Vaccine

A vaccine is a substance that is introduced into the body to prevent infection or to control disease due to a certain pathogen (a disease-causing organism, such as a virus, bacteria or parasite). Vaccination against both bacterial and viral diseases has been one of the major achievements in the field of immunology since the beginning of the last century.The use of antibiotics and vaccines has proven to be very effective for treating a number of infectious disease conditions in humans caused by microorganisms. The world's first vaccine was developed in 1796 when Edward Jenner demonstrated that a live cowpox virus could be used to vaccinate humans against smallpox. In the US many vaccines are routinely given to newborns, children and adults.

To understand how vaccines work you need to be familiar with the basic aspects of the human immune system. The immune system in humans and other animals is extremely complex. Foreign substances that stimulate an immune response are called antigens. The immune system typically responds to antigens by producing antibodies. This is called antibody-mediated immunity. Three types of white blood cells.

a) B-lymphocytes: antibody-mediated immunity
b) T-lymphocytes: cellular immunity
c) Macrophages: cell eating (phagocytosis)

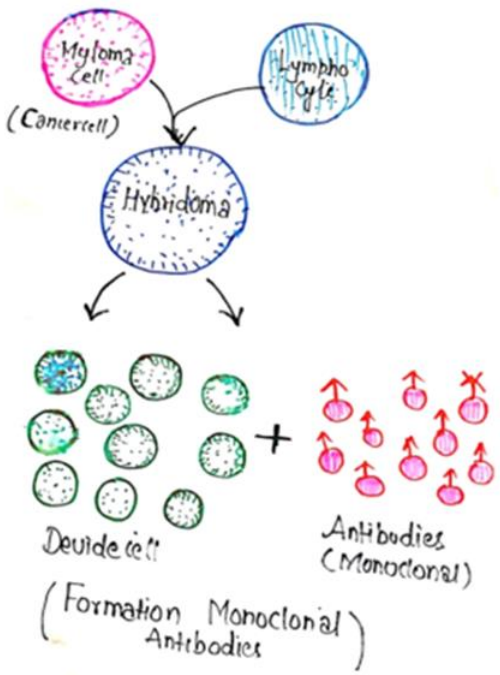
Types of Vaccines- The different types of vaccines are as follows:

1. **Inactivated Vaccine:** Vaccines of this type are created by inactivating a pathogen, typically using heat or chemicals such as formaldehyde or formalin. This destroys the pathogen's ability to replicate, but keeps it "intact" so that the immune system can still recognize it.
2. **Attenuated Vaccine:** Attenuated vaccines can be made in several different ways. Some of the most common methods involve passing the disease-causing virus through a series of cell cultures or animal embryos (typically chick embryos). When the resulting vaccine virus is given to a human, it will be unable to replicate enough to cause illness, but will still provoke an immune response that can protect against future infection.
3. **Toxoid Vaccine:** Some bacterial diseases are not directly caused by a bacterium itself, but by a toxin produced by the bacterium. Immunizations for this type of pathogen can be made by inactivating the toxin that causes disease symptoms. As with organisms or viruses used in killed or inactivated vaccines, this can be done via treatment with a chemical such as formalin, or by using heat or other methods.

4. **Subunit Vaccine:** Subunit vaccines use only part of a target pathogen to provoke a response from the immune system. This may be done by isolating a specific protein from a pathogen and presenting it as an antigen on its own.
5. **Conjugate Vaccine**: Conjugate vaccines are somewhat similar to recombinant vaccines: they're made using a combination of two different components. Conjugate vaccines, however, are made using pieces from the coats of bacteria. These coats are chemically linked to a carrier protein, and the combination is used as a vaccine
6. **Valence Vaccine**: Vaccines may be monovalent. A monovalent vaccine is designed to immunize against a single antigen or single microorganism.A multivalent or polyvalent vaccine is designed to immunize against two or more strains of the same microorganism, or against two or more microorganisms.
7. **Heterotypic Vaccine:** Heterologous vaccines also known as "Jennerian vaccines", are vaccines that are pathogens of other animals that either do not cause disease or cause mild disease in the organism being treated.
8. **mRNA Vaccine:** An mRNA vaccine (or RNA vaccine) is a novel type of vaccine which is composed of the nucleic acid RNA, packaged within a vector such as lipid nanoparticles.
9. **Toxin and toxicoids**- Toxin are secreted by the microbesis treated with formaldehyde to reduce the toxicity without changing antigenecity. Such toxins are known as toxicoids which are precipitated with aluminium sulphate to form antigens eg. Tetanus and diphtheria

a. Monoclonal antibodies- They are antigen-specific homologous immunologic reagents. They are produced by specialized cells of immunized rat. Hybridoma technique- Mylemo cells or cancer cells are used due to following region

I. Divide rapidly
II. Can divide outside the body



Hybridome antibodies

a. Specific protein can detect with the help of hybridome antibodies- Once antibodies that recognized discrete site on s molecule on interest have been produced and linked to a fluorescent dye. It can injected in cell or tissues under the study by using immunoflourescent microscope.

b. Now radiolebelled monoclonal antibodies are also used to identifying of any antigen antibodies complex and detected by auto radiography. This technology has been used to localized some hormone like epinephrine or norepinephrine.

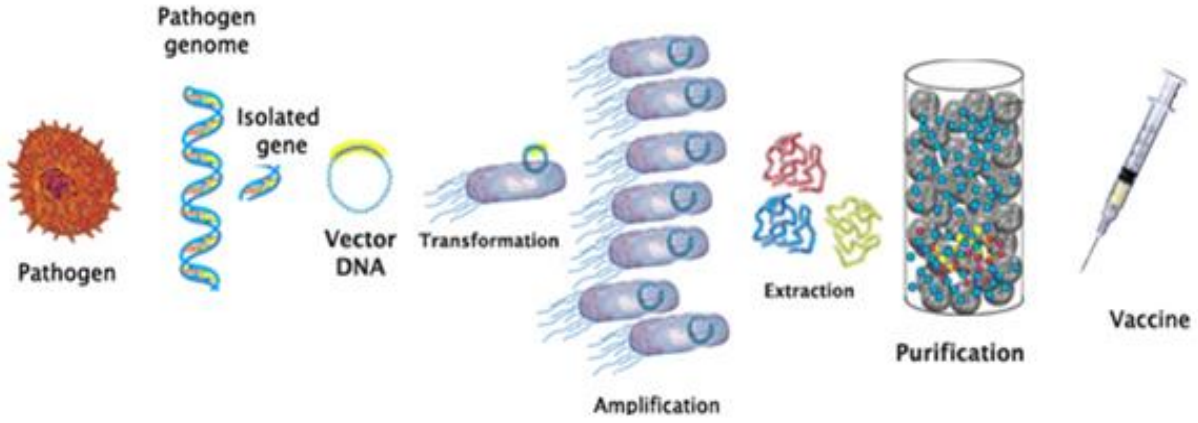
10. **Recombinant vaccines** Vaccine antigens may also be produced by genetic engineering technology. These products are sometimes referred to as recombinant vaccines. Recombinant vaccines are created by cloning genes for desired antigens and inserting the cloned antigen into a host cell to produce large quantities of the cloned viral or bacterial antigenic protein.

    This protein is then purified and injected into the patient, and the patient's immune system makes antibodies to the disease agent's protein, protecting the patient from natural disease.

Advantages of recombinant vaccine technology

I. It is similar to subunit vaccines, there is virtually no chance of the host becoming ill from the agent, since it is just a single antigenic protein and not the whole organism.

II. It includes the fact that the recombinant organism lacks virulence factors, and the vector can be chosen to be not only safe but also easy to grow and store, reducing production cost. Antigens which do not elicit protective immunity or which elicit damaging responses such as triggering an autoimmune response or fever can be eliminated from the vaccine. **Disadvantages** of recombinant vaccines are the development cost, since the genes for the desired antigens must be identified, cloned, and expressed efficiently in the recombinant host. Two recombinant vaccines currently used in humans are the Hepatitis B (HBV) vaccine and cervical cancer vaccine.



Recombinant vaccines

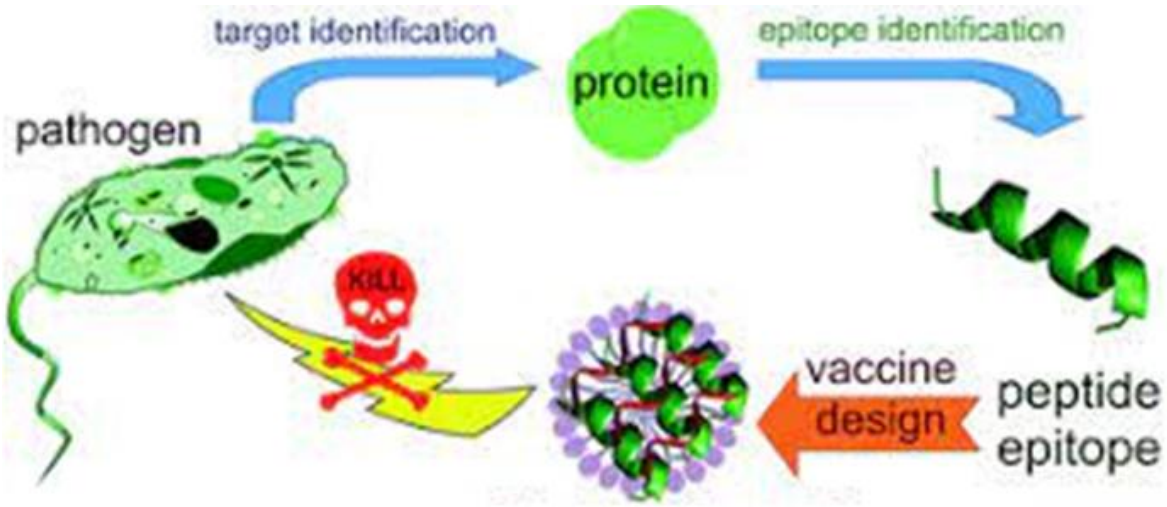
11. **Synthetic Vaccine-** The existing mode of vaccination includes the use of killed or live attenuated microbial agents, purified viral proteins or their subunits, and bacterial toxoids. In many cases, it led to successful vaccines, but there are still several major problems that await solution.

1. The lack of sufficient source material, since not all viruses can be cultured and developed into effective vaccines; or safety considerations due to hazardous effect of some vaccines, caused by insufficient attenuation.
2. Another problem, not overcome as yet is that many existing viruses constantly evolve into new strains, with different serological specificities, thus requiring the continuous development of new vaccines.

   The synthetic approach offers a potential solution to these problems. According to this approach the vaccine will consist of a synthetic material comprising only the relevant antigenic

moiety leading to protective immunity. Such vaccines can be synthesized in large amounts, and will not constitute any safety hazards to the individual or the community. The basis for the utilization of synthetic antigens for vaccination has been laid during their use for studies of antigenicity of proteins and by the finding that they are capable of eliciting anti-protein immune response

Synthetic peptide vaccines Synthetic peptide vaccines represent fragments of protein antigen sequences, synthesizing specific B cell and T cell epitopes offer the potential to induce diseases neutralizing immuno response with completely synthetic structure. Now it is well established that short chain peptides can be used to mimic antigenic sites of viruses and thus can be used the basics for vaccines and development. therefore, attempts have been made to synthesize such peptides which act as the serrogate immuunogens, as an alternative to the existing conventional vaccines with following advantages



Synthetic Vaccine

1. Relatively easy to produce
2. Stable for longer period of time without the need for refrigeration.
3. Scaleup to production and purification is easy in contrast to conventional vaccines.
4. To synthesize a peptide which can induce production of antibodies reacting with the coat of proteins of viruses it is necessary to identify the critical epitopes involves in producing protective immunity and determining the sequence of amino acid that consequent an epitopes.