IMMUNE RESPONSE TO INFECTIOUS DISEASES
Immune Response to Bacterial Infection
Characteristics of Bacteria

① X
② X
③ X
④ X
⑤ X
⑥ X
⑦ X
Bacterial Diseases

Any part of the body can be infected by many Infectious agents and many bacterial diseases and causing a disease due to:

① Growth of the microbe in a tissue
② Produce Bacterial factors that are harmful to host
③ Elicite an inflammatory response that causes damage

But also leads to acquired immunity
Steps of Bacterial Infection

① Attachment of bacterium to host tissue

- Persistence and growth called colonization
Steps of Bacterial Infection 2

② Invasion into deeper host tissues and production of toxins and leads to injury to host cell and tissue
Steps of Bacterial Infection 3

③ Inflammation at site of invasion

• Initiated by antibody binding to bacterium
• Initiated by complement activation at bacterial surface
• Initiated by wound healing mechanisms
• All can activate complement pathways that alters vascular permeability and activates local macrophage and neutrophils (PMNs)
Inflammation at site of invasion

- Antibody binding to bacteria and toxin
- Complement activation
- Anaphylatoxins
- Lysis of injured cells
- Kinin system
- Plasmin system
- Complement activation
- Anaphylatoxins
- PMN
Immunity to bacteria

The defence mechanisms used depend on:-

- Site of infection
- Structure of the invading bacteria
- How they cause damage
- Intracellular vs. extracellular location
How Can Bacteria Cause Damage?

- **Toxin production**
  - Clostridium tetani

- **Tissue invasion**
  - Mycobacteria

- **Both**
  - Most bacteria
Immunity to bacteria

• Innate and adaptive immune systems work together.

• In general, the innate response is important in preventing an infection becoming established, the adaptive subsequently in combating an established infection.
Innate immune system can recognise and respond to common bacterial components

① X
② X
③ X
④ X
⑤ X
⑥ X
⑦ X
Table 18.1 Innate immune effectors mediating resistance to bacterial infection

<table>
<thead>
<tr>
<th>Type of mechanism and examples</th>
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<tbody>
<tr>
<td><strong>Physical and physiologic barriers</strong></td>
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<tr>
<td>Skin, sebum, mucosal epithelial cells, mucus, and mucous flow</td>
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<tr>
<td><strong>Enzymatic and protein effectors</strong></td>
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<tr>
<td>Lysozyme, proteases, antimicrobial peptides, iron-sequestering</td>
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<tr>
<td>proteins, complement</td>
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<tr>
<td><strong>Recognition of PAMP</strong></td>
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<tr>
<td>TLRs</td>
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<tr>
<td>TLR2 and peptidoglycan and glycopeptides</td>
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<tr>
<td>TLR4 and LPS</td>
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<tr>
<td>TLR5 and bacterial flagella</td>
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<tr>
<td>TLR9 and CpG DNA</td>
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<tr>
<td><strong>Endocytic pattern recognition molecules</strong></td>
</tr>
<tr>
<td>Mannose receptor/scavenger protein</td>
</tr>
<tr>
<td>CR3</td>
</tr>
<tr>
<td><strong>Soluble collectins</strong></td>
</tr>
<tr>
<td>Conglutinin</td>
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<tr>
<td>Mannose-binding lectin</td>
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<tr>
<td>Surfactant proteins A and D</td>
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# Adaptive Immunity:

## I. Antibody mediated response

<table>
<thead>
<tr>
<th>Action</th>
<th>How</th>
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<tbody>
<tr>
<td>Block adhesion</td>
<td>Ab to surface proteins</td>
</tr>
<tr>
<td>Block proliferation</td>
<td>Ab to surface receptors eg. iron</td>
</tr>
<tr>
<td>Cause phagocytosis</td>
<td>Bind bacterial surface and allow phagocytes to bind bacteria</td>
</tr>
<tr>
<td>Lysis, phagocytosis and inflammation</td>
<td>Activate complement</td>
</tr>
<tr>
<td>Neutralise toxic products</td>
<td>Bind toxins</td>
</tr>
<tr>
<td>Prevent tissue invasion and damage</td>
<td>Neutralise bacterial products and proteases</td>
</tr>
</tbody>
</table>
Immunity to extracellular bacteria by antibodies:
Immunity to extracellular bacteria by antibodies:

① Antibodies and complement result in opsonisation via FcR or CR on MØ and PMN.

② Antibody can activate classical complement pathway resulting MAC formation and opsonisation.

③ Antibodies can also trigger antibody-dependent cell mediated cytotoxicity (ADCC) by PMN with FcR and CR and that leads to release proteases, nucleases, lipases.
Mechanisms of Immunity to intracellular bacteria by CMI
II. Cell mediated immunity vs intracellular bacteria

1. CD8+ T cells (Tc) cytotoxic T lymphocytes (CTLs).
2. CD4+ helper T cells ($T_{H1}$).
3. NK cells using ADCC
Do T Lymphocytes Have a Role in the Response to Bacteria?

1. **T cytotoxic lymphocytes** can kill infected cells (intracellular pathogens eg Mycobacterium tuberculosis)

2. **T helper cells** produce cytokines or interleukins
   
   A. more **antibody production**
   
   B. **Interferon γ** activates macrophages and increases bacterial killing, increases production of IgG used by phagocytes, increases cytotoxicity and CD8 T cell activity
How bacteria evade Host Immunity?

① Avoiding antibody
② Prevent phagocytosis
③ Avoiding complement
④ Down-regulate the expression of MHC-I and MHC-II.
⑤ Impede the function of lymphocytes and granulocytes (toxin, enzyme and proteins).
⑥ Overstimulate inflammation