Vaccines & Preventable Diseases

Learning outcome

- To have knowledge and understanding of various vaccines & their Preventable disease
- To have knowledge and understanding of the vaccines used in the Kenya national immunisation programme
- To offer accurate professional advice on vaccines to other health workers & users.
- To maintain proper storage & handling of vaccines

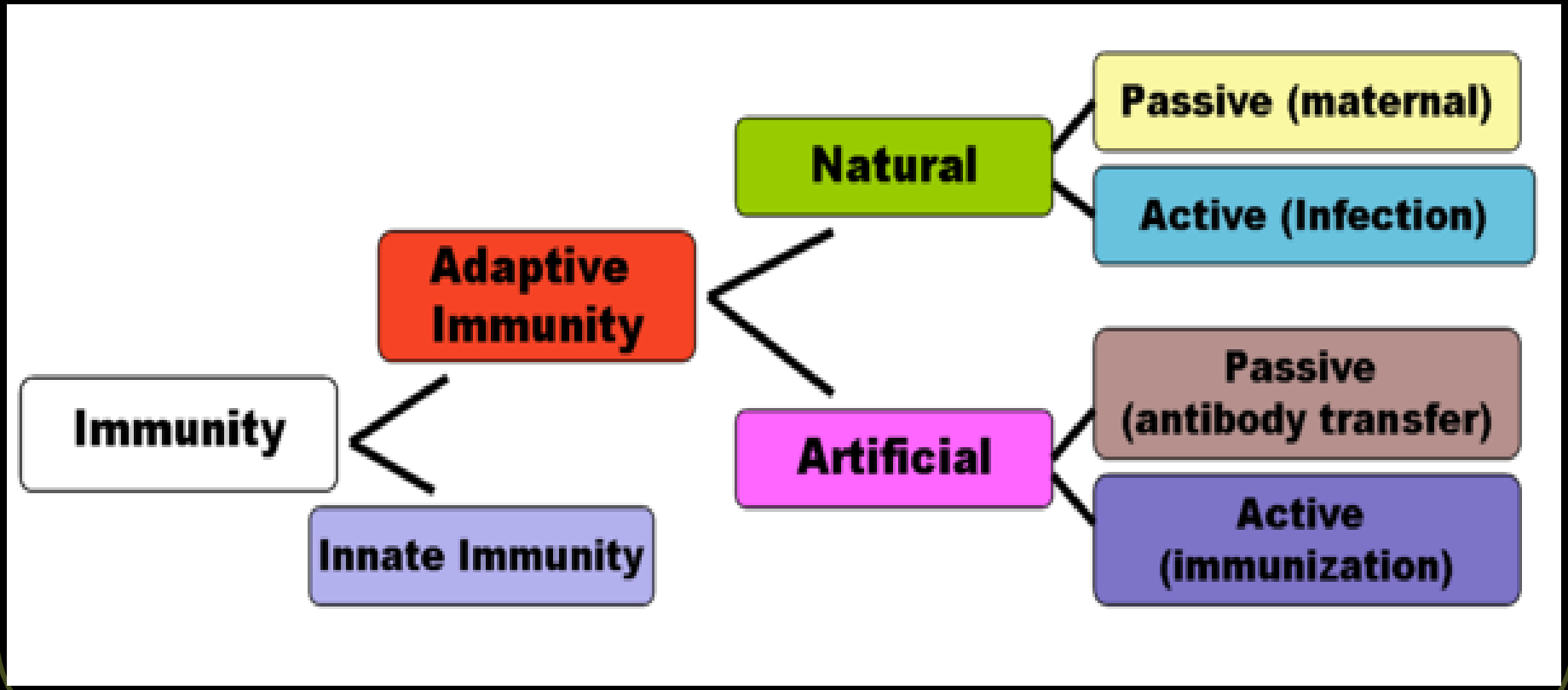
Learning objectives

- Identify in our pharmacy the types of vaccine we stock, their uses & doses.
- State when immunoglobulin is indicated
- Describe how vaccines work
- State the various types of vaccines
- Know what intervals & schedules need to be observed between doses of different vaccine

Medical Immunity

- ***Defination***
- **Immunity** is a biological term that describes a state of having sufficient biological defenses to avoid infection, disease, or other unwanted biological invasion

Types of immunity



Types of immunity. Cont’

1 ***Passive immunity***

Immunity with immediate protection against certain infective organisms can be obtained by injecting preparations made from the plasma of immune individuals with adequate levels of antibody to the disease for which protection is sought

2. ***Active immunity***

Active immunity can be acquired by ***natural disease*** or by ***vaccination***. Vaccines stimulate production of antibodies and other components of the immune mechanism;

What is a Vaccine?

- A vaccine is a ***nonpathogenic antigen*** that mimics a particular pathogen in order to elicit an immune response as if that actual pathogen were in the body.

- The overall goal of a vaccine is to establish immunity against that particular pathogen

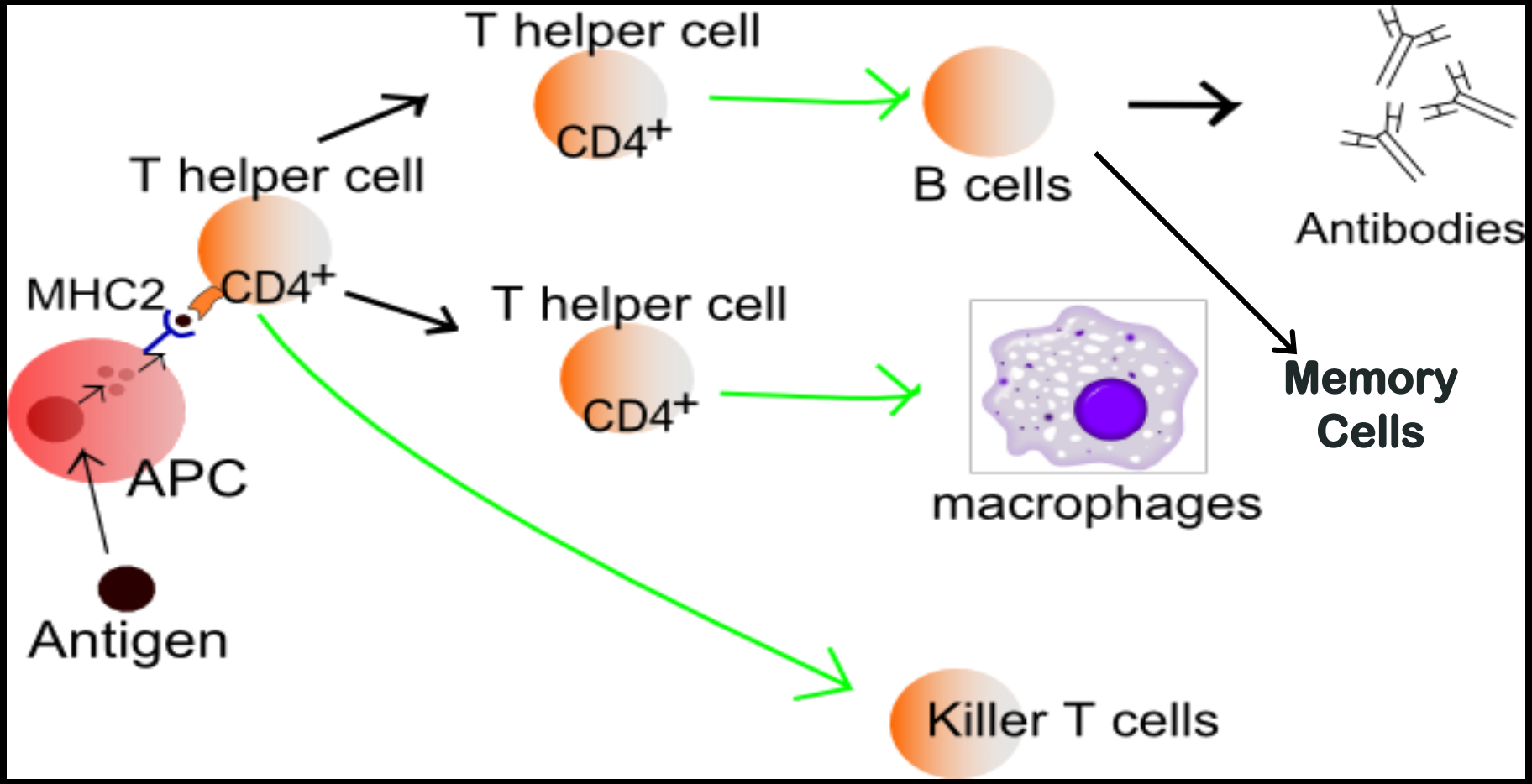
The Mechanism of a Vaccine

- In an ideal scenario, whenever a vaccine is first administered, it is phagocytized by an antigen presenting cell(APC).
- It is particularly important that the vaccine be taken up by a dendritic cell.
- This is because dendritic cells play a key role in activating T cells, which become helper T cells (Th cells).
- From there, the activated Th cells go on to activate mature B-cells.

Cont’

- These activated B-cells divides into two cell types, antibody-producing plasma cells and, most importantly, memory B cells.
- Memory T-cells are also established, however, they usually have a shorter half-life than memory B cells, thus, they play only a minor role in long-term immunity.
- Usually, there are no cytotoxic T-cells formed whenever the body responds to a vaccine.

Mechanism of action



Types of Vaccines

- Vaccines are dead or inactivated organisms or purified products derived from them.
- There are several types of vaccines currently in use.
- These represent different strategies used to try to reduce risk of illness, while retaining the ability to induce a beneficial immune response.

Types of vaccines cont’

They include

- Attenuated virus/bacteria
- Killed whole Organism
- Toxoids
- Surface molecules
- Anti-Idiotype Vaccines
- DNA Vaccines
- Chimeric Vaccines

1. Attenuated Virus/Bacteria

- These **vaccines** consist of live, but weakened, viruses or bacteria.
- These organisms have been altered, either genetically or chemically, in a way that they are not pathogenic.
- An example is the attenuated virus vaccine for yellow fever, *Measles, typhoid, TB*.

2. Killed Whole Organism

- This vaccine consist of the actual pathogen, however, it has been killed, either by a heat treatment or chemically.

- An example is the Salk vaccine for polio, which utilizes whole polioviruses that have been inactivated by formaldehyde. Also *flu & rabies vaccine*

3. Toxoids

- Some species of bacterial produce what is known as exotoxins.
- Toxoids are **vaccines** which consist of exotoxins that have been inactivated, either by heat or chemicals.
- These **vaccines** are intended to build immunity against the **toxins**, but not necessarily the bacteria that produce the toxins.
- Some examples of toxoid-based vaccines include tetanus and diphtheria.

4. Surface Molecules

- Proteins, carbohydrates, and lipids that are found on the surface of pathogens are isolated and used as a vaccine.
- Proteins are usually large and complex enough to be used on their own.
- Carbohydrates and lipids requires conjugated with a large protein in order to be immunogenic.
- An example of surface molecules used as a vaccine is hepatitis B surface antigens.

5. Anti-Idiotype Vaccines

- In this unique type of vaccine, antibodies from a sick individual are isolated.
- These antibodies are then injected into a lab animal, which may then produce an antibody whose antigen binding site mimics the epitope that the original antibody binds to.
- These antibodies are then isolated and injected into a healthy individual, who may produce antibodies with an antigen binding site that binds to the antigen binding site of the animals' antibodies.
- Because the animals binding site resembles the epitope of an antigen on a particular pathogen, the individual will have an immunity against that pathogen.

6. DNA Vaccines

- DNA vaccines consist of plasmids that contain genes for certain types of antigens.
- Once administered, the plasmid is taken up by the target cell and the genes are expressed.
- The cell then either excretes the antigen or displays it on an MHC-I molecule (M*ajor Histocompatibility Complex*).
- An example is *recombinant DNA hepatitis B vaccine*

7. Chimeric Vaccines

- Chimeric vaccines usually consist of attenuated viruses that have been engineered to carry antigens from multiple types of pathogens.
- For example, the *yellow fever vaccine YF17D has been engineered to carry antigens from HIV, different types of bacteria, malaria, even cancer.*
- The main of a chimeric vaccine is the establishment of immunity against several different diseases with one administration.

Common vaccine-preventable diseases

- ***Whooping cough (Pertussis):***
- A communicable disease. Spread by droplets. Symptoms include severe cough followed by a whoop and vomiting, leads to malnutrition, can cause death, severe under 1 year old.

- ***Diphtheria:***
- An infectious disease. Spread by droplets. Symptoms include difficulty in breathing, swallowing, enlarged neck. Very severe when it occurs.

- ***Tetanus: [see tetanus]***
- A clinical syndrome involving primarily the central nervous system and resulting from the tetanus toxins. Enters through open wounds, cuts and umbilical stump. Symptoms include stiffness, locked jaw, inability to suckle and muscle spasms. Has a very high mortality (>50%). Immunizing pregnant mothers ensures protection of her new born baby.

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Cont’

- ***Measles :***

  Killer disease. Highly infectious. Symptoms include rash, fever, cough, red eyes; is associated with blindness, malnutrition, deafness, pneumonia and death

Poliomyelitis (Infantile Paralysis):

An acute communicable disease. Spread by droplets and oro-faecal contamination. Symptoms include pain and flaccid paralysis in limbs, fever, vomiting; can lead to permanent deformity and can cause death.

Cont’

- ***Tuberculosis:***
- A communicable disease. Spread by droplet. Symptoms include fever, wasting, deep chesty cough, night sweats. May have lymphadenopathy. Leads to lowered resistance to other diseases and may be fatal.

- ***Hepatitis B:***
- It is a hihly contagious liver disease that ranges in severity from a mild illness lasting a few weeks to a serious, lifelong illness. It results from infection with the Hepatitis B virus. Hepatitis B can be either “acute” or “chronic.”
- Complications of HBV infection include: acute hepatitis, chronic hepatitis, liver cirrhosis, vascular disease, glomerulonephritis, and primary hepatocellular carcinoma

Cont’

- *Pneumococcal Diseases*

  This is an infection caused by a type of bacteria called ***Streptococcus pneumoniae*** (pneumococcus).

  There are different types of pneumococcal disease, such as pneumococcal pneumonia, bacteremia, meningitis, and otitis media.

  Pneumococcal disease can be fatal. In some cases, it can result in long-term problems, like brain damage, hearing loss, and limb loss

Cont

- *Rotavirus Infection*
- Rotavirus is the leading cause of severe acute gastroenteritis (vomiting and severe diarrhea) among children worldwide

- *Rabies*
- Rabies is a deadly viral infection that is mainly spread by infected animal's saliva that enters the body through a bite or broken skin.

- The virus travels from the wound to the brain in seven days, where it causes swelling, or inflammation. This inflammation leads to symptoms of the disease and death.

Cont’

- *Hemolytic disease of the newborn*
- It is a condition that develops in a fetus, when the IgG molecules (one of the five main types of antibodies) produced by the mother pass through the placenta.
- Among these antibodies are some which attack the red blood cells in the fetal circulation; the red cells are broken down and the fetus can develop reticulocytosis and anaemia.
- This fetal disease ranges from mild to very severe, and fetal death from heart failure (hydrops fetalis) can occur.

Child Immunization

- The basic principle of immunization is to administer into a healthy child a vaccine that will prevent it from getting a certain disease.
- Generally, several vaccines can be given at the same time. This is important since you do not know when you will see the child again. BCG, OPV, DPT-HeB-Hib and Measles vaccines can be given simultaneously if the child is of the appropriate age and has not received the early immunizations.
- A critically ill child needing hospital admission must be given the appropriate vaccines upon recovery.

Child Immunization Schedule

Vaccine	Age	Remarks
BCG,POLIO (OPV)	At Birth Dose	Or at first contact with the child
DPŢ-HeB1-Hib1 Dose POLIO (OPV 1)	6 weeks(1 ½ months)	Or at first contact with the child after that age.
DPT2-HeB2-Hib2 Dose POLIO (OPV 3)	10 weeks(2 ½ months)	4 weeks after DPT1 and OPV 1 can be given anytime after this period, when in contact with the child.
DPT3-HeB3-Hib3 Dose POLIO (OPV 3)	14 weeks(3 ½ months)	4 weeks after DPT 2 and OPV 2 can also be given anytime after this period, when in contact with the child.
Measles	9 months	May be given between 6 and 9 months if child is admitted to hospital for any other illness. Repeat at nine months as per KEPI

RABIES.

Rabies PEP modalities

Definition of categories of exposure and use of rabies biological:

- ***Category I*** **: -**touching, feeding of animals or licks on intact skin
- *no exposure therefore no prophylaxis if history reliable*

- ***Category II*****: -**minor scratches or abrasions without bleeding or and nibbling of uncovered skin.
- *use vaccine alone*

- ***Category III*****:** -single or multiple transdermal bites or scratches, licks on broken skin, contamination of mucous membrane with saliva (i.e. licks) and suspect contacts with bats:
- *use immunoglobulin plus vaccine(* ***but on opposite sides****)*

Rabies PEP modalities

Administration of rabies immunoglobulin (RIG)

- **Wounds infiltration with RIG is of utmost importance in category III exposure management**

. Infiltrate into the depth of the wound and around the wound as much as anatomically feasible of the RIG should be infiltrated around the wound

- remainder if any should be injected at an intramuscular site distant from that of vaccine

- inoculation e.g. into the anterior thigh

Rabies PEP modalities: Non-specific care

- Postpone suturing if possible; if suturing is necessary ensure that RIG has been applied locally;

- Apply antimicrobials and tetanus toxoid if necessary

Intramuscular regimens for rabies PEP

- **Two intramuscular schedules for category 2 and 3 exposures:**

 The 5 dose intramuscular regime: one dose of the vaccine should be administered on days 0, 3, 7, 14 and 28 in deltoid region or, in small children, into the antero-lateral area of the thigh muscle;

 The 2-1-1 regimen may also be used. Two doses are given on day 0 in the deltoid muscle, right and left arm. In addition one dose in the deltoid muscle on day 7 and one on day 21.

 Vaccines should not be injected into the gluteal region;

NB: The treatment can be stopped if animal remains healthy throughout an observation period of 10 days.

Previously Immunized Subjects

- Subjects having received a complete course of rabies pre-exposure or post-exposure prophylaxis

- ***Vaccination schedule:***
  Two injections; one each at day 0 & 7

- Schedule does not apply to immunocompromised patients

HEMOLYTIC DISEASE OF THE NEWBORN,

- The antibody anti-Rho(D) is responsible for hemolytic disease of the newborn (*erythroblastosis fetalis).*
- Occurs when an Rho(D)-negative woman carries an Rho(D)-positive fetus
- This antibody, once produced, remains in the woman's circulation and poses the threat of hemolytic disease for subsequent Rh-positive fetuses

Passive immunization against hemolytic disease

- its achieved with Rho(D) immune globulin, a purified concentrate of antibodies against Rho(D) antigen.
- The Rho(D) immune globulin (one vial of 300 ug intramuscularly) is given to the mother *within 72 hours* after delivery (or spontaneous or induced abortion or ectopic pregnancy).
- The antibodies in the immune globulin destroy fetal Rh-positive cells so that the mother will not produce anti-Rho(D).
- During her next Rh-positive gestation, erythroblastosis will be prevented.

Rotavirus Infection

- Its indicated for prevention of gastroenteritis caused by rotavirus

Posology(Dosage)

- Consists TWO doses
- The 1st administered from the age of 6 weeks
- The 2nd after at least 4 weeks
- The dosage should be completed by the age of 24 weeks

Administration

- Its is for ORAL use only.
- It should not be Injected
- No restriction on infants consumption of food or liquid either before or after vaccination
- It should be differed for kids suffering from diarrhea or vomiting
- ***Note***: Concomitant administration of OPV may slightly reduce the immune response to rotavirus

Hepatitis B Infection

- It is a hihly contagious liver disease that ranges in severity from a mild illness lasting a few weeks to a serious, lifelong illness. It results from infection with the Hepatitis B virus.

- Hepatitis B can be either “acute” or “chronic.”

- Complications of HBV infection include: acute hepatitis, chronic hepatitis, liver cirrhosis, vascular disease, glomerulonephritis, and primary hepatocellular carcinoma

Hepatitis B vaccine

- It is a recombinant DNA vaccine consisting of highly purified non-infectious particles of HB surface antigen

- Its indicated for immunization against infections caused by all subtypes of hepatitis B virus

Posology

- Its for intramuscular use only
- The pediatric dose: Children below 15yrs 0.5ml containing 10µg of HbsAg
- The adult dose: 1ml containing 20µg of HbsAg

Vaccination schedule

It consists of three doses,

- 1st dose at elected date
- 2nd dose 1 month after the 1st dose
- 3rd dose 6 months after the 1st dose.

Typhoid Fever

- It's a life threatening illness caused by bacterium *salmonella Typhi*
- It spread through contaminated water food
- Prophylaxis is by
  1. avoiding risky foods and drinks
  2. vaccination
- Typhoid rule.
- ***"Boil it, Cook it. Peel it* or *Forget it"***

Typhoid vaccine

- It consists of polysaccharides of *salmonella typhi* (25µg for one dose of 0.5ml)
- Indicated in adults and children over 2yrs & for travelers to endemic areas immigrants, healthcare professionals and military personnel
- For i.m and s.c use only.
- Revaccination should be performed every three yrs if the risk of exposure continues.

Tetanus (Lockjaw)

- A medical condition characterized by prolonged contraction of skeletal muscles
- Its caused by a neurotoxin, *tetanospasmin*, from the bacterium *clostridium tetani*
- *Spread through wound contamination involving e.g. a cut*
- *Muscle spasm of the jaw are dominant.*
- *Can be prevented by vaccination with tetanus toxoid.*

Treatment of tetanus

Mild Infection:

- Tetanus immunoglobulin I.V or I.M
- Metronidazole I.V for 10 days
- Diazepam
- Severe Infection

Severe infection

- admission
- Human tetanus immunoglobulin(intrathecally)
- Tracheotomy & mechanical ventilation for 3-4 wks
- i.v magnesium to prevent muscle spasms
- i.v diazepam

Vaccination

- 1st 0.5ml i.m
- 2nd dose 0.5ml i.m 4 weeks to 8 weeks after the 1st dose.
- 3rd dose at 6-12 months after the 2nd dose
- Pediatric dose

Influenza(Flu)

- The flu is a contagious respiratory illness caused by influenza viruses.
- Often called a respiratory but It affects the whole body
- It can cause mild to severe illness, and at times can lead to death.
- The best way to prevent the flu is by getting a flu **vaccine** each year.
- Symptoms similar to common cold but more dangerous.(high fever, headache, severe cough, extreme fatigue, aches & pains)

Flu Vaccine

- Each 0.5ml dose contains 15µg of heamaglutinin & 0.25ml dose contains 7.5µg of heamaglutinin.
- It is given by intramuscular or deep subcutaneous.
- Vaccination should happen before the flu season every year because the flu viruses are constantly mutating.
- NB: can also be given during the flu season.

Posology

- Adults & Children above 36 months. 0.5ml
- Children 6 months to 35 months 0.25ml
- For children under 9yrs who have not previously been vaccinated, a 2nd dose should be given after an interval of 4 weeks

Anti Snake Venom

- .Antivenom is a biological product used in the treatment of venomous bites or stings.
- Antivenom is created by milking venom from the desired snake, spider or insect.
- The venom is then diluted and injected into a horse, sheep, goat or cat.
- The subject animal will undergo an immune response to the venom, producing antibodies against the venom's active molecule which can then be harvested from the animal's blood and used to treat envenomation.

Antivenom Principle

- The principle of antivenom is based on that of vaccines
- However, instead of inducing immunity in the patient directly, it is induced in a host animal and the hyperimmunized serum is transfused into the patient.
- Antivenoms can be classified into
  1. ***Monovalent*** (when they are effective against a given species' venom) or
  2. ***Polyvalent*** (when they are effective against a range of species, or several different species at the same time).

Vaccines storage & handling

- Store only vaccine in refrigerator
- Check and log temperature twice a day
- Open the door only when necessary
- Stock vaccine on a first-in is the first-used basis
- Never leave vaccine outside the refrigerator
- Store full bottles of water on empty shelves and on the door
- Keep vaccine between 2°-8° C
- Don't store vaccine on the door shelves
- Stock only a one month supply

Proper storage of vaccines to maintain potency

- Most currently available vaccines require refrigeration, while some should be frozen until use.
- These storage requirements must be adhered to from the time of manufacture to the administration to the patient,
- This process is often referred to as maintenance of the “cold chain”.

Guidelines for vaccine handling and storage

- Provide information to all personnel handling vaccines regarding appropriate storage and documentation practices
- Check all vaccine shipments for any evidence of heat damage upon receipt; check cold chain monitor cards if appropriate
- Routinely check all refrigerators/freezers to ensure proper working order
- Place a thermometer in the refrigerator and maintain a daily log of refrigerator temperatures to document compliance with manufacturers' recommendations
- Avoid storing any food in the same area with vaccines

- Do not store vaccines in the refrigerator door shelf where temperature fluctuations may be greater
- If possible, store bottles of chilled water in refrigerators and ice in freezers to minimize temperature fluctuations in the event of brief electrical power failures
- Perform a monthly inspection of opened and unopened vials for out-of-date vaccines
- When opening or reconstituting a vial, note the date and time it was prepared; check the manufacturer's recommendations for storage of reconstituted vaccines
- Protect vaccines from light, especially MMR
- Perform a "shake test" for products containing tetanus toxoid; if the product has been allowed to freeze, an insoluble precipitate will form in clumps that cannot be dissolved with vigorous shaking of the vial.

The End