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Research Article

Mass Vaccination and Surveillance Reduced the Burden of Foot and Mouth Disease

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Abstract
The objective of this study was to investigate the status of Food and Mouth Disease (FMD) in cattle, buffalo, sheep and goats and to determine the effect of mass vaccination on morbidity and mortality due to FMD in two districts i.e Karak and Haripur of Khyber Pakhtunkhwa Province, Pakistan. A routine surveillance of FMD was conducted for the period of three years (June 2008- May 2011). In last two years (2009-2011), the surveillance was accompanied by mass vaccination. Data collected showed that morbidity rate due to FMD in cattle, buffalo, sheep and goat was 27.04%, 30.97%, 8.88% and 7.98%, respectively. This rate was reduced to 2.90%, 2.68%, 1.58%and 1.14%, respectively due to mass vaccination. The mortality rate before mass vaccination in cattle, buffalo, sheep and goat due to FMD was 0.98%, 2.36%, 0.78% and 0.80% that reduced to 0.06%, 0.09%, 0.00% and 0.02% respectively due to mass vaccination.The study concluded that mass vaccination strategy accompanied by surveillance can be adopted to reduce the burden of FMD.
Key Words: FMD, Vaccine, Surveillance, Cattle, Sheep, Goat

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Introduction

Foot-and-mouth disease (FMD) is a well-known contagious disease of cloven footed animals. It occurs in almost all parts of world and carries a major threat to world livestock industry [1]. In addition to production losses and mortalities, there are business menaces as well [2]. It is characterized by high fever, profused salivation, and vesicular eruptive lesions inside oral cavity and on the feet. The causative agent is a naked RNA virus known as *Aphthovirus*. It can strike all the age groups of animals in a herd. Although there are seven viral distinct types (A, O, C, Sat-1, Sat-2, Sat-3 and Asia-1) but types which are involved in outbreaks are O, A and Asia-1 [3]. Animals of wild origin may act as carrier or reservoir e.g. dogs, cats, deer, wild boars and even humans, birds and flies [4].

Some countries have managed to gain free status on the basis of strong surveillance system, geographical isolation, vaccination policies and control strategies [1, 5, 6]. According to OIE, South Asia including Pakistan, Iran, China, Afghanistan and India is considered as FMD endemic region with the O, A and Asia 1 serotypes [3, 7, 8]. Previous investigations applying participatory disease surveillance (PDS) also estimated FMD prevalence but these were considered as relatively high [3, 9]. Vaccination against FMD is generally not implemented. Animals are only vaccinated upon request or when it comes to free vaccination [10]. These local villagers lack the concept of vaccination, its long term benefits, fear of abortion in animals etc. The number of vaccine doses used varies between 12,000 to 95,000 doses for cattle and 7,000 to 60,000 for buffaloes annually from 1997-2002 [11]. This study was conducted to study the disease status of two districts to establish a surveillance system and policy of vaccination in the villages.

Materials and Methods

Study population

One tehsil (administrative division) each from district Karak and district Haripur was randomly included. From these tehsils, a total of 47 villages were included according to a set inclusion criteria. Inclusion criteria for the selection of villages were high poverty, no history of vaccination campaign in last 5 years but the history of FMD outbreak was there. The livestock population of Karak district according to 2006 census was 539421 animals; while, Haripur district had 130215 animals. Data from all the farmers of each village (17 villages from district Karak and 30 villages from district Haripur) were recorded on questionnaires through interview. Each year all the cattle, buffalo, sheep and goat populations were surveyed and diseased animals were included after fulfilling eligibility criteria.

Surveillance

The objective of the surveillance system was to diagnose the potential cases of FMD. Before starting and many times during the surveillance program, Livestock Extension Workers (LEWs) were directed to inform people and motivate them to visit the local

clinics. In addition, private practitioners were also contacted to inform the LEWs about the FMD infected animals. Different livestock auction markets and Religious Festival markets were also visited in the 5 km diameter of selected village. All the farmers were enquired about the total number of animals along with their age, sex and species. Further, people were asked about the economic losses and local prices of livestock of different age groups and different sex.

Case eligibility criteria

The animals with following symptoms were considered as samples and further verified by local practitioner during the whole period. The symptoms were depression, mucosa diffusely red, anorexia, encrusted hyperemic muzzle, erosions, laminitis, temperature 101 - $107F^0$, drooling of saliva, mastitis, polypnea, and abortion. Laminitis, erosions, drooling saliva and fever were the most common symptoms presented by the cases. A multi-component questionnaire was prepared that included questions about demographic characteristics and symptoms consistent with FMD. Single questionnaire was meant for one house-hold only.

Mass Vaccination

After one year of surveillance (2008-2009), mass vaccination control strategy against FMD was introduced that continued for next two years (2009-2011). In these two consecutive years, surveillance activity was also conducted along with FMD vaccination intervention. The objective of this intervention was to compare the frequency of FMD before and after FMD vaccination. A trivalent vaccine (O, A, Asia-1) with formalin inactivation and Aluminium Hydroxide precipitates (Veterinary Research Institute, Lahore) was used at recommended doses twice a year (Feb-Mar, Sep-Oct). Along with FMD vaccination local people were also educated about the disease and intended to improve their husbandry practices.

Statistical Analysis

Basic descriptive statistical rates were determined from the information obtained and compared to detect the change in disease burden and mortality.

Results

A total of 2162 owners were registered during the study (2008-2011) and a total of 6541 questionnaires were collected (2162 per year). Data were organized and analysed to determine the rates and frequency of the disease. Response rate of vaccination campaign was high (97%) as most of the people were convinced by involving local persons and practitioners. In first year (2008-2009), surveillance conducted prior to mass vaccination campaign, showed morbidity rate in cattle, buffalo, sheep and goat due to FMD as 27.04%, 30.97%, 8.88% and 7.98% respectively. The mortality rate due to FMD calculated in cattle, buffalo, sheep and goat was 0.98%, 2.36%, 0.78% and 0.80% respectively. FMD case fatality rate was 4%, 8%, 09% and 10% in cattle, buffalo, sheep and goat respectively (Table 1).

Table 1: Disease burden of FMD before mass vaccination (June 2008 to May 2009)

Animal Type	Animals	Morbidity	Mortality	Case
Cattle	3573	27.04%	0.98%	4%
Buffalo	1059	30.97%	2.36%	8%
Sheep	642	8.88%	0.78%	9%
Goat	5389	7.98%	0.80%	10%

Table 2: Reduced disease burden after first year of vaccination (June 2009 to May 2010)

Animal Type	Animals Surveyed	Morbidity Rate	Mortality Rate	Fertility rate
Cattle	3269	5.38%	0.15%	3%
Buffalo	1185	4.14%	0.17%	4%
Sheep	655	2.90%	0.15%	5%
Goat	5433	1.79%	0.04%	2%

Table 3: Reduced disease burden after second year of vaccination (June 2010 to May 2011)

Animal Type	Animals Surveyed	Morbidity Rate	Mortality Rate	Fertility rate
Cattle	3350	2.90%	0.06%	2%
Buffalo	1083	2.68%	0.09%	3%
Sheep	695	1.58%	0.00%	0%
Goat	5879	1.14%	0.02%	1%

Trend of Morbidity and mortality due to FMD is shown in Fig. 1 & 2. Morbidity due to FMD was estimated as highest in cattle whereas lowest in sheep. The calculated mortality revealed to be uncommon among diseased animals. In terms of both morbidity and mortality, young animals were more affected as compared to adult animals among all species. Lack of proper knowledge about vaccination and FMD were found to be associated with high disease burden. In second year (2009-2010) during

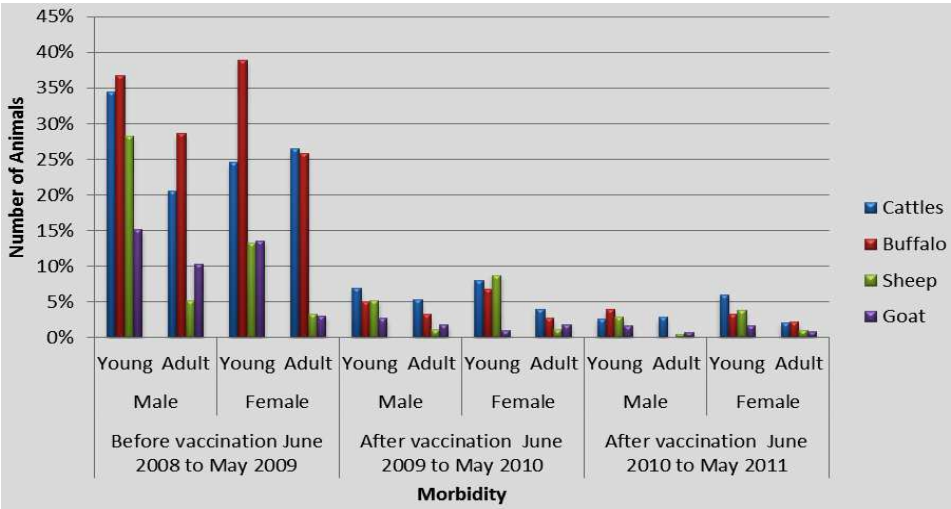

Fig. 1: Morbidity rates of FMD before and after vaccination.

first FMD vaccination campaign, morbidity rate in cattle, buffalo, sheep and goat reduced to 5.38%, 4.14%, 2.90% and 1.79% respectively. The mortality rate due to FMD in cattle, buffalo, sheep and goat also reduced to 0.15%, 0.17%, 0.15% and 0.04% respectively and observed case fatality rates were 3%, 4%, 05% and 02% in cattle, buffalo, sheep and goat respectively (Table 2).

In last year (2010-2011) with continued FMD vaccination campaign, morbidity rate due to FMD vaccination in cattle, buffalo, sheep and goat further reduced to 2.90%, 2.68%, 1.58%and 1.14%, respectively. The mortality rate noted in cattle, buffalo, sheep and goat was 0.06%, 0.09%, 0.00% and 0.02%, respectively. Case fatality rates were 02%, 03%, 0% and 1% in cattle, buffalo, sheep and goat respectively (Table 3).

Discussion

This study emphasizes on the dire need of a comprehensive surveillance system against the Foot and mouth disease (FMD) in poor rural setup of KPK province. FMD is considered as endemic in Pakistan [11] and should be controlled through vaccination and constraining the different risk factors [12]. Vaccination practices in far distant and rural areas are usually uncommon or practiced occasionally that is insufficient [5, 7, 8, 12]. Vaccines used should contain the locally prevalent strains of FMD virus. Most of the cheap and locally produced vaccines do not produce a yearlong titre and require two shots in a year. This incomplete vaccination schedule can lead to further increase in carrier animals and sub-clinical infections. Moreover, Sheep and goat are usually not vaccinated and they often become infected asymptomatically during the outbreak of FMD in large ruminants [14]. Hence, majority of these infected animals could be involved in the repeated FMD outbreaks as in 2001 in UK [14].

In first year of the study, actual disease frequency prevailing in the area was observed. Most of the affected animals were the young as compared to adult animals that is in agreement with the previous studies [1, 6, 9, 15]. The calculated burden is lesser than previous results of participatory disease surveillance that is 37.35% – 19.35% (3). While, in cattle and buffalo, the morbidity and mortality are in full accordance with the previous studies [7]. Morbidity rate in buffaloes was higher than cattle that are in accordance with Khan et al. [9]. In contrast to previous research conducted in Pakistan which limited their studies to the large animals, current study also signifies the trends in sheep and goat that are in full accordance with previous sheep and goat related studies [4, 16, 17].

In second year of the study, mass vaccination was introduced and its impact was noted in the form of reduction in disease frequency. After vaccination, morbidity of cattle was slightly high as compared to buffalo. The possible reason for this variation could be the population difference among both species (Ref: OIE). As per recommendations of Office International des Epizooties (OIE), this study also extended FMD vaccination to sheep and goats. Sheep and goats are always considered as less important as they seldom show clinical signs but they are most

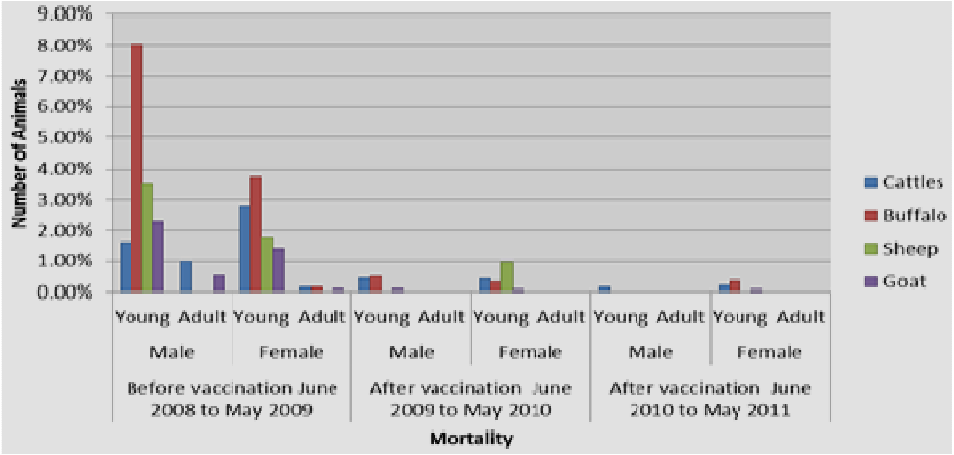

Fig. 2. Mortality rates before and after vaccination

important in disease spread by becoming carrier [2, 16]. Thus detection of their status is important in planning the future policies regarding FMD [18, 19]. Vaccination of these animals could be the possible reason of disease reduction in both large and small ruminants.

In third year (2010-2011), after vaccination and education regarding husbandry practices related to FMD, reduction in number of diseased and died animals was observed. Most people, when polished, were willing to vaccinate their animals that helped in setting the trend of vaccination. The implementation of husbandry practices also began its role in reducing the disease frequency. Mixed farming system in Pakistan scenario may be the possible reason that exposes large animals to FMD virus as sheep and goat are affected with mild to sub-clinical disease [11, 12].

This study also stresses upon the importance of vaccination and management system that help in reducing the disease spread in both large and small ruminants. All the risk factors i.e. health service providers, mixed farming systems, lack of quarantine measures, contact with infected animals and contaminated fodder sources can be limited and be avoided by implementing good husbandry practices [12]. Most of the population in the studied villages lacked the husbandry practices and knowledge about transmission of disease [9, 10]. Management practices like separate area/shed for different species and washing of utensils etc. are most important in limiting the contact with infected animals. Bio-security can also minimum the risk of introduction of viral agent [16, 17].

The gatherings and festivals including animals, especially Eid-ul-Azha, were considered as the difficult occasions regarding minimizing the contact between infected and healthy animals. In this festival, animals from different parts of country are brought to livestock markets and hence, due to least bio-security measures, animals come in contact with other animals that are either carrier or clinically infected. In current study, most of the cases had a history of exposure to livestock market or contact with the animals that has been purchased from such markets. Such un-controlled transportation and quarantine needing animals are the major source of infection for other animals residing near to them. In this way re-introduction of such exposed animals could spread the acquired disease [9]. Vaccination in such animals is major contribution to limit this risk factor.

Vaccination in districts of KPK province that borders the Punjab (major livestock population having province) and can built a buffer zone to prevent the disease spread. Previous studies also reveal that the serotypes involving in the outbreak are mostly from Iranian origin [7, 10]. Such buffer zone can be helpful in spreading the disease to other provinces; reducing the economic losses in long terms. Regular surveillance activities along with PCR detection can detect the trends up to serotype level. This molecular approach would be helpful in designing of vaccines according to actual needs.

Conclusions

The study concluded that continued surveillance of FMD followed by an interventional control strategy i.e. vaccination can reduce the disease burden in any area. The vaccination of sheep and goats should be an

important component of FMD control strategy. The finding of current study can be utilized as baseline information to develop a well-designed surveillance system for FMD and other important diseases of livestock in KPK Province, Pakistan, by the policy maker and livestock department. This will eventually improve the economical sustainability of poor small holder dairy farmers. In addition, awareness of farmers and LEWs should also be prioritized and effective educational campaigns are needed.

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