Immunology: Types of Immunity

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The Specific Immune System is the Third Line of Defense Against Infection

<table>
<thead>
<tr>
<th>Nonspecific Defense Mechanisms</th>
<th>Specific Defense Mechanisms (Immune System)</th>
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</thead>
<tbody>
<tr>
<td>First line of defense</td>
<td>Third line of defense</td>
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<tr>
<td>• Skin</td>
<td>• Lymphocytes</td>
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<tr>
<td>• Mucous membranes</td>
<td>• Antibodies</td>
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<tr>
<td>• Secretions of skin and mucous membranes</td>
<td>• Phagocytic white blood cells</td>
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<td></td>
<td>• Antimicrobial proteins</td>
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<td>• The inflammatory response</td>
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Immunity

Non specific\ Innate\ Non adaptive\ natural immunity

1. First and some times second line of defense.
2. Immunity an organism is born with.
3. Genetically determined.
4. No enhancement by repetition

Acquired\ Adaptive \ Specific Immunity

1. Third and some times second line of defense.
2. Immunity that an organism develops during lifetime.
3. Not genetically determined.
4. May be acquired naturally or artificially
5. Get enhanced by repetition
Acquired Immunity

Humoral Immunity
- Active Immunity
  - Naturally Acquired
  - Artificially Acquired

Cell Mediated Immunity
- Passive Immunity
  - Naturally Acquired
  - Artificially Acquired
Immunity

Innate immunity (Specific defence)
- First line defence
  - Physical barriers (skin and mucus membranes)
  - Chemical barriers (Antimicrobial, Substances in body fluids such as saliva, mucus, tears and gastric juices)

Acquired immunity (Nonspecific defence)
- Second line of defence
  - Cellular defences
    - Phagocytes
    - Neutrophils
    - Basophils
    - Eosinophils
    - Macrophages
  - Blood and lymph systems
  - Molecular defence
    - Death of dangerous microorganisms
      - Lymphocytes third line of defense
        - B-cells (humoral immunity): Cells produce antibodies to fight foreign microorganisms
        - T-cells (Cell mediated immunity)
Acquired Immunity
Immunity you develop during your life

Active Immunity
Immunity you develop after being exposed to an infection or from getting a vaccine

Passive Immunity
Immunity you acquire from someone or something else

Natural
Antibodies made after exposure to an infection

Artificial
Antibodies made after getting a vaccination

Natural
Antibodies transmitted from mother to baby (e.g., via mother's milk)

Artificial
Antibodies acquired from an immune serum medicine
<table>
<thead>
<tr>
<th>ACTIVE IMMUNITY</th>
<th>PASSIVE IMMUNITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural</strong></td>
<td><strong>Natural</strong></td>
</tr>
<tr>
<td>Infection</td>
<td>Maternal antibodies</td>
</tr>
<tr>
<td><strong>Artificial</strong></td>
<td><strong>Artificial</strong></td>
</tr>
<tr>
<td>Vaccination</td>
<td>Monoclonal antibodies</td>
</tr>
</tbody>
</table>
Immunity

Natural active:
- Antibodies remain in case of reinfection
- Immune system learns to fight pathogen
- Pathogen enters body
- Breastmilk

Natural passive:
- Antibodies passed from mother to child
- Across placenta

Artificial active:
- Vaccination
- Pathogen injected into body
- No exposure to pathogen

Artificial passive:
- Immunisation
- Give the body the appropriate antibodies
I. Naturally Acquired Immunity: Obtained in the course of daily life.

A. Naturally Acquired Active Immunity:

- *Antigens* or pathogens enter body naturally.
- Body generates an immune response to antigens.
- Immunity may be lifelong (chickenpox or mumps) or temporary (influenza or intestinal infections).
NATURAL ACTIVE IMMUNITY

- May be as a result of clinical or inapparent infection
- Measles infection gives the patient life long immunity
- Adults in developing countries have natural active immunity against polio because of inapparent infections in childhood
- Duration of immunity depends on the pathogen
  - Short term – Eg. Influenza
  - Long term – Eg. Measles, chicken pox
B. Naturally Acquired Passive Immunity:

- *Antibodies* pass from mother to fetus via placenta or breast feeding (colostrum).
- No immune response to antigens.
- Immunity is usually short-lived (weeks to months).
- Protection until child’s immune system develops.
II. Artificially Acquired Immunity: Obtained by receiving a vaccine or immune serum.

1. Artificially Acquired Active Immunity:

- **Antigens** are introduced in vaccines (immunization).
- Body generates an immune response to antigens.
- Immunity can be lifelong (oral polio vaccine) or temporary (tetanus toxoid).
2. Artificially Acquired Passive Immunity:

- Preformed *antibodies* (*antiserum*) are introduced into body by injection.
  
  - Snake antivenom injection from horses or rabbits.
  
- Immunity is short lived (half life three weeks).

- Host immune system does not respond to antigens.
### Natural

- **Active**
  - Active natural—contract disease and produce memory cells
- **Passive**
  - Passive natural—receive maternal antibodies through placenta or breast milk

### Artificial

- **Active**
  - Active artificial—receive a vaccination and produce memory cells
- **Passive**
  - Passive artificial—receive antiserum with antibodies from another host
PASSIVE IMMUNITY

- No infection
- Readymade antibodies are administered
- No latent period
- No negative phase
- Immediate protection
**Acquired immunity**

Acquired or adaptive immunity is the immunity that is developed by the host in its body after exposure to suitable antigen or after transfer of antibodies or lymphocyte from an immune donor.

**Characteristics of Acquired Immunity**

1. Antigenic Specificity
2. Diversity
3. Immunologic memory
4. Self/non-self recognition
Difference between Innate and Adaptive Immunity

Innate Immunity
- Dendritic cell
- Mast cell
- Macrophage
- Natural killer cell
- Complement protein
- Eosinophil
- Neutrophil
- Granulocytes

Adaptive Immunity
- B cell
- Antibodies
- CD4+ T cell
- CD8+ T cell

VS

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<table>
<thead>
<tr>
<th><strong>Innate memory</strong></th>
<th><strong>Adaptive memory</strong></th>
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</thead>
<tbody>
<tr>
<td>Effector molecules</td>
<td>Cytokines</td>
</tr>
<tr>
<td>Mechanisms</td>
<td>Epigenetic changes (e.g., DNA methylation, histone acetylation)</td>
</tr>
<tr>
<td>Type of response</td>
<td>Rapid (same as primary response), either enhanced (“trained memory”) or reduced (“tolerance”)</td>
</tr>
<tr>
<td>Specificity</td>
<td>Triggered by any molecule or stressful event (e.g., molecules shared by groups of related microbes or produced by damaged host cells, metabolic compounds, pollutants, etc.), upon a second exposure to the same or different agent/event</td>
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<tr>
<td>Feature</td>
<td>Innate immunity</td>
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<tr>
<td>Definition</td>
<td>The resistance to infection that an individual possesses by virtue of genetic and constitutional makeup</td>
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<tr>
<td>Types</td>
<td>Nonspecific and specific</td>
</tr>
<tr>
<td>Time taken to develop</td>
<td>Hours</td>
</tr>
<tr>
<td>Specificity</td>
<td>For structures shared by groups of related microbes</td>
</tr>
<tr>
<td>Memory</td>
<td>None; repeated exposure brings response like primary response</td>
</tr>
<tr>
<td>Components</td>
<td>Skin, mucosal epithelia, and antimicrobial chemicals</td>
</tr>
<tr>
<td>Physical and chemical barriers</td>
<td>Complement; leukins from leukocytes, plakins from platelets, lactic acid found in muscle tissue, lactoperoxidase in milk, and interferons (antiviral)</td>
</tr>
<tr>
<td>Blood and tissue antimicrobial substances</td>
<td>Phagocytes (macrophages and neutrophils) and natural killer cells</td>
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