

Adaptive (Acquired) Immunity

Adaptive immunity is also called acquired immunity, since the potency of immune response is acquired by experience only.

Differences between innate and acquired immunity

Feature	Innate immunity	Acquired immunity
Definition	The resistance to infection that an individual possesses by virtue of genetic and constitutional makeup	The resistance that an individual acquires during life
Time taken to develop	Hours	Days
Specificity	Nonspecific	specific
Memory	No	Yes
Components Physical and chemical barriers	Skin, mucosal epithelia, and antimicrobial chemicals	Lymphocytes in epithelia and antibodies secreted at epithelial surfaces
Cells	Phagocytes (macrophages and neutrophils) and natural killer cells	Lymphocytes

Types of acquired immunity

Acquired immunity against a microbe may be induced by the host's response to the microbe or by transfer of antibodies or lymphocytes specific for the microbes. It is of two types: active immunity and passive immunity.

1- Active immunity

The immunity induced by exposure to a foreign antigen is called **active immunity**. Active immunity is the resistance developed by an individual after contact with foreign antigens, e.g., microorganisms. This contact may be in the form of:

- clinical or subclinical infection,
- immunization with live or killed infectious agents or their antigens, or
- exposure to microbial products, such as toxins and toxoids.

In all these circumstances, the immune system of the host is stimulated to elicit an immune response consisting of antibodies and activated helper T (TH) cells and cytotoxic T lymphocytes/ cells (CTLs).

The active immunity is of two types: natural active immunity and artificial active immunity.

■ **Natural active immunity:** It is acquired by natural clinical or subclinical infections. Such natural immunity is long lasting. For example, individuals suffering from smallpox become immune to second attack of the disease.

■ **Artificial active immunity:** It is induced in individuals by vaccines. There is a wide range of vaccines available against many microbial pathogens. These may be live vaccines, killed vaccines, or vaccines containing bacterial products.

Mediators of active immunity: Active immunity is mediated by humoral immunity and cell-mediated immunity. These two types of immunities are mediated by different components of the immune system and function in different ways to kill different types of pathogens.

■ **Humoral immunity:** It is mediated by molecules in the blood and mucosal secretions called antibodies. The antibodies are secreted by a subset of lymphocytes known as B cells. The antibodies recognize microbial antigens, combine specifically with the antigens, neutralize the infectivity of microbes, and target microbes for elimination by various effector mechanisms. Humoral immunity is the principal defense mechanism against extracellular microbes.

■ **Cell-mediated immunity:** It is mediated by both activated TH cells and CTLs. Cytokines secreted by TH cells activate various phagocytic cells, enabling them to phagocytose and kill microorganisms. This type of cell-mediated immune response is especially important against a host of bacterial and protozoal pathogens. CTLs play an important role in killing virus-infected cells and tumor cells. They act by killing altered self-cells.

Differences between humoral and cell-mediated immunity.

Cell-mediated immunity	Humoral immunity
Immune response mediated by cells	Immune response mediated by antibodies
Protects against fungi, viruses, and facultative intracellular bacterial pathogens	Protects against extracellular bacterial pathogens and viruses infecting respiratory or intestinal tract; and prevents recurrence of viral infections
Mediates delayed (type IV) hypersensitivity	Mediates immediate (types I, II, and III) hypersensitivity
Only T-cell-dependent antigens lead to cell mediated immunity	B cells directly bind soluble antigens resulting in production of antibodies
Both CD4_ and CD8_ T cells are involved	Only TH cells are involved
Provides immunological surveillance and immunity against cancer	No major role in immunological surveillance
Participates in rejection of homografts and graftversus-host reaction	May be involved in early graft rejection due to preformed antibodies

Passive immunity

When immunity is conferred by transfer of serum or lymphocytes from a specifically immunized individual, it is known as **passive immunity**. This is a useful method for conferring resistance rapidly, i.e., without waiting for the development of an active immune response. Passive immunity may be natural or artificial.

Natural passive immunity: It is observed when IgG is passed from mother to fetus during pregnancy. This forms the basis of prevention of neonatal tetanus in neonates by active immunization of pregnant mothers. It is achieved by administering tetanus toxoid to pregnant mothers during the last trimester of pregnancy. This induces production of high level of antibodies in mother against tetanus toxin, which are subsequently transmitted from mother to fetus through placenta. The antibodies subsequently protect neonates after birth against the risk of tetanus. Natural passive immunity is also observed by passage of IgA from mother to newborn during breast feeding.

Artificial passive immunity: It is induced in an individual by administration of preformed antibodies, generally in the form of antiserum, raised against an infecting agent. Administration of these antisera makes large amounts of antibodies available in the recipient host to neutralize the action of toxins.

The preformed antibodies against rabies and hepatitis A and B viruses, etc. given during incubation period prevent replication of virus, and hence alter the course of infection. Immediate availability of large amount of antibodies is the main advantage of passive immunity. However, short lifespan of these antibodies and the possibility of hypersensitivity reaction, if antibodies prepared in other animal species are given to individuals who are hypersensitive to these animal globulins (e.g., serum sickness), are the two noted disadvantages of passive immunity.

Passive immunity	Active immunity
No active host participation; received passively	Produced actively by host's immune system
Antibodies transferred directly	Antibodies induced by infection or by immunogens
Passive immunity is due to readymade antibodies	Active immunity often involves both the cell-mediated and humoral immunity
Types: Natural—transfer of maternal antibodies through placenta; Artificial—injection of immunoglobulins	Types: Natural—clinical or inapparent infection; Artificial—induced by vaccines
Immediate immunity; no lag period	Immunity effective only after lag period
less effective	effective protection
No immunological memory	Immunological memory present