesis. They are the F (fusion) protein, which is responsible for fusion of virus and host cell membranes, viral penetration, and hemolysis, and the H (hemagglutinin) protein, which is responsible for binding of virus to receptors on host cells.
- Measles is a systemic infection. The primary site of infection is alveolar macrophages or dendritic cells of the lungs. Two to three days after replication in the lung, measles virus spreads to regional lymphoid tissues followed by a systemic infection.
- Following further viral replication in regional and distal reticuloendothelial sites, a second viremia occurs 5 to 7 days after initial infection. During this phase, infected lymphocytes and dendritic cells migrate into the subepithelial cell layer and transmit measles to epithelial cells. Following amplification in the epithelia, the virus is released into the respiratory tract.

Epidemiology

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

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Gastanaduy P, Haver P, Rota P, Patel M eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html#epidemiology

- Reservoir
  - Measles is a human disease. There is no known animal reservoir, and an asymptomatic carrier state has not been documented.
- Transmission
  - Measles transmission is primarily person to person via large respiratory droplets. Airborne transmission via aerosolized droplet nuclei has been documented in closed areas (e.g., office examination room) for up to 2 hours after a person with measles occupied the area.
- Temporal Pattern
  - In endemic, temperate areas, measles disease occurs primarily in late winter and spring.
- Communicability
  - Measles is highly communicable, with greater than 90% secondary attack rates among susceptible persons. Measles may be transmitted from 4 days before to 4 days after rash onset.

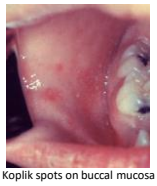
Measles Clinical Features

Prodrome

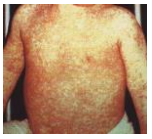
- 3 “Cs” – cough, coryza, and conjunctivitis
- Fever (103°F–105°F)
- Koplik spots on buccal mucosa

Rash

- Emerges 14 days after exposure and persists 5–6 days
- Begins at hairline, then involves face and upper neck
- Progresses downward and outward to hands and feet
- Severe areas peel off in scales
- Fades in order of appearance



Koplik spots on buccal mucosa



Maculopapular measles rash

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Gastanaduy P, Haver P, Rota P, Patel M eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html#clinical; https://www.cdc.gov/measles/hcp/index.html; Image sources: https://www.cdc.gov/measles/symptoms/photos.html https://phil.cdc.gov/Details.aspx?pid=21074.

- The incubation period of measles from exposure to prodrome averages 11 to 12 days. The time from exposure to rash onset averages 14 days, with a range of 7 to 21 days.

- The prodrome period is the time when patient presents with initial signs and symptoms of illness. This period lasts 2 to 4 days and is characterized by what you may have heard people refer to the classic three “Cs” of measles: cough, coryza (or inflammation and congestion of mucous membranes in the nose), and conjunctivitis (or inflammation of the inner surface of the eyelids, sometimes called “pink eye”). Fever is often also present fever, which increases in a stepwise fashion often peaking as high as 103°F to 105°F.

- In addition, sometimes Koplik [*pronounced “cop-lick”]* spots can be found in the mouth. Koplik spots, present on mucous membranes, are considered to be unique to measles. They occur 1 to 2 days before the measles rash (i.e., during the prodromal period), and appear as punctate blue-white spots on the bright red background of the buccal mucosa (as seen in the image on the right).

- The characteristic measles rash appears about 14 days after exposure. As seen in the bottom image, it is a maculopapular rash, with small bumps that become confluent, which means they run together. The rash is caused by deposits of measles antibody in the skin and may appear red in lighter-skinned people.

- The measles rash usually lasts 5 to 6 days. It begins at the hairline, then involves the face and upper neck. During the next 3 days, the rash gradually proceeds downward and outward, reaching the hands and feet. The lesions are generally individually distinct but may run together, particularly on the upper body. Initially, lesions blanch (become white or pale) with fingertip pressure. By 3 to 4 days, most do not blanch with pressure. The lesions peel off in scales in more severely involved areas. The rash fades in the same order that it appears, from head to extremities.

- Other symptoms of measles include anorexia and generalized lymphadenopathy.

Measles Clinical Features

Information from Centers for Disease Control and Prevention. *Measles Clinical Features* (2019) Retrieved from: https://www.youtube.com/watch?v=lBWgc2QubzI.

In this video, CDC's Dr. Manisha Patel describes clinical features of measles, how to diagnose it in a patient, and what to do if you suspect you have a case.

Measles Clinical Manifestations

- **People at high risk for severe illness and complications from measles include:**
  - Infants and children younger than 5 years
  - Adults older than 20 years
  - Pregnant women
  - People with compromised immune systems (e.g., leukemia, HIV infection)

Information from Centers for Disease Control and Prevention. *Complications of Measles*. 2020; https://www.cdc.gov/measles/symptoms/complications.html

- Measles can be serious in all age groups. However, there are several groups that are more likely to suffer from measles complications:
  - Children younger than 5 years of age
  - Adults older than 20 years of age
  - Pregnant women. Measles may cause pregnant women who have not had the MMR vaccine to **give birth prematurely or have a low-birth-weight baby.**
  - People with compromised immune systems, such as from leukemia or HIV infection

Measles Complications

Common complications

- Otitis media
- Diarrhea

Serious complications

- Pneumonia
- Encephalitis
- Death

Child hospitalized for complications of measles

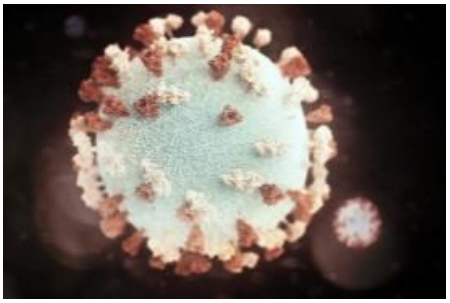
Information and image from Centers for Disease Control and Prevention. *Complications of Measles*. 2020; https://www.cdc.gov/measles/symptoms/complications.html

- Common complications of measles include ear infections and diarrhea. **Ear infections** occur in about one out of every 10 children with measles. **Diarrhea** is reported in less than one out of 10 people with measles.
- Some people may suffer from severe complications, such as pneumonia (infection of the lungs) and encephalitis (swelling of the brain). They may need to be hospitalized and could die.
- As many as 1 out of every 20 children with measles gets pneumonia, the most common cause of **death from measles in young children.**
- About 1 child out of every 1,000 who get measles will develop encephalitis (swelling of the brain) that can lead to convulsions and can **leave the child deaf or with intellectual disability**.
- Nearly 1 to 3 of every 1,000 children who become infected with measles will **die from respiratory and neurologic complications.**

MUMPS

Pathogenesis

- Mumps virus is a paramyxovirus.
- Transmitted through respiratory droplets
- Replication in nasopharynx and regional lymph nodes
- Parotitis onset 12 to 25 days after exposure with spread to tissues
- Multiple tissues infected during viremia



3D graphic representation of a spherical-shaped mumps virus particle

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Mariel M, Haber P, Hickman C, Patel, M., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/mumps.html#pathogenesis; https://www.cdc.gov/mumps/hcp.html#clinical

Image source: https://phil.cdc.gov/Details.aspx?pid=21073.

- Mumps virus is a paramyxovirus in the same group as parainfluenza and Newcastle disease virus. The virus has a single-stranded RNA genome.
- The virus is transmitted through respiratory droplets. It replicates in the nasopharynx and regional lymph nodes.
- Parotitis, which lasts from 3 to 5 days, onsets 12 to 25 days after exposure and spreads to tissues.
- During the viremia, the virus spreads to multiple tissues, including the meninges, and glands such as the salivary, pancreas, testes, and ovaries. Inflammation in infected tissues leads to characteristic symptoms of parotitis and aseptic meningitis.

Epidemiology

Reservoir	Human
Transmission	Inhalation or direct contact with infectious respiratory droplet secretions or saliva
Temporal pattern	No temporal pattern
Communicability	2 days before through 5 days after onset of parotitis

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Mariel M, Haber P, Hickman C, Patel, M., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/mumps.html#epidemiology

- **Reservoir:** Mumps is a human disease. Although persons with asymptomatic or nonclassical infection can transmit the virus, no carrier state is known to exist.
- **Transmission:** For mumps transmission, mumps is spread by person to person through direct contact or inhalation of respiratory droplets or saliva of infected person, so you can think of mumps as about as infectious as influenza, but less infectious than measles.
- **Temporal Pattern:** Mumps is reported throughout the year. There is no temporal pattern.
- **Communicability:** Although mumps virus has been isolated from seven days before, through 11–14 days after parotitis onset, the highest percentage of positive isolations and the highest virus loads occur closest to parotitis onset and decrease rapidly thereafter. The infectious period is considered 2 days before until 5 days after parotitis onset. Transmission also likely occurs from persons with asymptomatic infections and from persons with prodromal symptoms.

Mumps

- Prevaccine era: 15%–24% of infections were asymptomatic

Signs and symptoms

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

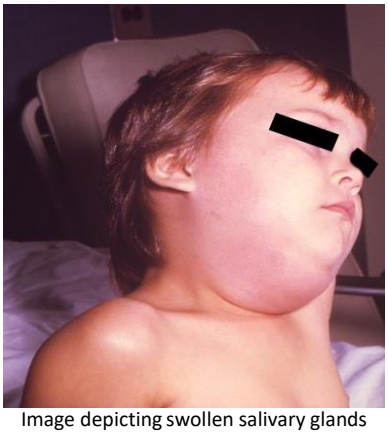


Image depicting swollen salivary glands characteristic of mumps

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Mariel M, Haber P, Hickman C, Patel, M., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/mumps.html#epidemiology

Image source https://phil.cdc.gov/details.aspx?pid=130.

- Before a vaccine was available, between 15% and 24% of persons who were infected with mumps had no symptoms at all.
- 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 Clinical Manifestations

Most common complications

- Orchitis (inflammation of the testicles)
  - As many as 30% of unvaccinated and 6% of vaccinated post-pubertal males with mumps develop orchitis

Other less common complications

- Oophoritis
- Mastitis
- Pancreatitis
- Unilateral deafness
- Meningitis
- Death

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Mariel M, Haber P, Hickman C, Patel, M., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/mumps/hcp.html; https://www.cdc.gov/vaccines/pubs/pinkbook/mumps.html#clinical-features

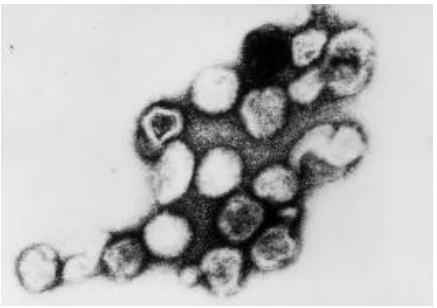
- Orchitis, or swelling of the testes, is the most common mumps complication in post-pubertal males. As many as 30% of unvaccinated and 6% of vaccinated post-pubertal males with mumps develop orchitis. While there is a theoretical risk for sterility given men with orchitis can develop testicular atrophy, low sperm count, or reduced sperm motility, no studies have assessed risk for infertility among men with mumps orchitis.

- Other less common complications seen in the vaccine era included:
  - Oophoritis (inflammation of the ovaries)
  - Mastitis (inflammation of breast tissue)
  - Pancreatitis (inflammation of the pancreas)
  - Unilateral deafness, which occurred in 1 out of 20,000 cases, although severe hearing loss on both sides was rare
  - Meningitis (inflammation of the brain and spinal cord membranes)
  - Death (between 1966 and 1971, there were 2 deaths per 10,000 reported cases)

RUBELLA

Pathogenesis

- Respiratory transmission of virus
- Replication in nasopharynx and regional lymph nodes
- Possible transplacental infection of fetus during viremia
  - Hearing impairment and ocular and cardiovascular abnormalities may result



Rubella Viral Particles

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Lanzieri T, Harber P, Icenogle J, Patel M, eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/rubella.html#pathogenesis;
Image source https://phil.cdc.gov/Details.aspx?pid=269.

- Rubella virus is classified as a togavirus, genus Rubivirus.
- Following respiratory transmission, the virus replicates in the nasopharynx and regional lymph nodes. In a pregnant woman, placental infection occurs during viremia and may lead to transplacental fetal infection. Fetal damage occurs through destruction of cells, as well as disruption of cell division. Fetal infection often results in a persistent infection typically leading to hearing impairment and ocular and cardiovascular abnormalities.

Epidemiology

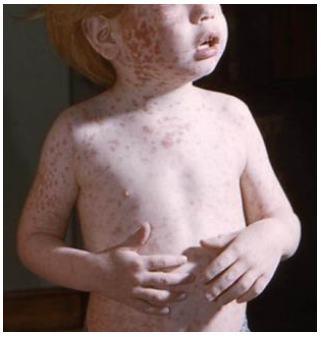
Reservoir	Human
Transmission	Person-to-person via droplets
Temporal pattern	No known temporal pattern
Communicability	7 days before to 5–7 days after rash onset Infants with congenital rubella syndrome may shed virus for a year or more

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Lanzieri T, Harber P, Icenogle J, Patel M, eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/rubella.html#epidemiology

- Reservoir: Rubella is a human disease. There is no known animal reservoir and no evidence of insect transmission. Infants with CRS may shed rubella virus for an extended period.
- Transmission: Rubella is spread from person-to-person via direct contact or droplets shed from the respiratory secretions of infected persons. Rubella may be transmitted by persons with subclinical or asymptomatic cases (up to 50% of all rubella virus infections).
- Temporal Pattern: Since rubella elimination in the United States, sporadic cases of rubella have been imported or linked to an imported case, with no temporal pattern.
- Communicability: Rubella is most contagious when the rash first appears, but virus may be shed from 7 days before to 7 days after rash onset. Infants with CRS shed large quantities of virus from body secretions for up to 1 year and can therefore transmit rubella to persons caring for them who are susceptible to the disease.

Rubella Clinical Manifestations

- Incubation period 14 days (range, 12 to 23 days)
- Rash first symptom in young children
- Prodrome with low-grade fever, malaise, lymphadenopathy, and upper respiratory symptoms before rash in older children and adults
- Maculopapular rash 14 to 17 days after exposure
- Arthralgia common in adult women



Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Lanzieri T, Harber P, Icenogle J, Patel M, eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/rubella.html#clinical-features; https://www.cdc.gov/rubella/hcp.html;
Image source https://phil.cdc.gov/Details.aspx?pid=22144;

- The average incubation period of rubella is 14 days, with a range of 12 to 23 days. Symptoms are often mild, and up to 50% of infections may be subclinical or inapparent. In young children, rash is usually the first symptom. In older children and adults, there may be a 1- to 5-day prodrome with low-grade fever, malaise, lymphadenopathy, and upper respiratory symptoms preceding the rash. Lymphadenopathy may begin a week before the rash and last several weeks.

- The rubella rash, shown in the image on the right, is maculopapular and occurs 14 to 17 days after exposure. The rash usually occurs initially on the face and then progresses from head to foot. It lasts about 3 days and is occasionally pruritic. The rash is fainter than a measles rash, does not coalesce, and is often more prominent after a hot shower or bath. Postauricular, posterior cervical, and suboccipital nodes may be involved.

- Arthralgia (joint pain) and arthritis are rare in children and adult males but occur frequently in adult women. Joint symptoms tend to occur at about the same time or shortly after the rash appears and may last for up to 1 month. Fingers, wrists, and knees are often affected. Chronic arthritis is rare. Other symptoms of rubella include conjunctivitis, testalgia, or orchitis. Small, red (Forschheimer) spots may be noted on the soft palate but are not diagnostic for rubella.

Rubella Complications

- Hemorrhagic manifestations (e.g., thrombocytopenic purpura) 1 in 3000 cases
- Encephalitis 1 in 6000 cases
- Other rare complications—granulomas, orchitis, neuritis, progressive panencephalitis

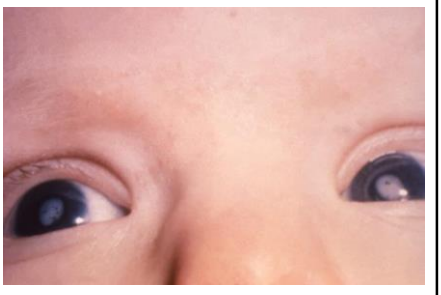
Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Lanzieri T, Harber P, Icenogle J, Patel M, eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/rubella.html#clinical-features; https://www.cdc.gov/rubella/hcp.html;

- Complications of rubella are rare. Hemorrhagic manifestations occur in approximately 1 per 3,000 cases. These manifestations may be secondary to low platelets and vascular damage, with thrombocytopenic purpura being the most common. Gastrointestinal, cerebral, or intrarenal hemorrhage may also occur. Effects may last from days to months, and most patients recover. Encephalitis occurs in 1 in 6,000 cases and may be fatal.

- Additional rare complications include granulomas in persons with primary immune deficiencies, orchitis, neuritis, and a late syndrome of progressive panencephalitis.

Congenital Rubella Syndrome (CRS)

- Prevention of CRS is the main objective of rubella vaccination programs
- May lead to miscarriages, stillbirths, and birth defects
- Birth defects may include deafness, eye abnormalities, and congenital heart disease



Cataracts of the lenses due to a case of CRS

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Lanzieri T, Harber P, Icenogle J, Patel M, eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/rubella.html#clinical-features; https://www.cdc.gov/vaccines/pubs/surv-manual/chpt15-crs.html;

Image source https://phil.cdc.gov/Details.aspx?pid=4284;

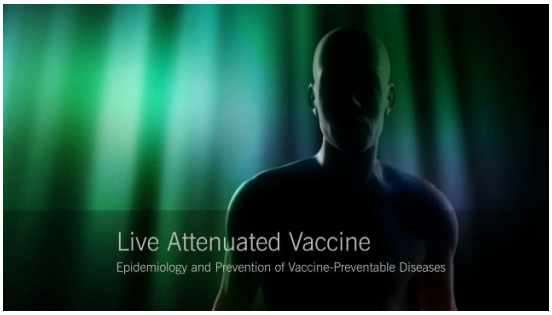
- Prevention of congenital rubella syndrome (CRS) is the main objective of rubella vaccination programs.
- Infection with rubella virus is most consequential in early gestation and can lead to miscarriages, stillbirths, and severe birth defects in infants. The risk of CRS is highest when a woman acquires rubella during the first 12 weeks of gestation. Congenital infection with rubella virus can affect many organ systems. Congenital rubella syndrome includes a constellation of birth defects, such as deafness, eye abnormalities (cataracts, glaucoma, retinopathy, microphthalmia), and congenital heart disease.

TYPE OF VACCINE

Type of Vaccine

Live, attenuated vaccine (weakened form of the organism)

- Must replicate to produce an immune response by the same mechanism as natural infection
- Derived from "wild" viruses or bacteria that are weakened so that they will not cause disease in a person with competent immune system



Live Attenuated Vaccine [Video]

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Wodi, A.P., Morelli, V., eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/prinvac.html#classification;
Media file from https://www2.cdc.gov/vaccines/ed/pinkbook/2020/downloads/pb1/PB1.pdf

- MMR vaccines are live, attenuated vaccines.
- To produce an immune response, live attenuated vaccines must replicate (grow) in the vaccinated person by the same mechanism as the natural infection. A relatively small dose of virus or bacteria is administered, which replicates in the body and creates enough of the organism to stimulate an immune response.
- Live vaccines are derived from "wild" viruses or bacteria that are weakened so that they will not cause disease in a person with a competent immune system, but they will induce a protective immune response in most vaccinated persons.
- The video on the right provides more detail about live, attenuated vaccines.

MMR Vaccine Products

- MMR
  - M-M-R II® is a combination measles, mumps, and rubella (MMR) vaccine.
  - Live, attenuated viruses
  - Indicated for individuals 12 months of age or older

- MMRV
  - ProQuad® is a combination measles, mumps, rubella, and varicella (MMRV) vaccine.
  - Live, attenuated viruses
  - Indicated for individuals 12 months of age through 12 years of age

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021.; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html#vaccine

- There are no longer any single-component measles, mumps, or rubella vaccines licensed in the U.S.

- MMR is the combined, live vaccine that contains all three attenuated viral antigens.
  - As long as there are no medical contraindications, MMR can be used in individuals 12 months of age and older.

- MMRV is a combination, live vaccine that contains attenuated measles, mumps, rubella, and varicella viral antigens.
  - As long as there are no medical contraindications, MMRV can be used in anyone 12 months of age through 12 years of age. It is not approved by the FDA or recommended by ACIP for anyone 13 years of age or older.
  - You should never mix MMR and varicella vaccines to get MMRV.

Vaccine Effectiveness

MMR

- Measles: 93% after one dose; 97% after two doses
- Mumps: 78% after one dose; 88% after two doses
- Rubella: 97% after one dose

MMRV

- Inferred from MMR vaccine and varicella vaccine, based on noninferior immunogenicity

Information from Centers for Disease Control and Prevention. *Measles, Mumps, and Rubella (MMR) Vaccination: What Everyone Should Know*. (2021) https://www.cdc.gov/vaccines/vpd/mmr/public/index.html. Marin M, Marlow M, Moore KL, Patel M. Recommendation of the Advisory Committee on Immunization Practices for Use of a Third Dose of Mumps Virus–Containing Vaccine in Persons at Increased Risk for Mumps During an Outbreak. MMWR Morb Mortal Wkly Rep 2018;67:33–38. DOI: http://dx.doi.org/10.15585/mmwr.mm6701a7external icon

- MMR vaccine is very effective at protecting people against measles, mumps, and rubella, and preventing the complications caused by these diseases. People who receive MMR vaccination according to the U.S. vaccination schedule are usually considered protected for life against measles and rubella. While MMR provides effective protection against mumps for most people, immunity against mumps may decrease over time and some people may no longer be protected against mumps later in life. An additional dose may be needed if you are at risk because of a mumps outbreak.

- One dose of MMR vaccine is 93% effective against measles, 78% effective against mumps, and 97% effective against rubella.

- Two doses of MMR vaccine are 97% effective against measles and 88% effective against mumps.

- MMRV vaccine was licensed on the basis of non-inferior immunogenicity compared with administration of MMR and varicella at the same time, therefore the two vaccination options are considered to provide the same protection against the respective diseases. MMRV vaccine is associated with an increased risk for fever and febrile seizures among children aged 12-23 months of age during the 5-12 days after the first dose compared with the use of MMR vaccine and varicella vaccine at the same visit. However, among children who received the second dose of MMRV vaccine at age 4-6 years data do not suggest an increased risk for febrile seizures.

IMMUNIZATION SCHEDULES

Advisory Committee on Immunization Practices (ACIP)

- A group of medical and public health experts who develop recommendations for the use of vaccines in the civilian population of the United States
- Provides guidance on use of vaccines and other biologic products to U.S. Department of Health and Human Services, CDC, and the U.S. Public Health Service
- ACIP recommendations are standard of care in the U.S.

Information from Advisory Committee on Immunization Practices https://www.cdc.gov/vaccines/acip/committee/index.html

The Advisory Committee on Immunization Practices (ACIP) is a group of medical and public health experts that develops recommendations for the use of vaccines in the civilian population of the United States. ACIP recommendations are considered standard of care in the U.S.

ACIP MMR Vaccine Recommendations: Pediatric

Routine pediatric recommendations are found in the Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger.

Information from Centers for Disease Control and Prevention. (2022) *Immunization Schedules*. Retrieved from https://www.cdc.gov/vaccines/schedules/index.html

- This is Table 1 from the 2022 Recommended Child and Adolescent Immunization Schedule for persons aged 18 years or younger.
- For routine administration:
  - The purple bar indicates a recommendation for high-risk children between 6 and 11 months who will be traveling internationally. Notes referenced in this purple bar can be found use the link to the childhood/adolescent immunization schedule at the bottom of the slide.
  - The yellow bar represents the 12- through 15-month age range for dose 1 and the 4 through 6-year age range for dose 2.
  - The green bars represent catch-up immunization for those who did not receive doses on time.
  - So, if the child did not receive the first dose by 15 months of age, then they should receive that dose as soon as possible and the same holds true for those who did not receive the second dose by 6 years of age.

Vaccination Schedule: First Dose of MMR

- 2-dose series beginning at 12–15 months of age
  - Minimum age is 12 months.
  - Doses given before 12 months of age are not counted as valid.
- Infants as young as 6 months should receive MMR before international travel.
  - Revaccinate at 12 months of age or older.

Measles travel case studies

Information from Information from Centers for Disease Control and Prevention. *Routine Measles, Mumps, and Rubella Vaccination*. (2021). https://www.cdc.gov/vaccines/vpd/mmr/hcp/recommendations.html; www.cdc.gov/mmwr/pdf/rr/rr6204.pdf.
Video from https://www.cdc.gov/measles/resources/multimedia.html

- MMR is administered as a 2-dose series. The first dose of MMR is routinely recommended for children between 12 and 15 months of age.
- The minimum age for a routine dose is 12 months.
- A dose administered more than 4 days before the first birthday does not count as one of the 2 valid doses; this is known as the 4-day grace period. A dose given more than 4 days before the first birthday should be repeated once the child is 12 months of age (as long as at least 4 weeks have elapsed since the invalid dose.
- Before any international travel—Infants 6 through 11 months of age should receive one dose of MMR vaccine. This dose does not count as part of the routine childhood vaccination. Infants who get one dose of MMR vaccine before their first birthday should get two more doses according to the routinely recommended schedule.
- There are several helpful case studies on MMR vaccine for children traveling internationally that can be found at the link shown under the video on this slide.

Vaccination Schedule: Second Dose of MMR

- Second dose at 4–6 years of age
  - May be administered before age 4 years (4-week minimum interval from initial dose)
  - Not a booster, but rather is intended to produce immunity in the small number of people who fail to respond to the first dose
  - People who received 2 doses of MMR vaccine as children according to the U.S. vaccination schedule are considered protected for life against measles and rubella.

Information from Immunization Action Coalition. *Measles, Mumps and Rubella. (2020).* Retrieved from https://www.immunize.org/askexperts/experts_mmr.asp; www.cdc.gov/mmwr/pdf/rr/rr6204.pdf

- The second dose is routinely recommended at 4 to 6 years of age, but it is considered valid given at any age as long as it is given 4 weeks after the first dose. If international travel is planned for a child older than 12 months of age, the second MMR dose should be given before traveling as long as 4 weeks have elapsed since the first dose.
- The second dose is not a booster, but rather is intended to produce immunity in the small number of people who fail to respond to the first dose.
- People who received 2 doses of MMR vaccine as children are considered to be protected for life against measles and rubella and do not need routine booster doses.

Vaccination Schedule: MMRV

- First dose
  - Recommendation to administer first dose at 12 through 15 months of age
  - Minimum age is 12 months
- Second dose
  - Recommendation is to administer second dose at 4 through 6 years of age.
  - May be given any time before 13th birthday at least 3 months (minimum interval) after the first dose

Information from Centers for Disease Control and Prevention. Use of Combination Measles, Mumps, Rubella and Varicella Vaccine: Recommendations of the Advisory Committee on Immunization Practices. (2010) Retrieved from www.cdc.gov/mmwr/pdf/rr/rr5903.pdf; https://www.cdc.gov/vaccines/vpd/mmr/public/index.html.

- We will now discuss recommendations for MMRV vaccine. If a provider is considering administering MMRV instead of separate MMR and varicella vaccines for the first dose in this age group, the benefits and risks of both options should be discussed with the parent or caregiver.
- If MMRV is chose for the first dose, CDC recommends administering this dose at 12 through 15 months of age. The minimum age of use is 12 months of age.
- CDC recommends administering the second dose of MMR at 4 through 6 years of age. However, the second dose of MMR may be given any time before 13th birthday at least 3 months (minimum interval) after the first dose.

ACIP MMR Vaccine Recommendations: Adult

- 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

MMR Vaccine Guideline for different 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 mm³	≥15% and ≥200 mm³							
MMR	Contraindicated*	Contraindicated		1 or 2 doses depending on indication							

Adult Immunization Schedule Recommendations for Ages 19 years or older, United States, 2022

Information from Centers for Disease Control and Prevention. *Recommended Adult Immunization Schedule*. (2022); https://www.cdc.gov/vaccines/schedules/downloads/adult/adult-combined-schedule.pdf

- Here is an image from the CDC 2022 Recommended Adult Immunization Schedule. As seen, an adult born in 1957 or later without evidence of immunity should receive 1 or 2 doses of MMR.
- (Yellow) Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection.
- Many people with medical indications shown in the bottom table can be vaccinated with MMR vaccine. However, MMR is contraindicated for pregnant women and immunocompromised persons.
  - (Red) Contraindicated or not recommended—vaccine should not be administered. *Vaccinate after pregnancy.
- Other precautions and contraindications to MMR vaccination will be discussed in a subsequent slide.

Measles, Mumps, and Rubella — Special Situations

- **Pregnancy with no evidence of immunity to rubella**: MMR contraindicated during pregnancy; after pregnancy (before discharge from health care facility), 1 dose
- **Nonpregnant women of childbearing age with no evidence of immunity to rubella**: 1 dose
- **HIV infection with CD4 count ≥200 cells/mm3 for at least 6 months and no evidence of immunity to measles, mumps, or rubella**: 2-dose series at least 4 weeks apart; MMR contraindicated for HIV infection with CD4 count <200 cells/mm3
- **Severe immunocompromising conditions**: MMR contraindicated
- **Students in postsecondary educational institutions, international travelers, and household or close, personal contacts of immunocompromised persons with no evidence of immunity to measles, mumps, or rubella**: 2-dose series at least 4 weeks apart if previously did not receive any doses of MMR or 1 dose if previously received 1 dose MMR

Information from https://www.cdc.gov/vaccines/schedules/downloads/adult/adult-combined-schedule.pdf;

- **Pregnancy with no evidence of immunity to rubella**: MMR contraindicated during pregnancy; after pregnancy (before discharge from health care facility), 1 dose
- **Nonpregnant women of childbearing age with no evidence of immunity to rubella**: 1 dose
- **HIV infection with CD4 count ≥200 cells/mm3 for at least 6 months and no evidence of immunity to measles, mumps, or rubella**: 2-dose series at least 4 weeks apart; MMR contraindicated for HIV infection with CD4 count <200 cells/mm3
- **Severe immunocompromising conditions**: MMR contraindicated
- **Students in postsecondary educational institutions, international travelers, and household or close, personal contacts of immunocompromised persons with no evidence of immunity to measles, mumps, or rubella**: 2-dose series at least 4 weeks apart if previously did not receive any doses of MMR or 1 dose if previously received 1 dose MMR

Measles, Mumps, and Rubella — Special Situations

- **Health care personnel**:
  - Born in 1957 or later with no evidence of immunity to measles, mumps, or rubella: 2-dose series at least 4 weeks apart for measles or mumps or at least 1 dose for rubella
  - Born before 1957 with no evidence of immunity to measles, mumps, or rubella: Consider 2-dose series at least 4 weeks apart for measles or mumps or 1 dose for rubella
- **Child International travel:**
  - Infants age 6–11 months: 1 dose before departure; revaccinate with 2-dose series at age 12–15 months (12 months for children in high-risk areas) and dose 2 as early as 4 weeks later.
  - Unvaccinated children age 12 months or older: 2-dose series at least 4 weeks apart before departure

Information from https://www.cdc.gov/vaccines/schedules/downloads/adult/adult-combined-schedule.pdf; https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html

- **Health care personnel**:
  - Born in 1957 or later with no evidence of immunity to measles, mumps, or rubella: 2-dose series at least 4 weeks apart for measles or mumps or at least 1 dose for rubella
  - Born before 1957 with no evidence of immunity to measles, mumps, or rubella: Consider 2-dose series at least 4 weeks apart for measles or mumps or 1 dose for rubella
- **Child International travel:**
  - Infants age 6–11 months: 1 dose before departure; revaccinate with 2-dose series at age 12–15 months (12 months for children in high-risk areas) and dose 2 as early as 4 weeks later.
  - Unvaccinated children age 12 months or older: 2-dose series at least 4 weeks apart before departure

Vaccination of Special Populations: 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, regardless if they have presumptive evidence of immunity.

Information from https://www.cdc.gov/vaccines/vpd/mmr/hcp/recommendations.html.

- 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, regardless if they have presumptive evidence of immunity.

Vaccination of Special Populations: Health Care Personnel (HCP)

- Serologic testing is not recommended for HCP with 2 documented, appropriately spaced doses of MMR.
  - If they are tested and results are negative or equivocal for measles, mumps, and/or rubella, NO additional MMR doses are recommended.
- Adults without evidence of immunity who work at a health care facility: 2 doses of MMR for measles or mumps or 1 dose for rubella
  - A third dose of MMR can be administered to adults who previously received 2 or more doses of mumps-containing vaccine and are identified by public health authority to be at increased risk for mumps in an outbreak.

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases.* Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html; https://www.cdc.gov/vaccines/vpd/mmr/hcp/recommendations.html.

- As we discussed, birth before 1957 generally is considered acceptable evidence of measles, mumps, and rubella immunity. However, for anyone born before 1957 who works in a health care facility and is unvaccinated and lacks laboratory evidence of immunity or laboratory confirmation of disease, CDC recommends that facilities vaccinate with 2 doses of MMR to protect against measles and mumps and 1 dose of MMR to protect against rubella.
- Serologic testing for immunity is not recommended for HCP with 2 documented, appropriately spaced doses of MMR.
- If HCP are tested and results are negative or equivocal for measles, mumps, and/or rubella, NO additional MMR doses are recommended.

Measles, Mumps, Rubella Serologic Testing

- Serologic screening does not need to be done before vaccinating for measles, mumps, or rubella.
- Do NOT test persons with documented history of MMR vaccination.
- Post-vaccination serologic testing to verify immunity is not recommended.
  - Documented, age-appropriate vaccination supersedes the results of subsequent serologic testing.

Information from www.cdc.gov/mmwr/pdf/rr/rr6204.pdf

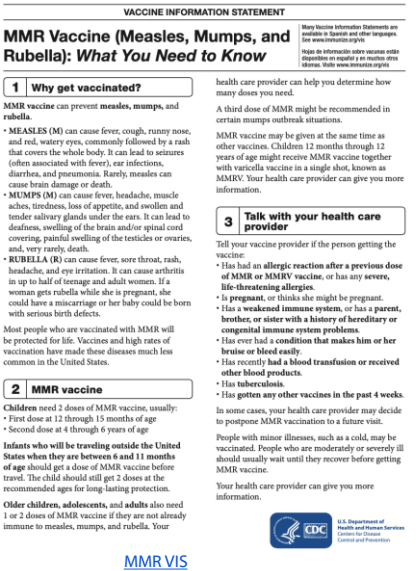
- Serologic testing does not need to be done before vaccinating for measles and rubella unless a health care facility considers it cost-effective. It would be appropriate if tracking systems are used to make sure those who are found to be susceptible are then vaccinated in a timely manner.
- If someone has documented evidence of immunity, they are considered immune and CDC does not recommend serologic testing to verify immunity.
- Do NOT test persons with a documented history of MMR vaccination.
- Post-vaccination serologic testing to verify an immune response is not recommended. Documented, age-appropriate vaccination supersedes the results of subsequent serologic testing.

COMMUNICATIONS

CDC Vaccine Information Statement (VIS)

- Federal law requires that a VIS be provided to a patient, parent, or legal representative before each dose of certain vaccines.

- VISs explain both the benefits and risks of the vaccine the patient is receiving.



VACCINE INFORMATION STATEMENT

MMR Vaccine (Measles, Mumps, and Rubella): *What You Need to Know*

Many Vaccine Information Statements are available in Spanish and other languages. See www.immunize.org/vis

Hojas de información sobre vacunas están disponibles en español y en muchos otros idiomas. Visite www.immunize.org/vis

1 Why get vaccinated?

MMR vaccine can prevent **measles, mumps,** and **rubella**.

- **MEASLES (M)** can cause fever, cough, runny nose, and red, watery eyes, commonly followed by a rash that covers the whole body. It can lead to seizures (often associated with fever), ear infections, diarrhea, and pneumonia. Rarely, measles can cause brain damage or death.
- **MUMPS (M)** can cause fever, headache, muscle aches, tiredness, loss of appetite, and swollen and tender salivary glands under the ears. It can lead to deafness, swelling of the brain and/or spinal cord covering, painful swelling of the testicles or ovaries, and, very rarely, death.
- **RUBELLA (R)** can cause fever, sore throat, rash, headache, and eye irritation. It can cause arthritis in up to half of teenage and adult women. If a woman gets rubella while she is pregnant, she could have a miscarriage or her baby could be born with serious birth defects.

Most people who are vaccinated with MMR will be protected for life. Vaccines and high rates of vaccination have made these diseases much less common in the United States.

2 MMR vaccine

Children need 2 doses of MMR vaccine, usually:
- First dose at 12 through 15 months of age
- Second dose at 4 through 6 years of age

Infants who will be traveling outside the United States when they are between 6 and 11 months of age should get a dose of MMR vaccine before travel. The child should still get 2 doses at the recommended ages for long-lasting protection.

Older children, adolescents, and **adults** also need 1 or 2 doses of MMR vaccine if they are not already immune to measles, mumps, and rubella. Your health care provider can help you determine how many doses you need.

A third dose of MMR might be recommended in certain mumps outbreak situations.

MMR vaccine may be given at the same time as other vaccines. Children 12 months through 12 years of age might receive MMR vaccine together with varicella vaccine in a single shot, known as MMRV. Your health care provider can give you more information.

3 Talk with your health care provider

Tell your vaccine provider if the person getting the vaccine:
- Has had an **allergic reaction after a previous dose of MMR or MMRV vaccine**, or has any **severe, life-threatening allergies**.
- Is **pregnant**, or thinks she might be pregnant.
- Has a **weakened immune system**, or has a **parent, brother, or sister with a history of hereditary or congenital immune system problems**.
- Has ever had a **condition that makes him or her bruise or bleed easily**.
- Has recently **had a blood transfusion or received other blood products**.
- Has **tuberculosis**.
- Has **gotten any other vaccines in the past 4 weeks**.

In some cases, your health care provider may decide to postpone MMR vaccination to a future visit.

People with minor illnesses, such as a cold, may be vaccinated. People who are moderately or severely ill should usually wait until they recover before getting MMR vaccine.

Your health care provider can give you more information.

CDC U.S. Department of Health and Human Services Centers for Disease Control and Prevention

MMR VIS

Information from vaccine information statements www.cdc.gov/vaccines/hcp/vis/;
Foreign language versions https://www.immunize.org/vis/.

- All public and private vaccine providers are required by the National Childhood Vaccine Injury Act to give the appropriate VIS to the patient (or their parent or legal representative) prior to every dose of certain vaccines. VISs have been translated into about 40 languages. These can be found on the website of CDC's partner, the Immunization Action Coalition. You can access the website by clicking on the image on the right of the slide. Additional resources on the use of VISs are listed in the resources and references slides at the end of this presentation.

CDC Vaccine Information Statement (VIS)

How to provide a VIS prior to vaccination:

- Paper copies of the VIS can be printed and given to patients prior to vaccination.
- Permanent, laminated office copies may be given to patients to read prior to vaccination.
- Patients may view VISs on a computer monitor or other video display.
- Patients may read the VIS on their phone or other digital device by downloading the pdf file from CDC's website.
- Patients may be given a copy of a VIS during a prior visit, or told how to access it through the internet, so they can read it in advance. These patients must still be offered a copy to read during the immunization visit, as a reminder.

Always offer the parent or legal representative an opportunity to ask questions about the vaccine you are administering.

Patients must still be offered a copy of the VIS to take away following the vaccination. The patient may decline.

Information from https://www.cdc.gov/vaccines/hcp/vis/about/facts-vis.html

- All vaccine providers, public or private, are required by the National Vaccine Childhood Injury Act to give the appropriate VIS to the parent or legal representative prior to every dose of rotavirus vaccine:
  - Paper copies of the VIS can be printed and given to the parent or legal representative.
  - Permanent, laminated office copies may be given to the parent or legal representative to read.
  - Parents or legal representatives may view VISs on a computer monitor or other video display.
  - Providing the VIS as an attachment or weblink contained within an email sent to the parent/legal representative.
  - Parents or legal representatives may read the VIS on their phones or other digital devices by downloading the pdf file from CDC's website.
  - Parents or legal representatives may be given a copy of a VIS during a prior visit or told how to access it through the internet so they can read it in advance. These patients must still be offered a copy to read as a reminder during the immunization visit.
- Always offer the parent or legal representative an opportunity to ask questions about the vaccine you are administering.
- Providers can make VISs available to the parent or legal representative on paper or in electronic form. The parent or legal representative must be offered a copy of the VIS to take home, but they may decline.
- If the parent/legal representative is not present, provision of the VIS prior to vaccination must be coupled with a method to verify parent/legal representative receipt of the VIS, in addition to parent/legal representative consent to vaccination in compliance with the applicable state medical consent law.

How to communicate vaccine benefits to vaccine hesitant individual

- Delay assumptions about the parent's position on vaccines
- Open ended questions to foster good discussion
- Recommend the vaccine
- Use mix of science and anecdote with talking to parents

Information from https://www.cdc.gov/vaccines/hcp/conversations/talking-with-parents.html#parents-refuse-vaccination; https://www.cdc.gov/washington/testimony/2019/t20190227.htm; https://www.medscape.com/viewarticle/882865; https://www.cdc.gov/flu/fluvaxview/coverage-1920estimates.htm; Media clip https://youtu.be/HQHnmrBKrpw

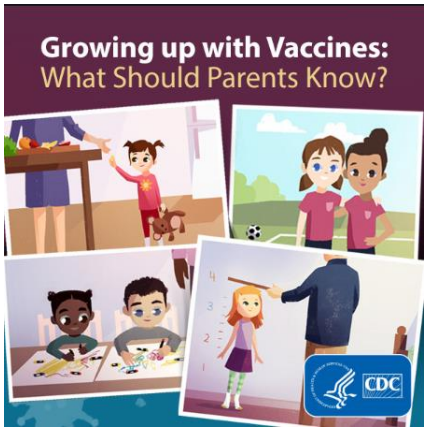
- While confidence in vaccines remains consistently high at the national level, there are pockets of people who are vaccine-hesitant, who delay or refuse to vaccinate themselves and/or their children. The World Health Organization named vaccine hesitancy as one of the top ten threats to global health in 2019.
- Centers for Disease Control and Prevention (CDC) analyzed data from two telephone surveys, the National Immunization Survey-Flu (NIS-Flu) and the Behavioral Risk Factor Surveillance System (BRFSS), to estimate flu vaccination coverage for the U.S. population during the 2018–19 flu season. Vaccination coverage varied by state, ranging from 46.0%–81.1% among children and from 33.9%–56.3% among adults. CDC estimated that increasing coverage by five percentage points could have prevented another 4,000 to 11,000 hospitalizations, depending on the severity of the season.
- Vaccine hesitancy, in general, is rooted in misinformation about the risk of disease and the safety and efficacy of vaccines. However, the specific issue fueling the hesitancy often varies by community. For some, it could be that, fewer and fewer doctors, other healthcare providers, and parents/patients have witnessed the serious and sometimes life-threatening consequences of Vaccine-preventable diseases. Parents/patients may wonder if vaccines are really necessary, and they may believe that the risks of temporary discomfort vaccinating themselves or their children may cause a vaccine may cause outweigh the benefits of protecting them from infection. For some, they question whether vaccines are safe, or whether they contain harmful ingredients. Others have religious beliefs that dissuade them from seeking medical care, including vaccination.
- When talking to individuals who may be hesitant about vaccine, it is important to delay assumptions about the individuals' position on vaccines. In reserving judgment from conversation, you can foster more trust in the relationship with the individual.
- Asking open ended questions is important way to foster good discussion with balanced answers to questions. It is important to acknowledge concerns but give correct information about vaccines as well.
- As a trusted source of information pertaining, to for them and their families' health, as a nurse it is important to recommend the vaccine, stating your confidence in the safety and efficacy of vaccines.
- Some individuals respond better to information about the science whereas others may respond better to personal anecdote from yourself or your practice.
- These are a few key strategies that can be used to foster good discussion with vaccine hesitant parents. You can find a short clip here with other great techniques that can be used to talk about vaccines with parents.

LEGAL/ETHICAL ISSUES

Legal and Ethical Considerations

State vaccination requirements

- All 50 states have vaccination requirements for child care and school entry.



Information from https://www.cdc.gov/vaccines/imz-managers/laws/index.html.; https://www.immunize.org/laws/mmr.asp;
Image source https://www.cdc.gov/vaccines/growing/school-vaccinations.html

READ SLIDE

Legal and Ethical Considerations

Vaccine exemptions

- All states provide medical exemptions.
- Some states offer religious and/or philosophical exemptions.
- Some states require these exemptions be sworn or affirmed through signed, notarized affidavits.
- Notwithstanding religious objections, children with vaccine exemptions may be excluded from child care facilities or school during an epidemic of any disease.

Information from https://www.cdc.gov/vaccines/imz-managers/laws/index.html.

READ SLIDE

Legal and Ethical Considerations

National Childhood Vaccine Injury Act (NCVIA)

- Passed by Congress in 1986
- Established VAERS to collect reports of vaccine adverse events
- Initiated the National Vaccine Injury Compensation Program (VICP) to compensate individuals who experience certain health events following receipt of a VICP-covered vaccine

Information from https://www.cdc.gov/vaccines/imz-managers/laws/index.html.

- Unsubstantiated vaccine injury claims caused a risk to the vaccine supply in the past because fear of lawsuits drove many manufacturers out of the vaccine business. In response, Congress passed the National Childhood Vaccine Injury Act in 1986. This law established the Vaccine Adverse Event Reporting System, which collects reports of vaccine adverse events, and includes a reporting table for the National Vaccine Injury Compensation Program. This program was also initiated by the law to compensate individuals who experience certain health events following vaccination. The VAERS reporting table complements the Health Resources and Services Administration Injury Table, outlining distinct outcomes that are compensable, along with the time period when the outcome occurred following vaccination.

Legal and Ethical Considerations

Consent for vaccines

- There is no federal requirement for informed consent relating to immunization.
- Individual states may have laws outlining consent requirements.
- Health care systems/facilities also may have consent policies.

Information from https://www.cdc.gov/vaccines/imz-managers/laws/index.html.

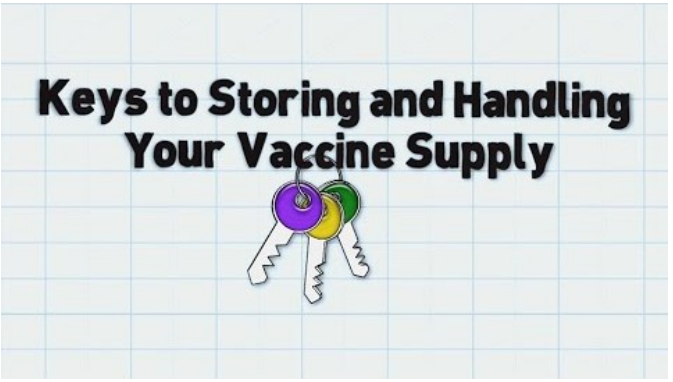
READ SLIDE

VACCINE STORAGE AND HANDLING

Vaccine Storage and Handling

Keys to vaccine storage

- Reliable storage and temperature monitoring equipment
- Accurate vaccine inventory management
- Well-trained staff



"Keys to Storing and Handling Your Vaccine Supply" Video

Information from Centers for Disease Control and Prevention. *Pink Book Webinar Series,* 2019.; https://www2.cdc.gov/vaccines/ed/pinkbook/2019/downloads/PB5/SHVA_webinar_7-17-19.pdf; Video from https://www.cdc.gov/vaccines/vpd/rotavirus/hcp/storage-handling.html

- Proper vaccine storage and handling are important factors in ensuring vaccine potency, thereby preventing many common vaccine-preventable diseases. Yet, each year, storage and handling errors result in revaccination of many patients and significant financial loss due to wasted vaccines. Failure to store and handle vaccines properly can reduce vaccine potency, resulting in inadequate immune responses in patients and poor protection against disease. Patients can lose confidence in vaccines and providers if they require revaccination because the vaccines they received may have been compromised.

- The following are necessary to protect a vaccine inventory:
  1) Reliable storage and temperature monitoring equipment
  2) Accurate vaccine inventory management
  3) Well-trained staff

- The "Keys to Storing and Handling Your Vaccine Supply" video linked on the right, is designed to decrease vaccine storage and handling errors and preserve the nation's vaccine supply by demonstrating to immunization providers the recommended best practices for storage and handling of vaccines. Additional resources on storage and handling are listed in the resources and references slides at the end of this presentation.

MMR Storage and Handling

Preparation

- Prepare vaccine just prior to administration.
- Discard if not used within 8 hours after reconstitution.

Vaccine Storage

- Must be stored between -58°F and +46°F (-50°C to +8°C).
- Protect vaccine from light.

Diluent Storage

- Store accompanying diluent in the refrigerator (36°F to 46°F, 2°C to 8°C) or at room temperature (68°F to 77°F, 20°C to 25°C).

Information from Merck & Co. Inc. MMRII (Measles, mumps and rubella virus vaccine live) [package insert]. U.S. Food and Drug Administration. Retrieved from https://www.fda.gov/media/75191/download;

- You should not draw reconstituted vaccine into a syringe until you are ready to administer it.
- Once it is reconstituted, the vaccine should be used as soon as possible. Store reconstituted vaccine in the vaccine vial in a dark place in the refrigerator and discard if not used within 8 hours.
- The vaccine Must be stored between -58°F and +46°F (-50°C to +8°C). It should be protected from light by keeping it in the original packaging until ready to administer.
- The diluent can be refrigerated or stored at room temperature, but it should never be frozen.

MMRV Storage and Handling

Preparation

- Prepare vaccine just prior to administration.
- Discard if not used within 30 minutes of reconstitution.

Vaccine Storage

- Before reconstitution, store the lyophilized vaccine in a freezer at a temperature between −58°F and +5°F (−50°C and −15°C) for up to 18 months.
- May be stored at refrigerator temperature (36° to 46°F, 2° to 8°C) for up to 72 hours prior to reconstitution. **Discard vaccine stored at refrigerated temperatures if not used within 72 hours of removal from freezer storage.**
- Reconstituted vaccine may be stored at room temperature, protected from light, for up to 30 minutes. **Discard Reconstituted vaccine if not used within 30 minutes**.
- Do not freeze reconstituted vaccine.

Diluent Storage

- Store accompanying diluent in the refrigerator (36°F to 46°F, 2°C to 8°C) or at room temperature (68°F to 77°F, 20°C to 25°C).

Information from Merck & Co. Inc. ProQuad (Measles, Mumps, Rubella and Varicella Virus *Vaccine* Live) [package inserts]. U.S. Food and Drug Administration. Retrieved from https://www.fda.gov/vaccines-blood-biologics/vaccines/proquad

- Because MMRV contains varicella vaccine virus, it should be stored with other varicella-containing vaccines.
- **Preparation**
  - Prepare vaccine just prior to administration.
  - Discard if not used within 30 minutes of reconstitution.
- **Vaccine Storage**
  - Before reconstitution, store the lyophilized vaccine in a freezer at a temperature between −58°F and +5°F (−50°C and −15°C) for up to 18 months.
  - May be stored at refrigerator temperature (36° to 46°F, 2° to 8°C) for up to 72 hours prior to reconstitution. **Discard vaccine stored at refrigerated temperatures if not used within 72 hours of removal from freezer storage.**
  - Reconstituted vaccine may be stored at room temperature, protected from light, for up to 30 minutes. **Discard Reconstituted vaccine if not used within 30 minutes**.
  - Do not freeze reconstituted vaccine.
- **Diluent Storage**
  - Store accompanying diluent in the refrigerator (36°F to 46°F, 2°C to 8°C) or at room temperature (68°F to 77°F, 20°C to 25°C).

VACCINE ADMINISTRATION

Before Vaccine Administration

- Assess for needed vaccines by reviewing the immunization history.
  - Accept only written (including electronic), dated medical records.*
  - Compare to recommended vaccination schedule.
- Screen for contraindications and precautions.
- Discuss vaccine benefits, risks, and vaccine-preventable diseases using VISs and other reliable resources.
- Provide after-care instructions.

*Self-reported doses of influenza and pneumococcal polysaccharide (PPSV23) vaccines are acceptable.

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/vac-admin.html

- The patient's immunization status should be reviewed at every health care visit. Using the patient's immunization history, health care personnel should assess for all routinely recommended vaccines, as well as any vaccines indicated based on health status, occupation, or other risk factors such as travel. Use the current immunization schedule based on the age of the patient to determine all vaccines that are needed.

- You can find a patient's immunization history by using information from immunization information systems, current and previous medical records, and personal vaccination record cards.

- Before administering any vaccine, patients should be screened for contraindications and precautions, even if the patient has previously received that vaccine. The patient's health status may change from one visit to the next or recommendations regarding contraindications and precautions may have changed. Using a standardized, comprehensive screening tool helps staff assess patients correctly and consistently. Staff should be knowledgeable about contraindications and precautions to vaccination and should only follow valid contraindications.

- Health care personnel should assess the level and type of information each patient or parent needs—for example, not everyone wants the same level of medical or scientific information about vaccines. Health care personnel need to be ready to answer questions. Fortunately, there are many resources available to help providers stay up to date on vaccine-related information, including vaccine information statements. Parent/patient education should also include a discussion of comfort and care strategies after vaccination. After-care instructions should include information for dealing with common side effects such as injection site pain, fever, and fussiness (especially in infants). After-care instructions should also include information on when to seek medical attention and when to notify the health care provider about any concerns that arise following vaccination.

MMR and MMRV Contraindications

Screen for contraindications and precautions before administering vaccines:

- **Contraindication**
  - Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component
  - Known severe immunodeficiency (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)
  - Family history of altered immunocompetence
  - Pregnancy

Information from https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html

Screen for contraindications and precautions before administering vaccines:

- **Contraindication**
  - Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component
  - Known severe immunodeficiency (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)
  - Family history of altered immunocompetence
  - Pregnancy

MMR and MMRV Precautions

- **Precaution**
  - Recent (≤11 months) receipt of antibody-containing blood product (specific interval depends on product)
  - History of thrombocytopenia or thrombocytopenic purpura
  - Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing
  - Moderate or severe acute illness with or without fever
  - A personal or family history of seizures*
  - Receipt of specific antiviral drugs (acyclovir, famciclovir, or valacyclovir) 24 hours before vaccination (avoid use of these antiviral drugs for 14 days after vaccination)*
  - Use of aspirin or aspirin-containing products*

*MMRV only

Information from https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html

- **Precaution**
  - Recent (≤11 months) receipt of antibody-containing blood product (specific interval depends on product)
  - History of thrombocytopenia or thrombocytopenic purpura
  - Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing
  - Moderate or severe acute illness with or without fever
  - A personal or family history of seizures*
  - Receipt of specific antiviral drugs (acyclovir, famciclovir, or valacyclovir) 24 hours before vaccination (avoid use of these antiviral drugs for 14 days after vaccination)*
  - Use of aspirin or aspirin-containing products*

*MMRV only

Vaccine Preparation

- Perform hand hygiene.
- Use designated, clean preparation area.
- Prepare your own vaccines.
- Prepare vaccine only when ready to administer.
- Always follow the vaccine manufacturers' directions, located in the package insert.
- Check expiration date on the vaccine and diluent (if needed).

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html; https://www2.cdc.gov/vaccines/ed/vaxadmin/va/index.html

- Preparing vaccine properly is critical to maintaining the integrity of the vaccine during transfer from the manufacturer's vial to the syringe and, ultimately, to the patient. CDC recommends preparing and drawing up vaccines just before administration. When preparing vaccines:
    - Follow strict aseptic medication preparation practices.
    - Perform hand hygiene BEFORE preparing vaccines.
    - Use a designated, clean medication area that is not adjacent to any area where potentially contaminated items are placed.
    - Always follow the vaccine manufacturer's directions, located in the package insert.
- Additional resources on vaccine preparation are listed in the resources and references slides at the end of this presentation.

Pediatric Vaccine Administration Technique

- Infants and toddlers best held in parent's arms
- Children best held in parent's lap

"Comfort and Restraint Techniques" Video

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html;

Media source https://youtu.be/r1dGpTCgerE

- Determine the best position and/or type of comforting restraint by considering the patient's age, activity level, administration route and site, safety, and comfort. Parents and guardians play an important role when children receive vaccines. They can soothe and comfort the child, making them feel safe and secure. Parent participation has been shown to increase the child's comfort and reduces the child's perception of pain. Engage the parent or guardian in the process. Instruct parents/guardians to hold infants and children in a position comfortable for the child and parent, so that one or more limbs are exposed for injections. A parent's embrace during vaccination offers several benefits.

- A comforting hold:
  - Avoids frightening children by embracing them rather than overpowering them
  - Allows the health care provider steady control of the limb and the injection site
  - Prevents children from moving their arms and legs during injections
  - Encourages parents to nurture and comfort their child

- While definitive guidelines for positioning patients during vaccination have not been established, some techniques have been suggested. Research shows that children age 3 years and older are less fearful and experience less pain when receiving an injection if they are sitting up rather than lying down. The exact mechanism behind this phenomenon is unknown. It may be that the child's anxiety level is reduced, which, in turn, reduces the child's perception of pain.

MMR and MMRV Vaccine Administration

Route

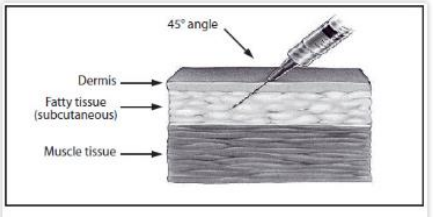
- Subcutaneous (Subcut) injection

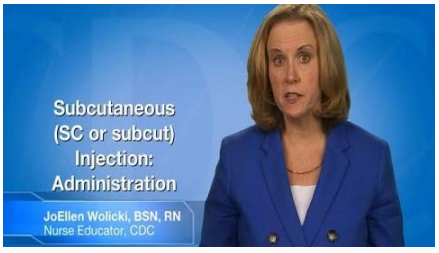
Site

- Upper outer triceps of the arm (≥12 months)
- Thigh (<12 months)

Needle Size

- 5/8 inch
- 23–25 gauge



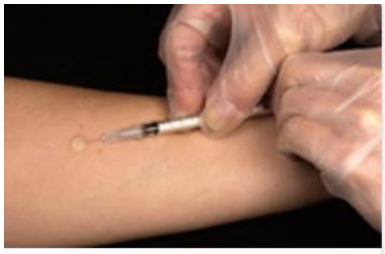


Information from www.cdc.gov/vaccines/hcp/acip-recs/general-recs/administration.pdf; Image source: adapted from California Immunization Branch; Media source https://www.youtube.com/watch?v=R5jd4SDEcsA

- Administer MMR and MMRV vaccine via subcutaneous injection using a 5/8-inch, 23- to 25-gauge needle.
- Subcutaneous injections are administered at a 45-degree angle, usually into the thigh for infants <12 months of age and in the upper-outer triceps area of persons age ≥12 months of age.
- Use the media link on the right-hand side of the slide for a short video on subcutaneous injection administration.

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

- Apply TST or IGRA at same visit as MMR or MMRV.
- Delay TST or IGRA at least 4 weeks if MMR or MMRV given first
- Apply TST first and administer MMR or MMRV when skin test read (least favored option because receipt of MMR or MMRV is delayed)



Administering the TB skin test

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html;
Image source https://phil.cdc.gov/Details.aspx?pid=6806

- A tuberculin skin test or an interferon-gamma release assay can be done before or on the same day that MMR or MMRV vaccine is administered.
- However, if MMR or MMRV is administered earlier, then the TST or assay should be delayed for at least 28 days.
- Live measles-containing vaccine given prior to the application of a TST or assay can reduce the reactivity of the test because of mild suppression of the immune system.

Measles Postexposure Prophylaxis

- People exposed to measles who cannot readily show that they have adequate presumptive evidence of immunity against measles can be offered post-exposure prophylaxis (PEP). There are two types of PEP for measles:
  - MMR vaccine, if administered within 72 hours of initial measles exposure, may provide some protection or modify the clinical course of disease.
  - Immunoglobulin (IG), if administered within six days of exposure, may also provide some protection or modify the clinical course of disease.
    - IG is recommended for patient groups at risk for severe disease and complications from measles who cannot be vaccinated because of contraindications: infants aged <6 months, pregnant women without evidence of measles immunity, and severely immunocompromised persons.
- There is no PEP for mumps and rubella

Information from https://www.cdc.gov/vaccines/vpd/mmr/hcp/recommendations.html; https://www.cdc.gov/vaccines/pubs/surv-manual/chpt07-measles.html

- People exposed to measles who cannot readily show that they have adequate presumptive evidence of immunity against measles can be offered post-exposure prophylaxis (PEP). There are two types of PEP for measles:
  - MMR vaccine, if administered within 72 hours of initial measles exposure, may provide some protection or modify the clinical course of disease.
  - Immunoglobulin (IG), if administered within six days of exposure, may also provide some protection or modify the clinical course of disease.
    - IG is recommended for patient groups at risk for severe disease and complications from measles who cannot be vaccinated because of contraindications: infants aged <6 months, pregnant women without evidence of measles immunity, and severely immunocompromised persons.
- There is no PEP for mumps and rubella

For more information on measles outbreak control and post-exposure prophylaxis, healthcare providers should consult their health department and refer to the measles chapter of the *Manual for the Surveillance of Vaccine-Preventable Diseases.*

MMR Revaccination Indications

- Revaccination is recommended for certain persons. The following groups should be considered unvaccinated and should receive at least 1 dose of MMR vaccine
  - Persons vaccinated before their first birthday
  - Persons vaccinated with killed measles vaccine
  - Persons vaccinated from 1963 through 1967 with an unknown type of vaccine
  - Persons who received immune globulin (IG) in addition to a further attenuated strain or vaccine of unknown type
  - Persons with perinatal human immunodeficiency virus (HIV) infection who were vaccinated before establishment of effective antiretroviral therapy (ART) and who do not have evidence of current severe immunosuppression.

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/mumps.html#mumps-vaccine; https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/special-situations.html

READ SLIDE

DOCUMENTATION

Documenting Vaccinations

Document vaccinations in the patient's permanent medical record

- Vaccine manufacturer
- Vaccine lot number
- Date of administration
- Name and title of the person who administered the vaccine and the address of the facility where the permanent record will reside
- Edition date of the vaccine information statement and the date it was provided to the patient, parent, or legal guardian

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html;
Media from https://www.youtube.com/watch?v=xlyqUgKGFPk.

- Accurate and timely documentation can help prevent administration errors and curtail the number and cost of excess vaccine doses administered. In addition, preventing excess doses of vaccines may decrease the number of adverse reactions. All vaccines administered should be fully documented in the patient's permanent medical record. Health care providers who administer vaccines covered by the National Vaccine Injury Compensation Program are required to document the following information in the patient's permanent record:
  - Vaccine manufacturer
  - Vaccine lot number
  - Date of administration
  - Name and title of the person who administered the vaccine and the address of the facility where the permanent record will reside
  - Edition date of the VIS distributed, and the date provided

- This federal law applies to all routinely recommended childhood vaccines, even for doses of the vaccine that are administered to adults. The law applies to the on-point provider, who is not liable for previous lack of documentation.

- Additional resources for documenting vaccinations after administration are listed in the resources and references slides at the end of this presentation.

Documentation: Best Practice Guidelines

- **Best practice guidelines also include documenting:**
  - Route
  - Dosage (amount)
  - Site
  - Expiration date
- **Provide personal immunization record that includes the vaccinations and administration dates.**
- **Update medical records to include:**
  - Adverse events after vaccination
  - Serologic test results related to vaccine-preventable diseases (e.g., those for rubella screening)

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html; https://www2.cdc.gov/vaccines/ed/vaxadmin/va/index.html

Medication administration best practices also include documenting the route, dosage (amount), site, and vaccine expiration date. The patient or parent/guardian should be provided with a personal immunization record that includes the vaccinations and date administered. Providers should update patients' permanent medical records to reflect any documented episodes of adverse events after vaccination and any serologic test results related to vaccine-preventable diseases (e.g., those for rubella screening).

Reporting Vaccine Adverse Events

Vaccine Adverse Event Reporting System (VAERS): A passive surveillance system to monitor adverse events following vaccination

Health care providers are required by law to report:

- Any adverse event listed by the vaccine manufacturer as a contraindication to further doses of the vaccine
- Any adverse event listed in the VAERS Table of Reportable Events Following Vaccination that occurs within the specified time period after vaccination

Health care providers are encouraged to report:

- Any adverse event after the administration of a vaccine
- Vaccine administration errors

Information from https://vaers.hhs.gov/reportevent.html

- Severe, life-threatening anaphylactic reactions following vaccination are rare.
- Report significant adverse events that occur after vaccination of adults and children, even if you are not sure whether the vaccine caused the adverse event.
- VAERS accepts all reports, including reports of vaccine administration errors.

Health care professionals are required to report:

- Any adverse event listed by the vaccine manufacturer as a contraindication to further doses of the vaccine
- Any adverse event listed in the VAERS Table of Reportable Events Following Vaccination within the specified time period

Reporting Adverse Events

VAERS Table of Reportable Events Following Vaccination*

Vaccine/Toxoid	Event and Interval from Vaccination **
Measles, mumps and rubella in any combination; MMR, MMRV, MM	A. Anaphylaxis or anaphylactic shock (7 days) B. Encephalopathy or encephalitis (15 days) C. Shoulder injury related to vaccine administration (7 days) D. Vasovagal syncope (7 days) E. Any acute complication or sequelae (including death) of above events (interval–not applicable) F. Events described in manufacturer's package insert as contraindications to additional doses of vaccine (interval–see package insert)

*The Reportable Events Table (RET) reflects what is reportable by law (42 USC 300aa-25) to the Vaccine Adverse Event Reporting System (VAERS) including conditions found in the manufacturer package insert. **Represents the onset interval between vaccination and the adverse event.

Information from https://vaers.hhs.gov/reportevent.html; https://vaers.hhs.gov/docs/VAERS_Table_of_Reportable_Events_Following_Vaccination.pdf

Providers should report all adverse events after vaccination to VAERS. This table reflects conditions reportable by law, but providers should report any adverse event that concerns them.

VAERS Table of Reportable Events Following Vaccination - Measles, mumps and rubella in any combination; MMR, MMRV, MM (see slide)

Reporting Adverse Events Continued

VAERS Table of Reportable Events Following Vaccination*

Vaccine/Toxoid	Event and Interval from Vaccination **
Rubella in any combination; MMR, MMRV	A. Chronic arthritis (42 days) B. Any acute complications or sequelae (including death) of above event (interval - not applicable) C. Events described in manufacturer's package insert as contraindications to additional doses of vaccine (interval - see package insert)

*The Reportable Events Table (RET) reflects what is reportable by law (42 USC 300aa-25) to the Vaccine Adverse Event Reporting System (VAERS) including conditions found in the manufacturer package insert. **Represents the onset interval between vaccination and the adverse event.

Information from https://vaers.hhs.gov/reportevent.html; https://vaers.hhs.gov/docs/VAERS_Table_of_Reportable_Events_Following_Vaccination.pdf

VAERS Table of Reportable Events Following Vaccination Continued - Rubella in any combination; MMR, MMRV (see slide)

Reporting Adverse Events Continued

VAERS Table of Reportable Events Following Vaccination*

Vaccine/Toxoid	Event and Interval from Vaccination **
Measles in any combination; MMR, MMRV, MM	A. Thrombocytopenic purpura (7-30 days) B. Vaccine-strain measles viral infection in an immunodeficient recipient ○ Vaccine-strain virus identified (interval - not applicable) ○ If strain determination is not done or if laboratory testing is inconclusive (12 months) C. Any acute complications or sequelae (including death) of above events (interval - not applicable) D. Events described in manufacturer's package insert as contraindications to additional doses of vaccine (interval - see package insert)

*The Reportable Events Table (RET) reflects what is reportable by law (42 USC 300aa-25) to the Vaccine Adverse Event Reporting System (VAERS) including conditions found in the manufacturer package insert. **Represents the onset interval between vaccination and the adverse event.

Information from https://vaers.hhs.gov/reportevent.html; https://vaers.hhs.gov/docs/VAERS_Table_of_Reportable_Events_Following_Vaccination.pdf

VAERS Table of Reportable Events Following Vaccination Continued - Measles in any combination; MMR, MMRV, MM (see slide)

VACCINE SAFETY

MMR Vaccine Adverse Reactions

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

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Gastanaduy P, Haver P, Rota P, Patel M, eds. 14th ed. Washington D.C.: Public Health Foundation; 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html#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 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 MMRV vaccine, compared with children who had received the first dose of MMR vaccine and VAR vaccine administered as separate injections at the same visit. Data from postlicensure studies do not suggest that this increased risk exists for children age 4 to 6 years receiving the second dose of MMRV vaccine.
- Multiple studies, as well as a National Academy of Medicine Vaccine Safety Review, refute a causal relationship between autism and MMR vaccine or between inflammatory bowel disease and MMR vaccine.

MMR Vaccine Safety

"The committee concludes that the evidence favors rejection of a causal relationship between MMR vaccine and autism."

Institute of Medicine, 2004

Information from https://www.cdc.gov/vaccinesafety/index.html; www.nap.edu/catalog/10997/immunization-safety-review-vaccines-and-autism; www.cdc.gov/measles/cases-outbreaks.html.

- MMR vaccine was erroneously linked to autism many years ago; this false claim has been repeatedly disproven by many reputable scientific bodies as well as organizations that support legitimate autism research.
- The Institute of Medicine (now called the "Health and Medicine Division") reported finding NO causal relationship between the MMR vaccine and autism.
- Unfortunately, despite all the scientific evidence, this misinformation has continued to persist among some small sectors of the population and there still measles outbreaks attributed to low vaccination coverage because of these concerns. Most parents trust their providers, understand the importance of vaccination, and are able to discern fact from fiction. A small percentage of parents remains vaccine-hesitant because of misinformation and vaccine stigma, despite the current scientific evidence. Nurses must ensure patients and parents receive accurate information about the MMR vaccine and its important role in preventing childhood disease and outbreaks.
- Also, don't forget to talk to your patients about their travel plans. Recommendations for MMR vaccine for travelers are different than those for routine vaccination because of the risks we just discussed related to travel. Ask patients about upcoming travel and administer needed vaccines or additional MMR doses as soon as it is clear that travel is likely; you don't have to wait until right before a patient travels.
- MMR vaccine is both safe and effective. And vaccination is still the best way to prevent the spread of measles and outbreaks in our communities. If you need resources to help discuss vaccine safety with patients, please visit CDC's vaccine safety web page (pictured and linked here).

NURSING CONSIDERATIONS

Guidance for Healthcare Providers

- Be vigilant about measles, mumps, rubella.
- 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 cases.
  - Isolation protocols should reflect practice setting and mode of transmission.
- Immediately report the suspect cases of measles, mumps, rubella to the health department.
- Obtain specimens for testing from patients with suspected cases of measles, mumps, and rubella.

Information from www.cdc.gov/mumps/hcp.html; www.cdc.gov/mmwr/pdf/rr/rr6007.pdf.

- In light of recent outbreaks, be sure measles is on your radar. Make sure all of your patients are immune to measles, mumps, and rubella.

READ SLIDE

Nursing Considerations

	Reaction Following Vaccine Administration	Supportive Treatment Recommendation
Mild to Moderate	**Most common:** • Pain, redness, itching or swelling at injection site • Mild fever	**Usually self-limiting** • Cool, damp cloth to help reduce redness, soreness, and/or swelling at the injection site • Antipyretics or analgesics may be indicated for supportive care.
Severe	**Anaphylaxis;** Hoarseness, wheezing, airway constriction, difficulty breathing, pale or mottled skin, hypotension, altered mental status, fever, redness, rash	Call 911, administer CPR, provide epinephrine or equivalent (e.g., EpiPen), immediate transfer to hospital

Information from Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J., et al., eds. 14th ed. Washington, D.C. Public Health Foundation, 2021; https://www.cdc.gov/vaccines/pubs/pinkbook/index.html; https://www.cdc.gov/vaccines/parents/by-age/months-1-2.html.

Supportive Treatment

- Mild to moderate reaction
  - Reactions: pain, redness, itching or swelling at injection site or mild fever
  - Treatment**:** Cool, damp cloth to help reduce redness, soreness, and/or swelling at the injection site. Evidence does not support use of antipyretics before or at the time of vaccination. However, they can be used for the treatment of fever and local discomfort that might occur following vaccination.

- Severe reaction (anaphylaxis)
  - Severe, life-threatening, anaphylactic reactions following vaccination are rare. Facilities must have in place and staff should be familiar with procedures for managing a severe reaction. Staff should be familiar with the signs and symptoms of anaphylaxis, which usually begin within minutes of vaccination.

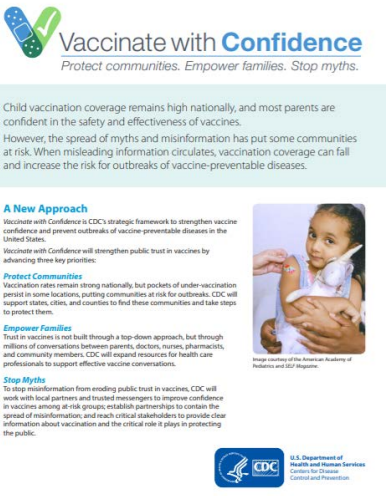
  - These signs and symptoms can include, but are not limited to, flushing, facial edema, urticaria, itching, swelling of the mouth or throat, wheezing, and difficulty breathing. Each staff member should know their role in the event of an emergency and all vaccination providers should be certified in cardiopulmonary resuscitation (CPR).

  - Epinephrine and equipment for maintaining an airway should be available for immediate use. After the patient is stabilized, they should immediately be transferred to an emergency facility for additional evaluation and treatment.

Nursing Considerations

Vaccinate with Confidence

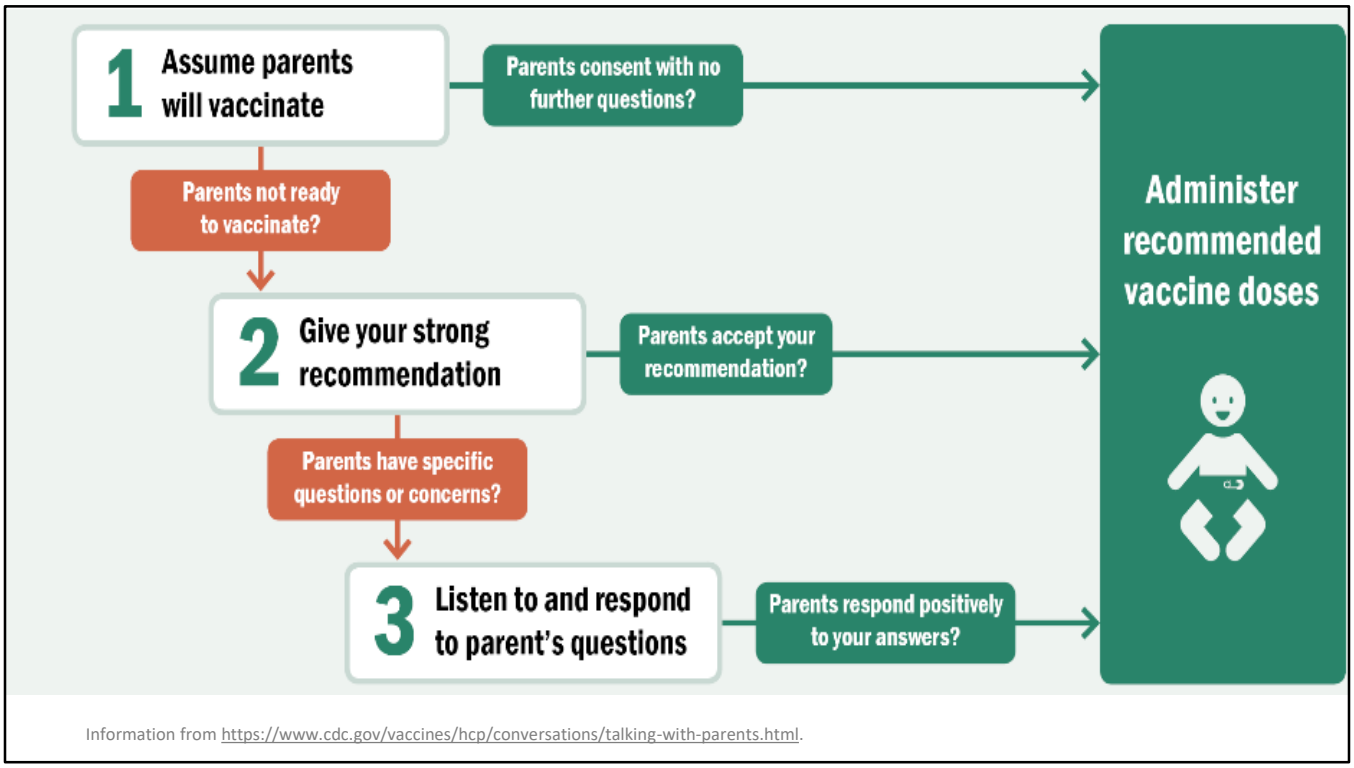
- CDC's strategic framework to strengthen vaccine confidence and prevent outbreaks of vaccine-preventable diseases in the United States
- Key priorities:
  - Protect communities.
  - Empower families.
  - Stop myths.



Vaccinate with Confidence fact sheet

Information from https://www.cdc.gov/vaccines/partners/vaccinate-with-confidence.html.

- *Vaccinate with Confidence* is CDC's strategic framework to strengthen vaccine confidence and prevent outbreaks of vaccine-preventable diseases in the United States. This slide contains links to the *Vaccinate with Confidence* web page and fact sheet.
- *Vaccinate with Confidence* will strengthen public trust in vaccines by advancing three key priorities:
  - Protect communities.
  - Empower families.
  - Stop myths.
- *Protect communities:* Vaccination coverage remains strong nationally, but pockets of undervaccination persist in some locations, putting communities at risk for outbreaks. CDC will support states, cities, and counties to find these communities and take steps to protect them.
- *Empower families:* Trust in vaccines is not built through a top-down approach, but through millions of conversations between parents, doctors, nurses, pharmacists, and community members. CDC will expand resources for health care professionals to support effective vaccine conversations.
- *Stop myths:* To stop misinformation from eroding public trust in vaccines, CDC will work with local partners and trusted messengers to improve confidence in vaccines among at-risk groups, establish partnerships to contain the spread of misinformation, and reach critical stakeholders to provide clear information about vaccination and the critical role it plays in protecting the public.



Information from https://www.cdc.gov/vaccines/hcp/conversations/talking-with-parents.html.

- Nurses play a key role in establishing and maintaining a practice-wide commitment to communicating effectively about vaccines and maintaining high vaccination rates. You can all answer parents' questions, provide educational materials, and ensure that families make and keep vaccine appointments.

- The MMR vaccine is very safe, and it is effective at preventing measles, mumps, and rubella. However, vaccines, like any medicine, can have side effects. Most people who get MMR vaccine do not have any serious problems with it. But all patients or caregivers of patients should be educated about common side effects and rare serious problems that should be reported to the health care provider. Getting MMR vaccine is much safer than getting measles, mumps, or rubella.

- Parents consider their child's healthcare professionals to be their most trusted source of information when it comes to vaccines. This is true even for parents who are vaccine-hesitant or who have considered delaying one or more vaccines. Invoking nursing ethical principles of veracity and beneficence, nurses have a critical role in helping parents choose vaccines for their child. When discussing vaccines for children, it is best to remember most parents and state which vaccines the child needs to receive. And although parents frequently consult family members, friends, and webpages for information on vaccines, parents consistently rank their child's healthcare professionals as their most trusted source for vaccine information. Clearly state your strong recommendation for vaccination. If a parent has concerns, resists following the recommended vaccine schedule, or questions your strong recommendation, this doesn't necessarily mean they won't accept vaccines. Sometimes parents simply want *your* answers to their questions. Your willingness to listen to their concerns will play a major role in building trust in you and your recommendation.

VACCINE RESOURCES AND REFERENCES

Vaccine Resources and References

ACIP recommendations

- Current ACIP MMR vaccine recommendations https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mmr.html
- Current ACIP MMRV vaccine recommendations https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mmrv.html
- ACIP General Best Practice Guidelines for Immunization https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/index.html

Disease information

- CDC measles disease web page https://www.cdc.gov/measles/hcp/index.html
- CDC mumps disease web page https://www.cdc.gov/mumps/hcp.html
- CDC rubella disease web page https://www.cdc.gov/rubella/hcp.html

Vaccine Resources and References

Immunization strategies

- Immunization Information Systems
  https://www.cdc.gov/vaccines/programs/iis/index.html
- Immunization Quality Improvement for Providers
  https://www.cdc.gov/vaccines/programs/iqip/at-a-glance.html
- Comprehensive Clinic Assessment Software Application
  https://www.cdc.gov/vaccines/programs/cocasa/index.html

Manufacturers' vaccine package inserts (PIs)

- M-M-R® II, Merck, Sharp & Dohme Corp.
  https://www.fda.gov/vaccines-blood-biologics/vaccines/measles-mumps-and-rubella-virus-vaccine-live
- ProQuad®, Merck & Co., Inc.
  https://www.fda.gov/vaccines-blood-biologics/vaccines/proquad

Vaccine Resources and References

Immunization schedules

- Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger
  https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html#birth-15
- Recommended Adult Immunization Schedule for ages 19 years or older
  https://www.cdc.gov/vaccines/schedules/hcp/imz/adult.html
- Catch-Up Immunization Schedule
  https://www.cdc.gov/vaccines/schedules/hcp/imz/catchup.html

Vaccine Resources and References

Communications

- Current vaccine information statements (VISs)
  https://www.cdc.gov/vaccines/hcp/vis/current-vis.html
- Instructions for Using VISs
  https://www.cdc.gov/vaccines/hcp/vis/about/required-use-instructions.html
- Translated VISs
  https://www.immunize.org/vis/?f=9
- Talking to Parents about Vaccines
  https://www.cdc.gov/vaccines/hcp/conversations/conv-materials.html

Vaccine Resources and References

Vaccine storage and handling

- *Vaccine Storage and Handling Toolkit*
  https://www.cdc.gov/vaccines/hcp/admin/storage/toolkit/index.html
- "Keys to Storing and Handling Your Vaccine Supply"
  https://www.youtube.com/watch?v=VCzO8Zod8DI

Vaccine administration

- Immunization Action Coalition Clinic Tools Screening for Vaccine Contraindications and Precautions
  https://www.immunize.org/clinic/screening-contraindications.asp
- CDC Vaccine Administration Resource Library
  https://www.cdc.gov/vaccines/hcp/admin/resource-library.html
- Vaccine Administration for Healthcare Professionals
  https://www.cdc.gov/vaccines/hcp/admin/admin-protocols.html

Vaccine Resources and References

Vaccine Administration Continued

- Standing Orders for Administering
  https://www.immunize.org/standing-orders/
- You Call the Shots Module- Vaccine Administration
  https://www2.cdc.gov/vaccines/ed/vaxadmin/va/ce.asp
- Subcutaneous (SC or Subcut) Injections: Supplies
  https://www.youtube.com/watch?v=oc2nC7Azbns
- Subcutaneous (SC or Subcut) Injection: Administration
  https://www.youtube.com/watch?v=R5jd4SDEcsA
- Subcutaneous (SC or Subcut) Injections: Sites
  https://www.youtube.com/watch?v=ylhdvNZBWN0

Vaccine Resources and References

Documentation

- Documentation of Vaccinations After Administration https://www.youtube.com/watch?v=xlyqUgKGFPk

Safety

- https://www.cdc.gov/vaccinesafety/vaccines/mmr-vaccine.html
- https://www.cdc.gov/vaccinesafety/vaccines/mmrv-vaccine.html

GLOSSARY

Glossary

- **Anaphylaxis:** A severe and sometimes fatal allergic reaction characterized by hives, itching, respiratory difficulty, and shock; this condition requires immediate medical attention.
- **Arthralgia**: Joint Pain.
- **Arthritis:** Inflammation of the joints that causes swelling, stiffness, and pain. also known as arthralgia.
- **Birth defects:** Physical or mental abnormalities that are present at birth; can be caused by faulty development, infection, heredity, or injury.
- **Childbearing age:** Range of ages during which a woman may become pregnant; often defined as 15–49 years of age.
- **Communicability:** Ability to spread disease; also known as infectious.
- **Confluent:** A pattern of skin lesions or eruptions in which the lesions or eruptions have run together and are no longer discrete.
- **Congenital rubella syndrome (CRS):** A pattern of birth defects caused by rubella virus exposure during pregnancy. CRS-related problems include deafness, cataracts, heart defects, microcephaly, mental retardation, bone alterations, and liver and spleen damage.

Glossary

- **Conjunctivitis:** Inflammation of the mucous membranes surrounding the eye that causes the area to become red and irritated: the membranes may be irritated because of exposure to heat, cold, or chemicals; this condition is also caused by viruses, bacteria, or allergies.
- **Contraindication:** A condition that increases the likelihood of a serious adverse reaction to a vaccine for a patient with that condition. If the vaccine is given in the presence of that condition, the resulting adverse reaction could seriously harm the recipient.
- **Coryza:** Runny nose; nasal discharge.
- **Diluent:** A diluting agent (e.g., a liquid) added to reconstitute lyophilized vaccine before administration (manufacturers of freeze-dried vaccine also supply the corresponding diluents).
- **Encephalitis:** Inflammation of the brain caused by a virus; encephalitis can result in permanent brain damage or death.
- **Endemic:** The continual, low-level presence of disease in a community.
- **Epidemic:** Occurrence of disease at a level higher than is expected.

Glossary

- **Gestational age:** Clinical term usually given in weeks and days to describe human development timed from the first day of the last menstrual period (LMP).
- **Immune globulin (IG):** Also called “immunoglobulin”; a sterile solution of plasma prepared from human blood that contains antibodies. Immune globulin is administered for passive immunization against measles and hepatitis A. There are also disease-specific globulins (e.g., tetanus, rabies, varicella zoster, hepatitis B, and respiratory syncytial virus). Immune globulin was previously called “gamma globulin.”
- **Immunocompromised:** A condition in which the immune system is unable to protect the body from disease. This condition can be caused by disease (like HIV infection or cancer) or by certain drugs (like those used in chemotherapy). Individuals whose immune systems are compromised should not receive live, attenuated vaccines.
- **Inactivated vaccine:** A vaccine in which the antigen is inactivated with heat and/or chemicals. These vaccines are not alive and cannot replicate. These vaccines cannot cause disease from infection, even in an immunodeficient person. Inactivated vaccines always require multiple doses.

Glossary

- **Incubation period:** The length of time between entry of an infectious agent into the body and the beginning of disease symptoms.
- **Informed consent:** Process by which a patient or parent makes a voluntary decision about a procedure or intervention after being fully informed by a health care provider about the risks and benefits of the procedure or intervention; some states have informed consent laws for vaccination.
- **Informed refusal:** Refusal of a recommended medical treatment, such as vaccination, based on an understanding of the facts and implications of not following the recommended treatment.
- **Koplik's spots:** Small, red spots with bluish-white centers found on the inside of the mouths of persons with measles.
- **Live vaccine:** A vaccine in which live virus is weakened (attenuated) through chemical or physical processes to produce an immune response without causing the severe effects of the disease. Also known as an "attenuated vaccine."

Glossary

- **Lymphadenopathy:** Enlargement of the lymph nodes, usually associated with infection or disease.
- **Maculopapular:** Containing both macules (flat, discolored patches of skin) and papules (small, solid inflammatory elevations of the skin).
- **Microcephaly:** Small head; usually reflects an underlying reduction in the size of the brain.
- **Monovalent:** Having specific immunologic activity against a single antigen, microorganism, or disease.
- **Neuritis:** Inflammation of a nerve or group of nerves, characterized by pain, loss of reflexes, and atrophy of the affected muscles.
- **Noninferior immunogenicity:** The ability of a particular substance to provoke an immune response.
- **Orchitis:** A complication of mumps infection occurring in males (who are beyond puberty); symptoms begin 7—10 days after onset of mumps and include inflammation of the testicles, headache, nausea, vomiting, pain, and fever; most patients recover, but in rare cases sterility occurs.

Glossary

- **Otitis media:** A viral or bacterial infection that leads to inflammation of the middle ear.
- **Outbreak:** Sudden appearance of a disease in a specific geographic area (e.g., neighborhood or community) or population (e.g., adolescents).
- **Parotitis:** Inflammation of the salivary glands, located below and in front of the ear, resulting in swelling and tenderness.
- **Precaution:** A condition in a recipient that might increase the risk for a serious adverse reaction, might cause diagnostic confusion, or might compromise the ability of the vaccine to produce immunity.
- **Preterm:** Born before completion of a pregnancy of normal length; born before 37 weeks of pregnancy.
- **Prodrome:** Early signs or symptoms of illness that precede more characteristic clinical features of disease.
- **Progressive panencephalitis:** A neurological disorder that may occur in a child with congenital rubella. It is a slow viral infection of the brain, characterized by chronic encephalitis.

Glossary

- **Reservoir:** Habitat in which an infectious agent normally lives, grows, and multiplies; reservoirs include humans, animals, and the environment.
- **Sequelae:** The after-effects of a disease or injury.
- **Standing orders:** Orders that authorize nurses, pharmacists, and other appropriately trained healthcare personnel, where allowed by state law, to assess a patient's immunization status and administer vaccinations according to a protocol approved by a medical director in a healthcare setting, a physician, or another authorized practitioner.
- **Supportive treatment:** Treatment provided to keep a person comfortable.
- **Temporal pattern:** Occurrence of health-related events by time.

Glossary

- **Thrombocytopenia:** A decreased number of platelets in the blood, which can be associated with bleeding.
- **Thrombocytopenic purpura:** A systemic illness that causes bleeding into the mucous membranes and skin, which causes petechiae (pinpoint size bruises) or larger bruises; associated with decreased platelets in the blood, prolonged bleeding times, anemia, and weakness.
- **Up to date:** An individual has received all doses of a vaccine series for a given age in accordance with ACIP recommendations.
- **Viremia:** Presence of virus in the blood.