

# **ACTIVE AND PASSIVE IMMUNIZATION**

**SOS In Microbiology  
M.Sc 2<sup>nd</sup> Semester  
Paper: Immunology (202)  
Unit -5 (1)**

# Introduction

- The incidence of diseases such as diphtheria, measles, mumps, pertussis (whooping cough), rubella (German measles), poliomyelitis, and tetanus has declined dramatically as vaccination has become more common.
- Clearly, vaccination is a cost-effective weapon for disease prevention.
- Immunity to infectious microorganisms can be achieved by active or passive immunization.
- In each case, immunity **can** be acquired either by
  1. Natural processes (usually by transfer from mother to fetus or by previous infection by the organism)
  2. Artificial means such as injection of antibodies or Vaccines .
- The agents used for inducing passive immunity include antibodies from humans or animals in active immunization is achieved by inoculation with microbial pathogens that induce immunity but do not cause disease or with antigenic components from the pathogens.

# A. Passive Immunization

- Pioneers of vaccination-Jenner and Pasteur
  - Emil von Behring and Hidesaburo Kitasato recognized the same for their contributions to passive immunity. They were the first to show that immunity elicited in one animal can be transferred to another by injecting it with serum from the first.
1. **Passive immunization-** In which preformed antibodies are transferred to a recipient
    - A. It occurs **naturally** by transfer of maternal antibodies across the placenta to the developing fetus.
      - Maternal antibodies to diphtheria, tetanus, streptococci, rubeola, rubella, mumps, and poliovirus all afford passively acquired protection to the developing fetus.
      - Maternal antibodies present in colostrum and milk also provide passive immunity to the infant

B. Passive immunization can also be achieved **artificially** by injecting a recipient with preformed antibodies.

- Passive immunization provided a major defense against various infectious diseases in past days.

### Conditions that warrant the use of passive immunization-

1. Deficiency in synthesis of antibody as a result of Congenital or acquired B-cell defects, alone or together with other immunodeficiency.
2. Exposure or likely exposure to a disease that will cause complications (e.g., a child with leukemia exposed to varicella or measles), or when time does not permit adequate protection by active immunization.

3. Infection by pathogens whose effects may be ameliorated by antibody. For example, if individuals who have not received up-to-date active immunization against tetanus suffer a puncture wound, they are given an injection of horse antiserum to tetanus toxin. The preformed horse antibody neutralizes any tetanus toxin produced by *Clostridium tetani* in the wound.
- Conditions when use Passive immunization-Botulism, tetanus, diphtheria, hepatitis, measles, and rabies, as well agisnt poisonous snake and insect bites.
  - To travelers or health-care workers who will soon be exposed to an infectious organism and lack active immunity to it .
  - Passive immunization does not activate the immune system, it generates no memory response and the protection provided is transient.

- For certain diseases such as the acute respiratory failure in children caused by respiratory syncytial virus (RSV), passive immunization is the best preventative currently available.

### Risk associated with passive immunization-

1. The recipient can mount a strong response to the isotypic determinants of the foreign antibody, which cause serious complications. immunization- If the antibody was produced in another species, such as a horse.
2. Some individuals, for example produce IgE antibody specific for determinants on the injected antibody. Immune complexes of this IgE bound to the passively administered antibody can mediate systemic mast cell degranulation, leading to systemic anaphylaxis.
3. Some produce IgG or IgM antibodies specific for the foreign antibody, which form complement-activating immune complexes. The deposition of these complexes in the tissues can lead to type III hypersensitive reactions.

# B. Active Immunization

- The goal of active immunization is to elicit protective immunity and immunologic memory.
- A successful active immunization elicits a heightened immune response after subsequent exposure to the pathogenic agent which help to eliminates the pathogen or prevents disease mediated by its products.

Active immunization can be achieved by

A. Natural infection with a microorganism,

B. Acquired artificially by administration of a **vaccine**.

- In active immunization, the immune system plays an active role—proliferation of antigen-reactive T and B cells results in the formation of memory cells.

- Vaccination of children is begun at about 2 months of age.
- The recommended program of childhood immunizations by the American Academy of Pediatrics, includes the following vaccines:
  - Hepatitis B vaccine
  - Diphtheria-pertussis (acellular)-tetanus (DPaT) combined vaccine
  - Inactivated (Salk) polio vaccine (IPV); the oral (Sabin) (vaccine is no longer recommended for use in the United States)
  - Measles-mumps-rubella (MMR) combined vaccine
  - *Haemophilus influenzae (Hib) vaccine*
  - Varicella zoster (Var) vaccine for chickenpox
  - Pneumococcal conjugate vaccine (PCV); a new addition to the list.
- In addition, hepatitis A vaccine at 18 months and influenza vaccines after 6 months are recommended for infants in high-risk populations.



- Children typically require multiple boosters (repeated inoculations) at appropriately timed intervals to achieve effective immunity. In the first months of life, the reason for this may be persistence of circulating maternal antibodies in the young infant.
- For example, passively acquired maternal antibodies bind to epitopes on the DPT vaccine and block adequate activation of the immune system; therefore, this vaccine must be given several times after the maternal antibody has been cleared from an infant's circulation in order to achieve adequate immunity.
- Passively acquired maternal antibody also interferes with the effectiveness of the measles vaccine; for this reason, the MMR vaccine is not given before 12–15 months of age.

- Polio vaccine are Multiple immunizations to ensure that an adequate immune response is generated to each of the three strains of poliovirus that make up the vaccine.
- Recommendations for vaccination of adults depend on the risk group. Vaccines for meningitis, pneumonia, and influenza are often given to groups living in close quarters (e.g., military recruits) or to individuals with reduced immunity (e.g., the elderly).
- Vaccination is not 100% effective. With any vaccine, a small percentage of recipients will respond poorly and therefore will not be adequately protected.
- This is not a serious problem if the majority of the population is immune to an infectious agent. In this case, the chance of a susceptible individual contacting an infected individual is so low that the susceptible one is not likely to become infected. This phenomenon is known as *herd immunity*.

**Herd immunity-** It is the indirect protection from a contagious infectious disease that happens when a population is immune either through vaccination or immunity developed through previous infection.

- This means that even people who are not vaccinated, or in whom the vaccine doesn't trigger immunity, are protected because people around them who are immune can act as buffers between them and an infected person.
- Once herd immunity has been established for a while, and the ability of the disease to spread is hindered, the disease can eventually be eliminated.