



The Proposed Strategic Plan to Limit The Spread of Foot-and-Mouth Disease

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Introduction

Hieronymus Fracastorius, an Italian monk, wrote the first account of possible diseases such as FMD in cattle in Venetian in 1514. The creatures in question declined food, displayed reddening of the salivary glands, and developed vesicles in both their mouths and on their feet. After a while, the majority among the afflicted creatures healed. This account, which was written more than 500 years ago, has a striking similarity to the contemporary understanding of FMD. Diseases such as FMD which affects around 70 wildlife species, including African buffaloes for meat constitutes one among those most significant illnesses affecting creatures with cloven hooves. That also affects cattle, buffaloes, pigs, sheep, among goats. The illness is being documented at nearly every region on Earth where animals were raised. Globally, infectious disease persists in more than one hundred nations, and its geographical spreading mostly mirrors the growth of economies. The condition is no longer present in the most industrialized nations. Nonetheless, amplification of an illness across nations that are typically unaffected by it might have severe Financial setbacks. This infection known as foot-and-mouth viral (FMDV, which is), an a single-strand infectious RNA (RNA) virus which is a member Aphthovirus genus that belongs to the Picornaviridae family members, is the root cause of the illness. The characteristics of the infectious agent as well as the techniques used for identifying and classifying infectious diseases epidemics are both described in this paper. The present spread of the illness/virus is next addressed using this data, along with the manner in which overall FAO/EuFMD/OIE Progressive Control Pathway can help limit the spread of the illness within nations where it is prevalent or lower chance of breaches towards infection-free areas. While Russia is the primary emphasis here, other regions are also taken into account where appropriate [1].

1. Structure of FMDV

With a radius of around twenty-five to thirty nm, the FMDV, which is particle has a broadly cylindrical form. It is made up of a capsule, or protein shell, enclosing the entire genome of RNA. There are sixty duplicates of each capsomer within the genome. Four architectural peptides that Vice President1, Vice President2, Vice President3, or Vice President4, make up each capsomer. The organism's exterior displays Vice President1, Vice President2, as Vice

President³, but its inside contains Vice President⁴. A single-strand positively charged RNA sequence of roughly 8400 nucleotides (nt) in length is encased in an amino acid sheath. Three distinct sections make up the RNA, namely, a lengthy coded sequence, the 3' untranslated region (3' UTR), and the untranslated region of the end (5'). The 3B section of the virus's genome area encodes a tiny protein, called VPg, that is 24 or 25 nucleotides in length and attaches covalently with the 5'-end of the genome. Its 5' untranslated region (is approximately 1300 nt long [2] and is made up of the intrinsic ribosomal entering region (IRES), a poly C path, a sequence of RNA pseudoknot frameworks, a cis-acting reproduction component, often referred to as the 3B-uridylylation site (bus). It is anticipated that the 360 nt-long S component will be folded into a sizable corkscrew configuration. More than 90 percent from the oligo C tract's lengths (150–250 nt) is made up of C proteins. It is uncertain what the pseudoknots are used for. The recurrent pattern (AAACA) in the strong stem-loop elements cre/bus functions as a starting point for the viral RNA polymerase to uridylylate VPg (3B1-3). This component has a length of approximately 55 nucleotides. Therefore, the start of the replication process for RNA involves the cre/bus. The cap-independent start of virus protein production is carried out through the approximately 450 nt-long IRES [2]. The 5' is followed by the code sequence. The sequence is roughly 7000 nt long and makes up the majority in the genome of a virus. This produces a big polyprotein that the virus's proteases break to produce four separate proteins with structures, eleven different informal amino acids, and a number of predecessors, some of with unique roles. Following translating, Lpro, P1-2A, P2, & P3 members are the first four primary metabolites to develop. The polyprotein's the N. Terminus part is the Leader protease (Lpro). The pair of distinct AUG start codons (often spaced nucleotides apart) found within the L decoding region produce the two distinct L isoforms known as Lab and Lb. Because the FMDV can work alongside the remaining C-terminal segment of eIF4G, the FMDV RNA is able to easily employ the host cell's protein manufacturing equipment for its individual peptide creation [2].

2. Clinical signs and lesions

The condition pyre, salivary dribbling, and the formation of compartments within and around the oral cavity, tongues, gums, feet, mammary gland, or the teats in adulthood are the hallmarks of diseases such as FMD [3, 4]. Up to a week or more prior to the development of vascular infections, viral infection could be present [5]. The initial manifestation of wounds is frequently blanched areas that later develop into packed with fluid vesicular. These jelly-like structures are more common in animals' mouths than in those of sheep and goats; this is likely a consequence of the oral epithelium's slenderness causing superficial infections to burst promptly and leave hollow deterioration that typically tend to in just a few days. The formation about capsules to a few days 0 to 2, vesicle breaking about a few days between three and four (with breaks down of epithelial cells first included), significantly marginated deterioration to days two to three, along with the accuracy lost to the third day, serofibrinous discharge to days four through six, and the commencement of reconstruction involving a defined tissue that is fibrous collateral at a minimum of seven days are the standard requirements that may be used to determine the maturity of wounds. Young creatures that succumb of hyper-acute illness may not exhibit any appreciable macroscopical cardiac diseases (or vascular abnormalities). The pulmonary arteries and their corresponding lymphatic systems had been extremely enlarged as well as swelling; the fundic and pyloric areas of the abdomen were swollen and showed brushes hemorrhages; the intestinal membrane was swollen and showed dispersed for inconsistent congestion hemorrhages throughout the serous tissue; the large intestines and mesenteric lymphoid nodes were swollen and bleeding-related; the liver in particular displayed distinct areas of hemorrhages across the membrane, as well as the gallbladder itself became larger alongside bluish-green the bile found in cattle and buffalo[6]. As seen in the necropsied instances,

unexpected mortality in buffaloes and cattle throughout their clinical stages as well as throughout the recuperation interval was attributed to the deterioration of both the myocardial and the circulatory system [7].

3. Transmission

After contracting a serious illness, infected animals excreted the virus in all bodily fluids, including milk, actually stool, urine, the sperm, nasal and lachrymal fluid, or breathed air [8,9]. There are reports of biological virus transmission from contaminated livestock to animals that are susceptible to a variety of routes [10], including individuals, vehicles, and fomites [11,12]. The afflicted creatures typically start discharge the virus within two to four days before indications appear [13,14]. Although grazing animals expel fewer infectious agents by their breath than other animals, they're nonetheless quite at risk for infections of the respiratory system brought about by transmission via air. Sheep can contribute significantly towards the transmission of disease because medical detection is frequently challenging in this species, making it feasible for the virus to go undetected. Numerous more possible points of illness, such as animal feces and wool, contaminated grass or straw, animals operators' shoes and clothes stained with mud or dung, livestock equipment, car tires, or the breeze, could all contribute significantly to facilitating the disease spread [15].

4. Mechanism of pathogenesis

The lateral cheek epithelial cells that line the covering inside the pharynx adjacent to the palate ("soft palate"), plus a portion for the tonsil tissue are believed to have a special role in the initial spread of diseases in cattle¹⁶; these tissues may serve as the location in other host species as well. According to recent research, the FMDV disease of cattle begins through the epithelial related lymphatic tissue's the epithelium after particle vaccination. [11,16,17]. Following the first stage of disease, known as the "pre-viremic" phase, FMDV multiplies extensively in bronchial pneumocytes and greatly reduces the amount of viruses in pharynx tissues [17]. The functions of the nasopharynx and pulmonary being the main sites of FMDV spontaneous disease in cattle are also the subject of multiple studies [18, 19]. The FMDV, which initially interacts with the sensors on the recipient membrane [20]. After beginning reproduction, a viraemic stage lasts for a period of three to five days. From the circulation, the infectious agent enters additional reproduction centers' tissue epithelial cells while in the viraemic stage. the FMDV multiplication at additional places, such as the mouth a cavity, foot skin, and mammary teat, which are made up of categorized, cornfield epidermal epithelia. The internal and externally vaginal epithelial is least impacted by FMDV. Damage around the lips, foot, and laughs that are mostly seen as a blanched region were indicative of the subsequent phase of infection [21,22, 23]. The generation of viral-specific antibodies confirms that the body's defense system is engaged and effective in clearing the infectious agent from circulatory systems or organs. This process can additionally rely on the relationship of the viral-antibody combination with the retinal endothelial system phagocytes cells [24–25].

5. Incubation period

Horizontal contact-related farm-to-farm distribution can take anywhere from two to fourteen days to incubate, based on the viral strain, dose, transmitting pathway, different species, and management techniques [17,26]. In piglets in situations of extreme difficulty, the duration of within-farm dissemination can be as brief as 24 hours, although it usually lasts around two and fourteen days. The standard duration of incubation for dissemination throughout a group of animals or flock is two to six days, though as was previously indicated, there are situations in which it can take as little as one day or as many as fourteen days. Aerial and laboratory results support these ranges in the incubation period [11, 27]. For ongoing, straight cattle-to-cattle

contact under experimental settings, the mean duration of incubation was 3.5 days, while for intense sheep-to-sheep interaction, it was 2 days 42, 53. Pigs were easily affected by having contact with other pigs, and the duration of incubation ranged from one to three days, according to the degree the interaction[11].

6. Diagnosis of FMD

The determination of the particular genotype of the pathogenic viruses causing outbreaks of diseases and its timely, highly sensitive, and personalized diagnostic testing are crucial given the rapid propagation of the disease with the potential catastrophic economic ramifications which may ensue during a pandemic. Clinical symptoms such as a higher body temperature, increased squeezing vesicles development on the mucous membranes of the mouth and nose, interdigital spaces, and myocardial banding on the soles of the feet are used to identify the condition.

1-Test for elimination The viral neutralize testing (VNT), which is required for the import/export certification of animals or products from animals, has come to be known as the "standard of excellence" for the identification of antibody to the protein scaffolding of FMDV [2]. Nevertheless, compared with additional serological examinations, VNTs can be more susceptible to variability since they employ a variety of original cell types and cell types have different degrees of sensitivity. Compared with different serological investigations that may utilize inactivated pathogenic viruses as the antigens, vector neutralization testing (VNT) additionally is more gradual, greater prone to contaminants, or demands specialized biological confinement infrastructure.

1- Polymerase chain reaction, also known as with reversal of transcription (rt PCR) It is being demonstrated that the technique known as reverse transcription-polymerase chain reaction (RT-PCR), which has the benefits of a rapid, precise, highly dependable assessment, is a beneficial method for determining the cause of FMD. Utilizing universal primers that are suitable for every single one of the types, a range of RT-PCR techniques have been described in the past decade enable the swift detection of RNA in an epithelium cell-cultivated individuals and other tissues were the very first to show that FMDV genotyping by RT-PCR could distinguish between and Since then, RT-PCR has been used to detect all seven FMDV serotypes using primers specific to each serotype.

2- Virus isolation: According to the World Organization for Animal Health (OIE)³², Terrestrial Manual, virus isolation onto cell culture is considered as the "gold standard" technique for FMD diagnosis³³. This method is highly sensitive, but it is time-consuming, lasting between 1 and 4 days and requires extraordinary laboratory facilities. The most sensitive cell culture to most of FMDV serotypes is the primary bovine thyroid³⁴, but they are difficult and exclusive and usually lose its susceptibility to FMDV after numerous passages³⁵. Primary lamb kidney (LK) cells are very sensitive to FMDV and vary from primary bovine thyroid (BTY) cells in preserving of their sensitivity to FMDV infection after cryopreservation. Cell lines like baby hamster kidney (BHK-21) is much easier to preserve but are less susceptible to specific animal-derived FMDV³⁶.

7. The epidemiological pattern of FMD in Iraq

The initial documented instance of diseases such as FMD in Iraqi occurred in 1937, through the Sulimanyha - Bashder international gate, involving 202 cattle, however reports of the infection date back towards the later the nineteenth and beginning of the twentieth century. Of these, eleven cattle showed progressing symptoms of the illness. Near the year 1938, arose the initial known epidemic of FMD in cattle and buffalo within the Iraqi-Iranian borderlands towns of Basra, Missan, and DIALA. The untamed boars that were living within the bordering swamplands of Missan and Basra were a major factor in the propagation of the virus and the

illness's transfer from Iran to Iraq. [30]. Roughly 3 million ruminant species or twenty-five percent of the worldwide ruminant population, were severely damaged by the 1998 FMD epidemics, which also resulted in significant losses among newborn animals.

The 1998–1999 FMD outbreak had an impact that lasted until 2000–2001. the 2004 reappearance of FMD. There were 2315 tiny ruminants and 967 cattle and buffalo affected. Unregulated agricultural & animal goods transportation in adjacent Iraqi states resulted in the introduction of a novel FMDV serotype with a lineage in 2006, which caused outbreaks of disease throughout Iraqi. FMD can cause disabling socioeconomic consequences, due to its high impact on production and trade. Ruminants have an ability to harbor the FMDV in their pharyngeal tissues for an extended period that occurs when recovered or vaccinated cattle expose to diseased animal. Moreover, these animals can become healthy carriers for 3-5 years. Moreover, sheep can be carriers of the virus for 4-6 months, whereas pigs are not a carrier [31-32]. The resurgence of diseases such as FMD in Iraq warrants investigation and identification given that it is a continuous disorder. It's possible that a novel sublineage of the virus caused that 2016 diseases such as FMD epidemic in the nation of Iraq, which resulted in a greater percentage of animals afflicted. Furthermore, it is likely that the vaccination strain used wasn't an adequate match for the field-isolated serotypes according This explanation concurs to the findings of [33] saw the implementation of vaccination measures to combat FMD by the Iraqi medical services. For cattle and buffalo and sheep and goats, respectively, two types of vaccinations were administered: a monovalent vaccine (O Manisa) or a trivalent because it comes vaccine (O, A22, and Asia 1) [34,35]. Following the vaccination effort, the total amount of sick animals decreased throughout the period between 2012–2015, however the 2009 severe FMD epidemics persisted in 2010–2011. But by the last month of 2015, this vaccination lost its effectiveness, which caused FMD to resurface in the first part of 2016.

8. Controlling and operational plan:

A-Vaccination:

The European Union is able to preserve the most stringent diseases such as FMD classification within global commerce regulations of " nations that do not have foot-and-mouth disease absent vaccination" because everyday life, prevention vaccination is prohibited by the European Union's laws. Nonetheless, the government is required by law to take into account if immunization might help with preventing illnesses and to put up plans to begin immunization as soon as a foodborne illness outbreak occurs. 18 Merely taking vaccination into account and initiating delivery plans does not imply that an emergency vaccination campaign should be launched. Vaccination wouldn't be taking precedence of the conventional disease-eradication strategy used on diseased farms and their hazardous associates. Vaccination is a highly complicated decision that is probably carefully considered. It will be based on an amalgamation of academic including veterinarian experts' recommendations, modeling findings, economic studies, and consumer opinions. When considering if vaccination might be advantageous for preventive purposes, many different issues are going to be considered, such as the effectiveness and accessibility of an appropriate vaccine. Should a choice be made to administer emergency vaccinations, it is likely to be based on the principle of immunization for survival, or protection.[36]

B- Controlling:

Procedures for containment then chemical disinfectants: every surface and contaminated items, including clothing, vehicles, as tools, must be thoroughly cleaned and properly disinfected. It's crucial to remove infected livestock products, mattresses, and carcasses in a hygienic manner³². The FMD virus is not resistant towards pH abnormalities. As a result, the viral infection can be eliminated by both bases (like sodium hydroxide, for example) and acidity

(like the acid citric). Disinfection agents that are commercially available can be employed to eradicate the FMD infection. It is advised to take extreme caution and use the disinfectant in the exact concentration that is specified in the directions provided by the manufacturer. [37]. Management for foot and mouth illness (FMD) in small ruminants: Approaches to treatment for miniature ruminants exhibiting typical clinical manifestations of FMD include the application of medication and analgesic substances (Vetalgine-Intervet), a wide-spectrum long acting prescription antibiotic (Terramycin/LA Pfizer), as well as immune-regulating or safeguarding dressings [38]. One useful method of treating inflammatory lesions around the tongue, lips, legs, fingers, the their teats locally is to rinse them out using a solution containing one percent citric acid, one percent permanganate of sodium, or two percent alum. [39] FMD still poses an imminent danger to the global animal business, notwithstanding a wealth of knowledge regarding the infectious agent, the illness, and medicines. Regular investigations on vaccine matching and selecting strains that are suitable for every area are crucial for preventing illness since the immunological variability in FMDV is an important challenge for infectious diseases prevention. Furthermore, fresh sub lineages of this virus keep evolving to create new types that occasionally overcome immunization conferred by vaccination and have the potential to cause significant pandemic. This justifies the requirement of ongoing monitoring, vaccination matchmaking, and standard assurance. This illness cannot be expected to be controlled by vaccination on its own unless it is combined without restrictions on animals mobility. Consequently, in order to successfully manage this illness, rules over animal transportation and registration must also be established place. Geographical limitations that naturally provide defense against FMD are strictly enforced in areas free from this disease, especially when it comes about the importation of livestock as well as possibly products that have been contaminated. Several scientists are currently working to avoid and eliminate this communicable illness with safer and more effective alternative vaccinations. In order to guarantee that the viral strains used in the vaccinations are the ones that cause FMD, thorough characterization of virus isolates, including antigenic analysis and molecular epidemiological research, serves as essential for the disease's successful containment and elimination. The development of regions determined by how prevalent and prevalent of illnesses ought to form part of vaccination efforts. In order to lower the prevalence of illnesses and eliminate infection foci, monovalent vaccinations need to be used for management of the most common kind. The effective management including elimination of foot and mouth disease additionally hinges on the regulation of animal movement, the establishing of infection-free sections, and the construction of buffer territories. These days, a lot of researchers are attempting to employ safer and more effective alternative vaccinations, but additional studies and other methods need to be carried out in order to completely eradicate viruses from the planet [40].

Thus, finally our recommendations: A joint strategic program should be developed to reduce future foot-and-mouth disease outbreaks in the Near East Region. This program should include the following:

- Conduct a detailed risk assessment and develop an appropriate control strategy in each country;

- Establishing a monitoring network capable of giving early warning and strengthening immediate control measures.

- Collect and exchange information on the epidemiological situation of the disease in the region. Study the epidemiological aspects of the disease in the region, especially in areas where the incidence is epidemic, first or second degree; -

- Develop control strategies targeting specific areas at the regional level. This may be the role of the Animal Health Authority in the Near East and North Africa.

- Coordination of emergency plans, allowing rapid reaction at country and regional levels.

- Reviewing national legislation.

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