**1. MYCOBACTERIUM TUBERCULOSIS** (Tuberculosis)

**Overview**

- Pathogenic bacteria

- Has an unusual waxy coating made mostly of myolic acid which makes it i previous to Gram staining

- Acid-fast staining is used instead

- Highly aerobic – requires large amounts of oxygen

- Infects the lungs and causes tuberculosis

- Divides very slowly – 15-20 hours

- Cell wall adds to its increased virulence

- Alveolar macrophages ingest bacteria but are unable to destroy it. The bacteria then multiplies inside the macrophage and when activated, destroys the macrophage

**Transmission**

- Airborne transmission is droplets expelled from the lungs when someone with active TB sneezes, coughs, spits, laughs or talks

- Overcrowding, poorly ventilated places, no exposure to sunlight (kills bacteria)

Latent TB and active TB

- Can lie dormant in macrophages in lungs for years

- Young children, people with underlying immune diseases – infection may overcome immune response and progress straight to active TB

* Risk of activation – highest for two years
* Increased when immune system is compromised (HIV etc)

Epidemiology

- One third of the world’s population is infected with TB, 9 million new cases a year, 2-3 million deaths per year

- Was almost eradicated and is now declared a global emergency

* Causes: deterioration of TB control, misuse of drugs leading to resistance, HIV epidemic, immigration from places with a high rate of TB, rising poverty and homelessness, overcrowding amongst urban populations

Control

- Diagnosis – infection control measures can reduce transmission of disease by people with active TB

- High risk LTBI can be identified through skin testing and subsequently treated and prevention of activation

- Drug use – ensuring patients take the full 6 month course of antibiotics

* Curable – drugs are cheap and readily available

- Early detection, identification of LTBI

* Extensive co-operation between public health authorities and clinical medical practitioners

Symptoms

- Coughing up blood and sputum, chronic cough, fever, night sweats, weight loss

BCG Vaccine

- No true TB vaccine

- Related bacteria – will provide protection against most dangerous types of TB

* Not compulsory in Australia, only given to high-risk groups

- Takes up to 3 months for BCG to provide immunity

Drug resistance

- Multiple drug resistance + complete resistance

- Natural selection occurs in bacteria

- Misuse of drugs, overuse of drugs

- People not taking full 6 month course

**2. CLOSTRIDIUM TETANI** (Tetanus)

**Overview**

- Caused by contamination of wounds by the bacterium clostridium tetani (or the spores they produce)

- Causes tetanus (“rigid and stretched”) describes the condition of the muscles after being infected by TB

- Anaerobic, gram-positive

- Spores (ubiquitous) found in soil, dust, and animal faeces

- Bacteria produce toxins

- Diagnosis done clinically – no blood tests

Transmission

- Acquired through contact with environment – not contagious

- Invades through puncture wounds, burns, any break in the skin, bites etc

Epidemiology

- International health problem due to ubiquitous spores

- Occurs in people who have not been vaccinated/immunised

- Worldwide, but more in hot/damp climates with soil rich in organic matter

* Developing countries – peak in summer and wet season

Features and Symptoms

- Incubation period – 8 days

- Lockjaw, difficulty swallowing, muscle rigidity, spasms, drooling, sweating.

- Spasms continue 3-4 weeks, recovery takes months

Pathogenesis

- Anaerobic conditions – allow germination of spores and production of toxins

- Toxins bind to CNS

- Interferes with neurotransmitter release to block inhibitor muscles – muscle contractions

Method of infecting host

1. Clostridium Tetani enters body through wound
2. Stays in sporulated form until anaerobic conditions are presented
3. Germinates under anaerobic conditions and begins to multiply and produce tetanospasmin
4. Tetanospasmin spreads using blood and lymphatic system and binds to motor neurons
5. Travels along the axon to spinal cord
6. Binds to sites responsible for inhibiting skeletal muscle contraction

- Initially binds to PNS, transported to CNS

Treatment

1. Neutralisation of unbound toxins – Human tetanus immunoglobulin
2. Prevention of further toxin production – antibiotics
3. Control of spasm

- Nursing in a quiet environment

- Avoid unnecessary stimuli

- Protecting airway

1. Supportive care

- Adequate hydration

- Nutrition

- Treatment of secondary infection

- Prevention of bed sores

Prevention

- Tetanus toxoid vaccine

* Inactivated tetanus toxin
* Booster every 10 years

**3. AGROBACTERIUM TUMEFACIENS** (Crown gall)

**Overview**

- rod-shaped (bacilli), Gram-negative pathogenic bacteria

- Aerobically

- Found in soil

- Inserts tDNA from plasmid into a plant cell where it is incorporated into the plant’s genome

- Affects walnuts, grape vines, stone fruits, nut trees, sugar beets, horse radish and rhubarb

Method of invading the host

- Enters the plant through wounds in the roots/stem and stimulates the plant tissues to grow in a disorganised way, producing swollen galls

- Spread by movement of infested soil, infected plant material and via tools

Life cycle

- After infection with the Ti plasmid, the T DNA is integrated with the plant’s chromosomal DNA

- Can be passed on to daughter cells

- T DNA contains genes that cause both tumours

Impact on host

- *A. tumefaciens* – contains a tumour-inducing plasmid which encodes oncogenes that causes the plant to develop unorganized tumours

- Not generally fatal – will reduce plant vigor and crop yield

- Crown gall tumours interfere with water and nutrient flow, resulting in stunted or non-reproductive plants

- Big problem for farmers and nurseries

Management and Control

- Protect against wounds in plants, particularly near the ground

* Protection from sub-freezing winter temperatures and control of chewing insects can prevent infection

- No cure for infected plants – prevention of infection is vital

- Quarantine infected plants – minimize contact with healthy plants

- Do not use soil that infected plants are in

**4. BATRACHOCHYTRIUM DENDROBATIDIS** (Amphibian chytrid fungus – Chytridiomycosis)

**Overview**

- Affects amphibian species associated with permanent water such as streams, moist bogs or soaks and ponds

- Mitigated by high temperatures and disease outbreaks have been seen to occur seasonally

- Little known about the fungus and the disease in the wild, including reasons for the death of hosts, how the fungus survives in the absence of amphibian populations and how it spreads

- Prevalent in upland frog populations

- Suggestion that environmental stress, perhaps from climate change may be reducing resistance to infection

- Strains vary in virulence

Impact

- Fungus invades the surface layer of the frog’s skin, causing damage to the outer keratin layer

- Amphibian skin is unique – physiologically active, allowing the skin to tightly regulate respiration, water and electrolytes

- Not fully known how the fungus kills amphibians but it is thought that it may cause mortality through disrupting the normal function of the skin, resulting in electrolyte depletion and osmotic imbalance

- Some disease species are highly susceptible

Treatment

- Terminal disease – not treated

- Early phases of infection have been treated successfully

Control

- No proven methods to control the disease in the wild

- For amphibian species currently listed as endangered, emergency measures are needed to increase population sizes via reintroductions, translocation and the establishment of captive disease-free assurance colonies

- *B. dendrobatidis* – widely distributed in Australia, control efforts should be aimed at protecting uninfected areas

- Education and research about the disease

- Monitoring and surveillance is necessary to

* Monitor the impact of the disease on frog populations
* Detect new outbreaks in currently uninfected populations or locations of unknown disease status
* Establish restricted and control areas to which quarantine and movement restrictions are applied
* Establish restricted control areas to which quarantine and movement restrictions are applied
* Establish infected and non-infected areas/zones
* Monitor the progress and success of a control strategy

Situation in Australia

- Endemic to Australia – not all of Australia due to extremely hot conditions

- 63/219 of Australia’s endemic frogs have positive records for infection

Epidemiology

- Mortality rate – when frogs show clinical signs, death usually follows within 2-3 days

Transmission

- Zoospore, waterborne

- Sources – shredding of zoospores from infected skin (zoospores require water to survive)

Clinical signs

- Clinical signs are absent

- Symptoms are usually present for a short period of time before death occurs

- Symptoms include – behavioural change, slow and uncoordinated movement, abnormal sitting posture, tetanic spasm, paralysis

- Skin changes – microscopic and not detectable at the clinical level

**5. MALARIA PLASMODIUM** (Malaria)

Life cycle

- When the malarial parasite (plasmodium) enters human blood it is called a sporozoite and is at the asexual stage of the life cycle

- To reproduce asexually, it enters the liver cells. Each sporozite divides repeatedly to produce 16 small spherical merozites

- The merozites invade red blood cells, where they continue to divide asexually and bust the blood cells. The merozites invade more blood cells and rupture them

- Some of the merozites develop into male gametocytes and some develop into female gametocytes

- These gametocytes are the precursors of the gametes. If they are transferred to the mosquito gut, they develop into gametes and may fertilise to form zygotes

- The zygotes grow and develop into sporozoites and the cycle is repeated

Mode of transmission

- Vector – Anopheles mosquito (female)

- Blood transfusion

- From mother to child before and or/during birth

Incubation period

- Approximately 10 days

Impact on the host

- Fever alternating with shivering (chills)

- Anaemia

Treatment

- Treatment chloroquine and other drugs

- Preventative (prophylaxis) antimalarial drugs for humans

- No vaccine

Problems with treatment include resistance to preventative drugs and the absence of a vaccine

Management Strategies and Prevention

- Eradication of mosquitoes

- Try to breed resistant mosquitoes (Biotech)

- Development of a vaccine is in the research stage

- Physical preventative measures

* Cover doors and windows with wire mesh/screens
* Use mosquito nets
* Arrange for indoor residual spraying with insecticide
* Apply insect repellents to the skin of the exposed part of the body
* Wear shirts with long sleeves/dresses/pants

- Disruption of pathogen life cycle

* Eliminating places where mosquitoes can lay eggs
* Reclaiming land by filling and draining
* Removing discarded containers that might collect water
* Covering water tanks with lids or mosquito nets
* Repairing leaks, preventing seepage of water and improving drainage
* Introduce special fish that eat mosquito larvae
* Insecticides in water tanks

Situation worldwide

- Tropical disease – endemic in the tropics.

- Decline in numbers

* Effective use of drugs, community protection and education, mosquito control etc

Situation in Australia

- Successfully eradicated in the 1960’s

- Tropical regions – still susceptible (NT and QLD – management strategies in place)

Climate change and malaria

**6. PHYTOPHTHORA CINNAMOMI** (Jarrah Dieback)

**Overview**

- Phytophthora cinnamomi – soil-borne water mould

- Used to be classified as a fungus, now a protest

- Present in temperate and tropical climates throughout Australia and the world

Life cycle

- *P.cinnamomi* grows through the root system (and sometimes stem) of a plant, destroying it and preventing the plant from absorbing water and nutrients

- Once the fungus has spread through the root system of a plant, it released zoospores (asexual spores) into the surrounding soil, if the conditions are warm and moist

- The spores easily spread through stormwater and drainage water

- During drought or when temperatures are cooler, *P. cinnamomi* produces two different types of spores – chlamydospores and oospores – that survive for long periods of time in soil or dead plant material

- When conditions become favourable for spores, they will germinate and infect new plants

Mode of transmission

- Spread through the movement of water, soil and plant material

* Human activities or natural means
* Humans – the main cause of *P. Cinnamomi* spread through the landscape

- Transfer of infected plants or contaminated soil

**Human activities at risk of spreading Phytophthora cinnamomi**

Earthworks

- Construction and maintenance of roads and trails

- Forestry operations

- Management of drainage

Movement of machinery, equipment, vehicles, livestock

- Between sites and along roads/tracks

- Logging and forestry operations

- Off-road vehicles

- Movement of livestock

Recreational activities

- Bushwalking, orienteering, trekking etc

- Horseriding, bike riding

- Camping

Symptoms

- Wilting and yellowing of foliage

- Foliage – dries out and the young feeder roots darken

- Infected plants usually die from lack of water and nutrients

- Stunted growth

Impact on host

- Flagellated zoospores enter the plant near the growing tip of the roots where they germinate, produce fungal-like hyphae and absorb carbohydrates in the root

- Destroys the internal structure of the roots and causes the death of the plant

Treatment

- Treated with fungicides (phosphite salts e.g calcium phosphite)

Management strategies and prevention

**Surveillance**

- Involves observation to detect occurrences of the pathogen at an early stage when control activities are more likely to be effective.

- Regular visits to potential sites of introduction, follow up monitoring of new works and reporting procedures

**Quarantine**

- Strict isolation of an area to prevent the spread of disease

- Limiting the degree of human entry to a location either permanently or seasonally

- Preventing access by vehicles and machinery

- Appropriate response to detection of a new infestation, especially where the site is of high biodiversity significance

Situation in Australia

- *P. Cinnamomi* – responsible for dieback of Eucalyptus trees, especially in the Jarrah Forrest bioregion of WA

* One of the most significant threats along the coast

**7. INFLUENZA VIRUS**

Type of pathogen

- RNA virus

Life cycle

- Viruses inject their genetic material into the host’s cells

- They use the host’s own genetic material and cell machinery to produce more virus particles which accumulate within the host cell and eventually cause the cell to burst.

- Virus particles are release and invade other cells – depletes and destroys the host’s cells

- Can persist outside of the body from minutes to days depending on the conditions

- Zoonotic disease – transmitted between humans and animals

Mode of transmission

- Direct transmission – coughing on someone, sneezing on someone etc

- Indirect contact – airborne (coughing and sneezing into air), contaminated surfaces

Incubation period

- Approximately 2 days

Impact on the host

- Fever, runny nose, sore throat, muscle pains, headache, coughing, exhaustion

Treatment

- Rest, analgesics, antiviral drugs for serious cases

Management Strategies and prevention

- Control precautions by infected people when sneezing and coughing

- Vaccines are effective against some strains of the virus

- Hygiene

- Hand washing

Limitations and obstacles

- Antigenic drift – protein coat changes slightly

- Antigenic shift – two new antigens coming together

**8. ROSS RIVER FEVER**

**Overview**

- Virus (RNA)

- Zoonotic – transmitted between humans and other animals such as bandicoots, kangaroos and possums

Life cycle

- Virus lands on cell surface and is engulfed by cell membrane

- Viral core is released into the cell

- RNA is released and instructs the cell to make new viral RNA and protein

- New viral surface proteins are made

- New viral components collect at cell membrane and new virus particle buds from the cell membrane

Mode of transmission

- Vector – mosquito bite

Incubation period

- Approximately 1-2 weeks

Impact on the host

- Fever, rash, muscle aches, headache, aching tendons, swollen lymph nodes, joint pain and swelling or stiffness, headache behind eyes, exhaustion

- Older people suffer more than younger people

- Some symptoms can last years

Treatment

- Analgesics – painkillers

- No vaccine or antiviral drugs available

Management Strategies and Prevention

- Insect repellent

- Burning citronella candles

- Wearing light coloured clothing

- Window screens

- Disrupt mosquito life

Situation worldwide

- Endemic to Australia, Papua New Guinea and other islands in the South Pacific

**9. HONEY BEE VIRSUS**

**Overview**

- Honey bee viruses are single-stranded RNA viruses

- There are over 20 different viruses that infect honey bees

* DWV – Deformed wing virus
* BQC – Black queen cell virus
* SBV – Sacbrood virus
* KBV – Kashmir bee virus
* ABPV – Acute bee paralysis virus
* CBPV – Chronic bee paralysis virus

Life cycle

- Viruses can attack at different developing stages and castes of honey bees including: eggs, larvae, pupae, adult worker bees, adult drones and queens

Mode of transmission

**Direct food-borne transmission**

- Eating pathogen-contaminated food and passing out viruses from the gut with faeces

- Influenced by high population density

- Feeding brood, attending the queen, packing pollen, processing nectar

**Direct venereal transmission**

- Transmitted during mating

**Indirect transmission of viruses by a vector**

- The parasitic mite *Varroa destructor*

- Obligate parasite of the honey bee

- Attack adults (workers, drones and queens) and brood, of which the drone brood is preferred

- Both adult mites and nymphs use their piercing mouthparts to penetrate the body wall of developing bees

- Repeated feeding on bee haemolymph shortens bee life spans and can result in a decline in host immunity, colony vigour and the eventual death of the colony within a few years

**Vertical transmission**

- Studies have revealed that viruses could be detected in all developmental stages of honey bees including adults, pupae, larvae and eggs

- Detection of a virus in eggs and larval stages that are not normally associated with Varroa mite infestation suggests that the queens might be infected with the virus and is transmitting it vertically from queens to eggs

* Further supported by the absence of viruses in royal jelly – used to feed newly hatched larvae – excluded the possibility of food contributing to the infection during larval stages of bees

Impact on the host

- Rarely cause symptoms until it is too late

- Dramatically affect honey bee health and shorted the lives of infected bees under certain conditions

- DWV – seriously harm the health and productivity of honey bees

Treatment

- No known cures for any of the honey bee viruses

Management Strategies and Prevention

- Prevent entry of Varroa mite into colonies

- Management of colonies to prevent losses associated with bee viruses should include

* Regular brood comb replacement
* Regular queen bee replacement with a resistant strain of bee, as some strains of bees seem to be more susceptible to some viruses
* Not breeding from stock demonstrating any signs associated with bee infection
* Minimalizing nutritional stresses to a colony by providing sugar syrup and pollen supplement during periods of deficiency

**10. AUSTRALIAN BAT LYSSAVIRUS** (ABLV)

**Overview**

- Virus (RNA)

- One of twelve types of lyssaviruses, which are found around the world

- ABLV – only one to occur in Australia

- Closely related to rabies virus

- ABLV infects Australian flying foxes (fruit bats) and microbats

- Zoonotic – transmitted from animals to humans

- Also transmitted to horses – potentially other animals

- Causes fatal swelling of the brain

- Shed in saliva

- Like rabies, it is presumed that ABLV is usually transmitted by bites or contamination of a fresh wound, scratch or mucous membranes infected with saliva

Mode of transmission

- Zoonotic – bats, horses, humans

- Direct contact

Incubation period

- In humans, the time from exposure to the virus to the development of symptoms in variable; of the three known human cases of ABLV infection, one become ill several weeks after being bitten by a bat and another became ill more than two years after a bat bite

Impact on host

**Bats**

- CNS disease – paresis (weakness), inability to fly, hang properly, swallow properly or move

- Paralysis – hind limbs

- Seizures, tremors

- Incessant licking

- Changes in behaviour – aggression, approaching people

* Fewer than 20% of infected bats show these signs

**Humans**

- ABLV infection in humans – causes a serious illness which results in paralysis, delirium, convulsions and death

- Death usually occurs due to respiratory paralysis

- Since Nov 1996 – three people have died as a result of ABLV infection after being bitten or scratched by bats

**Other animals**

- Clinical signs consistent with encephalitis (swelling of the brain) in that species

Treatment and Medical Prevention

**Bats**

- Euthanasia

**Other animals (pets)**

- Post-exposure vaccination of the animal with the rabies vaccine to prevent development of clinical disease

- Observation for clinical signs suggestive of ABLV infection – with reporting of a suspicion of clinical ABLV virus disease to Biosecurity Development

- Euthanasia

**Humans**

- Infection in people is extremely rare – no effective treatment once the person is clinically ill, taking action as soon as a person is bitten or scratched by a bat can prevent clinical disease

* If bitten or scratched by a bat, immediately wash the wound gently but thoroughly for at least 5 minutes with soap and water. Apply antiseptic with anti-virus action
* If bat saliva comes into contact with the eyes, nose or mouth or open skin, flush the area thoroughly with water
* Seek urgent medical advice from a doctor or nearest hospital

- Post-exposure rabies vaccinations and other treatments may be necessary if you have been bitten or scratched by a bat

Management Strategies and Prevention

- ABLV – reportable animal disease

- Suspected cases of ABLV must be reported

- Avoid touching or handling a live bat, contact with bats

Situation in Australia

- Endemic to Australia

- Infection is rare (less than 1%)