Principles of immunization

- **Objectives :**

1- Understand the types of acquired immunity
2- Differentiate between the different types of vaccines used in preventing illness
3- Understand the type of vaccine, its mode of delivery, and schedule for important immunizable diseases; TB, Pertussis, Rubella, Diphtheria, Measles, Tetanus, Hepatitis, Meningitis, Rabies, Polio
4- Define and understand the cold chain and its importance
5- List the vaccines in the current National compulsory vaccination schedule
For each disease, briefly describe epidemiology and mode of transmission
To identify the type of vaccine (live vs. inactivated), and route of administration

- **Resources :**

Slides.
Doctor's notes.

[Colors index : Important | Notes | Slides | Extra]

[Editing file | Share note]

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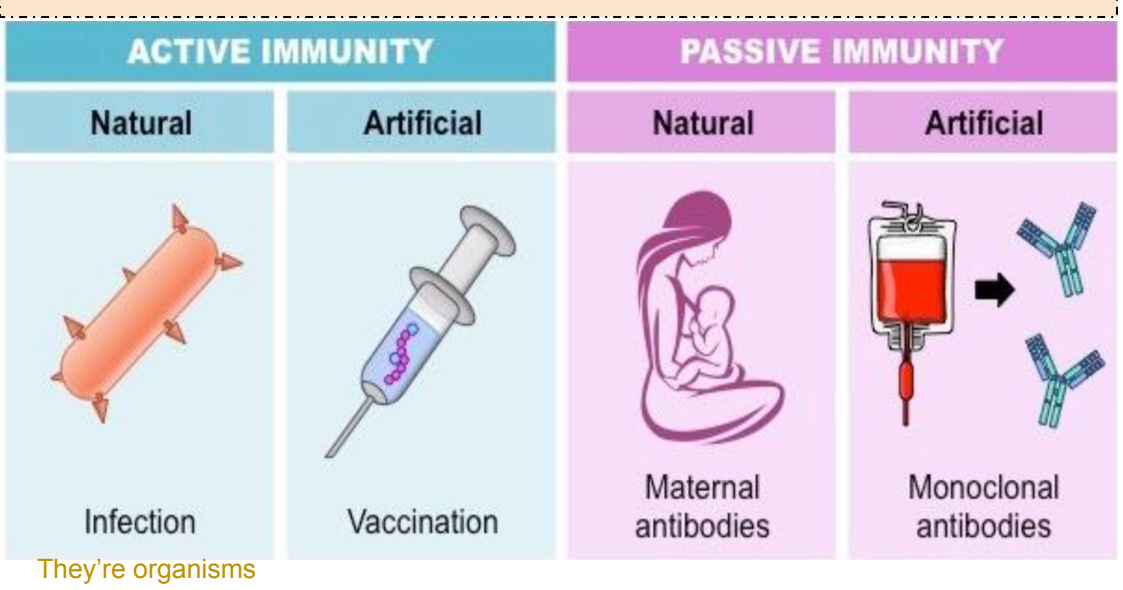
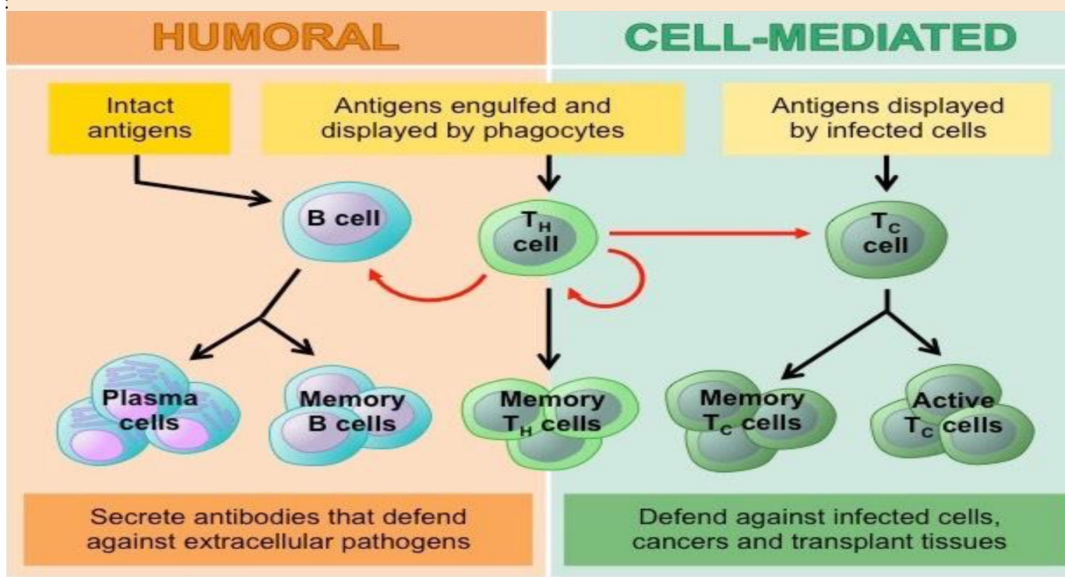
Types of Immunity



They're organisms that stimulate human response

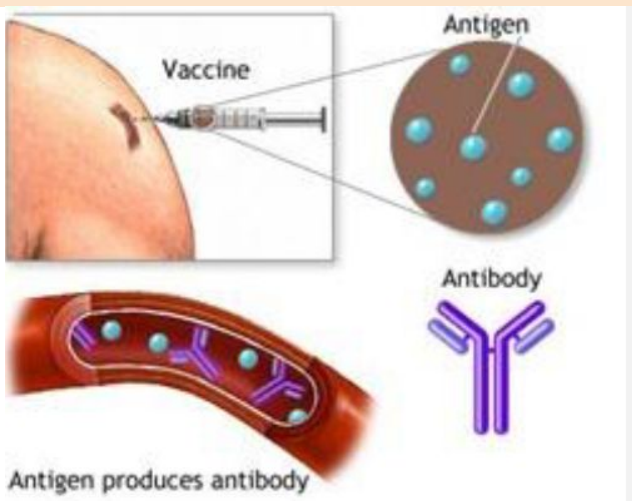
Types of Active Immunity



Sometimes both happen

Advantages of active immunity compared to passive immunity:

- Long-lasting protection
- Sever reactions are rare.
- Higher protective efficacy
- Less expensive



Herd immunity (Community immunity)

- When vaccination of a portion of population (or herd) provides protection to unprotected individuals.

How? 1- Because disease prevalence will be less, the likelihood of infection will automatically be less
2- Indirectly, non-vaccinated individuals produce antibodies due to exposure

- Higher number of immune individuals, the lower likelihood that a susceptible person will come in contact with an infectious agent.

- Provides an immunological barrier to the spread of disease in the human herd.

- On-going immunization programme will keep the herd immunity at a very high level.

E.g during hajj

Types of Used Vaccines

Live, attenuated vaccines

- Contain a version of the living virus or bacteria that has been weakened

- It does not cause serious disease in people with healthy immune systems. Produces signs and symptoms of the disease that are minimal and not dangerous.
  Produces high potency of immune response against disease.

Contraindication

- immunocompromised persons (leukaemia, lymphoma or cancer)
- Persons with immune deficiency disease.
- Pregnancy

Examples:

Viral

• Measles, mumps, rubella,

• Zoster,

• Varicella

• Yellow fever, • Rotavirus

• Influenza

• Oral polio I.M. polio is killed

• **bacterial**

• Bacille Calmette-Guérin (BCG)

• Oral typhoid vaccine.

Types of Used Vaccines

Inactivated vaccines (killed) less potency that live

• Produced by growing the bacterium or virus in culture media, then inactivating it with heat and/ or chemicals (usually formalin). This causes changes in the structure of the organism that kills it, but antigens are still there so immune response can still occur

• Not alive and cannot replicate.

• Cannot cause disease from infection, even in an immunodeficient person.

Inactivated vaccines are safe for immunocompromised patients.

• Always require multiple doses.

• In general, the first dose “primes” the immune system.

• A protective immune response develops after the second or third dose

Contraindication:

Severe local or general reaction to a previous dose.

Example:

- Polio (injectable NOT oral), Hepatitis A, Rabies
- Pertussis, Typhoid, Cholera, Plague

Polysaccharide Vaccines (based on the preparation method)

- Type of inactivated subunit vaccine composed of long chains of sugar molecules
- Pure polysaccharide vaccines are available for three diseases: pneumococcal disease, meningococcal disease, and Salmonella Typhi. All of them are encapsulated.
- The immune response to a pure polysaccharide vaccine is typically T-cell independent, which means that these vaccines are able to stimulate B cells without the assistance of T-helper cells.
- Conjugated polysaccharide (polysaccharide is chemically combined with a protein molecule). Example: Haemophilus influenzae type b (Hib)

Types of Used Vaccines

Recombinant Vaccines

- Vaccine antigens may also be produced by genetic engineering technology.
- Four genetically engineered vaccines are currently available.

- Hepatitis B
- human papillomavirus (HPV)

Always recombinant

- Live typhoid vaccine (Ty21a)
- Live attenuated influenza

Combinations Vaccines

- If more than one kind of immunizing agent is included in the vaccine it is called a mixed or combined vaccine.

The aims of combined vaccines are to

- Simplify administration
- Reduce costs
- Minimize the number of contacts of the patient with the health system
- Reducing the storage cost

- Usually does not increase the risk of adverse reactions

Examples

- DPT (Diphtheria-pertussis-tetanus)
- MMR (Measles, mumps and rubella)
- DPTP (DPT plus inactivated polio)
- DPT-Hep B-Hib (Diphtheria, pertussis, tetanus, hepatitis Band haemophilus influenza type B). Pentavalent vaccine

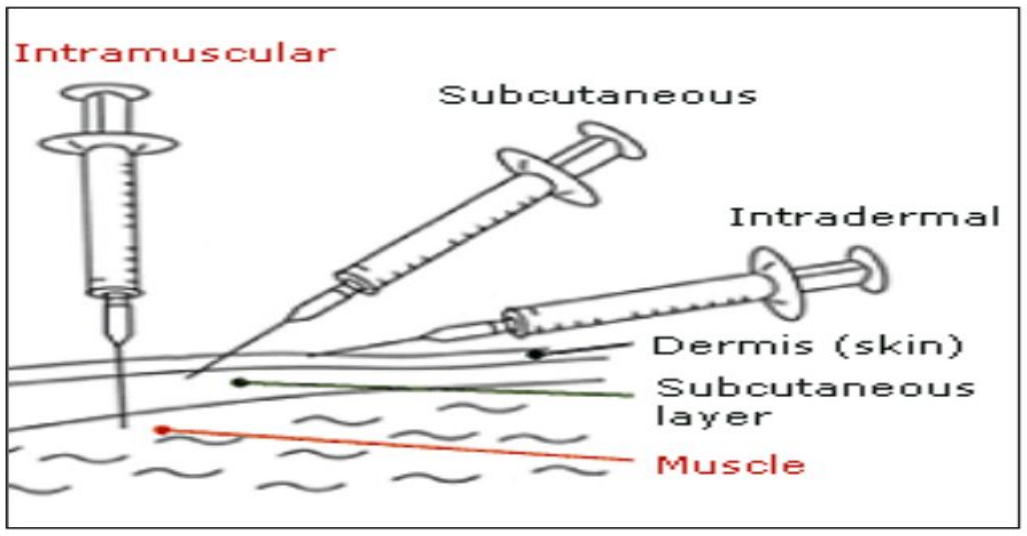
Routes of Administrating Vaccines

The route of administration is the path by which a vaccine is brought into contact with the body.

- This is a critical factor for success of the immunization.

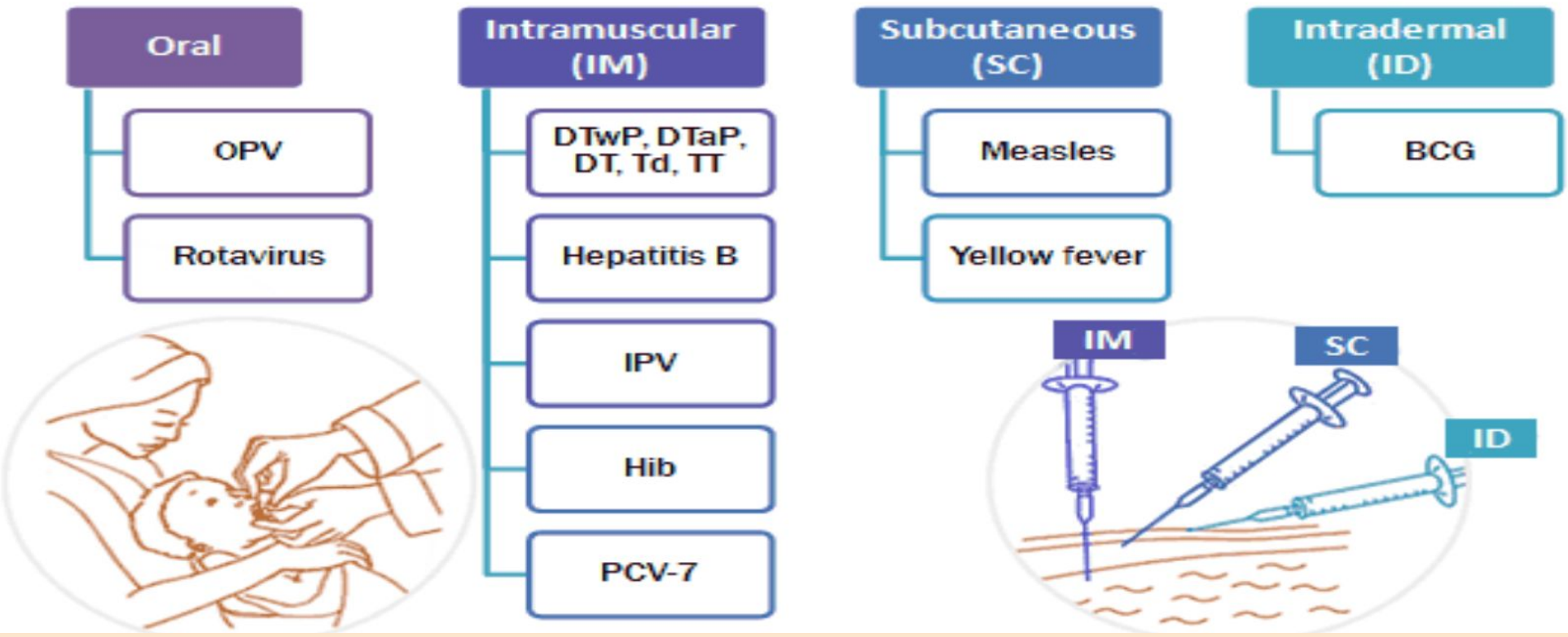
- Intramuscular route
- Subcutaneous route
- Intradermal route
- Oral route

NEVER Intravenous



Oral administration	Intradermal injection	Subcutaneous injection	Intramuscular injection
• Oral administration of vaccine makes immunization easier by eliminating the need for a needle and syringe.	•Administers the vaccine in the topmost layer of the skin. • BCG is the only vaccine with this route of administration. • Intradermal injection of BCG vaccine reduces the risk of neurovascular injury.	• Administers the vaccine into the subcutaneous layer above the muscle and below the skin.	• Administers the vaccine into the muscle mass. • Vaccines containing adjuvants should be injected IM to reduce adverse local effects. • Most common type • Thigh> babies • Deltoid>adults

Routes of Administrating Vaccines



Different types of vaccine vials

Single-Dose Vials	Multidose Vials Can be used for multiple people	Manufacturer-Filled Syringes
• A single-dose vial (SDV) contains one dose and should be used one time for one patient. • SDVs do not contain preservatives to help prevent microorganism growth.	• A multidose vial (MDV) contains more than one dose of vaccine. • MDVs typically contain a preservative to help prevent the growth of microorganisms, they can be entered or punctured more than once. •Only the number of doses indicated in the manufacturer's package insert should be withdrawn from the vial. •After the maximum number of doses have been withdrawn, the vial should be discarded, even if there is residual vaccine or the expiration date has not been	• A manufacturer-filled syringe (MFS) is prepared and sealed under sterile conditions by the manufacturer. • Activate an MFS (i.e., remove the syringe cap or attach the needle) only when ready to use. • An MFS does not contain a preservative to help prevent the growth of microorganisms. • Once the sterile seal has been broken, the vaccine should be used or discarded by the end of the workday.

Immunization Schedules

- Each country determines its own immunization schedule and chooses vaccine presentations.
- Health workers should always refer to their national schedules and vaccine handling instructions when providing immunization services.

National Immunization Schedule


وزارة الصحة
Ministry of Health

صورة
Pic

- شهادة تطعيم -
- Vaccination Certificate -

Name:
Date of Birth:
Family / Medical File No.:


Ministry of Health وزارة الصحة

Child Info بيانات الطفل

Health Center / Hospital:
Name:
Date of Birth:
Family / Medical File No.:
Child ID / Iqama Number:
No. in Immunization Registry:
Full Address:
Tel. Home:
Mobile:


Other Vaccine تطعيمات أخرى

التطعيم Vaccine	التاريخ Date	الختم Stamp	الاسم والتوقيع Name & Signature

رسالة

عزيزتي الأم، عزيزتي الأم .....

- الهدف من التطعيمات الواردة في هذه الشهادة
- حماية الأطفال بالمملكة وهتك المجتمع من الأمراض المستهدفة بالتحصين
- الحفاظ على حق المملكة من شلل الأطفال
- الحفاظ على حق المملكة من الكزاز الوليدي
- إزالة أمراض الحصبة، الحصبة الألمانية، التكزف
- خلاف معلومات باقي الأمراض المستهدفة بالتحصين
- التزامكم بتحصين أطفالكم لأحد التطعيمات سواء بالجرعات الأساسية أو المنشطة هو وقاية لهم بإذن الله من العديد من الأمراض و مضاعفاتها الخطيرة
- حرصكم على التعاون مع فرق وزارة الصحة في مراكزها الصحية أثناء حملات التطعيم هو الأساس للوصول إلى أهدافنا الوقائية المتمثلة في وطن خال من الأمراض المستهدفة من التحصين

This list is very important for MCQs and OSCE

National Immunization Schedule

جدول التطعيمات الوطني

Visit الزيارة	Vaccine التطعيم	Date التاريخ	Name & Signature الاسم والتوقيع	Stamp الختم	Next Visit Date تاريخ الزيارة التالية
At Birth عند الولادة	• BCG درن • Hepatitis B التهاب كبدي (ب)				
2 Months عمر شهرين	• IPV شلل أطفال معطل • DTaP الثلاثي البكتيري • Hepatitis B التهاب الكبدي (ب) • Hib المستدمية النزلية • Pneumococcal Conjugate (PCV)* البكتيريا العقدية الرئوية* • Rota** فيروس الروتا**				
4 Months عمر ٤ شهور	• IPV شلل أطفال معطل • DTaP الثلاثي البكتيري • Hepatitis B التهاب الكبدي (ب) • Hib المستدمية النزلية • Pneumococcal Conjugate (PCV)* البكتيريا العقدية الرئوية* • Rota** فيروس الروتا**				
6 Months عمر ٦ أشهر	• OPV شلل الأطفال الفموي • IPV شلل أطفال معطل • DTaP الثلاثي البكتيري • Hepatitis B التهاب الكبدي (ب) • Hib المستدمية النزلية • Pneumococcal Conjugate (PCV)* البكتيريا العقدية الرئوية*				
9 Months عمر ٩ أشهر	• Measles الحصبة المقرد • Meningococcal Conjugate quadrivalent (MCV4) الحمى الشوكية الرباعي المقترن				
12 Months عمر ١٢ شهر	• OPV شلل الأطفال الفموي • MMR الثلاثي الفيروسي • Pneumococcal Conjugate (PCV)* البكتيريا العقدية الرئوية* • Meningococcal Conjugate quadrivalent (MCV4) الحمى الشوكية الرباعي المقترن				
18 Months عمر ١٨ شهر	• OPV شلل الأطفال الفموي • DTaP الثلاثي البكتيري • Hib المستدمية النزلية • MMR الثلاثي الفيروسي • Vericella الجدري المائي • Hepatitis A التهاب الكبدي (أ)				
24 Months عمر ٢٤ شهر	• Hepatitis A التهاب الكبدي (أ)				
School Entry عند دخول الصف الأول الإبتدائي	• OPV شلل الأطفال الفموي • DTaP(Td)*** الثلاثي البكتيري الثنائي البكتيري*** • MMR الثلاثي الفيروسي • Varecilla الجدري المائي				

* Pneumococcal Conjugate (PCV13).
** Monovalent Rota Vaccine.
*** (Td) Starts from 7 Years of Age.

* لقاح البكتيريا العقدية الرئوية (PCV13)
** لقاح الروتا الأحادي
*** يعطى الثنائي البكتيري إبتداء من ٧ سنوات

IMPORTANT to know

Vaccines

Disease	Vaccine	Dose/Route of administration All are 0.5 ml except BCG 0.05 ml	Timing	Side effects All of them have mild side effects
tuberculosis	Bacille Calmette-Guérin (BCG)	0.05 ml Intradermal	At or as soon as possible after birth	Severe: generalized disease or infections such as osteomyelitis (bone infection); abscess; regional lymphadenitis (lymph node inflammation) Mild: injection site reactions +fever
hepatitis B	**(HepB)** Pentavalent with→ Diphtheria, tetanus, pertussis, and Haemophilus influenzae type b Quadrivalent →DTP+HepB	0.5 ml Intramuscularly	At birth 2, 4, 6 months	Severe: rare anaphylaxis Mild: injection site reactions (pain, redness, swelling); headache; fever
Diphtheria	**(DT/ dT)** with tetanus (DTP) with tetanus and pertussis **Pentavalent**→with tetanus, pertussis, hepatitis B and Haemophilus influenzae type b	0.5 ml Intramuscularly	2, 4, 6, 18 months and 4- 6 years	Severe adverse events due to diphtheria toxoid alone have not been reported Mild: injection site reactions, fever
Pertussis	(DTP) with tetanus and diphtheria Pentavalent→with tetanus, diphtheria, hepatitis B and Haemophilus influenzae type b	0.5 ml Intramuscularly	2, 4, 6, 18 months and 4- 6 years	Severe: rare anaphylaxis, hypotonic–hyporesponsive episodes (loss of muscle tone and responsiveness/consciousness); febrile seizures; prolonged crying Mild: injection site reactions (pain, redness, swelling); fever and agitation
Tetanus	TT (DT/ dT) with diphtheria (DTP) with diphtheria and pertussis Pentavalent →with diphtheria, pertussis, hepatitis B and Haemophilus influenzae type b	0.5 ml Intramuscularly	2, 4, 6, 18 months and 4- 6 years	Severe: rare anaphylaxis, brachial neuritis Mild: injection site reactions and fever

IMPORTANT to know

Vaccines

Disease	Vaccine	Dose/Route of administration	Timing	Side effects
Haemophilus influenzae type b (Hib)	Hib Pentavalent →with diphtheria, tetanus, pertussis and hepatitis B	0.5 ml Intramuscularly	2, 4, 6, 18 months	Severe: none reported to date Mild: injection site reactions, fever
Measles	Measles only (M) (MR)→with rubella (MM, MMR)→ with mumps/ rubella (MMRV)→with varicella	0.5 ml Subcutaneous	9, 12, 18 months and 4-6 years	Severe: thrombocytopenia, anaphylaxis, encephalitis Mild: fever, rash 5–12 days following administration
Mumps	(MMR)	0.5 ml Subcutaneous	12, 18 months and 4-6 years	Serious: aseptic meningitis (with some strains); orchitis (inflammation of the testicles); sensorineural deafness; acute myositis Mild: injection site reactions; parotid swelling
Rubella	(MR)→with Measles (MMR) →with mumps/measles	0.5 ml Subcutaneous	12, 18 months and 4-6 years	Mild: injection site reactions
Meningococcal disease	Meningococcal quadrivalent conjugate (A,C,W135,Y-D)	0.5 ml Subcutaneous	9 and 12 Months	Severe: rare anaphylaxis • Mild: injection site reaction, fever
Pneumococcal disease	PCVs	0.5 ml Intramuscular	2, 4, 6 and 12 months	Severe: none known Mild: injection site reactions and fever
Poliomyelitis	OPV IPV	OPV→2 drops orally IPV→ 0.5 ml intramuscularly	2, 4, 6, 12,18 months and 4-6 years	OPV – Rare vaccine-associated paralytic polio (VAPP) IPV – No known serious reactions; mild injection site reactions do occur
Rotavirus gastroenteritis	RV→Monovalent RV,Rotarix	1.5 ml of liquid Oral	2 and 4 months	Severe: intussusception Mild: irritability, runny nose, ear infection, diarrhoea, vomiting

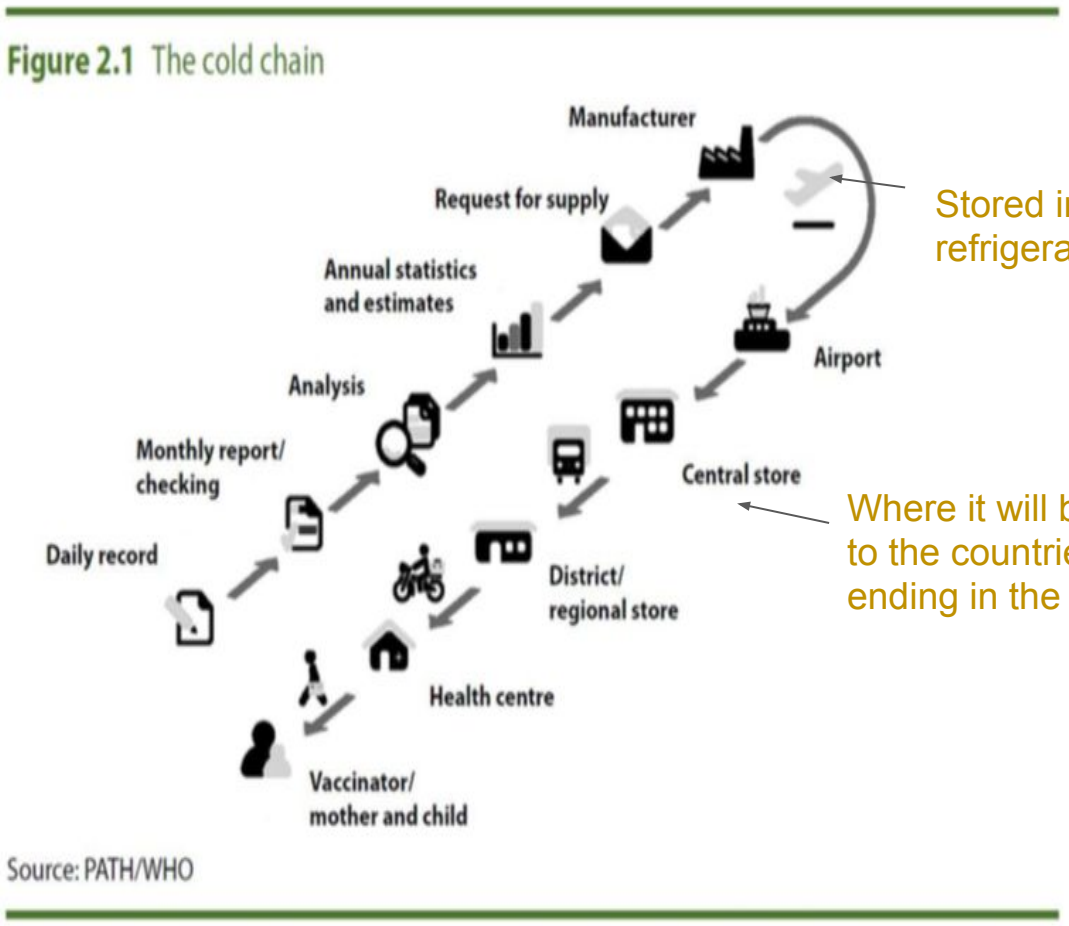
Vaccine Safety and Efficacy

As an immunization provider, you play a key role in helping to ensure the safety and efficacy of vaccines through proper:

- Vaccine storage and handling
- Vaccine administration — Considered a medical error
- Timing and spacing of vaccine doses
- Observation of precautions and contraindications — Need to be reported
- Management of vaccine side effects — Life support equipments must be there
- Reporting of suspected side effects — Need to be reported
- Communication about vaccine benefits and risks

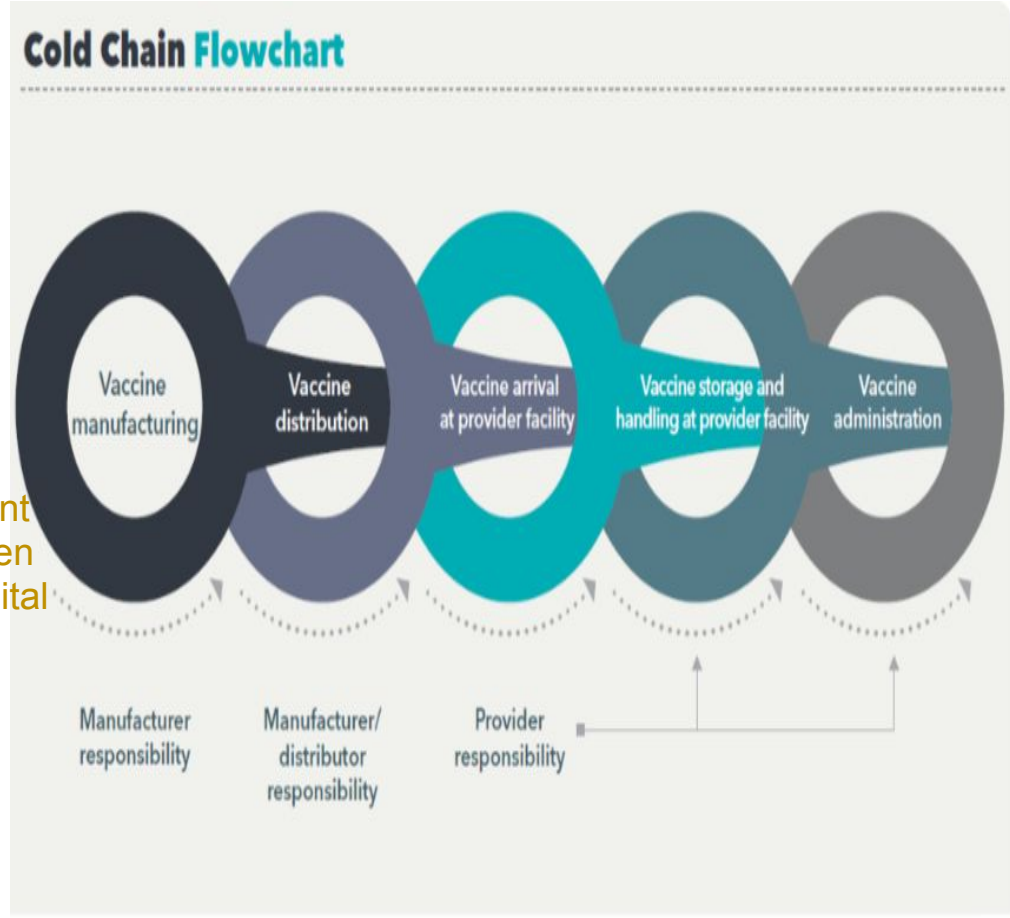
Why proper vaccine storage and handling are important?

Proper storage and handling begin with an effective vaccine cold chain



Stored in a refrigerator

Where it will be sent to the countries then ending in the hospital



Cold Chain

• A temperature-controlled supply chain that includes all vaccine- related equipment and procedures.

• It begins with the cold storage unit at the manufacturing plant, extends to the transport and delivery of the vaccine and correct storage at the provider facility (clinic), and ends with administration of the vaccine to the patient.

• Vaccines are sensitive biological products. Some vaccines are sensitive to freezing, some to heat and others to light. If not maintained, vaccine potency may be lost, resulting in a useless vaccine supply.

• Potency is reduced every time a vaccine is exposed to an improper condition. (This includes overexposure to heat, cold, or light at any step in the cold chain). Once lost, potency cannot be restored.

• Vaccines that are as sensitive to light as they are to heat include BCG, measles, measles-rubella, measles-mumps-rubella and rubella.

• These vaccines are often supplied in dark glass vials that give them some protection from light damage; but they should be kept in their secondary packaging for as long as possible to protect them during storage and transportation.

Purpose of the vaccine “cold chain”

To maintain **product quality** from the time of manufacture until the point of administration by ensuring that vaccines are stored and transported within WHO-recommended temperature ranges.

Vaccine Storage

Figure 2.4 Freeze sensitive vaccines

Not important

DO NOT FREEZE THESE VACCINES!!!

- Cholera
- DTaP-hepatitis B-Hib-IPV (hexavalent)
- DTwP or DTwP-hepatitis B-Hib (pentavalent)
- Hepatitis B (Hep B)
- Hib (liquid)
- Human papillomavirus (HPV)
- Inactivated poliovirus (IPV)
- Influenza
- Pneumococcal
- Rotavirus (liquid and freeze-dried)
- Tetanus, DT, Td

Carefully select and use the proper vaccine storage units to store vaccines.

Rotate vaccine stock so the oldest vaccines are used first.

Store vaccines in their original packaging with lids closed until ready for administration.

Have a properly calibrated thermometer or temperature recording device inside each storage compartment.

Check and record storage unit minimum and maximum temperatures at the start of each workday.

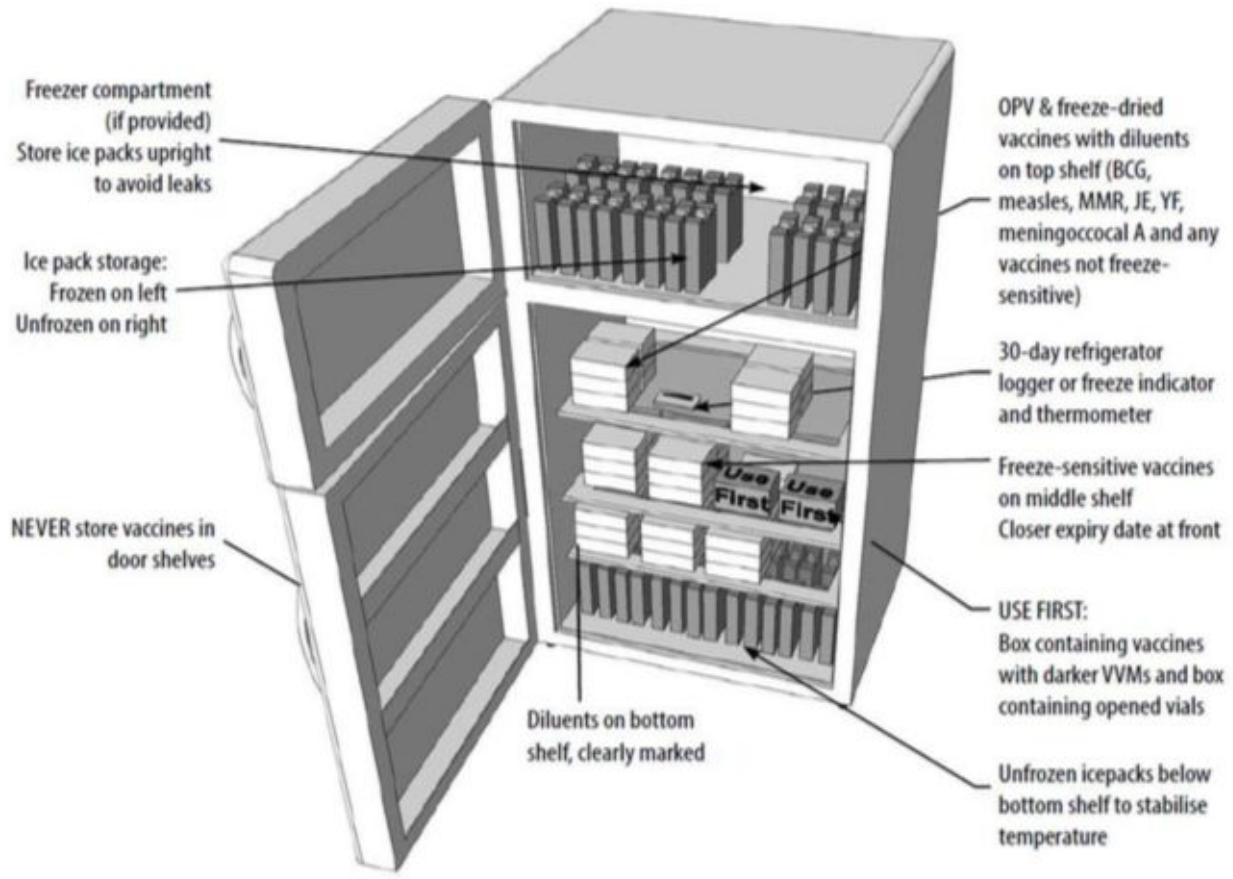
Refrigerator and Freezer Recommendations

• There are several types of vaccine storage units available.

• Purpose-built units are specifically designed to store vaccines.

It's ok to store other things but they have to be in the lower shelf

Figure 2.19 Vaccine and diluent arrangement in a front-opening domestic, gas or kerosene vaccine refrigerator



- Place water bottles or ice packs on the top shelf and floor and in the door racks.
- Putting water bottles in the unit can help maintain stable temperatures caused by frequently opening and closing unit doors or a power failure.

Is it ok to use conventional refrigerator if a medical one is not available? yes

This is not acceptable because there is a freezer on the top, making the temperature not well controlled.

Vaccine Storage Units: Refrigerator and Freezer Recommendations

• Every vaccine storage unit must have a Temperature monitoring devices (TMD).

• An accurate temperature history that reflects actual vaccine temperatures is critical for protecting your vaccines

• There are several types of (TMD)

Vaccine Organizing and Storing

To confirm vaccines are stored correctly and to minimize the risk of administration errors, implement the following practices

- Store each type of vaccine or diluent in its original packaging and in a separate container.
- Position vaccines and diluents two to three inches from the unit walls, ceiling, floor, and door.
- Whenever possible, store diluent with the corresponding refrigerated vaccine. Never store diluent in a freezer.

- Avoid placing or storing any items other than vaccines, diluents, and water bottles inside storage units.

- If other medications and biological products must be stored in the same unit as vaccines, they must be clearly marked and stored in separate containers or bins from vaccines.
- Potentially contaminated items (e.g., blood, urine, stool) should be properly contained and stored below vaccines due to risk of contamination from drips or leaks.

- Arrange vaccines and diluents in rows and allow space between them to promote air circulation.