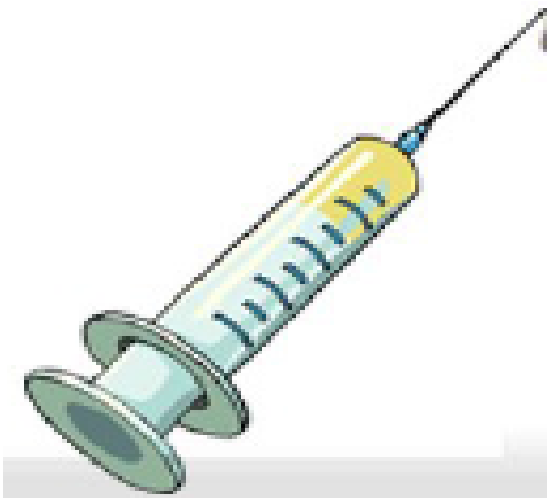


Vaccine

Mr. Sandip Murmu
Assistant Professor of Zoology
Jogamaya devi College

Contents:

- Introduction
- History
- Types
  - i) 7 Types
  - ii) Their uses with example
  - iii) Saponins as vaccine adjuvants
- Vaccine Schedule
- Conclusion

Introduction:

- A **vaccine is a biological preparation that** improves immunity to a particular disease.
- A vaccine typically contains an agent that resembles a disease-causing micro organism and is often made from weakened or killed forms of the microbe.

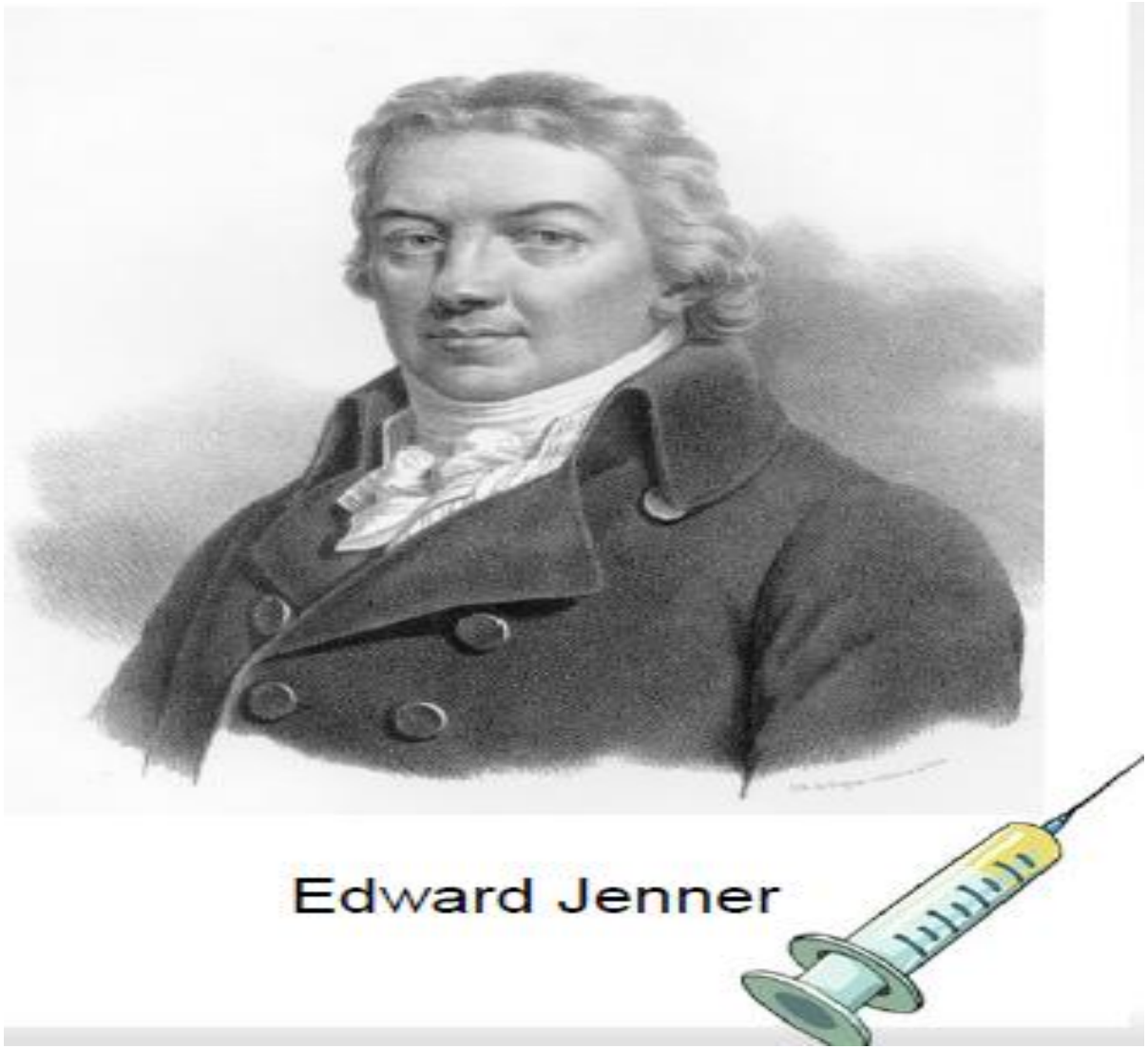
Contd..

- The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and keep a record of it.
- So that the immune system can more easily recognize and destroy any of these micro organisms that it later encounters.
- The terms *vaccine and vaccination are derived* from *Variolae vaccinae (smallpox of the cow),* the term devised by Edward Jenner to denote cowpox.

History:

- During the late 1760s whilst serving his apprenticeship as a surgeon Edward Jenner learned of the story, common in rural areas, that dairy workers would never have the often-fatal or disfiguring disease smallpox
- Because they had already had cowpox, which has a very mild effect in humans.

Contd..



Contd..

- In 1796, Jenner took pus from the hand of a milkmaid with cowpox, scratched it into the arm of an 8-year-old boy.
- Six weeks later inoculated the boy with smallpox, afterwards observing that he did not catch smallpox.
- Jenner extended his studies and in 1798 reported that his vaccine was safe in children and adults.

Contd..

- The second generation of vaccines was introduced in the 1880s by Louis Pasteur who developed vaccines for chicken cholera and anthrax.
- From the late nineteenth century vaccines were considered a matter of national prestige, and compulsory vaccination laws were passed.

Types:

1. Live, attenuated vaccines
2. Inactivated vaccines
3. Subunit vaccines
4. Toxoid vaccines
5. Conjugate vaccines
6. DNA vaccines
7. Recombinant vector vaccines

1. Live, Attenuated Vaccines:

- Live, attenuated vaccines contain a version of the living microbe that has been weakened in the lab so it can't cause disease.
- Because a live, attenuated vaccine is the closest thing to a natural infection, these vaccines are good "teachers" of the immune system.
- Example: Vaccines against measles, mumps, and chickenpox

2. Inactivated Vaccines:

- Scientists produce inactivated vaccines by killing the disease-causing microbe with chemicals, heat, or radiation. Such vaccines are more stable and safer than live vaccines.
- Because dead microbes can’t mutate back to their disease-causing state.
- Example: Vaccines against influenza, polio, hepatitis A, and rabies.

3.Subunits Vaccines:

- Instead of the entire microbe, subunit vaccines include only the antigens that best stimulate the immune system.
- In some cases, these vaccines use epitopes the very specific parts of the antigen that antibodies or T cells recognize and bind to.
- Because subunit vaccines contain only the essential antigens and not all the other molecules that make up the microbe.
- Example: Plague immunization.

4.Toxoid Vaccines:

- For bacteria that secrete toxins, or harmful chemicals, a toxoid vaccine might be the answer.
- These vaccines are used when a bacterial toxin is the main cause of illness.
- Scientists have found that they can inactivate toxins by treating them with formalin. Such “detoxified” toxins, called toxoids, are safe for use in vaccines.
- Example: *Crotalus atrox toxoid is used to* vaccinate dogs against rattlesnake bites.

5.Conjugate Vaccines:

- If a bacterium possesses an outer coating of sugar molecules called polysaccharides, as many harmful bacteria do, researchers may try making a conjugate vaccine for it.
- Polysaccharide coatings disguise a bacterium's antigens so that the immature immune systems of infants and younger children can't recognize or respond to them.
- Example : *Haemophilus influenzae type B vaccine.*

6.DNA Vaccines:

- Still in the experimental stages, these vaccines show great promise, and several types are being tested in humans.
- DNA vaccines take immunization to a new technological level.
- These vaccines dispense with both the whole organism and its parts and get right down to the essentials: the microbe's genetic material.
- Example: Influenza vaccine.

7.Recombinant Vector Vaccines:

- Recombinant vector vaccines are experimental vaccines similar to DNA vaccines
- But they use an attenuated virus or bacterium to introduce microbial DNA to cells of the body.
- “Vector” refers to the virus or bacterium used as the carrier.
- Example : DPT

Saponins as vaccine adjuvant:

- At first: what is **vaccine adjuvant ?**
- A vaccine adjuvant is a substance that is added to the vaccine to increase the body's immune response to the vaccine.
- **Saponins are natural glycosides of steroid or** triterpene which exhibited many different biological and pharmacological activities.
- Notably, saponins can activate the mammalian immune system, which have led to significant interest in their potential as vaccine adjuvants.

Contd..

- The most widely used saponinbased adjuvants are Quil A and its derivatives QS-21, isolated from the bark of *Quillaja saponaria Molina, which* have been evaluated in numerous clinical trials.
- Their unique capacity to stimulate both the Th1 immune response and the production of cytotoxic T-lymphocytes (CTLs) against exogenous antigens makes them ideal for use in subunit vaccines and vaccines directed against intracellular pathogens as well as for therapeutic cancer vaccines.

Name of diseases prevented with vaccines

- Tetanus
- Polio
- Mumps
- Measles
- Hepatitis b
- Hepatitis A
- Yellow fever
- Influenza
- Diphtheria
- Meningococcal
- Haemophilus
- influenza type b(Hib)
- Typhoid
- Rubella

Schedule:

Name of vaccine	Name of disease	Dosage and administration	Immunization schedule
Hepatitis b vaccine (booster dose isn't recommended)	Hepatitis b	0.5 ml IM injection child <10 years, 10 mcg/dose child> 10 years, 20 mcg.	Second dose is given 1month after first and third after 5months(Three doses) Babies:1,2,12 month
Hepatitis A	Hepatitis A	0.5ml (1st dose) 1.0ml(2nd dose)	2yrs or above and6 to 12 months after first(two doses)
BCG vaccine	tuberculosis	0.1ml ID injection	Younger than 3-5 years

Schedule:

Name of vaccine	Name of disease	Dosage and administration	Immunization schedule
Yellow fever vaccine	Yellow fever	0.5ml SC injection	9 months or older before traveling to epidemic area (Single dose)
Measles vaccine	Measles	0.5 ml SC injection	First dose 12-15 months and second dose 4-5 years age (Two doses)
Measles Rubella vaccine	Measles and Rubella	0.5ml SC injection	(two doses)

Contd..

Name of vaccine	**Name of disease**	**Dosage and administration**	**Immunization schedule**
Diphtheria – tetanus toxoid vaccine (DT)	Diphtheria and tetanus	0.5ml IM injection	6weeks to 7yeras old(single doses)
MMR vaccine	Mumps , Measles and Rubella	0.5ml SC injection	12 to 15 months first dose and 4-6 years second dose(Two doses)
Haemophilus influenza type b vaccine (hib)	Haemophilus influenza b	0.5ml IM injection	First three doses at intervals of every three months and final dose 12-15 months of age (Three to four doses)

Contd..

Name of vaccine	**Name of disease**	**Dosage and administration**	**Immunization schedule**
Inactivated Polio Vaccines (IPV)	Polio(booster dose is required at the age of 4-6 years)	0.5ml IM/SC injection	1st dose 2 month,2nd dose 4 month,3rd dose 6-18 months of age (Three doses)
Typhoid vaccine	Typhoid fever	0.5ml IM injection	1 week before travel to the area sensitive. (Single dose)
Cholera vaccine (Sachets are available and dissolved in water to take orally)	cholera	3ml Oral route of administration	2 years and over Three doses(2 for adults)

Conclusion:

- Where pathogens show great antigenic variation or multiple strains, the problems of vaccine development revolve around difficulties in identifying critical antigens that show little variation and which induce protective immunity. The challenge to achieve this has not yet been met for a number of important infectious diseases, which still lack effective vaccines(Table 4). Nevertheless, with the possible exception of prions, there are no theoretical reasons why vaccines cannot be developed to give protection against most infectious diseases.

Table 4 Some examples of infections that cannot yet be controlled by vaccination.

Pathogen	Examples	Disease	Problem with vaccine design
helminths	*Schistosoma* species	schistosomiasis	antigenic disguise with host proteins
protoctists	*Plasmodium* species	malaria	antigenic variation and morphological complexity
protoctists	*Trypanosoma* species	sleeping sickness	extreme antigenic variation

Contd..

Pathogen	Examples	Disease	Problem with vaccine design
Fungi	*Pneumocystis*	fungal pneumonia	ignorance of effective immunity
Fungi	*Candida*	thrush	ignorance of effective immunity
Bacteria	*Streptococci*	skin and throat infections	multiple serotypes
Bacteria	*Treponema pallidum*	Syphilis	ignorance of effective immunity
viruses	HIV	AIDS	antigenic variation
viruses	'cold' viruses	common cold	many different types of unrelated virus
Prions	vCJD prions	variant Creutzfeldt-Jakob disease	lack of immunogenicity

Research & Development:

- WHO have a separate unit for the research and development of vaccine.
- WHO's Initiative for Vaccine Research (IVR) facilitates vaccine research and development (R&D) against pathogens with significant disease and economic burden, with a particular focus on low and middle income countries.
- Finding a safe, effective, and durable HIV vaccine remains a top priority for world.

Contd..

- Through the Vaccine Research Center and the Division of Acquired Immunodeficiency Syndrome, NIAID (National Institute of Allergy and Infectious Disease) is recently busy in conducing and supporting biomedical research that leads to increased knowledge about how HIV interacts with the human immune system and evaluation of the most promising vaccine candidates.

***


Thank You