Basic principles of Vaccination

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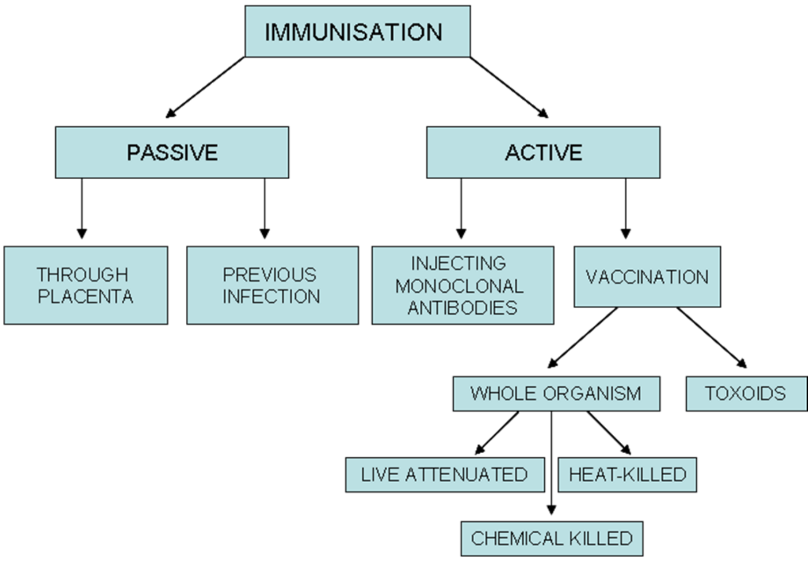
ACTIVE AND PASSIVE IMMUNIZATION:

Immunity to infectious microbes can be achieved by active or passive immunization. In each case, immunity can be acquired either by natural processes (usually by transfer from mother to fetus or by previous infection by the organism) or by artificial means such as injection of antibodies or vaccines.



PASSIVE IMMUNIZATION

- Emil von Behring and Hidesaburo Kitasato are recognized for their contributions to passive immunity. These investigators were the first to show that immunity elicited in one animal can be transferred to another by injecting it with serum from the first.
- Passive immunity is the availability of immune molecules antibodies in particular, raised by a natural course of infection within an individual's body either from previous infection or from mother's body (across the placenta).
- Maternal antibodies to diphtheria, tetanus, streptococci, rubella, mumps, and poliovirus all afford passively acquired protection to the developing fetus.
- Antibodies present in colostrum and milk also provide passive immunity to the infant.
- Despite the risks incurred by injecting animal sera, usually horse serum, this was the only effective therapy for otherwise fatal diseases.

MERITS OF PASSIVE IMMUNISATION

- Passive immunization is routinely administered to individuals exposed to botulism, tetanus, diphtheria, hepatitis, measles, and rabies.
- It can provide immediate protection to travellers or health-care workers who will soon be exposed to an infectious organism.
- Passively administered antiserum is also used to provide protection from poisonous snake and insect bites.

ACTIVE IMMUNIZATION: Active immunization can be achieved by natural infection with a microorganism, or it can be acquired artificially by administration of a vaccine.

MONOCLONAL ANTIBODY INJECTION: Vaccination refers to a procedure in which the presence of an antigen stimulates the formation of antibodies. The antibodies act to protect the host from future exposure to the antigen.

A vaccine is a medical preparation given to provide immunity from a disease. Vaccines use a variety of different substances ranging from dead microorganisms to genetically engineered antigens to defend the body against potentially harmful microorganisms.

PURPOSE OF VACCINATION

- Effective vaccination provides protective immunity by inducing memory response (promoting the development of antibodies) to an infectious microorganism when it enters the body preventing disease development.
- It boosts production of memory B and T lymphocytes that acts against the pathogenic compounds during secondary infection.
- An ideal vaccination always comes in booster doses ie; in an aim to elevate a persistent immunity against a microbe that last for life.
- Timing of vaccination depends upon the likelihood of the infection. However an early age vaccination

is always preferred because it not only protects infants from deadly childhood diseases but also that time their immune system is not formed.

PROPERTIES OF AN IDEAL VACCINE

The World Health Organization (WHO) has stated that the ideal vaccine would have the following properties:

- Heat stable
- Affordable worldwide
- Effective after a single dose
- Administered by a mucosal route
- Applicable to a number of diseases
- Suitable for administration early in life

COMMON TYPES OF VACCINE

1. **ATTENUATED VACCINE:** Microorganisms can be attenuated so that they lose their ability to cause significant disease (pathogenicity) but retain their capacity for transient growth within an inoculated host. Attenuation often can be achieved by growing a pathogenic bacterium or virus for prolonged periods under abnormal culture conditions.

EXAMPLE: **Bacillus Calmette-Guerin (BCG)** was developed by growing *M. bovis* on a medium containing increasing concentrations of bile.

Sabin polio vaccine, consisting of three attenuated strains of poliovirus, is administered orally to children on a sugar cube or in sugar liquid.
Yellow fever, Varicella zoster (chickenpox), Mumps, Measles, Typhoid vaccines.

2. **TOXOID:** Some bacterial pathogens, including those that cause diphtheria and tetanus, produce exotoxins. Diphtheria and tetanus vaccines, for example, can be made by purifying the bacterial exotoxin and then inactivating the toxin with formaldehyde to form a toxoid.

3. **HEAT OR CHEMICAL KILLED VACCINE:** Another common approach in vaccine production is inactivation of the pathogen by heat or by chemical means so that it is no longer capable of replication in the host. Heat inactivation is generally unsatisfactory because it causes extensive denaturation of any epitopes that depend on higher orders of protein structure are likely to be altered significantly. Chemical inactivation with formaldehyde or various alkylating agents has been successful.

   EXAMPLE: Salk polio vaccines use formaldehyde as bactericidal chemical.

4. **SYNTHETIC PEPTIDE VACCINE:** Peptides are not as immunogenic as proteins, and it is difficult to elicit both humoral and cellular immunity to them. The use of conjugates and adjuvants can assist in raising protective immunity to peptides.