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# CONTROL OF ANIMAL DISEASES CAUSED BY BACTERIA: PRINCIPLES AND APPROACHES

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## ABSTRACT

To continue to exist, a bacterial pathogen must reproduce and be disseminated among its hosts. Thus, an important aspect of bacterial disease control is a consideration of how reproduction and dissemination of the organism occur. One must identify components of bacterial dissemination that are primarily responsible for a particular disease. Control measures should be directed toward that part of the cycle which is most susceptible to control the weakest links in the chain of disease process. Reducing or eliminating the source or reservoir of infection, breaking the connection between the source of the infection and susceptible animals and reducing the number of susceptible animals by raising the general level of herd immunity with immunization are three main kinds of control measures against bacterial diseases.

**Key words**: Animal diseases, bacteria, control.

## INTRODUCTION

Bacterial diseases are infectious in nature i.e., they can be transmitted from one host to another. Outbreaks of infectious diseases are often compared with forest fires. Once a fire has spread through an area, it does not return until new trees have grown up. Outbreaks develop when a large population of susceptible animals is present. If immunized animals are present in the herd (i.e., herd immunity) then outbreaks can not occur until a sufficient number of young, non resistant animals have been bred or non immune animals from outside are introduced in the herd.

### Herd Immunity

Herd immunity is the resistance of a population to the spread of an infection and a pathogen (Smith, 1995). The larger the proportion of immune animals in the herd, the smaller is the probability of effective contact between infective and susceptible animals (i.e., many contacts will be with immunes and thus the population enjoys an immunity that is not of its own making but instead arises because of membership in the group). Any increase in the number of susceptibles may result in an outbreak of disease. The proportion of immune animals to susceptibles must be constantly monitored because new susceptible animals continually enter into the population. The number of susceptible animals is influenced by population dynamics such as the number of births, deaths, additions and removals from the population (Martin *et al*., 1987).

### Disease control measures

The development of a bacterial disease is a complex process involving many factors. Many a times, control activities reflect compromises among alternatives. To proceed intelligently, one must identify components of the bacterial dissemination which are primarily responsible for a particular disease. Control measures should be directed towards that part of the cycle which is most susceptible to control the weakest links in the chain of disease process. There are three kinds of control measures:

1. Reducing or eliminating the source or reservoir of infection.
2. Breaking the connection between the source of the infection and susceptible animals.
3. Reducing the number of susceptible animals by immunization.

### 1. Reducing or eliminating the source or reservoir of infection

### Quarantine

The restriction of movement of animals suffering from, or exposed to, infections is one of the oldest tool known to preventive medicine. The principle of quarantine of domesticated animals was applied as early as roman times. The establishment of International Livestock Quarantine in the United States in 1890 provided for the holding of all imported cattle, sheep and swine at the port of entry. In this way, infections caused by *Brucella melitensis* have been eliminated from the United States.

The period of isolation should be equal to, or longer than, the incubation period of the suspected disease. The term quarantine has been derived from the Italian word *quarantina* (40 days). It is sensible precaution that new stock introduced to farms, zoos, etc. should be kept separate until it is certain that they have not brought in new diseases or virulent strains, even if this is not required by law. Quarantine is usually imposed on animals entering a country or establishment so that any disease they may be carrying or incubating can be identified. They may also be vaccinated against diseases in their new environment.

**Destruction of an animal reservoir of infection**

The early detection of a disease in a population of animals - a herd of cattle, for example - is particularly useful in controlling certain chronic infectious diseases, such as mastitis, brucellosis and tuberculosis. Laboratory tests like agglutination test in pullorum disease, the tuberculin skin test for tuberculosis and chemical tests performed on milk to diagnose bovine mastitis are used for the detection of diseases in an animal population. Laboratory tests to confirm the existence of diseased animals in a population, followed by slaughter of the affected animals, has been of great value in controlling infectious and genetic diseases. Bovine tuberculosis has been eliminated from Denmark, Finland and Netherland and reduced to a low level in various other countries like Great Britain, Japan, United States and Canada by this method.

**Environmental control**

Animal diseases have been prevented by methods involving environmental control, including maintenance of safe water supplies, the hygienic disposal of animal excrement, air sanitation, pest control and improvement of animal housing. One specific environmental programme called the portable-calf-pen system, involves routine movement of the pens to avoid a concentration build up of specific pathogens in them. The underlying principle is to keep the exposure level below the minimum infective dose. Other programmes involve the utilization of automatic and sanitary watering and feeding equipments, and environmentally controlled buildings. Environmental control methods in the poultry industry have resulted in the most efficient means of poultry production.

**Therapy for elimination of bacterial infections**

Due to intensive farming, farms have become increasingly polluted, harboring greater numbers and kinds of microorganisms. Many of these micro-organisms are posing health hazard to animals. Salmonellosis and *E. coli* related diarrhea are among examples of complications caused by microorganisms during animal feeding. Therefore, microbial control is one of the most important management strategies for the success in animal production (Swick, 1995).

There is a considerable amount of uncertainty as to the value of antibiotics for sub-therapeutic purposes. There have been claims of improved rate of production, improved feed conversion and decreased mortality after the continuous or intermittent administration of certain antibiotics to the animals. In recent years, controversy has developed over the use of the antibiotics because of the concern that drug resistant strains of the bacteria may be developed by livestock and then passed on to the human population. In response to this concern, the scientific community has been searching for alternatives that will help producers get maximum production and will not produce the resistant strains. Researchers also indicate that one way of achieving this objective is through feeding organisms (probiotics) which are beneficial to treat animals and promote growth by preventing bacterial infections. The use of organic acids in feed has also been proven to be a conventional and effective approach to control harmful microorganisms in the animal feed, which is always contaminated by a wide range of different microorganisms (Liang, 1995).

**2. Breaking the connection between the source of infection and susceptible animals**

Transmissible diseases, i.e. diseases where the agent can be transmitted from one animal to another, can be divided into contagious and non-contagious diseases. Contagious diseases require contact, whether direct or indirect, with the animal that is the source of the pathogen. Non-contagious diseases are transmitted through the intermediary of a vector. Control measures against a transmissible disease must be strictly adapted to the preferred mode or "usual" mode of transmission of the disease agent (Toma *et al*., 1999). General cleaning and sanitation measures usually help in breaking the connection between sources of infection e.g., use of proper disinfectant before and after milking to disinfect the milking machine to prevent udder infection.

**3. Reducing the number of susceptible animals and raising the general level of herd immunity by immunization**

Mass immunization as a preventive technique has the advantage of allowing the resistant animals freedom of movement, unlike environmental control, in which the animal is confined to the controlled area. Immunization may, however, provide only shot-lived and partial protection. Mass immunization has been successful in many diseases. Immunization can be divided into passive immunization and active immunization. Passive immunization gives a temporary immunity following exposure to a pathogen or when a disease threatens to take an epidemic form. Active immunization protects animals from the pathogen and the host population from the epidemic.

## DISCUSSION

The immune response, being a biological process, never confers absolute protection and is never uniform in whole of the vaccinated population. Since the immune response is influenced by a large number of genetic and environmental factors, the level of immune responses in a large population of animals tends to follow a normal distribution. This means that most animals respond to antigens by mounting an average immune response, a few will mount an excellent response and small proportion will mount a very poor immune response. The group of poor responders may not be protected against infection in spite of vaccination. Therefore, it is impossible to guarantee 100% protection in a population of animals by vaccination. Thus, presence of immunocompromised animals could permit the spread of disease and would

disrupt control programmes. Therefore, in countries where prophylactic measures and other remedies have not been adopted properly, the chances of any outbreak and its spread are very high (Noordhuizen *et al*., 2001).

**Conclusion**

Control measures for infectious diseases should be directed to break the weakest links in the chain of disease transmission. Early detection of disease in the herd, quarantine at farm level, biosecurity, medication and vaccination are all extremely valuable and necessary for control of bacterial diseases in animals.

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