

References

NHMRC (2010) Australian Guidelines for the Prevention and Control of Infection in Healthcare. Commonwealth of Australia

<http://www.nhmrc.gov.au/guidelines/publications/cd33>

Gillespie S, Bamford K. Medical microbiology and infection at a glance, 2nd edition: 2003

Resources

For other booklets and resources visit the Grampians Region Health Collaborative Website—Infection Control at:

<http://infectioncontrol.grampianshealth.org.au>

Cartoons in this booklet by:

<http://www.davegibb.com.au/index.htm>

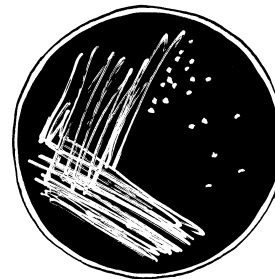


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A LITTLE YELLOW INFECTION CONTROL BOOK

BASIC MICRO AND INFECTIONS



**Grampians Region Infection Control Group
2018**

About this book:

A Little Yellow Book Basic Micro and Infections

is designed to provide beginning knowledge on important concepts of medical microbiology for workers in the health care setting who have no background in microbiology. Because of its simple nature this booklet will grossly oversimplify some of the very complex processes and interactions which occur in microbiology, medical microbiology, human physiology, and pathology. Students requiring detailed information in any of these fields should consult more detailed texts.

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Removing Microbes

There are some areas where we wish to reduce the number of microbes to assure public safety.

For example:

- Cooling towers – prevention of Legionnaires Disease by cleaning and disinfecting air-handling plant
- Chlorine treatment of public water supplies

In Hospitals

We reduce the number of microbes in the hospital situation to protect people who are already sick and therefore more prone to infection by:

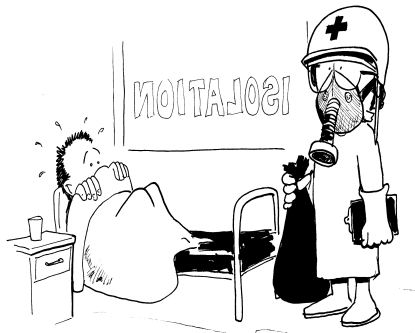
- Good cleaning in wards to reduce the overall number of microbes in the environment
- Cleaning of equipment between patients
- Decontamination of staff hands between patient contacts
- Sterilisation of supplies used in patient treatment where necessary
- Filtration of air into operating rooms
- Operating Room staff wearing special clothing so that they won't shed microbes from their skin/nose into the patient
- Some patients with infections which can be readily transmitted are isolated from non-infected patients
- Protecting ourselves from potentially infectious sources by wearing disposable gloves, protective clothing

Living with Microbes

We live all our lives in contact with many microbes — some of which are harmful to humans, and others which aren't.

To reduce our chances of acquiring enough pathogens to cause us an infection we routinely do the following things (or our Public Health Department does them for us):

- Wash ourselves and our clothing in clean water, and keep our home and working environment clean
- Ensure our water and food supplies are free from infection-causing levels of microbes
- Boost our infection-resistance with a good diet
- Boost our immunity by immunisation against vaccine-preventable diseases
- Hand washing prior to eating
- Maintain our pets in good health
- Isolate patients with highly-infectious diseases in hospital



Microbiology is the study of very small organisms called micro-organisms or microbes.

These living organisms are so small they can only be seen through a microscope.

Microbes are found almost everywhere.

Most microbes are of **benefit** to humans, as they are vital in many fermentation processes, and breaking down processes.



A few microbe species live on or in humans and animals and cause no harm **if they stay in their usual locations**, for example — on the skin — in the large bowel — these groups of microbes are called **commensals, normal flora or indigenous microflora**



Skin microbes are well adapted to life on the skin

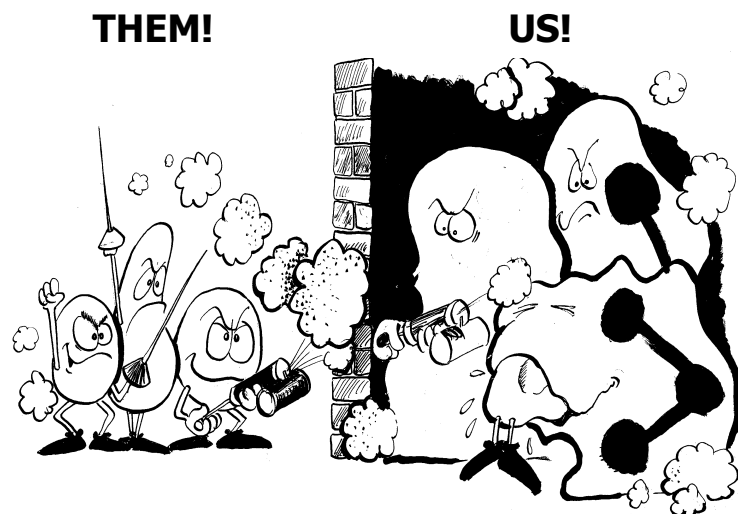
A few microbial species cause infection/disease in man. These infection-causing microbes are called **pathogens**, or pathogenic microbes/micro-organisms.

Pathogens vary in their ability to cause infection/disease (their **virulence**), depending on their ability to **invade** the person's body, **overcome** their defences and **survive** and **multiply** within the person's body.

It's a real war— the microbes have invasive weapons, we have defensive weapons.

Microbial weapons are often poisonous chemicals which damage body cells and defences; allowing spread through the tissues, killing protective white blood cells, dissolving red blood cells, and producing serious effects on specific body cells/systems.

Our body defences are tough skin, protective chemicals, protective proteins called antibodies, and defensive blood cells which attempt to engulf the invaders.



TRANSMISSION-BASED PRECAUTIONS:

AIRBORNE PRECAUTIONS

IN ADDITION TO STANDARD PRECAUTIONS



- VISITORS -

PLEASE SEE NURSE IN CHARGE PRIOR TO ENTERING

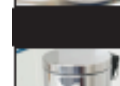
Before entering room:



Put on a P2 mask/respirator



Perform fit check



Food services speak to nurse

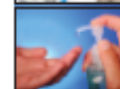
On leaving room:



Discard mask



Clean patient-related equipment



Perform hand hygiene

KEEP DOOR CLOSED AT ALL TIMES



Airborne Precautions are indicated for patients with respiratory infections which produce fine aerosols which can be dispersed by air currents, e.g. TB, measles

DROPLET PRECAUTIONS

IN ADDITION TO STANDARD PRECAUTIONS

- VISITORS -

PLEASE SEE NURSE IN CHARGE PRIOR TO ENTERING

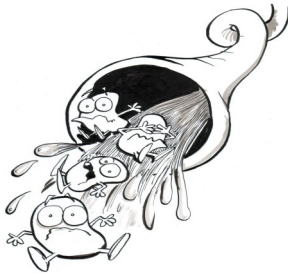
Before entering room:	
	Perform hand hygiene
	Put on a surgical mask
On leaving room:	
	Discard mask
	Clean patient-related equipment
	Perform hand hygiene

KEEP DOOR CLOSED AT ALL TIMES



5

Flushing action of urine flow removes microbes from the lower section of the urinary tube to the outside.

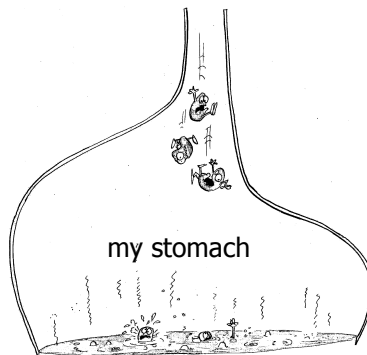


Commensals in the **large intestine** compete with pathogens for food and space, and some produce **antimicrobial poisons** against pathogens.

Mucus-producing tissue lining the openings of many body tubes produces mucous which traps pathogens

In the **vagina** commensals produce an **unfavourable environment** for many pathogens.

In the stomach **hydrochloric acid** kills many swallowed pathogens, as do **digestive secretions** in the **small intestine**.



TRANSMISSION- BASED PRECAUTIONS:

CONTACT PRECAUTIONS

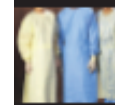
IN ADDITION TO STANDARD PRECAUTIONS



- VISITORS -

PLEASE SEE NURSE IN CHARGE PRIOR TO ENTERING

Before entering room:



Put on apron or gown



Perform hand hygiene and put on gloves

On leaving room:



Discard gloves and apron



Clean patient-related equipment



Perform hand hygiene



Contact Precautions are indicated for care of patients identified or suspected of having multiple-antibiotic-resistant microbes, and for isolation of patients with gastroenteritis which does not have an aerosol-spread

Routine infection control measures to be used at all times during patient care

STANDARD PRECAUTIONS



When microbes get IN!

Second line of defence, comprising non-specific and chemical responses

Fever

- stimulates mobile protective white blood cells to locate and engulf pathogen
- stimulates fixed white blood cells to engulf pathogens
- reduces the concentration of iron in the blood (necessary for pathogens which require iron for growth and replication)
- stimulates the production and activation of lymphocyte white blood cells which are involved in killing some microbes

Chemicals

- a number of chemicals have specific roles in combating microbes
- some act as chemical messengers between different types of white blood cells causing them to become more active
- some chemicals in the blood and inside engulfing white blood cells damage microbe cell walls
- some chemicals produced by virus—affected body cells prevent the spread of the viruses to other cells
- some chemicals act as a coating on the invading microbes making them attractive for the white blood cells to engulf and destroy

Inflammation

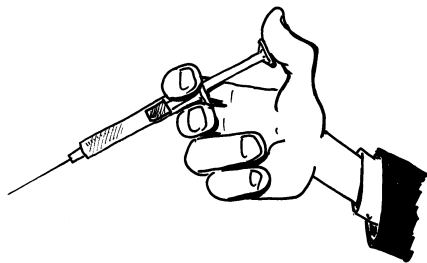
- body tissue damaged by invading microbes tries to limit their spread and effects by increasing its blood supply, and summoning more protective white blood cells and protective elements to the area

When microbes get IN! (continued)

Third line of defence, comprising the immune response

Immunity

- is the presence of protective antibodies to particular microbes in the body fluids
- the specific antibodies are heavy protein particles made by some white blood cells which attach to the specific microbes
- this attachment of antibody will either inactivate, damage or destroy the specific microbes, or make them more easily engulfed by protective white blood cells
- immunity can be developed against specific microbes (infections) by:
  - ⇒ getting an infection—when you get over it you usually don't get it again because your white blood cells have developed memory of how to make the specific antibodies when the same microbes come at you again
  - ⇒ coming into contact with a dose of weakened microbes on purpose—by having an immunisation with a vaccine containing those microbes



STANDARD PRECAUTIONS

Standard Precautions are used for all patient care to prevent infection transmission because any person, their body fluids and excretions; may be colonised or infected with transmissible microbes.

Standard Precautions should be used in handling of blood (including dried blood); all other body substances, secretions, and excretions (excluding sweat), regardless of whether they contain visible blood, non intact skin and mucous membranes.

Standard precautions consist of:

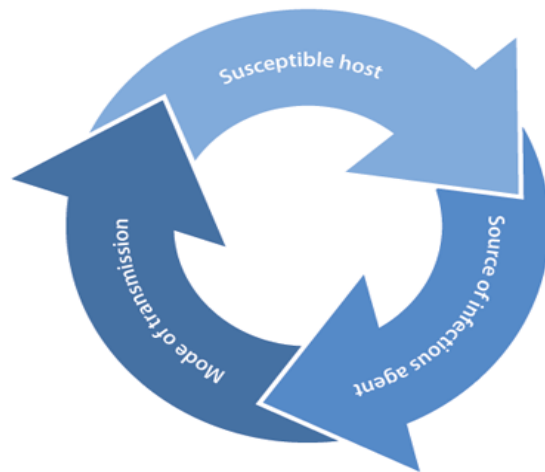
- Hand hygiene
- Use of Personal Protective Equipment (PPE)
- Safe use and disposal of sharps
- Routine environmental cleaning
- Reprocessing of reusable medical equipment
- Respiratory and cough hygiene
- Aseptic non-touch technique
- Waste management
- Appropriate handling of linen

TRANSMISSION BASED PRECAUTIONS

Used in addition to Standard Precautions when the infecting microbes require more stringent precautions to contain, for example: multiple antibiotic resistant organisms like MRSA.

Also used when the infecting microbes are transmitted by the respiratory route, for example: TB, Influenza

Three Requirements for Infection Transmission



1. Susceptible host

- Older person
- Babies
- Someone with a chronic medical condition
- Smoker

2. Source of infectious agent

- Food
- Water
- Objects
- Environment

3. Mode of transmission

- **Contact**
Directly or indirectly from person or object
- **Droplet**
Large droplets from respiratory secretions that float in the air for a short time and then drop to the ground
- **Airborne**
Small droplets from respiratory secretions that float in the air for some time before settling

BASIC MICROBIOLOGY

Microbes belong to **5 main groups** depending on their structure and characteristics:

- **bacteria**
- **algae**
- **protozoa**
- **fungi**
- **viruses** (ultra microscopic, and must live within living cells)

The **majority** of infections are caused by **bacteria** or **viruses**.

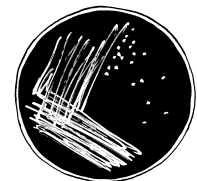
Multiplication of Microbes

Bacteria reproduce by dividing into two, at varying rates. Given the right conditions, some bacteria divide every twenty minutes; thus doubling a microbial population in this time.

Viruses must penetrate living cells, they hijack the cells machinery to duplicate more viruses, then burst out of the body cell to invade other body cells.

Growing Microbes in the Laboratory (cultures)

To aid in diagnosis of infections bacteria and other larger microbes can be grown on nutrient medium plates, enriched with blood, or extracts of meat or yeast.



Viruses are grown on the living cells found in eggs or in cultures of living tissues, or in living animals.

Microbial Growth Requirements

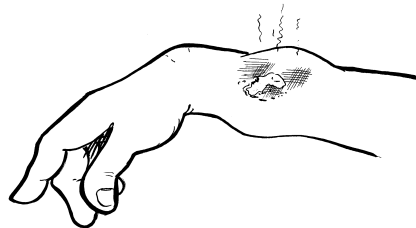
Bacteria which are pathogenic to humans have specific growth requirements in the body. These are very **specific** for different families of bacteria, and include some of the following:

- most require oxygen (these are called **aerobes**)
- some require no oxygen (some microbes cannot live in the presence of oxygen these are called **anaerobes**) There is a wide range of oxygen requirements in between these two extremes
- all require basic elements, eg: carbon, hydrogen, nitrogen. Some have needs for special elements or vitamins
- a few require a level of carbon dioxide
- all require adequate moisture
- all require a suitable temperature range
- some can go into a protective state of dormancy when conditions are unfavourable, and survive as **spores** for long periods

Features of Infection

Overcoming of the infected person's local defences will result in a localised infection. The features of infection are most easily seen in a surface infection:

- pain
- tenderness
- swelling
- redness
- pus
- fever



Features of Deep Infections

In deep infections the development of pus is not obvious, but may be evidenced by such things as:

- diarrhoea in bowel infections
- purulent sputum ("yukky" phlegm) coughed up from lung infections
- internal collections of pus may burst to the outside, into body tubes, or be found during surgery
- internal pain may be caused by infection irritating the tissues, or due to the pressure of pus collection
- fever will usually be present
- the infected person will usually feel **quite** unwell.

Life-threatening Infections

Occur when the body defences are substantially overwhelmed, and microbes are able to spread through the bloodstream (septicaemia) - leads to failure of body organs and systems if untreated.

Treatment of Infections

Treatment aims at supporting the patients' own defences, draining collections of pus, and giving the appropriate antibiotics (antimicrobial drugs) to slow the growth of the invading microbes.

