

Principles of Immunization



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Objectives:

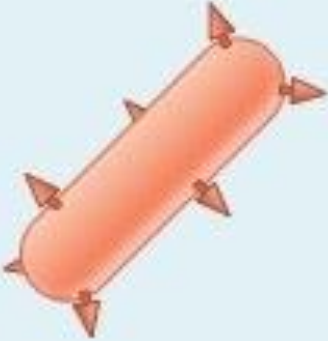


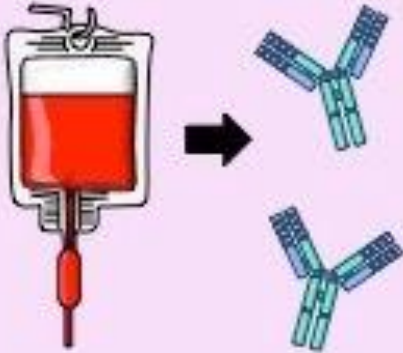


- To understand the types of acquired immunity
- To differentiate between the different types of vaccines used in preventing illness
- To understand the type of vaccine, its mode of delivery, and schedule for important immunizable diseases; TB, Pertussis, Rubella, Diphtheria, Measles, Tetanus, Hepatitis, Meningitis, Rabies, Polio
- To define and understand the cold chain and its importance
- To list the vaccines in the current National compulsory vaccination schedule
- For each disease, briefly describe epidemiology and mode of

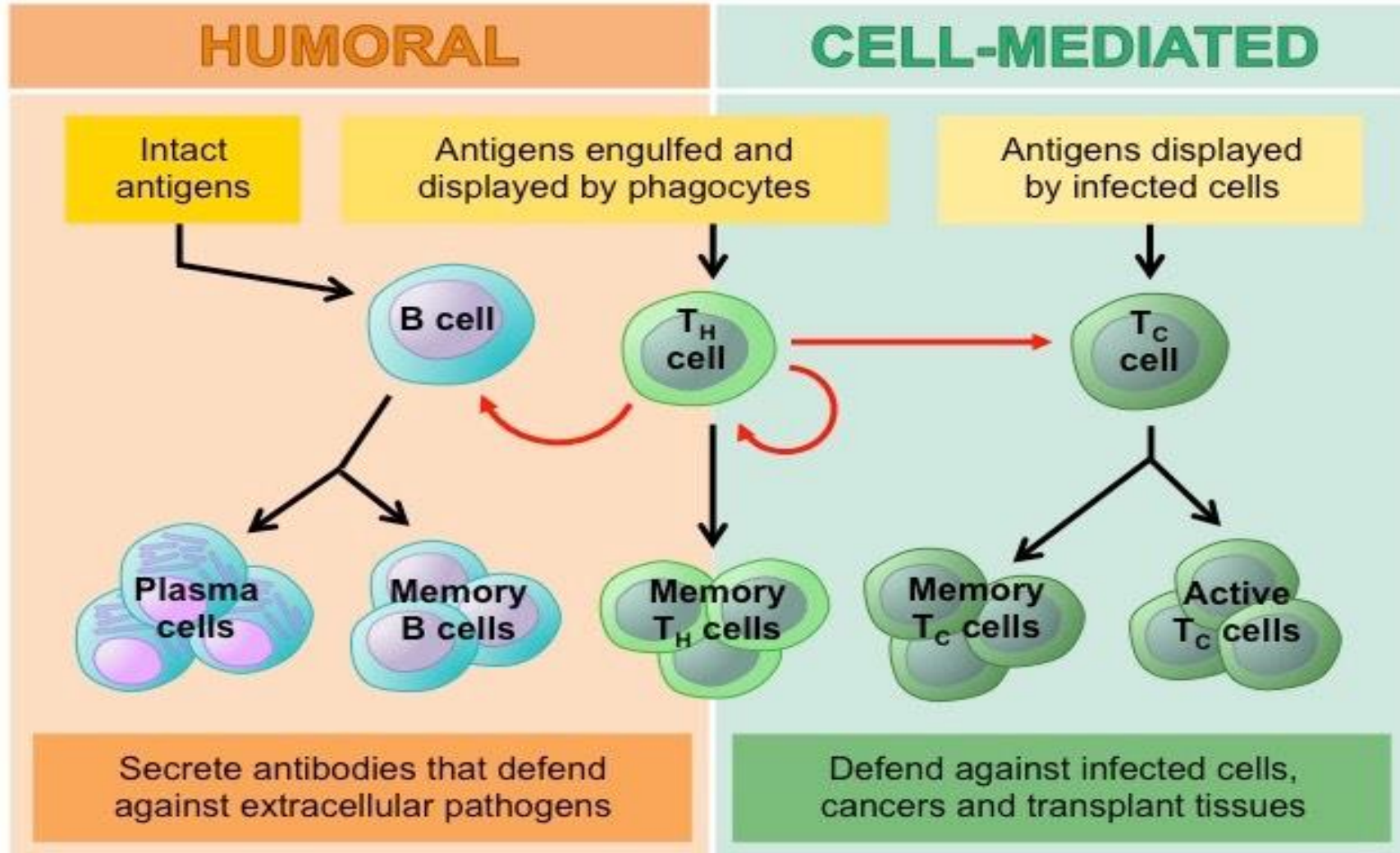
Types of acquired immunity



Types of Immunity

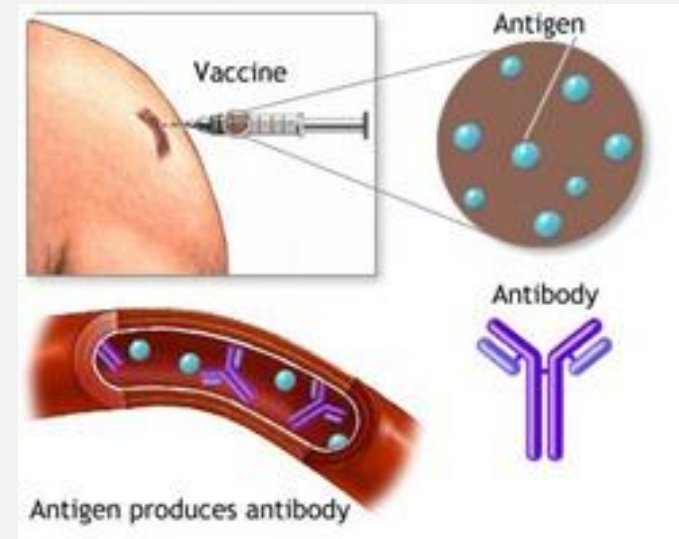
ACTIVE IMMUNITY		PASSIVE IMMUNITY	
Natural	Artificial	Natural	Artificial
 <p>Infection</p>	 <p>Vaccination</p>	 <p>Maternal antibodies</p>	 <p>Monoclonal antibodies</p>

Types of Active Immunity



Advantages of active immunity compared to passive immunity:

- Long-lasting protection
- Severe 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.
 - 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.

The background image shows a collection of medical supplies. At the top, there is a row of six small vials with teal-colored caps. Below this, a syringe with a pink plunger and a clear barrel is positioned diagonally. The syringe has '10 ml' printed on it. In the foreground, several larger vials with white labels and teal caps are scattered. Some are upright, while others are lying on their sides. The overall scene is set against a light, neutral background.

Vaccines

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.

Contraindication

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

Types of Used Vaccines

Examples:

▪ Viral

- Measles, mumps, rubella,
- Zoster,
- Varicella
- Yellow fever,
- Rotavirus
- Influenza
- Oral polio

• bacterial

- Bacille Calmette–Guérin (BCG)
- Oral typhoid vaccine.



Types of Used Vaccines



Inactivated vaccines

- Produced by growing the bacterium or virus in culture media, then **inactivating** it with heat and/ or chemicals (usually formalin).
- Not alive and **cannot replicate**.
- Cannot cause disease from infection, even in an immunodeficient person.
- Always require **multiple doses**.
 - In general, the first dose **“primes”** the immune system.
 - A protective immune response develops after the second or third dose.

Types of Used Vaccines



Contraindication:

- Sever local or general reaction to a previous dose.

Example:

- Polio, Hepatitis A, Rabies
- Pertussis, Typhoid, Cholera, Plague

Types of Used Vaccines



Polysaccharide Vaccines

- 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.
- 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 protein molecules). For example, **the meningococcal polysaccharide (MPS)**

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)
 - 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

Combinations Vaccines



Examples

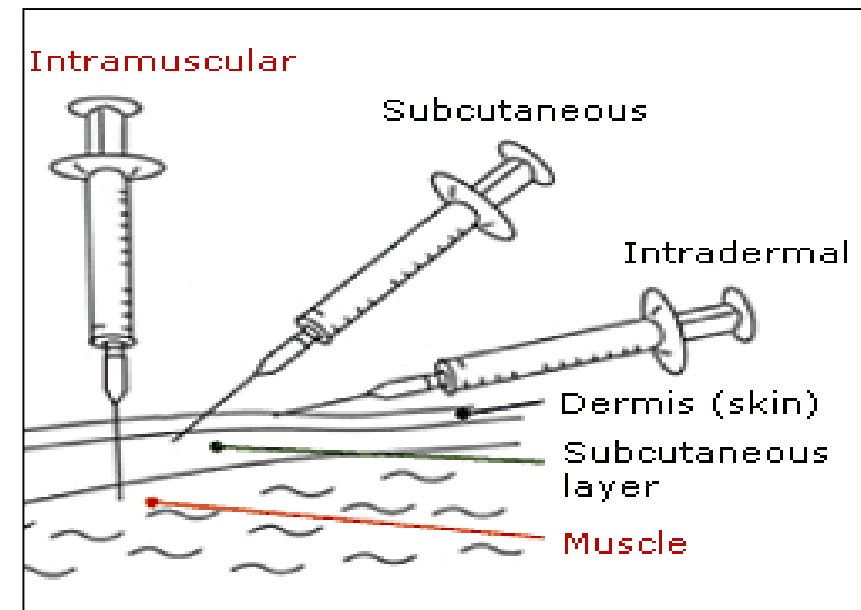
- DPT (Diphtheria–pertussis–tetanus)
- MMR (Measles, mumps and rubella)
- DPTP (DPT plus inactivated polio)
- DPT–Hep B–Hib (Diphtheria, pertussis, tetanus, hepatitis B and haemophilus influenza type B).

Route of administration of Vaccines

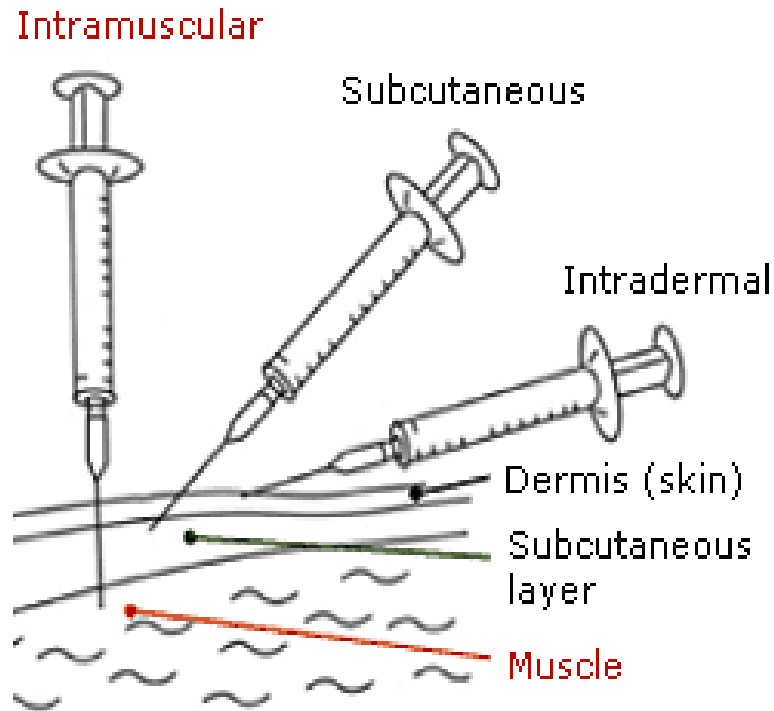


Routes of Administering Vaccines

- **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



Routes of Administrrating Vaccines



Intramuscular (IM) injection

- Administers the vaccine into the muscle mass.
- Vaccines containing adjuvants should be injected IM to reduce adverse local effects.

Subcutaneous (SC) injection

- Administers the vaccine into the subcutaneous layer above the muscle and below the skin.

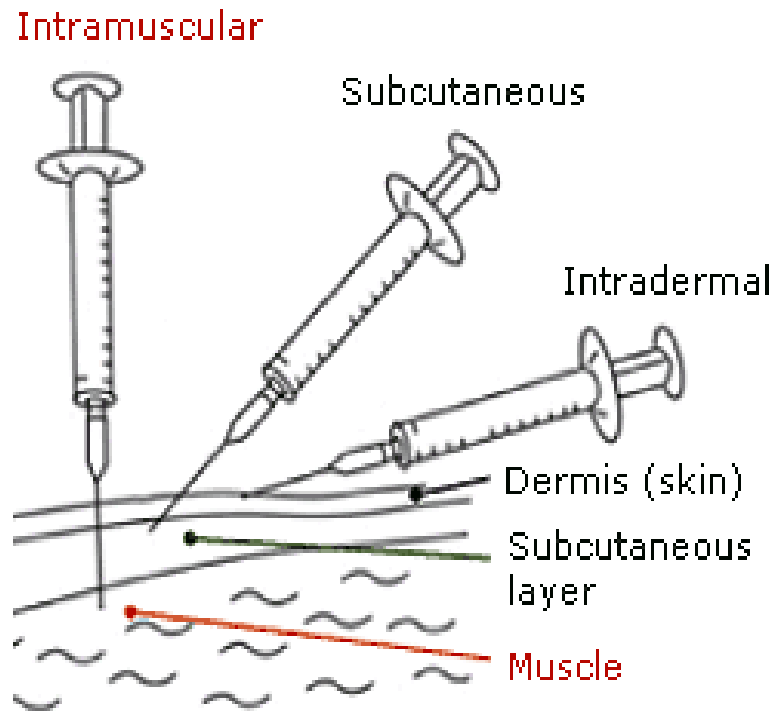
Routes of Administering Vaccines

Intradermal (ID) injection

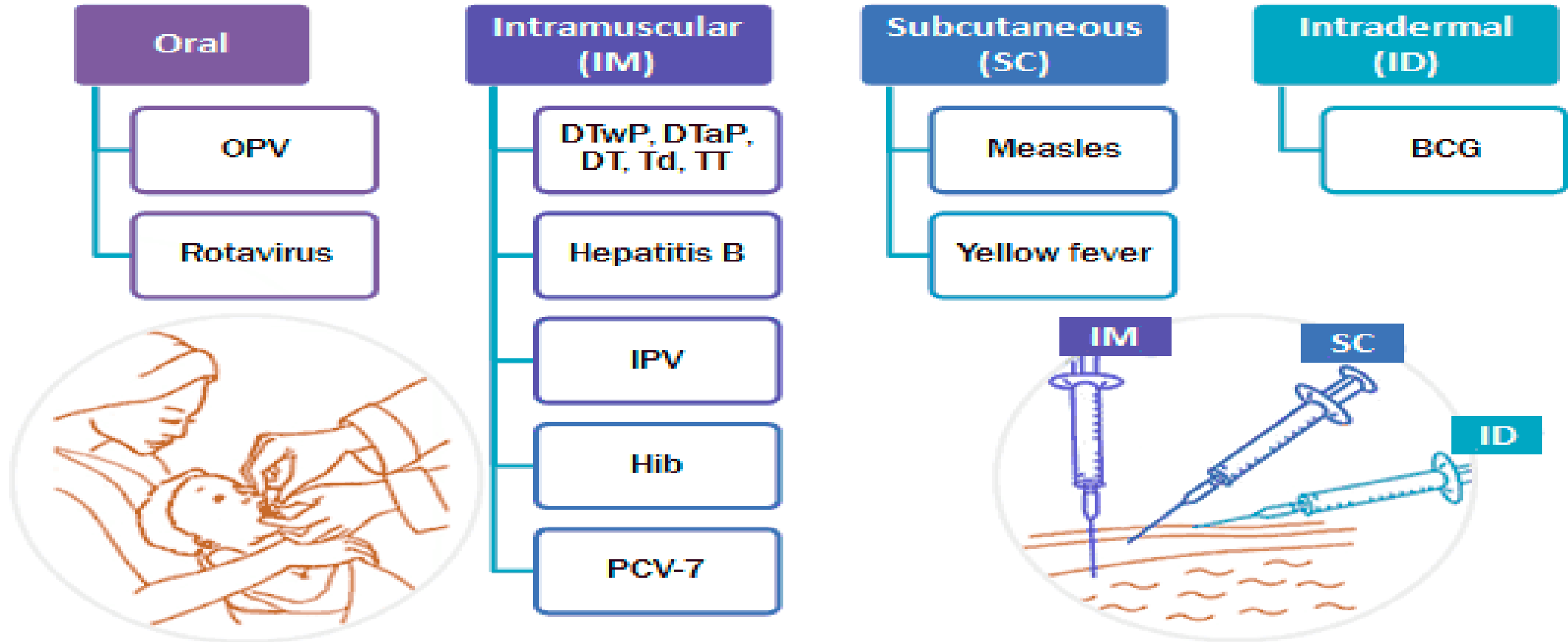
- Administers the vaccine in the topmost layer of the skin.
- BCG is the only vaccine with this route of administration.
- Intradermal injection of BCG vaccine reduces the risk of neurovascular injury.

Oral administration

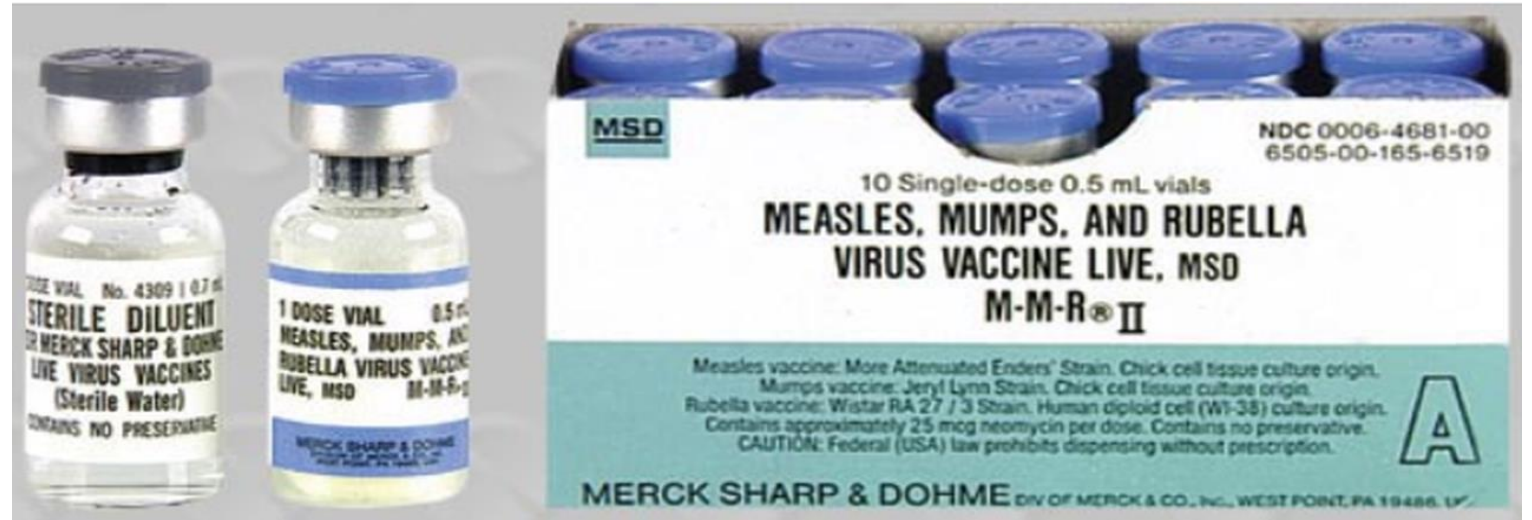
- Oral administration of vaccine makes immunization easier by eliminating the need for a needle



Routes of Administering Vaccines



Different types of vaccine vials



Single-Dose Vials

- 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.

Different types of vaccine vials



Multidose Vials

- 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

Different types of vaccine vials



Manufacturer-Filled Syringes

- 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



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.

Vaccination	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	24 months	4 to 6 years
HepB <small>(protects against hepatitis B)</small>	1st	2nd			3rd					
DTaP <small>(protects against diphtheria, tetanus, pertussis)</small>		1st	2nd	3rd			4th			5th
Hib <small>(protects against haemophilus influenzae type B, also see 3 or 4 doses)</small>		1st	2nd	3rd	4th					
IPV <small>(protects against polio)</small>		1st	2nd	3rd						4th
RV <small>(protects against rotavirus, may be 2 or 3 doses)</small>		1st	2nd	3rd						
PCV13 <small>(protects against pneumococcal disease)</small>		1st	2nd	3rd	4th					
Flu <small>(protects against influenza)</small>					1 or 2 doses each year					
MMR <small>(protects against measles, mumps, rubella; if traveling outside the U.S., your baby can get his first dose at 6 months)</small>						1st				2nd
Varicella <small>(protects against varicella, also called chickenpox)</small>						1st				2nd
HepA <small>(protects against hepatitis A)</small>					1st and 2nd		6 to 18 months apart			

Diseases and Vaccines

Disease	Name of vaccine	Disease	Name of vaccine
TB	BCG	Meningitis	MCV4
Hepatitis (A , B)	HepB, HepA	Measles	MMR
polio	OPV , IPV	Mumps	
Diphtheria	DTaP DT Td	Rubella	
Tetanus		Chicken box	varicella
Pertussis		H. Influenza	Hib
Pneumococcal	PCV	Gastroenteritis	Rota

National Immunization Schedule



وزارة الصحة
Ministry of Health

المملكة العربية السعودية
وزارة الصحة

المحافظة/ المنطقة:
الجهة الصحية:
Region/City:
Health Directorate/
Cluster :

شهادة التطعيم

Health Center/Hospital مركز صحي / مستشفى

Name: الاسم:

Date of Birth هـ الموافق / / تاريخ الميلاد

Family/Medical File No. رقم السجل الطبي

ID رقم السجل المدني/ الإقامة

HESN Client ID رقم حصن

Full Address العنوان كاملاً:

Tel. Home: هاتف المنزل:

Mobile: الهاتف الجوال:

National Immunization Schedule

vaccine* التطعيم	Influenza ¹ الانفلوانزا	Tdap or Td ² الثلاثي البكتيري		MMR ⁴ الثلاثي الفيروسي	Varicella ⁵ الجديري المائي	Herpes Zoster ⁶ الحلا النطاقي	HPV ⁷ فيروس الورم الحليمي	Pneumococcal المكورات العقدية الرئوية		Hep B ¹⁰ الكبد ب	MCV4 ¹¹ الحمي الشوكية الرباعي المدمج	Other Vaccinations اخرى
		Adults ² لل كبار	Pregnants ³ للحوامل					PPSV23 ⁸ المكورة الرئوية المتعدد	PCV ⁹ العقدية الرئوية المدمج			
Date and Signature												
Date and Signature												
Date and Signature												
Date and Signature												
Date and Signature												

Timing/ Indication

- 1 dose annually
- 1 dose Tdap then Td booster every 10 years.
- Pregnant women (For each pregnancy between 27 & 36 Weeks).
- For unvaccinated individuals, premarital and post natal women if no evidence of immunity or prior disease (1 or 2 doses depend on indication).
- If no evidence of immunity or prior disease (2 doses 8 weeks apart)
- 2 doses 2-6 m apart for adult age 50 years or older
- 3 doses (0,1-2,and 6m) from the first dose catch up immunization for female age 15-26 years
- 1 dose adults aged 65 years or older (1 year after PCV 13 dose) from the first dose.
- 1 dose adults with comorbid/immunocompromised conditions and adults aged 65 years or older.
- 3 doses (0,1m and 6m) if no previous immunization or no evidence of immunity.
- 1 dose depending on indication, then booster every 5 years if risk remains.

الوقت / دواعي الاستعمال

- جرعة واحدة سنويا.
- جرعة واحدة ثم جرعة منشطة كل 10 سنوات.
- للحوامل جرعة مع كل حمل جديد (في الفترة ما بين الأسبوع 27 إلى 36).
- إذا لم تكن هناك مناعة مؤكدة أو مرض سابق جرعة واحدة أو اثنتان تبعاً للحالة تطعيم السيدات قبل الزواج وبعد الولادة.
- إذا لم تكن هناك مناعة مؤكدة أو مرض سابق جرعتان بينهما 8 أسابيع.
- جرعتان بينهما 2-6 أشهر لعمر 50 سنة أو أكبر.
- ثلاث جرعات للنساء عمر 50-65 سنة الجرعة الثانية بعد شهرين من أول جرعة والجرعة الثالثة بعد 6 أشهر من الجرعة الأولى.
- جرعة واحدة للكبار من عمر 65 أو أكبر بعد جرعة البكتريا العقدية الرئوية بعاهم واحد.
- جرعة واحدة لمنقوصي المناعة أو أصحاب الأمراض المزمنة المصابة أيضاً لعمر 65 سنة أو أكبر.
- ثلاث جرعات إذا لم يكن هناك مناعة مؤكدة أو تطعيم سابق الجرعة الثانية بعد شهر من الجرعة الأولى والجرعة الثالثة بعد 6 أشهر.
- جرعة واحدة حسب الحالة ثم جرعة منشطة كل 5 سنوات.

Vaccines (1)

Disease	Vaccine	Dose / Rout of administration	Timing	Side effects
Tuberculosis	Bacille Calmette-Guérin (BCG)	0.05 ml Intradermal	At 6 months	Severe: generalized disease or infections such as osteomyelitis (bone infection); abscess; regional lymphadenitis (lymph node inflammation) Mild: injection site reactions
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

Vaccines (2)

Disease	Vaccine	Dose / Rout of administration	Timing	Side effects
Diphtheria	<p>(DT/ dT) with tetanus (DTP) with tetanus and pertussis Pentavalent → with tetanus, pertussis, hepatitis B and Haemophilus influenzae type b</p>	0.5 ml Intramuscularly	2, 4, 6, 18 months and 4-6 years	<p>Severe adverse events due to diphtheria toxoid alone have not been reported Mild: injection site reactions, fever</p>
Pertussis	<p>(DTP) with tetanus and diphtheria Pentavalent → with tetanus, diphtheria, hepatitis B and Haemophilus influenzae type b</p>	0.5 ml Intramuscularly	2, 4, 6, 18 months and 4-6 years	<p>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</p>

Vaccines (3)

Disease	Vaccine	Dose / Rout of administration	Timing	Side effects
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
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

Vaccines (4)

Disease	Vaccine	Dose / Rout of administration	Timing	Side effects
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 Intramuscular	9 and 12 Months	Severe: rare anaphylaxis • Mild: injection site reaction, fever

Vaccines (5)

Disease	Vaccine	Dose / Rout of administration	Timing	Side effects
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:

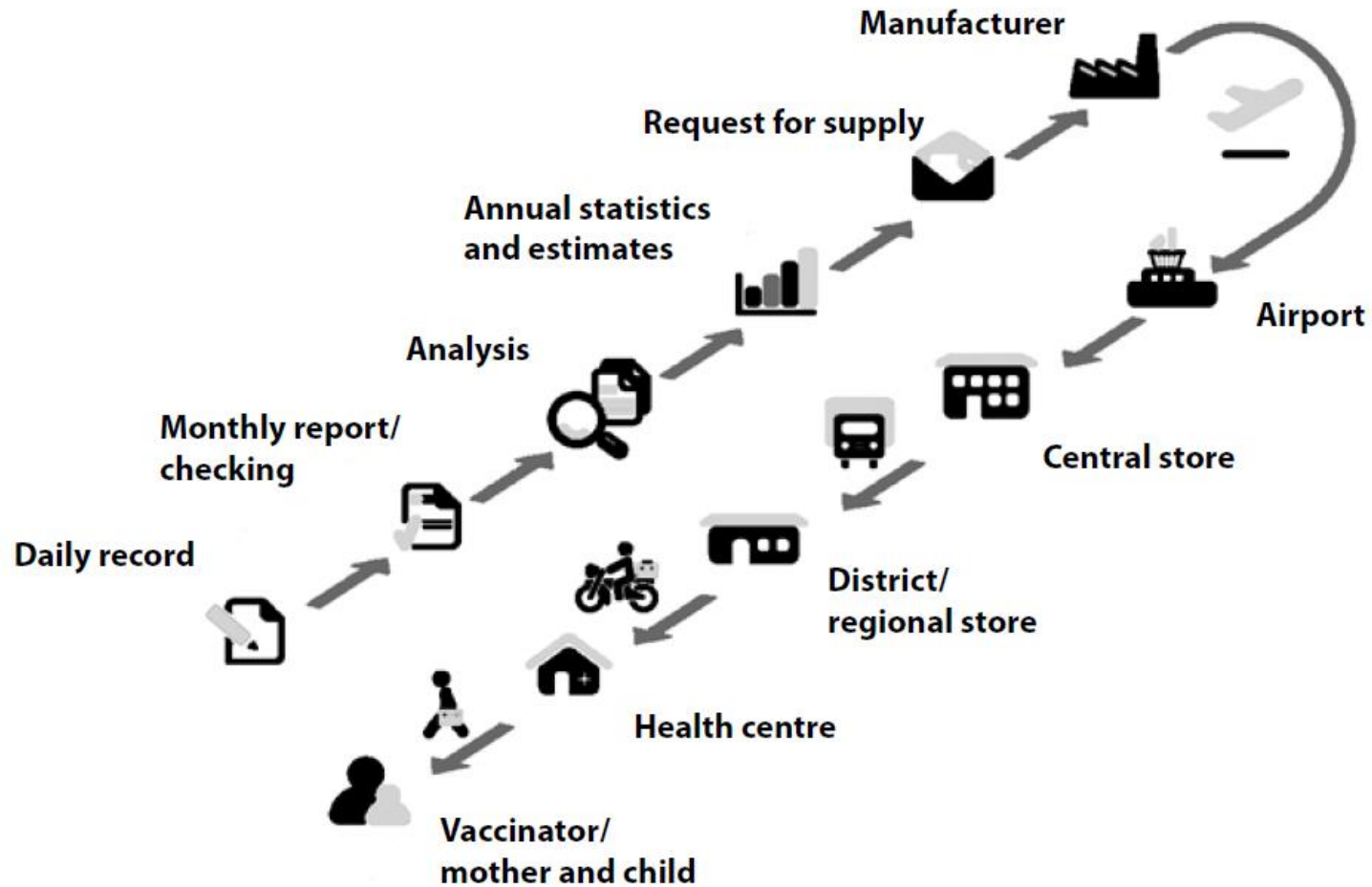
- Vaccine storage and handling
- Vaccine administration
- Timing and spacing of vaccine doses
- Observation of precautions and contraindications
- Management of vaccine side effects
- Reporting of suspected side effects
- Communication about vaccine benefits and risks

Why proper
vaccine storage and
handling are
important?



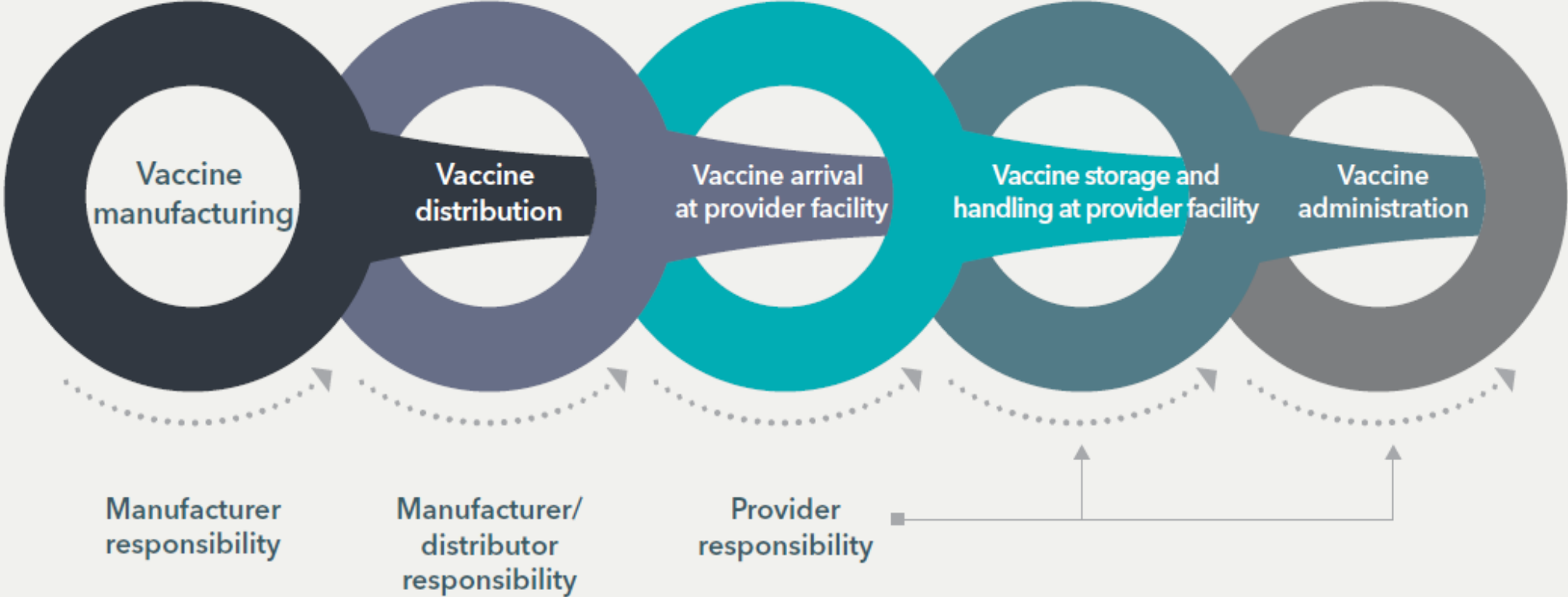
Proper storage and handling begin with an effective
vaccine cold chain

Figure 2.1 The cold chain



Source: PATH/WHO

Cold Chain Flowchart



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, and ends with administration of the vaccine to the patient.

Cold Chain

- 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.

Cold Chain

- 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.

Vaccine Storage

Figure 2.4 Freeze sensitive vaccines

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
-

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.

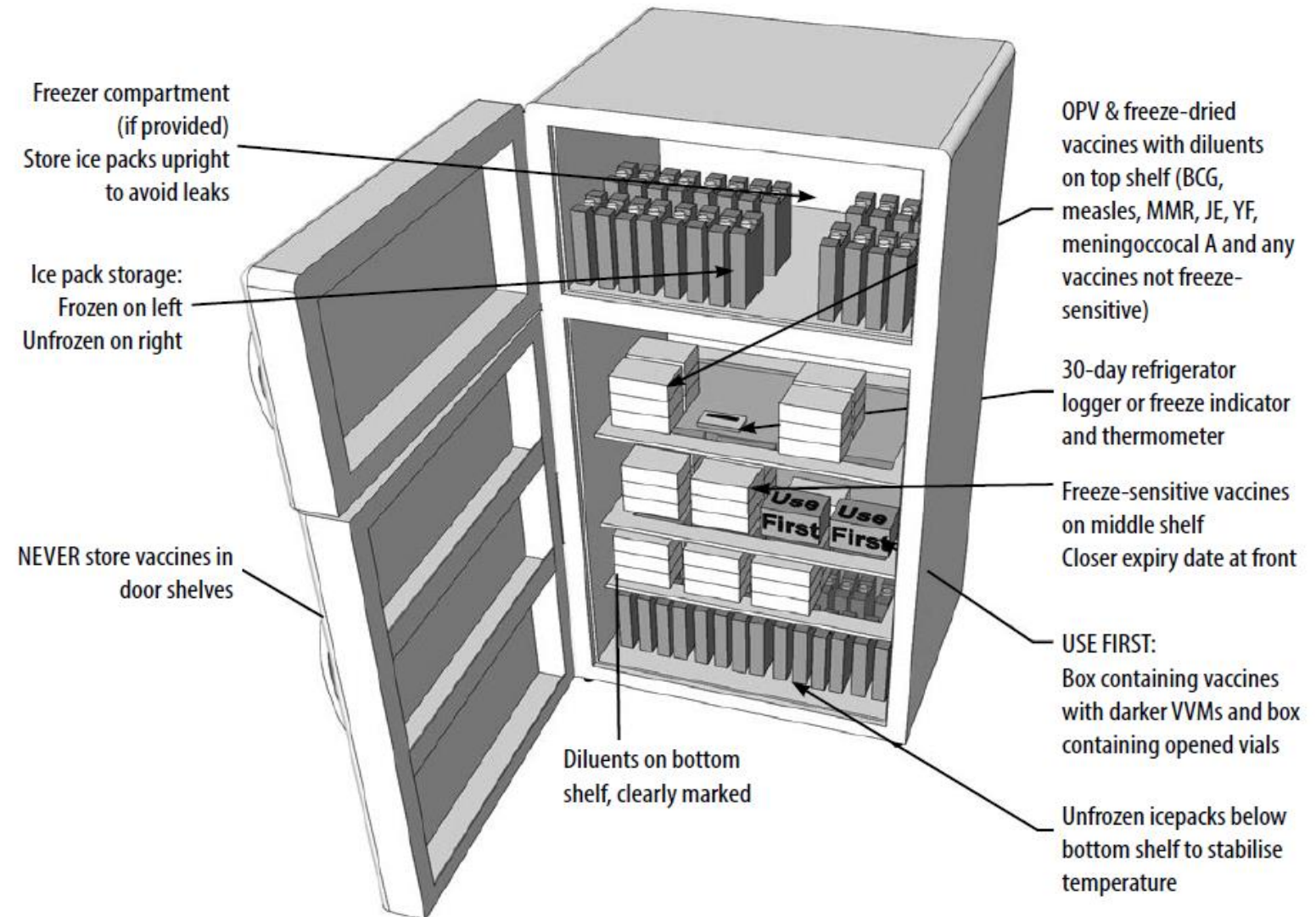
Vaccine Storage

- 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.

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



Refrigerator and Freezer Recommendations

- Place water bottles 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.



Refrigerator and Freezer Recommendations



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)

Figure 2.12 30-day electronic temperature loggers



FridgeTag2™ with USB



LogTag® temperature recorder

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.

Vaccine Organizing and Storing

- 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.



THANK YOU