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Understanding Infectious Diseases

An information leaflet for farmers, advisors and vets in Northern Ireland

Disease

THIS GUIDE IS PART OF A SERIES OF LEAFLETS ON VARIOUS ASPECTS OF BIOSECURITY

1. Understanding Infectious Diseases

2. Bioexclusion: Keeping Infectious Diseases Out of Your Herd

3. Purchasing stock: Reducing Disease Risks

Introduction

Infectious agents include many different types of bacteria, viruses, fungi and parasites that can cause a wide range of clinical diseases. Individual infectious diseases often require quite different treatment and control strategies. Trying to put separate strategies in place for each one can be a difficult task.

However, there are many similarities between infectious diseases that can help our understanding of these diseases and their control. Control strategies are often effective against more than one infectious agent.

Figure 1 illustrates the interactions common to infectious diseases. This highlights that there are three different components which all interact to influence the occurrence and severity of infectious disease. Thinking about each component when infectious disease is confirmed on your farm is a good starting point to understanding infectious disease and preventing future disease outbreaks.
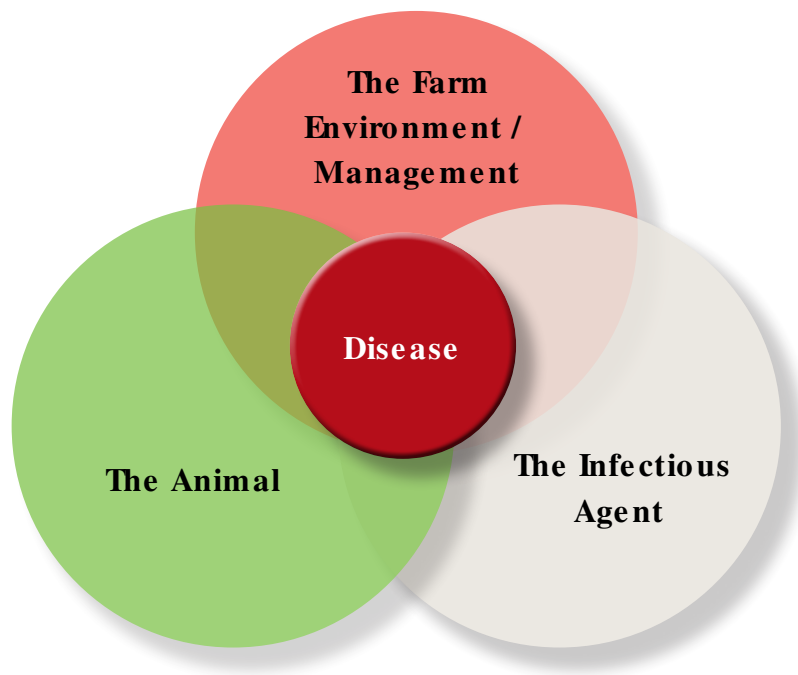
Figure 1: The most important influences on infectious diseases.

The Infectious Agent

Infectious agents or pathogens are the small organisms (mainly bacteria, viruses and parasites) that are capable of causing an animal to become sick. However, infectious agents don't necessarily cause an animal to become obviously ill, and they can often be found in and around healthy animals.

Primary infectious agents in cattle

Many of the disease challenges faced on farms are from infectious agents that have adapted to be able to infect cattle and to spread from animal to animal.

Animals with little or no immunity to these pathogens will often show severe signs of disease. This happens most often when a pathogen enters the herd for the first time and, when many animals are affected, this is often referred to as an epidemic or an outbreak. To prevent outbreaks of disease requires good farm biosecurity management.

When a pathogen has been circulating in the herd for some time, animals will have been infected and develop adequate immunity. However, the disease may remain present in the herd usually by persisting in 'apparently healthy' animals called carriers. Pathogens can cause illness if they spread from carriers to animals with little or no

immunity, such as stock previously unexposed to the pathogen (e.g. younger stock) and animals whose immunity is compromised. Susceptible animals are at high risk of developing disease. When infection in the herd reaches this state it is called an 'endemic infection' or 'endemic disease'. Many of the common cattle diseases are capable of establishing endemic infections within herds and several different endemic diseases can be present in a herd at the same time. Common examples of primary pathogens that may cause endemic disease in a herd include bacteria (e.g. those causing salmonellosis, leptospirosis and Johne's disease) and viruses (IBR and BVD). In some cases endemic infections (e.g. Johne's disease) can be present in a herd for a long time (years) before any animal becomes visibly sick. With proper long-term controls some endemic infectious agents can be eliminated from a herds.

Environmental organisms

These infectious agents are called 'environmental' because they reside mostly in the environment. They are **always** present in and around cattle on **every** farm and do not normally cause any disease. However, they are opportunists and may cause disease when they are allowed to multiply in the farm environmental or in susceptible animals.

As environmental organisms are practically everywhere, they can never be truly eliminated. This means the management of both the animal and environment is critical in the control of diseases caused by these agents.

Common examples include *E.coli* and *Streptococcus* bacteria.

The Animal

Not all animals will get sick when exposed to an infectious agent. The outcome will depend on the balance of the severity of the challenge by the infectious agent and the status of the animal's immune system.

Young animals

An animal is born with very little immunity to any infectious agents (including environmental and primary pathogens). Colostrum contains antibodies that will give a new-born calf rapid and increased protection. Without adequate intake of colostrum shortly after birth, the animal will be very susceptible to infectious disease. For certain diseases, vaccination of the dam pre-calving can boost the quality of the colostrum and hence improve protection of the new-born calf if colostrum intake is adequate and timely.

Case example

E.coli septicaemia is a common cause of death in new-born calves. The bacterium is environmental and it is always present, on every farm. A frequent contributing factor is that the calf has not received sufficient colostrum of adequate quality and therefore has almost no immunity to the bacteria.

Calves with a low immunity are very susceptible to picking up infections directly from their environments

Naïve animals

An animal must come in contact with an infectious agent before the immune system can respond. Until an animal meets an infectious agent it is said to be naïve regarding that agent. Naïve animals are more susceptible to disease caused by pathogens. Once an animal has been exposed to the infectious agent, it will mount an immune response and, if it recovers, it will be much better at defending against this disease in the future. Calves can receive antibodies that will provide some immunity via colostrum but this tends to decrease over time. Typically these antibodies have reduced to very low levels by 6-8 months and the animal will become naïve unless the animals immune system is challenged. For some diseases an immune response can be created in a controlled way using vaccination.

Case example

If a closed herd (one to which a farmer does not add any animals) is naïve to an infectious disease such as IBR (the animals do not have protective antibodies to the IBR virus), the risk of an IBR outbreak is high if carrier cattle are then introduced.

Immuno-compromised animals

Even after an animal has been exposed to some of the environmental and primary pathogens in a herd, its immune system can become compromised leaving it at risk of disease again.

Common factors which can affect an animal's immune system are:

- Inadequate amounts or quality of colostrum
- Other diseases
- Inadequate or unbalanced nutrition
- Calving
- Stress (e.g. from weaning, lameness, overcrowding, castration, dehorning, etc)
- Immuno-suppressive drugs.

Animals affected by one or more of these factors will be at an increased risk of getting sick.

Case example

If suckler calves are dehorned or castrated close to weaning these stressors increase the risk of weanling pneumonia.

The Farm Environment

In some situations, infectious agents can build up in the farm environment to such high levels that the immune system can be overwhelmed (even when it is not compromised). Contamination of the farm environment with pathogens can be controlled by simple farm biosecurity management procedures such as cleaning and disinfecting. There are commonly three types of infected animal capable of contaminating the farm environment.

Case example

Coccidia are very commonly found in the farm environment. In most cases, growing animals are able to rapidly mount a good immune response after first exposure, so that they show no signs of disease and shed only moderate numbers of coccidia into the environment.

If conditions favouring a large increase of coccidia are allowed to occur (e.g. in an overcrowded pen), the immune system can be overwhelmed and animals can develop severe scour and become very sick. The sick animals will shed many more coccidia, resulting in many more clinical and sub-clinical cases. Therefore, both the poor management of the animals and the infectious agent both contribute to the outbreak.

Infection types

Once an animal is infected it may result in a range of outcomes. Knowing the different ways infection can be present on a farm is important when trying to prevent or tackle infectious diseases.

- **Clinically sick animals:** A clinically sick animal is one that is showing visible signs of illness. The identification of such an animal is often the first sign of a disease problem in the herd. These clinically sick animals often produce large amounts of the infectious agent, potentially spreading it to other animals and shedding the agent into its immediate environment; for example, in dung, urine, nasal secretions, abortion and calving fluids.

- **Sub-clinically affected animals:** Animals can be infected without appearing ill (their performance may be reduced). Sub-clinically affected animals can only be identified using diagnostic tests and monitoring performance. An example of this is a cow with a high somatic cell count (SCC). She has an infection in her udder even though there are no obvious signs of mastitis. Sub-clinically affected animals can often also act as carrier animals (see below) shedding infectious agents into the farm environment and directly to nearby animals. Often the number of sub-clinical cases may be far greater than the number of clinically sick animals. Thus, once you detect a sick animal in a group you should look further for any sub-clinical cases. Figure 2 shows the typical distribution of infection states for an endemic disease such as IBR.

- **Carrier animals:** Carrier animals cannot be identified by any visible signs of disease but they remain infected and may shed infectious agents continually, affecting their own health or production. Environmental agents, such as E. coli, are carried by almost all animals on the farm; primary pathogens are usually only carried by a smaller number. See the AHWNI Bioexclusion and Biocontainment leaflets for further information.
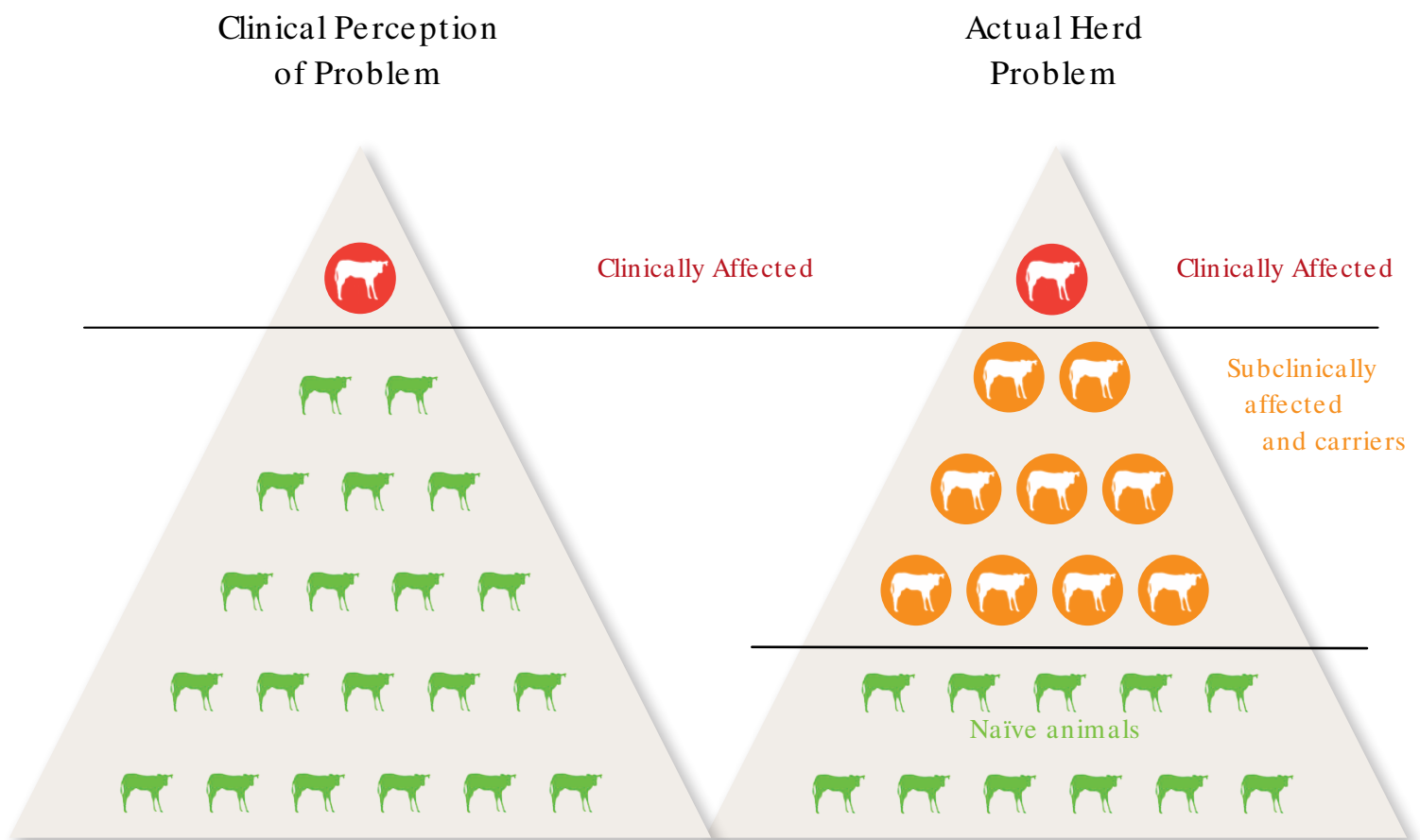

Figure 2: The typical pattern of infections for an endemic disease such as IBR where there can be a high number of subclinically affected animals.

Farm Management: Preventing and Controlling Infectious Disease

All infectious diseases involve an interaction between the infectious agent, the animals' immune system and the farm environment. Preventing infectious disease requires paying attention to the management of all three factors as they affect the two main ways in which you can manage infectious diseases.

Managing Infectious Diseases

All infectious diseases can be managed by the combination of two actions:

1. Controlling the sources of infections

2. Controlling the spread of infections

For long-term control of an existing infectious disease problem, the more important of these two actions is to reduce the spread of disease. If this can be successfully achieved then the level of infection will eventually reduce as infected animals are treated or removed from the herd. However, these two actions are interrelated, with the spread of disease being easier to control when there are reduced sources of disease on the farm and it is easier to reduce the amount of disease on a farm when its spread is slower. Therefore it is wise to address both issues at the same time.

Endemic Disease

When a pathogen (or infectious agent) first enters a herd, it may cause a serious outbreak or may be spread by apparently healthy animals for a long time, causing a low level of clinical disease. At times, triggered by stress or management activities, these diseases may flare up to cause an outbreak. See www.animalhealthni.com for information on other animal health programmes such as BVD, Johne's Disease and IBR.

Vaccination

Vaccination can play an important role in boosting the immunity of your herd and reducing clinical disease signs. In addition, for some diseases it can also prevent or reduce the shedding of pathogens by infected animals. Vaccination works by stimulating the animal's immune system against a particular pathogen. For most dead (inactivated) vaccines to provide a long lasting high level of protection an initial course of two doses is required, followed by regular boosters (Figure 3). Without the second initial vaccination or booster shots the immunity may not reach a high enough level or last long enough to provide adequate protection to the animal or to its offspring e.g. in the case of of clostridial vaccination to prevent calf diarrhoea.

To ensure that vaccination is as effective as possible there are several key actions that should be taken.

1. **Vaccinate animals so that they are protected prior to the greatest period of risk/challenge.**
    *   Typically animals need at least 2-3 weeks after completion of the course to develop adequate immunity.
    *   Endemic diseases often show recurring but predictable seasonal patterns. Vaccinate BEFORE the greatest periods of risk for the pathogen in question.
    *   If two doses of vaccine are required, give the two doses.

2. **Always read and follow the instruction label**
    *   Studies have shown that a large proportion of vaccines are not stored properly on farm, thus reducing their effectiveness.
    *   Be careful to administer the correct dose by the correct route with clean equipment.

3. **Animals need to be able to mount an immune response to the vaccine in order for the vaccine to be effective.**
    *   If animals are immunosuppressed for some reason (such as poor nutrition or another disease) they may not respond adequately to the vaccine.

4. **Make sure you are vaccinating against the correct agent.**
    *   Many agents can cause similar clinical signs (e.g. viruses causing respiratory disease) so use diagnostic testing in conjunction with your own veterinary practitioner to identify the correct vaccine to use for the disease you are trying to control.

It should be remembered that given a large enough challenge, any level of immunity will fail; no vaccine is always 100% effective.

Immunity declines if required booster not given

Two doses spaced a few weeks apart

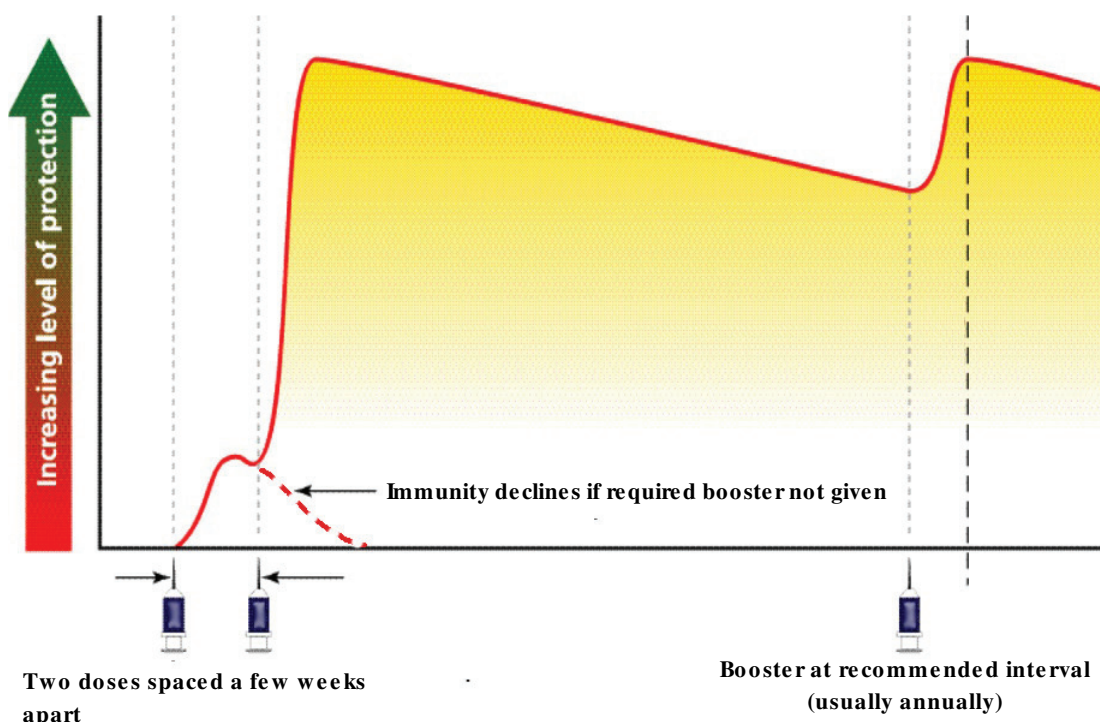**Booster at recommended interval (usually annually)**

Figure 3: Many vaccines require two vaccinations to get a long lasting high level of immunity through antibodies. Administer vaccines exactly in-line with instructions.

Figure 4 below shows the factors and their relationships that influence the source and spread of disease on farm.
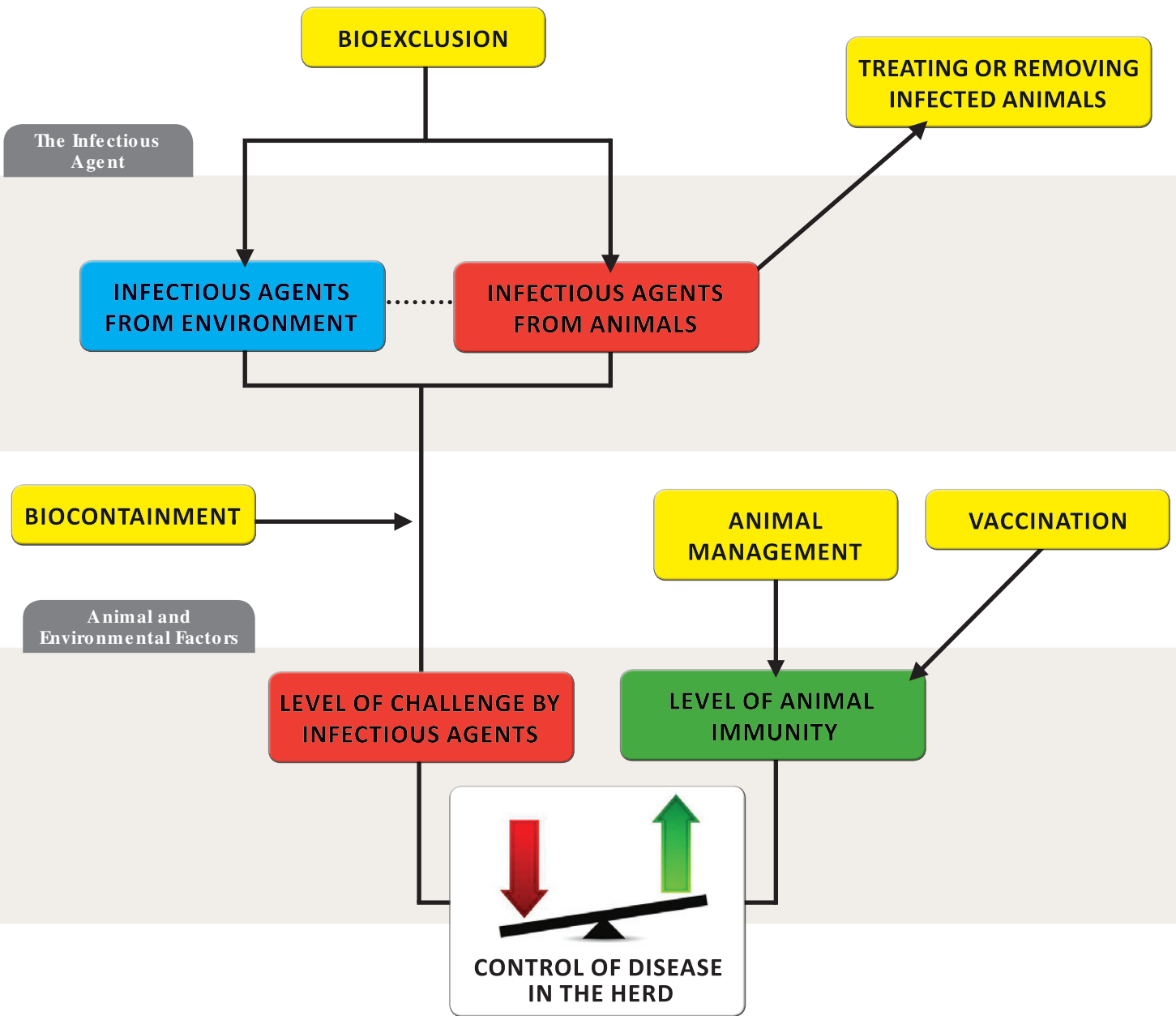

Figure 4: Factors and their relationships that influence the source and spread of disease on farm

The diagram shows that biosecurity (both bioexclusion and biocontainment) and animal management, the treatment/ removal of infected animals and for some diseases vaccination are the major factors affecting disease control that can be influenced by a farmer. All of these factors ultimately determine the balance between disease and immunity. When the animal's immunity is overcome the animal will succumb to disease and the disease will spread to that animal. A disease is only under control if it is spreading at a slower rate than the infected animals are recovering or being removed. For some disease, such as Johne's disease, treatment and vaccination are not possible therefore control relies on management alone (including culling). Where treatment is possible it can be used to aid the effectiveness of management controls but they should not be used to replace management completely as a substitute for good husbandry.

Whether an animal gets sick or not depends on its immunity, its environment and the challenge by the infectious agent invoved

Animals with compromised immunity are more likely to get sick

Sick, sub-clinically infected and carrier animals are major sources of infection

The farm environment is normally contaminated with environmental pathogens (e.g. *E.coli*)

A build up of environmental pathogens can cause disease

Some farms and animals are also sources of primary pathogens such as Johne's disease

In controlling infections, focus on the animals' immunity, their environment, the infectious agent and how it is spread

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