# Basic Field Epidemiology

## Participant Manual

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# About this manual

This manual contains a very brief outline of the session headings and key concepts from the training course on Basic Field Epidemiology.

A copy of this manual is intended to be provided to every participant attending the training course in Basic Field Epidemiology.

A more detailed *Basic Field Epidemiology – Resource Book* has been prepared as a complete reference book for this training course. It will be accessible via the iSIKHNAS web site either directly or as a downloadable electronic file.

This manual is arranged by session headings based on the order and content of the teaching sessions in a three day training course prepared for delivery of the material.

# Session 1 Welcome and Introduction

## 1.1 Course structure

| Session | Session title |
|---|---|
| Session 1 | Welcome and Introduction |
| Session 2 | Overview of Epidemiology |
| Session 3 | Signs, syndromes and making a diagnosis |
| Session 4 | Disease Investigation |
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## 1.2 Introduction

This course has been developed as part of the Australian-Indonesian Partnership for Emerging Infectious Diseases program to support the work of para-vets in the field, to recognise their important role in the success of the animal health information system, iSIKHNAS, and to support strong relationships between Government services and the local farming communities around Indonesia. It is aimed at strengthening

the skills, confidence and general approach of para-vets when dealing with animal health problems. The impacts of improvements in animal health and production will be better overall health and well-being of the whole community.

## 1.3 What are we going to learn in the course?

Over the next three days we will be talking about:

- the difference between signs, syndromes, disease and diagnosis;
- a systematic approach to investigation of disease in animals that involves the collection of different types of evidence - through the animal's history, clinical examination, looking at the environment and laboratory testing;
- understanding causes of disease and how to use this information to assess and explain options for farmers to treat and prevent diseases in their livestock using this additional information;
- contributing useful data to iSIKHNAS and accessing information from iSIKHNAS to help you in your work

By learning about each of these areas, participants will be gaining new skills.

**What will you be able to do by the end of this course?**

By the end of this course you will all be able to use field epidemiology skills *together* with individual animal clinical skills to provide better diagnostic, treatment and disease prevention services to livestock and their owners.

# Session 2 Overview of Field Epidemiology

**Key concepts**

**Epidemiology** is the study of the patterns and causes of disease in groups of animals or populations.

**Field epidemiology** refers to applying epidemiology skills in the field - on farms and in day-to-day work to address real problems for livestock owners.

Field epidemiology skills will help you to gain a deeper understanding of how and why disease occurs. This helps you to:

- understand causes of disease at the population level to explain why diseases are occurring, even when you are not sure of the exact cause
- provide better advice to farmers on disease treatment and prevention

Para-veterinarians provide services to livestock owners to diagnosis, treat and prevent disease in animals.

Para-veterinarians are often employed by local government as district animal health officers to help with activities such as disease investigations, control and vaccination programs, collecting census data and provision of breeding services.

iSIKHNAS is Indonesia's animal health information system. The success of iSIKHNAS depends on para-vets contributing data into the iSIKHNAS system.

Learning field epidemiology skills and applying these in day-to-day work will help para-vets provide better services to farmers and to use iSIKHNAS more effectively. Para-vets will be better prepared to investigate disease and provide effective disease control. Improved livestock health and production will benefit the health and wellbeing of Indonesian communities.

# Session 3 Signs, syndromes, and making a diagnosis

**Key concepts**

**Diseases** in animals will often result in reduced health and production and may result in death.

**Signs** are changes in an animal that are caused by disease and that people can detect.

S**yndrome** refers to a particular sign or a group of signs that can be easily recognised and which may indicate a particular important disease.

A **differential diagnosis** is a disease that could cause the clinical signs that have been observed. Often there is more than one disease that can cause the same signs.

A **definitive diagnosis** is reached when the veterinarian is confident there is one disease that is most likely to be affecting the sick animal(s).

Some signs of disease are easy to see such as lameness, coughing, diarrhoea, severe weight loss and death. Some diseases may produce little signs of illness or produce changes that are subtle and harder to see, such as reduced fertility, reduced weight gain or reduced milk production. iSIKHNAS has lists of common signs and codes to make reporting signs easier and more consistent. Village reporters (pelsa), para-vets and veterinarians play a vital role in the identification, reporting, and treatment of these signs.

Syndromes are used to identify animals that *may* be suffering from a specific disease of importance.

A respiratory syndrome may be defined as including any animal that shows one or more of the following clinical signs: coughing, difficulty breathing, nasal discharge, elevated respiratory rate, and so on.

A syndrome based on changes in behaviour (aggression, biting, salivation, depression) is used to identify dogs that may have rabies. These dogs can be isolated and watched to see if they continue to develop signs of rabies and they may be killed or sent for post mortem to test for rabies.

iSIKHNAS uses several defined priority syndromes for disease reporting. These are designed to help identify animals that may have one of the following priority diseases: highly pathogenic avian influenza, brucellosis in cattle, anthrax, foot-and-mouth disease in livestock, rabies and classical swine fever.

Disease investigations try and identify possible causes of illness in animals. Findings are used initially to develop a differential diagnosis list and then to narrow this list and identify the definitive diagnosis. Sometimes we can only identify a most likely diagnosis amongst a short list of differential diagnoses.

# Session 4 Disease Investigation

**Key concepts**

A disease investigation is a structured process with four parts:

- The history
- Clinical examination of sick animals
- Examination of the environment
- Collection of samples for laboratory submission (in some cases)

Information from the investigation is used to:

- Develop a differential diagnosis list (possible diseases that could produce the signs)
- Narrow the list of differential diagnoses to identify the most likely diagnosis
- Understand possible causes and decide on treatment
- Advise the farmer on control strategies to prevent future cases to animals or humans

The findings from the investigation will identify the **signs** or **syndromes** displayed by the sick animals. These are used to determine a list of **differential diagnoses**.

As each of the four steps of the examination are conducted, the **differential diagnosis** list should be reviewed and changed depending on new information.

Correct diagnosis of disease in an individual animal often requires clinical and epidemiology skill and may require laboratory testing and/or pathology examination.

Laboratory testing needs to be used and interpreted with care. Laboratory testing may take time, cost money and may or may not make a useful contribution to the diagnosis and management of disease.

Sometimes it is not possible to establish a single definitive diagnosis. In this situation the findings of the investigation are used to identify the most likely diagnosis and to shorten the differential diagnosis list as much as possible. This is still very useful when deciding on treatment and prevention measures.

Disease investigations combine clinical veterinary skills (ability to examine an individual sick animal and identify signs of illness and what they mean) and epidemiology skills (understanding of causes of disease and how causes interact to produce disease). A good investigator also needs the ability to communicate effectively with farmers and to observe things around them when they visit a farm to conduct an investigation.

# Session 5 Causes of disease

**Key concepts**

- A **cause** is anything that can influence whether or not a disease occurs in one or more animals
- Disease investigations aim to identify causes of disease
- Understanding causes of disease will help you to understand how a particular instance of disease happened and help you to identify treatments and preventive measures to reduce disease in populations
- Treatment and prevention measures are often aimed at breaking the effect of specific causes on the occurrence of disease

Knowledge of the causes of a disease and how they act to cause disease is important.

Epidemiological investigations help identify the important causes of disease and epidemiologic knowledge about the causes of a disease and how they interact with each other can be used to develop measures that vets, para-vets and farmers can apply to prevent or control disease.

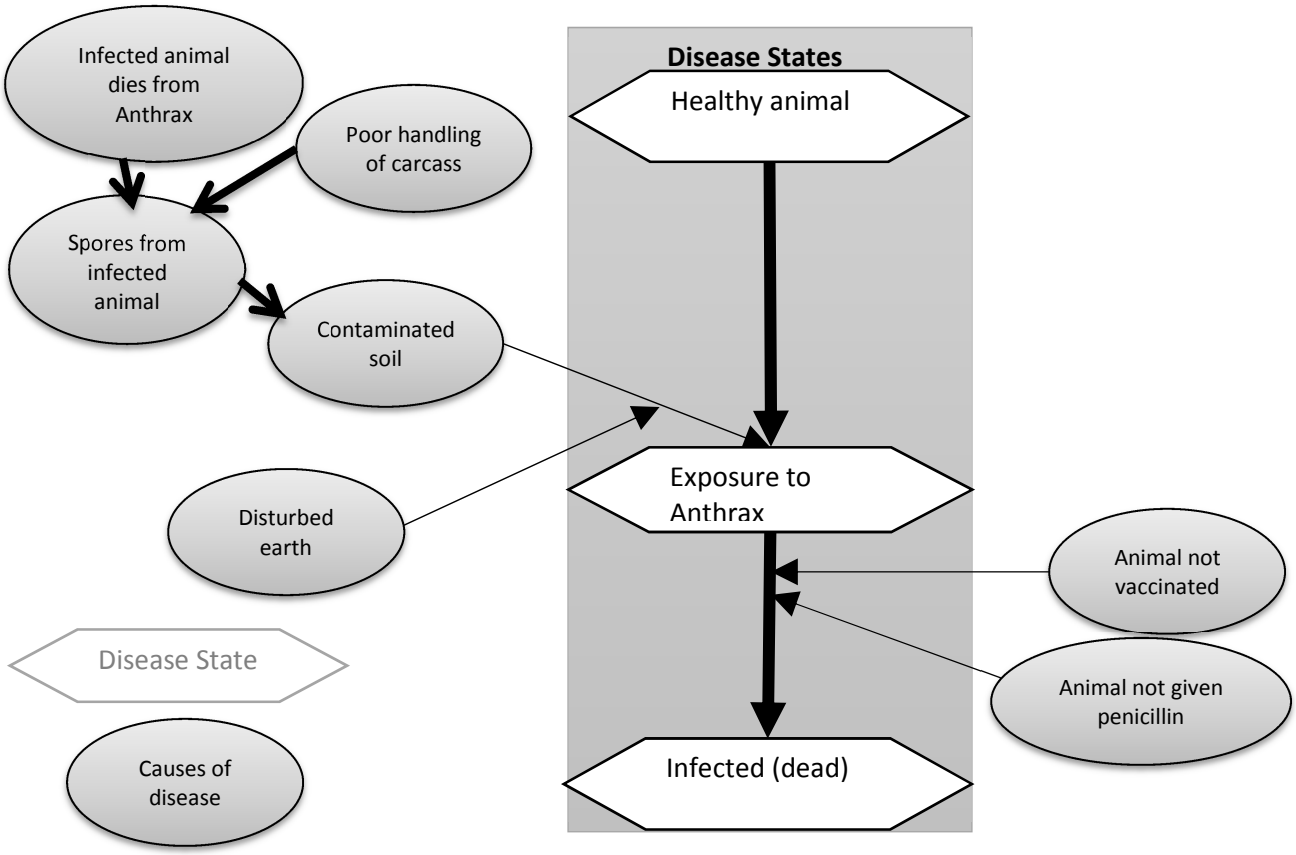
The relationships among causes of disease can be represented in causal diagrams (see causal diagram for anthrax on the following page). Causal diagrams can show in a diagram how causes related to the environment, the agent and the host (animal) can act together to influence whether or not disease occurs.

An animal infected with Anthrax sheds the disease on the ground. These spores can stay alive in the soil for a very long time if the spores are not properly killed through burning and decontamination. Unvaccinated animals coming into contact with the spores can become infected. Disturbing the soil can bring spores to the sruface where animals may be more likely to ingest them or breathe them in. The interaction between these causes and how they influence the occurrence of anthrax in an animal is shown in the causal diagram on the following page.

Understanding causes and how they interact can lead to interventions. For anthrax, burning any carcases to ash, properly disposing of soil contaminated with body fluids from the infected animals and vaccinating the entire herd will lower the risk of ongoing infection from spores in the environment.

Each of these measures can be thought of as breaking a line on the causal diagram and preventing disease from occurring.

## Causal diagram for anthrax



*The following disease information sheet has been written to represent information para-veterinarians might access during their day to day work to aid in managing disease events. It is intended to accompany a group activity undertaken during Session 5.*

## Newcastle Disease Information sheet

**Infectious agent:** The infectious agent is Newcastle Disease Virus (NDV). Different strains of NDV cause mild, moderate, or severe disease in chickens.

**Host species:** Chickens are highly susceptible to disease. Many other bird species can be infected and may show milder disease signs (turkeys, pheasants, quail, parrots, pigeons). Wild bird species may carry and shed NDV without disease. NDV can infect humans and cause eye infections, headache and flu-like signs.

**Clinical signs of infection in a susceptible flock:** NDV is highly contagious and can spread through a susceptible flock in days. Where NDV is endemic it may cause less severe disease.

The incubation period is usually 5-6 days (range from 2-15). Young birds are most susceptible.

- Respiratory signs include gasping, coughing and sneezing
- Digestive signs include watery-green diarrhoea
- Nervous signs include depression, tremors, paralysis, twisted necks, circling.
- Egg production drops or stops. Eggs may be abnormal in colour, shape, or surface.
- The head and neck (including comb and wattles) may be swollen and cyanotic (bluish in colour)

**Post mortem changes:** Chickens dying suddenly may show little change on post mortem. Changes include oedema of the neck, haemorrhages in the respiratory tract and through many organs.

**Laboratory testing:** Samples collected from sick birds (serum or blood, and cloacal and tracheal swabs are collected into viral transport medium) to test for virus.

**Differential diagnoses:** There are many conditions that may cause similar signs. These include:

- Poor management such as lack of food, water or inadequate ventilation.
- Parasites (external and internal)
- Other infectious diseases include: avian influenza, fowl cholera, laryngotracheitis, fowl pox, mycoplasmosis , infectious bronchitis, marek's disease, gumboro disease

**Transmission:** Virus is shed from mouth, nose, faeces and eggs from infected birds. Virus is in all parts of the carcass of infected birds when they die or are killed. Chickens are infected by direct contact with sick birds or by contaminated water or food. Infection can be spread by movement of infected birds or contaminated people, equipment, food etc. from infected farms to uninfected farms.

**Epidemiology:** NDV cases may show seasonal patterns, when more birds are brought to market (increased mixing) or when migratory birds travel to new locations.

**Control of NDV disease in chickens:**

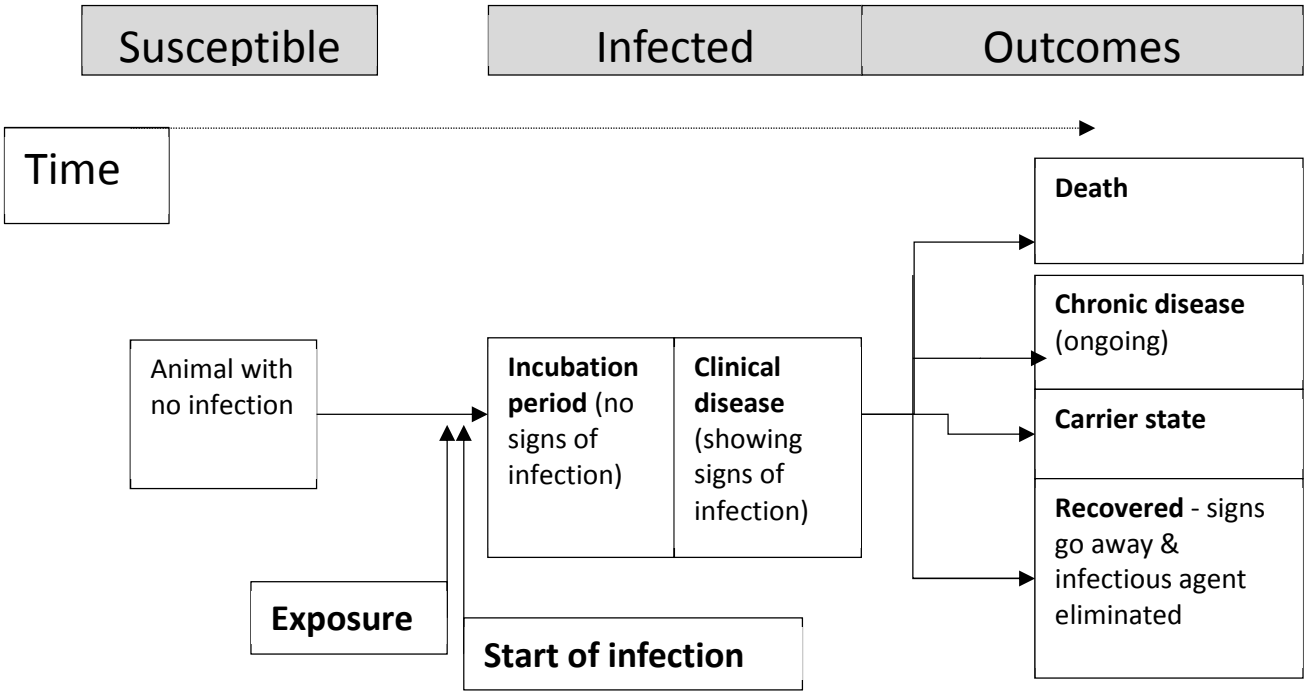
- Vaccination of chickens can result in a very large reduction in mortality due to NDV.
- General husbandry measures are also important in controlling NDV.
    - Keep chicken housing areas clean and dispose of dead birds, droppings, feathers etc in a way that prevents other birds from coming into contact with them (burning or burial)
    - Provide good food and water and housing for birds.
    - Prevent or treat for internal and external parasites if necessary.
- Don't buy sick birds. Have a quarantine area where new birds can be kept separate for ~2 weeks to make sure they don't develop any disease and introduce disease into the flock.

# Session 6 How infectious disease progresses

**Key concepts**

- Within the host (animal) there are a number of steps that determine if the animal develops disease after being exposed to an infectious agent.
- Infected animals may develop chronic disease, die from the disease or may recover.
- Animals that recover often develop immunity to the infectious agent. Immunity may last a lifetime or it may be shorter. If the immunity declines the animal may become susceptible to infection again.
- **Herd immunity** describes a form of immunity that occurs when a significant portion of a population of animals is immune and this provides protection for the susceptible animals

**Figure: Progression of an infectious disease in individual animals showing disease states and outcomes in shaded boxes at the top. The diagram is ordered in time from left to right.**




Firstly an animal must be susceptible to a disease to become infected. A susceptible animal must be exposed to an infectious agent in order for infection to occur. Exposure means that the infectious agent has entered the body of the animal in some way. Not every exposure will result in infection. Sometimes after exposure the infectious agent will die or be killed by the animal's immune system before it can

cause infection. If the infectious agent begins to grow and replicate within the body then at this point the animal moves from exposure to infection. In the very early stages of infection the animal will usually show no signs of disease. This is called the incubation period.

The incubation period starts with infection of the animal and ends with the onset of clinical signs of disease. In some cases infected animals may not show any signs of disease.

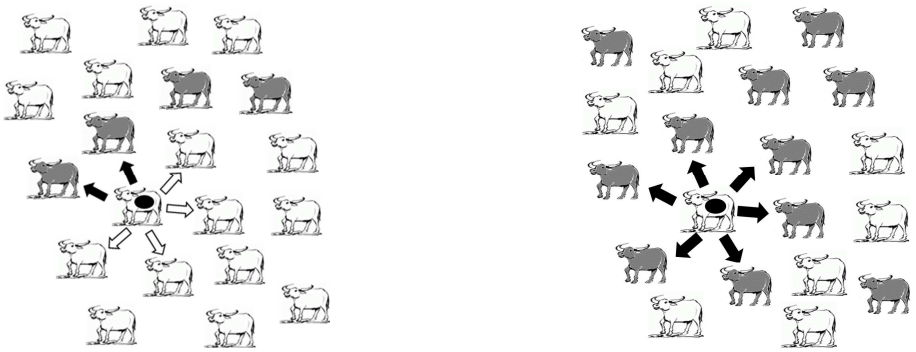
Infected animals may develop chronic disease (continue to be infected and show signs of disease), die from the disease or may recover. Recovered animals may recover completely and eliminated all infectious agent from their system. Sometimes recovered animals stop showing any clinical signs of disease but continue to carry the infectious agent (carrier).

In some diseases, infected animals may never develop clinical signs of disease. In other diseases almost all infected animals may develop signs of disease.

We are also interested in the way disease may spread through the population. Some diseases spread quickly through a population whereas other disease spread slowly. For diseases that are present in the population already (endemic diseases) the population will be made up of a mixture of susceptible animals, infected animals and recovered animals. Recovered animals may or may not be immune influencing whether or not they can get re-infected with the same disease if exposed again.

When many animals are immune, introduction of infection may result in little spread because an infectious animal may be more likely to encounter immune animals than susceptible animals. This is called herd immunity.

**Figure Progression of an infectious disease in a population showing a single infected animal (black circle), susceptible animals (outline with no shading) and immune animals (gray shading). The infected animal is shedding agent and exposing either susceptible animals (no shading) or immune animals (shading) to infection. If the infectious animal only encounters immune animals (see image on the right) there will be no disease transmission.**



# Session 7 Transmission and spread of disease

**Key concepts**

- **Transmission** describes how an infectious agent can move from one animal to another
- **Maintenance** describes how an agent can survive in a population over time
- **Spread** describes how an agent can move from one population to another

For transmission or spread to occur, an infectious agent must leave the infected animal and enter a susceptible animal.

Infectious agents can leave an infected host in biological fluids or excretions from eyes, nose mouth, or in milk, faeces, urine or in pus or other discharges from wounds or in blood or tissues.

Susceptible animals may get exposed to infectious material via direct contact (by touching or sniffing or licking an infectious animal that is shedding infectious agent) or indirectly by ingesting or contacting infectious material in the environment. Indirect contact only works if the infectious agent can survive for a period in the environment.

Exposure (entry of an agent into a new host) may occur through different mechanisms such as ingestion, breathing in the agent, through mucous membranes of the eye or mouth or nose, through skin, during breeding or by some management or procedure (injection, dehorning etc).

Infectious agents have developed different ways to survive over time (maintenance). Some agents have a resistant form that can survive in the environment (anthrax spores). Some agents have intermediate forms that survive in other hosts (parasites). Some agents are capable of infecting multiple species (rabies). Some agents form persistent infections or carrier states. Some agents cause little immune response or alter their genetic make up so they can re-infect animals again (influenza).

# Session 8 Field epidemiology to approach larger disease investigations

**Key concepts**

Field epidemiology skills are important in all disease investigations even when only one animal or one farm is affected. Epidemiology skills are even more important where there are larger numbers of animals affected, the disease is spreading rapidly and where it is unclear what the causes of the disease may be.

Larger disease investigations start with the usual disease investigation (as outlined earlier) and then involve additional procedures including:

1) Developing a case definition and assign animals to cases and non-cases

2) Collecting data on cases and non-cases

3) Applying simple analyses to data on cases and non-cases to describe the disease and identify possible causes

4) Describing initial findings and making recommendations

A ***case definition*** is a set of standard criteria for deciding whether an individual animal has a particular disease or other aspect of interest. Often there are 3 levels: confirmed case; suspect case; and non-case.

A case is an animal with characteristics and clinical signs that meet a case definition for the disease being investigated

Once a case definition is developed, all sick animals are compared to the case definition and assigned to confirmed case, suspect case, or non-case. Information is then collected and examined to look for associations that identify potential causes of the disease.

Case definitions ensure that your focus is maintained on the specific disease of interest and that you can exclude other diseases that may be occurring in the population at the same time.

# Session 9 Collecting data and counting cases

**Key concepts**

Data on cases and non-cases are collected through a process like the disease investigation:

- Asking the farmer questions (history)
- Direct observations (examination) of cases and non-cases and of the environment
- Laboratory results (if samples were submitted to the lab)

Example of questions you may ask the farmer:

- When did the first case of this disease become apparent?
- Is it possible to get the date when each affected animal first showed clinical signs?
- Where were animals when they got sick and where were they in the days to weeks before they got sick?
- Is it possible to collect information on all the animals on the affected farm (or that mix together in a village population) over the days or weeks before cases started to occur?
- Have there been any animal movements into this group or out of this group?
- Were any treatments given to animals (what was administered and when)?
- Were there any other changes (change of feed, chemicals dumped in the paddock or river, new fence erected, etc)?

# Session 10 Making sense of the information

**Key concepts**

Data on cases and non-cases are then analysed to look for patterns including:

- Patterns of disease occurrence over time (epidemic curve)
- Patterns of disease occurrence in space (mapping)
- Patterns of disease occurrence by animal characteristics (were there more cases in males than females or young animals compared with old animals etc)

Understanding patterns of disease will help you to identify general causes and allows you to put effective control strategies in place even if you don't know exactly what disease might be causing the signs.

Use patterns to determine if the disease is likely to be contagious or not contagious and put general control measures in place based on this finding while you conduct further tests to try and identify a diagnosis and more specific causes.

Immediate control measures where the cause might be contagious include:

- Separate sick and healthy animals (isolate sick animals)
- Stop movement of animals off the farm (or onto the farm)
- Apply treatments to sick animals
- Consider applying treatment to other healthy animals on the farm to try and stop them getting infected
- Other biosecurity measures – cleaning and disinfection, dispose of infectious material (bodies, fluids etc)

Immediate control measures where the cause might be non-contagious include:

- Look for exposures – consider moving animals to a new paddock or changing feed
- Consider treatment of sick animals if appropriate
- Make sure animals have good feed and water and clean dry bedding or pastures.

If you are not sure what the diagnosis might be and you are not even sure whether the signs are consistent with a contagious disease or not, then the safest course of action is to implement initial control measures based on controlling a contagious disease. If additional information is collected that then suggests the disease may not be contagious then you can relax the control measures.

If you think the disease could be a priority disease then you will be likely to conduct further investigations and collect samples for testing in the laboratory. If a priority disease is confirmed (FMD, HPAI etc) then there may be additional formal control measures put in place including quarantine of affected farms, test and slaughter programs, vaccination programs or other activities.

# Session 11 Application of epidemiological approach to routine cases

**Key concepts**

Using field epidemiology skills even in routine day-to-day activities will improve the way you think about diseases and disease control.

- Think about the possible **causes** of disease and whether they may be associated with the **host**, **agent**, or the **environment.**
- Use this information to understand how and why the disease has occurred and to guide your treatment and preventive measures.

Field epidemiology skills are particularly important in investigating larger disease events or situations where the diagnosis and causes are unclear.

Field epidemiology skills are also very important for para-vets involved in priority disease control programs.

The understanding of causes and the effect of disease at a population level is very helpful when thinking about why different strategies are used to control specific diseases, and also in explaining the processes to farmers.

# Session 12 Course evaluation, conclusion, and closing