

# Unit title: **Infectious Diseases**

Unit code: **M/601/0231**

Level: **5**

Credit value: **15**

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## **Aim**

This unit provides an understanding of infection and disease and uses the dynamic relationship between micro-organism and host to examine infectious microbial strategies. Learners also develop skills in diagnostic techniques used to identify pathogens.

## **Unit abstract**

The ability to investigate and study the underlying cause, effect and treatment of infectious diseases is of utmost importance in the biomedical sciences industry in order to ensure the effective control of pandemic diseases. This unit introduces learners to the underlying principles of specimen collection and diagnostic microbiology.

Learners will examine the features of micro-organisms which contribute to microbial infection and infectious diseases in the human body. They will become familiar with diagnostic and microbiology techniques through carrying out a range of laboratory-based investigations.

This unit also enables learners to examine the host-parasite relationship and the nature of pathogenesis. Learners will have the opportunity to explore how micro-organisms can evade the immune response, the resulting damage that occurs to the body during disease processes, and how diseases spread throughout the population.

This unit gives learners opportunities to carry out scientific investigations in the laboratory, using scientific equipment and diagnostic techniques to examine specimens in order to accurately identify the virulence factors of a range of micro-organisms. Integral to scientific practical investigations is the need to work safely and accurately, adhering to laboratory safety guidelines and protocol.

## **Learning outcomes**

### **On successful completion of this unit a learner will:**

- 1 Understand host-microbial relationships
- 2 Understand microbial features that contribute to infection at different body sites
- 3 Understand the virulence factors for major microbial diseases
- 4 Be able to use diagnostic techniques to identify pathogens.

## Unit content

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### 1 Understand host-microbial relationships

*Normal microbiota:* bacteria eg vaginal (lactobacilli), oral (streptococci, staphylococci), skin (actinobacteria, firmicutes, proteobacteria, bacteroidetes); fungi in gut eg candida; on skin eg malassezia; archaea eg methanogens; relationship with host eg commensals, mutualistic, pathogenic, symbiotic

*Normal gut flora:* roles eg fermentation, triggering immune responses, prevent growth of harmful species, production of biotin and vitamin K, production of hormones involved in fat storage causing disease (cancer, infections)

*Pre-disposition factors to infection:* immunosuppressant drugs eg cancer treatments; genetics eg predisposition to ascariasis, malarial infection

### 2 Understand microbial features that contribute to infection at different body sites

*Microbial strategies to avoid the first line of defence:* adherence to host cells; contribution of capsules and cell walls to pathogenicity

*Evasion of the immune response:* microbial strategies to evade phagocytosis; complement; adaptive immune response

*Damage to host cells:* enzymes; direct damage; toxin production; cytopathic effects of viral infections

*Innate immune responses:* mechanisms eg receptors on epithelial cells (toll like receptors), cytokines, natural killer cells (triggering apoptosis), phagocytes, complement activation (phagocytic action), antimicrobial peptides

### 3 Understand the virulence factors for major microbial diseases

*Virulence factors:* adherence and colonisation; invasions; capsules and surface components; endotoxins; exotoxins; siderophores

*Microbial diseases:* skin infections eg bacterial (impetigo, folliculitis, furuncle), fungal eg tinea (ringworm), candidiasis, viral (herpes simplex, shingles, warts); wound infections; respiratory tract infections eg upper respiratory tract infections (common cold, croup, pharyngitis, laryngitis), lower respiratory tract infections (pneumonia, influenza, bronchitis, whooping cough); fungal diseases of the respiratory tract; diseases of the nervous system eg meningitis, encephalitis, brain and spine abscess, poliomyelitis, syphilis; diseases of the urinogenital tract eg urinary tract infections, gonorrhoea, syphilis, herpes simplex, papilloma virus, chlamydia; infections of the gastrointestinal tract, diarrhoeal diseases eg food poisoning, gastroenteritis

*Global infections:* effect on human population eg measles, mumps, influenza (bird flu, swine flu), haemorrhagic fever (ebola virus)

**4 Be able to use diagnostic techniques to identify pathogens**

*Diagnostic procedures:* specimens eg collection of samples from blood, urine, faeces, wounds and abscesses, genital specimens; culture of anaerobes; transport of specimens; handling of pathogens; laboratory safety; protocols; receiving and analysing specimens; which tests to use; quality control

*Identification:* techniques eg growth-dependent identification methods, polymerase chain reactions (PCR), precipitation reactions, agglutination reactions, neutralisation tests, complement fixation test, enzyme-linked immunosorbent assay (ELISA), radioimmunoassay (RIA), fluorescent antibodies

*Data:* report eg written, graphical, charts, comparison with the norm, machine error, accuracy of diagnostic techniques

*Report:* appropriate presentation of results eg graph, chart, written; reliability and limitations of tests used; inclusion of relevant factors if appropriate eg contamination, significance of pathogen levels, deterioration of specimen, levels of false negative/false positive results, sensitivity of tests used

*Molecular methods:* for diagnosis eg isothermal techniques, nucleic acid hybridisation techniques, nucleic acid probes, diagnostic virology, microarray, genotyping

## Learning outcomes and assessment criteria

<b>Learning outcomes</b> On successful completion of this unit a learner will:	<b>Assessment criteria for pass</b> The learner can:
LO1 Understand host-microbial relationships	1.1 describe the locations of normal microbiota 1.2 discuss the roles of normal gut flora 1.3 discuss predisposing factors for disease
LO2 Understand microbial features that contribute to infection at different body sites	2.1 explain strategies used by micro-organisms to evade the immune response 2.2 explain the mechanisms of damage to host cells used by micro-organisms 2.3 analyse the innate immune responses shown by humans
LO3 Understand the virulence factors for major microbial diseases	3.1 explain the main features of virulence factors 3.2 explain clinical features and possible outcomes of the major microbial diseases 3.3 explain the effect of global infections on the human population
LO4 Be able to use diagnostic techniques to identify pathogens	4.1 follow guidelines to carry out diagnostic procedures safely 4.2 follow guidelines for the identification of micro-organisms, using safe practices 4.3 report on data from a range of identification procedures 4.4 report experimental results clearly and concisely, including possible errors 4.5 review molecular methods for diagnosis.

## Guidance

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### Links

This unit has particular links with the following units within this qualification:

- *Unit reference number T/601/0215: Cell Biology*
- *Unit reference number L/601/0219: Laboratory Techniques for Applied Biology*
- *Unit reference number Y/601/0224: Neurophysiology and Homeostatic Control of the Human Body*
- *Unit reference number D/601/0225: Molecular Biology and Genetics*
- *Unit reference number M/601/0228: The Immune Response System*

### Essential requirements

#### Delivery

The application of the principles of diagnostic microbiology must be integrated into the laboratory-based element.

Tutors must emphasise the importance of health and safety throughout delivery and assessment of this unit. Learners must understand the importance of adhering to laboratory health and safety guidelines. Practical tasks and activities must include risk analyses consistent with COSHH guidelines.

The medical relevance of the unit must be emphasised whenever possible. Industry links, work placements and visits from personnel with technical expertise would enhance delivery of this unit.

#### Assessment

Learning outcome 1 involves an understanding of normal flora and the principles of infection and disease. Learning outcome 2 focuses on the characteristics of micro-organisms that allow for successful colonisation and how the body responds to these invasions.

Learning outcome 3 involves the application of the knowledge and principles from learning outcomes 1 and 2 to a broad range of microbial diseases. Evidence could include laboratory studies and the use of case studies.

Learning outcome 4 involves learners carrying out laboratory investigations, selecting appropriate methods in a laboratory situation, handling medical specimens safely, interpreting results and applying them to medical situations. The techniques used will depend on the equipment available in the centre but must encompass a range of identification and diagnostic techniques, including serological methods and the use of manufactured diagnostic kits.

The use of patient case histories or 'whodunnit' scenarios in either a tutorial or laboratory-based exercise may allow learners to apply the knowledge gained from many aspects of the unit and allow generation of evidence covering several learning outcomes.

## **Resources**

Learners require access to a microbiology laboratory and a range of different micro-organisms. The range of techniques should include some growth-dependent methods and rapid diagnostic assays or kits. Ideally, some of the diagnostic virology should be experienced in the laboratory, but this can be covered without the need to actually handle viruses.

## **Employer engagement and vocational contexts**

Learners will benefit from visits to industrial laboratories and biomedical facilities to observe practical diagnostic techniques in operation.