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INSTITUTE OF MEDICAL SCIENCES

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# READY RECKONER FOR PAEDIATRIC PRACTICAL EXAM

## MODULE 3 : IMMUNIZATION

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**Immunization** is estimated to annually prevent 3.5 to 5 million deaths from common diseases. Important milestones achieved through immunization include eradication of small pox and near eradication of poliomyelitis.

The Expanded Programme on Immunization (EPI) introduced by WHO in 1974 was the first global immunization initiative. The Universal Immunization Programme UIP (1985) improved nation-wide coverage of immunization.

Currently there are 2 immunization schedule – National Immunization Schedule (NIS) and the schedule recommended by the Indian Academy of Pediatrics (IAP). The IAP Advisory Committee on Vaccines and Immunization recommends certain additional vaccines based on the regional burden of vaccine preventable diseases and fully supports the NIS.

## NATIONAL IMMUNIZATION SCHEDULE

Age	Vaccines	Dose, Route	Site
Birth	bOPV 0	2 drops, oral	
	Hep B 0 (birth dose)	0.5 ml, IM	Anterolateral thigh, left
	BCG	0.1 ml, ID	Left upper arm at insertion of deltoid
6 weeks	Pentavalent 1	0.5 ml, IM	Anterolateral thigh, left
	Rota 1	5 drops, oral	
	bOPV 1	2 drops, oral	
	fIPV 1	0.1 ml, ID	Right upper arm, right
	PCV 1	0.5 ml, IM	Anterolateral thigh, right
10 weeks	Pentavalent 2	0.5 ml, IM	Anterolateral thigh, left
	Rota 2	5 drops, oral	
	bOPV 2	2 drops, oral	
14 weeks	Pentavalent 3	0.5 ml, IM	Anterolateral thigh, left
	Rota 3	5 drops, oral	
	bOPV 3	2 drops, oral	
	fIPV 2	0.1 ml, ID	Right upper arm, right
	PCV 2	0.5 ml, IM	Anterolateral thigh, right
9 completed Months	MR-1	0.5 mL, SC	Right upper arm
	JE-1 (endemic areas)	0.5 mL, SC	Anterolateral thigh, left
	PCV-3	0.5 ml, IM	Anterolateral thigh, right
	fIPV -3	0.1 ml, ID	Left upper arm, left
16-18 months	DTwP- B1		
	bOPV B	2 drops, oral	
	JE -2 (endemic areas)	0.5 mL, SC	Anterolateral thigh
	MR-2	0.5 mL, SC	Right upper arm
5-6 years	DTwP- B1	0.5 ml I/M	Upper arm
10-12 years	Td	0.5 ml I/M	Upper arm
9-14 years	HPV-1, HPV-2		
16 years	Td	0.5 ml I/M	Upper arm

## Vitamin A

**First dose** at 9 months – 1 lakh IU.

**Second dose** at 16–18 months – 2 lakh IU.

Then **one dose** every 6 months up to the age of **5 years** – 2 lakh IU.

## IAP Immunization Schedule

Age	Vaccine	Comments
Birth	BCG OPV Hepatitis B-1	BCG before discharge OPV as soon as possible after birth Hepatitis B - within 24 hours of birth
6 weeks	DTwP/DTaP-1 IPV-1 Hib-1 Hep B-2 Rotavirus-1 PCV-1	DTwP or DTaP may be administered in primary immunization; IPV: 6wk-10wk-14wk is the recommended schedule
10 weeks	DTwP/DTaP-2 IPV-2 Hib-2 Hep B-3 Rotavirus-2 PCV-2	RV1 (GSK): 2-dose schedule; all other rotavirus brands: 3-dose schedule
14 weeks	DTwP/DTaP-3 IPV-3 Hib-3 Hep B-4 Rotavirus-3 PCV-3	An additional 4th dose of Hep B vaccine is safe
6 months	Influenza (IIV)-1	Uniform dose of 0.5 mL $\geq$ 6 mo
7 months	Influenza (IIV)-2	To be repeated every year, in pre-monsoon period, till 5 y of age
6-9 months	Typhoid conjugate vaccine	No recommendation for a booster
9 months	MMR-1	
12 months	Hepatitis A vaccine	Single dose for live attenuated

Age	Vaccine	Comments
15 months	MMR-2 Varicella-1 PCV-Booster	
16-18 months	DTwP/DTaP-B1 Hib-B1 IPV-B1	
18-19 months	Hepatitis A-2, Varicella-2	Only for inactivated hepatitis A vaccine
4-6 years	DTwP/DTaP-B2, IPV-B2, MMR-3	
9-14 years	HPV	2 doses: 0-6 mo
10 years	Tdap	Tdap is to be administered even if it has been administered earlier (as DTP-B2)
15-18 years	HPV	3 doses; 0-2-6 mo (if not administered earlier)
16-18 years	Td	

## TYPES OF VACCINES

Vaccines may be broadly classified as follows:

Live-attenuated vaccines (LAVs):	
Bacterial	BCG, Typhoid Ty21a
Viral	Oral Polio, Measles, MMR (Measles, Mumps, And Rubella), Varicella, Rotavirus, Yellow Fever, Live Influenza Vaccine (Intranasal), And Live Hepatitis A
Inactivated vaccines	
Whole-cell inactivated	Whole-cell pertussis vaccines, whole- cell killed typhoid vaccines, rabies, inactivated poliovirus (IPV), and hepatitis
Toxoid	Tetanus and diphtheria
Sub-unit vaccines	
Recombinant vaccines	Acellular pertussis, HBV, HPV
Pure polysaccharide vaccines	Typhoid, pneumococcal polysaccharide vaccine (PPSV), and meningococcal polysaccharide vaccine
Conjugated polysaccharide vaccines (CV)	Hib-CV, typhoid-CV, PCV, and meningococcal-CV
Viral vector borne	SARS-CoV 2

## Vaccines in NIS

### 1. BCG VACCINE

- Strains- Copenhagen -Danish 1331 (the strain used in India) and Pasteur
- What is the protective efficacy of BCG vaccine?
  - Primary infection – 40 %
  - Pulmonary infection – 8-79%
  - Severe forms of TB (TB meningitis and miliary TB)- 72-100%
- As childhood TB accounts for 15-20% cases and is often disseminated it reduces serious morbidity
- **Phases of evolution of BCG scar:**
  - 5-7 mm wheal at the time of injection
  - Papule - 1 week
  - Ulcer - 3-6 weeks (remember as 1 months)
  - Scar - 6-12 weeks (remember as 2-3 months)

<b>Dose, route</b>	0.1 ml ID
<b>Site</b>	Left upper arm at insertion of deltoid
<b>Schedule</b>	
<b>National programme</b>	At birth, catch up till 1 year
<b>IAP -2021</b>	At birth, catch up till 5 years
<b>Adverse reaction</b>	Local ulceration Discharging sinus Axillary lymphadenitis In immunodeficient – disseminated infection, osteomyelitis, scrofuloderma
<b>Contraindications</b>	Cellular immunodeficiency, symptomatic HIV
<b>Storage</b>	2-8 C, sensitive to heat and light Discard reconstituted vaccine after 4 hours

### 2. POLIOMYELITIS VACCINES

- What are the 2 types of available polio vaccines – live OPV and killed IPV
- Describe the immunological differences between OPV and IPV

	<b>IPV</b>	<b>OPV</b>
Composition	Contains formaldehyde killed Salk poliovirus strains of all three serotypes	Contains live attenuated Sabin poliovirus strains of serotypes -1 and 3 are in current bOPV use
Administration	Administered by intramuscular or subcutaneous routes	Administered orally as liquid drops.
Immune Response	Induces strong humoral immunity, limited mucosal immunity. No herd immunity	Induces both strong humoral and mucosal immunity, hence induces herd immunity
Safety	Very safe; Not associated with VAPP or Cvdpv	Generally safe. Rarely can cause VAPP or cVDPV outbreaks.

- **What are the vaccine strains in Trivalent and bivalent OPV**
  - Trivalent OPV contains OPV1, OPV2 and OPV 3
  - Bivalent OPV will continue to target the remaining polio types (types 1 and 3)
- **What is fractional IPV (fIPV)?**
  - A 2-dose fractional IPV (fIPV) schedule is proposed to ensure all eligible infants receive IPV until sufficient supply of the full intramuscular (IM) dose is available.
  - This fIPV strategy is dose-sparing, using one-fifth the IM dose.

	<b>OPV</b>	<b>IPV</b>
Dose, route	2 drops oral	0.5 ml IM or S/C 0.1 ml ID
Strains	Bivalent OPV (bOPV) targets type 1 and type 3, but not type 2	
Schedule		
National programme	Zero dose -at birth or till < 2 weeks 3 doses -6,10,14 weeks Booster – 15-18 months	3 doses of fIPV at 6 weeks, 14 weeks and 9-12 months
IAP -2021	At birth	3 doses of IM IPV at 6,10,14 weeks OR 2 IM doses at 8- and 16-weeks f/b 2 booster 15-18 months and 4-6 years
Catch up	Up to 5 years, 3 doses 4 weeks apart	Up to 5 years, 3 doses 0,2,6 months
Adverse reaction	VDPP, VAPP	Local pain, swelling
Contraindications	Inherited or acquired ID, symptomatic HIV	Known allergy
Storage	2-8 C, sensitive to light and heat, Use VVM	2-8 C, sensitive to light and heat, Use VVM

## **Pulse polio immunization-Last pulse polio day – October 12, 2025**

### **3. DIPHTHERIA PERTUSSIS AND TETANUS VACCINES**

- Combination of diphtheria toxoid, tetanus toxoid and Pertussis vaccine
- The vaccine contains diphtheria toxin (DT), Tetanus toxin inactivated by formalin and uses aluminum hydroxide as an adjuvant.
- The quantity of toxoid is expressed in limit of flocculation (Lf) content.
- Contains 20-30 Lf of DT, 5-25 Lf of tetanus toxoid (TT), and >4 IU of whole cell killed pertussis.
- The vaccine's efficacy ranges from 80% to 100%.

<b>Administration</b>	0.5 ml IM in the anterolateral aspect of the mid-thigh
<b>Storage</b>	2–8°C; sensitive to light
<b>Schedule</b>	NIS- recommend primary immunization at 6, 10, and 14 weeks as pentavalent vaccine. Boosters at 15-18 months and 5 years. IAP 2021 - DTwP or DTaP for the primary series and boosters in the same schedule as above. Tdap or Td is recommended at 10–12 years, followed by Td every 10 years
<b>Catch up</b>	For those younger than 7 years: DTwP or DTaP at 0, 1, and 6 months For those 7 years or older: Tdap at 0-month, Td at 1 and 6 months, then Td every 10 years
<b>Adverse Reactions</b>	Local pain, swelling, and fever and is chiefly attributed to the pertussis component (more frequent with DTwP than DTaP)
<b>Contraindications</b>	Absolute contraindications: Anaphylaxis after a previous dose Encephalopathy within 7 days of a previous dose Relative contraindications: Progressive neurological disease
<b>Precautions</b>	High fever (>40.5°C), hypotonic-hyporesponsive episode, persistent inconsolable crying for > 3 hours within 48 hours and seizures within 72 hours.

- Individuals with DTP contraindications should use the DT vaccine to complete their immunization schedule.
- For those over 7 years of age the Td vaccine is recommended

### 3. TETANUS VACCINE

How will you plan Tetanus Vaccine / immunoglobulin (Ig) for wound prophylaxis ?

Doses of tetanus toxoid received previously	Clean minor wound		All other wounds	
	Tetanus toxoid <sup>1</sup>	Tetanus Ig	Tetanus toxoid <sup>1</sup>	Tetanus Ig
–	Tetanus toxoid <sup>1</sup>	Tetanus Ig	Tetanus toxoid <sup>1</sup>	Tetanus Ig
< 3 doses or uncertain, or immunodeficient	Yes <sup>2</sup>	No	Yes	Yes
≥ 3 doses, 10 years back	Yes	No	Yes	No <sup>3</sup>
≥ 3 doses, 5–10 years back	No	No	Yes	No <sup>3</sup>
≥ 3 doses, <5 years back	No	No	No	No <sup>3</sup>

1- Administer any tetanus toxoid containing vaccine (DT or DTaP ≤7-yr-old, Tdap, Td or TT if older) based on age-appropriateness and ease of availability

2- The vaccination course should be completed with three doses of an age-appropriate vaccine containing tetanus toxoid, given 1 month apart

3- Yes, if immunodeficient

## 4. HEPATITIS B VACCINE

Vaccine contains surface antigen of Hepatitis B virus produced by rDNA technology

Dose and route	<ul style="list-style-type: none"><li>● 0.5 mL (10 µg) for children</li><li>● 1 mL (20 µg) for adults</li><li>● IM in the anterolateral thigh/ deltoid.</li></ul>
Schedule NIS	Birth, 6 weeks, 10 weeks, and 14 weeks
IAP	As above
Catch up	Three doses at 0, 1, and 6 months
Adverse reaction Contraindication	<ul style="list-style-type: none"><li>● Local soreness, fever, and fatigue.</li><li>● Anaphylaxis after a previous dose is a contraindication</li></ul>
Storage	Storage between 2-8°C Should not be frozen

### How will you plan immunization in a baby born to Hepatitis B positive mother?

- Infants of HBsAg-positive mothers should receive the hepatitis B vaccine 0.5 ml IM and HBIG 0.5 ml IM within 24 hours of birth at separate sites. Baby should then receive Hepatitis B Vaccine as per schedule
- If HBIG is not administered, the baby should follow an accelerated immunization schedule at 0, 1, and 2 months, with a final dose at 9-12 months.

## 5. HEMOPHILUS INFLUENZA B VACCINATION

- Monovalent Hib-CV is no longer available. Hib-CV is available in combination with DPT/HBV/IOPV as a quadrivalent or pentavalent or hexavalent combinations.
- The vaccination schedule for Hib is as follows: minimum age: 6 weeks
  - Primary series:
    - NIS - Pentavalent vaccine at ages 6, 10, and 14 weeks
    - IAP schedule -includes Hib conjugate vaccine at ages 6, 10, and 14 weeks with a booster at age 12 through 18 months
    - Catch-up vaccination: Catch-up is recommended till 5 years of age
    - <6 months: 3 doses 4 weeks apart followed by booster- 12-18 months of age.
    - 6–12 months: Two primary doses 8 weeks apart and one booster- 12-18 months of age.
    - 12–15 months: One primary dose and one booster- 15-18 months of age.
    - Above 15 months: Single dose
- Catch-up vaccination is not recommended for healthy children >5 years. Immunocompromised, those planned for cochlear implant and splenectomy, sickle cell anemia, require catch-up

### What are the components of Pentavalent vaccine?

Diphtheria, Pertussis, Tetanus, Hepatitis B and Hib vaccine

Each dose is 0.5 ml, given intra-muscular injection in antero-lateral aspect of the mid-thigh

## 6. PNEUMOCOCCAL VACCINES

### ● What are the available pneumococcal vaccines?

Pneumococcal Conjugate (PCV13, PCV10) and Polysaccharide (PPSV23) Vaccines  
PCV10-Pneumosil is the vaccine given in NIS

Feature	Pneumococcal Conjugate (PCV)	Pneumococcal Polysaccharide (PPSV23)
Type	PCV13 (Prevenar), PCV10 (Synflorix, Pneumosil)	PPSV23 (Pneumovax)
Dose, route	0.5 mL; intramuscular (IM)	0.5 mL; intramuscular (IM) or subcutaneous (SC)
Site	Anterolateral thigh (infants/young children) or deltoid (older children/adults)	Deltoid
NIS (Pneumosil)	2 doses at 6 weeks, 14 weeks and 1 booster at 9 months	--
Schedule (IAP 2021)	3 doses at 6, 10 and 14 weeks one booster at 15-18 months	Only in high-risk category: 1 dose $\geq$ 8 weeks after primary course with conjugate vaccine Repeat once after 5 years if risk persists
Storage	2-8°C; do not freeze	2-8°C
Adverse reactions	Fever, local pain, soreness, malaise	Local pain, redness, soreness (30-50%)
Contraindication	Anaphylaxis after previous dose or diphtheria toxoid containing vaccine	Anaphylaxis after previous dose or any vaccine component
Immune Response	Triggers a T-cell dependent immune response, leading to immunological memory.	Triggers a T-cell independent B-cell response, resulting in poor immunological memory.
Age Effectiveness	Effective in children under 2 years of age and adults.	Poorly immunogenic/ineffective in children under 2 years of age; primarily for adults and older children
Duration of Protection	Provides more durable, long-lasting protection.	Protection may wane more quickly.
Herd Immunity	Can reduce nasopharyngeal carriage of bacteria, contributing to herd immunity.	Does not reduce nasopharyngeal carriage or provide herd immunity

## 7.ROTA VIRUS VACCINE

Feature	Rotavac	Rotasiiil
Strains	Indian neonatal (116E); human-bovine monovalent	Bovine pentavalent; thermostable
Number of Strains	1	5
Dose, Route	5 drops, oral (0.5 mL)	2.5 mL, oral
National schedule	3 doses at 6,10,14 weeks	Not included
IAP	3 doses at 6,10,14 weeks	3 doses at 6,10,14 weeks
Catch up	<p>NIS - Upto 1 year of age</p> <p>IAP: The first dose should be given before 16 weeks of age, and the series must be completed by 32 weeks of age.</p> <p>The IAP recommends vaccination at 6 and 10 weeks for the first two doses in India due to the higher risk of early natural infections</p>	
Adverse event	Fever, diarrhea, vomiting, cough, rhinitis, rash, and irritability. Intussusception is a potential, but very rare, serious adverse event.	
Contraindications	Do not administer the vaccine if the infant has a history of intussusception or severe immunodeficiency	
Precautions	Vaccination should be postponed during ongoing diarrhea or moderate illness	

## 8. MEASLES CONTAINING VACCINES

Measles vaccine is available as measles vaccine, measles rubella (MR) vaccine, mumps measles rubella (MMR) vaccine and mumps measles rubella varicella (MMRV) vaccine. MMR-Varicella (MMRV) vaccine is avoided in children under 2 years of age.

## In NIS – it is administered as MR vaccine. Mumps is not a part of NIS

Feature	MR Vaccine
Dose & Route	0.5 mL, Subcutaneous
Site	Right upper arm (deltoid insertion) or anterolateral thigh
NIS Schedule	2 doses: 9–12 months and 15–18 months (Catch-up allowed up to 5 years)
IAP 2021 Schedule	3 doses: 9–12 months, 15–18 months, and 4–6 years (Preferably as MMR)
Catch-up (IAP)	No upper age limit; 2 doses with a 4-week interval
Adverse Reactions	Mild fever, transient rash (7–12 days), arthralgia, lymphadenopathy, aseptic meningitis; rare febrile seizures
Contraindications	Immunosuppression, pregnancy, previous anaphylaxis, malignancy, primary immunodeficiency, symptomatic HIV, recent immunoglobulin infusion
Storage	2–8°C; sensitive to heat

- After reconstitution, it must be used within 4–6 hours as delayed use can cause TSS as there is no preservative.

## 9. JAPANESE ENCEPHALITIS VACCINE

- The available JE vaccines are Live attenuated cell culture derived SA-14-14-2 vaccines and inactivated cell culture derived SA-14-14-2 vaccine and inactivated Vero cell derived Kolar vaccines
- JE vaccine strain in National Immunization Program → Live attenuated SA-14-14-2
- JE vaccination is given only endemic areas; Alappuzha, Trivandrum, Calicut and Malappuram districts in Kerala

Feature	Live Attenuated- SA-14-14-2
<b>Type</b>	Live attenuated
<b>Dose</b>	0.5 mL
<b>Route</b>	Subcutaneous
<b>Site</b>	Anterolateral thigh / upper arm
<b>Schedule</b>	2 doses, 9 months & 16–18 months as per NIS
<b>Age</b>	≥9 months
<b>Catch-up</b>	Up to 15 years & adults
<b>Adverse Effects</b>	Fever, malaise Rare hypersensitivity

## 10. HUMAN PAPILLOMA VIRUS VACCINES

- The available HPV vaccines in India are
- Cervarix (HPV2) – 2 strains
- Gardasil (HPV4) – 4 strains
- Gardasil 9 (HPV9)-9 strains
- Common adverse reactions include local pain, swelling, erythema, and fever; anaphylaxis after a previous dose is a contraindication.

Vaccine name	Cervarix (HPV2)	Gardasil (HPV4)
<b>Target age: years Girls</b>	9-45	9-45
<b>Target age: years Boys</b>	Not available	9-26
<b>Schedule</b>		
<b>Age &lt;15 years</b>	2 doses at 0, 6–12 months	2 doses at 0, 6–12 months
<b>Age ≥15 years</b>	3 doses at 0, 1, 6 months	3 doses at 0, 2, 6 months
<b>Dose, route</b>	0.5 mL, intramuscular	
<b>Site</b>	Upper arm (deltoid)	
<b>Schedule National program</b>	In some states, in girls 11–13 years, as above	
<b>IAP</b>	As above	
<b>IAP 2021 Catch up</b>	Up to 45 years (IAP); preferably before initiation of sexual activity	

<b>Adverse reactions</b>	Local pain, swelling, erythema; fever Syncope (due to injection, not vaccine)
<b>Contraindication</b>	Anaphylaxis after previous dose
<b>Storage</b>	2–8°C; protect from light

## VACCINES NOT INCLUDED IN NATIONAL IMMUNIZATION SCHEDULE

### VARICELLA VACCINE

<b>Dose &amp; Route</b>	0.5 ml, subcutaneously
<b>Site</b>	Anterolateral thigh or upper arm
<b>IAP 2021 Schedule</b>	All children, especially high-risk; two doses, 3-6 months apart. First dose at 15 18-months (minimum 12 months)
<b>Catch-up Schedule</b>	Complete two doses $\geq$ 3 months apart ( $\geq$ 4 weeks apart for those $\geq$ 13 years old)
<b>Adverse Reactions</b>	Fever, rash, local pain or redness; mild rash 2-3 weeks later (5%)
<b>Contraindications</b>	Previous anaphylaxis, immunodeficiency, active leukemia/lymphoma, immunosuppressive therapy
<b>Precautions</b>	Moderate/severe illness, thrombocytopenia, recent blood products/immunoglobulins, therapy with aspirin
<b>Storage</b>	Freeze dried/lyophilized; 2-8°C; protect from light; use within 30 mins of reconstitution

### INFLUENZA VACCINE

2 types of vaccines are available – Inactivated Influenza Vaccine (IIV) and Live Attenuated Influenza Vaccine (LAIV)

<b>Feature</b>	<b>Inactivated Influenza Vaccine (IIV)</b>	<b>Live Attenuated Influenza Vaccine (LAIV)</b>
<b>Route</b>	Intramuscular (IM) injection	Intranasal (Accuspray device)
<b>Dose</b>	0.5 ml (15 $\mu$ g)	0.25 ml in each nostril
<b>Site</b>	Anterolateral thigh/upper arm	Nasal mucosa
<b>Target Age</b>	6 months to 5 years All children >5 years (High-risk)	2 to 18 years (Healthy children)

<b>First-Time Schedule (&lt;9 years)</b>	2 doses, 2–4 weeks apart	2 doses, 2–4 weeks apart
<b>First-Time Schedule (≥9 years)</b>	Single dose	Single dose
<b>Maintenance</b>	Annual single dose (before rainy season)	Annual single dose (before rainy season)
<b>Common Side Effects</b>	Local pain, fever, nausea (10-35%)	Runny nose, headache, wheezing, fever, vomiting
<b>Severe Side Effects</b>	Anaphylaxis, Guillain-Barre Syndrome (rare)	Potential wheezing in young children
<b>Key Contraindications</b>	Previous anaphylaxis to the vaccine	Pregnancy, immunosuppression, salicylate therapy, recent antiviral use
<b>Storage</b>	2–8°C; Do not freeze	2–8°C; Do not freeze

## RABIES VACCINE

### Rabies Exposure Categories and Treatment

Category	Type of Contact	Recommended Treatment
<b>Category I</b>	Touching/feeding animals or licks on unbroken skin	None (no exposure)
<b>Category II</b>	Nibbles, minor scratches or abrasions without bleeding	<ul style="list-style-type: none"> <li>Local Rx (treatment) of wounds</li> <li>Anti-rabies vaccine - on days 0, 3, 7, and 28 - ID/IM (0.1 ml of ID or 0.5 ml of IM)</li> </ul>
<b>Category III</b>	Single or multiple transdermal bites with bleeding, licks on mucous membrane or broken skin	<ul style="list-style-type: none"> <li>Local Rx of wounds</li> <li>Anti-rabies vaccine - on days 0, 3, 7, and 28.</li> <li>Rabies immunoglobulin (HRIG/ERIG or Rabies Mabs Dosage: Human RIG (HRIG) is 20 IU/kg, Equine RIG (ERIG) is 40 IU/kg. Monoclonal antibodies like Rabishield (3.33 IU/kg) or Twinrab (40 IU/kg) are often preferred over RIG.</li> </ul>

- Re-exposure: For individuals with documented prior prophylaxis, two booster doses of vaccine are given on days 0 and 3. RIG is not required in these cases.
- Administration Notes: Vaccines should never be administered in the gluteal region. RIG should be infiltrated into and around the wound site(s), not in the same location as the vaccine.
- Immunocompromised Patients: These individuals require a 5-dose vaccine series and a post-vaccination antibody test

## HEPATITIS A VACCINE

	<b>Inactivated vaccine</b>	<b>Live attenuated vaccine</b>
<b>Dose, route</b>	0.5 mL (720 U); intramuscular	0.5 ml; intramuscular
<b>Site</b>	Deltoid	Deltoid
<b>Schedule</b>		
<b>IAP 2021</b>	>1 year: Two doses 6 months apart	>1 year: One dose
<b>Catch up</b>	1-10 years: As above >10 years: After confirming seronegativity- two doses 6-12 months apart Higher dose (1440 U; 1 mL) if >18-yr-old	As for inactivated vaccine
<b>Adverse reactions</b>	Local pain, headache, malaise	Soreness, erythema, fever, malaise
<b>Contraindications</b>	Anaphylaxis after previous dose	Hypersensitivity to egg protein; immunodeficiency, chemotherapy or radiotherapy
<b>Storage</b>	2-8°C; protect from light; Use within 30 minutes of reconstitution	2-8°C; do not freeze; Use within 30 minutes of reconstitution.

## TYPHOID VACCINES

The available Typhoid vaccines are

Typhoid Conjugate (TCV)-(Brands -PedaTyph, Typhar-TCV, TyphiBEV),Vi Capsular Polysaccharide -(Brands: Typhar, Vactyph, Biovac), Live Attenuated Ty21a vaccines.

	<b>Typhoid Conjugate (TCV)</b> <b>(Brands -PedaTyph, Typbar-TCV, TyphiBEV)</b>
Dose, route	0.5 mL (25 $\mu$ )
Schedule	(Preferred) One dose at $\geq$ 6 months of age.
Booster	No routine booster recommended currently by IAP, though manufacturers mention after 3 years for those at continued risk
Catch up	One dose, up to 18 years
Adverse reaction	Local pain, swelling, redness; fever
Contraindication	Anaphylaxis after previous dose

## MENINGOCOCCAL VACCINES

2 types of Meningococcal vaccines – polysaccharide and conjugate vaccines

Bivalent conjugate vaccines contains groups A,C and quadrivalent (Menactra, Menveo) – contain A,C,Y,W135 V

Polysaccharide vaccines are presently not marketed in India

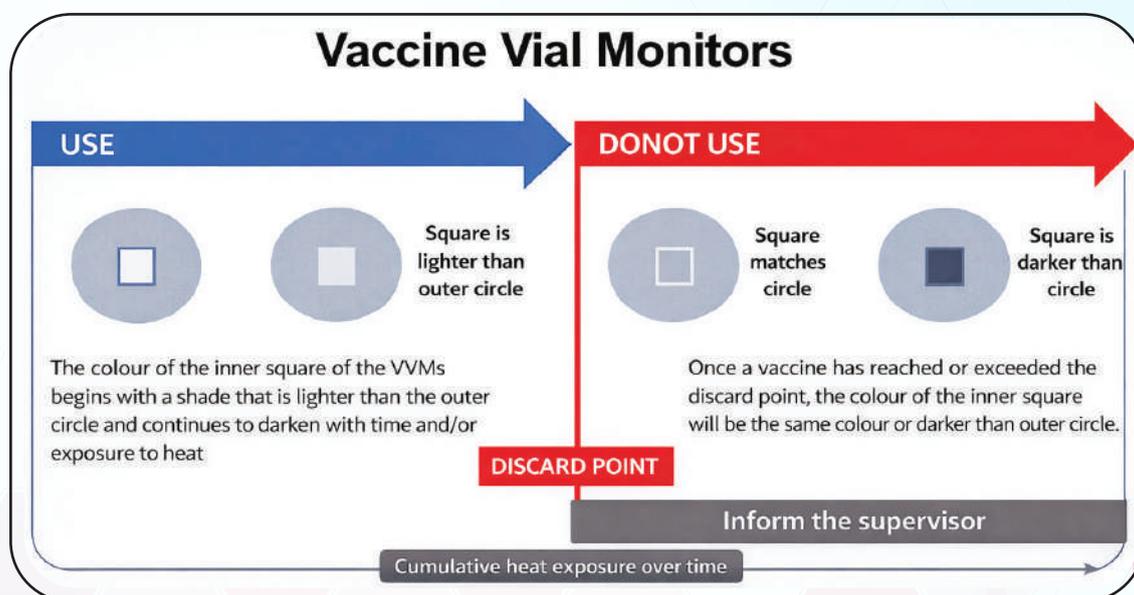
Feature	Quadrivalent Conjugate Vaccine
Dose/Route	0.5 mL, Intramuscular (IM)
Schedule	9–23 months: 2 doses 3 months apart; >24 months - single dose >24 months: revaccination after 3–5 years in high-risk children and adolescents
Site	Anterolateral thigh or upper arm
Adverse Reactions	Local pain, swelling, or redness; rarely, Guillain-Barré syndrome (GBS)
Storage	2-8°C; do not freeze

## YELLOW FEVER VACCINE

- It is a live attenuated vaccine of either the 17D-204 or 17DD strain.
- A single dose provides long-lasting immunity, with antibodies developing within 10 to 21 days.
- The vaccine is administered at least 10 days before travel to endemic areas in Africa and South or Central America.
- Administration is avoided in young infants and pregnant women

## What is Vaccine Vial Monitor (VVM)?

- VVM tag contains a heat sensitive material which changes colour in response to cumulative heat exposure
- The combined effect of time and temperature cause the inner square of the VVM to darken gradually and irreversibly



## Adverse event following immunization (AEFI)

Adverse event following immunization (AEFI) is defined as any untoward medical occurrence which follows immunization, and which does not necessarily have a causal relationship with the usage of the vaccine

**Based specifically on the severity, cause and frequency, vaccine reactions or AEFIs may be broadly grouped as under:**

### AEFIs by severity of the event:

a. Minor reactions

b. Severe reactions

Cause-specific AEFIs:

a) Vaccine product-related reactions

b) Vaccine quality defect-related reactions

c) Immunization error-related reactions

d) Immunization-triggered stress response (ITSR)

e) Coincidental event

## SPECIAL SITUATIONS IN IMMUNIZATION

Children on steroid therapy

- Children receiving oral corticosteroids in high doses (prednisolone 2 mg/kg/day for those weighing 10 kg, 20 mg/day or its equivalent) for >2 weeks should not receive live until the steroids have been discontinued for at least 1 month.
- Killed vaccines are safe but may be less efficacious.
- Local steroid injections, inhaled or topical steroid therapy, long term alternate day treatment with short acting steroids, steroid replacement therapy do not cause immunosuppression. Hence, children on these treatments can receive all vaccines safely.

## ADOLESCENT VACCINATION

Epidemiological shift of the VPDs due to improved coverage of childhood immunization can lead to higher-than-expected incidence of vaccine-preventable diseases (VPDs) in adolescents

The adolescent-specific vaccines are Tdap/Td and human papillomavirus (HPV) vaccines.

NIS had diphtheria and tetanus booster, JE vaccine in endemic areas, HPV and MR vaccine in campaign programmes.

TCV, Varicella, Hepatitis A and B can be offered

Pneumococcal and meningococcal vaccines in high-risk groups

**Indian Academy of Pediatrics, Advisory Committee on Vaccines and Immunization Practices-recommended vaccines in adolescents with range**

Vaccine	Age 7–10 years	11–12 years	13–18 years
Tdap	One dose (if indicated)	One dose	One dose (if indicated)
HPV-1	Two doses 0–6 months	Two doses 0–6 months	< 15 years -2 doses 0–6 months >15 years, 3 doses 0–2–6 months
MMR	Complete two-dose series, at least 4 weeks apart		
Hepatitis B	Complete three-dose series, 0–1–6 months		
Hepatitis A	Complete two doses 6–12 months apart, series of inactivated or single dose live		
Varicella	Two doses at 4–8 weeks' interval		
TCV	Single dose		
Influenza	Single annual dose		
JE	Two doses at 4 weeks' interval		

## ROUTES OF ADMINISTRATION OF DIFFERENT VACCINES

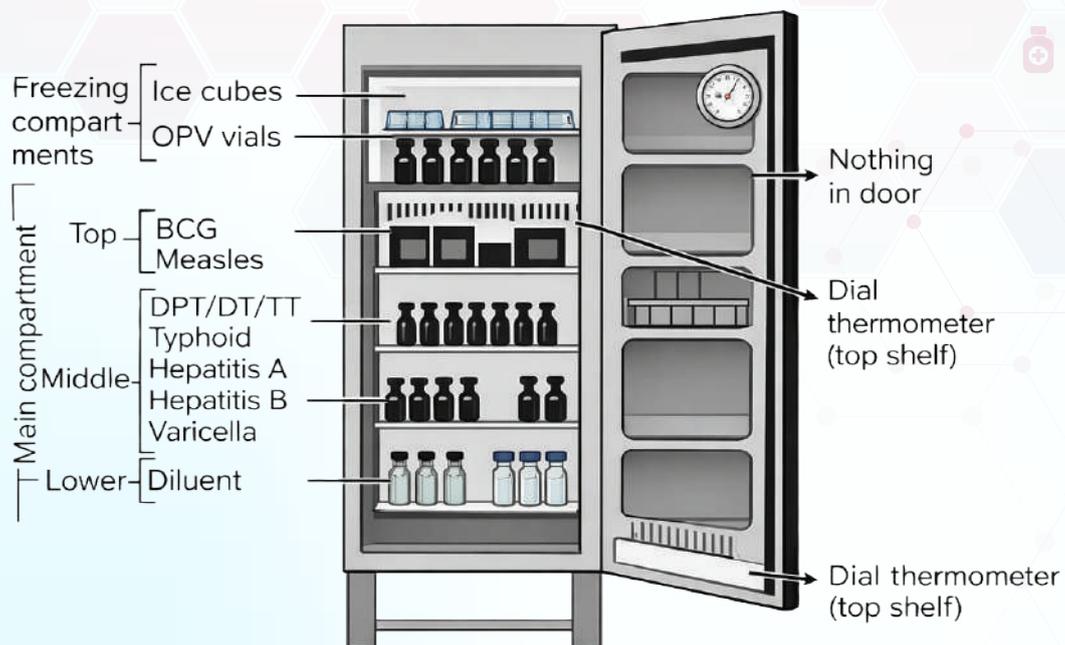
- Oral-OPV, Rotavirus
- ID-BCG, IPV, Rabies
- SC-M/MR/MMR/varicella/MMRV/coagulation disorders
- IM-DPT, DT, IPV, Hep B, Hep A, DTaP, HiB, Pneumococcal, typhoid
- Nasal – influenza

## DIAGRAMS PERTAINING TO IMMUNIZATION

Ice Lined Refrigerator (ILR)



Storage of vaccine in refrigerator



## QUESTIONS

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1. Enumerate the differences between adaptive and innate immunity.
2. Enumerate the immunogenic differences between live and killed vaccines
3. Enumerate 4 live vaccines
4. Enumerate 4 killed vaccines
5. What is herd immunity?
6. What is herd effect?
7. What are the principles of immunization?
8. What are the differences between conjugate and polysaccharide vaccines?
9. Timeline of evolution of BCG scar
10. What will you do if BCG scar is absent?
11. What is the importance of continuing OPV despite addition of IPV in NIS?
12. Differentiate between OPV and IPV - Enumerate 4 differences
13. What is the significance of zero dose of OPV?
14. Explain briefly about the significance of pulse polio programme
15. What is the difference between acellular and whole cell pertussis vaccines?
16. Enumerate 2 absolute contraindications of DPT vaccine?
17. What are the difference between Td,TT and Tdap?
18. How will you plan Hepatitis vaccination in a baby born to Hepatitis B positive mother?
19. How will you plan vaccination to a 2-year -old unvaccinated child who come to your OP?
20. How will you plan vaccination to a 8- year -old unvaccinated child who comes to your OP?
21. Why is antero-lateral thigh preferred to gluteal region for vaccination?
22. Enumerate 4 freeze sensitive vaccines
23. Which are the heat sensitive vaccines?
24. What are the vaccines that provide protection against childhood pneumonia?
25. What are the vaccines that provide protection against childhood meningitis?
26. What is VVM and what is its significance?
27. Mission Indradhanush
28. Adolescent vaccination
29. How will you advice vaccination in a child diagnosed with nephrotic syndrome?

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