INFECTION

(CHAPTER 13)

QUESTION 1

Are the numbers of deaths worldwide from infection significant? What percentage of deaths do they represent?

Yes. Mortality from communicable disease has accounted for as much as **1 in 3** deaths as recently as 1990.

This number continues to fall with new advances in medicine and increased access to healthcare in developing countries, reaching 25% by 2010 and now closer to 20%.

QUESTION 2

Why are communicable diseases such a prominent cause of death?

Strains of infectious disease are **constantly evolving**: new disease emerge, old diseases evolve and recur in new forms, existing treatments become ineffective as pathogens adapt to resist them.

QUESTION 3

Define mechanism of action, infectivity, pathogenicity, virulence, immunogenicity, toxigenicity, and portal of entry.

mechanism of action – **how** does the pathogen cause damage to the body?

(What disease process is involved?)

infectivity – ability of a pathogen to **invade** a host—related to transmissibility

(How easy or hard is it to catch the disease?)

pathogenicity – whether an infectious agent is capable of causing disease in a host

(Is it a **pathogen** or not?)

virulence – a quantitative measure of **how much damage** a pathogen is capable of doing to the host

(Does it cause mild disease or serious, potentially fatal problems?)

immunogenicity – the ability of a substance to induce an **immune response** in the host

(Does the body respond to the presence of the foreign material?)

toxigenicity – ability to **produce substances** which damage the body (endotoxins or exotoxins)

(Does the pathogen cause harm by producing **toxins**?)

portal of entry – the **route** that is used to enter the body from the environment

(How does the pathogen **get into** the body? Inhaled, GI tract, through the skin?)

QUESTION 4

Describe some of the defensive mechanisms of pathogens.

- Formation of a protein "S-layer" in many types of bacteria to protect against phagocytosis
- Antigenic drift in viruses, the gradual accumulation of mutations to the surface antigens that inhibit immune response
- Antigenic shift, "donation" of DNA from one virus to another, resulting in quick, drastic changes

QUESTION 5

Describe the classes of microorganism.

bacteria – single-celled prokaryotes

fungi – yeasts and molds

helminths – multicellular "worms," e.g. flatworm, tapeworm, etc.

protozoa – single-celled eukaryotes including amoebae

viruses – non-living, organic intracellular parasites

QUESTION 6

How is iron involved in the concept of infection?

Iron is used in the synthesis of many crucial proteins used by **bacteria**.

Bacteria produce compounds called **siderophores** that help absorb iron across the cell membrane, where it is used in the synthesis of many enzymes and other proteins—DNA transcription, ATP production, etc.

QUESTION 7

Compare exotoxins with endotoxins.

Exotoxins are injurious substances actively **secreted** by bacteria.

Examples include botulinum toxin (produced by Clostridium botulinum) and tetanospasmin/tetanolysin (produced by Clostridium tetani.)

Endotoxins are injurious substances present on the **cell membrane** of Gram-negative bacteria that are not released until the bacterium dies.

QUESTION 8

Describe septicemia.

Septicemia refers specifically to an **infection of the blood** (usually bacterial,) as opposed to solid tissues.

Related to the concept of **sepsis**, a systemic inflammatory response due to widespread infection which can be life-threatening, especially if it progresses to **septic shock**.

QUESTION 9

How does the body respond to bacterial infection?

Cytokines (tiny signaling proteins) produced by the immune system help direct neutrophils towards the site of infection, where they release granules to attack the invading bacteria. Neutrophils and macrophages then attempt to phagocytose (envelop) the bacteria to prevent the infection from spreading.

Antibodies attach onto surface antigens on the exterior of the pathogen, "marking" it as a target for the immune system.

The **complement system**, a complex series of enzyme reactions that contribute to the immune response, is also triggered by antibodies binding to an infectious agent. This system leads to inflammation and the stimulation of phagocytes.

QUESTION 10

What term refers to disease caused by fungal infection?
What is the most common fungal disease?

The general term for any type of fungal infection is **mycosis**.

The most common type of mycosis is **candidiasis**, caused by the fungi of the genus Candida (most commonly C. albicans.)

QUESTION 11

Describe parasitic infections. What is the most common infection worldwide?

Three main types of parasite: **protozoa**, **helminths**, and **ectoparasites**

- **protozoa** – single-cell eukaryotes (more "advanced" than bacteria,) e.g. amoebae
- **helminths** – "worms," e.g. flatworm, tapeworm, etc.
- **ectoparasites** – parasites that live outside the body, e.g. ticks, fleas

The most common type of infection worldwide is the parasitic infection **malaria**, caused by protozoa of the genus **Plasmodium**.

Malaria can be caused by any of five species of protozoa, but **P. falciparum** is responsible for most deaths due to malaria.

QUESTION 12

Describe the structure of a virus.

A **virion** (virus particle) is a tiny intracellular parasite—not technically "alive," but do contain RNA or DNA that code for the proteins used to contruct additional virions.

Their genetic material is contained in a protective protein shell known as a **capsid**. The specific structure varies; some viruses have a protective lipid bilayer, others do not.

QUESTION 13

List some common viral diseases.

- Common cold
- Influenza
- Varicella-zoster virus (chicken pox/shingles)
- Herpes simplex virus (HSV)
- Viral hepatitis (Hep A–E)
- Human immunodeficiency virus (HIV)

QUESTION 14

Describe the life cycle of a virus. Describe some cellular effects of viruses.

Viruses have no way of reproducing on their own and **must** rely on host cells to proliferate.

The virus first attaches itself to the membrane of the host cell, and is either **absorbed** or **injects** its genetic material into the host.

This genetic material is integrated with the host DNA and results in the host cell producing large numbers of identical virions.

Once viral replication reaches a critical level, the host cell **sheds** the new virus particles, usually through either budding or apoptosis.

QUESTION 15

What are the consequences of HIV infection when it progresses to AIDS?

Human immunodeficiency virus (HIV) is the pathogen responsible for acquired immunodeficiency syndrome (AIDS,) but infection with HIV **does not** imply that a person suffers from AIDS.

Rather, AIDS is a **progression** of HIV infection if not adequately treated or if treatment is unsuccessful, such as with drug-resistant strains or in patients who are already immunocompromised.

HIV is particularly dangerous because it preys on the cells of the immune system, reproducing and crippling the immune system simultaneously and making it difficult for the body to fight back.

Disease progression is monitored through tracking **CD4 count**, or the number of T-helper cells in the blood. AIDS occurs when the CD4 count reaches **dangerously low** levels (<200 cells/mm^3.)

When the CD4 cells are depleted, the body is unable to fight off other infections, and opportunistic infection may occur which can be life-threatening.

With new treatment strategies such as antiretroviral therapy, AIDS-related mortality in HIV patients has declined by about 40% since 2010.

QUESTION 16

Describe some countermeasures against pathogens.

Incidence of many infections can be prevented through **vaccination**, which result in acquired immunity to a particular pathogen.

Pharmacological treatment after infection begins depends on the pathogen: antibiotics, antiviral drugs, antifungal drugs, etc.