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KNOWLEDGE AND CASES USED FOR THE DIAGNOSIS AND TREATMENT OF FOOT-MOUTH-CATTLE DISEASES IN JIMMA ZONE OF ETHIOPIA.

Lawrence Abraham Gojeh[1], Mesfin Alemu[2], Seifu Neda[3],

[1]Department of Information Science, College of Computing and Informatics, Haramaya University, Ethiopia
[2]Jimma Institute of Technology, Jimma, Ethiopia
[3]Department of Statistics, College of Computing and Informatics, Haramaya University, Ethiopia

Corresponding Author: Lawrence Abraham Gojeh[1]: Department of Information Science, College of Computing and Informatics, Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia. Mobile: +251 911567414; E-mail: lawrencegojeh786@gmail.com

ABSTRACT

Foot-Mouth-Cattle Disease is one of the most serious livestock diseases that the virus is highly contagious, which affects cloven-hoofed animals (those with divided hoofs), including cattle, buffalo, camels, sheep, goats, deer and pigs. It deeply affects the productivity, losses of livestock, causing hardships for farmers and ranchers, disrupting regional and international trade in animals. The objective of this study assessed the knowledge and cases of foot-mouth-cattle diseases used by domain experts for the diagnosis and treatment of the disease at Seka Chokorsa and Shebe Sombo Weredas in the Jimma zone of Ethiopia. Acquiring of such previous knowledge and solved cases will go a long way to helping cattle rural farmers tackle or overcome the prevailing problems associated with the disease in the domain area through developing technological systems for the rural cattle farmers to diagnose and treat the disease. A cross-sectional survey research method was used to gather preliminary data through questionnaire, interview and observation schedules from domain experts that included Veterinary doctors, Development agents and Model rural cattle farmers. The data collected supported the researchers make inferences about the relationships of previous knowledge and cases diagnosed and treated of the disease in the study area. The study found that the domain experts had previous knowledge and cases of the viruses that transmits the foot-mouth-cattle diseases. The two categories of domain experts (Veterinary doctors and Development agents), identified serotypes viruses 'A' (25%); 'C' (12.5%) and 'SAT-1, SAT-2 and SAT-3' (37.5%) with 'SAT-1, SAT-2 and SAT-3' as the most prevalent. However, model rural farmers indicated the most affecting serotype virus as 'A' (50%) and 25% for 'SAT-1, SAT-2 and SAT-3' in the domain area. This finding should form a base for the development of a knowledge base system for the diagnosis and treatment of foot-mouth-cattle disease for the rural cattle farmers at Seka Chokorsa and Shebe Sombo Weredas in the Jimma zone of Ethiopia.

Keywords: *Knowledge And Cases, Foot-Mouth-Cattle-Diseases, Diagnosis, Treatment, Jimma Zone*

1. INTRODUCTION

Foot-Mouth-Disease (FMD) is one of the most serious livestock diseases that is highly contagious virus, which affects cloven-hoofed animals (those with divided hoofs), including cattle, buffalo, camels, sheep, goats, deer and pigs. It is a trans-boundary animal disease (TAD) that deeply affects the productivity, losses of livestock, causing hardships for farmers and ranchers, disrupting regional and international trade in animals. The disease circulates in 77% of the global livestock population, in Africa, the Middle East and Asia, as well as in a limited area of South America. Africa and Eurasia are the regions which incur the largest costs, accounting for 50% and 33% of the total costs respectively (Sahle et. al., 2004; htts://www.oie.int/en/home). However, a single detection of FMD will likely stop international trade completely for a period. Since the disease can spread widely and rapidly and has grave economic consequences (FAO, 2005, 2006).

Ethiopia has the largest livestock population of any African country with an estimate of 43.1 million heads of cattle and cows (CSA, 2008). The aggregate annual economic losses from animal diseases through direct mortality and reduced productive and reproductive performance estimated at US$ 150 million. The diseases of FMD in Ethiopia are causing devastating effects both to the producers and to the national economy. Livestock production has a significant role to the Ethiopian economy by contributing up to 45% of the agricultural GDP, 19% of total GDP and one fifth of the country's export. Within the livestock population of the country, cattle represent about 71% of the total 42.2 million tropical livestock units (livestock biomass) (MoARD, 2007).

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The outbreak of Foot-Mouth-Cattle Disease (FMCD) frequently occurs in the pastoral herds of the marginal low land areas in Ethiopia and referred to as one of the endemic diseases in Ethiopia that occurs recurrently, causing several outbreaks every year (Ayelet et al., 2012). The last outbreak reported and confirmed in November 2014 by the Global Foot-and-Mouth Disease Situation, Food and Agriculture Organization of the United Nations Monthly Report of 2015. Gelaye, et al. (2009) & Sahle *et al*. (2004) considered FMCD in Ethiopia as alarming. It ranks first among the noticeable infectious diseases of livestock and are the major causes of economic losses to the farmers and pastoralists in Ethiopia; amounting to hundreds of millions of Ethiopian birr annually (OIE, 2000). The FMCD virus caused by the genus Aphthovirus, family Picornaviridae, which have seven serotypes of the virus, namely: A, O, C, SAT1, SAT2 SAT3 and Asia1. That infection with one serotype does not confer immune protection against another. Thomson (1994) characterized the disease as the animal has high fever, loss of appetite, salivation and vesicular eruptions on the feet, mouth and teats.

The problems of FMCD in Ethiopia include lack of qualified professionals. In addition, lack of finances to treat the disease, remoteness and inaccessibility of the FMCD location areas, unspeakable nature of cattle to identify the disease from other similar less affecting disease types to diagnose and treat at early stage and lack of enough attention for the sector, lack of integrity between stakeholders. In addition and in most rural areas of Ethiopia veterinary clinics, found at district (wereda) levels (on the average of 100,000 populations). Although there is an opportunity for farmers and cattle breeders to get animal science educated extension workers (Development Agents) at their kebele (ward) levels, they cannot get them at regular basis or on time. Development agents expected to serve on the average 1,090 farmers. Additionally these development agents lack the skill and experience to give treatment for infected animals; the authors revealed. There is the Lack of laboratory equipment, lack of diagnostic facilities and low quality animal health services at the spot with absence of vaccines are other problems observed in rural veterinary clinics.

Therefore, the objective of this study assessed the knowledge and cases of foot-mouth-cattle diseases (FMCD) used by domain experts for the diagnosis and treatment at Seka Chokorsa and Shebe Sombo Weredas or Districts in the Jimma Zone or Local Government Area in Ethiopia. The Amharic names and their English concepts in Amharic and their English translation are used in this paper interchangeably. This is for purposes of easy reporting. In addition, domain experts, such as Veterinary doctors, Development agents and Cattle rural farmers were the key informants for data collections on the diagnosis and treatment of FMCD. However, acquiring previous knowledge and solved cases will go a long way to helping Veterinary doctors, development agents and rural farmers to overcome the prevailing problems associated with FMCD as observed and identified in the domain areas for this study.

2. METHODOLOGY

The research method used for the study was cross-sectional survey research method, which involves the researchers collected data from a population at one specific point in time. The method allowed the researchers gather preliminary data that supported them make inferences about the relationships among domain experts that were involved in the diagnosis and treatment of FMCD. Such domain experts included veterinary doctors, development agents and rural model cattle farmers at Shebe Weredas with Sambo and Kishe Kebeles. Plus Seka-Chokorsa Wereda with Shene-Koche and Gibe-Baso Kebeles found in Jimma Zone of Ethiopia.

Data collections made use of English version questionnaire veterinary and development agents and a transited version of Amharic language of the questionnaire used for rural model cattle famers respectively at the Shebe Weredas with Sambo and Kishe Kebeles. In addition in the Seka-Chokorsa Wereda with Shene-Koche and Gibe-Baso Kebeles found in the Jimma Zone. This also followed with interview and observation schedules and translated again into Amharic version and used for the rural model farmers diagnosing and treating the FMCD at site respectively.

The survey also involved collecting previously solved cases of the FMCD to identify the match or preference for the diagnosis and treatment of the diseases. The data collected from the cross-sectional surveyed data were analyzed; to answer the research question on “What knowledge and cases were used by domain experts (i.e. veterinary doctors, development agents and rural model cattle farmers) for the diagnosis and treatment of FMCD at Shebe Weredas with Sambo and Kishe Kebeles. Plus Seka-Chokorsa Wereda with Shene-Koche and Gibe-Baso Kebeles found in Jimma Zone of Ethiopia?”

The study sites were Shebe Weredas with Sambo and Kishe Kebeles. Plus Seka-Chokorsa Wereda with Shene-Koche and Gibe-Baso Kebeles found in Jimma Zone of Ethiopia. The total population of the study was 36 participants. This figure purposively derived by categorizing the domain experts into three categories (i.e.

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Veterinary Doctors 8no, Development Agents' 8no. and 20number rural model cattle farmers). The populations of the study had the following domain areas and participants. The domain areas included the domain experts with the domain knowledge that include eight (8) specialized animal health professionals or veterinary doctors. The distribution of the eight was two (2) from the two local Government Areas/Waradas of Shebe and Seka-Chokorsa respectively; two (2) from Ministry of Livestock and Fisheries, Ethiopia; two (2) from Jimma Zone Livestock and Fisheries Development Office and two (2) from Jimma University College of Veterinary Medicine. The second category had eight (8) Development agents with four (4) each from the districts/Kebeles of Sambo and Kishe Kebeles and that of Shene-Koche and Gibe-Baso in the Local Governments/Waradas of Shebe and Seka-Chokorsa respectively. The third category of twenty (20) rural model cattle farmers had ten (10) each from the districts/Kebeles of Sambo and Kishe Kebeles and that of Shene-Koche and Gibe-Baso in the Local Governments/Waradas of Shebe and Seka-Chokorsa respectively. The rural model farmers identified to have the knowledge about the diagnosis and treatment of foot-mouth-cattle diseases traditionally.

The sampling technique for this study was purposive. In which case, FMCD knowledge experts and model rural farmers selected based on their knowledge on diagnosis and treatment of Foot-mouth-cattle disease from the selected institutions, Local Government Areas/Weredas and Districts/Kebeles. The study sites/areas selected purposively depending on frequently observed FMCD of the areas. While the participants derived for the study based on specialized animal health professionals knowledge on the diagnosis and treatment of FMCD in Jimma Zone of Ethiopia.

3. RESULTS

3.1.Demographic Characteristics

Participants provided basic demographic information regarding their designation, gender, educational status and location of domain experts. Table 1 below is summary participants' demographic data that included characteristics, groups, sample size, percentages, mean and standard deviation (SD).

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Table 1: Summary of participant demographic data

Characteristics	Groups	Sample (n=36)	Frequency (%)	Mean	SD
Domain experts/Designation					
	Veterinary Doctors	2	7.4		
	Development agents (animal health clinic officers	6	22.2		
	Model cattle farmers experts	19	70.4		
Total		27	100	.70	.465
Location of domain experts					
	Jimma zone Ministry livestock and fisheries development	8	29.6		
	Shebe Wereda-Sambo Kebele	4	14.8		
	Shebe Wereda-Kishe Kebele	9	33.3		
	Seka chokorsa Wereda-Shene koche Kebele	6	22.2		
Total		27	100	1.48	1.156
Gender					
	Male	25	92.6		
	Female	1	3.7		
	No response	1	3.7		
Total		26	100	.04	.196
Educational status					
	Cannot read and write	12	44.4		
	Can read and write	6	22.2		
	Diploma	6	22.2		
	1st degree and above	1	3.7		
	No response	2	7.4		
Total		25	100	.84	.943

As depicted in table 1 above, 92.6% participants were males with majority 70.4% were model cattle farmers. The only female 3.7% was development agent staff, while veterinary doctors were 7.4%. From the observation and interviews held at the Shebe Weredas, there was lack of animal health professionals with particular reference to veterinary medicine doctors or diploma holders in animal healthcare at (wereda) offices and at veterinary clinic levels. Most of the animal healthcare professionals found in the veterinary clinics at the (weredas); were diploma holders in animal science or related fields, not in particular animal health profession like cattle. Although, there existed one veterinary doctor in the veterinary clinic at Seka Wareda, he had some mental health problem, and so was not properly stable and that affected his duties. In fact, there was a skill gap from the veterinary doctor at the Weredas.

The gender group in Table 1 showed the mean and standard deviation levels for domain expert group as $\dot{X}$=0.70 and SD=0.465. This implied that there is high response of the domain expert for the study but low gender mean for female at $\dot{X}$=0.04 and SD=0.196. The highest educational status observed was 1st degree 3.7%. with mean $\dot{X}$=0.84 and SD = 0.943. Regarding the location of participants 33.3% comprise domain experts located in Shebe Wereda-Kishe Kebele; 29.6% located in Jimma zone Ministry of livestock and fisheries development; 22.2% located in Seka chokorsa Wereda-Shene koche Kebele, while 14.8% were in Shebe Wereda-Sambo Kebele and had a total mean value of $\dot{X}$=1.48 and SD=1.156.

The implication of the demographic groupings of domain experts involved in the study of the FMCD (i.e. veterinary doctors 7.4%, Development health clinic agents 22.2% and model farmers 70.4%) showed a good representation of domain experts; expected to have professional qualification, knowledge, job experience and practice on FMCD. OIE & FAO (2012) opined that the diagnosis and treatment of cattle diseases as not an easy task; it needs experience and knowledge of cattle and their diseases by experts that require accuracy in describing the signs and symptoms of diseases. Cattle owners/persons can depend on a system that posses

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experience and knowledge of experts and help users in identifying any type of disease, making the right decision and choosing the right treatment.

3.2. Virus knowledge for Foot-Mouth-Cattle Diseases diagnosis in domain areas

Foot-Mouth-Cattle Diseases have some specific viruses that transmit it. The researchers considered the knowledge of the virus in the study area as very important for diagnosis and treatment of the FMCD. Hence, the domain experts who were the veterinary doctors, the development agents and model rural farmers asked to identify the type of virus found in the study area. Table 2 shows the identified virus type in the study area.

Table 2: Identified serotypes virus

Virus	Respondents	%
A	2	25
C	1	12.5
SAT- 1, SAT- 2, SAT -3	3	37.5
No response	2	25.0
Total	8	100.0%

Key
SAT = South African Territories

Of the 8 domain experts that included: veterinary doctors and the development health clinic agents requested to respond to the questionnaire item, only 6 participants indicated six serotypes viruses found in the area, while two of the domain experts did not respond to the questionnaire item. However, the identified serotypes viruses were 'A'= 2 (25%); 'C'= 1 (12.5%) and 'SAT-1, SAT-2 and SAT-3'= 3 (37.5%); with 'SAT-1, SAT-2 and SAT-3' identified as the most prevalent.

Model rural farmers asked independently to distinguish the most affecting kind of serotype virus in the area. However, 10 (50%) of the respondents indicated virus 'A', while 5 (25%) indicated 'SAT-1, SAT-2 and SAT-3'. The study observed that both domain experts and rural model cattle farmers agreed on the serotype viruses (i.e. 'A' and 'SAT-1, SAT-2 and SAT-3') found in the study area.

The implication of the identified serotypes virus ascertain that domain experts (i.e. veterinary doctors, the development agents and model rural farmers) have the knowledge of the FMCD virus in the domain areas to include viruses 'A', 'C' and 'SAT-1, SAT-2 and SAT-3'. The findings seem to agree with (Vosloo et al., 2002) on six out of the 7 serotypes (i.e. serotypes: O, A, C, SAT 1, SAT 2 and SAT 3) that are endemic in most countries in sub Saharan Africa but reportedly occurring in East Africa. There are more subtypes of the FMD virus, whose immunity to one type does not protect an animal against other types (USDA's Veterinary Services TARGET Center, 2007).

3.3. Services of Animal Health Clinic

Interview with domain experts (Veterinary doctors, development agents and rural model cattle farmers),followed with observations of the diagnosis and treatment of the FMCD at the clinic sites revealed that attention given to human health is not seen in the case of animals health care that includes diagnosis and treatment of the FMCD. The main problems they mentioned were:

i. *"Lack of resources like laboratory equipment and chemicals, standard diagnosis area, as well as availability of medicine; there was no any laboratory equipment that can help in the diagnosis of FMCD".*
ii. The wereda experts mentioned that *"if many cases are observed, experts from regional or federal laboratories come and take samples to identify the exact disease type and sereotype of the FMCD"*
iii. *"The medicine present at the veterinary clinic levels were antibiotics, but if vaccination is proposed/prescribed, samples have to be taken to the central laboratories because there are different vaccines for different sereotype of FMCD"*
iv. *"Lack of budget"*
v. *"Lack of integration from different stakeholders, government offices and Non-Governmental Organizations (NGOs)".*
vi. *Lack of enough attention for cattle healthcare like human health care*

As observed at veterinary clinics at wereda levels, there was no standard protection of separate places for diagnosis of FMCD made available within the compound of the clinics. All diagnosis procedures for all types of

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animals and disease types conducted at the same place in the field. The places identified/bounded by sticks standing at the corners of the diagnosis and treatment areas. Researchers had expected that the diagnosis and treatment of the FMCD was going to be in a separate place from goats, sheep, goats and dogs but were all diagnosed and treated in the same place. The observations revealed:

a. *Lack of animal health professionals (in particular veterinary medicine doctors or diploma holders) in animal healthcare at wereda offices and veterinary clinic levels*
b. *Most of the animal healthcare professionals found in the veterinary clinics at the weredas was diploma holders in animal science or related fields, not in particular animal health profession as indicated in the case of cattle diseases.*
c. *From the observation and interview at the Shebe-wereda livestock and fishery office expert (i.e. animal science diploma holder), although there exist one veterinary doctor in the veterinary clinic (the veterinary doctor), had some mental health problem, and so was not properly stable and that also, affected his duties. In fact there was a skill manpower professional gap from the veterinary doctor at the wereda to identify the disease type and give proper treatment.*
d. *There was lack of documentation of cases. There were no private history cards to register the health history in terms of the diagnosis and treatment of animal/cattle health at wereda veterinary clinics; this has its own effect on the researchers' collecting private animal healthcare cases that helped in the diagnosis and treatment of cattle disease.*
e. *The registration of the animals in the clinic were not separated by animal classification (like; cattle, sheep, hens and so on) and by disease type. So, it needed time to identify and to collect the data as required for this particular research.*
f. *The documentation was also done in a manual system and no computerized system was used (no computers were found at the weredas/district (kebele) level of the veterinary clinics*
g. *The cattle farmers or breeders were not coming to the clinic frequently for further diagnosis and treatment of FMCD due to what they claim as "similar signs and symptoms seen on the cattle with some other less affecting diseases types". This then made the farmers try to give traditional medicine by themselves without properly identifying the exact disease type. The reasons adduced during researchers' observations and interviews of cattle farmers' reactions and activities revealed that:*
    a. *The farmers didn't want to lose their cattle from their daily planned work activities. It may be for ploughing, cultivating, harvesting with oxen, or milking the cows.*
    b. *They were not separating the FMCD patient from others because they did not believe the disease was transmitted by contact*
    c. *They tried to give traditional treatment without identifying the exact disease/serotypes. However, their diagnosis may not provide enough information to identify the disease types. Hence, it may be misleading in giving proper treatment.*
    d. *They did not want to take a longer time seeking diagnosis and treatment from the clinic due to:*
        i. *not expecting enough diagnosis and medicine*
        ii. *unwilling to pay higher money (even though the vaccine was not available in a regular basis, if they needed they will be charged higher money to get the vaccine in their vicinity; the vaccine is expensive because it needs foreign currency)*
        iii. *some of the farmers (Shebe-Sombo wereda) also give the remoteness of the clinic from their residence area as a problem to bring their cattle to the veterinary clinic*

3.4. Causes and Transmission of FMCD

For the diagnosis and treatment of FMCD, researchers were interested in knowing first the causes and mode of transmission of the disease. Figure 1 below shows the percentage responses of domain experts 33.02% and the model farmers 66.98% on causes and transmission of the FMCD.

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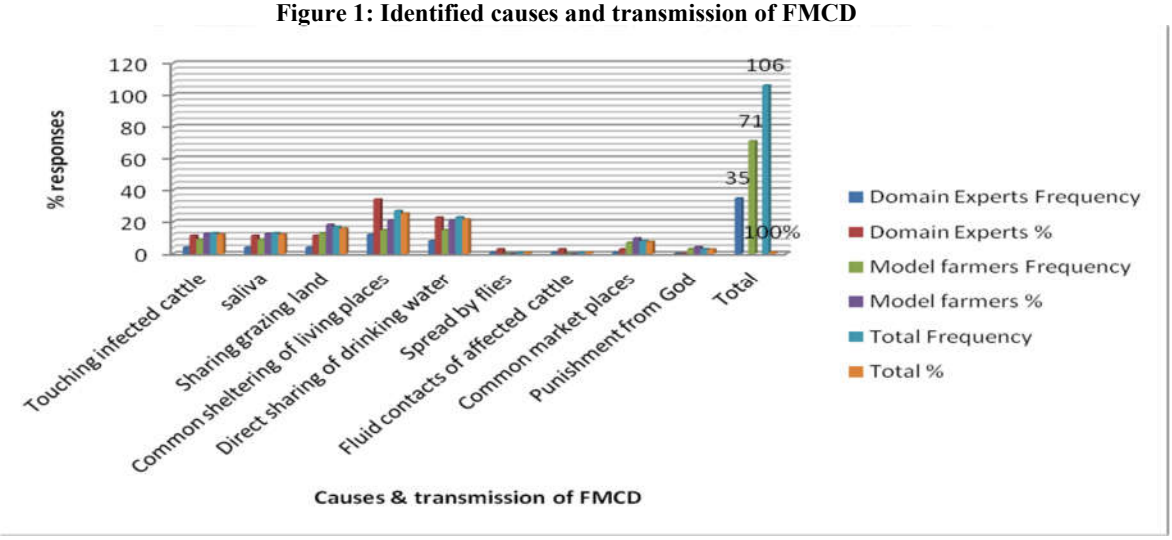
Figure 1: Identified causes and transmission of FMCD



However, the Figure 1 seems to show that the prevalent cause and transmission was through sharing drinking water as well as sharing grazing land and common sheltering of living places. The least transmission agents were contact with fluid from blisters of infected cattle and flies. It is interesting to note that belief system identified by rural model cattle farmers as *"punishment from God"*. Such belief system serves as a source of pacification for the affected cattle owners; for he/she cannot have a say on what God was capable of doing.

Although Derah et al (2005) indicated that infected animals shed the virus into their feces, urine, saliva, and can spread the virus by coughing but this mode of transmission are not at variant with those found in this study. However, Mikkelsen et. al. (2003) pointed out that the mechanisms for transmitting FMCD is through direct and indirect routes, which makes it one of the most formidable cross border diseases. In addition, that the virus is responsible for the occurrence of the numerous serotypes/topotypes and certain wild species, such as the African buffalo, are a reservoir for many of them, for example the SAT (South African Territories) strains. In addition, droplets and droplet nuclei exhaled in the breath of infected animals are other sources. Such spread can be rapid and extensive, and it is known in certain circumstances to have transmitted disease over a distance of several hundred kilometres.

USDA's Veterinary Services TARGET Center (2007) opined that FMCD viruses can be spread by animals, people, or materials that bring the virus into physical contact with susceptible animals. An outbreak can occur when:

i. *Animals carrying the virus introduced into susceptible herds.*
ii. *Contaminated facilities are used to hold susceptible animals.*
iii. *Contaminated vehicles are used to move susceptible animals.*
iv. *Raw or improperly cooked garbage containing infected meat or animal products is fed to susceptible animals.*
v. *People wearing contaminated clothes or footwear, or using contaminated equipment, pass the virus to susceptible animals.*
vi. *Susceptible animals are exposed to materials such as hay, feedstuffs, hides, or biologics contaminated with the virus.*
vii. *Susceptible animals drink common source contaminated water.*
viii. *A susceptible animal is inseminated by semen from an infected animal.*

3.5. FMCD diagnosis

FMCD diagnosis and treatment constitute the quest to answer the first research question on "What knowledge and cases are used by domain experts (i.e. veterinary doctors, development agents and model cattle farmers) for the diagnosis and treatment of FMCD at Seka Chokorsa and Shebe Sombo Weredas found in Jimma Zone of Ethiopia?" The researchers collected data on the diagnosis of FMCD from both domain experts and model cattle farmers on diagnosed and treated cases. The diagnosis and treatment of the cases based on the signs and symptoms identified from the affected FMCD cases. Table 3 showed the identified signs and symptoms from the affected FMCD during diagnosis and treatment.

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Table 3: Signs and Symptoms of FMCD diagnosis according to domain experts and model cattle farmers

Signs and Symptoms	Domain Experts		Model farmers		Total	
	Frequency	%	Frequency	%	Frequency	%
1. High fever	6	4.41	4	2.94	10	7.35
2. Loss of appetite	8	5.88	14	10.29	22	16.18
3. Salivation	7	5.15	18	13.24	25	18.38
4. Vesicular eruption on the feet	8	5.88	3	2.21	11	8.09
5. Vesicular eruption on the mouth	9	6.62	7	5.15	16	11.76
6. Loss of milk	2	1.47	3	2.21	5	3.68
7. Wounds in and around the mouth	1	0.74	14	10.29	15	11.03
8. Wounds at the feet/hoofs	1	0.74	3	2.21	4	2.94
9. Blisters on the tongue and lips	1	0.74	-	-	1	0.74
10. Blisters in and around the female glands	1	0.74	-	-	1	0.74
11. Loss of weight	1	0.74	10	7.35	11	8.09
12. Drought	1	0.74	-	-	1	0.74
13. Abortion	1	0.74	1	0.74	2	1.47
14.Kicking the ground with infected legs	-	-	4	2.94	4	2.94
15. Depression	-	-	8	5.88	8	5.88
Total	47	34.56	89	65.44	136	100%

Table 3 above, identified 15 signs and symptoms for FMCD. The diagnosis include high fever, loss of appetite, salivation, vesicular eruption on the feet, vesicular eruption on the mouth, loss of milk, wounds in and around the mouth, wounds at the feet/hoofs, blisters on the tongue and lips, blisters in and around the female glands, loss of weight, drought, abortion, kicking the ground with infected legs and depression. Of the 15 signs and symptoms identified, domain experts did not identify two, which were kicking the ground with infected legs and depression. On the other hand, the model cattle farmers did not also identify three of the signs and symptoms that included blisters on the tongue and lips, blisters in and around the female glands and drought from the affected cattle. The implication for the identified signs and symptoms of the FMCD diagnosis implies the well-known FMCD existence in the study area, which in turn calls for the treatment of the FMCD.

3.6. Challenges identified during the FMCD diagnosis

The domain experts expected to state the challenges they face during the FMCD diagnosis. Figure 2 below highlights the challenges the domain experts face in the diagnosis.

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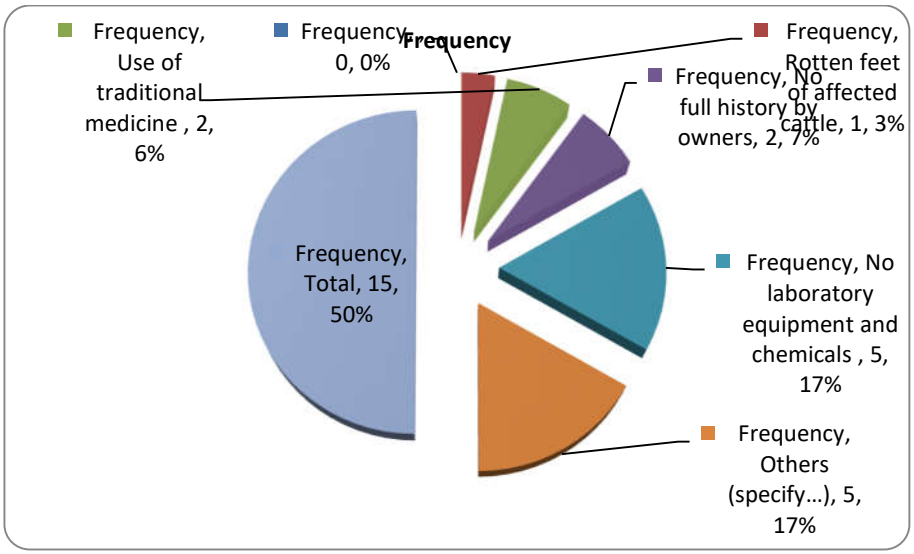

Figure 2: Challenges faced by domain experts in the diagnosis of FMCD.

Challenges faced by domain experts in the diagnosis of FMCD were: rotten feet, use of traditional medicine, no full history by owners, no laboratory equipment and chemicals; specified to include: lack of vaccination in the locality and where available; then was very expensive. No proper attention given to the treatment of the affected cattle, difficulty in identifying the particular serotype virus, FMCD may be confused with other vesicular diseases and breeders (i.e. rural model cattle farmers) not taking the affected cattle for early diagnosis and treatment.

USDA's Veterinary Services TARGET Center (2007) characterized/described the disease with signs and symptoms that show in the affected cattle. There the signs of: vesicles (blisters) followed by erosions in the mouth or on the feet and the resulting excessive salivation or lameness are the best known signs of the disease. Often blisters may not be observed because they easily rupture, leading to erosions. These signs may appear in affected animals during an FMCD outbreak:

i. *Marked rise in body temperature for 2 to 3 days.*
ii. *Vesicles that rupture and discharge clear or cloudy fluid, leaving raw, eroded areas surrounded by ragged fragments of loose tissue*
iii. *Production of sticky, foamy, stringy saliva*
iv. *Reduced consumption of feed due to painful tongue and mouth lesions*
v. *Lameness with reluctance to move*
vi. *Abortions*
vii. *Low milk production (dairy cows)*
viii. *Myocarditis (inflammation of the muscular walls of the heart) and death, especially in newborn animals*
ix. *Animals do not normally regain lost weight for many months. Recovered cows seldom produce milk at their former rates, and conception rates may be low.*
x. *Fever and blister like lesions followed by erosions on the tongue and lips, in the mouth, on the teats, and between the hooves. Most affected animals recover, but the disease leaves them debilitated. It causes severe losses in the production of meat and milk.*
xi. *Since it spreads widely and rapidly and because it has grave economic as well as clinical consequences, FMD is one of the animal diseases that livestock owners dread most.*
xii. *Signs of illness can appear after an incubation period of 1 to 8 days, but often develop within 3 days. The virus survives in lymph nodes and bone marrow at neutral pH, but is destroyed in muscle when pH is less than 6.0, i.e., after rigor mortis. The virus can persist in contaminated fodder and the environment for up to 1 month, depending on the temperature and pH conditions.*

However, there is confusion with other diseases types because FMCD can be confused with several similar but less harmful diseases, such as vesicular stomatitis, bluetongue, bovine viral diarrhoea, foot rot in cattle, and vesicular disease. Whenever mouth or feet blisters or other typical signs observed and reported, laboratory tests completed to determine whether the disease causing them is FMCD or not (USDA's Veterinary Services TARGET Center (2007).

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3.7. Clinical treatment of affected FMCD

On the treatment of the affected FMCD, the domain experts usually decide on the type of treatments based on the discretion of the domain experts as indicated in Figure 3 below.

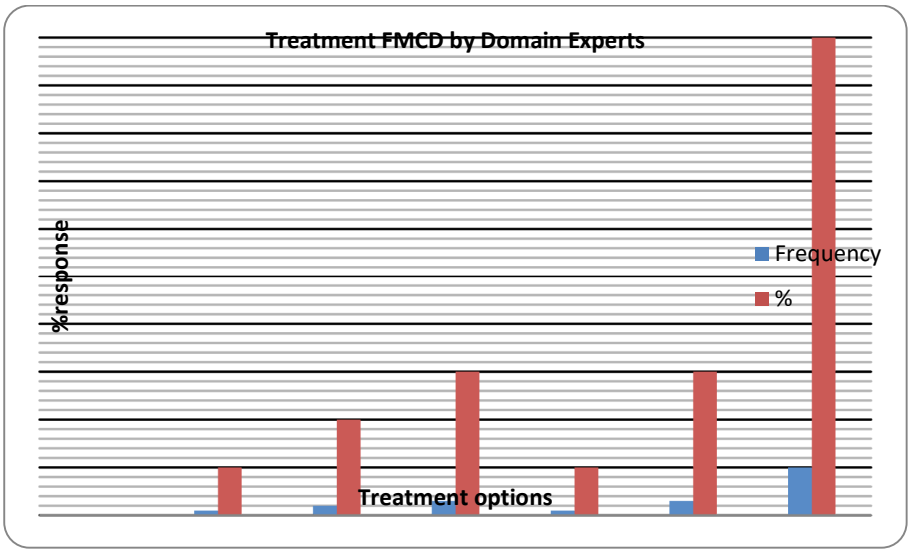

Figure 3: Clinical treatment of affected FMCD

Figure 3 above shows the treatment options of domain experts at the study areas to include vaccines (where available) to the cattle owners for home injection. In addition, cattle owners using approved traditional medicine.

USDA's Veterinary Services TARGET Center (2007) indicated "vaccines for FMD are available, but must be matched to the specific type and subtype of virus causing the outbreak. Vaccination can help contain the disease if it is used strategically to create barriers between FMD-infected zones and disease-free areas". Hence, the need by the domain experts in the study to have samples tested before treatment of the affected FMCD in the area.

But when the model farmers were asked on whether they acquire treatment from the animal health clinics of the Wereda and Kebele, their responses 19 (100%) was 'yes' which implies that the availability of the health clinics near their homes are not only functional but also of great assistance to the cattle farmers. Nevertheless, what treatment did they acquire, when the clinics had no vaccines? However, a further interview and observation at the clinics in the study areas revealed a dire need of vaccines, which were none available in the clinics. Hence, the model farmers asked if there were any traditional medicine for the cure of FMCD. The answer was also 'yes' 19 (100%) responses. However, the model farmers faced the challenges of FMCD treatment, which was due to lack of vaccine in the study area clinic, which resulted to the use of traditional medicine.

From the interview rendered to the domain experts and model cattle farmers on the procedures used for the diagnosis and treatment of the FMCD; in their response, they indicated using personal experiences (indigenous knowledge) known to exist in the signs and symptoms found from the cattle. In addition, the domain experts used chemical laboratory test and procedures, which they also indicated the unavailability of laboratory and chemicals for laboratory diagnosis in the study area, but samples were usually taken to a specific animal health clinic laboratory in Jimma town. This situation warrants an intervention; such as the knowledge based system development, which will in turn encourage the creation of a laboratory by the constituted authority (i.e. Government).

3.8. Effectiveness of the available traditional medicine for FMCD

The model farmers asked in their questionnaire to indicate their opinion on the effectiveness of the available traditional medicine as findings showed in Figure 4 below.

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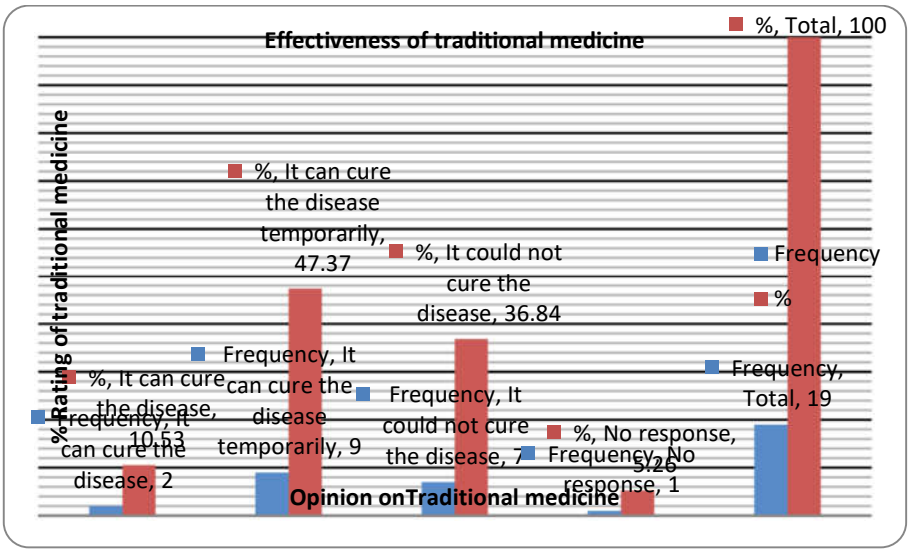

Figure 4: Effectiveness of traditional medicine

Figure 4 above shows the frequency and percentages of respondents on the effectiveness of traditional medicine on the treatment of FMCD. The rating showed that "the traditional medicine can cure the disease temporarily 47.37%", followed by "it could not cure the disease 36.84%" and a definite response of "it can cure the disease 10.53". However, 6.26 respondent could not respond to the questionnaire item.

3.9. Challenges Identified during FMCD Treatment

Domain experts asked to indicate their challenges identified during FMCD treatment. Figure 5 shows their response.

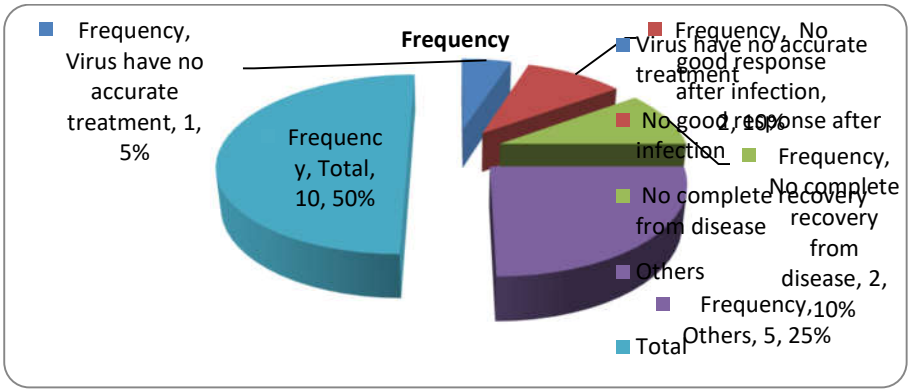

Figure 5: Challenges of FMCD Treatment

Challenges identified in figure 5 included viruses having no accurate treatment 5%; No good response after infection 10%; no complete recovery from disease 10%. Other challenges said to be painstreopedoxy/antibiotic, wound Rx procedure, use of professionals for checkups, lack of awareness of the disease, strong vaccine for different sereotype and error treatment during administering the drugs.

3.10. Interval occurrence of FMCD in the study area

Model rural cattle farmers asked to specify the occurrence of the FMCD in the study area. All 100% of the respondents indicated the interval as yearly, which means the cattle live with the occurrence of the FMCD in a yearly basis is dangerous. It also revealed that developing a knowledge base system will go a long way to coping not only the interval occurrence of the FMCD but the endemic nature of the disease for the cattle in the area.

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3.11. Prevention of FMCD

The model rural cattle farmers were requested to provide solutions towards preventing the FMCDs. Their suggestions were for better attention of FMCD by human health personnel employed by Government. They went further to seeing the FMCD as having no cure. Although, according to Vosloo (2000); the prevention and control of FMCD is one of the most difficult animal infections to control. Because the disease occurs in many parts of the world, there is always a chance of its accidental introduction, which animals and animal byproducts from areas spread to areas not previously affected through routine livestock movements unless it was detected early and eradicated immediately. If FMCD were to spread unchecked, the economic impact could reach billions of dollars in the first year. Deer and other susceptible wildlife populations could become infected and potentially serve as a source for re-infection of livestock.

3.12. Strategies Developed to Combat FMCD in the study area

Domain experts and model farmers interviewed on their opinions on the strategies developed to combat FMCD in the study area. Some responses revealed the availability of strategies that include standard guidelines developed by the Ministry of livestock and fisheries development agency, which is being used by domain experts, others responded "I do not know" or "think any strategy exist, which may have been developed by government". But on the prevention procedures for FMCD applied in the area of study; the interviewee responded that prevention of FMCD was priority in the study area. The domain experts continuously create awareness training and teaching rural cattle farmers on hygiene and preventing the spread of the FMCD. They also try to identify the sereotype disease when occurred.

3.13. Effect of FMCD to Community and Ethiopia

The domain experts and rural model cattle farmers were requested to state their opinions on the effect of FMCD to the community and Ethiopia at large. Table 4 below shows their different opinions.

Table 4: Shows different opinions on effect of FMCD to the community and the entire country

Effect of FMCD	Frequency	%
Loss of flesh of the affected cattle	2	4.7
No good response of health of affected cattle after infection	3	7
No complete recovery of the disease	2	4.7
Reduced productivity of hides and skin	2	4.7
Financial loss of cattle owners	4	9.3
Not eating the meat/flesh of infected cattle	5	11.6
Taking a long time to treat affected cattle	9	20.9
High mortality rate of cattle	7	16.3
Others	9	20.9
Total	43	100%

Table 4 above shows varied effects of FMCD to the community in the study area, whose effect extents to the country in general. Such include: loss of flesh of the affected cattle, no good response of health of affected cattle after infection, no complete recovery of the disease, reduced productivity of hides and skin, financial loss of cattle owners, not eating the meat/flesh of infected cattle, taking a long time to treat affected cattle, high mortality rate of cattle and others. The considered higher percentage of effects was taking a long time to treat affected cattle (20.9%) and others (20.9%). A further analysis revealed the "other effects" to include: farm ploughing problem, problem in the milk, reduced productivity, reduced milk, high cost of vaccine, problem in selling the cattle.

Knight-Jones & Rushton (2013) referred to FMCD as a disease of low mortality but the global impact of FMD is colossal due to the huge number of animals affected. The economic impact of the FMD as represented in Figure 6 by Rushton, 2000; separates the impact into two components of:
(1) direct losses due to reduced production and changes in herd structure; and
(2) indirect losses caused by cost of FMCD control, poor access to marketing and limited use of improved production technologies.

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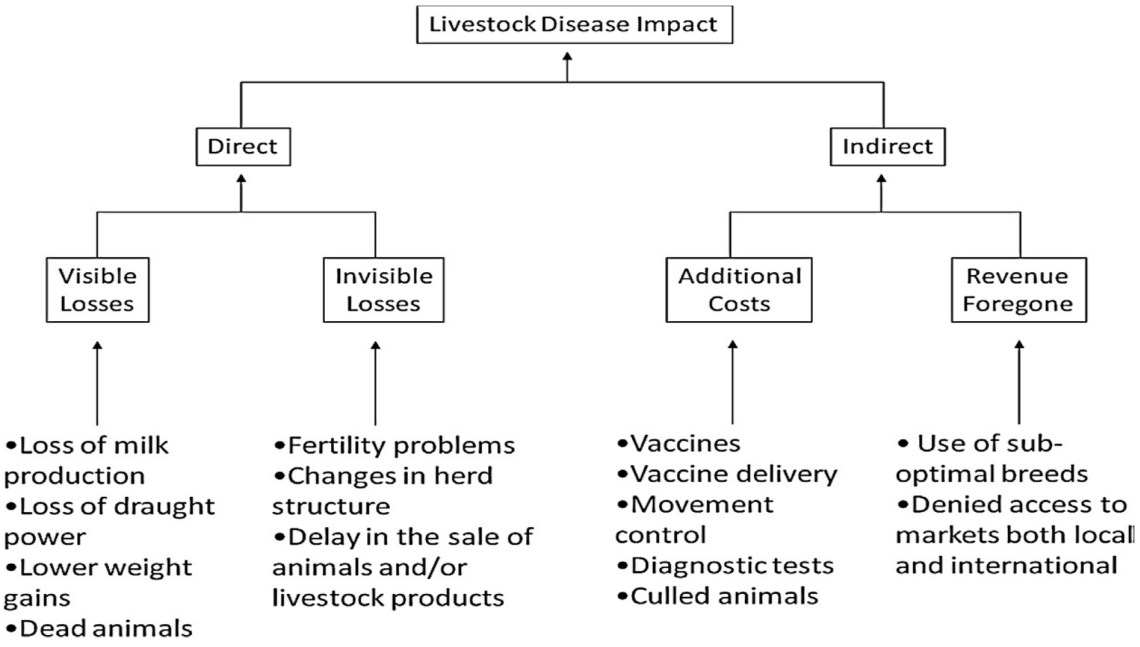

Figure 6: Source: The impacts of foot-mouth-disease Rushton (2009)

Knight-Jones & Rushton (2013) indicated the FMD impacts as not the same throughout the world; they categorized them into four as:

1. FMD production losses have a big impact on the world's poorest; where more people are directly dependent on livestock. FMD reduces herd fertility leading to less efficient herd structures and discourages the use of FMD susceptible, high productivity breeds. Overall the direct losses limit livestock productivity affecting food security.

2. In countries with ongoing control programmes, FMD control and management creates large costs. These control programmes are often difficult to discontinue due to risks of new FMD incursion.

3. The presence, or even threat, of FMD prevents access to lucrative international markets.

4. In FMD free countries outbreaks occur periodically and the costs involved in regaining free status have been enormous.

They estimated the visible production losses and vaccination in endemic regions alone amounted between 6.5 and 21 billion. While the outbreak in FMD free countries and zones cause losses of less US and 1.5 billion a year. Direct visible losses incur on losses to milk production, loss of drought power, lower weight, gains and dead animals. Nevertheless, indirect visible losses occur on fertility problems, changes in herd structure, delay in the sale of animals and/or livestock products. While the indirect losses in form of additional cost of vaccines, vaccine delivery, and movement control, diagnostic tests and cullied animals do evolve. However, the revenue foregone adds up to the use of sub-optimal breeds, denied access to markets both local and international; also makes up for the indirect losses.

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