

<b>COURSE CODE:</b>	VCH 601
<b>COURSE TITLE:</b>	DISEASE DISTRIBUTION AND PREVENTION
<b>NUMBER OF UNITS:</b>	2 Units
<b>COURSE DURATION:</b>	Two hours per week

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## COURSE DETAILS:

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## COURSE CONTENT:

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

## COURSE REQUIREMENTS:

This is a compulsory course for all 600 level students in the college of Veterinary Medicine. In view of this, students are expected to participate in all course activities and have minimum of 70% attendance to be able to write the final examination.

## READING LIST:

Pfeiffer, D. U. (2010). *Veterinary Epidemiology An Introduction*. Wiley-Blackwell. U. K. 135pp

Thrusfield, M. (2007). *Veterinary Epidemiology*. Third Edition. Black Publishing. U. K. 610pp

## LECTURE NOTES

### **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.

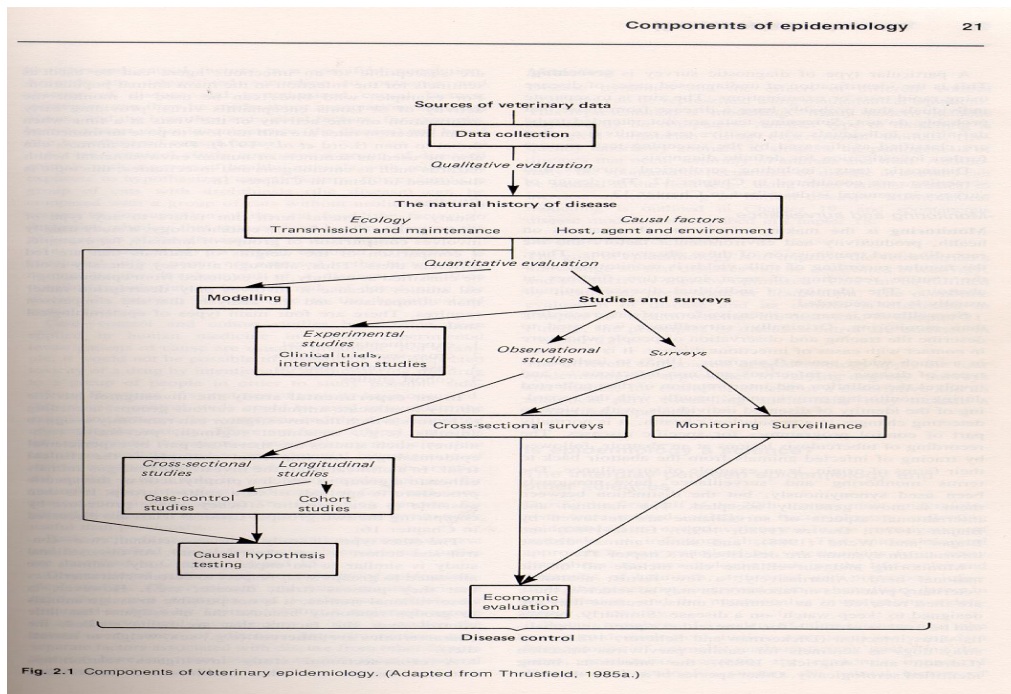


Fig. 1. Components of Veterinary Epidemiology

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.

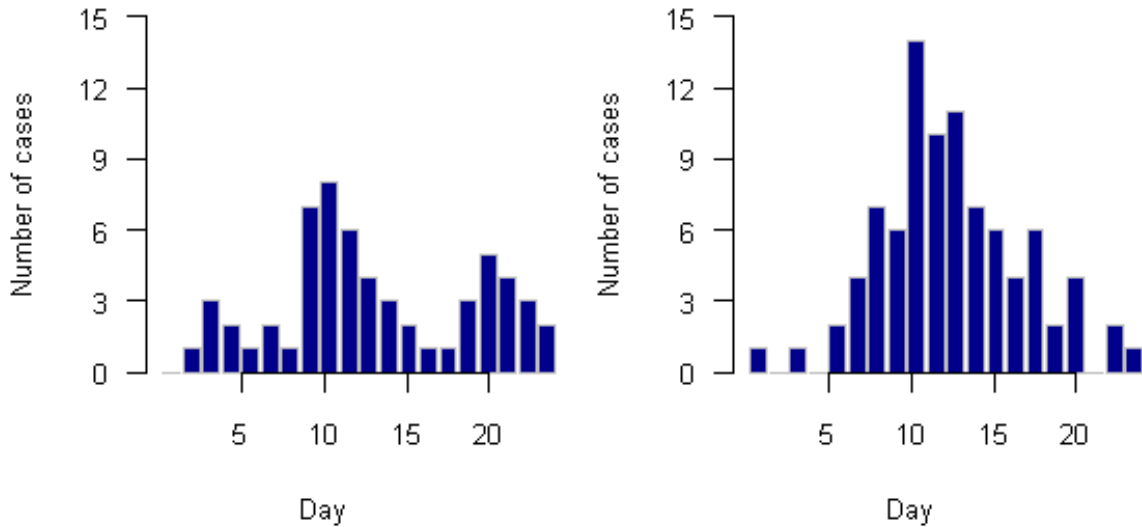
### **Descriptive studies**

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

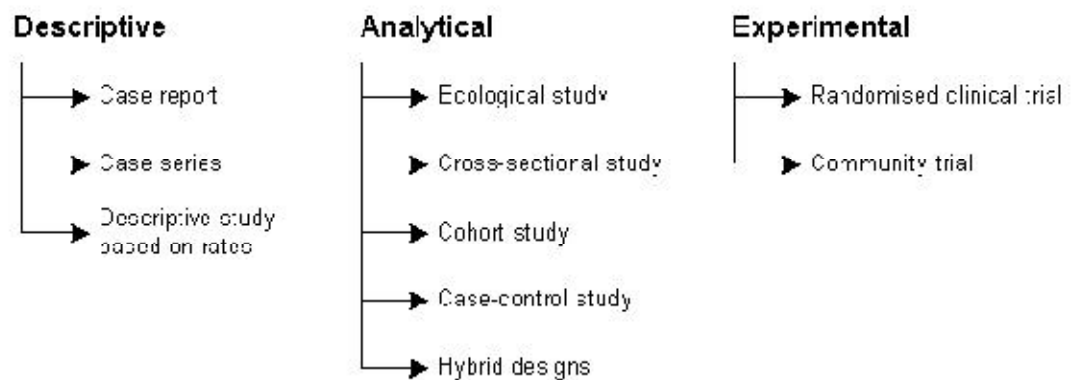
increase its susceptibility to disease or provide conditions that favour the survival of the agent. Descriptive studies can be a rich source of hypotheses that lead later to analytical studies

**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**

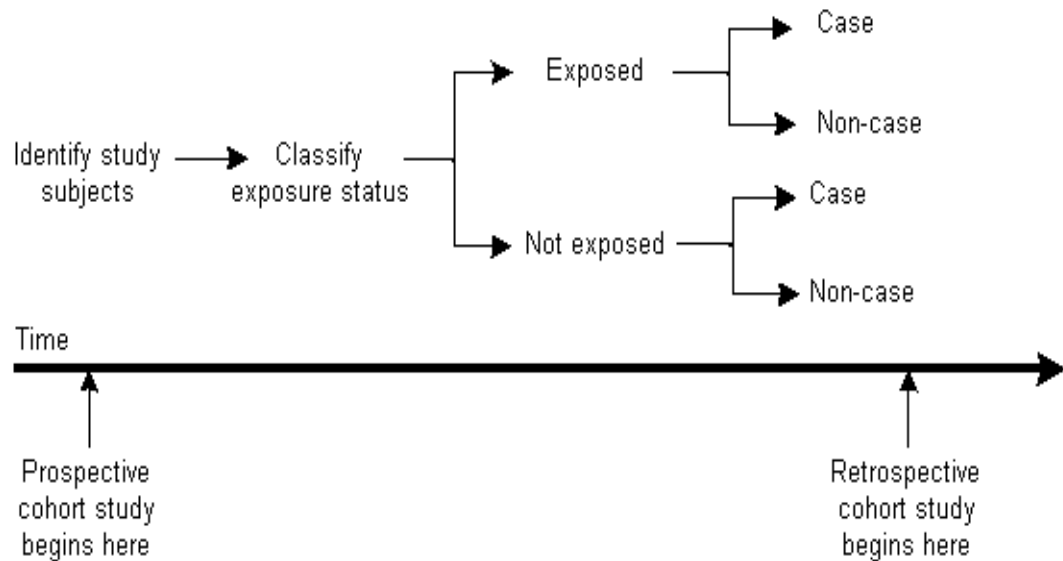
A cohort study involves comparing disease incidence over time between groups (cohorts) that are found to differ on their exposure to a factor of interest. Cohort studies can be distinguished as either prospective or retrospective.

**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.

## **HYBRID STUDY DESIGNS**

A **nested case-control study** is similar to a cohort study with the key difference that samples of non-cases are selected for analysis (rather than the entire cohort, as in the case of a cohort study). Nested case-control studies are useful when it is either too costly or not feasible to perform additional analyses on an entire cohort (e.g. if collection of specimens and laboratory analysis of specimens is expensive)

Compared with standard case control studies, nested studies:

- 1) can utilise exposure and confounder data originally collected before the onset of the disease, thus reducing potential recall bias and temporal ambiguity, and
- 2) include cases and controls drawn from the same cohort, decreasing the likelihood of selection bias.

The nested case-control study is thus considered a strong observational study, comparable to its parent cohort study in the likelihood of an unbiased association between an exposure and an outcome. A concern, usually minor, is that the remaining non diseased persons from whom the controls are selected when it is decided to do the nested study, may not be fully representative of the original cohort due to death or losses to follow-up

**A panel study** combines the features of cross-sectional and a prospective cohort designs. It can be viewed as a series of cross-sectional studies conducted on the same subjects (the panel) at successive time intervals (sometimes referred to as waves). This design allows investigators to relate changes in one variable to changes in other variables over time.

**A repeated survey** A repeated survey is a series of cross-sectional studies performed over time on the same study population, but each is sampled independently. Whereas panel studies follow the same individuals from survey to survey, repeated surveys follow the same study population (which may differ in composition from one survey to the next). Repeated surveys are useful for identifying overall trends in health status over time. However, Prospective cohort studies require a long follow-up period. In the case of rare diseases large groups are necessary. Losses to follow-up can become an important problem. Often it is quite expensive to run.

## **EXPERIMENTAL STUDIES**

The experimental epidemiologist observes and analyses data from groups of animals from which he can select, and in which he can alter, the factors associated with the groups. An important component of the experimental approach is the control of the groups. Experimental studies are also designed to test hypotheses between specific exposures and outcomes. The major difference is that in experimental studies the investigator has direct control over the study conditions.

**Randomised clinical trials** The randomised clinical trial is the epidemiologic design that most closely resembles a laboratory experiment. The major objective is to test the possible effect of a therapeutic or preventive intervention. The design's key feature is that a formal chance mechanism is used to assign participants to either the treatment or control group. Subjects are then followed over time to measure one or more outcomes, such as the occurrence of disease. All things being equal, results from randomised trials offer a

more solid basis for inference of cause and effect than results obtained from any other study design.

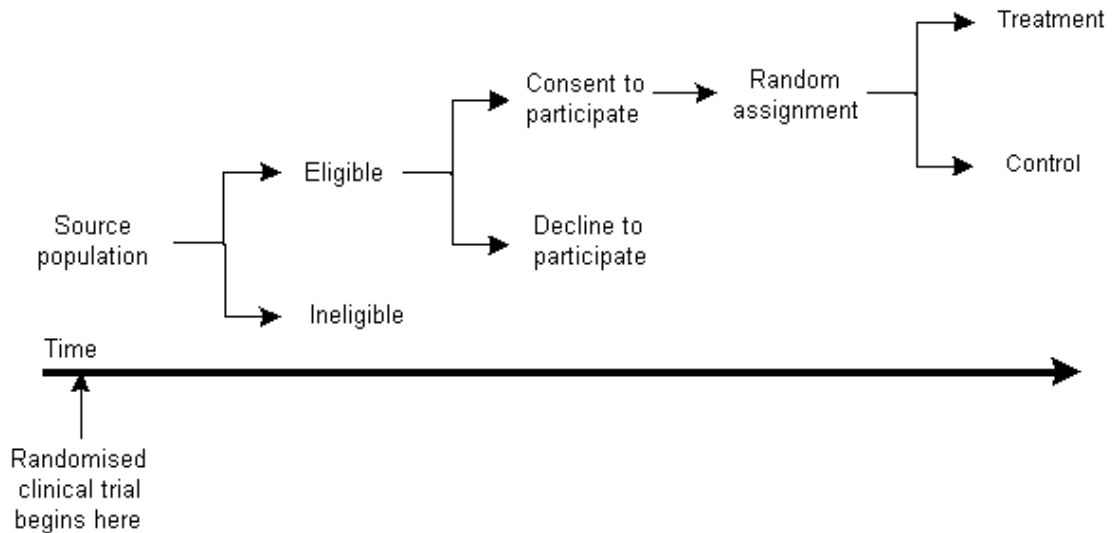


Fig. 3. Schematic diagram of a randomised clinical trial

**Advantages:** Randomisation generally provides excellent control over confounding, even by factors that may be hard to measure or that may be unknown to the investigator.

**Disadvantages:** For many exposures it may not be ethical or feasible to conduct a clinical trial (e.g. exposure to pollution). Expensive. Impractical if long periods of follow-up required.

**Community trials** Instead of randomly assigning individuals to treatment or control groups, community trials assign interventions to entire groups of individuals. In the simplest situation one group (community) receives the treatment and another serves as a control.



## **QUANTIFICATION OF DISEASE EVENTS IN POPULATIONS**

Data used to quantify disease events in populations are often dichotomous in nature i.e. an animal can either be infected with a disease agent or not infected. Such data are frequently presented in the form of an epidemiological *rate*.

In epidemiology, a rate can be defined as the number of individuals having or acquiring a particular characteristic (normally an infection, a disease or a characteristic associated with a disease) during a period of observation, divided by the total number of individuals at risk of having or acquiring that characteristic during the observation period. The expression is then multiplied by a factor, normally a multiple of 10, to relate it to a specified unit of population.

Rates are commonly expressed as decimals, percentages, or events per standard units of population e.g. per 1000, 10000 animals etc. This produces a standardised measure of disease occurrence and therefore allows comparisons of disease frequencies over time to be made between or within populations. Note that in a rate, the numerator is always included in the denominator, while in a ratio it is not included. In an epidemiological rate, the period of observation should always be defined.

It is difficult to make valid comparisons of disease events between or within populations unless a denominator can be calculated. The use of "dangling numerators" to make comparisons is one of the biggest "crimes" that the epidemiologist can commit, and it should be avoided whenever possible.

For example, suppose we were interested in comparing the numbers of cases of infection with a particular disease agent over a particular time period in two herds of cattle of the same breed but under different management systems. We are told that in herd A the number of animals infected with the disease agent in question in the month of June 1983 was 25, while in herd B the number of animals infected with the same disease agent in the same month was 50. We might therefore conclude, erroneously, that the disease was a greater problem in herd B than in herd A. Note that we did not know the denominator i.e. the population of animals at risk of being infected with the disease agent in each herd. Suppose we investigated further and found that the population at risk in herd A during the month of June was 100 while in herd B it was 500. Then, calculating a rate for each herd, we find that the rate of infection in herd A was  $25/100$  or 0.25 or 25% or 250 in 1000, while in herd B it was  $50/500$  or 0.10 or 10% or 100 in 1000. The true position, therefore, is that the disease was a greater problem in herd A!

The two main types of rates used in Veterinary epidemiology are:

*Morbidity rates*, which are used to measure the proportion of affected individuals in a population or the risk of an individual in a population of becoming affected.

*Mortality rates*, which measure the proportion of animals dying in a population.

### **Morbidity rates**

Morbidity rates include incidence, attack, prevalence and proportional morbidity rates.

*Incidence rate* is the number of new cases of a disease occurring in a specified population during a specified time period, divided by the average number of individuals in that population during the specified time period.

For example, suppose that out of an average population of 4000 cattle in a quarantine camp, 600 animals developed symptoms of rinderpest during the month of June. The incidence of rinderpest in that quarantine camp for the month of June was  $600/4000 = 0.15$  or 15% or 150 new cases per 1000 animals.

The incidence rate is a way of measuring the risk that a susceptible individual in a population has of contracting a disease during a specified time period. Therefore, if a susceptible animal had been introduced into the quarantine camp on 1 June, it would have had a 15% chance of contracting rinderpest by the end of the month.

When calculating incidence rates, problems frequently arise in estimating the denominator. Because of births, deaths, sales, movements etc. livestock populations rarely remain stable over periods of time, and such fluctuations in the denominator will obviously affect the calculation of the incidence rate. There are various ways of estimating the denominator in incidence rate calculations. These normally involve measuring the population at various intervals during the study period and averaging the results.

For instance, suppose that in our previous example there were 4000 animals present at the beginning of June but that 100 animals died of the disease by the end of the second week and a further 300 by the end of the month. Assuming that no new animals were introduced or born, the animal population in the quarantine camp at the start of the

observation period was therefore 4000, at the mid-period 3900 and at the end 3600. We might decide to calculate the denominator by taking the populations present at the beginning and end of the observation period and averaging them:

$$(4000 + 3600)/2 = 3800$$

The corresponding incidence rate would be  $600/3800 = 0.158$  or 15.8%.

Alternatively, we might take the populations present at the beginning, middle and end of the observation period and average them -

$$(4000 + 3900 + 3600)/3 = 3833$$

- and the incidence rate in this case would be  $600/3833 = 0.156$  or 15.6%.

Note that the different methods of calculating the denominator have resulted in slightly differing estimates of incidence. Because of this, the method used in calculating the denominator should always be specified when comparisons of incidence are being made, and the same method should be used throughout. Due to difficulties in the calculation of the denominator in incidence rates, another form of morbidity rate, the attack rate, is sometimes used.

The *attack rate* is the total number of cases of a disease occurring in a specified population during a specified time period, divided by the total number of individuals in that population at the start of the specified time period. The denominator, therefore, remains constant throughout the period of observation. Thus, in our previous example, the attack rate would be  $600/4000 = 15\%$ .

Strictly speaking, the definition of the attack rate requires that all cases of disease, not just new cases, are included in the numerator. Attack rates are normally used, however, to quantify the progress of a disease during an outbreak. In most instances there would have been no cases of the disease in question prior to the onset of the outbreak, so that all the cases are, in fact, new cases, and the attack rate becomes a modified form of incidence rate, sometimes referred to as a cumulative incidence rate.

*Prevalence rate* is the total number of cases of a disease occurring in a specified population at a particular point in time, divided by the total number of individuals in that population present at that point in time.

For example, suppose that in a population of 4000 cattle held at a quarantine camp there were 60 cases of rinderpest when the population was examined on June 18. The prevalence of rinderpest at that camp on 18 June would then be  $60/4000 = 0.015$  or 1.5% or 15 cases per 1000 animals.

Note that prevalence is a cross-sectional measure referring to the amount of disease present in a population at a particular point in time, hence the term *point prevalence*. However, when dealing with large populations, point prevalence becomes almost impossible to obtain, since it is not possible to examine all the individuals in that population at a particular point in time. In general, therefore, measurements of prevalence have to take place over a period of time, and this is known as *period prevalence*. Provided that the time taken to measure the prevalence remains reasonably short, this parameter retains a fair degree of precision. If, however, the time interval becomes too long, a significant number of new cases of the disease will have occurred since

the start of the measurement period. The parameter then becomes a mixture of point prevalence and incidence and, as such, loses precision.

The terms incidence and prevalence are frequently confused and misused. Confusion normally arises due to a failure to define accurately the denominator i.e. the actual population being considered. This can result in the population at risk being either ignored or not considered in its entirety.

Examples of this can be found in reports from veterinary offices laboratories, in which the term "incidence" is often used to express the number of diagnoses or isolations of a particular disease agent as a percentage of the total number of diagnoses or isolations performed. In this case the denominator is not the population of individuals at risk from the disease, and the rate calculated resembles a form of a proportional morbidity rate.

*A proportional morbidity rate* is the number of cases of a specific disease in a specified population during a specified time period, divided by the total number of cases of all diseases in that population during that time period.

For example, suppose that an outbreak of contagious bovine pleuropneumonia (CBPP) occurs in a herd of cattle. During a 6-month period there are 45 cases of different diseases, including 18 cases of contagious bovine pleuropneumonia. The proportional morbidity rate for contagious pleuropneumonia in that herd for the 6 months would then be  $18/45 = 0.4$  or 40% or 400 cases of CBPP in 1000 cases of all diseases.

## **Mortality rates**

The most commonly used mortality rates are crude death rate and cause-specific death rate.

*Crude death rate* is the total number of deaths occurring in a specified population during a specified time period, divided by the average number of individuals in that population during the specified time period.

The denominator for this rate can be estimated in the same ways as that for an incidence rate. Note, the method of calculating the denominator should always be defined and the same method used throughout to enable meaningful comparisons to be made.

Example: Suppose that in a herd of cattle there were 40 deaths in a year. The number of animals in the herd at the start of the year was 400, at mid-year 420, and at the end of the year 390. The average herd size could therefore be either

$$(400 + 390)/2 = 395$$

or

$$(400 + 420 + 390)/3 = 403$$

Depending on which method we used to calculate the denominator, the crude death rate would be either  $40/395 = 0.101$  (10.1%) or  $40/403 = 0.099$  (9.9%).

*Cause-specific death rate* is a useful mortality rate and can be defined as the total number of deaths occurring from a specified cause in a specified population during a specified time period, divided by the average number of individuals in that population during that time period.

The denominator is calculated in the same way as for an incidence or crude death rate, and the same caveats apply in its calculation.

Example: Suppose that there were 20 deaths from babesiosis in the herd mentioned above, then the death rate due to babesiosis in that herd would be either  $20/395 = 0.051$  (5.1 %) or  $20/403 = 0.050$  (5.0 %).

#### *Other useful mortality rates*

*Proportional mortality rate* is the total number of deaths occurring from a specified disease in a specified population during a specified time period, divided by the total number of deaths in that population during that time period.

Example: Suppose that out of 40 deaths in a herd 20 were from babesiosis, then the proportional mortality rate due to that disease would be  $20/40 = 0.5$  or 50%.

*Case fatality rate* is the number of deaths from a specified disease in a specified population during a specified period, divided by the number of cases of that disease in that population during that time period.

Example: assuming that there were 50 cases of babesiosis in the herd, then the case fatality rate due to babesiosis would be  $20/50 = 0.4$  or 40%.

The rates described above are those that are most likely to be used in epidemiological studies in Africa.

#### **The use of specific rates**

In epidemiology, we are nearly always involved in studying the effects of determinants on the frequency of occurrence of disease. This often involves the comparison of some of the rates mentioned previously, either in the same population over time - normally before and after a



determinant is added or removed - or between populations - either with or without an added determinant, or with different frequencies of occurrence of the determinant, either at the same point in time or over a period of time.

For such comparisons to be valid, the comparison groups should differ from one another only in the presence, absence, or frequency of occurrence of the particular determinant being studied. Since epidemiology usually involves the study of determinants under uncontrolled field conditions, these criteria are extremely difficult to fulfill. Nevertheless, if rates are expressed in such a form as to ignore the different characteristics which may be present within the disease agents or host populations being compared, there is a danger that such rates may give an oversimplified and even false impression of the actual situation.

Rates can be made more specific, and the comparisons between them more valid, by taking into account various different characteristics. Differences in subspecies and strains of disease agents can be accounted for by clearly defining the subspecies or strain being studied and by making sure that only those individuals affected by that particular subspecies or strain are included in the numerator. Differences in the characteristics of host populations due to age, breed and sex can be expressed by calculating rates **which** take these specific characteristics into consideration.

Thus, for example, one could calculate an *age-specific incidence rate* which is defined as the number of new cases of a disease occurring among individuals of a specified age group in a specified population during a specified time period, divided by the average number of

individuals in that specified age group in that population during that time period. Alternatively, one could calculate a *breed-specific incidence rate* which is defined as the total number of new cases of a disease occurring among individuals of a specific breed in a specified population during a specified time period, divided by the average number of individuals of that breed in that population during that time period. One could go even further and calculate an *age-breed specific incidence rate* which is defined as the total number of new cases of a disease occurring among individuals in a specified age group of a specified breed in a specified population, divided by the average number of individuals of that specific age and breed in that population during that time period.

The same procedures can be applied to other morbidity and mortality rates. A large variety of specific rates can thus be calculated by using appropriate definitions of the numerator and the denominator. As a general principle, rates should be made as specific as the data allow, but not so specific as to make the numbers involved too small for statistical analysis. For analytical purposes there is little or no advantage in calculating and comparing age- or breed-specific rates if an age-breed specific rate can be calculated.

The following is an example illustrating the advantages of using specific rates in making comparisons. Suppose we wished to assess the efficiency of a tick control programme in two East Coast fever (ECF) endemic areas, where the level of disease challenge, the environmental conditions and the systems of management were approximately the same. In area A there was an average population of 10 000 head of cattle present during a 1-month study period, and 500 animals from that population developed symptoms of ECF during that period. In area B there was an average population of 15 000 head of which 1500

developed symptoms of the disease during the study period. The crude incidence rate of the disease in area A was  $500/10\ 000 = 5\%$  and in area B  $1500/15\ 000 = 10\%$ . We might conclude, therefore, that the tick control programme in area A was more efficient than in area B.

### **TEST EVALUATION**

A test may be defined as any process or device designed to detect (or quantify) a sign, substance, tissue change, or body response in an animal. The two key requirements of a diagnostic test are: (1) the test will detect diseased animals correctly, and (2) the test will detect non-diseased animals correctly.

To work out how well a diagnostic test performs, we need to compare it with a 'gold standard.' A gold standard is a test or procedure that is absolutely accurate. It diagnoses all diseased animals that are tested and misdiagnoses none. Once samples are tested using the gold standard and the test to be evaluated, a  $2 \times 2$  table can be constructed, allowing test performance to be quantified.

### **2 X 2 CONTINGENCY TABLE**

	Diseased	Non-diseased	Total
Test positive	a	b	a + b
Test negative	c	d	c + d
Total	a + c	b + d	a + b + c + d

### **SENSITIVITY**

The sensitivity of a test is defined as the proportion of subjects with disease that test positive. A sensitive test will rarely misclassify animals with the disease. It is the proportion of animals with disease

that have a positive test for the disease. It can also be referred to as the true positive rate (relative to all animals with disease).

### **SPECIFICITY**

The specificity of a test is defined as the proportion of subjects without the disease that test negative. A highly specific test will rarely misclassify animals without the disease.

Specificity is:

- The conditional probability of a negative test, given the absence of disease.
- The likelihood of a negative test in an animal without disease.
- The proportion of animals without the disease that have a negative test for the disease.
- The true negative rate (relative to all animals without disease).

Sensitivity and specificity are inversely related and in the case of test results measured on a continuous scale they can be varied by changing the cut-off value. In doing so, an increase in sensitivity will often result in a decrease in specificity, and vice versa. If the primary objective is to find diseased animals (that is, to minimise the number of false negatives and accept a limited number of false positives) a test with a high sensitivity and good specificity is required.

If the objective is to make sure that every test positive is 'truly' diseased (minimise the number of false positives and accept a limited number of false negatives) the diagnostic test should have a high specificity and good sensitivity

#### *Positive Predictive Value*

The positive predictive value is the proportion of subjects with positive test results which have the disease.

The predictive value of a positive test is the post test probability of disease following a positive test.

### *Negative Predictive Value*

The negative predictive value is the proportion of subjects with negative test results which do not have the disease.

Negative predictive value is:

- The predictive value of a negative test.
- The post test probability of no disease following a negative test.

Sensitivity and specificity are generally independent of prevalence. If the prevalence increases, positive predictive value increases and negative predictive value decreases. If the prevalence decreases, positive predictive value decreases and negative predictive value increases. The more sensitive a test, the better its negative predictive value. The more specific a test, the better its positive predictive value.

## **EPIDEMIOLOGICAL INVESTIGATIONS**

Epidemiological investigations are normally conducted in a series of stages, which can be broadly classified as follows:

1. A diagnostic phase, in which the presence of the disease is confirmed.
  
2. A descriptive phase, which describes the populations at risk and the distribution of the disease, both in time and space, within these populations. This may then allow a series of hypotheses to be formed about the likely determinants of the disease and the effects of these on the frequency with which the disease occurs in the populations at risk.

3. An investigative phase, which normally involves the implementation of a series of field studies designed to test these hypotheses.

4. An experimental phase, in which experiments are performed under controlled conditions to test these hypotheses in more detail, should the results of phase 3 prove promising.

5. An analytical phase, in which the results produced by the above investigations are analysed. This is often combined with attempts to model the epidemiology of the disease using the information generated. Such a process often enables the epidemiologist to determine whether any vital bits of information about the disease process are missing.

6. An intervention phase, in which appropriate methods for the control of the disease are examined either under experimental conditions or in the field. Interventions in the disease process are effected by manipulating existing determinants or introducing new ones.

7. A decision-making phase, in which knowledge of the epidemiology of the disease is used to explore the various options available for its control. This often involves the modelling of the effects that these different options are likely to have on the incidence of the disease. These models can be combined with other models that examine the costs of the various control measures and compare them with the benefits, in terms of increased productivity, that these measures are likely to produce. The optimum control strategy can then be selected as a result of the expected decrease in disease incidence in the populations of livestock at risk.

8. A monitoring phase, which takes place during the implementation of the control measures to ensure that these measures are being properly applied, are having the desired effect on reducing disease incidence, and those developments that are likely to jeopardise the success of the control programme are quickly detected.

### **Disease Surveillance and Monitoring**

*Surveillance:* Is the act of collecting data and using it to implement action. It provides important knowledge to epidemiologists about the occurrence of disease and events in the population; whether it is the frequency or distribution of a disease in a population or the use of a specific drug or device. Surveillance incorporates various methods of collecting data, analyzing and interpreting the data, and then initiating some form of action; either preventive or for the purpose of intervention. This action also includes the dissemination of information to health professionals and the public. A surveillance system is a collection of activities that complement each other, e.g. case finding, disease reporting, and laboratory confirmation.

The characteristics of effective surveillance system are as follows:

1. High detection rate: The system should be able to detect as many disease events as possible.
2. Sensitive and specific
  - Sensitivity is the number of true cases a system correctly identifies out of the total number of truly diseased subjects studied. The higher the sensitivity of the system, the more truly diseased cases are identified (hence a lower number of false negative cases).

- Specificity is the number of non-diseased animals a system correctly identifies out of the total number of truly non-diseased subjects examined. The higher the specificity of a system, the more truly non-diseased animals identified (hence a lower of false positive cases).
3. Timely: The system should be able to detect, investigate provide feedback and allow for action on a suspect disease event within a timeframe relative to the infectious cycle of the disease.
  4. Representative: The system should reflect the truly occurrence and distribution of the event in all communities, production systems and social strata.
  5. Flexible: the system should be able to detect and accommodate emerging diseases.
  6. Simple: If the procedures are too difficult farmers and surveillance staff will probably not be motivated to report, act and control suspect disease events.
  7. Ownership: Stakeholders should feel a sense of ownership based on their participation in the design of the system and the relevance of the output to their needs.

In practice, no single surveillance system will have all these seven characteristics, so a surveillance system must integrate different activities to meet stakeholders' needs and achieve its goals and technical objectives.

*Monitoring:* Is a less intensive form of surveillance. Monitoring programs are normally done just to collect information on a general basis.

#### Types of Surveillance

Surveillance is considered Active or Passive according to the data collected.



**Passive Surveillance:** Is an established system that collates reports that are sent by health professionals to health departments or disease registries. These systems are easy to maintain and are inexpensive.

**Active Surveillance:** Requires the health departments to go out and collect detailed information on a specific disease or problem at a given point in time. This surveillance type is money and labour-intensive, but collects much more detailed data.

Monitoring and surveillance are often used interchangeably because they are similar, but they have different meanings and goals. Monitoring is basically an observation and collection process. It is important for increasing knowledge about disease and/ population. Monitoring involves the observation and analysis of a disease or events to accomplish the goal of detecting changes in the frequency or distribution in the population. It involves the collection of complete information for assessment but usually determines the occurrence of an event or a disease less rapidly than a surveillance program.

Surveillance on the other hand, is more active in the analysis, interpretation, and action on the results of the data collected. It is a systematic approach of collecting, analyzing, and interpreting data, with the goal to initiate control measures or further investigative programs. Surveillance can include any aspect relevant to the control of disease(s). It is important to interpret the data quickly to initiate further action, therefore the process attempts to determine as early as possible the occurrence and distribution of a disease or an event in a population. The information collected is then disseminated to health professionals or to the public.

Surveillance can be initiated to test a specific hypothesis, to survey a general or specific population, to survey disease indicators such as the

animal population or reservoirs or vectors of disease, or to survey drug, and biologic utilization of the population. During the planning and in the evaluating of a surveillance system, there are several issues to keep in mind: the usefulness, the flexibility and the simplicity of the system, the representativeness, the timeliness, and the accuracy and quickness of the detection of new cases or epidemics.

**Sources of data for surveillance:** These are very important for the surveillance process. The most common sources of data are mortality records, or death certificates, morbidity reporting or reportable diseases required by law, the reporting of epidemics and field investigations, laboratory investigations and surveys. Each source has advantages and disadvantages when used for surveillance purpose. Death certificates are a good source because a denominator or population at risk can be calculated with the census data. In addition death certificates are fairly standardized, easy to obtain, and include other basic demographic information such as age, gender, race, and occupation; hence they can be used by researchers as an indicator of certain disease frequencies in the population.

Two disadvantages of death certificates are the inconsistent coding of diagnoses by different professionals, and the fact that highly fatal diseases are more likely to be represented. Also, death certificates request coding of primary and secondary causes of death. The interpretation, and therefore the listing of primary versus secondary causes, may differ among individuals filling out the certificates. This difference in interpretation and listing can influence the measurement of a particular disease. The primary cause of death for example, may be listed for an individual as pulmonary oedema, and the secondary cause as coronary heart disease: when in actuality, coronary heart disease is

the primary disease that causes the pulmonary oedema. For the study of occupational disease, death certificates provide both a source of the mortality and the occupation of individuals. Mortality ratios can be calculated and compared for each occupational group. Sometimes more information can be collected from the listed employers.

Each surveillance program must be planned to meet a particular objective. For infectious disease surveillance, the objectives are to identify newly diagnosed cases and high-risk groups; to understand the mode of transmission, and to control or eliminate disease transmission. Surveillance can collect baseline incidence data to detect the occurrence of an epidemic. Seasonal, temporal, geographic, and sub-group patterns are important for understanding the mode of transmission and for determining ways in which to control the disease. Seasonal and temporal trends can give information about times in which control programs should be initiated/ implemented. Geographic and subgroup patterns help epidemiologists focus control programs in the most effective areas.

The pervasive problems that occur with any surveillance system are underreporting, lack of representativeness, inconsistency in definition, and the lag time between the occurrence of any event, and the actual reporting. Most surveillance systems consist of events that are underreported unless there is aggressive/ active solicitation of reports of a particular disease or event. Normally medical professionals do not report a disease or an event unless it is serious or of specific interest. This kind of reporting can lead to reports in a system from those most interested, and may not be representative of the general population. Reporting from various sources usually has inherent differences in diagnosis or definition of a disease. Finally, in any surveillance system

there is a period of time that passes between the event and the time it gets reported.

The design and management of surveillance activity of a National Animal Health services is usually the responsibility of the Veterinary Epidemiology or Epizootiology section. The section utilizes the result of its data analysis for:

- i. Assessing the need for, progress of disease control in control eradication\_programme at farms, area, regional and national level.
- ii. National and International reporting of disease statistics
- iii. Developing and motoring National Animal Health programmes
- iv. Developing and monitoring quarantine policy.
- v. Facilitating export trade in animals and their by-products.

This is assuming greater significance as efforts to reduce non-traffic, barrier in international trade programme. The evidence needed by a country to support and justify imposition of quarantine barrier is its ability to document freedom from some particular disease, evidence of which can only be provided by efficient surveillance. Similarly, evidence of economic impact of a condition is required to persuade politicians/government to finance a control campaign; this may also come from the data of a surveillance programme.

## **CLIMATE CHANGE AND SPREAD OF DISEASES**

Climate change could cause changes in the incidence of infections diseases. Higher ambient temperatures may result in an increase in some temperature sensitive food borne diseases such as gastroenteritis, paralytic shell fish poisoning and botulism.

An increase in mean temperature may influence the incidence of infectious diseases of animals that are spread to humans (zoonoses) by changing the population and range of animal hosts and insect vectors e.g. there is a particular breeding season of ticks leading to an increase in the incidence of tick borne infections e.g. babesiosis.

An increase in flooding events may result in outbreaks of water borne infections, such as *Giardia*, *lamblia* or *croptosporidium parvum*; which have been implicated in water borne outbreaks of diarrhoea following heavy rainfall.

A change in rodents and fox populations may result in an increase in rabies or echinococccosis. *E multilocularis* is a parasitic tapeworm, the life cycle of which involves foxes, dogs and rodents, whose range could vary with a changing climate. Humans are incidentally infected when they ingest eggs passed by dogs or foxes.

### **Recommendations**

To detect and respond to changes in infectious disease epidemiology caused by climate change will require:

1. Strengthening public health infrastructure and ensuring surveillance for disease most likely to be influenced by climate with particular attention to those with potentially large public health
2. Monitoring of animal host and arthropod vectors involved in transmission of infectious disease and most likely to be influenced by climate change.
3. Early warning systems should be developed to generate public advisories and to generate preventive public health messages,

such as use of insect repellents, boiling water & cooling before use e.t.c

4. Health care providers should be aware of the potential for the emergence of new pathogens in their regions and report unusual occurrences to public health officials.

## **SAFETY PRECAUTIONS FOR ANIMAL HANDLERS AND VETERINARY PERSONNEL**

Veterinarians are unavoidably exposed on a daily basis to risks of physical trauma, chemical hazards and biological threats that can harm their health, reduce their productivity and even shorten their career if not properly dealt with.

- (a) **Physical hazards:** These include animal bites, needle pricks, animal kicks, allergies falls (especially in abattoirs) etc.

**Precautions:** It is necessary for a veterinarian to understand the behaviour and temperament of animals he is handling. No animal should be trusted; hence to safeguard personnel from injuries, proper mouth guards or tape muzzle should be used in dogs, use of crush in cattle ranch, , appropriate towel to wrap cats (to avoid scratches) etc.

In case of falls from slippery floor of the abattoir, use of gum boots is advised.

- (b) **Chemical hazards:** these can be from noxious anaesthetic gases, cytotoxic and other toxic drugs/substances. Organophosphate used for fumigation. etc.

**Precautions:** Proper disposal of chemicals, use of goggles, protective clothing, hand gloves and nose mask when handling chemical and toxic substances.

It is also necessary to avoid radiations by always wearing lead jacket when using X-ray mechanise.

- (c) **Biological Hazards:** The most obvious being infectious/zoonotic diseases e.g. rabies, brucellosis, anthrax, salmonellosis, psittacosis, e.t.c.

**Precaution:** Protective clothing, adequate disinfectant and hygienic practices is recommended.

For workers working in a veterinary clinic, it is recommended that pre-exposure antirabies immunisation be administered annually. Also used needles and syringes should be properly disposed off, while empty vaccine bottles buried. Hand gloves should always be used when handling animals, laboratory coats should be regularly washed.

In poultry farms, measures must be taken to make washing of hands a habit after touching birds or treating them.

## **TYPES OF VACCINES AND IMMUNIZATION PROCEDURE**

### ***Definitions***

*Vaccines:* these are suspension of attenuated or killed micro organisms (Viruses, Bacteria or Rickettsiae), administered for prevention of infectious diseases. They can provoke effective and often specific, long term immunity. They can also be defined as any biological agent used to produce active immunity. Vaccines are used in disease prevention and not curative. They are effective in disease prevention, control and eradication. The eradication of diseases such as small pox from the globe, elimination of rabies, brucellosis in many countries as well as control of diseases such

as FMD, RP Canine distemper, would not have been possible without vaccines.

*Vaccination/immunization*: this is the introduction of vaccine into the body of animals to produce immunity to a specific disease.

The term vaccination comes from the Latin word *Vacca* (cow) and was coined when the first inoculations were given with organisms that cause the mild disease cow pox to produce immunity against small pox.

Vaccination also means immunization (i.e. the process of rendering a subject immune or becoming immune.)

Vaccination has proved to be far the most effective and cost effective method of controlling major infectious disease in domestic animals. Ongoing developments in vaccine design and production have resulted in great improvement in both vaccine safety and precautions.

**Herd immunity**: This is the resistance of an entire group of animals to a disease as a result of the presence in that group, of a proportion of immune animals. When vaccines are used in control of disease in a population rather than in an individual the concept of herd immunity should be considered. Herd immunity reduces the probability of a susceptible animal meeting an infected one so that the spread of disease is slowed or terminated.

### **Types of Vaccines**

Vaccines are produced in several different forms for several specific types of immunity response. They may be prepared from live organisms; inactivated or killed organisms or from genetically engineered subunits of the pathogenic fraction of the organisms; or from toxoid.

1. **Modified live virus vaccine**: These are prepared by attenuating micro organism by growing and adapting in different media or tissues. During



this process organism must lose their virulence but remain sufficiently antigenic to induce an immune response. The process of reduction of virulence is called attenuation. The most common used method of virus attenuation has been prolonged tissue culture e.g. TCRV, Live Antirabies Vaccine

The main features of live vaccines are:

- (a) The vaccine or antigenic component replicates in the host after vaccination ensuring adequate stimulation for antibody production. Immunity is usually of long duration
- (b) They are easy to handle with some exception where special requirement needs to be met.
- (c) The vaccine may produce mild disease.
- (d) There could be poor replication hence poor response.
- (e) They may produce carrier status
- (f) There may be danger of cross infection and environmental contamination.
- (g) The vaccine may produce natural antibody interference
- (h) Chemicals may inactivate the vaccine.

(2) *Killed/ inactivated vaccine* : This is prepared by killing the microorganism or by extracting the antigenic components from them which serves as antigen when injected. The organism is rendered incapable of causing the disease but still capable of inducing production of antibodies. E.g. Killed Infectious Bovine rhinotracheitis vaccine. Methods used for inactivation include the use of formaldehyde and alkylating agents such as ethylene oxide, ethyleneimine.

Killed vaccines are generally considered as less effective than the live vaccines hence they are often given in higher or multiple doses and usually contain an adjuvant ( this greatly enhance the body's response

to vaccines, delay the elimination of the antigen and maximizes the effectiveness of the vaccine.) e.g. aluminium salt

The main features of Killed Vaccines include:

- (a) They do not replicate in the recipient host.
- (b) The immunity is of short duration.
- (c) They can produce harmful immune reactions following natural infection.
- (d) There could be local tissue reaction due to adjuvant.

(3) *Recombinant DNA vaccines*: This is the immunization of animals by injecting it with bacterially derived DNA coding for an antigen. The DNA coding for the antigen of interest is first isolated and then inserted into a bacterium or yeast, and the recombinant antigen is expressed. If the DNA is incorporated into an appropriate plasmid, it is capable of expressing the protective antigen which is then harvested, purified and incorporated into a vaccine.

The use of modern molecular techniques can produce new and improved vaccines which are safe ,cheaper and effective.

*Bacterins*: These are suspension of killed or inactivated disease organisms. They will not cause the disease but do initiate an immune response. An example of a Bacterin is the blackleg bacterin.

*Toxoids*: Inactivated toxins or poisons or disease organisms. They do not cause the disease but produce immunity to the disease. E.g. tetanus toxoid.

*Antisera or antitoxins*: These are products designed to produce a short-lived passive immunity. They are produced by exposing an animal to massive doses of vaccine or live disease organisms. The serum from this animal is used to produce the antisera; an example of an antitoxin or antisera is tetanus antiserum.

## **Administration of Vaccine**

Vaccines are usually provided in standard doses irrespective of weight or size. There must be a sufficient amount of an antigen to trigger the cells of the immune system and response. This does not depend on the size of the animal.

Most vaccines are administered by injection. The simplest and the most common routes are the S/C and the I/M injections. This approach is excellent for relatively small numbers of animal and for disease in which systemic immunity is important.

Where local immunity is sometimes more important than systemic immunity, it is appropriate to administer vaccine at the site of potential invasion e.g. Intranasal vaccines are effective in protecting cattle against infectious bovine rhinotracheitis, and poultry against infectious bronchitis and Newcastle disease. Aerosolization of vaccines enables them to be inhaled by all the animals in the herd or flock. This is commonly used in poultry. Alternatively, Vaccines can also be administered orally via drinking water and feed in poultry. Fish and shrimps may be vaccinated by immersion in a solution of antigen.

## **How do Vaccines Work?**

Following the first vaccination, the immune system is stimulated and starts to produce antibodies against the infectious agent in the vaccine. Antibody production continues until the antigen wanes. The result of this immunologic stimulation is the production of a reserve pool of antibodies that is capable of overcoming the virulent variant of the same disease agent in the vaccine.

However, antibodies naturally decline with time and therefore it is necessary to re-stimulate (boost) the immune system with a subsequent booster dose or vaccination.

The first vaccination produces a primary immune response which usually develops slowly and is weak (low antibody levels) and of short duration. It also helps to induce immunologic memory (i.e. stimulates the memory cells) that allows the immune system to respond rapidly and efficiently on second contact with the same infectious agent. The subsequent vaccination results in a secondary immune response in which the antibody concentrations is higher stronger and persists for a longer duration.

### **Care and Handling of Vaccines**

All animal biological products are produced under license. They must be pure, effective, and safe before permission is given to sell. It is very important to know how these vaccines should be handled after leaving the manufacturing plant till when they are administered to the animals.

(1) All biologicals should be shipped in cool and well insulated containers. They should be stored in a refrigerator. Do not freeze your vaccines. Freezing destroys some vaccines.

(2) Lyophilized dry vaccines should not be re-constituted until ready to be used. Do not mix more than what will be used in one hour maximum.

(3) Always observe the expiry date printed on the bottles. Do not use expired vaccines.

(4) Never allow vaccines to stand in the sun before or after reconstituting. Sunlight/ heat destroy or denature the vaccines.

(5) Always use sterile needle and syringes. Never use needle and syringes that are contaminated or have been chemically disinfected. Chemicals destroy live and modified live vaccines.

(6) Always burn or otherwise destroy vaccine bottles. Do not leave them lying around as a hazard to humans and animals.

- (7) Be as clean as possible with the inoculation procedure. Keep adequate supply of clean sterile needle and syringes and change when one gets contaminated.
- (8) Give vaccines according to manufacturer's instruction.
- (9) Get your vaccines from reliable or reputable sources.
- (10) Any adverse reactions after vaccination should be reported to the appropriate licensing authority and vaccine manufacturer.

### **Immunization Procedures for Large and Small Animals**

Vaccination in small animals is generally less demanding. In large animals vaccination is an elaborate task, necessitating prior organization of personnel, vaccines and equipments to be used. The general procedure for cattle vaccination is as follows:

- a. Beneficiaries should be informed about time and place of vaccination
- b. Vaccines should be conveyed to the field in cold boxes or cooler with ice packs.
- c. Ensure that appropriate or sufficient diluents are carried along.
- d. Ensure that all staffs are in their protective covering.
- e. Group the animals in batches to ease vaccination. Stock should be taken of the number of animals in each group. Change needle between vaccinating every 20 animals if it's a large population.
- f. Reconstitute vaccine as prescribed. This can be done using normal saline
- g. Restrain animals and give at appropriate quantity at the specified site.
- h. Dispose the vaccines appropriately.
- i. Issue certificates. Keep a record of vaccination and other relevant records concerning the herd.

As listed above adequate preparation should be made before poultry vaccination. Water should be withdrawn overnight from birds prior oral vaccination. After vaccination it is advisable to give antistress.

Antibody titer should be usually determined at 2-4 weeks interval to determine the antibody titer. When antibody level is low, vaccinate. It is highly advisable not to vaccinate sick animals. Vaccinating sick animals seldom produce immunity and could worsen the situation.

### **POULTRY VACCINATION PROGRAMME**

Age	Type of vaccine	Route of administration
Day 1	Marek's disease vaccine	Subcutaneous (S/C) (under the neck)
Day 1-10	Hitchner B1 (NDV)	Intra ocular (I/O) or aerosol
Day 3-5	Immucox or Livacox	Per os (P/O) via drinking water
Day 10	IBDV	P/O in drinking water
Day 18	IBDV	P/O drinking water
Day 21.	NDV Lasota	P/O drinking water
Week 5	FPV	S/C wing web
Week 6-8	NDVK	Intramuscular (I/M)
Week 16	EDSV	S/C
Week 6-16	FTV	S/C
Week 6-16	FCV	S/C
Week 16-18	NDVK (Booster)	I/M

*N:B Polyvalent vaccines as oil based are now available as*

- (1) Newcastle disease vaccine + Egg drop syndrome vaccine.
- (2) Newcastle disease vaccine + Infectious bronchitis + Egg drop syndrome vaccine.
- (3) Newcastle Disease vaccine + Fowl cholera vaccine.

## LARGE ANIMAL VACCINATION PROGRAMME

### CATTLE

Vaccine		Dose/Route of vaccination	Age	Schedule of vaccination	Duration of immunity	Source of vaccine
Anthrax Vaccine	Spore	0.5ml / S/C	6months	Annual	1Year	NVRI
Black Quarter Vaccine	quarter	2ml / S/C	4months	Annual	1Year	NVRI
CBPP Vaccine		0.5-1ml S/C	3months	Annual	1Year	NVRI
Hemorrhagic Septicaemia Vaccine		5ml S/C	4months	Annual	3-6 months	NVRI
Brucella Vaccine	Abortus	5ml	6months	Annual		NVRI

### SHEEP, GOAT AND PIGS

Vaccine		Dose/Route of vaccination	Age	Schedule of vaccination	Duration of immunity	Source of vaccine
Anthrax Vaccine	Spore	0.5ml / S/C	6months	Annual	1Year	NVRI
PPR Vaccine (sheep and goat)		1ml / S/C	4months	Annual	1Year	NVRI

## SMALL ANIMAL VACCINATION PROGRAMME

### DOGS

Vaccine		Dose/Route of vaccination	Age	Schedule of vaccination	Duration of immunity	Source of vaccine
Antirabies Vaccine (ARV)		2.5ml / I/M	3months	Annual	3Years	NVRI
ARV (killed)		1ml / I/M	4months	Annual	3Years	Foreign
DHLPP Vaccine		1ml S/C	8, 12,16 wks	Annual	3Years	Foreign

## CATS

Vaccine	Dose/Route of vaccination	Age	Schedule of vaccination	Duration of immunity	Source of vaccine
ARV/HEP	1.5ml / I/M	3months	Annual	1Year	NVRI
ARV (killed)	1ml / I/M	3months	Annual	1Year	Foreign

The NVRI i.e. National Veterinary Research Institute, VOM has been responsible for the local production of vaccines in Nigeria. However, other vaccines are imported.

### Active and Passive Immunizations

These are the 2 basic methods by which animals may be made immune to infectious disease used to induce immunity against infectious disease in animals. (Acquired immunity)

*Passive immunization:* This produces temporary immunity by transferring antibodies from a resistant to a susceptible animal. Passive immunity requires that antibodies be produced in donor animals by active immunization and is given or inoculated in susceptible animals in order to confer immediate protection. It is usually a short lived immunity that lasts from 2 weeks to 6 months. In animals, this is usually derived from the transfer of antibodies in colostrums to the new born within the first 24 hours of birth (Natural immunity). The longevity of immunity depends on the amount of antibodies passed, the type of the antibody and what disease the protection is for. Passive immunity can also be transferred by blood transfusion or use of specific antisera or antitoxins (Artificial immunity). Antisera can be produced against a wide range of diseases. For instance they can be used to produce antisera in cattle against anthrax, in dogs against distemper, and in humans against measles.



*Monoclonal antibodies* are another source of passive immunity for animals. These are mainly produced by mouse hybridomas. They stimulate immune response when inoculated in animals of other species.

*Active Immunization:* Immunity is developed in animal that have actually had and recovered from a disease or from inoculating them with a vaccine derived from the disease organism. These vaccines produce immune response i.e. immunity without the symptoms or problems associated with the disease.

Active immunization has the following advantages compared to the passive immunity.

- (1) They have prolonged period of protection. Immunity is long lived and usually last over 1 year to life time.
- (2) Immunity is conferred on both the animal immunized and the foetus carried by it.

*Chemoprophylaxis:* The use of chemicals including drugs for disease prevention in animals e.g. antibiotics, antitrypanicides.

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