

## **Investigating Vaccination Failure in Poultry Flocks<sup>1</sup>**

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Gary D. Butcher and Mojtaba Yegani<sup>2</sup>

Protecting poultry against disease involves more than simply administering preventive vaccines. Disease prevention is a complex and multifaceted process. Vaccine quality is commonly blamed when a disease occurs; however, there are usually other factors responsible. A comprehensive investigation is often called for to identify the cause(s) and to resolve the problem.

Commercial poultry farms have continued to increase in size and more birds and farms are located in a geographic area; this has resulted in a dynamic disease situation. In recent years, several new infectious diseases have infected poultry and spread widely. However, existing diseases have undergone considerable changes. Many of these were well controlled in the past by existing health and management practices. Due to selection pressures; however, these agents have changed to more virulent or variant forms. In these cases, the existing vaccination programs are often not adequate to provide protection against disease challenge. It is clear that no single vaccination program will be suitable for all farms in all areas. Thus, poultry producers and technical advisors must recognize that vaccine recommendations may change as new

information regarding bird immunity and disease is discovered.

### **Why Vaccinate?**

Vaccines are used to prevent or reduce problems that can occur when a poultry flock is exposed to field disease organisms. Vaccinations should be thought of as insurance. Like insurance, there is a price to be paid for the protection against a potential threat. Costs include price of the vaccine, time spent designing the vaccination schedule and paying for the crew that administers the vaccines. Another major cost for vaccination, which is rarely considered, is due to the losses from vaccine reactions from the live type vaccines and local tissue reactions associated with the inactivated vaccine injections.

Diseases are ubiquitous, and where there are concentrations of commercial poultry their effects can be devastating. The primary strategy for controlling disease should not be vaccination but measures to prevent the disease from entering the premises. Prevention efforts must focus on new management systems, products and practices that help block entry of infectious disease and that improve the innate or inherent resistance of the bird.

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  2. Gary D. Butcher, professor and poultry veterinarian, College of Veterinary Medicine, Institute of Food and Agricultural Sciences, University of Florida; Mojtaba Yegani, poultry veterinary consultant, Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB; Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

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Vaccines can be the next line of defense when the diseases occasionally breach the premises due to failures in biosecurity. The effects of the disease can be minimized if the birds have immunity because of prior vaccination.

Only necessary vaccines should be included in the program because total cost can be expensive. Thus, the decision to vaccinate must be based on the risk of infection in an area. If the risk of a particular disease is low, it makes little sense to vaccinate against it because costs may outweigh the benefits. To ensure success, the vaccination program must be adapted to meet the needs of the specific area due to local disease challenge conditions.

### **Vaccination Failures**

A vaccination failure occurs when, following vaccine administration, the chickens do not develop adequate antibody titer levels and/or are susceptible to a field disease outbreak. When a vaccination fails, the natural tendency is to blame the vaccine. Although this is certainly an important factor to consider, many other factors must be evaluated to determine the cause of the failure. The following are common factors responsible for vaccine failures in commercial poultry.

#### **Vaccination Program**

Each region typically has its own specific diseases. Thus it is not wise to try to develop a "one size fits all" or international vaccination program. In areas with a high density of poultry production, small flocks in close proximity to commercial flocks, or where farms have poor biosecurity and management practices, more comprehensive and intensive vaccination programs may be necessary. In some areas, broiler integrations use no vaccines. In other areas, extreme programs are implemented that include combinations of live and inactivated Newcastle, Gumboro, bronchitis, influenza and other vaccines. The excellent performance seen in broiler integrations that are free of disease and do not require the use of vaccines is profound. In these areas, the adverse effects of vaccine reactions on production performance are obvious. It is also clear to poultry producers that extensive use of vaccines to control

disease in the absence of a sanitation program is not a sustainable approach.

The vaccination program must be well studied and executed, or the result is more damaging than the benefit to the birds. When introducing any live vaccine into an area, it is imperative to ensure that the vaccine is needed. Haphazardly introducing new vaccines, and new strains of vaccines, into an area is irresponsible and may result in a new disease in the area if the vaccine is able to spread and increase in virulence over time. As an example, in the southeastern region of the United States, the most costly disease affecting the broiler industry is Infectious Laryngotracheitis (ILT). Evidence to date suggests that this disease is actually a strain of the vaccine virus that is spreading and, in some cases, actually increasing in virulence!

When administering vaccines to flocks, records must include details on vaccine type, lot number and expiration date. In addition, details on chicken ages, route of administration and person administering the vaccine could be valuable when investigations are conducted at a later time. Without detailed records, it is often not possible to determine that a vaccination problem has occurred.

#### **Administration and Handling of the Vaccine**

A well designed vaccination program will not be effective if the vaccine is damaged by improper handling prior to administration. Live vaccines can be inactivated when exposed to adverse conditions. Store and handle vaccines as recommended by the manufacturer. Once a vaccine is reconstituted, the "time clock is ticking" for it to be used. Certain live vaccines, such as for Marek's disease, are extremely fragile and failure to follow the manufacturer's recommended handling practices will result in the inactivation of the virus prior to administration. Infectious bronchitis virus vaccine is reported to lose approximately 50% of its potency in warm conditions less than one hour after reconstitution.

#### **Vaccine Administration Deficiencies**

Improper vaccine administration of the vaccine is the most common cause of vaccine failure in poultry. Prior to application of the vaccine, the details

of the whole process must be well planned. This includes ensuring that the crew is trained in handling and applying the vaccine. The results of proper vaccination will be improved disease control and performance of the poultry. As one poultry grower commented, "Vaccines are no good if they do not get into the chicken."

Poor distribution of live vaccine administered by mass application methods, including water or spray route, may result in chickens being "missed" in parts of the house. Relying on replication of the vaccine virus in chickens and then horizontal transmission of the vaccine from bird to bird is risky. This usually results in excessive or rolling reactions of long duration, increased intensity and delayed immunity in the flock. Birds missed with killed vaccines will result in chickens with no protection, as inactivated vaccines will not spread from bird to bird.

Live vaccines administered by drinking water can be destroyed before they are able to infect the bird if water sanitizers have not been removed prior to addition of the vaccine. Vaccines that are administered by intramuscular or subcutaneous route can also fail if vaccinators do not deliver the vaccine to the appropriate vaccination site. A routine monitoring program of examining random birds in the flock to ensure vaccine is being injected correctly is advised. It cannot be assumed that because each chicken is being individually injected each will be vaccinated. In many cases, 10% to 15% of the birds may be missed!

Review labels on the vaccine vials and check them against the vaccination schedule prior to vaccination. Errors in vaccination are relatively common and in most cases are simply wastes of vaccine. In other cases, serious problems may result. For example, pox vaccine has mistakenly been confused with ILT vaccine and given by eye drop route which resulted in pox lesions in the eyes with substantial losses.

### **Maternal Antibodies**

The immune status of the breeder flock can have an affect on the success of progeny vaccination. If the breeder flock has high levels of circulating antibodies which pass to the progeny through the egg, they may

interfere with the replication of live vaccine viruses as they would for field challenge viruses. This will decrease the immune response to the vaccine because it is not stimulating the immune system as long and to as great an extent. For example, if a chick comes from a breeder hen with high levels of antibody against Infectious Bursal Disease (IBD), the chick will typically have high levels of maternal antibodies for several weeks. If vaccination is attempted in the presence of these antibodies, some of the vaccine virus will be neutralized and a decreased response to the vaccine results. On the other hand, delaying vaccination until maternal antibodies have been catabolized may leave the birds susceptible to field challenge.

### **Stress**

Vaccination is a stress. A bird being inoculated with a live vaccine is actually being infected with a mild form of the disease. Stress may reduce the chicken's ability to mount an immune response. Stress could include environmental extremes (temperature, relative humidity), inadequate nutrition, parasitism and other diseases.

Vaccination of sick birds is not advisable because their immune systems are already functioning at diminished capacity. Presenting these birds with a live virus vaccine often results in reduced immune response and an excess reaction because they are unable, in many cases, to develop a response to even the milder vaccine virus. A basic rule for vaccination is to always delay vaccination until the birds are healthy. It is better to skip a vaccine in a diseased flock than to vaccinate in the presence of a concurrent disease.

### **Timing**

Chickens may also already be incubating the disease at the time of vaccination. Despite proper administration, the birds become diseased because time is needed for antibody production to reach protective levels. Following first exposure to a live virus vaccine, antibody type G is detected approximately four to five days following exposure. Additional days are required for titers to reach protective levels.

## Immunosuppression

The status of the immune system of the flock must also be considered when vaccinating. Chickens may be immunosuppressed due to infection with IBD, Chicken Infectious Anemia (CIA) or Marek's disease viruses or from consumption of feed with high levels of mycotoxins. The term immunosuppression refers to circumstances where the non-cellular (antibody) and cellular components of the immune system are not functioning properly. This may result in the development of limited protection from vaccination and an excessive vaccine reaction including morbidity and mortality.

## Management Practices

Poor management practices in poultry flocks may contribute to vaccine failures. If infectious disease agents are allowed to build up in successive flocks without prior decontamination, it is possible that the challenge dose of a particular infectious agent will be large enough so that a normally effective vaccination program will be overwhelmed. In the long run, vaccines cannot replace a good management program.

## Vaccine Quality

Vaccine quality is sometime blamed when antibody titers are insufficient or disease breaks out in a flock. However, evidence shows that, in the great majority of cases, vaccines are of excellent quality and are not responsible for the failure. To allay concerns about vaccine quality, purchase only from reputable pharmaceutical companies whose products are manufactured under stringent quality control practices.

## Vaccine Modifications

Commercial poultry companies may try to reduce costs by eliminating vaccines or administering partial doses. The decision to vaccinate is based on a risk analysis assessment. If the disease is not present, do not vaccinate. If it is a risk, the vaccine must be administered according to the recommendations of the manufacturer. When partial doses are given, birds will not get enough vaccine to properly stimulate their immune system. The result will be decreased resistance to disease.

Use of vaccines that have been excessively attenuated can lead to a lack of immunogenicity and enhanced susceptibility to field challenge. The proper vaccine must be selected based on local conditions. Levels of maternal antibodies would neutralize milder vaccines. Conversely, vaccines that are not sufficiently modified may result in prolonged reactions and increased susceptibility to secondary bacterial infections, such as of *E. coli*. In some cases, the losses would be similar to those usually associated with the field disease challenge.

## Vaccine Strain/Serotype

Many diseases are caused by agents that consist of several different strains/serotypes. For example, there are more than 100 recognized strains of IBV and over 2000 strains of *Salmonella* bacteria. In some cases, the vaccine may not contain the proper strains or serotypes of organism required to stimulate protective immunity against the agent causing the field challenge. Although the vaccine is administered properly and uniform/adequate antibody titers are present, the chickens still contract the disease. In recent years, problems with variants are seen with IBV, IBD, Pox, Marek's and others.

Most IB vaccination programs include the Massachusetts and Connecticut serotypes of IB virus. The disease may still develop if the chickens in the field are challenged with a variant serotype because the virus will not be neutralized by the antibodies present.

Likewise, if protective levels of antibodies against IB virus are present, it does not suggest the chickens are necessarily protected against Newcastle or other diseases. Antibody titer levels must be determined for each disease as antibodies are very specific for the virus to which they attach and neutralize.

In some cases, the field strain of an organism is of high virulence and the vaccine strain selected for the program highly attenuated. In this situation, the flock may be effectively immunized, but the immunity is insufficient to protect against disease completely.

## Concluding Comments

Vaccines that are administered properly, at the correct time, and with the appropriate antigen content do not guarantee protection against a field disease challenge. A lot of other variables must also be considered and there is a need for continuous evaluation since the disease situation is dynamic. In many situations, vaccinations may only be employed as a means of minimizing the economic impacts of a disease rather than total prevention in the flock. Attention to details of the vaccination program can mean the difference between success and failure. However, a well designed, well timed and soundly executed vaccination program coupled with good management, nutrition and biosecurity will decrease the probability of disease problems and increase the likelihood the flock will perform to its genetic potential.

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