PATTERNS OF ANIMAL DISEASE

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What is Epidemiology?
It is the Pattern of diseases.

- It is the study of outbreaks of infectious disease.

- Veterinary epidemiology deals with the investigation of diseases, productivity and animal welfare in populations. It is used to describe the frequency of disease occurrence and how disease, productivity and welfare are affected by the interaction of different factors or determinants.
The term **epizootiology** came into existence when investigations of rinderpest were carried out in Britain by 1877.

- After that, incidence of tuberculosis and contagious abortion were recorded.
- Epidemiology is the study of diseases in masses rather than the individual animal.
- It deals with the cause of the disease, also all the factors influencing that cause, also effects of disease and its distribution in place, in herds, in age-groups and in time.
Epidemiology asks:

- What species of animals are affected?
- What age groups?
- Which sex?
- At what time of the year?
- In what circumstances of husbandry?
- In what sort of weather?
- Is there any association with other species of domesticated animal?
- Or with wild animals or birds?
- Insects or ticks?
The Continuity of infectious diseases

- Certain pathogens exist mainly or entirely within the host. - Streptococcus agalactiae, the cause of one form of bovine mastitis.
- Most pathogens, however, are excreted from their hosts.
- **Where does the pathogen go when it not in the host animal?** Much emphasis was not put on this question. Yet this question is at the root of all disease prevention and control.
- If we can combat the pathogen only when it has invaded our stock we shall never eradicate it. If it has any other habitat to hide in, we must find that habitat.
Pathogens are of two kinds

1) Those which must find a living organism to inhabit to remain alive
   - most of the viruses, some of the more delicate bacteria, and protozoan parasites such as Babesia and Trypanosomes.

2) Those which have some sort of resistant stage.
   - Worm parasite lay eggs which can be resistant to various climatic conditions.
   - Coccidia are passed out of the host’s body as very resistant oocyst forms
   - Some bacteria resist desiccation.
   - Other bacteria formed long lived spores.
The short-cycle type of infection

In canine distemper, the virus invades the dog’s body and rapidly multiplies there, causing damage through its own replications and debilitating the animals.

Secondary infection such as pneumonia can start at once.

Virus is poured out of the dog in vast quantities— in droplets from the respiratory tract, in the faeces & in urine.

Within a few days the dog is completely rid of the virus, but may still be quite ill because of the complications which will have arisen.
From the point of view of the pathogens, there is the utmost urgency to invade another susceptible dog. The virus is not very resistant, and cannot survive in the surroundings. Sunlight, drying & most chemical kill most viruses quickly, but when distemper virus is introduced into a new dog population it spreads rapidly. Once the number of susceptible puppies drops below a critical level, however the infection dies out.
Infectious bronchitis of poultry is another short cycle infection. In modern intensive housing system, chickens are kept in thousands and even hundred of thousands, in close confinement in houses containing all birds of the same age. These houses, when infected, can generate positively large amount of virus. Since the life span of the poultry is short, there is a constant renewal of the susceptible population and virus spreads very rapidly
Rinderpest:

Some what similar picture is seen in this disease. Virus is rapidly infectious and again it is not very resistant to weather, especially to the ultra violet light. Most adult cattle are immune. Cows are protected by the antibodies in their mother’s colostrums. But when this protection wanes, the yearlings are open to invasion by the virus. The disease therefore, smoulders on in these young cattle. It is the young animal which carry the disease on and which are, therefore, the chief target of the vaccination campaigns.
Persistence of pathogen by chronicity of infection

There are infections which ensure the survival of the pathogen by the chronic nature of the infection it causes. Few hosts being needed in any period of time.

1) Tuberculosis, if left untreated, will kill, but it will take many years to do so, and during that time many opportunities will occur to infect other hosts.

2) Brucellosis of cattle, where bacteria resides almost permanently within the host tissues. The newly infected female may abort once or twice, but after that she is though infected is without symptoms but having danger to other cattle.
In the biological sense, the parasite has won. It has gained a base in which it can survive as a species until the death of the host from other causes. And it can go forth from time to time to infect other hosts and establish other long-term infections.
Another example—infection of cattle by salmonella

Though there is sickness and even mortality among cattle exposed to salmonella infection, a certain no. of adult animals recover and so no further symptoms, yet harbour the bacteria in their gut.

In this case bacteria have not been able to invade the tissues; there is no serological reaction, and no evidence, apart from the occasional shedding of a few salmonellae to indicate infection.

but if the animal is stressed, the salmonella begin to multiply and cause disease.
Persistence of pathogen in slow virus infection

In some diseases, there is long period of apparent latency between infection and the onset of clinical signs. There is a slow progress to death

1) **Visna** disease of sheep - affects the nervous system and have long incubation period, as long as 2 or 3 years. signs of incoordination appears and sheep show a progressive illness & recovery has been never observed

2) **Maedi**, a disease of sheep where there is increased difficulty in breathing and death after 3 to 9 months. At P.M. Exam. the cause of the respiratory distress is seen to be the replacement of normal lung tissue by a massive proliferation of connective tissue and finally reducing the air spaces

3) **Scrapie** of sheep & mouse leukemia are other diseases of slow virus nature.
Persistence of pathogens by the adaptation of a resistant form

- Many pathogenic organisms adopt some resistant form during their life cycles.
- Some bacteria form spores, which are almost indestructible in normal circumstances.

Exa.-1) Anthrax bacillus assumes a spores state when expose to oxygen. Spore is resistant to heat, drying and chemicals. The area contaminated with anthrax organisms remains infective for many years.
-2) Clostridia which causes tetanus , gas gangrene are very tough and difficult to destroy.
-3) The pox group of viruses are unaffected by drying and scales of lesions containing pox viruses has been stored for many years without losing their infectivity.
4) A round worm or a multiplying form of coccidium, would die very quickly if it were to be exposed to conditions outside host; but both these parasites & many others have a tough resistant phase.

The round worm’s egg has a thick shell to reduce the danger of desiccation.

The coccidium in its sexual reproduction cycle produces an oocyst which is very hard to destroy.
Perpetuation in reservoirs

- Many bacteria, viruses, and parasites have the capacity to invade a species of host other than its primary one.
- The dog harbours Leptospira canicola which causes disease in it. The same bacteria is present in rats as an almost silent infection.
- Other leptospires which can cause illness in man, are to be found hiding in the kidneys of various small rodents. Many viruses are obliged to stay inside the cell of their hosts, and most viruses have a short survival time in the outside world. Admittedly, they can be preserved and viable for years in the virologist’s laboratory, but in those conditions they are kept in a refrigerator or deep-freezer, and are in pure culture.
Viruses adopt a wide spectrum of hosts and live in some of them (the reservoir) without causing any disease.

Viruses, bacteria and protozoa are transmitted by ticks and flies directly into the host tissues. The pathogenic organisms usually cause no harm to the arthropod. It may retain it as a silent infection for many months or even in some cases pass on to its progeny.

Viruses or protozoan parasites hide within the body of larger metazoan parasites.
Virus of pig influenza is carried inside the egg of pig lungworm. The worm hatch and are eaten by other pigs, so that the transfer of the virus from pig to pig is effected without the risk of destruction of virus.

The protozoan parasite *Histomonas meleagridis* is the cause of killing disease of turkeys known as ‘blackhead’. In the caecum of turkey, a small worm *Heterakis gallini*, where a part of life of histomonas is led. It invades the worm and is transferred safe inside the caecal worm’s egg to another turkey.
In case of short cycle type of infection (viral and bacterial) such as swine fever and FMD, the best promise of success is by preventing their arrival into a country.

When these pathogens arrive and established in our stock, one method of dealing with them is by the local depopulation of the host species. Certain countries have this policy.

The other defense is by vaccination. We must attain a very high level of protection in the majority of animal population.
Chronic infections are sometimes combatted by vaccination programme, but more usually by the method of identification and elimination.

Disease caused by bacteria resistant to antibiotic and chemotherapeutic agents is a real hazard.

Certain diseases especially clostridial diseases and John’s disease, are indeed spreading slowly.

To stamp out a pathogen it is not enough to eliminate it from only one or two of its possible hosts but all the hosts must be controlled or sterilized of the infection.
The dissemination of disease

General concepts –

- A Disease – any deviation from normal structure or function.

- An Infectious disease – caused by invasion or multiplication of a living agents in or on a host. —viral, bacterial, mycotic or parasitic.
Infestation—the invasion but not multiplication of an organism in or on a host. Parasitic diseases can either infestation or infection depending on the life cycle of the parasite in question.

Describing the transmission dynamics of Lyme disease provides an opportunity to use both terms; the tick vector *Ixodes scapularis* infests a host while the bacterial pathogen *Borrelia burgdorferi* is transmitted by the tick and infects the host.
A contagious disease – that is transmitted from one animal to another via direct or air borne means.

Agents that cause a contagious disease can be spread from animal to animal in excretion or secretion, respiratory aerosols, scabs or other body fluids or tissues.
Example.- PPR, a serious viral disease of small ruminants. Infectious disease can also be communicable without being contagious.

One example of a directly contagious disease of animals is **Peste des Petits Ruminants (PPR)**, a viral disease of small ruminants caused by a morbillivirus (Family Paramyxoviridae). The disease, found in Africa, the Arabian Peninsula, the Middle East and India, may manifest with acute signs of fever, nasal discharge, non-hemorrhagic diarrhea, conjunctivitis, stomatitis, pneumonia, and abortion; death usually occurs within 5-10 days.
Ocular discharge and oral lesions associated with PPR.
A communicable disease caused by agent capable of transmission by direct, airborne or indirect route from an affected person, animal or from contaminated inanimate reservoir such as the soil.

Indirect route include transmission by insects or on vehicle such as food, water, clothing and equipment.

Many important communicable diseases are not directly contagious but are transmitted between animals by arthropod vectors.

Exam.-African horse sickness.—Arbi virus, vector - culicoides
African Horse Sickness, a severe cardiac and pulmonary disease of horses and other equidae, is caused by an orbivirus (Family Reoveridae) that is transmitted by a biting midge vector, Culicoides spp. Although highly fatal, the disease is not transmitted from one equid to another by direct contact. African Horse Sickness is primarily endemic to Africa, but several outbreaks have occurred in Spain, Portugal, and the Far East.
Transfer of a pathogen from a parent, usually the dam to the offspring through reproduction. Infectious disease are usually transferred from the mother to the embryo, fetus or newborn prior to, during, or shortly after parturition.

- Classical swine fever virus is an example of a disease agent that can be transmitted vertically.
An example of a disease agent that can be transferred vertically is bovine viral diarrhea virus (BVDV). If a cow becomes infected with BVDV while she is pregnant, transplacental transmission can occur resulting in abortion. *Toxoplasma gondii*, the causative agent of toxoplasmosis can also be transmitted vertically through the placenta. Transplacental transmission of *T. gondii* may cause ovine abortion and severe congenital abnormalities in humans. *Strongyloides stercoralis*, a small intestinal nematode of dogs, cats, and humans, can be transmitted via the milk from a dam to her nursing offspring. This nematode can also be transmitted by skin penetration.
A dam may transmit disease to nursing offspring via colostrum or milk, such as *Strongyloides ransomi*.
Horizontal transmission
Transfer of pathogen from infected animal to a naive animal, independent of the parental relationship of these individual.

- It can occur by other direct or indirect contact
- Direct contact- licking, rubbing, biting, coitus.
- Classical swine fever virus is the example.
- Airborne transmission is also horizontal transmission - transfer so considered to be a form of direct horizontal transmission. FMD is the classic example.
Indirect contact through fomites and vectors-

Fomites are inanimate objects that can carry infective agents from one animal to another. Exa.- used needles, contaminated clothing or vehicles.

• Iatrogenic transmission- a specific form of horizontal transmission by fomites in which vet accidentally furthers the spread of a disease agent.
- Vector borne transmission – a form of Indirect horizontal transmission in which a biological intermediary, often an arthropod carries a disease agent between animals
- A biological vector- that supports replication of pathogen.
Office international des épizootics (OIE) was formed in 1924 to prevent outbreak of rinderpest and other diseases, with 24 countries.

In 2002, its name is changed as World Organization of Animal Health & expanded.

As of May 2004, it contained 167 member nations.

The purpose is to help countries coordinate animal disease information and decrease the potential for epizootics.

To inform governmental veterinary services of the occurrence & course of epizootic that could endanger animal health.

Maintains a list of infectious diseases of particular concern in international trade.

Promotes and coordinates research into the surveillance and control of animal diseases throughout the world.

To set the standard of diagnostic methods and vaccine methodologies in international trade.
OIE – List A diseases:

- Transmissible diseases which have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products.
## OIE List A diseases

<table>
<thead>
<tr>
<th>OIE code</th>
<th>Name of List A disease</th>
</tr>
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<tbody>
<tr>
<td>A010</td>
<td>Foot and mouth disease</td>
</tr>
<tr>
<td>A020</td>
<td>Vesicular stomatitis</td>
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<tr>
<td>A030</td>
<td>Swine vesicular disease</td>
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<tr>
<td>A040</td>
<td>Rinderpest</td>
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<tr>
<td>A050</td>
<td>Peste des petits ruminants</td>
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<tr>
<td>A060</td>
<td>Contagious bovine pleuropneumonia</td>
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<tr>
<td>A070</td>
<td>Lumpy skin disease</td>
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<tr>
<td>A080</td>
<td>Rift Valley fever</td>
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<tr>
<td>A090</td>
<td>Bluetongue</td>
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<tr>
<td>A100</td>
<td>Sheep pox and goat pox</td>
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<tr>
<td>A110</td>
<td>African horse sickness</td>
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<tr>
<td>A120</td>
<td>African swine fever</td>
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<tr>
<td>A130</td>
<td>Swine fever</td>
</tr>
<tr>
<td>A150</td>
<td>Highly pathogenic avian influenza</td>
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<tr>
<td>A160</td>
<td>Newcastle disease</td>
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</tbody>
</table>
Of lesser importance are the LIST B diseases.

“Transmissible diseases which are considered to be of socio-economic and/or public health importance within countries and which are significant in the international trade of animals and animal products.”

This group includes such diseases as: Rabies, Heartwater, Tuberculosis, New and Old World Screw worm, Brucellosis, and many others.
### Multiple species diseases
- Anthrax
- Aujeszky's disease
- Echinococcosis/hydatidosis
- Heartwater
- Leptospirosis
- Q Fever
- Rabies
- Paratuberculosis
- New World screwworm (*Cochliomyia hominivorax*)
- Old World screwworm (*Chrysomya bezziana*)
- Trichinellosis

### Cattle diseases
- Bovine anaplasmosis
- Bovine babesiosis
- Bovine brucellosis
- Bovine genital campylobacteriosis
- Bovine tuberculosis
- Bovine cysticercosis
- Dermatophilosis
- Enzootic bovine leukosis
- Haemorrhagic septicaemia
- Infectious bovine rhinotracheitis / infectious pustular vulvovaginitis
- Theileriosis
- Trichomonosiosis
- Trypanosomosis (tsetse-transmitted)
- Malignant catarrhal fever
- Bovine spongiform encephalopathy
Sheep and goat diseases

- Ovine epididymitis (*Brucella ovis*)
- Caprine and ovine brucellosis (excluding *B. ovis*)
- Caprine arthritis/encephalitis
- Contagious agalactia
- Contagious caprine pleuropneumonia
- Enzootic abortion of ewes (ovine chlamydiosis)
- Ovine pulmonary adenomatosi
- Nairobi sheep disease
- Salmonellosis (*S. abortusovis*)
- Scrapie
- Maedi-visna

Equine diseases

- Contagious equine metritis
- Dourine
- Epizootic lymphangitis
- Equine encephalomyelitis (Eastern and Western)
- Equine infectious anaemia
- Equine influenza
- Equine piroplasmosis
- Equine rhinopneumonitis
- Glanders
- Horse pox
- Equine viral arteritis
- Japanese encephalitis
- Horse mange
- Surra (*Trypanosoma evansi*)
- Venezuelan equine encephalomyelitis
<table>
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<tr>
<th>Swine diseases</th>
<th>Avian diseases</th>
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<tr>
<td>Atrophic rhinitis of swine</td>
<td>Avian infectious bronchitis</td>
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<tr>
<td>Porcine cysticercosis</td>
<td>Avian infectious laryngotracheitis</td>
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<tr>
<td>Porcine brucellosis</td>
<td>Avian tuberculosis</td>
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<tr>
<td>Transmissible gastroenteritis</td>
<td>Duck virus hepatitis</td>
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<tr>
<td>Enterovirus encephalomyelitis</td>
<td>Duck virus enteritis</td>
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<tr>
<td>Porcine reproductive and respiratory syndrome</td>
<td>Fowl cholera</td>
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<td>Fowl pox</td>
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<td></td>
<td>Fowl typhoid</td>
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<td></td>
<td>Infectious bursal disease (Gumboro disease)</td>
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<td></td>
<td>Marek's disease</td>
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<td></td>
<td>Avian mycoplasmosis (M. gallisepticum)</td>
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<tr>
<td></td>
<td>Avian chlamydiosis</td>
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<td>Pullorum disease</td>
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Transboundary animal diseases (TAD’S)

“Those diseases that are of significant economic, trade and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epidemic proportions; and where control/management, including exclusion, requires co-operation between several countries”.
African Swine Fever (ASF)
Avian Influenza
- Contagious bovine pleuropneumonia (CBPP)
- Foot-and-Mouth Disease (FMD)
- Haemorrhagic Septicaemia
- Rift Valley Fever (RVF)
- Rinderpest
When is a disease occurrence an epidemic?

“The occurrence in a community or region of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of normal expectancy”.

(J.M. Last)
Where a disease is unknown in an area or has been absent for a long time, only one or two cases may qualify as an epidemic and warrant immediate attention.

Where a disease has been present at a fairly constant prevalence level for some time, a marked upswing in the number of cases seen may signal a change in status from endemic to epidemic and will require investigation.
An *endemic* disease is a disease that occurs in a population with predictable regularity and with only minor deviations from its expected frequency of occurrence.

*Hyperendemic* is an endemic disease that affects a high proportion of the population at risk.

*Mesoendemic* is an endemic disease that affects a moderate proportion of the population at risk.

*Hypoendemic* is an endemic disease that affects a small proportion of the population at risk.
An *epidemic* disease is a disease that occurs in a population in excess of its normally expected frequency of occurrence. In an epidemic disease

A *pandemic* is a large epidemic affecting several countries or even one or more continents.
• A sporadic disease is a disease that is normally absent from a population but which can occur in that population, although rarely and without predictable regularity.
THANK YOU.....