Field services: Eradication and control of animal diseases

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ABSTRACT

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Prevention, eradication and control of animal diseases, as well as public health assurance are major functions of veterinary authorities. The strategies to control animal diseases differ from disease to disease but are often similar on a disease basis from country to country depending on the main objective of the measure employed. These measures include among others movement control and quarantine, vaccination, treatment and mass slaughtering. However, not every country uses all these control measures at the same time. A combination of measures may be employed to avoid spreading of the disease from infected to clean animals and success is dependent on a variety of factors, including the strength and capacity of the veterinary services, cross border efforts for disease surveillance, political will, diagnostic facilities and financial support.

INTRODUCTION

Global trade in animals and animal products has grown significantly in recent years. The improvement of global transport systems makes it easier for animal products to be transported much faster and so can animal disease causing agents. The impact caused by these diseases may be localized or global. Some diseases are not apparent but cause severe economic losses because of their nature. Some that affect man are notorious for causing lower productivity. For these reasons, it is important to prevent, control and eradicate animal diseases using a science-based approach. Disease control measures are undertaken to minimize the various impacts they may have. When disease control measures are undertaken, often some unintended impacts are experienced. These undesired results need to be monitored, measured and the cost thereof be determined so as to justify the choice of the measure employed.

In addition, it is necessary to take into consideration factors contributing to animal disease occurrence which include climate, vegetation, animal population, interaction of the wild and domesticated animals, farming systems and management of animals, presence of vectors, and type of animal breed (e.g. indigenous Sanga and Zebu cattle's resistance to tick-borne diseases). It is also important to ensure that the interaction between wild animals and domesticated animals is limited as this interaction may have undesired effects on both. This interaction can be minimised in a number of ways including fences and movement control. Climate and its changing nature has recently become an important consideration since it is believed to influence the epidemiology and spread of some diseases, particularly arthropod-borne ones. Understanding of the epidemiology of animal diseases is a very significant consideration in animal disease outbreak control and prevention.

The World Organisation for Animal Health (OIE) provides adequate guidance on disease prevention and outbreak management and serves as an international standard-setting body and a world reference centre for activities involving animal disease outbreak management and trade involving animals and animal products. However, there are still some animal disease management approaches that are not yet harmonised. As a result, research on animal diseases and outbreak management carried out in different parts of the world at research institutes and universities is necessary and will continue being necessary for many years to come. It is for this reason that approaches to animal disease and outbreak management is constantly changing as new knowledge is gathered and new discoveries are made available to veterinarians. Traditional approaches to disease control for purposes of trade are receiving a strong challenge from new concepts like compartmentalisation, commodity-based trade and containment zones. Although some of these concepts are not really new disease control approaches, they tend to contribute to new thoughts in disease control.

MANAGEMENT OF DISEASE OUTBREAKS

Prevention, eradication and control of animal diseases, as well as public health assurance, are major functions of veterinary authorities in most countries. Strategies to control animal diseases differ from disease to disease but are often similar for the same diseases from country to country depending on the main objective of the measure employed. The success of these measures is dependent on a variety of factors amongst which the strength and capacity of the veterinary services, cross-border efforts for disease surveillance, political will, diagnostic laboratory and financial support are important (Perry & Sones 2007).

Those countries that are successful in effectively managing animal diseases have strong animal disease policies and legislation, normally based on principles and guidelines of the OIE's terrestrial and aquatic animal health codes (2007), and a strong laboratory network guided by the biological standards of the OIE (2007). Furthermore, these countries have statutory bodies that also monitor the conduct of veterinarians, including those in the private sector. Privately practising veterinarians, although independent, are expected to report certain animal diseases to the state once they have been diagnosed. This emphasizes the importance of the existence of strong links between the state veterinary service and private practitioners.

Prevention of disease outbreaks is more cost effective than eradication and control after outbreaks have taken place. Effective and efficient organization of preventative measures following a risk assessment approach is essentially the first step in controlling the spread of disease. In addition, effective movement control and quarantine, vaccination, treatment and mass slaughtering can be used for disease confinement and eradication purposes (Perry & Sones 2007). Each control measure acts by reducing the effective reproductive index of the infective agent in the population. It is not necessary to use all these control measures simultaneously. However, a combination of these measures may be required to avoid spreading of the infective agent from infected to clean animals.

Movement control and quarantine

The prevention of the interaction of wild and domesticated animals is often a necessary step in the prevention of disease outbreaks as some diseases can be easily exchanged between the two. The classical examples where diseases can be exchanged in this manner are foot-and-mouth disease (FMD), classical swine fever, avian influenza and even bovine tuberculosis. Separation of wild and domestic animals could be achieved by fencing or other physical or natural barriers like rivers, forests, mountains, thus effectively controlling the movement of animals and confining them to their respective territories. Electrified fences are sometimes used for this purpose. Such separation can however be resource intensive and has recently been questioned as the cost and benefits have not been assessed, particularly for African countries (Perry & Sones 2007).

In addition to separating wild and domestic animals, movement controls are also essential in separating animals of different disease status, such as vaccinated from unvaccinated animals. It is often necessary that these animals be identifiable in order to detect an animal that is wandering out of its rightful territory on time. Such fences need to be checked for intactness, and should be immediately repaired as soon as any damage is detected.

The South African approach for the control of foot and mouth disease, as explained in the unpublished FMD protocol of the Department of Agriculture (2005), is to have the infected area enclosed by an electrified game proof fence, and immediately surrounded by a zone in which all ruminants are vaccinated twice a year and inspected regularly for FMD lesions. This zone is commonly referred to as the buffer zone. All animals in this zone are identified as animals that have been vaccinated. The buffer zone is in turn surrounded by a zone in which all ruminants are inspected at less regular intervals but also separated from the vaccinated animals with a fence. This zone is often referred to as the surveillance zone. The surveillance zone is traditionally a disease free area. The same zoning concepts are applied during disease outbreaks, when certain zones like infected zone, buffer zone and surveillance zones are declared.

Movement control also aims at controlling the translocation of possibly infective animal products either by people or mechanically. It is often necessary that only products that have been rendered safe be allowed out of the infected area into areas that are free from disease. It may be necessary that vehicles and other mechanical means be disinfected with an effective disinfectant. The need for roadblocks is brought about by these procedures.

Quarantine is an extreme form of movement control where animals, their products and sometimes even handlers are confined to an area with limited movement in order to avoid contact with susceptible animals or their handlers. All the principles explained above are applicable.

Vaccination

Without doubt vaccination, when available and applicable, is still the most cost effective means of preventing and controlling and even eradicating infectious animal diseases (Pastoret, Lombard & Schudel 2007). Vaccines are normally easily available, also to farmers, unless their application needs special attention. Vaccination can, however, interfere with future diagnoses of disease if an inappropriate vaccine has been used. The dawn of marker vaccines has to a large extent contributed to reducing these interferences significantly and led to the ability to differentiate between vaccinated and diseased animals (Vannier, Capua, Le Potier, MacKay, Muylkens, Parida, Paton & Thiry 2007).

Scudamore (2007) reported that the FMD outbreak in the United Kingdom was unprecedented with the need to develop a vaccination policy at the height of an epidemic. He also indicated that during a survey conducted in that country it was very clear that a high percentage of consumers have a propensity not to consume animals that have been vaccinated. However, this new technology, being able to differentiate between diseased and vaccinated animals commonly known as DIVA, also contributed to continued disapproval by the public of the culling of large numbers of animals when there are other alternatives like vaccination.

In an unpublished report of the South African Department of Agriculture on the outbreak and control of classical swine fever in the eastern Cape (2005) it is stated that vaccination in most cases requires the possibility to handle animals individually, often repeatedly for boosters, which can be a challenge in more extensive, free-ranging farming systems without intensive handling facilities. In some instances it is possible to use bait vaccines and still be able to sufficiently and effectively control animal diseases as was the case in the control of rabies in the Czech Republic (Matouch, Vitasek, Semerad & Malena 2007).

Treatment

Treatment can be aimed at treating the affected animal against the particular agent of concern or treating the animal to prevent it from being attacked by disease-carrying arthropods like ticks and insects. Dipping the animals, together with vaccination where appropriate, is still considered to be one of the most effective strategies against some arthropod borne diseases. Dipping, however, has to be properly applied as resistance to some acaricides is developing at an alarming rate (Ntondini, Van Dalen & Horak 2008).

Mass slaughtering

The availability of the technology enhancing the differentiation of diseased from vaccinated animals has contributed to an increase in public disapproval of some veterinary prophylactic measures such as mass slaughtering of livestock to control outbreaks of epizootic diseases (Scudamore 2007). Although this is the case, slaughtering of infected animals will still be necessary in many circumstances.

It is emphasized therefore that decision-making in the control of animal disease outbreaks should be a dynamic and flexible process. (Ge, Mourits & Huirne 2007). When a disease is diagnosed at the beginning of an outbreak there are many uncertainties about the consequences and success of control options. In the South African context and probably everywhere else in the world, there is always a possibility of a strong public outcry at the methods employed to control outbreaks of animal diseases. Industries and the public should therefore be involved for successful animal disease prevention and control. At the same time, flexible decision-making can avoid unnecessary control costs through learning and adjusting.

NEW CONCEPTS IN ANIMAL DISEASE CONTROL AND TRADE

Although the above guidelines have been applied for many years and are still applicable, the concept of trading with animals and their products on the basis of geographical freedom from disease is currently being challenged. In the concept, any incursion of the disease in the so called disease free area automatically resulted in loss of trade from the entire country or region. New concepts such as compartmentalization, containment zones and commodity based trade have recently been introduced. These concepts, as well as the dawn of marker vaccines, have changed disease control approaches significantly.

Compartmentalization

Trade 'regions' and 'zones' are based on principles of epidemiological science and risk analysis that assess and manage animal disease risks so that the safety of trade can be ensured by establishing geographical boundaries (Scott, Zapeda, Garber, Smith, Swayne, Rhorer, Keller, Shimshony, Batho, Caporale & Giovannini 2006). These scientists argue that the boundaries of geographical regions and zones can be breached through numerous epidemiological pathways. The concept of a 'compartment' extends the application of a 'risk boundary' beyond that of a geographical interface and considers all epidemiological factors that can contribute to the creation of an effective boundary.

Containment zone

The terrestrial animal health code (OIE 2008) describes a containment zone as a defined zone around and including suspected or infected establishments, taking into account the epidemiological factors and results of investigations, where control measures to prevent the spread of the infection are applied. The concept has helped to a large extent to spur authorities in a country to move with speed in the control of animal diseases and the necessary establishment of measures to prevent the spread of disease so as to allow trade on safe commodities even if the freedom status of the country by the OIE has not been established yet.

Commodity-based trade

In the context of trade, commodities could be anything from live animals to their products or even genetic and pathological material (OIE 2008). The concept of trading in commodities only from countries that are free from the disease in question is believed to be trade limiting and unnecessarily wasteful by the British Department for International Development (2008). It is argued that the ability to export should be determined by the product or animal's disease status and not by the country's disease status. The advantage is that this approach allows countries with endemic diseases that cannot be eradicated, to participate. It is also believed that this approach will help many developing countries to participate in international trade even if they have not eradicated certain animal diseases. It is however also argued that this may not necessarily be the case, as once this approach is made a standard, every country, including the developed ones, will be allowed to use the same standard. It is also believed that this will be a disincentive for countries to control animal diseases that can be eradicated. Some of these diseases, especially erosion diseases, could become endemic and lead to general low production of food worldwide.

THE SITUATION IN SOUTH AFRICA SINCE 2000

Since 1994, South Africa has joined the global village with regards to tourism and trade, contributing to the occurrence of some diseases. It is now understood that the 2000 FMD outbreak in the KwaZulu-Natal Province occurred as a result of the illegal feeding of swill or galley waste obtained from ships in the Durban harbour ((Department of Agriculture, unpublished 2001). It is also clear that the avian influenza outbreak was probably facilitated by insufficient attempts by ostrich farmers to keep ostriches apart from wild birds, especially water fowl (Department of Agriculture, unpublished 2005). It is not known how classical swine fever (CSF) was introduced into the country.

Foot-and-mouth disease: Camperdown outbreak

Since 2000, outbreaks in South Africa mainly affected the Limpopo Province, but also occurred in the Mpumalanga and KwaZulu-Natal Provinces. These FMD outbreaks led to the suspension of international trade in a number of commodities, including beef and cloven-hoofed animal products. The main outbreak occurred in 2000 when a type O FMD virus was introduced into South Africa for the first time. This outbreak was dealt with decisively by Veterinary Services. The occurrence of the disease affected international agricultural trade negatively, but also affected local trade in diverse agricultural products such as milk and strawberries. The major concern was the fact that type O FMD virus was diagnosed for the first time in South Africa. The natural response was to go ahead and cull all affected and at risk animals. The culling process was slower than desired, however, and the disease was spreading fast. The strategy was consequently changed to that of vaccination after due consideration of a number of factors including the fact that the disease was moving into territories which were difficult to access.

Foot-and-mouth disease: Middelburg outbreak

The Mpumalanga outbreak of FMD occurred shortly after the one in KwaZulu-Natal. This outbreak, however, occurred as a result of the contact between buffaloes that escaped from the Kruger National Park and domestic cattle. Cattle from this outbreak area were inadvertently taken to a feedlot in Middelburg from where animals were sold to a slaughterhouse in Swaziland. A clinical diagnosis of the infection was made at the abattoir and as a result Swaziland lost its export status and the much needed revenue. The outbreak was approached from a significantly different angle because the animals were confined to a feedlot and only a few pens were affected. The affected animals were culled and buried, whereas those that were still free from the disease were vaccinated and later slaughtered under supervision at designated abattoirs. This again demonstrates that there are no hard and fast rules in disease eradication, especially if we consider that the same disease, although due to a different strain of the virus, was involved at Camperdown and Middelburg but were controlled differently, depending on the prevailing conditions.

Equine influenza: Cape Town

Equine influenza occurred in horses in the Western and Eastern Cape Provinces. It is believed that the disease occurred when infected horses that were certified to have been vaccinated against the disease, entered South Africa via Cape Town from Europe. These horses could not be quarantined properly to prevent transmission of the infection. In this case, vaccination and supportive treatment of affected animals was employed.

Porcine reproductive and respiratory syndrome

Outbreaks of a few animal diseases unknown to South Africa before 2004 raised some concern amongst veterinarians. One of these diseases is caused by *Salmonella cholerasuis,* which was diagnosed for the first time in April 2004 in pigs in the Western Cape Province (Department of Agriculture, unpublished 2004). Not long thereafter, another disease, which had not been diagnosed before in this country, i.e. porcine reproductive and respiratory syndrome (PRRS), was discovered and again in pigs in the Western Cape Province. For PRRS, isolating infected farms and slaughtering affected herds were used without the need for vaccination.

Notifiable avian influenza in ostriches

Notifiable avian influenza (NAI) occurred in ostriches in the Eastern and Western Cape Provinces in 2004. This disease had been diagnosed before in this country, but had never been reported in its highly pathogenic form. This time it caused high morbidity and mortalities in ostriches and led to suspension of trade in all poultry and poultry products with trading partners. The ostrich industry lost close to R700 million and had to lay off 4 000 workers due to this loss of income during the period (Department of Agriculture, unpublished 2005). The poultry industry, including ornamental birds, also lost several million rand as they could not export their produce for months causing a severe shortage of poultry meat in this region. South Africa had to prove to trading partners that the poultry industry itself was not affected by the disease before they could be allowed to export meat to the region. In this instance, the approach utilized was testing, isolating infected flocks, culling and burying the culled birds. It ended up as an exercise which adversely affected the emotional wellbeing of veterinarians and technicians alike, requiring psychological counselling in some cases. This is an example of an unintended impact that needs to be taken into consideration when disease eradication campaigns are planned.

Classical swine fever

Classical swine fever (CSF) devastated the pig industry and affected both the Eastern and Western Cape Provinces. Control measures for this disease continued for more than two years, at a great cost to the state, and included the establishment of road blocks in and around the province and a surveillance programme. Animals that tested positive for the disease were put down humanely and buried. Food security within the province and in other provinces was affected adversely.

Brucella canis

Brucella canis was never before reported in South Africa and was introduced into the country in 2005 in the Western Cape Province. So far it is not known how the disease was introduced, but it is suspected that an infected dog escaped from a ship/sea vessel and found its way inland where it may have infected other dogs. The canine was put down and no further cases were seen.

GENERAL CONSIDERATIONS

It is not easy to predict when and how a disease will be introduced into a country. Governments therefore have to be vigilant at all times and ensure that animal diseases are kept out of its territory to the best of their abilities. When these diseases are introduced, pre-conceived mitigation strategies should be implemented immediately.

If an exotic disease is introduced, the speed of detection and prompt reaction of the veterinary services are of paramount importance in limiting the impact of such an outbreak. This requires surveillance strategies that include all parts of the livestock farming sector, a particular challenge for countries with a large informal and emerging farming component. A strong veterinary service component is essential for executing effective surveillance strategies and effective response to outbreaks. South Africa is grateful for the support of international organizations, like the OIE, for their assistance in promoting on a political level the need for independent and strong veterinary services systems to safeguard animal and human health, food safety and security as well as international trade in animals and animal products. Poor implementation of disease control measures may contribute to localized negative impacts. Improper use of chemicals and drugs, in particular, can expose animals, humans and the immediate environment to possible toxic effects, either directly, and/or indirectly, or through residues in livestock products (Perry & Sones 2007).

Participatory epidemiology

The use of ‘existing veterinary knowledge’ or indigenous knowledge for epidemiological purposes and early detection and the use of local communication routes, e.g. tribal heads and chiefs, often improve the success rate in disease control and eradication. These traditional routes of communication are often an effective means to inform the public of the existence of serious animal diseases, but also of vaccination and inspection days and points. Disease control programmes are also more acceptable to the affected community when their traditions are taken into account (McLeod & Rushton 2007).

Geographic information systems

A strong veterinary service component is essential for executing effective surveillance strategies and effective response to outbreaks. Geographical information systems (GIS) are able to provide information from a database and display it on a map. It can, for instance, depict the percentage of animals vaccinated at each dip tank in a particular year. It gives a clear picture of the disease situation in a particular country or area and can provide vast amounts of information during an outbreak such as:

- Exact location of index cases/infected farms
- Farms involved
- Farms located within a specified radius

Therefore, GIS is valuable during the planning of control efforts.

CONCLUSION

Many factors have to be considered when deciding which disease control measure to employ. The approach to disease control differs from situation to situation and depends on available resources. It is advised that decision makers in animal disease control should constantly evaluate the effectiveness of control measures employed and adjust them where necessary. At the same time, disease control approach is moving with the times—as new technologies are discovered.

A better understanding of the epidemiology of diseases is also leading to new approaches, such as compartmentalization and containment zones, to facilitate trade in commodities. These new concepts emphasize the necessity for flexibility in disease control decision-making.

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