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# CONCEPT OF ANIMAL DISEASES


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# CONCEPT OF ANIMAL DISEASES

- Disease is the result of complex interactions (some would say imbalance) between the triad of the agent (toxic or infectious), the host and the environment. The components of this interaction differ depending upon the specific circumstances of each group of affected animals.

- Particularly for agricultural animals, this triad is strongly influenced by husbandry and management factors, which are often the most important. For vector-borne diseases, vector factors are also linked to the other factors.

- Recognizing the different components of this triad is important because they are the source of opportunities to reduce disease at multiple points in the transmission cycle. A common mistake is to focus on only one aspect of the triad for disease control or prevention and to overlook the others.

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# CONCEPT OF ANIMAL DISEASES

## Agent Factor Examples

- Dose
- Environmental hardiness
- Virulence (microbial)
- Infectivity (microbial)
- Toxicity (poisons)

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# Host Factor Examples :

- Innate resistance (e.g. gastric barrier, mucocilliary transport mechanism)
- Previous exposure
- Passive immune status (neonates)
- Vaccination status and response
- Age
- Gender
- Behavior (e.g. mutual grooming, dominance, pica)
- Production status (e.g., lactating vs. non-lactating)
- Reproductive status (e.g., pregnant vs. non-pregnant, sterile vs. intact)
- Genetics

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Intrinsic (non-changeable in the individual)

- Age is very important because the risk of many diseases change widely over the animals life time due to underlying physiological changes that are associated with age. Neonates are very susceptible to many enteric and respiratory infections but resistance increases as the animals mature. As immune function declines with advanced age, susceptibility begins increasing again.

- Clinical disease due to ubiquitous agents, such as the viral scour agents, can be reduced by delaying the neonate's exposure to the agent (innate resistance increases with age) and reducing the infectious dose by changing the environmental factors.

- Due to genetics different breeds have different risks for diseases, such as hip dysplasia in German Shepherds. Within breeds, some infectious diseases occur due to underlying genetic defects (e.g., Holstein BLAD, Arab CID, Quarter Horse HPP).

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## Extrinsic (changeable in the individual)

- Intact bitches are at risk of pyometra and mammary gland tumors than spayed (excluding stump pyometras) are not. Intact dogs behave differently than non-intact dogs, tending to roam more and thus being at higher risk of being hit by cars and of acquiring communicable infectious diseases.
- Vaccination increases an individual's resistance to disease but the protection is not absolute for most biologics.

## Environmental Factor Examples

- Animal stocking density
- Animal movement between groups
- Housing (e.g. ventilation, sanitation)
- Environmental conditions (e.g. temperature, humidity, wind velocity, precipitation)
- Nutrition (protein, energy and macromineral and micromineral adequacy)

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- Many infectious agents are susceptible to the ultraviolet (UV) in direct sunlight and to desiccation. Many infectious agents survive for long periods in damp environments.

- Strangles (Strep. equi) in horses appears to occur more frequently during damp cold weather. This is likely because the agent is able to survive longer in damp environments.

- Salmonellosis in all animals including humans occurs more frequently during summer than during other times of the year. This is likely because the agent is able to replicate to infectious doses in moist feedstuffs at summer temperatures.

- Bluetongue virus grows more rapidly in Cuilicoides variipennis at higher temperatures.

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- A strong association has been shown between bluetongue infection in cattle and both temperature and rainfall.

- These factors interact in complex ways that are often under the control of man.

- Eg: Increased animal density may lead to increased microbial load in the environment, a roof may prevent exposure of microbe to killing UV, low ventilation may increase humidity from animal respiration which in turn increases environmental survival of the organism which in turn increases exposure dose and infects more animals.

- It has been said that:

"Bovine mastitis is a disease of man with signs in the cow."

"Bad management will overwhelm the best immunology."

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# The "Iceberg" Concept

- In outbreaks of most disease in animal groups, both clinical cases (the tip of the iceberg) and subclinical cases (unobserved beneath the ocean surface) are present in the group.

- For many infectious agents, particularly those that are endemic, more of the infections in a group are subclinical (silent) than are clinical.

- For some exceptions, such as rabies, few if any subclinical infections occur and almost all if not all clinical infections end in death.

- This iceberg concept of severity distribution also holds for most induced, non-infectious diseases affecting a group, such as hypomagnesemia, ketosis and hypocalcemia.

- Disease in an individual is often evidence of a group phenomena because the factors that caused the disease in that individual are usually affecting others adversely as well.

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# The "Iceberg" Concept

- For most groups, the response to the host-agent-environment interaction that results in disease is usually not an either / or, black or white phenomenon.

- Instead, it is usually a continuum, with different individuals expressing different degrees of severity at different times as determined by the unique combinations of agent – host – environment risk factors that they experience.

- For each problem outbreak, the "shape" of this iceberg (the proportion affected, the proportion of the affected that become clinical and the proportion of these that die) at any point in time depends on the specific combination of agent, host, environment, vector (if one is involved), and human husbandry / management factors acting in that specific situation.

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# The "Iceberg" Concept

- Because these factors change over time (e.g., animal immune responses eliminate the infection, humans change their management practices, the environment changes both seasonally, day-to-day and year-to-year), this "shape" changes over time.

- This does make outbreak investigation and problem solving both challenging and rewarding for the clinician.

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# The "Endemic Stability" Concept

- Many endemic infectious agents do not cause clinical disease in newly infected hosts under normal circumstances of transmission and infection (low dose to an immunocompetent host).
- Disease is most often the result of the disruption of this relationship (e.g., high infectious dose, stressed host, failure of passive transfer).
- Disease associated with such agents is much less often due to the introduction or emergence of a more infectious or more virulent strain.

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## The "Herd Immunity" Concept

- Transmission of most communicable infectious agents will not continue within an exposed group of animals if the proportion of resistant animals in that group is above a threshold level, typically 70 to 80%.
- This level depends upon the agent and factors influencing the likelihood of transmission, such as animal density and the typical dose of the agent.
- This resistance can be passive immunity (acquired antibodies), active immunity (previous infection or immunization) or innate resistance.
- On the other hand, if the animal density or the agent dose is significantly high, all individuals in a population may effectively be susceptible to infection even with adequate vaccination.

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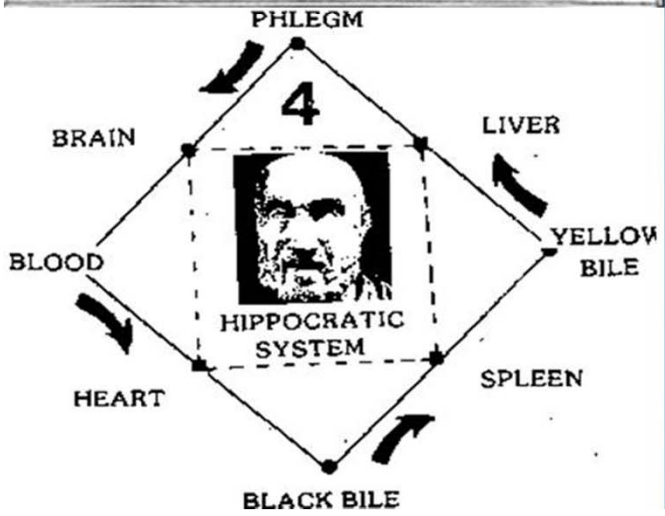
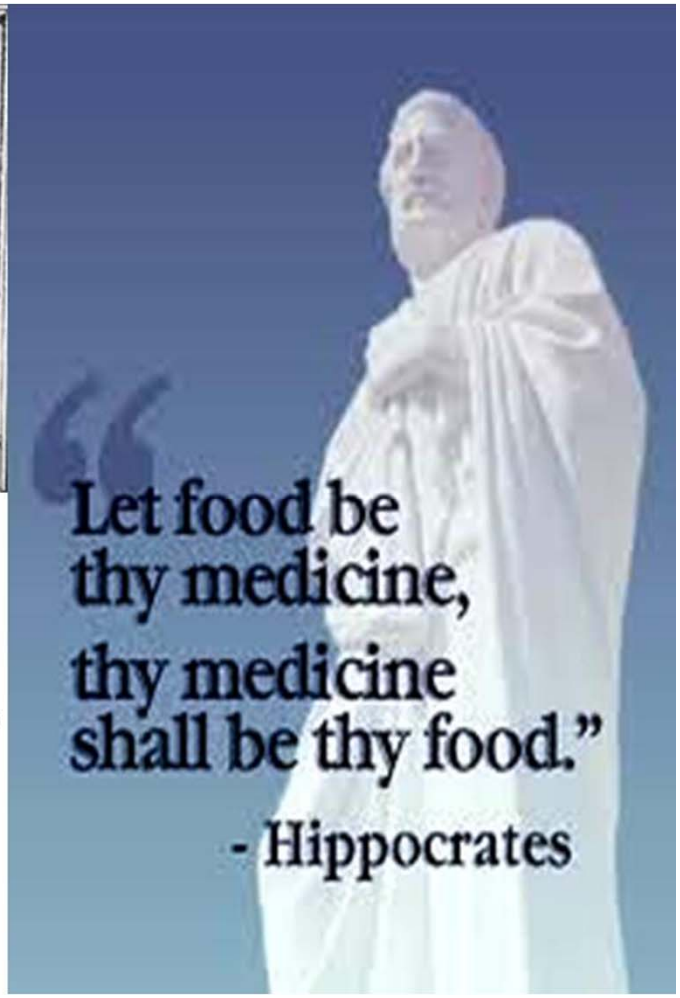
# Hippocrates and the Humoral Theory

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# Hippocrates and the Humoral Theory

The quotes from Hippocratic treatises concisely summarized the humoral theory:

- The human body contains blood, phlegm, yellow bile, and black bile. These are the things that make up its constitution and cause its pains and health. Health is primarily a state in which these constituent substances are in the correct proportion to each other, both in strength and quantity, and are well mixed.

- All human diseases arise from bile and phlegm; the bile and phlegm produce diseases when, inside the body, one of them becomes too moist, too dry, too hot, or too cold; they become this way from foods and drinks, from exertions and wounds, from smell, sound, sight, and venery, and from heat and cold.

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# Hippocrates and the Humoral Theory

- Diseases arise because of humoral imbalances. For example, too much bile can produce various fevers, and too much phlegm can cause epilepsy or angina. Imbalances arise from natural causes such as heredity (phlegmatic parents have phlegmatic children), regimen (diet and other behavior), and climate (temperature, wind, and moisture conditions).

- Different kinds of imbalance produce different diseases with symptoms and development that were acutely observed by the Hippocratics. They described in detail not only the symptoms of patients with a particular disease, but also the ways that the patients tended to develop toward recovery or death.

- The course of a disease was affected by the development of a particular humor, producing crises that signaled basic changes in patient outcome. Fevers were classified as tertian, quartan, and so on based on the number of days before a crisis occurred.

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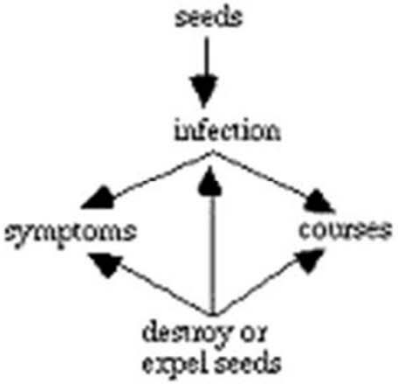
# Fracastoro and the Contagion Theory

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# Fracastoro and the Contagion Theory

- Fracastoro, the Italian Physician suggested that the persons can contract infections even if their humors are normally balanced. He defined a contagion as a "corruption which develops in the substance of a combination, passes from one thing to another, and is originally caused by infection of the imperceptible particles".

- He called the particles the seminaria (seeds or seedlets) of contagion. He described how contagion can occur by direct contact, by indirect contact via clothes and other substances, and by long-distance transmission. In addition, he stated that diseases can arise within an individual spontaneously.

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# Pasteur, Lister, Koch and the Germ Theory

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# Pasteur, Lister, Koch and the Germ Theory

- The germ theory viewed diseases in terms of a causal network similar to that of Fracastoro, but with much more detail about the nature of germs and possible treatments.

- The Hippocratics were largely confined to a taxonomy of diseases in terms of symptoms, and Fracastoro' theory allowed only a limited causal classification based on kinds of contagion; but the germ theory of disease made possible a detailed and clinically powerful taxonomy of diseases in terms of their microbial causes.

- Today, infectious diseases are typically classified as bacterial (e.g. tuberculosis,), viral (e.g. herpes), protozoal (e.g. trypanosomes), and so on.

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# Current Concepts of Diseases

- Currently the authoritative Textbooks of Medicine are divided into parts that implicitly classify diseases in two complementary respects: organ systems and pathogenesis.

- Most of these are organized around physiological systems, such as the cardiovascular and respiratory systems. But there are also parts that group diseases in terms of pathogenetic mechanisms that can affect various organ systems: oncology, metabolic diseases, nutritional diseases, infectious diseases, and so on.

- Some diseases are naturally discussed in more than one part, as when myocarditis occurs both under cardiovascular diseases and infectious diseases.

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# Current Concepts of Diseases

- Modern medical classification thus blends two overlapping taxonomies of disease.

  - Cardiovascular diseases
  - Respiratory diseases
  - Renal diseases
  - Gastrointestinal diseases
  - Diseases of the liver, gall bladder, and bile ducts
  - Hematologic diseases
  - Oncology
  - Metabolic diseases
  - Nutritional diseases, etc.

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# Thank You

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