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University of Gondar

Preventive Veterinary Medicine (VCME-574)
Chapter -1 3 Cr hr (2.5+0.5)
Compiled by Dr Seleshe N, CVMASc, UoG
http://www.uog.edu.et

Lesson Objectives

- Define Prev vet medicine
- To introduce the role of vet preventive medicine in health
- Resistance in disease
- Immunity type

Introduction

What is “Preventive Veterinary Medicine”?

Definition:-

-it is a branch of vet med, which deals with the diseases of infectious origin and of contagious nature ; its occurrence among animal population and its prevention and control measure by suitable and appropriate measure

Preventive Vet Medicine

- prevent animal diseases from affecting people.
  - prevent diseases ***associated with animal usage*** from affecting people.
- The veterinarian’s role in human health is through preventive medicine for people.

Clinical Vet Medicine v/s Preventive Vet Medicine

-Objective of **clinical** vet medicine =
- "cure sick"
- deals with individual animal

-Objective of **preventive** vet medicine
-"solve herd problem"
- deals prevention in the flock / herd
➔ also called *"herd health medicine. "*

Historical View

- The history of mankind has been dominated by epidemic disease - not great armies

"Swords and lances, arrows, machine guns, and even high explosives have had far less power over the fates of the nations than the typhus louse, the plague flea, and the yellow fever mosquito."

Zinsser,

Current Perspectives in the War Against the Microbes

- Joshua Lederberg:
  - "Infectious Disease as an Evolutionary Paradigm"
    - Infectious agents are constantly changing, DNA exchange among microbes is extensive.
    - There are remnants of over 300 retroviruses in our genome.
- Laurie Garrett- "The Coming Plague"
  - The war against microbes has not been won.
  - Most emerging human infections are zoonotic.
- The current COVID-19 which is caused by SARS-CoV-2 up to now causes devastating losses both economically and on human life and yet human binges are not fully equipped and ready to control it

- Epidemic disease is largely controlled through preventive medicine by:
  - Sanitation (food hygiene, pest control, etc.)
  - Good nutrition
  - Disease control measures
    - education, isolation, vaccination, eradication, control of disease in animals, etc.
- Major improvements were made before the advent of antibiotics or curative medicine.
  - Due to improvements in sanitation (preventive medicine, disease control practices) and nutrition
    - Both of which are key elements of preventive medicine

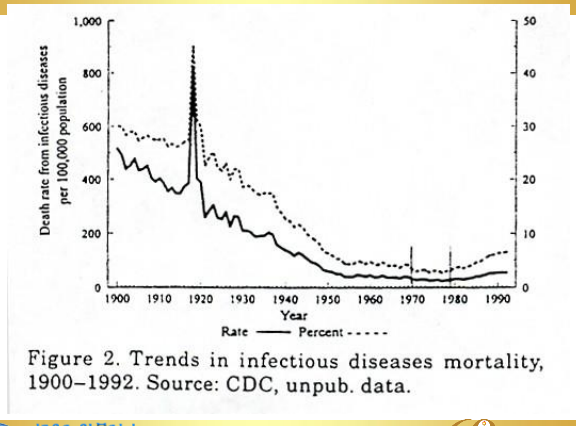
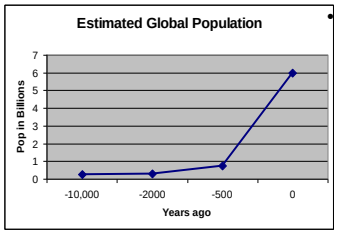


Figure 2. Trends in infectious diseases mortality, 1900–1992. Source: CDC, unpub. data.

Graph of the Human Population Over Time



- Two inflection points
  - Agricultural revolution
  - Industrial revolution

- Preventive Vet Med
  - look upon ways in which veterinarians participate in (human) preventive medicine.
- Veterinarians work for human society *through* their work with animals
  - *The field of public health is specifically mentioned in the veterinary oath*

Health Management of Food Animals

- Health Management of Food Animals relats with animal husbandery .
  - **Animal husbandry** is the management and care of farm animals by humans for **profit**, in which genetic qualities and behavior, considered to be advantageous to humans,

- **Integrated veterinary herd health management** is the basis for **sustainable animal production**

Development in farm leads to:-

- More free trade and competition in farm products
- Industrialization of farming
- Animals in large units

  Minimization of investment costs for animal facilities
- Individual productivity has increased very much by selected breeding
- Cows are forced to the maximum limits of their productivity

- Consequences of developments
  - Animal health problems
  - Impaired animal welfare
  - The use of large amounts of medicines
  - High risk for residues (medicament)
  - Consumers interest increased:-
    - Demand daily food at a low price
    - Ask questions directed to animal welfare
    - Concerned about residues in food of animal origin

What to do?

- How…
  - to keep animals in good health
  - to improve animal welfare
  - to produce safe food for a reasonable price
- Necessary to :-
  - To start a herd health management program
  - The veterinarian has to develop strategies to improve animal health and welfare and to produce safe food.
  - Farmers should pay more attention to animal health and welfare and save food.

History of Health management

- Originally the emphasis was on the **individual** cow affected with a **clinical disease.**
- About 30 years ago **subclinical disease** was recognized as the major cause of economic loss
- It turned out that regularly scheduled visits to farms were effective in improving the health status. Because most health problems are complex and are of **multifactorial** origin
  - For example fertility and mastitis.

HEALTH STATUS AND ANIMAL WELFARE

- Are mainly influenced by:
  - Housing conditions
  - Feeding
  - Hygienic measures
  - Infections
  - Breeding and selection
  - Management

- For example: **Fertility** is influenced by
  - Housing
    - : slippery slatted floors and poor quality beddings
  - Feeding
    - : negative energy balance
  - Hygiene
    - : endometritis, abnormal discharge
  - Infections
    - : Bovine Viral Diarrhea Virus
  - Breeding
    - : high or low "fertile" bulls
  - Management
    - : heat detection

HERD HEALTH MANAGEMENT PROGRAMMES

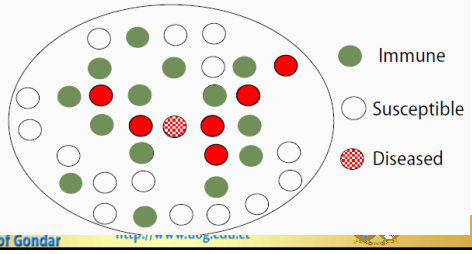
- Goal:
  - to eliminate production inefficiencies
    - which are caused by factors that impair animal health
  - the animals and animal products entering the food chain (dairy, slaughterhouse) must be *free from disease and residues*
- A herd health management programme **is a total quality assurance system**, which consists of :
  - Regularly scheduled **veterinary** activities
  - Good herd management by the **farmer**

CORNERNSTONES OF HERD HEALTH PROGRAMMES

- A **competent veterinarian**
  - Cattle specialist–
  - Services must be delivered economically
- **A farmer** who is committed to the programme comply with the recommendations of the veterinarian
- A **good data recording** system
  - Simple Manual or
  - computerized data recording

Herd Immunity and Disease Transmission

- In a population, disease transmission may stop before all susceptible individuals are infected
- **Herd immunity** is the resistance of a group to attack from a disease to which a large portion of members are immune, thus lessening the likelihood of a patient with a disease coming into contact with a susceptible individual



Requirements of Herd Immunity

- The disease agent is restricted to a single-host species within which transmission occurs
  - For example, smallpox in human; no reservoir
- There is relatively direct transmission from one member of the host species to another (direct contact only)
- Infections must induce solid immunity (also from immunization)

Factor that affect the Success of heard immunity

- The **success** of herd immunity in controlling the disease **depends on**
  - the proportion of animals with immunity in a population
    - Immunity can be from immunization or infection
- when the population is immunized (e.g. ,vaccinated) at or above the herd immunity level (critical immunization threshold), the infectious disease will not spread and will be eliminated
- Herd immunity level differs for various diseases
  - Ex
    - **94% of the population must be immune before measles can be controlled**
    - around **90% for** mumps
- The more infectious the disease is, the higher the herd immunity level required to control the disease

Prevention and control of infectious diseases include different approaches :--

- **Hand washing** - one of most important means of preventing infection
- **Sterilization**
  - Moist heat
    - *Autoclaving* (121°C => 15 lb pressure 15 min) invented by Charles Chamberland in 1879
    - *Tyndallization* (90-100°C for15 min for three successive days with interval in b/n => in which spore germinates to vegetative form, so can be killed easily (Invented by the 19th century scientist John Tyndall.)
    - *Boiling*
    - *Pasteurization (LTLT, HTST) (*after microbiologist Louis Pasteur, 1864)
  - Dry heat
    - Red –hot (eg:- inoculating wire …sterilized on blue flam till it gats red)
    - Flaming (eg:-glass slide passed over a flame to sterilize , not expected to be red
    - Hot air oven (160 °C for 1 hr)
- Disinfectants (freeing of objects from harmful org) (affected by Tem, pH, Concentration..)
- Antiseptics (prevent the *growth* of mic org)
- Antibiotics (Chemo prophylaxis)
- **Vaccinations (to enhance the immune system)**

History of Immunization

- 1st century BC in India and Chaina

=>Variolotion

inoculation of dried exudate from smallpox

- In 1796 (98) Edward Jenner (British)

Vaccination with cowpox to prevent small pox

- Lewis pasture
  - 1879 Importance of reducing the ability of an immunizing organism (accidentally discovered *pasturella multicida* vaccine)
  - 1885 the 1st successful vaccine against rabies (by drying spinal cord of rabied dog)

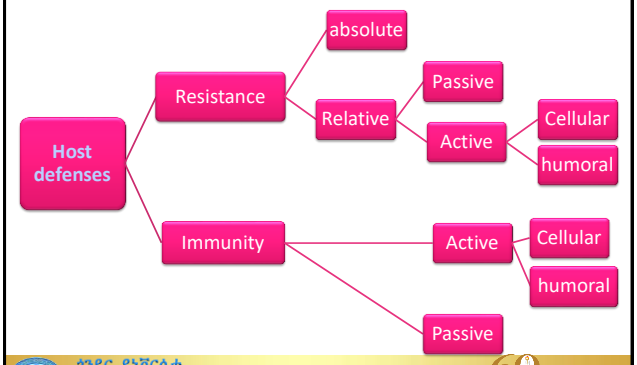
- Salmon (in US)
  - Vaccine from dead mic org (heat killed culture) develop against *Salmonella cholerasuis*
- Van Behring & Kitasato (in Germany)
  - Develop filters from *Cl. tetani* (bacteria toxin and not the bacteria) can serve as vaccine

Defense Mechanism against Infection

- Known that local breeds (with their genetically determined resistance mechanism)
  - have better defense than the exotic
    - to infections
    - also for the poison plants in the tropical country.
- **=> *Resistance***
  - *Congenital and hereditary* trait
    - of the organism used for defending itself against infection, toxin, allergic and neoplastic antigen=>*passive resistance*
  - *Cellular and humeral factors* => *active resistance*

- ***=> immunity***
  - Acquired **actively** or **passively**
  - Combat to a particular Ag to which it is formed
  - **=> specific**
    - Active if only unspecific mechanism are unable to control

Host defense mechanism



Resistance

- The totality of defense before an immune response has developed
- Enables
  - To suppress the clinical manifestation or
  - Mitigate (moderate) mic org (Ag) to stimulate the development of specific defense
- Is not specific to Ag
- Divided to
  - **Absolute** and **relative** resistance

- ***Absolute*** *resistance*
  - *Complete insusceptibility* of an organism to a specific pathogen
  - Usually specific to a given species
  - No immune response that can be detected serologically exist
    - Eg equine is not susceptible to FMD viruses
- ***Relative*** *resistance*
  - *Composed of passive or active resistance*

✓ *Passive resistance*

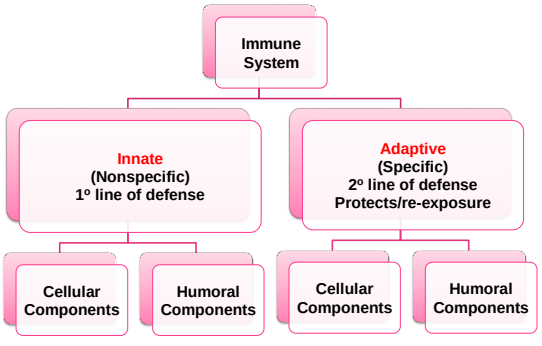
- Basically is components of constitution of the animal (anatomical and physiological properties important for adaptation)
  - Eg adaptation of tropical climate of *Bos taurus indicus*
    - Skin thickness, pigmentation, color, location and structure of sweet glands ,
    - Metabolism (capacity of water retention, capacity of digestion of crud fibers …)
    - Relative low level of productivity (saving energy)
    - Various secretions in the body
- Variation can occur b/n breeds of the same species (exotic breeds are more sensitive to CBPP, photophobia)

✓ *Active resistance*

- Is complex in nature
- Important is **cellular resistance factors** but assisted and **stimulated by humoral** resistance
  - **i.e . Phagocyting cells**
    - Micro and Macrophages
  - **Macrophages**
    - Have single rounded nucleus and avidly **phagocytic** (mono nuclar phagocytic)
    - Capable of **repeated** phagocytic activity
    - Process and present Ag for immune rxn

- Macrophages appear
  - In the blood as=> **monocytes**
  - In the connective tissue as=> **histocytes**
  - In liver as=> **Kupffer cells**
  - In the brain as=> **micro glial**
  - In the lung as =>**alviolar macrophages**

Overview of the Immune System

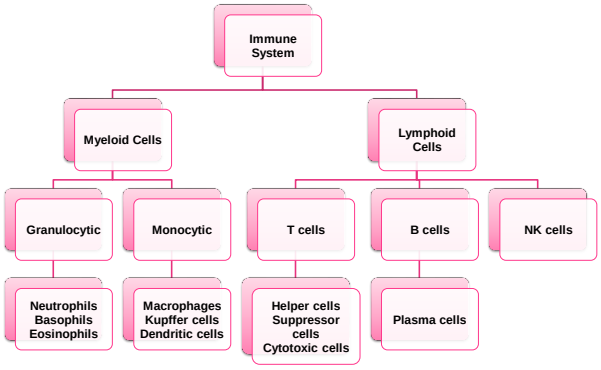


Interactions between the two systems

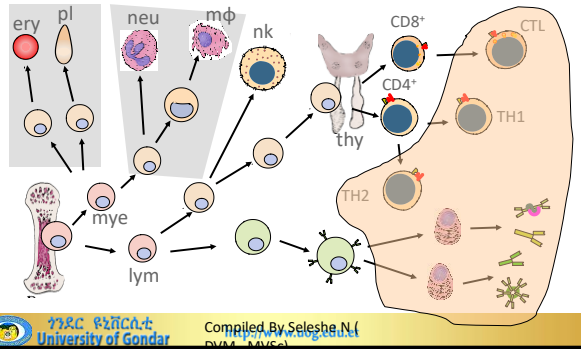
Comparison of Innate and Adaptive Immunity

Innate Immunity	Adaptive Immunity
No time lag	A lag period
Not antigen specific	Antigen specific
No memory	Development of memory

Cells of the Immune System



Development of the Immune System



Innate Host Defenses Against Infection

- Anatomical barriers
  - Mechanical factors
  - Chemical factors
  - Biological factors
- Humoral components
  - Complement
  - Coagulation system
  - Cytokines
- Cellular components
  - Neutrophils
  - Monocytes and macrophages
  - NK cells
  - Eosinophils

Anatomical Barriers - Mechanical Factors

System or Organ	Cell type	Mechanism
Skin	Squamous epithelium	Physical barrier Desquamation
Mucous Membranes	Non-ciliated epithelium (*e.g.* GI tract)	Peristalsis
	Ciliated epithelium (*e.g.* respiratory tract)	Mucociliary elevator
	Epithelium (*e.g.* nasopharynx)	Flushing action of tears, saliva, mucus, urine

Anatomical Barriers - Chemical Factors

System or Organ	Component	Mechanism
Skin	Sweat	Anti-microbial fatty acids
Mucous Membranes	HCl (parietal cells) Tears and saliva	Low pH Lysozyme and phospholipase A
	Defensins (respiratory & GI tract)	Antimicrobial
	Surfactants (lung)	Opsonin

Anatomical Barriers - Biological Factors

System or Organ	Component	Mechanism
Skin and mucous membranes	Normal flora	Antimicrobial substances Competition for nutrients and colonization

Cellular Components

Cell	Functions
Neutrophils	Phagocytosis and intracellular killing Inflammation and tissue damage
Macrophages	Phagocytosis and intracellular killing Extracellular killing of infected or altered self targets Tissue repair Antigen presentation for specific immune response
NK and LAK cells	Killing of virus-infected and altered self targets
Eosinophils	Killing of certain parasites

Humoral Components of innate immunity

Component	Mechanism
Complement	Lysis of bacteria and some viruses Opsonin Increase in vascular permeability Recruitment and activation of phagocytic cells
Coagulation system	Increase vascular permeability Recruitment of phagocytic cells B-lysin from platelets – a cationic detergent
Lactoferrin and transferrin	Compete with bacteria for iron
Lysozyme	Breaks down bacterial cell walls
Cytokines	Various effects

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