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Assessment on Handling, Storage, Transport and Utilization of Veterinary Vaccines in Selected Districts of Sidama Zone, Southern Ethiopia

Samrawit Yohannes, Bashahun G Michael and Waktole Yadeta*

School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma University, Ethiopia

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***Corresponding author**: Waktole Yadeta, School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma University, PO Box: 307, Jimma, Ethiopia

Abstract

A cross-sectional study was conducted from November 2018 to March 2019 to assess handling, storage and utilization of veterinary vaccines in selected districts of Sidama zone, Southern Ethiopia. A purposive and snowball sampling techniques were employed to select study areas and study participants, respectively. Questionnaire based survey was performed on fifty (50) veterinarians on their practice of vaccine handling and storage and forty-five (45) farmers to describe the occurrence of the disease condition following vaccination. Analysis was performed by using SPSS version 22 and P-value less than 0.05 at 95% confidence level was considered as significant. Accordingly, Blackleg vaccine, Pastuerellosis vaccine, Anthrax vaccine, Lumpy Skin Disease (LSD) vaccine, Newcastle disease vaccine, African Horse Sickness (AHS) vaccine and Rabies vaccine were commonly utilized vaccines. Bar type refrigerators were used (100%) to store live and freeze stable vaccines. The Odds of keeping vaccines for six months (OR = 1.06, 95% CI: 0.56 - 2.00) and three months (OR = 0.68, 95% CI: 0.28 - 1.61) were found to be significant. The Odds of leaving vaccine as it is when power gets off for several days (OR = 3.17, 95% CI: 0.52 - 1.26) was also recognized. Large proportion of professional and farmers 29(58%) and 32(71.1%) respectively reported experiencing disease following vaccination. Motor bicycle were the major (86%) transportation means. Thirty-nine (78%) and 11(22%) of respondents described using ice box and plastic bags. 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: Electric power; Refrigerator; Temperature; Sidama zone; Vaccine storage

Abbreviations: LSD: Lumpy Skin Disease; AHS: African Horse Sickness; OR: Odds ratio; CI: Confidence interval; SNNPR: Southern Nations, Nationalities, and Peoples' Region

Introduction

Vaccines are a key component of livestock disease prevention and control worldwide. Vaccines have a major role in protecting animal health and public health, reducing animal suffering, enabling efficient production of food animals, and greatly reducing the need for antibiotics to treat food and companion animals [1]. Vaccination (immunization) is a tried and tested method of assisting in the continual fight against disease in man and animals [2]. Veterinary vaccine is used primarily to promote animal health by preventing disease outbreaks that can have a devastating effect on animal production, as well as on human and animal health [3]. Vaccination, therefore, is an effective way in which to promote both good animal health, good animal welfare, and economic stability for farmers and the communities [4]. Good-quality veterinary vaccines are essential for the maintenance of animal health. They are an important means of control for many animal diseases, and crucial components of many national disease-control or eradication programs [5]. To ensure these qualities, Vaccines are supplied with specific instructions such as dose rate, storage and administration procedures, any side effects that may potentially occur, withdrawal periods, and the expiry date of the product. These instructions are very important and must be understood and followed to ensure that the product does what it is supposed to do [6]. However, these important activities can be seriously compromised by poor vaccine storage, handling and transport [7].

The term cold chain is used to emphasize the importance of keeping vaccine at an appropriate temperature throughout the chain of transport, storage and administration [8]. Proper transport, storage and handling of vaccine are issues that frequently overlooked when creating or implementing vaccine protocols [9]. Between the time vaccine leaves the manufacturer's plant and the

time it is injected into an animal, there are many opportunities for inadvertent contamination or inactivation [10]. By being aware of these potential "weak points" in a vaccine protocol, technician can help ensure that vaccines are not rendered ineffective because of improper handling [11]. For vaccine storage the important criteria are establishing Storage and Handling Policies, Using Proper Storage Equipment, ensuring optimal operation of storage units, Maintaining Correct temperatures, maintaining daily temperature logs, taking emergency action as needed when vaccines are exposed to improper storage conditions [12]. Proper supplies are essential for the safe transport of vaccines and proper packing should be maintained before transporting [13]. During transportation, refrigerated and frozen vaccines must maintain their optimal temperature values to preserve their potency. Means of transport used must maintain the potency of the vaccine as it is [14].

The loss of vaccine effectiveness due to cold chain exposures to adverse conditions is cumulative, permanent and irreversible [15]. Vaccine wastage results in increased costs (to replace the wasted vaccines, human services and specialized transportation). With the globalization of the vaccine manufacturing industry, and intermittent global vaccine shortages, it is not always possible to quickly obtain additional quantities of vaccines to replace vaccine that is wasted [16]. Awareness of vaccine transport, storage and handling issues is greater in humane medicine than in veterinary medicine because of the risk of epidemic diseases such as polio, influenza, and smallpox [12]. By reviewing research on human vaccine protocol, veterinary professionals can learn a great deal about proper vaccine handling [17]. In Ethiopia there are problems related to vaccine efficacy and continuous outbreaks in vaccinated animals [18]. This might be due to improper production or storage and handling of the vaccines. Therefore, the objectives of this research were: To assess the transportation, storage, utilized veterinary vaccines, and occurrence of diseases after a vaccination in the study area.

Materials and Methods

Study Area

The study was conducted from November 2018 to April 2019 in Sidama zone, which is located in the Southern Nations, Nationalities, and Peoples' Region (SNNPR) of Ethiopia. It is named for the Sidama People, whose homeland is in the zone. Sidama is bordered on the south by the Oromia Region (except for a short stretch in the middle where it shares a border with Gedeo zone), on the west by the Bilate River, which separates it from Wolayita zone, and on the north and east by the Oromia Region. Towns in Sidama include Hawassa, the capital of Sidama and SNNPRS, Yirgalem and Wendo. A zone has a population of around 3.2 million in 2017 who speak the Cushitic language, Sidama (also known as Sidamigna). Sidama has 879 kilometers of all-weather roads and 213 kilometers of dry-weather roads, for an average road density of 161 kilometers per 1,000 square kilometers. Sidama has geographic coordinates of latitude, north: 5′ 45″ and 6′45″ and longitude, East, 38′ and 39′. It has a total area of 10,000 km 2, of which 97.71% is land and 2.29% is covered by water. Hawassa Lake and Logita falls are water bodies that attract tourists. Of the land, 48.70% is cultivated, 2.29% is forested, 5.04% is shrub and bush land, 17.47% is grazing land, 18.02% is uncultivated, 6.38% is unproductive and 2.10% has other uses.

Study Design

A questionnaire based cross-sectional study was carried out from November 2018 to April 2019 in Sidama Zone, selected districts veterinary clinics and farmers. Purposive and convenient sampling techniques were employed to select study areas and study participants, respectively. Farmers were selected by using snowball sampling technique.

Source population and study population

All districts veterinary clinics keeping vet vaccines, veterinary professionals working at office and field and farmers are the source population. Our study populations were those selected districts veterinary clinics, all the professionals working in these districts and the selected farmers (key persons).

Sample size determination and sampling techniques

Due to small study population of the clinic and filed veterinary professionals the entire population (50) was included in the study by using census. Snowball sampling technique was used to identify farmers (potential respondents) 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.

Data collection

The structured questionnaire was developed to assess 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

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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 will be developed based on the information gathered from literatures. The questionnaire was first prepared in English and later it was translated to regional working language.

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.

Ethical Concern

Letter of permission was obtained from Jimma University College of Agriculture and Veterinary Medicine and given to Sidama Zone and the selected districts Livestock and Fishery's offices. The aim of the research was clearly explained to the selected study participants. Data was collected soon after the confirmation of respondents for their willingly participation.

Study Limitations

Documentation on vaccines stored outside recommended temperature range alone does not allow for inference about the potency of the vaccines. Testing vaccine vials to ascertain potency when found to be improperly stored is expensive and also doing serological testes to evaluate whether the vaccinated individuals are immunized or not and beyond the scope of this study. Since snowball sampling method is used to obtain the farmers, representativeness of the sample is not guaranteed. The researcher has limitation on getting the true distribution of the population and of the sample.

Results

Socio-demographic characteristics of respondents

A total of 50 veterinary professionals and 45 farmers were participated in the study. Mean age of respondents was 39 years. Greater numbers of respondents were male (84.2%) and highest proportions (37.9%) were between 31 to 40-year age groups. Seventy one percent were married as at the time of the study. Majorities of respondents (61.1%) and (74.0%) were College or University graduates and married, respectively (Table 1).

Table 1: Demographic features of respondents.

Variables	Category	Frequency	Percent (%)
Sex	Male	80	84.2
	Female	15	15.8
Age	20-30	24	25.3
	31-40	36	37.9
	41-50	29	30.5
	51+	6	6.3
Marital status	Single	20	21.1
	Married	71	74
	Divorced	4	4.2
Level of education	Primary	26	27.4
	Secondary	11	11.5
	College/University	58	61.1

(Table 2) below shows the major livestock disease reported to be occurred. In this study, Blackleg, Pasturellosis, lumpy skin disease, anthrax, new castle disease was the most commonly occurring disease as an outbreak in the studied districts.

Common veterinary vaccines used in the study area

The following (Table 3) shows available livestock vaccines in the study districts and their storage temperature. Vaccines kept at room temperature in the study area veterinary clinics were Blackleg vaccine, Pastuerollosis vaccine, and Anthrax whereas vaccines stored below zero degree centigrade includes Lumpy skin disease vaccine, Newcastle disease vaccine, African horse sickness and Rabies vaccine.

Means of transportation, storage and utilization of veterinary vaccines

As information obtained from selected districts livestock and fishery's office, and veterinarians, livestock vaccines are purchased from NVI and transported in cold ice box to the districts clinics and live vaccines stored in the bar type refrigerator

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at<0°C. However, killed vaccines and diluents are stored at room temperature. Vaccines were stored at the clinics for one month 19(38%), three month 11(22.2%), and six month 20(40%). Electric power interruption was common problem in all studied districts with frequency of 92% and 8% twice per day and more than twice per day respectively. During power disruption, (88%) of the respondents reported to leave the vaccines in the refrigerator as it is. Motor bicycle were the dominant (86%) means of transportation to distribute vaccines from districts to sub districts and village clinics. Thirty-nine (78%) and 11(22%) of respondents were described to use ice box and plastic bags, respectively to transport vaccines to sub districts. Training on vaccine handling and storage protocol is most ignored subject in these districts (Table 4).

Table 2: Major livestock diseases in the study areas.

Common diseases	Frequency	Percent (%)
Blackleg, Pasturellosis, Fasiolosis, Newcastle, Fungi	19	38
LSD, Anthrax, CCPP, Newcastle	21	42
Blackleg, Pasturellosis, LSD, Newcastle Disease	10	20
Schedule of Vaccination in the study area		
Periodically	20	40
When disease outbreak begins	0	0
On request	6	12

Table 3: Veterinary vaccines available in the study area.

Vaccines	Type	Way of storage
Blackleg	Killed	Room T^0
Pastuerollosis	Killed	Room T^0
Anthrax	Live	Room T^0
Lumpy Skin Disease	Live	Below 0^0C
Newcastle Disease	Live	Below 0^0C
African horse sickness	Live	Below 0^0C
Rabies	Killed	+2-8 °C

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

Variables	Category	Frequency	Percent (%)
Types of refrigerator	Bar refrigerators	100	0
	Purpose-built refrigerator	0	0
	Domestic	0	0
Storage T^o for live & freeze stable vaccines	$<0^0C$	50	58
Average length of storage	One month	19	38
	Three months	11	22
	Six months	20	40
Temperature monitoring	Yes	0	0
	No	50	100

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Frequency of power interruption	Twice in a day	46	92
	> 2 times in a day	4	8
Storage option when power went off for >24hrs	Kept in ice box	6	12
	Left as it is	44	88
Means of transport from district to different clinics	Motor bicycle	43	86
	Car	7	14
	Horse/Donkey	0	0
Way of package during transport to the field	Kept in ice box	39	78
	In plastic bag	11	22
T° Monitoring while Transporting vaccines	Yes	0	0
	No	50	100
Training on vaccine handling	Yes	0	0
	No	50	100

Occurrence of livestock diseases following vaccination

In the current survey, (58%) and (71.1%) 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 (44.8%) respondents consider vaccination of already unhealthy animal and use of spoiled vaccine as possible factors and 16(55.2%) of them suspect occasionally unvaccinated animals as an additional reason for the occurrence following vaccination (Table 5). Possible factors related with the livestock vaccine usefulness are summarized in (Table 6). Lengths of vaccine storage and storage option during power interruption have significant influence on vaccine efficacy. The Odds of keeping vaccines for six months (OR = 1.06, 95% CI: 0.56 - 2.00) and three months (OR = 0.68, 95% CI: 0.28 - 1.61) were found to be significant. The Odds of leaving vaccine as it is during power interruption (OR = 3.17, 95% CI: 0.52 - 1.26) was the most important factor identified.

Table 5: Livestock disease occurrence after vaccination.

Variables	Frequency	Percent (%)
Occurrence of diseases following vaccination (Vets)		
Yes	29	58
No	21	42
Occurrence of diseases following vaccination (Farmers)		
Yes	32	71.1
No	13	28.9
Reasons for the occurrence of disease after vaccination		
Due to unvaccinated animals and vaccine defect	13	44.8
Due to unvaccinated animal, vaccine defect and vaccination of sick animals	16	55.2

Table 6: Probable factors related with vaccine handling and storage.

Variables	Odds ratio	95% CI	P- value
Average length of storage			
One month	1.0		
Three months	0.68	0.28 - 1.61	0.01
Six months	1.06	0.56 - 2.00	0.002
Storage option when power went off for several days			

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Left the vaccine as it is	3.17	0.52 - 1.26	0.002
Stored in the ice box	1	-	-
Way of package while transporting			
Use ice box	1		
Use plastic bag	1.92	0.49 - 7.41	0.95

Discussion

The present study has identified that; Blackleg vaccine, Pastuerollosis vaccine, Anthrax vaccine, LSD vaccine, Newcastle disease vaccine, AHS vaccine and Rabies vaccine were commonly available vaccines and bar type refrigerator was used (100%) to store live and freeze stable vaccines. 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 [19]. 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 [20]. In the course of the current study period temperature monitoring was not performed in any of the units at the studied clinics and the refrigerators were maintained below zero degree centigrade (<0°C). But most livestock vaccines require maintenance at the refrigerator temperature of 35-45°F [16,19]. However, about 25-76% of refrigerators used for vaccine storage in the livestock industry failed to maintain these temperatures [21]. Thus, vaccines stored in the current studied districts were not within the recommended ranges.

There was significant difference ($p<0.05$) in storage periods of the vaccine. The Odds of keeping vaccines for six months (OR = 1.06, 95% CI: 0.56 - 2.00; P=0.002) and three months (OR = 0.68, 95% CI: 0.28 - 1.61; P=0.01) were found to be significant. At the district level where the facilities are not appropriate for vaccine storage and handling, prolonged storage may have an accumulative effect on the vaccine efficacy. Delayed and inadequate handling has been reported to be the main cause of loss of vaccine potency in Nigeria [22].

In the present study districts, electric power interruption was one of the common problems with frequency of interruption twice per day (90%) and more than twice per day (10%) 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 (87%) until the power gets back. Thus, the Odds of leaving vaccine as it is during power interruption (OR = 3.17, 95% CI: 0.52-1.26) was found to be statistically (P=0.002) significant. Most animal health field workers (86%) use motor bicycle to transport vaccines to sub districts and villages from the districts. Majorities (78%) of them were use ice box to transport vaccine whereas (22%) use plastic bags.

The result of an interview indicated that (58%) and (71.1%) veterinary professionals and farmers, respectively believe the occurrence of animal diseases after a vaccination program. About (44.8%) respondents consider vaccination of already unhealthy animal and use of imperfect vaccine as possible factors and 16(55.2%) of them suspect occasionally unvaccinated animals as an additional reason for the occurrence following vaccination. The result of the current study shown in (Table 2) indicated that LSD, Anthrax, CCPP, Newcastle were found to be major (42%) disease problem reported. However, periodic vaccination program was conducted in all studied districts. When we see frequency of the occurrence viral disease were dominantly reported. Therefore, the live vaccines used for these disease, storage of vaccines for long periods, use of bar type refrigerator, absence of period temperature monitoring, frequent electric power interruption, means of transport used, use of plastic bags to transport vaccines and 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, immunosuppresses (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 [23].

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 in placed by CDC, WHO, AAEP and vaccine manufacturing companies. Absence of purpose-built refrigerator, temperature monitoring devices and data logger, frequent interruption of electric power and absence of other alternatives to keep vaccines at the recommended temperature, prolonged

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storage of vaccine, use of plastic bags to transport vaccines and means of transportations used are likely to affect vaccine efficacy.

Thus, based on the above occlusion the following recommendations are forwarded

a) Ensuring that no more than one month's supply of stock is on hand to reduce wastage.

b) Have a designated individual responsible for handling and storage of vaccines

c) Care should be taken on vaccine handling and storage as it is essential in ensuring vaccine potency and maximizing effectiveness.

d) Use purpose-built refrigerator to store vaccine, if not possible using domestic refrigerator are acceptable than the bar refrigerators.

e) There should be an annual training program to staffs who are involved in vaccination, vaccine storage and handling activities.

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