# MICROBIOLOGY

**Stages of Disease**

Clinical disease = signs and symptoms

Non clinical: 1. preclinical = not yet apparent but will become clinical disease (relating to the period of a disease before the appearance of symptoms)
2. subclinical = Without clinical signs or symptoms (Not manifesting characteristic clinical symptoms). Sometimes used to describe the early stage of a disease or condition, before symptoms are detectable by clinical examination or laboratory tests. (diagnosis is by antibody response)
3. persistent (chronic) = cannot 'shake off', persists for years or life
4. latent disease = infection with no active multiplying of agent only genetic message present, not viable organism. (Describes a condition that is present but not active or causing symptoms)

**Carrier status**

Individual harbours organism
Not infected (no evidence of antibody response or clinical illness)
Can infect others
Time: may be limiter or chronic
Typhoid Mary (salmonella typhi) Cook in New York, responsible for 10 outbreaks of typhoid fever

**Pathogen**
An organism that can invade the body and cause disease. [Organisms can be colonizers or pathogens. The human body is colonized on the skin and mucosal surfaces with numerous micro organisms that form the normal flora of the body. These organisms provide benefit to the host by competing with potential pathogens for attachment sites and nutrients and by producing antimicrobial substances toxic to pathogens.]

**Infection**
A disease caused by a pathogen. Associated with tissue damage.

**Communicable Disease**
An infection that is capable of spreading from person to person. Not all infections are communicable.

**Pathogenicity**
Ability to cause disease.

**Virulence**
A pathogen's power to cause severe disease. (pathogenicity and virulence are not necessarily related).

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**Infectious agents**
Bacteria
Yeasts & Fungi
Protozoa
Viruses – strand of nucleic acid (DNA or RNA) that contains genetic instructions concerning viral reproduction enveloped by protein coat

- RNA virus (has RNA as its genetic material, e.g. retrovirus, SARS and has a high mutation rate as they lack DNA polymerases which can find and edit out mistakes)
- DNA virus (a virus whose nucleic acid core is composed by DAN, such as poxviruses, herpes viruses

Helminths – worms
Prions – causative agents of several infectious diseases, contain no nucleic acid (i.e. DNA/RNA)
[parasite – an organism that lives on or in another organism, deriving benefit from it but providing nothing in return]

**Reservoir of infection** – the habitat of the infectious agent (may be humans, e.g. measles or environment, e.g. legionella) or animals, e.g. cryptosporidium)
**Source of infection –** may be reservoir or may be a vehicle, e.g. food
**Mode of transmission** – the method by which infection spreads

**Incubation –** interval from receipt of infection to the time of onset of clinical illness. Influenced by the time needed to replicate; site; dose of agent at time of infection. No precise period but a range of periods.
Incubation period refers to the time elapsed between infection and the onset of symptoms. Each organism has a characteristic incubation period, although this can vary somewhat depending upon the status of the host – e.g. age and susceptibility.

**Attack rate**
Proportion of the population at risk that fell ill during an outbreak

$$\text{–}\ \frac{\text{number of people at risk in whom illness develops}}{\text{Total number of people at risk}}$$

Similar to incidence rate.
Food specific attack rate – $\frac{\text{No of people who ate certain food and ill}}{\text{Total people who ate certain food}}$
**Primary case –** acquired disease from exposure
**Secondary case** – acquired disease from primary case
**Secondary attack rate** – attack rate in susceptible persons exposed to primary case

**Host defences – we talk about**

1. **Immunity & Susceptibility**
2. **Herd immunity**
   The resistance of a group to an attack by a disease to which a large proportion of the members of the group are immune. If large % of pop immune, their entire pop

is protected. This is because as a disease can't find a 'susceptible' person. Immunisation programmes can be successful despite not having 100% immunisation rates. % varies from disease to disease (measles = 94%)

3. **Community immunity:**
   A concept of protecting a community against certain diseases by having a high percentage of the community's population immunized. (Sometimes referred to as "herd" immunity). Even if a few members of the community are unable to be immunized, the entire community will be indirectly protected because the disease has little opportunity for an outbreak. However, with a low percentage of population immunity, the disease would have great opportunity for an outbreak.

Examples of the key role of community immunity include being vaccinated with Hepatitis B, Diphtheria, Acellular Pertussis, *Haemophilus Influenzae* type b, Inactivated Polio, Pneumococcal Conjugate, Measles, Mumps, Rubella, Varicella, and Hepatitis A because these are diseases that can spread through person-to-person transmission. Tetanus, on the other hand, cannot be spread through person-to-person transmission. It is transmitted through skin wounds. For example, if a person steps on a nail or sustains some kind of penetrating injury from something that has been contaminated with Tetanus spores, there is significant risk for a life-threatening Tetanus infection. The level of community immunity would have no impact on this risk.

**Factors influencing microbial growth and survival**

- Cleaning – When we talk about cleaning environment, we are referring to they physical removal of dirt that harbours germs. This is usually with water and detergent. Cleaning does not destroy germs but it can reduce their numbers a hundred or thousand-fold. To further reduce the level of germs, you need to disinfect the surfaces. This is done with chemicals (such as bleach).
- Antisepsis
- Antibiotics
- Sanitisation
- Disinfection
- Sterilisation

**Two groups of antibiotics**

1. Bacterisiatic
   - Broad spectrum
   - Gram positive & gram negative bactiera equally
   - sensitive
   - Stops growth of bacteria
   - E.g. tetracycline
2. Bactericidal
   - Narrow spectrum
   - Gram positive bacteria are very sensitive
   - Gram negative bacteria – intrinsic resistance (outer membrane of gram negative bacteria prevents penicillin uptake)

- Kills bacteria
- E.g. penicillin

An **antibody** is a protein used by the immune system to identify and neutralize foreign objects like bacteria and viruses. Each antibody recognizes a specific antigen unique to its target. The production of antibodies is called the humoral immune system. Immunoglobulins are glycoproteins in the immunoglobulin superfamily that function as antibodies. The terms *antibody* and *immunoglobulin* are often used interchangeably. They are found in the blood and tissue fluids, as well as many secretions. According to differences in their heavy chain constant domains, immunoglobulins are grouped into five classes, or isotypes: *IgG*, *IgA*, *IgM*, *IgD*, and *IgE*. An **antigen** is a substance that stimulates an immune response, especially the production of anitbodies.

Resistance mechanism of bacteria to antibiotics:

- Mutate to become resistant to antibiotics-penicillin (many bacteria produce B-lactamase, which attacks penicillin structure)
- Mutate to become resistant to tetracycline – drug specific efflux pump (pumps tetracycline out again)
- Extrachromosomal DNA (a cell that is drug resistant can send –i.e. transfer by conjugation - its resistance to a cell that is sensitive to antibiotics)

**Microbiological Tests for Meningitis**

- Antibiotics can affect outcome of blood tests (usually given before tests taken)
- Typically 48 hours needed for blood test results
- CSF (spinal fluid) can't be done if intercranium pressure is present. If CSF is done, gram stain results can be back within an hour. CSF is putb into a broth, allowed to grow and then put on an agar plate.
- Gram stain tells you if bacteria are present, what strain they are. Gram positive (purple under microscope) and gram negative (pink under microscope). Helps determine what antibiotic group to use (different antibiotics for gram positive than for gram negative)
- Haemophilus type B can be a nasty and is common in under 4 year olds. It causes meningitis. It's a thin gram-negative rod. One dose of rifampicin for 4 days. Like meningococcal disease, intervention with antibiotics can prevent secondary cases.
- Meningococcal is gram negative bean shaped, occurs in pairs. Group B tends to be clusters, group C tends to be colonial.

**Microbiological Tests for Enteric Infections**

- Dysentry – blood & mucous in stools, means inflammation of the gut. Causes: shigella dysenterae (bacteria) & entomobea histolytica (parasite)
- Ecoli EO157 – lives in guts of animals and causes a range of infections. A particular sero subtype (O antigen) which causes diarrhoea and releases shigella toxin which can lead to hemolitic urenemic syndrome (HUS). [This means that

red blood cells breakdown and there is renal failure]. In the UK, HUS usually = EO157. If someone (particularly elderly and children) presents with HUS, the Ecoli 0157 has done its damage. Don't isolate the ecoli from the stools, find out immediately where they would have got Ecoli. Look at one week, if nothing comes up go back 2 weeks. When did they first get diarrhoea? When did they first get blood in the stools? Ecoli picked up form contaminated environment, food (like uncooked burgers), unpasturised fruit juices and milk, pets. In UK, Ecoli most likely from farms. In USA, Ecoli is most likely from food. Ask if they have been to a farm, countryside, garden centre, pet zoo etc. Environmental health officers have legal rights to enter the premises so get them involved at an early stage. Ask microbiologist is it a proper identification of Ecoli then follow national guidelines for single and clusters of ecoli (HPA website). Ecoli is a low infective dose (need only a few to infect). If a person is infected or suspected (close contact of ill person) and is a food handler, they must be excluded from work. Nursery children should be excluded from the nursery. Ecoli – incubation is usually 3 to 7 days and can be up to 14 days.

- Salmonella typhi and paratyphi – often not diarrhoea, always a fever, often classed as fever of unknown origin, fever won't go away, sometimes a cough, sometimes constipated. Pink spots on abdomen.
- Typhoid – low infective dose. Can be spread in water. Usually a sign of poor ares (where there are inadequate water cleaning processes). Associated with foreign developing countries. Carried in stools, passed faceo-oral route yet causes sisteric infection. Need 3 clear stools before returning to work (Get travel details).

**Microbiological Tests for Respiratory Infections**

- Legionella pneumophila – gram negative rod
- Wherever you find free-living amoeba, you'll get legionella but not all are disease carrying. Diseases in humans caused by legionella pneumophila. Single most important factor is smoking as it damages airways and allows the organism into the alveoli. Difficult to do tests. Need to get sputum from deep in the lung, like washings (aspirate) from the bronchus. Symptoms: persistent cough, pain in chest, confusion and doesn't respond to penicillin. Needs microcline antibiotics. Sources are things that generate a fine spray of water (showers, hot tubs, fountains etc). Where there is slime build up like hot tubs, bath spas, you'll get legionella pneumephilla. Need to descale and hyperchloridate. Keep water at appropriate temperatures – cold water, really cold and hot water really hot.