Principles of Communicable Diseases Epidemiology-L-3/21-22

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Objectives

- Recognize the types of immunity and vaccines
- Recall common combination vaccines for childhood immunizations
- Describe routine vaccine schedules for common childhood vaccines in Iraq
- Identify the principles and components of cold chain

Immunization

Each year, vaccines prevent more than 2.5 million child deaths globally. An additional 2 million child deaths could be prevented each year through immunization .

Why vaccines are so special?

- **Vaccines promote health:** unlike many other health interventions, they help healthy people stay healthy, removing a major obstacle to human development.
- **Vaccines have an extensive reach:** they protect individuals, communities, and entire populations.
- **Vaccines have rapid impact:** the impact of most vaccines on communities and populations is almost immediate.

- **Immunization:** is the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine. Vaccines stimulate the body's own immune system to protect the person against subsequent infection or disease.

- **Immunization procedure called vaccination and the immunizing agent called vaccine.**

IMMUNIZING AGENTS

The immunizing agents may be classified as vaccine, immunoglobulin and antisera.

Vaccines

A vaccine is a biological preparation that improves immunity to a particular disease .

A vaccine typically contains an agent that resembles a disease –causing microorganism , and is often made from weakened or killed forms of the microbe or its toxins. The agent stimulates the body's immune system .

Characteristics of Effective Vaccines

- **Safety**
- **Protection**
- **Long-lasting effects**
- **Cost Inexpensive to produce and deliver**
- **Administration easy to deliver with no side-effects**

There are several types of vaccines, including:

- **Inactivated vaccines**
- **Live-attenuated vaccines**
- **Messenger RNA (mRNA) vaccines**
- **Subunit, recombinant, polysaccharide, and conjugate vaccines**
- **Toxoid vaccines**
- **Viral vector vaccines**

TYPES OF VACCINES

Live attenuated (LAV)

- Tuberculosis (BCG)
- Oral polio vaccine (OPV)
- Measles
- Rotavirus
- Yellow fever
- Varicella-Zoster virus (VZV)
- Seasonal influenza (nasal spray)

Inactivated (killed antigen)

- Whole-cell pertussis (wP)
- Inactivated polio virus (IPV)
- Hepatitis A
- Seasonal Influenza (injectable)

Subunit (purified antigen)

- Acellular pertussis (aP)
- Haemophilus influenzae type b (Hib)
- Pneumococcal (PCV-7, PCV-10, PCV-13)
- Hepatitis B (HepB)
- Human papillomavirus (HPV)

Toxoid (inactivated toxins)

- Tetanus toxoid (TT)
- Diphteria toxoid

Viral vector vaccine

- Zaire Ebola virus (rVSV-ZEBOV)

1-LIVE VACCINE:

Only small pox vaccine is no more in uses at present.

2- LIVE ATTENUATED VACCINE:

Live attenuated vaccines contain whole bacteria or viruses which have been “weakened”(attenuated) so that they create a protective immune response but do not cause disease in healthy people.

For most modern vaccines this “weakening” is achieved through genetic modification of the pathogen either as a naturally occurring phenomenon or as a modification specifically introduced by scientists.

Live vaccines tend to create a strong and lasting immune response

Live attenuated vaccines should not be administered to persons with immune deficiency diseases or to persons whose immune response may be suppressed because of leukemia, lymphoma or malignancy or because of therapy with corticosteroids, alkylating agents, anti - metabolic agents, or radiation.

Pregnancy is another contraindication.

When two live vaccines are required they should be given either simultaneously at different sites or with an interval of at least 3 weeks.

In the case of live attenuated vaccines, immunization is generally achieved with a single dose.

Available live attenuated vaccines are

BCG **Use for prevention of TB. ID injection in left deltoid**

OPV (oral polio vaccine) (Sabin)

- OPV live attenuated , 2 drops

NORMAL BCG REACTIONS

- < 5 mm of erythematous induration,
- bluish-red pustule @ 2 - 3 wks
- Ulceration, drainage, crust formation @ 4 - 6 wks
- healing 10 - 12 wks,
- small scar

- Non suppurative adenopathy

- ✓ **Measles**
- ✓ **MMR (measles, mumps, rubella)**
- ✓ **Rubella**

•**0.5 ml** •**Subcutaneous -arm**

Rotavirus vaccine

A rotavirus vaccine protects children from rotaviruses, which are the leading cause of severe diarrhea among infants and young children.

Rota virus vaccine is a live, oral pentavalent vaccine that contains five rotaviruses.

3-INACTIVATED VACCINES (killed vaccine)

Inactivated vaccines contain whole bacteria or viruses, which have been killed or have been changed, so that they cannot replicate. Because inactivated vaccines do not contain any live bacteria or viruses, they cannot cause the diseases against which they protect, even in people with severely weakened immune systems.

Inactivated vaccines do not always create such a strong or long-lasting immune response as live attenuated vaccines.

They tend to provide a shorter length of protection than live vaccines and are more likely to require boosters to create long-term immunity.

TAB (ENTERICA), Pertussis, cholera, Salk (parenteral) for polio, hepatitis A and rabies vaccine.

4 - Sub unit vaccines

Subunit, recombinant, polysaccharide, and conjugate vaccines use specific pieces of the germ—like its protein, sugar, or capsid (a casing around the germ).
Because these vaccines use only specific pieces of the germ, they give a very strong immune response that's targeted to key parts of the germ.

- **They can also be used on almost everyone who needs them, including people with weakened immune systems and long-term health problems.**

- **One limitation of these vaccines is that need to give booster shots to get ongoing protection against diseases.**

❑ Recombinant Protein Vaccines

Recombinant vaccines are made using bacterial or yeast cells to manufacture the vaccine. For example, to make the hepatitis B vaccine, part of the DNA from the hepatitis B virus is inserted into the DNA of yeast cells.

- **Hepatitis B vaccine (in the 6-in-1 vaccine and as the separate hepatitis B vaccine)**
- **HPV vaccine**

❑ Conjugate Vaccines

‘Conjugate’ means ‘connected’ or ‘joined’. With some bacteria, to get protection from a vaccine there is a need to train the immune system to respond to polysaccharides (complex sugars on the surface of bacteria) rather than proteins.

- **Hib vaccine**
- **PCV (children’s pneumococcal vaccine)**

5- Virus Like Particles

Virus-like particles (VLPs) are molecules that closely resemble viruses, but are non-infectious because they contain no viral genetic material.

A few VLP-based vaccines are currently used worldwide:

- **Hepatitis B vaccine**
- **HPV vaccine**

6-Nucleic Acid Vaccines

❖ Messenger RNA vaccines—also called mRNA vaccines

mRNA vaccines make proteins in order to trigger an immune response.

- **mRNA vaccines have several benefits compared to other types of vaccines, including shorter manufacturing times and, because they do not contain a live virus, no risk of causing disease in the person getting vaccinated.**

- **There are two RNA vaccines authorized for emergency use at present. The Pfizer BioNTech and the Moderna COVID-19 vaccines are both RNA vaccines.**

❖ DNA vaccines

There are currently no licensed DNA vaccines, but there are many in development.

7-Viral Vectored Vaccines

As with nucleic acid vaccines, viral vectored vaccines are a newer technology, using harmless viruses to deliver the genetic code of target vaccine antigens to cells of the body, so that they can produce protein antigens to stimulate an immune response.

The Oxford-AstraZeneca COVID-19 vaccine

8-TOXOIDS

Some bacterial diseases are not directly caused by a bacterium itself, but by a toxin produced by the bacterium.

They are detoxicated exotoxins preparations which stimulate formation of humoral antitoxin immunity.

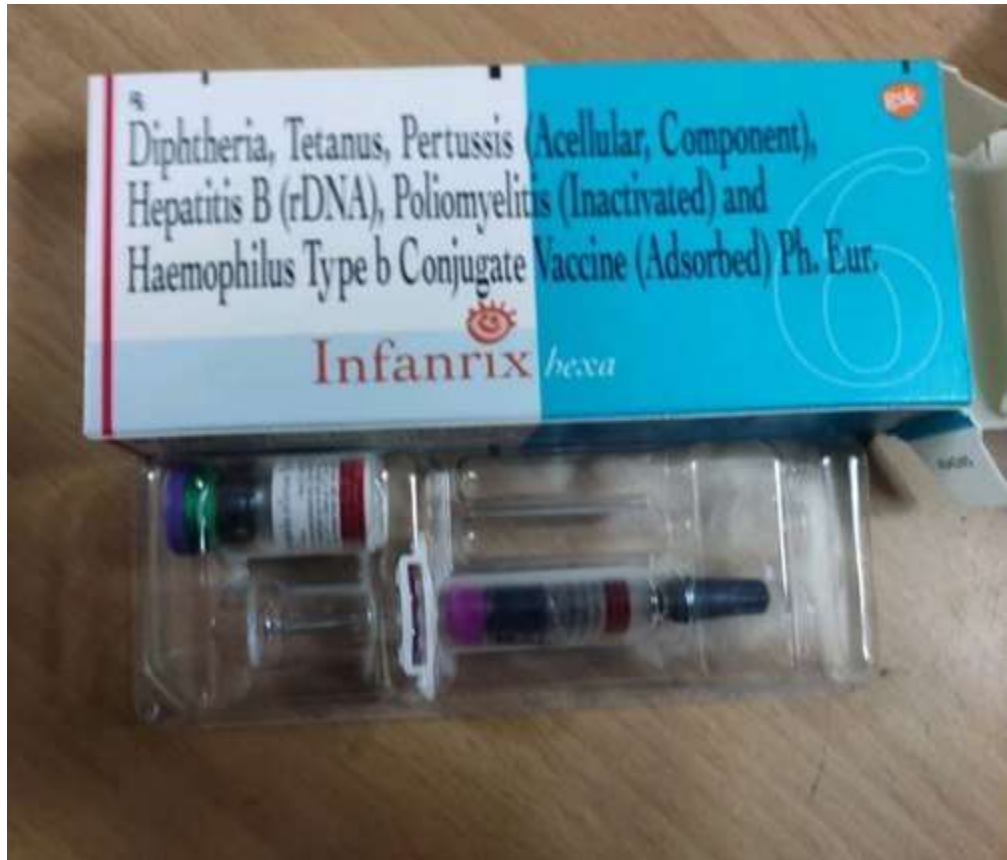
Diphtheria toxoids & tetanus toxoids are widely used for active immunization, each by itself or in combinations (DPT& DT) ,Pertussis toxoids (less reaction), Cholera toxoid ;oral , against cholera exotoxin, which is the major pathogenic factor of cholera vibrios.

Combination Vaccines

Combination vaccines take two or more vaccines that could be given individually and put them into one shot.

Combination vaccines defines as “a product whose components can be equally divided into independently available routine vaccines.”

Some examples of combination
DPT
MMR
DT
DTaP-Hib-polio
DTaP-hepatitis B- IPV
DTP-HB-Hib –IPV



Advantages of combination vaccines

1. Fewer injections
2. Reduced trauma to the infant
3. Higher rates of compliance with complex vaccination schedules[3,4]
4. Better vaccine coverage[5]
5. Timely vaccination – vaccination schedule completed on time[5]
6. Reduced administration costs
7. Lower storage space requirements
8. Allows incorporation of new vaccines into immunization schedules[7]

SCHEDUALE of ACTIVE IMMUNIZATION in IRAQ (CHILDREN)

Age &dose	Vaccine
After birth(1st week	BCG, OPV (0 dose) , HBV-1 (within 24hr)
2 Months 1st dose	(الخماسي)[Panta -1] (DwPT+ Hib , HBV)& Rota virus & OPV-1+ Pneumococcal(PCV13-1)
4Months 2nd dose	Panta-2 [DwPT, Hib , HBV] , IPV-1 Rota virus-2 OPV-2+ Pneumococcal (PCV13-2)
6Months 3rd dose	[D wPT, Hib , HBV] . IPV-2, OPV-3 + Pneumococcal(PCV13-3)
9Months	Measles vaccine + vit A (100.000 IU)
12 Months	MMR
18 Months	[DwPT +Hib] الرباعيTetra (1st booster dose) MMR , OPV 1st booster , vit A (200.000IU)
4- 6 Years	DwPT الثلاثي (2ND booster dose), OPV, Vit A(200.000IU)

Protective period of full primary & booster immunization:

- short period of some months; cholera & plague vaccines which are protective for about 6M.
- 3- 5 years: DPT, Tetanus toxoids
- 5 or more years : BCG
- Solid, lifetime immunity: Measles, MMR, Mumps.

What are the factors determining effectiveness of active immunization prevention of a particular infectious disease in the community?

1-Vaccine or toxoids:

* Protective (immunologic) value.

* How handled since prepared until used, including the cold chain.

* For organisms characterized by frequent antigenic changes – influenza vaccine must be prepared from the prevailing organisms of outbreak or epidemic.

2-Process of immunization: requirements of primary & booster immunization, or revaccination, including doses, spacing & route of administration must be fulfilled.

3-Vaccination coverage: it is the percent of individuals of at risk group or population, who has been fully immunized. For satisfactory benefit of a given vaccine, coverage must be not less than 80- 85%.

Why an actively immunized individual may get disease when exposed to infection?

1-Causes related to the vaccine/ toxoids & process of immunization : inactivation of live attenuated vaccine used; not using updated vaccine of antigenic ally changing organisms, moderate protective value of vaccine

2- Host factors:

* **Unsatisfactory or impaired immune response .**

* **Serum antibody level at time of immunization; the higher the level, less immune response to active immunization & vice versa.**

Application of active immunization

- **Infants and children expanded immunization program EPI (schedule)**

- **Active immunization for adult females(MMR vaccine is given in adolescence girls, or rubella vaccine .Tetanus toxoid in pregnancy**

❑Vaccination for special occupations

- **Health care workers:** hepatitis B, influenza, MMR, polio
- **Public safety personnel** (police, fire fighters) **and staff of institutions for the developmentally disabled:** hepatitis B, influenza
- **Vets and animal handlers:** rabies, plague and anthrax
- **Sewage workers:** DT, hepatitis A, polio, TAB
- **Food handlers:** TAB
- **Military troops and camp dwellers:** pneumococcal, meningococcal, influenza, BCG (for non reactors), tetanus.

- **Vaccinations for special health status persons.**

✓ **Immuno-compromised persons (Leukemia, lymphoma, HIV, malignancy…)**

Hemodialysis and transplantation should receive the following vaccines according to their situation:
HBV, Influenza, Pneumococcal vaccines

- **Vaccinations in travel: Haj for instance necessities meningococcal vaccination from all over the world , TAB, YF from places like south Africa, and cholera from places like India.**

cold chain

The cold chain is the system used for keeping. and distributing vaccines and other Biologicals in good conditions. • It consists of a series of storage and transport. links, all designed to keep vaccines within an acceptable range until it reaches the user.

- **Maintaining the cold chain ensures that vaccines are transported and stored according to the manufacturer's recommended temp range +2C to +8C until point of administration**

  - **Polio vaccine is the most sensitive vaccine to heat.**
  - **Vaccine sensitivity to freezing**
  - **Most sensitive**

    DTaP

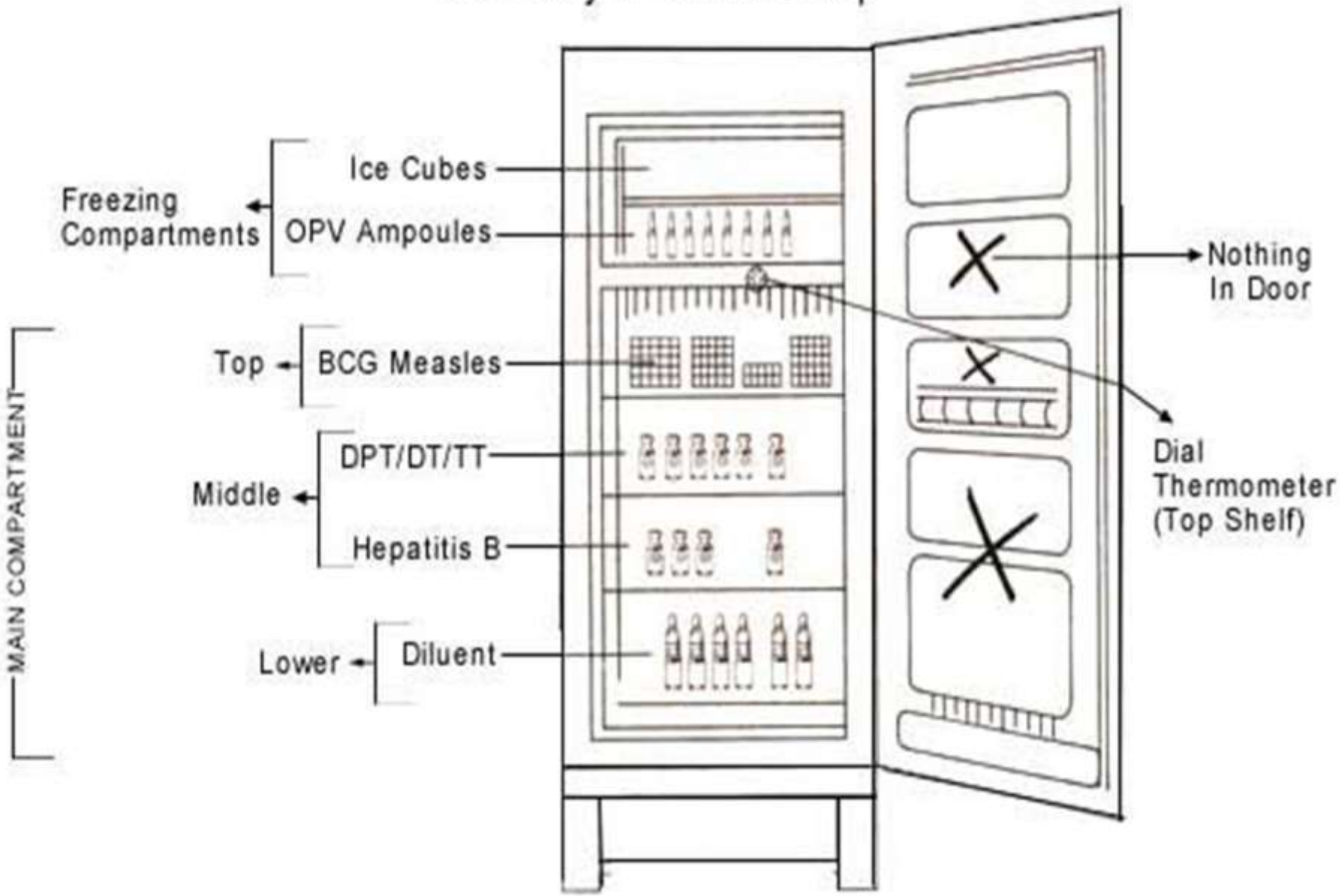
    DTaP-hepatitis B-Hib-IPV (hexavalent)

    Hepatitis B

These vaccines are not damaged by freezing are:

- Bacillus Calmette- Guérin(BCG)
- Measles
- Measles, mumps, rubella
- Oral poliovirus
- Rabies
- Rotavirus
- Rubella

Refrigerator Showing vaccines Stored Correctly in Clinic Setup



Light Sensitive

Sensitive to strong light, sunlight, ultraviolet, fluorescents (neon)

{most sensitive}BCG

MMR

Varicella

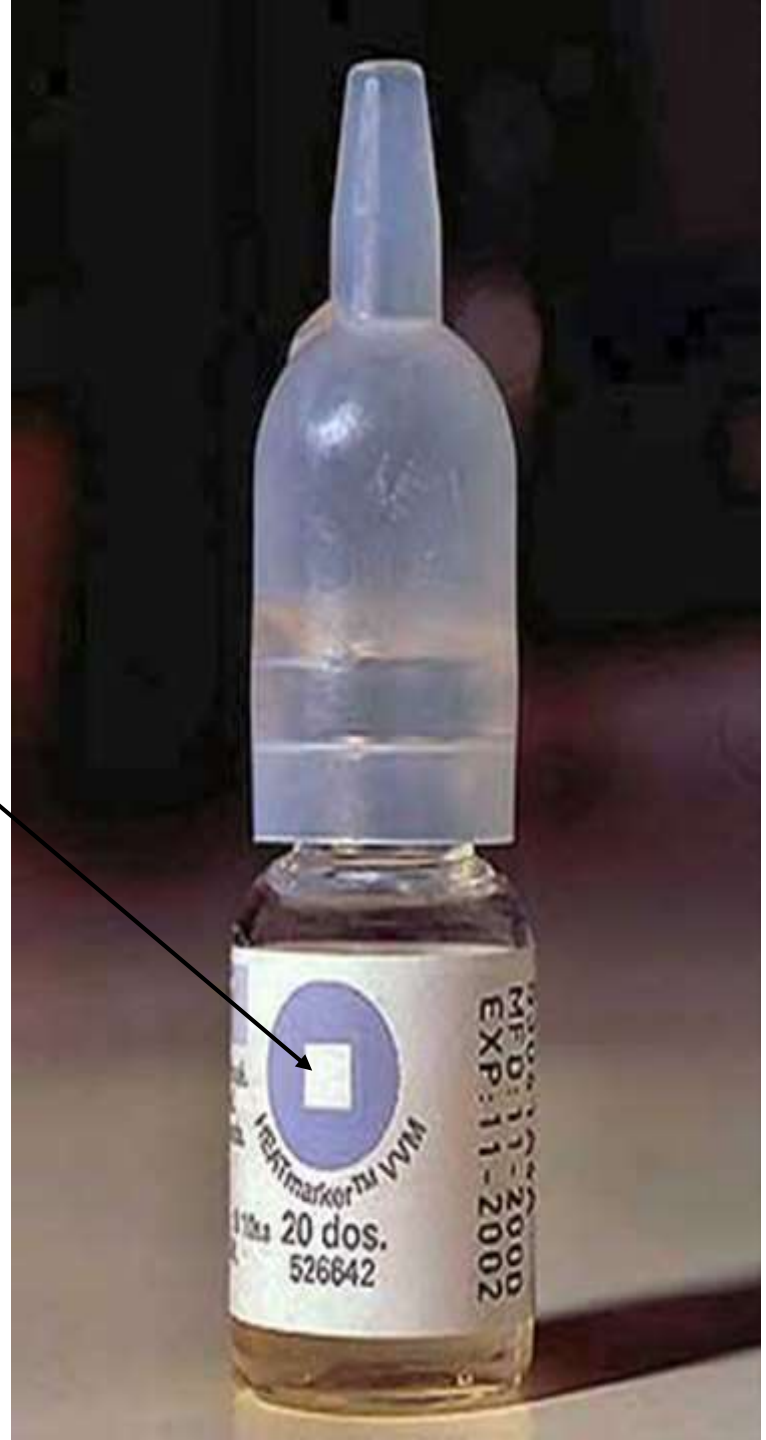
Meningococcal C Conjugate

Most DTaP containing vaccines

Vaccines should always be stored in their original packaging until point of use to protect them from light.

Vaccine vial monitors

Every vial is shipped with a temperature-sensitive label, that health workers monitor during vaccination sessions.

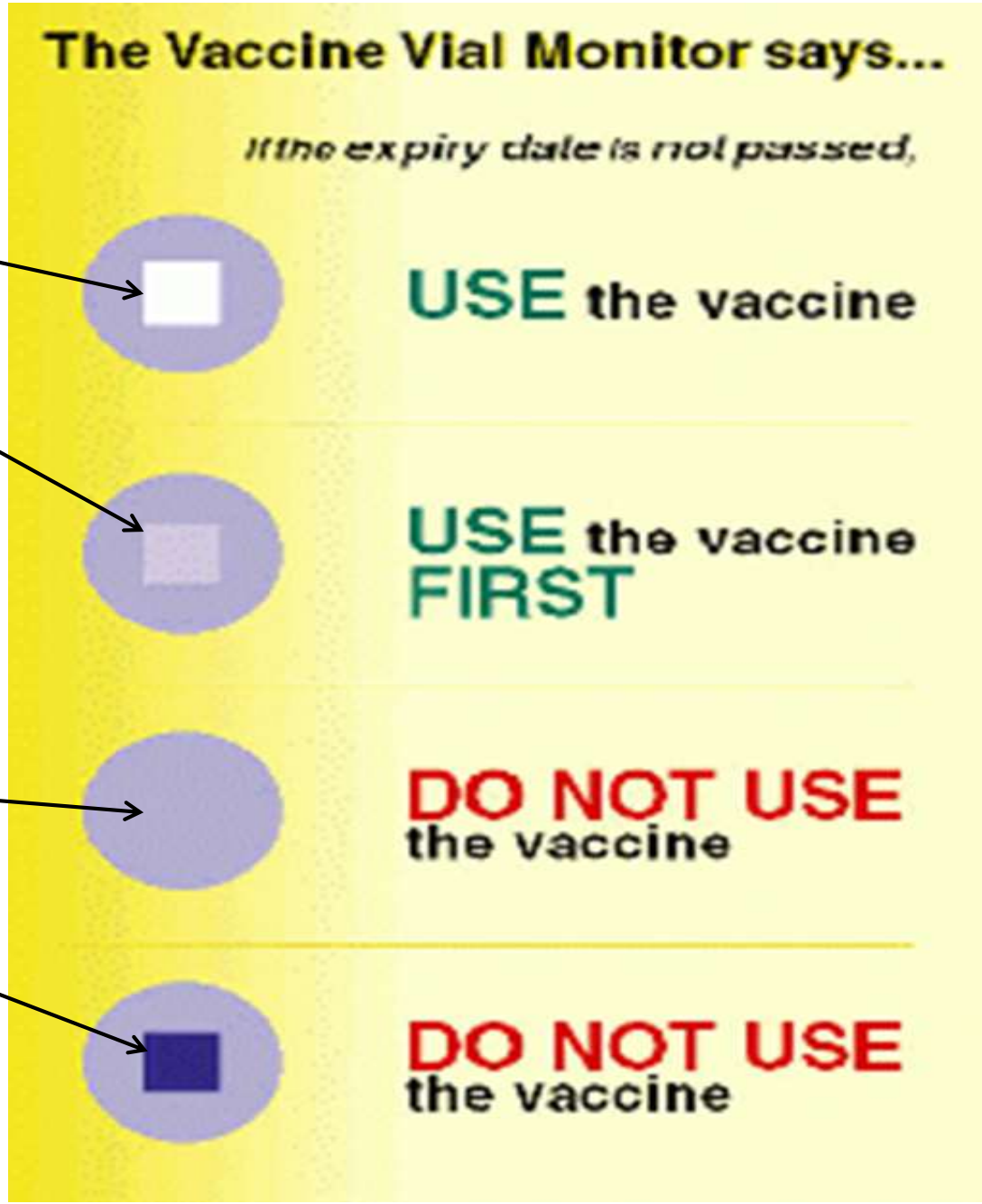


SAFE

If the inner square is lighter than the outer ring and the expiration date is valid, the vaccine is usable

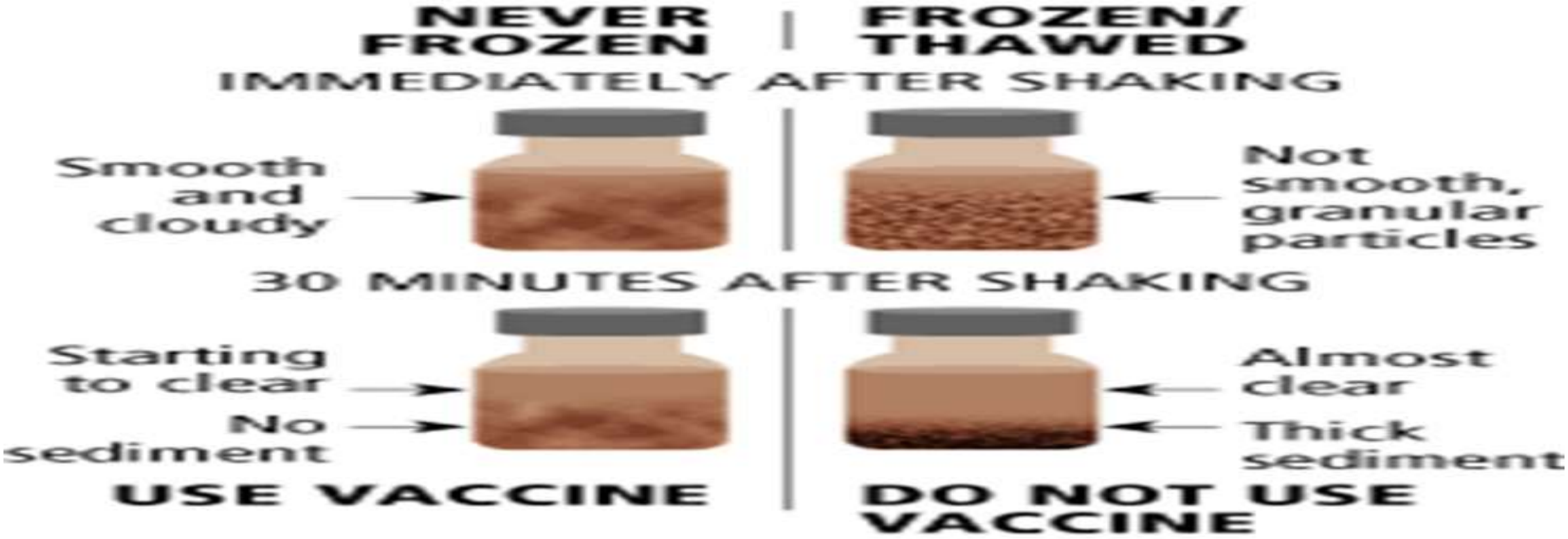
SPOILED

If the inner square matches or is darker than the outer ring, the vaccine must be discarded.



THE SHAKE TEST

DPT, hepatitis B and tetanus toxoid vaccines can all be damaged by freezing. By shaking two vials, side-by-side, one that might have been frozen and one that has never been frozen, health workers can determine if a vaccine has spoiled.



WHAT DAMAGES THE VACCINES?

1. Any defect in the cold chain.
2. Out date expiry.
3. Using skin antiseptic at the site of injection (e.g. BCG).
4. Using the reconstituted vaccine (MMR, measles, BCG) after the recommended period (6 hours).
5. Exposure of the vaccine to unacceptable temperature during the immunization session.
6. Exposure of the vaccine to direct sunlight.