VCH 601: DISEASE DISTRIBUTION AND PREVENTION (2 UNITS)

Course Synopses

Role of Epizootiology in Veterinary Practice

Definition of Veterinary Epidemiology, Uses of Veterinary Epidemiology, Planning and Monitoring of Disease Control Programmes

Types of Epidemiological Investigation, Components of Epidemiology

Methodologies of Descriptive and Analytic Epizootiological Investigations including Design, Experimentation, Data Analysis and Result Interpretation

Diseases in Population

Disease Surveillance and Monitoring

Safety Precautions for Animal Handlers, Mass Action against Diseases

Types of Vaccine and Immunization Procedures

Active and Passive Immunization

Chemoprophylaxis

Influence of Climate on Disease Spread

Role of Epizootiology in Veterinary Practice

Epizootiology is also referred to as Veterinary Epidemiology and this is concerned with disease in animal populations.

Many contemporary disease problems can be solved by the investigation of animal populations rather than the individual animal. The natural history of infectious diseases can be understood by studying their distribution in different populations. The measurement of the amount of infectious and non-infectious disease in a population assists in determining their importance and the efficacy of control campaigns.

Complex and unknown causes of diseases can be eliminated by studying the diseases in various age groups of animals. The effect of diseases on production can be realistically estimated only in relation to decreased production in the herd/flock rather than in a single animal. The economic impacts of disease and of attempts at its control similarly are best evaluated in groups of animals ranging from the individual farm to the national level.

The investigation of disease in populations is the basis of epidemiology.

Epidemiology is the study of disease in populations and of factors that determine its occurrence; the key word being population. Once the cause of disease and the risk factors for disease are determined then prevention and control programmes can be implemented.

Veterinary Epidemiology involves the study of the occurrence and the risk factors of disease or health-related events in an animal population and the application of such to the prevention and control of the disease. Veterinary Epidemiology additionally includes investigation and assessment of other health-related events, notably productivity. All of these investigations involve observing animal populations and making inferences from the observation.

The first step in determining the cause of disease is to describe and measure the distribution of the disease in the affected animal population. Epidemiology not only involves the study of disease in population, but also the application of prevention and control programmes in the population, which also lead to the prevention and control in individual animals. Preventive measures keep disease from occurring.

Control of a disease involves the management of the disease in individual animal, so that it does not progress. It involves the prevention of the spread of the disease in a population.

Definition of Veterinary Epidemiology

Epidemiology is the study of disease and its treatment, control and prevention in a population, including the factors that determine its occurrence. The keyword here is population. Epidemiology is opposed to clinical medicine which deals with disease at the individual level.

Veterinary Epidemiology (Epizootiology) is the comprehensive study of the variable factors, events, forces and circumstances that may contribute to the occurrence, distribution, control and prevention of ill-health, diseases and other problems in groups (herds, flocks or populations) of animals.

All these investigations involve observing animal population and making inferences from the observations. Since the total animal population cannot be studied, samples will have to be taken from the population, and these must be representative of the population for the results to be generalized to the total population of animals under consideration.

The Uses of Veterinary Epidemiology

The uses of Veterinary Epidemiology can be broadly classified under five main objectives:

i. determination of the origin of a disease whose cause is known;
ii. investigation and control of a disease whose cause is either unknown or poorly understood;
iii. acquisition of information on the ecology and natural history of a disease;
iv. planning and monitoring of disease control;
v. assessment of economic effects of a disease and analysis of the costs and economic benefits of alternative control programmes

Components of Veterinary Epidemiology

Veterinary epidemiology is a holistic approach aimed at coordinating the use of different scientific disciplines and techniques during an investigation of disease or impaired productivity or welfare.

The field of veterinary epidemiology can be divided into different components as presented in the Figure below.

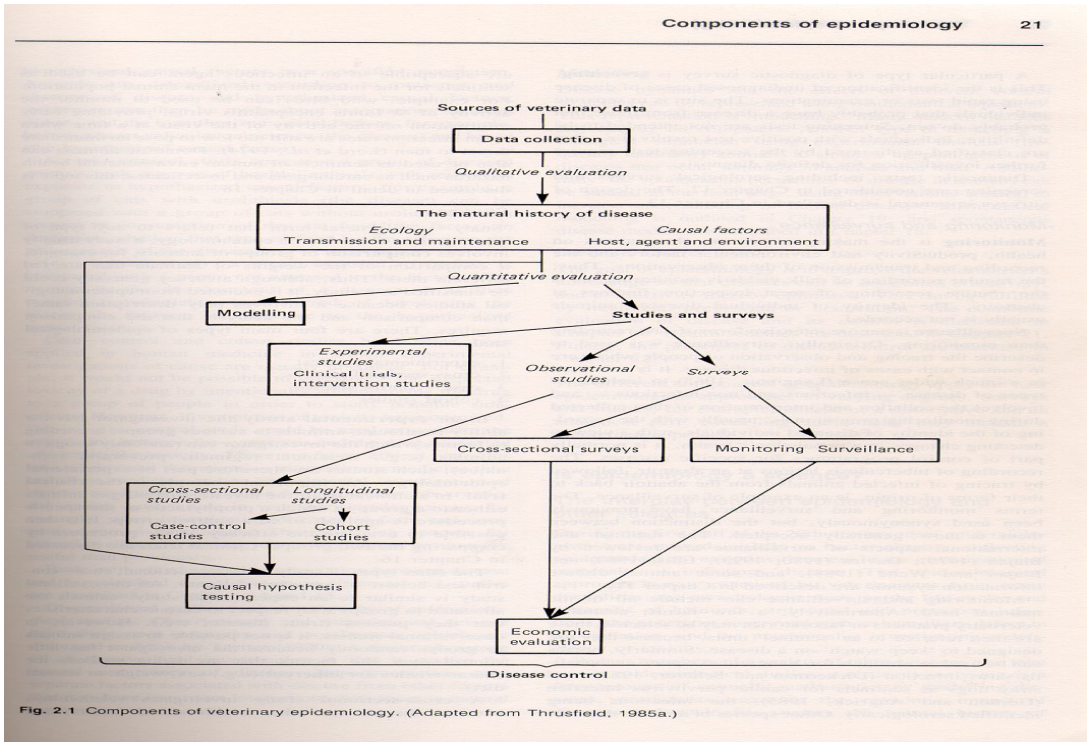


Fig. 1. Components of Veterinary Epidemiology

One of its essential foundations is the collection of data, which then has to be analyzed using qualitative or quantitative approaches in order to formulate causal hypotheses.

The natural history of disease

The ecology of diseases including the distribution, mode of transmission and maintenance of infectious diseases, is investigated by field observation, and patterns of disease occurrence. Field observations also may reveal information about factors that may directly or indirectly cause disease.

Causal hypothesis testing

If field observations suggest that certain factors may be causally associated with a disease, then the association must be assessed by formulating a causal hypothesis.

QUANTITATIVE INVESTIGATIONS

Quantitative investigations involve measurement (e.g., the number of cases of disease), and therefore expression and analysis of numerical values. Quantitative investigations include surveys, monitoring and surveillance, studies, modelling, and the biological and economic evaluation of disease control.

Survey

A survey is an examination of an aggregate of units. A group of animals is an example of an aggregate. The examination usually involves counting members of the aggregate and characteristics of the members. In epidemiological surveys, characteristics might include the presence of particular diseases, weight, and milk yield. Surveys can be undertaken on a **sample** of the population. Less commonly, a **census,** which examines the total animal population, can be undertaken (e.g., tuberculin testing).

A **cross-sectional** survey records events occurring at a particular point in time. A **longitudinal** survey records events over a period of time. These latter events may be recorded **prospectively** from the present into the future; or may be a **retrospective** record of past events.

Monitoring and surveillance

Monitoring is the making of routine observations on health, productivity and environmental factors, including the recording and transmission of these observations. The regular recording of milk yields is monitoring, as is the routine recording of meat inspection findings at the abattoir.

Surveillance is a more intensive form of data recording than monitoring. It involves the collation and interpretation of data collected during monitoring programmes, usually with the recording of the identity of diseased individuals, with a view to detecting changes in a population's health. It is normally part of control programmes for specific diseases. The recording of tuberculosis lesions at an abattoir, followed by tracing of infected animals from the abattoir back to their farms of origin, is an example of surveillance.

Monitoring and surveillance can include the entire national herd. Alternatively, a few farms, abattoirs, veterinary practices or laboratories may be selected; these are then referred to as 'sentinel' units, because they are designed to 'keep watch' on a disease.

Study

Study is a general term that refers to any type of investigation. A study usually involves comparison of groups of animals, for example, a comparison of the weights of animals that are fed different diets. There are four main types of epidemiological study:

- Experimental studies;
- Cross-sectional studies;
- Case-control studies;
- Cohort studies

Disease control

The goal of epidemiology is to improve the Veterinarian's knowledge so that diseases can be controlled effectively, and productivity optimized. This can be fulfilled by treatment, prevention or eradication.

EPIDEMIOLOGICAL STUDIES

Epidemiological study is a population study designed to examine associations (commonly, hypothesized causal relations) between personal characteristics and environmental exposures that increase the risk of disease.

A **study design** is a plan for selecting study subjects and for obtaining data about them.

Descriptive studies

These are often the earliest studies done on a new disease in order to characterise it, quantify its frequency, and determine how it varies in relation to individual, place and time. Descriptive epidemiology involves observing and recording diseases and possible causal factors.

An important component of epidemiological research is aimed at determining the influence of **individual** characteristics on the risk of disease. Individuals can be grouped or distinguished on a number of characteristics: age, sex, and breed, coat colour etc.

Temporal patterns of disease in populations are presented graphically using epidemic curves. An epidemic curve consists of bar charts showing time on the horizontal axis and the number of new cases on the vertical axis. Epidemics are defined as disease occurrence which is higher than expected. Endemic disease describes the usual frequency of disease or constant presence of disease. Pandemic disease occurrence refers to widespread epidemics affecting a large proportion of the population and possibly many countries. Sporadic disease occurrence is characterised by situations with single cases or clusters of cases of disease which are normally not present in an area.

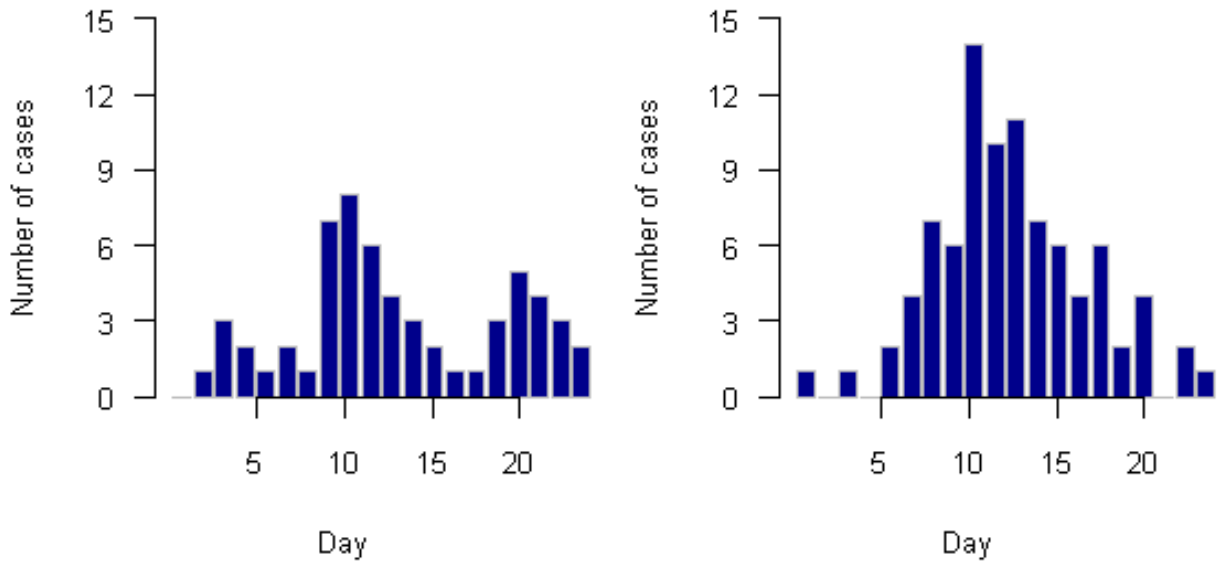


Fig. 2. Epidemic curves. The plot on the left is typical of a propagated epidemic. The curve on the right is typical of a common source epidemic

The **spatial pattern** of disease is typically a consequence of environmental factors. Environmental factors include aspects of climate (temperature, humidity, rainfall) as well as aspects of animal management (management of animals in a certain area of a country may result in high rates of disease that may not be seen in other areas.

The term **epidemiological triad** refers to the three components of epidemiological system thinking: **agent, host** and **environment**. The host is the animal (or human) that may contract

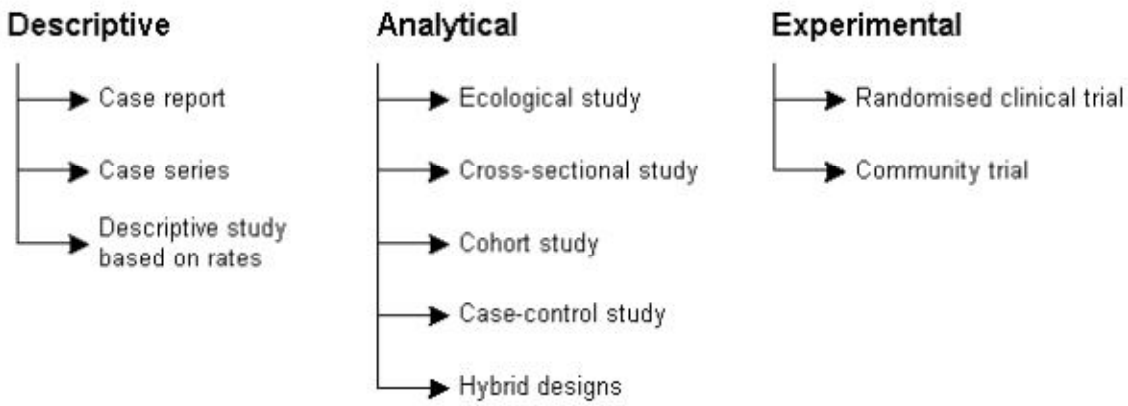
a disease. Age, genetic makeup, level of exposure, and state of health all influence a host's susceptibility to developing Disease .The agent is the factor that causes the disease (bacteria, virus, parasite, fungus, chemical poison, nutritional deficiency etc) — one or more agents may be involved. The environment includes surroundings and conditions either within the host or external to it that cause or allow disease transmission to occur. The environment may weaken the host and increase its susceptibility to disease or provide conditions that favour the survival of the agent. Descriptive studies can be a rich source of hypotheses that lead later to analytical studies

Case reports: A case report describes some 'newsworthy' clinical occurrence, such as an unusual combination of clinical signs, experience with a novel treatment, or a sequence of events that may suggest previously unsuspected causal relationships. Case reports are generally reported as a clinical narrative.

Cases series: Where as a case report shows that something can happen once, a case series shows that it can happen repeatedly. A case series identifies common features among multiple cases and describes patterns of variability among them.

Descriptive studies based on rates: Descriptive studies based on rates quantify the burden of disease on a population using incidence, prevalence, mortality or other measures of disease frequency. Most use data from existing sources (such as birth and death certificates, disease registries or surveillance systems

EPIDEMIOLOGICAL STUDIES



ANALYTICAL STUDIES

Analytical epidemiology is the analysis of observations using suitable diagnostic and statistical tests. Analytical studies are undertaken to identify and test hypotheses about the association between an exposure of interest and a particular outcome

Ecological studies: In an ecological study the unit of analysis is a group of individuals (such as local government area, states, cities, or wards) and summary measures of exposure and summary measures of outcome are compared. A key feature of ecological studies is that inference can only be made at the group level, not at the individual level. Ecological studies are relatively quick and inexpensive to perform and can provide clues to possible associations between exposures and outcomes of interest.

Cross-sectional studies: In a cross-sectional study a random sample of individuals from a population is taken at a point in time. Individuals included in the sample are examined for the presence of disease and their status with regard to the presence or absence of specified risk factors. Cross sectional studies commonly involve surveys to collect data. Surveys range from simple one-page questionnaires addressing a single variable, to highly complex, multiple page designs.

There is a whole sub-field of epidemiology associated with design, implementation and analysis of questionnaires and surveys.

Advantages: Cross-sectional studies are relatively quick to conduct and their cost is moderate, compared with other study designs.

Disadvantages: Cross-sectional studies cannot provide information on the incidence of disease in a population — only an estimate of prevalence. Difficult to investigate cause and effect relationships.

Cohort studies

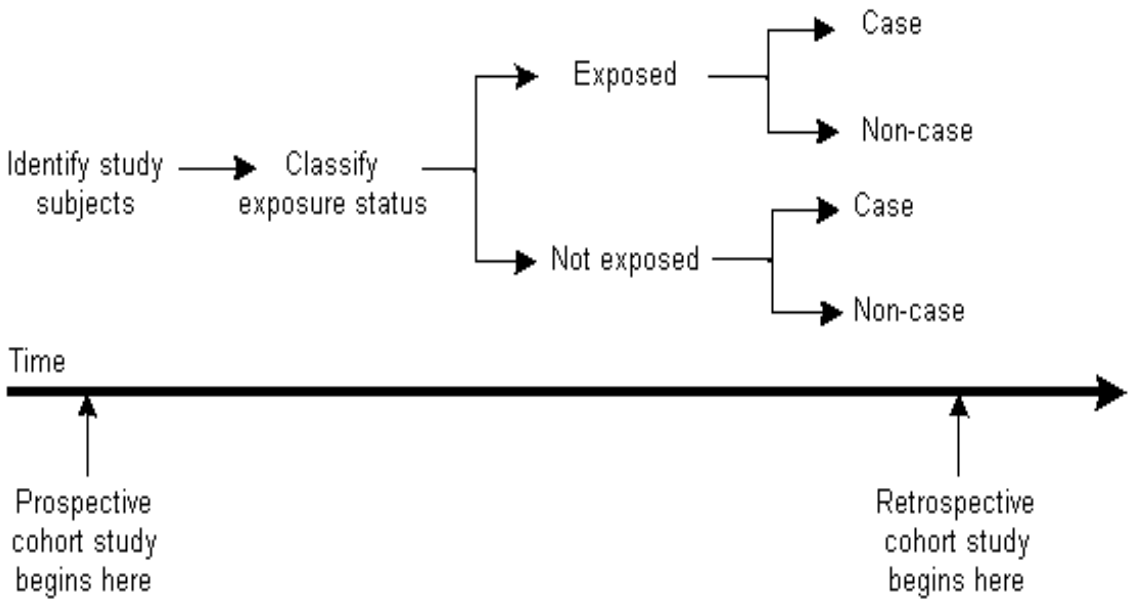
A cohort study involves comparing disease incidence over time between groups (cohorts) that are found to differ on their exposure to a factor of interest. Cohort studies can be distinguished as either prospective or retrospective.

Prospective cohort study A prospective cohort study begins with the selection of two groups of non-diseased animals, one exposed to a factor postulated to cause a disease and the other unexposed. The groups are followed over time and their change in disease status is recorded during the study period.

Retrospective cohort study: A retrospective cohort study starts when all of the disease cases have been identified. The history of each study participant is carefully evaluated for evidence of exposure to the agent under investigation.

Advantages: Because subjects are monitored over time for disease occurrence, cohort studies provide estimates of the absolute incidence of disease in exposed and non-exposed individuals. By design, exposure status is recorded before disease has been identified. In most cases, this provides unambiguous information about whether exposure preceded disease. Cohort studies are well-suited for studying rare exposures. This is because the relative number of exposed and non-exposed persons in the study need not necessarily reflect true exposure prevalence in the population at large.

Cohort studies



Case-control studies: A case-control study involves comparing the frequency of past exposure between cases who develop the disease (or other outcome of interest) and controls chosen to reflect the frequency of exposure in the underlying population at risk.

Advantages: Case-control studies are an efficient method for studying rare diseases. Because subjects have experienced the outcome of interest at the start of the study, case-control studies are quick to run and are considerably cheaper than other study types.

Disadvantages Case-control studies cannot provide information on the disease incidence in a population. The study is reliant on the quality of past records or recollection of study participants. It can also be very difficult to ensure an unbiased selection of the control group and, as a result, the representativeness of the sample selection process is difficult to guarantee.