Vaccine

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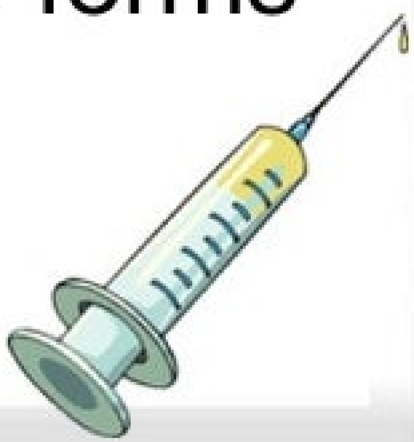
Introduction:

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



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- 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 microorganisms 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.

Edward Jenner

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- 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.

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- 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.

Louis Pasteur

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.

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- 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.

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.

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- 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.

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Thank You