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Review Article

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Review on cause of animal vaccination failure in Ethiopia

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Abstract

The least cost method to restore health and productivity in perspectives of disease should focus to preventive medicine. But veterinary vaccinations there is so many problems, such as shortage of knowledge about the vaccines how to store, transport and how to vaccinate the animals. The absence of trained person on handling vaccines or importance of good vaccine storage and transportation techniques. Storing vaccine in the refrigerator normally but when the electric power is cut off there is no any action taken to solve the problems (there is no backup system) especially in rural districts of Ethiopia. This causes economic impacts on farmers who vaccinate their animals and impacts on government budget.

Vaccines and Vaccination programs may be considered as insurance against different infectious diseases. A successful vaccination program is dependent on many factors including vaccine handling, quality, and nature of the vaccine, use of local antigens, and immunogenic response inside the body of the animal and following the Manufacturer's instructions. The potential threat of disease outbreaks even in vaccinated animals cannot be avoided completely, due to vaccine failures. Vaccine failure could be because of host factors such as stress, interference with maternally derived antibodies, lack of booster doses, and vaccination for immune suppressed animals, use of inappropriate dosage and route and untimely vaccination schedule. Moreover, it could also be due to antigen factors such as improper storage, use of expired vaccine and improper vaccine formulation. However, these factors can be avoided by proper vaccine storage, use of an adjuvant, none use of expired vaccines, use of stabilizers, practicing proper vaccination schedule, preparing animals for vaccination. Therefore, farmers should follow stick biosecurity to prevent the outbreaks and vaccine manufacturer's guidelines for storage, timing, and due dates, consult veterinarians before any vaccine administration and monitor the health status of animals before vaccine administration.

Keywords: livestock, Vaccine, Disease, Ethiopia, Antibody, Antigen, Control Measures, Immunization, Risk factor, Vaccine failure.

Introduction

Livestock are susceptible to a variety of diseases. One key to keeping livestock healthy is by implementing a proper vaccination program. Having a valid veterinary-client-patient relationship is a key first step to understanding what is involved in developing a vaccination program and in getting guidance if an animal becomes ill. Veterinarians or local extension office can provide useful advice in dealing with specific production practices. The purpose of a vaccine is to provide exposure to a non-virulent (non-infective) form of a disease agent before the animal is exposed to a natural infection. Vaccination causes the animal to develop antibodies and cellular resistance that protect against disease or infection. It is always preferable to prevent disease rather than having to resort to treatment.

The consequences of disease may be transmission to other animals or people, loss of efficiency through reduced animal growth, drop in milk production and death. Good husbandry, including efficient bio-security measures, is the most important factor in

prevention of diseases in livestock. Nevertheless, animals can become ill and highly infectious diseases can spread rapidly with devastating results. Vaccines are an important part of the veterinarian toolbox.[1]

A vaccination failure arises when animals fail to develop adequate antibody titer levels and/or are at a risk of field disease outbreak. According to different research outputs, vaccination failure occurs due to inappropriate vaccines schedule (timing), improper handling of vaccine, vaccine quality, vaccine strain/serotype and insufficient amount of antibody titer levels after vaccination that predisposes disease outbreak. Moreover, immune suppression, maternal antibodies, stress, and management practices were also known causes of vaccination failure. [2-3] Vaccines have a significant role in disease prevention and control worldwide. This, in turn, has a great importance in minimizing the emergence of outbreaks at the farm level and contributes a lot to the growth in animal production. There different type of vaccines and vaccination schedule throughout the world and their efficiency depends on several factors such as the method of production, biosecurity level, disease pattern, maternal immunity, availability of vaccines, costs and potential losses[4-5]. Even though different methods have been applied and recommended for controlling infectious diseases. vaccination was found as the most important tool[6]. Thus, Immunization is the process of boosting immunity using biologically prepared antigen in the form of vaccines and used as prophylactic measures against specific pathogens[7].

Literature Review

General Description Of Vaccines

A vaccine is a manufactured compound that is designed to help animals fight against particular diseases caused by specific bacteria and viruses. It contains materials called antigens that stimulate the body's defenses to produce either antibodies or activated cells that in turn modify or inactivate the agents of disease while vaccination is the introduction of a vaccine into the body to produce immunity to a specific disease. The vaccine may be administered by subcutaneous, intra dermal or intramuscular injection, by mouth, by inhalation or by scarification. Each vaccine also contains a component called an *adjuvant* that stimulates the animal's immune system. It is this component that causes animal to form where the vaccination was given; this property contributes to the adjuvant's ability to stimulate the animal's immunity over a sustained period of time. Vaccines may contain live viruses (though these are modified to reduce their potential harmful effects), killed viruses, or inactivated bacterial cultures or toxics. Through regular usage, vaccines are designed to reduce the incidence and/or severity of a specific disease. Few vaccines can completely prevent disease occurrence. However, when used properly, their beneficial effects far outweigh their drawbacks.

Types Of Vaccine

Vaccines are usually prepared in different forms, mainly live vaccine, killed vaccine and toxoid vaccines.

Killed vaccines

Killed vaccines are produced by inactivating the infectious agent (so that it can’t replicate in the host) without altering the immunogenicity of the protective protein (s). They induce predominantly humoral type of immunity, i.e. antibody-mediated. Generally they require two doses with an appropriate interval. These vaccines contain adjuvants that enhance the immune reaction. Booster doses of inactivated vaccines are often administered annually e.g. black leg, pasteurellosis.

Live vaccines

This type of vaccine could be prepared either by using less virulent or by attenuating highly virulent strain/type of an infectious organism. Attenuation is usually made by growing of an infectious organism under abnormal culture condition. These types of vaccines induce complete type of immune response (both humoral and cellular) and confer higher level and longer period of protection than killed vaccines. Live vaccines especially attenuated ones may revert to full virulence after inoculation into an animal and elicit disease e.g. PPR, rinder pest, lumpy skin disease.

Toxoid vaccine

Toxoid vaccines are toxins obtained from microorganisms and heat or chemical treated to destroy their deleterious properties without affecting the ability to stimulate the formation of antibodies.

Routes Of Vaccination

The site and route of administration may vary depending on the vaccine. Most vaccines are administered by under-the-skin (subcutaneous) injections. A few are administered intramuscularly, and occasionally some are given topically (e.g., soremouth vaccine) or intranasal.

Subcutaneous injection (S/C)

Subcutaneous injection is particularly convenient in small companion animals where the loose skin at the back of the neck is a commonly used route. Potential disadvantages are slower uptake of antigen as compared to a more vascular site such as muscle. Lower antibody response has been obtained with the S/C rout as compared to intramuscular injection.

Intramuscular injection (I/M)

This rout deposits vaccine in to location of high vascularity and provides efficient exposure of antigen to the immune system. Attention must be paid to the anatomical choice of vaccination site to ensure adequate delivery and exposure to responsive cells.

Intradermal injection (I/D)

Intradermal injection is very efficient immunizing route due to antigen capture and lymphatic draining to regional lymph nodes. Smaller doses of antigen are required to achieve responses equivalent to I/M injection.

Oral route

This route offers a convenient, powerful route for stimulating local immunity. Mass oral vaccination via drinking water has been used primarily in poultry.

Intranasal vaccination

Intranasal vaccination is an alternative mucosal route and has been advocated as a means of avoiding interference from maternal antibody.

In ovo vaccination

Chickens develop immunological responsiveness well before hatching, and early protection against infection, such as Marek's disease, infectious bronchitis, infectious Bursal and Newcastle disease has been demonstrated.

Age At Vaccination

The main obstacle to successful vaccination in young animals is the presence of blocking level of maternally derived antibody, therefore, all vaccination schemes, whether they are for an individual animal or for a herd health vaccination program must be planed considering the presence and extent of maternal antibody.

Dam vaccination

Dam vaccination schemes are especially beneficial for the protection of neonates in heavily contaminated environments. The strategy is to enhance neonatal immunity by augmenting colostral titers Vaccination of the dam, with a second dose just prior to parturition, maximizes colostral antibody titers, examples of such approaches are E. coli, rota and corona virus vaccines in cows and heifers.

Strategies for vaccine use

Use the vaccine's label as a guide regarding how and when to give that particular product. Vaccines should be given at strategic times of the year or season. These times vary depending on the vaccine and particularly on the disease which you are trying to control.

Epidemiology

Strategies for the use and measurement of the success of vaccination in the control of animal disease have to be considered in the context of epidemiology of that specific disease. Among the animal diseases, which are not ubiquitous in nature, could be successfully controlled. They should also show a high case-fatality rate and if recovered, animals show long lasting immunity. Persistent infections are uncommon, and the cycle of transmission can therefore be readily broken.[1]

How do Vaccines Work?

Vaccines stimulate the body to produce its own defense against infection. Mimicking what happens when an animal has been exposed to disease, the body and its defensive system will "remember" the identity of the invading organisms. So, when the animal comes into contact with a disease, its body is ready to fight it

and the animal will not fall ill and suffer. This protects the individual animal and because this animal will not develop the disease and will not become infective, it will also help protect the population from the disease - **"herd immunity"**.

A vaccine may consist of live but attenuated viruses or bacteria, or killed (inactivated) viruses or bacteria, or parts of them.

• "Killed" or inactivated vaccines are prepared from killed organisms or fractions of the organism incapable of causing disease. They generally provide a relatively short period of immunity.

• In attenuated vaccines, the immunizing agent (antigen) is an organism such as a virus, bacterium or parasite, which has been developed to stimulate the production of the appropriate antibodies without causing the disease. Live vaccines are particularly effective in providing long-term protection, because they are a more powerful stimulus to the immune system. They are also more versatile in their route of administration.

• Biotechnology can provide vaccines for diseases which cannot be controlled by conventional vaccine technology and create more specific, better defined products with even greater safety and efficacy.

Vaccination can be by a wide variety of routes: through water, baits, air spray, eye inoculation, intranasal, orally or using the more classical injection.

Achieving initial immunity may require more than one injection. Once established, this can be boosted by subsequent vaccination, as required. Modern vaccine research and technology means that some vaccines can actively protect against a variety of diseases, in a single product. These are called multivalent vaccines and using these reduces the number of injections, broadens disease protection - and helps reduce costs to the farmer.

Factors to be considered during Vaccination

Vaccination is not a simple process that automatically produces immunity. There are many reasons that vaccines can fail as noted below;

Animal factors

Immune status

Protection against infection of newborn animals is best obtained by passive transfer of antibodies from the dam. Some vaccines are given to the dam in anticipation that she will transfer specific preformed antibodies to her young. These are passively acquired antibodies that are effective for only one to two months in the offspring. However, if she does not respond with adequate antibody levels, or if her offspring do not suckle adequately in the first 12 hours of life, there may be a failure to transfer antibodies to her young.

Age:-The very young animal has not had time to develop a competent immune system. On the other hand, the very old animal may have various deficiencies in immunological capability.

Young animals that have received colostrum have also received large quantities of antibodies from their dam. High levels of these passively acquired antibodies can interfere with the development of the young animal's own immune response to vaccines for 1 to 2 months or longer.

Concurrent infection

Certain diseases, if present at the time of vaccination, may prevent an adequate immune response to the vaccine.

Vaccination

Nutritional status

Animals deficient in nutrients may respond poorly to vaccines, as well as being below their genetic production potential

Biological Variation

Some animals, due to heritable traits, respond less than the normal population does to antigens either through vaccination or natural infection. Even though they have been inoculated with the vaccine, they may not become immunized.

Antibody Interference

When the antibody level within an animal is present due to maternal or other passive immunity, the antigenic properties of vaccine can be neutralized and no immunity develops. As the passive antibody levels wane, the animal may then have no protection because the vaccine used earlier was inhibited by the very antibody that is now depleted.

Stress

Poor nutrition, shipping, crowding, and other stressful events may produce hormonal or chemical Imbalances in the animal that suppress the immune system and its response to vaccines.

Environmental factors

- Temperature
- Air quality
- Feed/water access
- Density
- Seasonal influence
- Transport

Factors associated with pathogen

- Exposure level
- Virulence
- Survival outside host
- Transmission

Wrong Serotype

The immune response is very specific. A vaccine may contain organisms of the same family as those involved in a disease outbreak, but if they are not of the same serotype (type within the family), the results may be disappointing.

Potency and Purity

Vaccines must have adequate antigenic mass to properly stimulate an immune response. Vaccines not made under strict controls may not have this capability. Purity is also an important factor as contamination may render the vaccine worthless by destroying antigenic properties. Other adverse effects may include abscess development at the site of inoculation, or the introduction of an entirely different disease problem.

Outdated Vaccine

Outdated vaccine may not contain the required antigenic properties due to deterioration or other factors. It is not worth taking a chance that it may work. The investment to obtain fresh, quality vaccine far outweighs the possibility of losing just one animal due to poor vaccine.

Vaccine failure can occur due to many causes

- Improper storage
- Temperature
- Ultraviolet light
- Use after expiration
- Attenuated vaccines need to be used soon after mixing
- Insufficient time between vaccination and exposure

Vaccine Limitations

All vaccines have limitations. Some vaccines for certain diseases occasionally do not cause production of enough immunity at both the local and systemic levels to give adequate protection against that disease. Alternate routes of administration and/or boosters are sometimes used to help alleviate this problem. We must not expect more than the vaccine manufacturer indicates.

Improper administration

Good animal restraint is essential to properly administering any vaccine. Vaccines have been designed to work in specific sites under specific conditions: if a product is labeled for subcutaneous (sub-Q) injection, it must be given subcutaneously and not intramuscularly (IM), and vice versa. Follow the label carefully and administer the product according to label.

If giving multiple vaccinations, space them at least 4 inches apart. While not usually a concern with common vaccine products, never give more than 10cc of a product in the same site. Don’t forget some of the basic Beef Quality Assurance recommendations: If a product is labeled for either SQ or IM, give the injection SQ, and always in front of the shoulders. Never, ever mix two different vaccines in one syringe.

Improper mixing of vaccines

Mixing vaccines properly is a "must" as the "antigenic mass," or dosage, is calibrated to produce antibody levels that are protective. Modified live virus (MLV) vaccines must be reconstituted properly, using the diluent supplied for that vaccine in the correct quantity. Administer vaccine only from sterile syringes that have been sterilized without the use of chemicals. Never mix other vaccine types together when *not* specifically recommended by the manufacturer, as chemical incompatibility is possible.

Improper handling and storage

Vaccines are biological products that can be sensitive to environmental conditions. Always check the expiration date on the bottle and discard outdated vaccine. Vaccine products must be kept cold and out of direct sunlight. Keep a cooler on hand when transporting vaccine or when working cattle. If using modified-live virus products (MLV), use the entire bottle shortly after being reconstituted. A good rule to follow is to only mix enough products that you will use within an hour. Use transfer needles when mixing vaccine and avoid going into a bottle multiple times with a needle to decrease product contamination. If only working a small number of animals, use the smaller dose bottle first.

Overwhelming Challenge

This can occur when excessive animal stress combines with entrance of extremely large numbers of virulent disease-causing organisms. This overwhelming infection can overcome even a relatively strong immune protection.

Mechanics of Vaccination

At the time the vaccine is administered, strict attention to details is very important to prevent "misses." Animals can be missed at vaccination time when too many jobs are being donesimultaneously. Organization is very important. Escape-proof pens or corrals and other methods to reduce the "missed ones" are also very important.

Animal Protection

Precautions should be taken to ensure the physical well-being of the animal. In addition to vaccine recommendations, precautions should be followed so as not to mechanically damage nerves, joints, or other body parts with the needle. This includes paying attention not only to the area of the animal injected, but also such things as length and gauge of the needle.

Certain drug therapies:- For example, high doses of steroids are immunosuppressive and may interfere with vaccinations. The use of antibiotics may also interfere with vaccination. Fever or hypothermia. Already debilitated, exposed or incubating disease Stress. Needle and syringe care are also important when vaccinating animals. When using a multiple-dose syringe, inspect all parts and make sure it is cleaned and calibrated properly. When using a disinfectant for your needles between animals, only disinfect needles being used with killed vaccine products since disinfectants can inactivate modified-live vaccine components. Remember that no vaccine is 100% protective, and vaccination is only part of a preventative cattle health program. A good vaccination program cannot overcome poor management. Your herd veterinarian can help you develop a comprehensive herd health management program to avoid future vaccine failures. For good cattle health, give the right vaccine, at the right time, in the right way.

Improper timing: - Maternal antibodies that the calf receives through the colostrums can last for several months. Vaccination during this time may interfere with the calf's ability to mount his own immune response. For this reason, most vaccines are given after several months of age. The exact timing of these first vaccinations can vary and often depend on other management practices such as branding or pregnancy checking as well as immune status of the dam. It takes several weeks for an animal's immune response to provide full protection following vaccination. Remember that animals can still get sick during the time that immunity is building, so we need to plan ahead. For calves, this can mean vaccinating several weeks prior to weaning and commingling in order to give them the best protection during their highest risk period. Stress decreases an animal's immune response; therefore we want to avoid vaccinating during other high periods of stress as well if at all possible. In mature cows, we want to vaccinate with some of the reproductive antigens pre-breeding in order to give them the best protection prior to the breeding season. Finally, don't forget boosters, especially in calves, or animals who are receiving a specific vaccine for the first time.

The first vaccine in a naïve animal is meant to "prime" the immune system, and the second vaccine gives it the boost of antigens it needs to provide a more complete immune response. Vaccines do not ensure lifetime immunity, so annual or semi-annual boosters are also needed for mature animals.[8]

Vaccine handling and transport:- Even when a vaccine is administered properly and an immune response occurs, it can fail to protect from disease.Vaccine failure can be minimized by carefully handling and administering the product

• Environmental stress
• Transport
• Keep vaccines refrigerated (not frozen).
• Keep vaccine out of direct sunlight.
• Be sure to use vaccines before expiration date.
• Vaccinate healthy animals, avoid vaccination of stressed livestock.
• Follow all label directions on proper routes of administration and injection site selection.
• Vaccines are administered with a repeating syringe and you will need enough doses to vaccinate all animals, allow for some waste and accidents.
• Keeping opened containers or reconstituted vaccines is not recommended which may lead the vaccine to fail to achieve protection and it could also cause illness due to the growth of contaminants in reconstituted vaccines.
• In general, vaccines take 10-14 days to give protection. Vaccination should be part of a herd or flock health program. For vaccines to be most effective consider their use carefully in relation to the type of stock, season, previous property history and disease incidence e.g. young animals should be protected against the common and predictable diseases before management events such as castration, shearing, weaning and movement to new properties.
• To get the most out of your vaccines protect them from heat or sunlight by keeping them until required. Keep vaccines and equipment away from dirt and dust, which can contaminate equipment and introduce infection. Use a small table to help keep vaccines and equipment clean and off the ground.
• Do not mix different vaccines together. Combined vaccines require a great deal of care in balancing the components. However, if more than one vaccine is required use separate syringes and administer them at different sites, at least 15 cm apart and preferably on different sides of the animal's body.
• If conducting tick fever vaccinations, do not give other vaccinations at the same time. If it is unavoidable, use a separate syringe for each treatment and administer them on opposite sides of the animal's body. Ideally, other inoculations should be performed either two weeks before or four weeks after tick fever vaccination, particularly in adult animals, which are more likely to react to the tick fever vaccine.
• Avoid carcass damage by administering the vaccine according to label instructions and use the least commercially valuable site on the animal, for example high on the neck behind the ear.
• When vaccinating a herd, ensure a full dose of vaccine is given to every animal. Check syringes carefully to ensure that the correct dose is being delivered. Give the required booster injection at the correct time to all animals that require it
• Follow all label directions on vaccination of pregnant animals, and age of animals at vaccination.
• In addition, it may be necessary to administer booster injections if indicated on the label directions.[9]

Vaccine Failure and Other Adverse Events in Animals

There are many reasons why vaccination may fail. In some cases, the vaccine may not be effective because it contains strains of organisms or antigens different from the disease-producing agent. In other cases, the method of manufacture may have destroyed the protective epitopes, or there may simply be insufficient antigen. Such problems are uncommon and can be avoided by using vaccines from reputable manufacturers. More commonly, an effective vaccine may fail due to unsatisfactory administration or storage. For example, a live bacterial vaccine may lose potency as a result of use of antibiotics. Route of administration may also affect efficacy. When vaccine is administered to poultry or mink by spraying or in drinking water, the spray may not be evenly distributed throughout a building, or some animals may not drink adequate amounts. Also, chlorinated water may inactivate vaccines. If an animal is incubating the disease before vaccination, the vaccine may not be protective; vaccination against an already contracted disease is usually impossible.

The immune response, being a biologic process, never confers absolute protection nor is equal in all individuals of a vaccinated population. Because the response is influenced by many factors, the range in a random population tends to follow a normal distribution: the response will be average in most

animals, excellent in a few, and poor in a few. An effective vaccine may not protect those with a poor response; it is difficult to protect 100% of a random population by vaccination. The size of this unresponsive population varies among vaccines, and its significance depends on the nature of the disease. For highly infectious diseases in which herd immunity is poor and infection is rapidly and efficiently transmitted, such as foot-and-mouth disease, the presence of unprotected animals can permit the spread of disease and disrupt control programs. Problems also can arise if the unprotected animals are individually important, as in the case of companion animals or breeding stock. In contrast, for diseases that are inefficiently spread, such as rabies, 60%–70% protection in a population may be sufficient to effectively block disease transmission within that population, and therefore may be satisfactory from a public health perspective.

The most important cause of vaccination failure in young animals is suppression of an immune response to a vaccine caused by the presence of maternal antibodies. Vaccines may also fail when the immune response is severely suppressed, as in heavily parasitized or malnourished animals. (Such animals should not be vaccinated.) Severe stress, including pregnancy, extremes of cold and heat, and fatigue or malnourishment may reduce a normal immune response, probably due to increased glucocorticoid production.

Modern, licensed vaccines are subjected to rigorous safety and quality control standards and hence are very safe. (This was not always the case in the past, especially when many vaccines were first developed). Nevertheless, they are not always innocuous. The more common risks associated with vaccines include mild toxicity, which may cause injection-site reactions, depression, allergic responses, disease in immunodeficient hosts (modified live vaccines), neurologic complications, and rarely, contamination with other live agents. For example, lesions of mucosal disease may be seen in persistently infected calves vaccinated against bovine viral diarrhea because vaccines contain cytopathic strains. Vaccines that contain killed gram-negative organisms may also contain traces of endotoxins that stimulate release of interleukin-1 and can cause fever and leukopenia and occasionally abortion.

In general, it is prudent to avoid vaccinating pregnant animals unless the risks of not vaccinating are greater. Certain modified live virus bluetongue vaccines have been reported to cause congenital anomalies when given to pregnant ewes. The stress from a vaccination reaction may be sufficient to activate latent infections. For example, activation of equine herpesvirus has been demonstrated after vaccination against African horse sickness. Another adverse reaction is the “sting” that occurs when some vaccines are administered. Some vaccines and vaccine mixtures may cause mild, transient immune suppression.

In addition to potential toxicity, vaccines, like any antigen, may provoke hypersensitivity. For example, allergic reactions (type I hypersensitivity) may occur in response to the antigens found in vaccines, including those from eggs or tissue-culture cells. All forms of hypersensitivity are more commonly associated with multiple injections of antigen; therefore, they tend to be associated with use of inactivated products. Immune complex (type III) reactions are also potential hazards of vaccination. These may cause an intense local inflammatory reaction or a generalized vascular disturbance such as purpura. An example of a type III reaction is clouding of the cornea in dogs vaccinated against canine adenovirus 1 (CAV1) using CAV1 modified live vaccines. This reaction is not seen with CAV2. Delayed (type IV) hypersensitivity reactions, such as granulomas, may develop at the site of inoculation in response to the use of depot adjuvants. Some chronic inflammatory reactions to long-acting feline vaccines may eventually lead to development of a vaccine-associated sarcoma at the injection site in cats[10].

Precaution And Contraindication Of Vaccines

When using vaccines as one of your management tools, it is important to consider all the potential reasons a vaccination program may fail to prevent disease on animals. Being aware of the potential problems that can arise will allow a more effective (profitable) means of disease control in animals.

- Sick animal is shouldn’t be vaccinated.
- Animals under immunosuppressive drug treatment should not be vaccinated within three to four weeks,
- Care should be taken in the use of antibiotics when a vaccine containing live bacteria is administered.
- During mass vaccination of multiage group with live vaccines the transmission of infection due to the

organism in the vaccine it susceptible young animals should be considered.
 The full vaccination course as recommended by manufacturer should always be administered.
 Stressed animal should not be vaccinated.
 Don't vaccinate through dirty, wet skin.
 Avoid repeated use of needle and syringe within herd/flock.
 Liquid preparations should always be adequately shaken before use to ensure uniformly of the maternal to be injected.

Vaccine Transport, Storage, And Handling How-To

The agents that make up vaccines have a limited shelf life. They are reliably effective only when handled as directed by the manufacturer. Following consistent storage and handling protocols helps ensure that the vaccines have the best potential of inducing an immune response when you administer them.

Transport

• Use an insulated cooler to transport vaccines.
• Keep a thermometer in the cooler.
• Maintain the temperature between 2°C–7°C.
• Use refrigerated or frozen packs as needed to maintain the appropriate temperature in the cooler.
• Place insulation (e.g., bubble wrap) between the vaccine vials and the frozen pack to prevent direct contact.
• Keep the vaccines in their original packaging.
• To minimize exposure to extreme temperatures, keep the cooler in the interior of the vehicle instead of the trunk or truck bed.

Storing Vaccines

• Always read and follow manufacturer label directions for storage.
• Do not store vaccines in bins or drawers in the fridge. Temperatures often vary in these areas.
• Measure and log the temperatures regularly in refrigerators used for vaccine storage.
• Clean and defrost the refrigerator regularly.
• Rotate stocks when new shipments arrive — use a "first in, first out" system.
• Discard vaccines that have reached their expiration date.
• Keep vaccines in a standard-size refrigerator with a separate freezer compartment.
• Keep a good-quality thermometer in the vaccine storage refrigerator.
• Maintain the refrigerator between 2°C–7°C.
• Do not store vaccines in a mini dormitory style refrigerator.
• Do not over pack the refrigerator.
• Store vaccines in their original packaging.
• Stack vaccines by type, and rotate the stock so that the batch with the earliest expiration date is used first.
• Record the temperature twice daily on a log sheet.
• If the temperature is above or below the recommended range, notify the supervisor and call an appliance repairperson if necessary.
• Store jugs of water in the vaccine refrigerator to help maintain steady temperatures.
• Check the refrigerator seals regularly.
• Make sure all staff members close the refrigerator door tightly after opening.
• Do not store food or beverages in the vaccine refrigerator. Mark the refrigerator's electrical outlet with "do not unplug" signs.

Preparing Vaccines for Use

• Always read and follow manufacturer label directions for preparing vaccines.
• Reconstitute vaccines with the proper diluents (liquid portion) at the correct volume.
• Prepare only what you will use immediately.
• Do not reconstitute and store vaccines for later use.
• Do not leave reconstituted vaccines on icepacks.
• Discard any unused vaccines.
• Use sterile technique, including using a new needle and syringe for each animal, (if it is possible).
• Protect from sunlight.
• Do not mix different vaccines.
• Do not split doses even if the animal is very small. Vaccines are meant to be dosed in a full dose.
• Clean up any spills with bleach or alcohol.

Administering Vaccines

• Vaccinate in teams: having two people checking that the correct vaccine is drawn up, administered, and logged on the animal's record reduces the opportunities for mistakes.

Two people also allow for safe handling of the animals being vaccinated.

• Give by proper route: subcutaneous injection, intranasal, etc. Administering by the wrong route can have serious consequences. For example, an intranasal

vaccine that is injected subcutaneously can cause liver damage.

- Use sterile technique, including using a new needle and syringe for each animal. (if it ispossible).
- Administer a full dose.
- Clean up spills with bleach or alcohol.
- Dispose of used needles, syringes, and vials in appropriate containers.
- Report mistakes.

Documenting Vaccines

- Record the vaccine information on the animal's record.
- Vaccines come with labels you can stick directly to the paper record that show the type of vaccine, manufacturer, serial number and expiration date.
- In addition to the product information, be sure to record the date, name of person administering, the dosage volume, and the site of administration (right forelimb, right rear limb).
- Good documentation is extremely helpful if a problem occurs that you think may be related to a vaccine.General Designate primary and backup personnel to be in charge of vaccine inventory, storage, and handling.
- Maintain a vaccine inventory log that notes the vaccine's quantity, manufacturer, brand, lot number,expiration date, date of arrival, and arrival condition.
- When a shipment arrives, check the temperature inside the shipping box and immediately refrigerate the vaccines. Use only the diluents supplied with the vaccine.
- Do not reconstitute or draw up the vaccine into the syringe until it is needed.
- Avoid mixing different vaccines in the same syringe unless licensed for that use.
- Properly dispose of syringes and needles in a sharps container.[11]

Conclusion and Recommendation

The potential threat of disease outbreaks even in vaccinated animals cannot be avoided completely, due to vaccine failures. Vaccine failure could be because of host factors such as stress, interference with maternally derived antibodies, lack of booster doses, and vaccination for immune suppressed animals, use of inappropriate dosage and route and untimely vaccination schedule. Moreover, it could also be due to antigen factors such as improper storage, use of expired vaccine and improper vaccine formulation. However, these factors can be avoided by proper vaccine storage, use of an adjuvant, none use of expired vaccines, use of stabilizers, practicing proper vaccination schedule, preparing animals for vaccination. Therefore, veterinarians should follow stick biosecurity to prevent the outbreaks and vaccine manufacturer's guidelines for storage, timing, and due dates, and farmers should consult veterinarians before any vaccine administration and monitor the health status of animals before vaccine administration.

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