

VACCINATION

Immunization is one of the most beneficial and cost-effective disease prevention measures. As a result of effective and safe vaccines, smallpox has been eradicated, polio is close to worldwide eradication, and measles and rubella are no longer endemic in the U.S

Immunization is the process of inducing immunity against a specific disease. Immunity can be induced either **passively** through administration of antibody-containing preparations or **actively** by administering a vaccine or toxoid to stimulate the immune system to produce a prolonged humoral and/or cellular immune response.

PASSIVE IMMUNITY

Passive immunity is achieved by administration of preformed antibodies to induce transient protection against an infectious agent. Passive immunity also can be induced naturally through transplacental transfer of antibodies during gestation, protection for some diseases can persist for as long as 1 year after birth, depending on the quantity of antibody transferred and the time until levels fall below those considered protective.

Passive immunity can be divided in to following types:

A- Anti-toxins ; derived from hoarse serum used for prophylaxis and treatment of tetanus , diphtheria & others

B- Immunoglobulins , used for:

1- Prophylaxis against infections such as chicken pox and measles.

2-Treatment of hypogammaglobulinemia ,Gullain- Barrie syndrome, Immune-mediated thrombocytopenia (I.T.P) and neonatal septicemia

C- Monoclonal Antibodies which are antibody preparations produced against a single antigen e.g. **Palivizumab** that is used for prevention of severe disease from respiratory syncytial virus among children 24 mo of age and younger with chronic lung disease or congenital heart diseases.

ACTIVE IMMUNIZATION

Involves stimulating the immune system to produce either antibodies or cellular immune responses that protect against the infectious agents.

Vaccines are defined as whole or parts of microorganisms administered to prevent an infectious disease. Vaccines can consist of whole inactivated microorganisms (polio and hepatitis A), parts of the organism (acellular pertussis, hepatitis B), polysaccharide capsules (pneumococcal and meningococcal polysaccharide vaccines), polysaccharide capsules conjugated to protein carriers (Hib, pneumococcal, and meningococcal conjugate vaccines), live attenuated microorganisms (measles, mumps, rubella, varicella, rotavirus, and influenza vaccines).

A **toxoid** is a modified bacterial toxin that is made nontoxic but is still able to induce an active immune response against the toxin (tetanus and diphtheria)

BCG vaccine

It is a live attenuated strain of *Mycobacterium bovis* known as Bacillus Calmette-Guérin (BCG) uses shared antigens to stimulate the development of cross-immunity to *Mycobacterium tuberculosis*. It lost its virulence in humans by being specially cultured in an artificial medium for years, which gives considerable protection against TB. It is given routinely to all newborns, when vaccination is delayed to end of first year prior tuberculin testing is important, vaccine can be given to tuberculin negative children and to adolescent.

The dose is 0.1ml intradermal in the deltoid region; successful vaccine produces a small indurated area (2-4mm), after 3-4weeks the lesion progresses to a papule or shallow ulcer of approximately 10 mm diameter and heals within 12 weeks to form a small, flat scar.

Side effects

local abscess, axillary lymphadenitis, allergy, dizziness, vertigo, keloid scarring. No live vaccine should be given within 3weeks except (OPV) and there be no vaccination in the same area for 3months. BCG is **contraindicated in profoundly immunocompromised** patients (including HIV) because they can develop disseminated TB infection.

Unfortunately, BCG vaccine does not give complete protection from TB disease throughout life. It has been suggested that BCG is only 50% effective in preventing pulmonary TB and slightly higher (50-80%) in preventing disseminated and meningeal TB.

Polio vaccines

The two vaccines have eradicated polio from most of the countries in the world and reduced the worldwide incidence from an estimated 350,000 cases in 1988 to less than 2000 cases in 2008.

Salk's Polio vaccine "Inactivated Polio Vaccine" IPV injectable, It Contains 3 serotypes of vaccine virus, the injected Salk vaccine confers IgG-mediated immunity in the bloodstream, which prevents polio infection from progress to viremia and protects the motor neurons, thus eliminating the risk of bulbar polio and post-polio syndrome. It offers no protection to the mucosal lining of the intestine.

IPV has essentially no adverse effects associated with it other than possible rare hypersensitivity reactions.

Sabin's polio vaccine "Oral live-attenuated vaccine" is a live-attenuated vaccine, contains 3 serotypes of vaccine virus, It replicates very efficiently in the gut producing(mucosal IgA immunity), the primary site of infection and replication, Unable to replicate efficiently within nervous system tissue, Shed in stool for up to 6 weeks following vaccination.

The OPV proved to be superior in administration, and also provided longer lasting immunity than the Salk vaccine. Oral Polio Vaccine on very rare occasions has been associated with paralysis (vaccine-associated paralytic poliomyelitis), about 1 case per 750,000 vaccine recipients.

It is given in 3doses, each of 2drops (oral) at age of 2, 4, 6 months. A booster dose is given at age of (1.5-2years). 2nd booster dose is given at age of 4-6yrs. It is C/I in immunocompromised persons & their household contacts because of the risk of VAPP, these should receive only IPV.

DTaP vaccine

Diphtheria and tetanus toxoids combined with acellular pertussis vaccines (DTaP) are licensed in children younger than 7 yrs of age. DTaP vaccines have fewer adverse effects than the vaccines containing whole-cell pertussis (DTP), dose is 0.5ml **IM** given to all infants. Four doses of DTaP should be administered during the 1st 2 yrs of life, generally at ages 2, 4, 6, and 4 th dose (first booster dose) at 15-18 mo of age .The 5th dose of DTaP (2nd booster) is recommended for children at 4-6 yrs of age.

- Minor reactions are quite frequent in 20–50% of vaccines. Local reactions , inflammation, induration or a painless nodule at the site of injection. These are progressively more common after the first injection
- Moderate reactions occur in 0.1% to 1.0% of children and include:
 1. ongoing crying (for three hours or more in the first 12 hours)
 2. a high fever (up to 40°C)
 3. an unusual (screaming), high-pitched crying
- Severe problems happen very rarely (1 in 140,000 cases of DPT). Include;
 1. Serious allergic reaction,
 2. prolonged seizures,
 3. Encephalopathy, or even death.

For children less than 7 yrs of age in whom pertussis immunization is contraindicated, **DT** is used.

dT vaccine(adult preparation): It is a mixture of toxoid of diphtheria &tetanus is given to children ≥ 7 years of age, as pertussis vaccine is contraindicated after this age. Dose 0.5ml IM.

Measles vaccine

It is a live attenuated vaccine given to all infants at age of 9-12months. But it can be given to children & adolescent too.

Dose 0.5ml **subcutaneously** (single dose). It is generally safe vaccine, in children with egg allergy & asthmatic patient it should be given under hospital supervision.

MMR vaccine

It is a mixture of 3 vaccines (live attenuated of measles, mumps & rubella).

It is given to children at age of 15mo, it can also be given to older children, A booster dose at age of 4-6years is currently recommended. Seroconversion is slightly lower in children who receive the 1st dose before or at 12 mo of age because of persisting maternal antibody.

Dose is 0.5ml **subcutaneously** (single dose).the vaccine is safe. Because MMR is a live-attenuated vaccine, adverse events from the measles-mumps-rubella vaccine include fever (usually 6-12 days following vaccination), rash in approximately 5% of vaccinated persons, and, rarely, transient thrombocytopenia .

Children prone to febrile seizures may experience an event following vaccination, so the risks and benefits of vaccination should be discussed with parents. Encephalopathy and autism have not been shown to be causally associated with the measles-mumps-rubella vaccine or vaccine constituents.

Contraindications and Precautions

- MMR vaccine should not be administered if there is severe allergic reaction to vaccine component or following prior dose.
- MMR is a live vaccine so should not be administered to pregnant women or to immunodeficient or immunosuppressed patients. However, patients with HIV who are not severely immunocompromised should be immunized with measles vaccine.

Hepatitis B vaccine

It is a recombinant DNA vaccine contains purified HBsAg particles of viruses (inactivated viral antigen).

Vaccine usually is given intramuscularly as a three-dose series (0, 1, and 6 mo). Three doses induce seroconversion in 90-95% of healthy infants, children and adults. Dose for infants and children is 0.5ml IM (not in the buttock). Current vaccination recommendations are as follows:

1. For all medically stable infants weighing >2,000 g at birth and born to HBsAg-**negative** mothers, the 1st dose of HBV vaccine should be administered before hospital discharge; single-dose antigen HBV vaccine should be used for the birth dose. Subsequent doses to complete the series are given at 1–4 mo, and at 6–18 mo of age (0,1,6).
2. Preterm infants weighing <2,000 g at birth and born to HBsAg-**negative** mothers should have their initial dose delayed until 1 mo of age or before hospital discharge.
3. **Infants born to HBsAg-positive women** should receive vaccine at birth, 1–2 mo, and 6 mo of age. The 1st dose should be accompanied by administration of HBIG as soon after delivery as possible (within 12 hrs) because the effectiveness decreases rapidly with increased time after birth.

Postvaccination testing for HBsAg and anti-HBs should be done at 9–18 mo.:

- If the result is positive for **anti-HBs** → the child is **immune**.
- If the result is positive for **HBs Ag** only → the parent should be counseled and the child evaluated by **pediatric gastroenterologist**.
- If the result is **negative for both** HBs Ag & anti-HBs → **2nd complete hepatitis B vaccine** series should be administered, followed by testing for **anti-HBs** to determine if subsequent doses are needed.

It is indicated in children & adults who are at risk of infection especially health care personnel and patients subjected to repeated blood transfusion.

Side effects

Transient erythema and induration at the site of injection, fever, malaise, flu-like illness, arthritis, myalgia and arthralgia.

Rotavirus vaccine

In early childhood, the single most important cause of severe dehydrating diarrhea is Rota virus infection. The vaccine protects against Rota virus gastroenteritis, oral route, three doses; 2,4, and 6 months,

Immunization should not be initiated for infants **15 wks** of age and older and the final dose in the series must be administered no later than **8 mo** of age.

Rotavirus vaccine did not increase the risk for intussusception.

Meningococcal vaccine

Meningococcal vaccine refers to any of vaccines used to prevent infection by Neisseria meningitides. It includes: meningococcal polysaccharide vaccine (MPSV) and meningococcal conjugate vaccine (MCV).

Meningococcal vaccine is recommended for children 2 months through 10 years old who are at increased risk for meningococcal disease due to certain medical conditions (functional or anatomic asplenia, HIV, terminal complement or properdin deficiency), people who are traveling to a country with high rates of meningococcal disease, or because of an outbreak in their community.

Meningococcal vaccine is routinely recommended also for all 11 through 18 year olds. The first dose should be given at 11-12 years old and a booster dose at 16 years old. Adolescents who receive their first dose of quadrivalent meningococcal conjugate vaccine at or after 16 years old do not need a booster dose. Dose 0.5ml S.C .

Hemophilus influenza type b vaccine

It is indicated for prevention of invasive diseases caused by H.influenza especially meningitis, septicemia, epiglottitis, arthritis &cellulitis. Dose 0.5ml IM or SC.

Doses of Hib vaccine are usually recommended at these ages:

First Dose: 2 months of age

Second Dose: 4 months of age

Third Dose: 6 months of age

Final/Booster Dose: 18 months of age

Children over 5 years old and adults usually do not need Hib vaccine. But it may be recommended for older children or adults with asplenia or sickle cell disease, before surgery to remove the spleen, or following a bone marrow transplant. It may also be recommended for people 5 to 18 years old with HIV.

Pneumococcal vaccine

Streptococcus pneumonia is the leading cause bacterial pneumonia , bacteremia and bacterial meningitis in children.

2 types: Conjugate and Polysaccharide type

Administer a 4-dose series of PCV-13 (pneumococcal conjugate vaccine) at ages 2, 4, and 6 months and at age 12 through 15 months.(in Iraq 2,4,6 mo).

High-risk children age 2 yrs and older should receive the PPSV (pneumococcal polysaccharide vaccine) 8 weeks or more after their last PCV dose, those children are with certain health conditions including:

1. Chronic respiratory diseases
2. Diabetes mellitus
3. Chronic heart diseases
4. Chronic renal diseases
5. Chronic liver diseases
6. Asplenia
7. Immunosuppression
8. Immunodeficiency
9. Hemoglobinopathies

Influenza vaccine

Influenza vaccine is recommended for all children beginning at 6 mo of age, with a minimum age of 6 mo . There are two types: IIV (Inactivated Influenza vaccine) which is given intramuscularly and LAIV (Live attenuated influenza vaccine) by intranasal route.

Children 6 mo of age through 8 yrs of age should receive 2 doses of vaccine at least 1 mo apart.

Indicated in:

1. Immunosuppression
2. Cardiac disease
3. Chronic lung diseases
4. Chronic renal diseases
5. Hemoglobinopathy
6. Long term Aspirin treatment
7. Chronic metabolic diseases
8. Given in epidemic
9. Diabetes mellitus

Rabies vaccine

Inactivated virus vaccine, human diploid cell vaccine (HDCV) is available given intramuscularly.

Post exposure prophylaxis is given as 4 doses (1 mL) of vaccine on days 0, 3, 7, and 14.

Varicella vaccine

Live attenuated virus vaccine, is available as a monovalent vaccine and is also available in combination with Measles, Mumps, and Rubella (MMRV) vaccines, can be given at least 4 wks apart.

Children who have never had chickenpox should get 2 doses of chickenpox vaccine at these ages:

1st Dose: 12-15 months of age

2nd Dose: 4-6 years of age

It is given in a dose of 0.5ml IM or SC.

Avoid using Salicylates for 6 weeks after getting Varicella vaccine; this is because of the potential risk of **Reye syndrome**.

Hepatitis A vaccine

Hepatitis A vaccine, inactivated virus, licensed for administration to children 12 mo of age and older, is recommended for universal administration to all children at 12 through 23 mo of age and for certain high-risk groups.

Vaccine given in 2 doses, should be separated by at least 6 mo.

Dose 0.5ml IM (1-5yrs) of age, 1ml (adult)

Indications:

1. Travel to endemic area
2. During outbreak
3. Hepatitis B, C and other chronic liver diseases.

Vaccination schedule in Iraq

Age Vaccine	At birth	2 months	4 months	6 months	9 months	15 months	18 months	4-6 years
BCG	BCG							
OPV	OPV	OPV	OPV	OPV			OPV	OPV
HBV	HBV							
Pentavalent (DTP, Hib, and HBV)		Pentavalent		Pentavalent				
Quadruple (DTP, and Hib)			Quadruple				Quadruple	
DTP								DTP
Measles					measles			
MMR						MMR		MMR
Rota vaccine		RV	RV	RV				
PCV-13		PCV-13	PCV-13	PCV-13				

Contraindications & Precautions of Vaccinations

1. Anaphylaxis to the vaccine (or any of its constitution) in the prior dose is an absolute contraindication to that vaccine.

2. Immunodeficiency; patients with *Cellular immune deficiency*, should not be given Live attenuated vaccines but can receive all other types of vaccines.

* Patients on Steroid therapy in dose <2 mg/kg/day can receive LAV during therapy, whereas patients on higher dose for >2 wk should receive LAV only after cessation of steroid Rx for at least 1 mo.

3. Patient with severe or moderate (but not mild) acute illness.

4. Preterm can be vaccinated at the same schedule of the full- term infants, except the birth dose of HBV can be deferred for 1 mo after birth if his mother has HBs Ag -ve.

5. Immunoglobulines may interfere with some vaccines e.g; Immunoglobulines should be administered at least 2 wk after measles vaccine.

6. Generally, all vaccines can be given simultaneously except that different LAV if not given simultaneously; they should be given at least 1 month apart due to a theoretical concern about viral interference.