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Assessment of animal vaccination failure and associated factor in Arbaminch Zuriya Woreda and Arbaminch city administration, Southern Ethiopia

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Abstract

A cross-sectional study was conducted from November 2021 to December 2022 to assess animal vaccination failures and associated factors in Arbaminch zuriya woreda and Arbaminch city. A purposive sampling techniques were employed to select study areas and study participants, respectively. Questionnaire based survey was performed on Thirty-nine (39) veterinarians on disease occurrence after vaccination and their practice of vaccine handling and storage and hundred (100) farmers to describe the occurrence of the disease condition following vaccination. Analysis was performed by using SPSS version 20 and P-value less than 0.05 at 95% confidence level was considered as significant. There was significant difference in storage option when power went off for >24 hour periods of the vaccine having χ^2 = 7.8 and P=0.005, receiving training on cold chain and vaccine management was significantly associated factor with disease development after vaccination having χ^2 = 6.154 and P=0.013 and also there was a significant difference in temperature monitoring in refrigerator having χ^2 = 6.6241 and P=0.01.

About 38.46% veterinary professionals and 61% farmers respectively believe the occurrence of animal diseases after a vaccination program. About (46.7%) respondents consider vaccination of already unhealthy animal and (33.3%) of them suspect occasionally unvaccinated animals as an additional reason for the occurrence following vaccination Thus, these all conditions collectively shown that there is mishandling and storage of vaccines in the study areas, which may affect vaccine efficacy. Thus, a safe use of vaccine transportation, handling and storage is highly recommended.

Keywords: Refrigerator; Temperature; Arbaminch zuriya; Arbaminch city

1. 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 biosecurity 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] 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[3-4]. Even though different methods have been applied and recommended for controlling infectious diseases. vaccination was found as the most important tool[5]. 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[6].

2. Background

2.1 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.

2.2 Types Of Vaccine

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

2.2.1 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.

2.2.2 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.

2.2.3 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.

2.3 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.

2.3.1 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.

2.3.2 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.

2.3.3 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.

2.3.4 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.

2.3.5 Intranasal vaccination

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

2.3.6 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.

2.4 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.

2.5 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.

2.6 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.

2.7 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]

2.8 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.

2.9 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;

2.9.1 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

2.9.2 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.

2.9.3 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.

2.10 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

2.11 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.

2.11.1 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.

2.11.2 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.

2.11.3 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.

2.12 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.

2.12.1 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.

2.12.2 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.

2.12.3 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 multipledose 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 modifiedlive 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.

2.12.4 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" he 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]

2.13 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.

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 vaccineassociated sarcoma at the injection site in cats[9].

2.14 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.

2.14.1 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, andlogged 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.[10]

3. Materials and Methods

3.1 Description of Study Area

ArbaMinch Zuria woreda.

Arbaminch zuriya woreda is one of the zonal woreda of Gamogofa zone located south west 505Km from the capital city of Addis Ababa and 345 Km from regional center of Hawassa. The woreda has twenty nine rural kebeles.

A part of the Gamo Zone located in the Great Rift Valley, Arba Minch Zuria is bordered on the south by the Dirashe special woreda, on the west by Bonke, on the north by Dita and Chencha, on the northeast by Mirab Abaya, on the east by the Oromia Region, and on the southeast by the Amaro special woreda. This woreda also includes portions of two lakes and their islands, Abaya and Chamo. Nechisar National Park is located between these lakes.

The woreda has a total population of 164,529, of whom 82,199 are men and 82,330 women. The majority of the inhabitants were Protestants, with 53.91% of the population reporting that belief, 29.31% practiced Ethiopian Orthodox Christianity, and 12.6% practiced traditional beliefs. Arbaminch zuriya has 150,798 cattle, 50,727 sheep, 61,889 goats, 354,372 poultry, 4370 horse,2310 mule and 6462 donkey.

Arba Minch city. "Arba Minch" means "40 Springs" the name was originated from the presence of more than 40 springs. It was located in the Gamo Zone of the Southern Nations, Nationalities, and Peoples Region about 500 kilometers south of Addis Ababa, at an elevation of 1285 meters above sea level. It is the largest town in Gamo and It is surrounded by Arba Minch Zuria woreda. Arba Minch consists of the uptown administrative centre of Shecha and 4 kilometers away the downtown commercial and residential areas of Sikela, which are connected by a paved road.[1] On the eastern side of Sikela is the gate to Nechisar National Park, which covers the isthmus between Lake Abaya to the north and Lake Chamo to the south. Arbaminch city has 20,531 cattle, 5,047 sheep, 9,061 goats, 83,806 poultry, 436 donkey

3.2 Study animals

The study was conducted on all species of animal having reared by farmers in the study are.. Both sex and all age groups of animals were included in the study.

3 .3 Data collection

The structured questionnaire was developed to assess animal's vaccine failures based on the respondents' handling, storage, and utilization of vet vaccines in the study area. The questionnaire was comprised of items regarding respondents' sex, age, and levels of education, and practice with respect to handling and utilization of vaccines. Data was then collected via face-to-face interview using pre-tested structured questionnaire and visual observation. The questionnaire developed based on the information gathered from literatures. The questionnaire was first prepared in English and later it was translated to Amharic language.

3.4 Sample size

$N=0.25/SE^2$, Where, N= Sample size, SE= Standard error. As a standard error of 0.05 was taken to calculate the total households to be involved in the questionnaire survey. $N=0.025/(0.05)^2=100$. (50 household from Arbaminch zuriya woreda and 50 household from Arbaminch city). Total veterinarians working in the two district(39) were included in the study.

3.4.1 Sampling technique and procedures

Due to small study population of the clinic and filed veterinary professionals the entire population which is in Arbaminch city 6 veterinarian (2 DVM,3BSC and 1 Diploma holder) and Arbaminch zuriya woreda 20 kebele and 12 veterinary professionals (DVM 5,BSC 5, Animal health assistant 2) at veterinary clinic office and 21 field veterinarian at kebele level total **33** was included in the study by using census. Snowball sampling technique was used to identify **100** farmers (50 farmers from arbaminch zuriya and 50 farmers from Arbaminch city) who have had better awareness and understanding on the vaccines provided to their animal and occurrence of disease condition following vaccination. The clinic and filed veterinary professionals were used as a primary data source. Purposive and convenient sampling methods were used to collect information in the study areas. Semi-structure questionnaire with regard to handling and utilization of veterinary vaccines was developed and administered to selected respondents of the Districts. A regular visit was made on weekly base to the selected districts clinics, veterinary officers and field workers, and farmers (key persons) to assess the way of storage, transportation and utilization of vaccine.

3.5 Data analysis

The raw data were entered into Microsoft excel spread sheet to create a data base. Then the data was further analyzed by using SPSS version 22 statistical software program. P-value less than 0.05 at 5% level of significance and 95% CI was considered as significant. Finally, the data were summarized in tables.

4. Results

A total of 39 veterinary professionals participated in the study. Mean age of respondents was 35.92 years. Greater numbers of respondents were male (66.7%) and highest proportions (38.5%) were between 31 to 40-year age groups. 43.6 percent were married as at the time of the study. (Table 1).

Table 1: Demographic features of veterinarians in Arbaminch zuriya and Arbaminch city Administration

Variables	Category	Frequency	percent
District	Arbaminch zuriya	33	84.6
	Arbaminch city	6	15.4
sex	Male	26	66.7
	Female	13	33.3
Marital status	Married	17	43.6
	Not Married	22	56.4
Age	20-30	14	35.9
	31-40	15	38.5
	41-50	10	25.6

A total of 100 farmers Mean age of respondents was 39.24 years. Greater numbers of respondents were male (94%) and highest proportions (51%) were between 31 to 40-year age groups. 94 percent were married as at the time of the study. (Table 1).

Table 2: Demographic features of farmers in Arbaminch zuriya and Arbaminch city Administration

Variables	Category	Frequency	percent
District	Arbaminch zuriya	50	50
	Arbaminch city	50	50
sex	Male	94	94
	Female	6	6
Marital status	Married	94	94
	Not Married	6	6
Age	20-30	9	9
	31-40	51	51
	41-50	31	31
	Above 50	9	9

Table 3: demographic factors related with Occurrence diseases following vaccination

Variables	Number examined	Occurrence diseases following vaccination	percent	χ2	P-value
sex					
male	26	8	30.8	1.950	0.163
female	13	7	53.8		
Marital status					
Married	17	6	35.3	0.128	0.721
Not Married	22	9	40.9		
Age					
20-30	14	4	28.6	1.156	0.561
31-40	15	6	40		
41-50	10	5	50		

Occurrence of disease following vaccination to animals was higher in female veterinarian (53.8%) than male veterinary professionals, but no significant difference was observed on overall disease development after vaccination (*p>0.05*).

Those not married veterinarians were more report to disease occurrence after vaccination than Married but the difference in the disease occurrence after vaccine administration to animals was not significant (*p>0.05*).

The present study also revealed that the occurrence of disease after vaccine administration to animals was not significant (*p>0.05*) with respect to the age veterinary professionals. Highest occurrence of disease after vaccine administration was observed in veterinarians' with age 41-50 (50%) years (Table 6).

Table 4. Livestock vaccine storage and handling scheme in the study areas.

Variables	Category	Frequency	Percent (%)
Types of refrigerator	Bar refrigerators	18	46.2
	Purpose-built refrigerator	0	0
	Not available	21	53.8
Storage To for live & freeze stable vaccines	Less than o degree centigrade	15	38.5
	Greater than o degree centigrade	15	38.5
	No storage	9	23.1
Use of refrigerator for killed vaccine	yes	15	38.5
	No	24	61.5
Average length of storage	Up to one month	13	33.3
	Up to three month	12	30.8
	Up to six month	14	35.9
Temperature monitoring	yes	16	41
	No	23	59
Frequency of power interruption	Twice in a day	16	41
	> 2 times in a day	23	59
Storage option when power went off for >24hrs	Kept in ice box	13	33.3
	Left as it is	26	66.7
Means of transport from district to different health post	Motor bicycle	21	53.8
	Car	18	46.2
Way of package during transport to the field	Kept in ice box	25	64.1
	In plastic bag	14	35.9
To Monitoring while Transporting vaccines	Yes	13	33.3
	No	26	66.2
Training on vaccine handling	Yes	14	35.9
	No	25	64.1
Reasons for the occurrence of disease after vaccination	Due to un vaccinated animals	24	61.5
	Vaccination of sick animals	15	38.5
What kind of water do you used for vaccine suspension	Tap and any water	24	61.5
	Saline and distilled water	15	38.5

As information obtained from selected districts Agriculture office livestock and fishery's unit, and veterinarians, livestock vaccines are delivered from and from Gamo zone Agriculture office and transported in cold ice box to the districts clinics and live vaccines stored in the bar type refrigerator were 46.2%. However, 38.5% of veterinarians store killed vaccines and diluents at room temperature and 38.5 % store live and freeze stable vaccine less than zero degree centigrade. 41 % of veterinarians check temperature monitoring on refrigerator and 33.3% monitor temperature during transporting vaccine to the field. 64.1% use icebox for transporting vaccine from clinic to field and 38.5% use saline and distilled water for vaccine dilution. Vaccines were stored at the clinics for one month 13(33.3%), three month 12(30.8%), and six month 14(35.9%). Electric power interruption was common problem in the two studied districts with frequency of 41% and 59% twice per day and more than twice per day respectively. During power disruption, (66.7%) of the respondents reported to leave the vaccines in the refrigerator left as it is. Motor bicycle (53.8%) and car (46.2%) means of transportation to distribute vaccines from districts to sub districts and village clinics. 25 (64.1%) and 14(35.9%) of respondents were described to use ice box and plastic bags, respectively to transport vaccines to sub districts(kebele). 35.9 % of veterinarians get Training on vaccine handling and storage in the two districts. (Table 4).

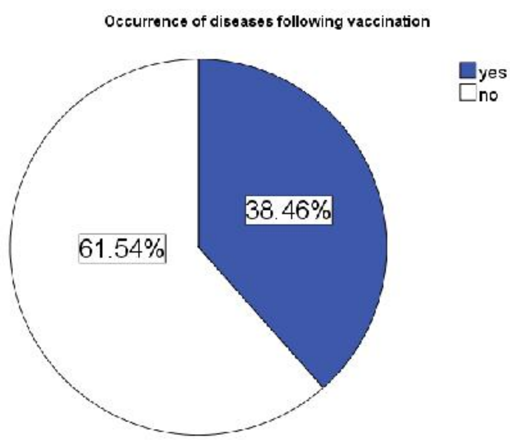
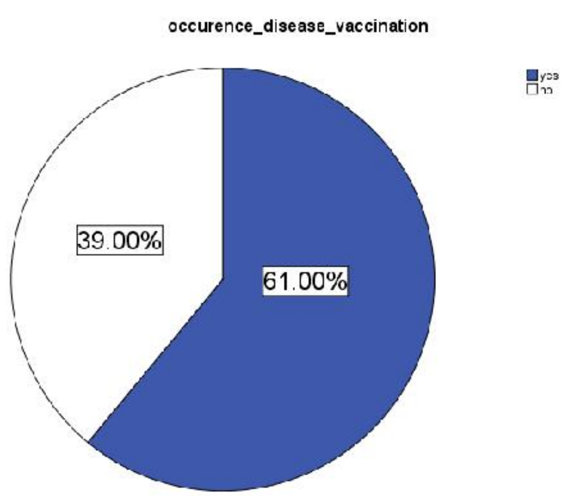


Figure :2 Occurrence of diseases following vaccination (Veterinerians)



Occurrence of diseases following vaccination (farmers)

In the current survey, (38.41%) and (61%) veterinary professionals and farmers believe that the occurrence of animal diseases after a vaccination program respectively. Professionals were also asked for the possible reason for the occurrence and about (61.5%) respondents consider due to un vaccinated animals and 38.5% of them suspect Vaccination of sick animals as an additional reason for the occurrence following vaccination (Table 5).

Table 5: vaccine handling factors related with Occurrence diseases following vaccination

Variables	Number examined	Occurrence diseases following vaccination	percent	χ2	P-value
Types of refrigerator					
Bar refrigerators	18	5	27.8	1.612	0.204
Not available	21	10	47.6		
Storage To for live & freeze stable vaccines					
Less than o degree centigrade	15	6	40	0.318	0.853
Greater than o degree centigrade	15	5	33.3		
No storage	9	4	44.4		
Use of refrigerator for killed vaccine					
yes	15	8	53.3	2.278	0.131
No	24	7	29.2		
Average length of storage					
Up to one month	13	7	53.8	2.263	0.322
Up to three month	12	3	25		
Up to six month	14	5	35.7		
Temperature monitoring On refrigerator					
yes	16	10	62.5	6.624	0.010*
No	23	5	21.7		
Frequency of power interruption					
Twice in a day	16	9	56.2	3.627	0.057
> 2 times in a day	23	6	26.1		
Storage option when power went off for >24hrs					
Kept in ice box	13	1	7.7	7.8	0.005*
Left as it is	26	14	53.8		
Means of transport from district to different health post					
Car	18	8	44.4	0.506	0.477
Motor bicycle	21	7	33.3		
Way of package during transport to the field					
Kept in ice box	25	8	32	1.228	0.268
In plastic bag	14	7	50		
To Monitoring while Transporting vaccines					
Yes	13	7	53.8	1.950	0.163
No	26	8	30.8		
Training on vaccine handling					
Yes	14	9	64.3	6.154	0.013*
No	25	6	24		
Reasons for the occurrence of disease after vaccination					
Due to un vaccinated animals	24	8	33.3	0.693	0.405
Vaccination of sick animals	15	7	46.7		
What kind of water do you used for vaccine suspension					
Tap and any water	24	7	29.2	2.278	0.131
Saline and distilled water	15	8	53.3		

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Occurrence of disease following vaccination to animals was higher in veterinarian not having refrigerator (47.6 %) than having bar refrigerator, but no significant difference was observed on overall disease development after vaccination ($p>0.05$). Those veterinarians not storing live and freeze stable vaccine less than zero degree centigrade were 44.4 % higher occurrence of disease following vaccination and no association with disease development ($p>0.05$). Almost 53.8% occurrence of disease following vaccination in veterinarians who store vaccine up to one month and there is no association of disease occurrence following vaccination ($p>0.05$). Veterinarians check temperature monitoring on refrigerator 62.5% disease occurrence following vaccination and also there is a significant association ($p<0.05$) between occurrence of disease and temperature monitoring on refrigerator. Twice in day power interruption in veterinary clinic has 56.2% disease occurrence following vaccination and greater than two times in day power interruption has 26.1% disease occurrence following vaccination but no significant difference was observed on overall disease development after vaccination ($p>0.05$). 53.85% occurrence of disease following vaccination is due to left the vaccine as it is when power went of greater than 24 hour but no significant difference was observed on overall disease development after vaccination ($p>0.05$). 44.4% occurrence of disease following vaccination were on veterinarians using car as means of transportation from district to health post and 33.3 % of disease occurrence following vaccination was in veterinarian using motorcycle for means of transportation but no significant difference was observed on overall disease development after vaccination ($p>0.05$). 50% of disease developments following vaccination were in veterinarian using plastic bag for packaging during transport to the field and health and 30.8% of disease occurrence were in veterinarians who didn't monitor temperature while transporting vaccine but no significant difference was observed on overall disease development after vaccination ($p>0.05$). 24% of Veterinarians who didn't get training on vaccine handling were more likely linked to disease occurrence following vaccination and also there is a significant association ($p<0.05$) between occurrence of disease and training on vaccine handling. In the reason of occurrence of disease after vaccination 46.7% of occurrence of disease following vaccination is due to vaccination of sick animals and 33.3 are due to not vaccinated animals but no significant difference was observed on overall disease development after vaccination ($p>0.05$). 29.2% of disease occurrence following vaccination is due to veterinarians use tap and any water for vaccine suspension and 53.3% occurrence of disease following vaccination were in veterinarians using saline and distilled water for vaccine suspension but no significant difference was observed on overall disease development after vaccination ($p>0.05$).

5. Discussion

Bar type refrigerator was used 46.2% to store live and freeze stable vaccines and 53.8% of them don't have refrigerator to store live vaccine. However, reports shown that bar-type refrigerators are not capable of consistently maintaining temperatures within the 2°C to 8°C (+35°F to +46°F) range [11]. Because, within combined refrigerator and freezer units the freezer compartment unit is incapable of maintaining temperatures cold enough to store freezer-stable vaccines. This also expose the refrigerator stable live vaccine to the freezing temperature and exposure of this vaccines to temperatures outside of the allowed range may result in decreased vaccine potency and increased risk of vaccine preventable diseases [12]. In the course of the current study period 59% of veterinarian didn't perform temperature monitoring on refrigerator in any of the units at the studied clinics. But most livestock vaccines require maintenance at the refrigerator temperature of 35-45°F [11, 13]. However, about 25-76% of refrigerators used for vaccine storage in the livestock industry failed to maintain these temperatures [14]. Thus, vaccines stored in the current studied districts were not within the recommended ranges.

There was significant difference in storage option when power went off for >24 hour periods of the vaccine having χ^2 = 7.8 and P=0.005. At the district level where the facilities are not appropriate for vaccine storage and handling, absence of generator in woreda district and at field level have effect on vaccine efficacy when power went off for >24 hour. Delayed and inadequate handling has been reported to be the main cause of loss of vaccine potency in Nigeria [15].

And also there was a significant difference in temperature monitoring in refrigerator having χ_2 = 6.6241 and P=0.01.

In the current study, receiving training on cold chain and vaccine management was significantly associated factor with disease development after vaccination having χ_2 = 6.154 and P=0.013. This finding is supported with previous studies which revealed that vaccine handlers who had received training had better knowledge than vaccine handlers who had not received training [16-19]. Training could increase the vaccine handlers' curiosity and attention to apply the principles obtained from the training. This in-turn could increase the knowledge of vaccine handlers on cold chain and vaccine management.

The success of cold chain and vaccine management depends on the knowledge of cold chain handlers[20]. In this study, having good knowledge on cold chain and vaccine management was significantly associated with good cold chain and vaccine management status. The finding is consistent with previous studies [21-23]. This could be the possible explanation that if vaccine handlers have good knowledge, they may have good motivation, and feel responsibility and accountability to practice the proper cold chain and vaccine management.

In the present study districts, electric power interruption was one of the common problems with frequency of interruption twice per day (56.2%) and more than twice per day (26.1%) with duration of outage varies from minutes to hours in some occasions the interruption may last for days and weeks. Despite this there is no emergency storage and handling plan and the vaccines were left in the refrigerator until the power gets back. Most animal health field workers (53.8%) use motor bicycle to transport vaccines to sub districts and villages from the districts. Majorities (50%) of them were use plastic bag to transport vaccine whereas (32%) use Icebox.

The result of an interview indicated that (38.46%) and (61%) veterinary professionals and farmers, respectively believe the occurrence of animal diseases after a vaccination program. About (46.7%) respondents consider vaccination of already unhealthy animal and (33.3%) of them suspect occasionally unvaccinated animals as an additional reason for the occurrence following vaccination. However, periodic vaccination program was conducted in all studied districts. When we see frequency of the occurrence viral disease were dominantly reported. Therefore, the storage option when power went off for >24 hour periods, temperature monitoring in refrigerator and training on cold chain and vaccine management is cause of the occurrence of those viral diseases after vaccination is an indicator for the loss of vaccine efficacy in the study areas. However, several factors may influence vaccine potency. Such factors include the manufacturing errors and user errors, animal's genetic background, immune suppresses (parasitism, poor nutrition, stress, etc.), and an immature immune system in a young animal, advanced age and other factors that affect individual susceptibility will also affect the vaccine's efficacy[24].

6. Conclusion and Recommendations

According to this study the method of vaccine storage, transportation and handling in the districts are by far deviated from the standards vaccine manufacturing companies. Absence of purpose-built refrigerator, training on cold chain and vaccine management, frequent interruption of electric power and absence of other alternatives to keep vaccines at the recommended temperature is cause of the occurrence of those viral diseases after vaccination is an indicator for the loss of vaccine efficacy in the study areas.

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