book of abstracts

SCIENTIFIC DEVELOPMENTS AND TECHNICAL CHALLENGES IN THE PROGRESSIVE CONTROL OF FMD IN SOUTH ASIA

New Delhi, India
13-15 February 2012

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2012

INTRODUCTION

The three-day conference being organized by the Food and Agriculture Organization (FAO) and the Indian Ministry of Agriculture's Council for Agricultural Research (ICAR) from 13-15 February 2012, is an important regional venue to gauge the best technologies and techniques available to control foot-and-mouth disease (FMD) in South Asia. The conference will capture national and regional experiences, basic and applied science complemented by the participation of leading FMD centers across the globe.

FMD is not only a disease of importance to trade. The fact that the socio-economic impact of FMD is not well documented, its local occurrence decreases efficient production parameters in terms of milk production, ability to prepare the fields for crops and irrigation, transport, reproductivity efficiency and expression of an animal's genetic potential, hampering income generation to millions.

The international conference, titled "Scientific Developments and Technical Challenges in the Progressive Control of Foot-and-Mouth Disease in South Asia," is being held in New Delhi under the broad umbrella of the FAO/OIE Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs), which has identified priority diseases in different regions that merit attention due to their high impact on efficiencies in production, importance to people's livelihoods, and safe trade.

The conference focuses on vaccine technologies available to reduce the incidence of FMD in livestock in the world and South Asia region in particular, which have high numbers of susceptible livestock and where several FMD viruses circulate at the same time making virus identification, antigenic and molecular virus characterization, and vaccine selection critical for improved disease management efforts. The challenges for the progressive control of FMD in regions with hundreds of millions of susceptible animals is enormous, yet control by vaccination alone is insufficient.

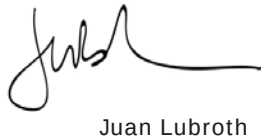
A long term Roadmap for FMD control in the region is required that includes the use of effective high quality vaccines, understanding production and marketing social networks, best practices in communications and outreach programmes, preparedness and investigative epidemiology, with the application of performance reviews of control programmes and the optimization of scarce resources to have the greatest impact.

The conference brings together the leading FMD research institutions, FAO Reference Centers, OIE Reference Laboratories, and a range of technical and scientific experts on FMD from South Asia, East Asia, and the West Eurasian epidemiological sub-regions. Progress of long term FMD control Roadmaps in West Eurasia and in South-East Asia will be shared, with emphasis on the technical lessons learnt from applying the Progressive Control Pathway for FMD (PCP-FMD) as a tool for measuring national and regional progress.

This Conference reviews the developments in the field of FMD vaccines and vaccination programmes, diagnostics, their costs, the science of progressive control (managing risks via policy making and appropriate response), identification of priorities for investments in good animal production practices, veterinary system capacity development and health which will impact regional, and likely global FMD control efforts. These proceedings and summary are to be presented at the FAO/OIE Second Global Conference on FMD Control to be held in Bangkok, in June 2012.

FAO extends its gratitude to ICAR and all the experts, scientists, research partners, and funding institutions that contributed to this Conference.

For a world free from hunger,



Juan Lubroth
Chief Veterinary Officer
Food and Agriculture Organization of the United Nations

ACKNOWLEDGEMENTS

The EuFMD Commission and the FAO gratefully acknowledge the Director General and staff of the Indian Council of Agriculture Research (ICAR) of the Ministry of Agriculture of India, and the FAO India and Regional Office for Asia (FAO-RAP) for their efforts to organize this meeting. The EuFMD also thanks the European Union and the Dutch Government for their support.

Thank you to Ms Elisabeth Beer (FAO-India) and colleagues from FAO-India, and Ms Priya Markanday (FAO-Rome) for their unfailing support throughout.

Special thanks to Enrique Anton without whom this book of abstracts would not have been assembled.

The graphic design of the logo for the meeting and web update are work of the excellent FAO graphic designers, Ms Murguia and Ms Ciarlantini.

AGENDA IN BRIEF

Day-Session	*Scientific developments and technical challenges in the Progressive Control of FMD in South Asia*
12 Feb	**Pre-registration**
13 Feb **- Day 1**	**Science and progress**
1-1	OPENING
1-2	Global and regional status of FMD
1-3	Immunology and transmission: new findings which could change FMD control
1-4	Improving impact of conventional FMD vaccines
	POSTER SESSION
14 Feb **- Day 2**	**Science and the progressive control of FMD in Eurasia**
2-1	Progressive Control of FMD; science, experience, lessons
2-2	Working Groups (WG) Parallel Sessions
WG1	South Asia group: PCP progress and the long term vision (Roadmap)
WG2	Regional FMD laboratory network services
WG3	Regional FMD epidemiology: gaps and priorities
WG4	FMD Research in Eurasia: success stories and priorities for investment
2-3	Rapid Feedback from Working Groups
2-4	FMD epidemiology and Socio-economic Impacts
15 Feb **- Day 3**	**Big issues, big potentials: science and future impacts**
3-1	Laboratory services
3-2	Animal production systems, marketing and biosecurity
3-3	Priorities for basic and applied research on FMD

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THE GLOBAL SYSTEM (OIE/ FAO NETWORK): ACTIVITIES, DIRECTIONS

David Paton
WRL, Pirbirght, UK

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SOUTH ASIA: ACTION PLANS, FUTURE DIRECTIONS AND NEEDS

B. Pattnaik
Mukteswar, India

AVAILABLE UPON REQUEST

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SOUTHEAST ASIA: ACTION PLANS FUTURE DIRECTIONS AND NEEDS

Panithan Thongtha

The RRL Pakchong was first established in 1958, and has since served as the National FMD Laboratory in Thailand. Upon the recommendation of the OIE Sub-Commission for FMD Control in South East Asia to develop the Laboratory into the SEAFMD Regional Reference Laboratory, the DLD refurbished laboratory capacity by constructing a BSL-3 Containment Laboratory. The BSL-3 has been designated as the SEAFMD RRL and has received samples from South East Asian countries. The RRL has experience in using diagnostic tests in accordance with standards of the OIE Manual of Diagnostic tests and Vaccines for terrestrial Animals. It routinely uses FMD Antigen Typing ELISA, virus isolation and PCR. It has the capacity to conduct phylogenetic tree analyses of sequenced PCR products.

The RRL also conducts analysis of r-value or vaccine matching of field isolates in comparison with relevant vaccine strains. In terms of serology, the RRL routinely uses liquid phase blocking (LP) and non structure protein (NSP) ELISA. It has been involved in several validation tests conducted for NSP ELISA under the IAEA Project. In addition, the RRL routinely produces and supplies the FMD diagnostic reagents to laboratories both within Thailand as well as SEAFMD countries.

The RRL provides a substantial regional role in diagnostics, training, quality standards and harmonization of methods. It has conducted several on-the-job trainings and has sent its expert staff to assist national FMD laboratories of member countries. To continuously develop the technical capability of its staff, the RRL also participates in international training and conferences.

NOTES

FMD EPIDEMIC SITUATION AND CONTROL STRATEGY IN CHINA

Jijun He, Jianhong Guo, Qiang Zhang, Yamin Yang, Weimin Ma, Lv Lv, Juan Chen, Youjun Shang, Haixue Zheng, Zaixin Liu, Xiangtao Liu, Hong Yin**

State Key Laboratory of Veterinary Etiological Biology; National Foot and Mouth Disease Reference Laboratory; Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences. Xujiaping 1, Lanzhou, Gansu, People's Republic of China. 730046.

Introduction

In the past 7 years, FMD outbreaks caused by serotypeAsia1, A and O viruses were detected successively in China. To find the virus isolates source, molecular epidemiology studies and active surveillance were undertaken. For eradication of these diseases, proactive precautionary measures were applied and expanded into areas where stamping-out policy was implemented. Vaccination, and monitoring programs have been carried out in the field, especially in the surveillance zones.

Materials and methods

Complete VP1 sequences were determined following viral RNA amplification by RT-PCR. Phylogenetic analysis was carried out using the Neighbor-Joining algorithm. The information of outbreaks in China can be found at http://www.wrlfmd.org.

Results

From 2005 to now, total 81 FMD outbreaks were reported to OIE. 46 type Asia1 outbreaks were confirmed in 17 provinces, and the virus belong to South Asia topotype, Group V. They were very closely related to virus from India collected in 1980s. Since June 2009, there have no FMD Asia1 occurred.

On 22nd January 2009, FMD cases due to serotype A were recognized in Wuhan city of Hubei province. The VP1 sequences of A/HuB/WH/2009 is related to some published VP1 sequences of A/May/02 (95.9%), A/Tai/07 (95.7%) and A/Lao/8/06 (95.3%), and a comparison with WRLFMD sequence data revealed a strong similarity to A/Tai/08 virus. After March 2010, no new outbreaks of type A were found in China.

Nowadays, a main threat comes from affecting of Mya-98 strain. VP1 sequences from PR China share a close relationship (>97%) with those sequences from outbreaks in Southeast Asia nations.

Discussion

FMDV isolates responsible for the outbreaks in China were closely related to the viruses detected in South-East Asia and South Asia. These findings prove that regional FMD control programs based on the regional virus pools are needed, while routine control measures such as compulsory immunization, epidemiological survey and risk analysis, monitoring are adopted in China.

NOTES

WEST EURASIA: RECENT EPIDEMIC SITUATION AND PROGRESS AND CHALLENGES TO IMPLEMENT THE REGIONAL ROADMAP FOR PROGRESSIVE FMD CONTROL

Aktas[1], S., Bulut[2], N., Jamal[3], S., Ferrari[4], G, and Sumption[5], K

[1]FAO Sub Regional Office for Central Asia, Ankara; [2]FMD Institute, Turkey; [3]Livestock Wing, Ministry of Commerce, Islamabad, [4]FAO Animal Health Service , Rome, [5]EuFMD Commission Rome.

Introduction

West Eurasia is considered to maintain an independent pool (Pool 3) of related FMD viruses of serotypes A, Asia-1 and O, with only occasional entry of FMDV from other virus pools, such as South Asia . Epidemics emerging within this region frequently involve the neighbours and in recent years, the boundaries of the type A Iran-05 epidemic and type O Panasia-2 epidemic have been seen to extend from Pakistan/Afghanistan to Turkey, with more occasional or short incursions into Central Asia and middle-east countries (reaching Israel, and on two occasions, Libya). Some 14 countries are at direct risk (and many others indirectly) of FMD incursions across their land borders and most of those directly affected use routine vaccination. In response to the repeated epidemic events, and requests for assistance by affected and at risk countries, FAO convened a meeting of 14 directly affected countries in Shiraz, Iran in 2008 to develop a long term (2020) vision for FMD control in the region. The FAO developed Progressive Control pathway (PCP-FMD) was utilized to develop national and regional actions plans and support; several FAO projects (principally funded by Italy, EuFMD/EC but later also FAO and USDA) supported national PCP activities and regional activities, such as improved FMD laboratory networking (WELNET) and epidemiology support.

This paper illustrates how the Roadmap and PCP has assisted in the review and revision of national control programmes, to improve surveillance for threat identification, and the continued challenge of emergent FMDV in the region.

Material and methods

The presentation will review the FMD situation in West Eurasia in the past 4 years, using virological and epidemiological data to illustrate viral diversity, FMDV emergence and rapidity of spread.

The progress at national level along the PCP-FMD was assessed at 3 regional meetings, in 2008, 2009 and 2010, at which country representatives could peer-review the evidence presented of national activities. Presentation of FMD monitoring results (particularly sero-surveillance for NSP antibodies detection) has provided evidence that FMD infections are far more frequent than previously recognized, and may provide a more useful indicator of impact of control measures than outbreak case numbers.

Vaccine suitability for the region − and threat of vaccine breakthroughs − have been monitored by the WELNET, working with the FAO-WRL for FMD at Pirbright.

Results

The activities implemented since the 2008 meeting in Shiraz (Iran) have allowed to detect the occurrence of three epidemics of regional significance in the past 3 years; type A Iran-05 (BAR-08 strain) in 2008, the type O Panasia-2 epidemic in 2010-11, and the Asia-1 epidemic of 2011-12, all of which involved east to west travel and to some extent involved Central Asian countries. The rapidity and frequency of incursions in the past 3 years presents a major problem for disease control, particularly where the strains involved are poorly matched to the routine vaccines in use.

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The FAO projects, through supporting virological surveillance, assisted identifying in Pakistan the Asia-1 strain not matched to the Shamir vaccine; the early warning to WELNET assisted when the first evidence of spread to the west was detected, and willingness to share isolates assisted in vaccine development (FMD Institute Ankara) for local use.

The Roadmap assessment and peer review system has encouraged reporting of serological findings but FMD remains highly sensitive and the move towards open and transparent reporting of findings across the region is a challenge.

Discussion

The Roadmap process and regular and systematic review process has been popular and appreciated, and the PCP framework has assisted countries to review their national short and long term objectives.

The rapidity for spread of FMDV across borders of the region highlight some difficult issues for FMD control, such as the limited use or impact of effective quarantine measures, the lack of control at animal exchanges/markets, and achievement of effective immunity in animals before short or long distance trade. Application of the PCP should assist countries to develop rational, risk based and feasible control strategies with clear objectives to either prevent disease in selected populations or sectors (PCP Stage2), or to prevent circulation (PCP Stage 3).

The recent epidemic waves illustrate that early warning is not enough, effective preventive measures must be in place, and regional actions will continue to be essential to 2020 and possibly beyond.

NOTES

KEYNOTE: IMMUNOLOGY AND TRANSMISSION: NEW FINDINGS WHICH COULD CHANGE FMD CONTROL

Nicholas Juleff, Simon Gubbins, Bartlomiej M Bankowski, Lucy Robinson, Miriam Windsor, Liz Reid, Debi Gibson, Veronica Carr, Paul V Barnett, Richard Howey[1], Margo Chase-Topping[1], Mark EJ Woolhouse[1], Bryan Charleston.

Pirbright Laboratory, Institute for Animal Health, Ash Rd, Woking, Surrey, GU24 0NF, UK.
[1] Centre for Infectious Diseases, University of Edinburgh, Ashworth Laboratories, Kings Buildings, West Mains Rd, Edinburgh EH9 3JT.

Foot-and-mouth disease (FMD) virus causes one of the world's most important infectious animal diseases and can be transmitted by many routes. The most common way in ruminants is by direct contact between infected and naïve animals.

Experimental studies have determined the infectious period of FMDV in cattle is shorter (mean 1.7 days) than currently realized and animals are not infectious until, on average, 0.5 days after clinical signs appear. This is the first study to identify, in detail, statistically significant indicators of infectiousness at defined time periods during disease progression in a natural species for FMD or indeed any acute viral disease. These results imply that pre-clinical sampling and early intervention may be possible to limit the spread of disease.

Furthermore, rapid induction of CD4 T cell-independent antibody responses and the formation of virus-antibody immune complexes (IC) have been identified as a key event in disease pathogenesis. IC formation triggers productive infection and apoptosis of dendritic cells (DC) and induction of type-1 interferon from plasmacytoid DCs, events that correlate with induction of clinical signs and transmission.

Current FMD virus vaccines are highly effective at inducing protective immunity in cattle. A single low microgram dose in adjuvant can generate protection from disease (though not necessarily infection) within 4-5 days. Nevertheless present vaccines are unsatisfactory in a number of aspects.

We have performed proof-of-principle experiments for a vaccine produced from non-infectious cultures. The implementation of methods to produce non-infectious FMDV capsids as vaccines, outside of high containment facilities, would significantly lower costs, improve production capacity and eliminate the risks associated with infectious virus during vaccine production and use.

In addition, our initial work has demonstrated that a non-infectious source of virus capsids allows sequence manipulation to address the issue of antigen stability. Implementation of improvements in vaccine stability would reduce the quantity of antigen required per vaccine dose, mainly by reducing losses during production and improving the shelf life of the formulated product.

NOTES

THE EARLY PATHOGENESIS OF FMD AND THE IMPLICATIONS FOR CONTROL MEASURES

Luis Rodríguez, Jonathan Arzt
ARS, USDA, USA

Understanding the early pathogenesis of foot-and-mouth disease (FMD) is of critical importance to ongoing and future efforts to decrease the impact of FMD in endemic regions and prevent incursions to disease-free territories. The importance of the early phase of virus-host interaction lies in two key facts: 1) it is the early events which determine if a susceptible host becomes infected and 2) successful abrogation of the early events is the logical goal of vaccines and biotherapeutic countermeasures. Ultimately, even population level trends and transboundary movement of FMD virus (FMDV) is dependent upon the virus-host interactions which occur in the hours immediately subsequent to individual animals' exposure to FMDV.

In this presentation the scientific literature describing the early pathogenesis of FMD in various host species will be reviewed and specifically related to the development of proper vaccines and control methods aimed at preventing infection at the primary sites as opposed to only suppressing generalization and clinical disease.

NOTES

NOVEL FMD VACCINE RESEARCH IN CHINA

Qiang Zhang, Jijun He, Jianhong Guo, Haixue Zheng, Guohua Wu, Huiyun Chang, Ye Jin, Jisheng Liu, Zhiyong Li, Yongguang Zhang, Yonglu Wang, Zengjun Lu, Shiqi Sun, Zaixin Liu, Xiangtao Liu, Hong Yin**

State Key Laboratory of Veterinary Etiological Biology;National Foot and Mouth Disease Reference Laboratory; Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences. Xujiaping 1,Lanzhou, Gansu, People's Republic of China. 730046.

Introduction

Since 1970s, Oil adjuvant vaccines against FMD in which the virus antigen producing by BHK21, and inactivating by binary ethylene imine (BEI) have been developed in China. Presently, some novel vaccines were attempted. These novel vaccines include synthetic peptide vaccine, empty capsid subunit vaccine, live carrier vaccine, DNA vaccine, etc..

Materials and methods

FMDV epidemic strains were isolated by LVRI recent years. Live carrier virus strains (adenovirus, goat pox virus AV41 strains, pseudo rabies virus) came from China Veterinary Culture Collection (CVCC). Express vector were constructed by LVRI, and some gene information of virus strains was found from CVCC and NCBI.

Results

After the outbreak affected with O/Mya-98 strain, a new vaccine strain from Mya-98 lineage had been selected successfully by LVRI in 2010.
An FMDV capsid subunit vaccine which the capsid proteins were expressed in silkworm-baculovirus was developed. The results showed the vaccine could achieve 6.34 PD_{50} per dose.
The P12A and 3C genes of FMDV were expressed successfully using the attenuated goat pox vaccine strain (AV41) as live vector. The next-step researches are going on.
A DNA vaccine based on FMDV reverse genetics system has strong T cell response and high protective potency against Mya-98 (19/21) and Cathay (8/10) strains.

Discussion

Vaccine and vaccination play an important role for FMD prevention and control in China. The technology for vaccines research made rapid progress recent years. Some novel vaccines have been developed successfully and used in China. However, some novel vaccines research meet difficulty due to the recent development of technology in this field.

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FMD VACCINE RESEARH AND DEVELOPMENT IN INDIA

Ramamurthy Venkataramanan
Indian Veterinary Research Institute
Hebbal, Bangalore
India

In India, Foot and Mouth Disease (FMD) research started in the then Imperial Bacteriological Laboratory at Mukteswar as early as in 1929. The work on the production of vaccines using cell culture technique commenced at Mukteswar in early sixties initially in goat kidney/calf kidney cell cultures and subsequently by 1971-72 with the availability of the BHK 21 cell line in monolayer cultures. With the increased demand for the FMD vaccines, the Bangalore campus of IVRI was established in 1972 with the objective of large scale production in fermenters. This plant became fully operational by 1980 and the production of the vaccine in suspension cultures of BHK21 cells commenced. Subsequently several private companies have established the large scale production plants and by now India is having well established FMD Vaccine plants with a capacity to produce about 350-400 Million doses of trivalent vaccine.

It is expected that by the year 2015, the country will produce about 600 - 800 million doses of trivalent vaccine annually. In Asia as a whole, well organized production facilities are available and several countries in the region source the vaccine from India. Keeping abreast with the contemporary developments research efforts are going on in addressing the major challenge of increasing the duration of immunity and development of new generation vaccines. The salient research accomplishments in the development and application of FMD vaccines in India are described here.

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KEYNOTE: DEMAND, SUPPLY AND THE GAPS BETWEEN THE BEST CONVENTIONAL VACCINES AND THE WORST ON THE MARKET; WHAT NEEDS TO BE DONE?

Danny Goovaerts
Holland, MSD Animal Health

Demand and supply

The Animal Health Industry is committed to provide the required vaccine quantities for the successful roll-out of the PCP program. There are several approaches to increase production capacity, both short- term (e.g. extra shifts) as well as long-term (investment facilities). The financial commitment from donors to the PCP program will be an incentive for capacity extension. The success of the program is determined by both quality of the program and quality of the vaccine. The relative cost of vaccine in a FMD control and eradication program is limited. Therefore a high priority should be given to assurance of vaccine quality.

Quality

Most crucial factors for a vaccine are safety and efficacy. Quality is the consistency of safety and efficacy in the product on the market guaranteed during the entire shelf life of the vaccine. For an efficacious vaccine the biological integrity of the virus particle is essential. The FMD virus particle is very sensitive to chemical and physical factors. The manufacturer needs to have thorough knowledge of the influence of each of the factors and implement measures from the start of virus production up to the packaging of the produced vaccine in order to prevent negative influences on the integrity.

Procurement should be focussed on quality assured safe and efficacious vaccines. Independent assessment is a challenge. Over the years there has been a shift in philosophy from independent re-testing (batch test) to independent assessment of the manufacturing process and the manufacturer. The assessment is based on the chain of evidence: (1) the manufacturer compiles a dossier with product and process characteristics; (2) the national authority reviews the data and approves the dossier; (3) the manufacturer assures that the product is produced and released in accordance with the dossier; (4) the government inspects the manufacturer for compliance with the principles of Good Manufacturing Practice and the specifications of the approved dossier. A system of spot checks (batch test) by the World Reference Laboratory would provide an independent proof of compliance.

NOTES

MANUFACTURERS' EXPECTED CONTRIBUTIONS TO THE PROGRESSIVE CONTROL OF FMD IN SOUTH ASIA

Philippe Dubourget
Merial, France

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COMMON VACCINES FOR EURASIA A, O AND ASIA -1, THE WAY TO GO?

David Paton
WRL, Pirbirght, UK.

AVAILABLE UPON REQUEST

FMD VACCINES AND VACCINATION IN INDIA: PRODUCTION, USE AND QUALITY

Villapanur Alwar Srinivasan,
Indian Immunologicals, India.

AVAILABLE UPON REQUEST

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FMD VACCINES AND VACCINATION IN CHINA: PRODUCTION, USE AND QUALITY

Li Huachun
Yunnan, PR China

H. Li[1], Sun Yan[2], Xu Tiangang[2]

[1]Yunnan Animal Science and Veterinary Institute, Jindian, Kunming 650224, People's Republic of China

[2]Veterinary Bureau, Ministry of Agriculture, People's Republic of China, 11 Nongzhanguannanli, Beijing 100125

Introduction

Currently, compulsory vaccination for FMD is implemented in China. Inactivated FMD vaccines for serotype O, A and Asia-1 are produced by five vaccine plants in China. They are CAHIC Lanzhou Bio-Pharmaceutical, CAHIC Baoshan Bio-Pharmaceutical, Jinyu Baoling Bio-Pharmaceutical, Xinjiang Tiankang Animal Science Bio-technology Co. Ltd. and China Agricultural Vet. Bio. Science & technology Co. Ltd. Synthetic peptide vaccine is also produced for serotype O by Shenlian Bio-Pharmaceutical in Shanghai.

Materials and methods

China produces 3 billion ml FMD vaccine for serotype O, 1.1 billion ml for Asia-1 and 80 million ml for A annually. Large-scale animal farms have to be carried out vaccination strictly according to vaccination rules. Two vaccination campaigns have been applied for backyard-farming animals respectively in spring and autumn every year. Catch-up vaccinations on restocked animals have been conducted promptly to achieve full coverage of animals subject to vaccination. Around 800 million animals were received FMD vaccination in spring and 700 million animals in autumn every year. For quality control, the effectiveness of the vaccination is monitored. Sera have collected at 28 days of post vaccination for swine and 21 days for other animals. Liquid phase blocking (LPB) ELISA is used for test inactivated vaccines. VP1 ELISA is used for test Synthetic Peptide Vaccine. When a serum LBP-ELISA titre is ≥26, the vaccination will be considered effective.

Results

Monitoring results showed that 96.1% to 98.6% of animals after vaccination have protection potency against FMDV infection. In 2011, there were seven FMD O outbreaks, and in January 2012 there is one outbreak in China. There is no outbreak of FMD A in the past 22 months and no outbreak of Asia-1 in the past 31 months.

Discussion

Compulsory vaccination is successful for control FMD in China. Further work will consider conduct intensive virology and serology survey to assess the circulation FMD A and Asia-1 and be recognized as FMD A and Asia-1 free.

NOTES

CURRENT VACCINES AND THEIR USE IN THE DESIGN OF VACCINATION PROGRAMMES: THEORY AND PRACTICE

Chris J.M. Bartels[1], Melissa McLaws[1], Naser Rasoli[2], Theodore Knight-Jones[3], Keith Sumption[1]
[1]EuFMD/FAO, Rome, Italy; [2]Iranian Veterinary Organization, Tehran, Iran; [3]World Reference Laboratory for FMD, Pirbright, England

Introduction

Foot and Mouth Disease (FMD) is a global problem impairing animal health and production, livelihoods and food safety. The OIE and FAO are calling for its global control and eradication. This requires tools that realistically facilitate countries to reduce FMD and control the transmission of FMD virus (FMDv). Currently, vaccines are widely used but have a number of shortcomings as there is little or no cross-protection between serotypes and subtypes, a short duration of protection requiring repeated vaccination and boostering and conventional vaccines are primarily capable to reduce FMD but not transmission of FMDv infection.

However, many endemic countries have no option but to embark on campaigns using these vaccines extensively. This paper will discuss the use of conventional vaccines as a component of integrated FMD control strategy, targeting husbandry systems and/or regions with high FMD risks or with high impact of FMD and thus trying to maximize the impact and the cost-effectiveness of vaccination. It will describe the need for ongoing monitoring and evaluation and define a number of key performance indicators. These concepts (risk-based control and continuous monitoring of implementation and impact) are inherent in the philosophy behind the Progressive Control Pathway (PCP-FMCD).

Strategic application of FMD vaccines

Vaccine quality

Important aspects of the vaccine are the proportion of the vaccinated that are protected, the duration of protection and its capacity to antigenically match with circulating strains. The first aspect relates to the potency of the vaccine expressed in PD50. 3PD50 vaccines are used extensively however, these may just protect 75% of the animals that have been correctly and timely vaccinated. For this reason, the use of vaccines with higher potency needs to be considered. Not only will a single vaccination protect a higher percentage of animals, also the duration of protection and the antigenic coverage will be enhanced.

As large quantities are needed for vaccination, different vaccine batches have to be produced. This requires vaccine quality control to safeguard both safety and potency of the vaccine in subsequent batches. Such quality control is best done by an independent organisation reporting to both the vaccine producer and the Veterinary Services (VS).

Vaccination coverage

Vaccination coverage relies largely on the capacity of the VS to implement mass vaccination. This is challenged by many issues such as willingness of farmers to cooperate, who pays for vaccination and motivation of vaccinators (either public servant or private vaccinators under contract) to conscientiously go from house to house and a fully-functional cold chain that guarantees FMD vaccines to stay refrigerated up to time of injection. These issues and the high turnover of livestock population (especially in beef fattening and high-producing dairy sector) convert setting a predefined coverage target into a theoretical approach. In such situation, it is taken for granted that each animal vaccinated is fully protected for a minimum duration of 6 months, disregarding the fact that within weeks the livestock population has already changed with new susceptible animals being introduced.

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Vaccination strategy

To develop a vaccination strategy, knowledge about the livestock production system(s) and FMD epidemiology is required to target FMD control to activities (risks, hotspots) that have increased risk of FMDv transmission.

Knowledge of the local situation allows for definition of the epidemiological unit which in turn is important to set the vaccination strategy. Vaccination coverage must be considered both within and between epidemiological units. Because livestock are kept by owners, animals are clustered in herds. However, in rural areas with extensive communal grazing, with no distinct separation between premises (eg. manure being piled high on the streets, milk collectors going undisturbed from house to house) livestock may even be clustered at a village level (or a cluster of villages, or a valley between mountains).

Application of a risk-based FMD vaccination strategy – the Iranian situation

From across the periphery of Iran, bull calves (with no or limited vaccination) from dairy herds are transported through local and major cattle markets to large beef-fattening complexes close to cities. Knowledge of the different production systems and their interactions is essential to develop a coherent FMD control strategy.

The example above also indicates that transmission of infection does not occur randomly amongst individual animals or clusters of animals. Livestock (and animal products) are traded by people, who are motivated for different reasons. It becomes increasingly difficult to control FMD if the distances covered by trading become longer. For this reason, in the initial phases of FMD control in endemic countries, the focus could be on reducing transmission between provinces rather than within provinces (or between districts rather than within districts). As an example, of cattle that were transported long distances in Turkey and Iran, 80% were younger than 1 year of age. These calves are extremely vulnerable to FMDv as their maternally-derived antibodies are waning, primary vaccination may not be provided or if provided may not be given the booster vaccination.

A recent sero-survey in West Azarbaijan province - Iran, revealed that almost all villages sampled for FMD NSP-Ab in young cattle (6-24 months of age) tested positive. This finding indicated that FMDv infection had occurred recently in all these villages. However, clinical signs of FMD had been observed in only 18% of villages. The within-unit prevalence was higher on commercial farms (either dairy or beef) than in rural villages.

Based on these results the Iranian Veterinary Organisation (IVO) has developed a revised FMD control plan, targeting its vaccination strategy on the following:

1) Cattle on commercial farms will be vaccinated every 4 months in combination with training of owners and workers on biosecurity measures and risks of introducing new livestock.
2) In villages, the focus will be on vaccinating young stock rather than adult stock. With fewer animals to vaccinate, it will become feasible to stringently apply booster vaccination, prior to young stock being traded to commercial farms.
3) Cattle for trading will require a certificate confirming recent vaccination (4-21 days prior to marketing). This will first be applied to young stock. Over time, this regulation will be extended to cattle of all ages.
4) Ring vaccination around a reported FMD outbreak will be abolished (for the time being). Upon first reading, this may seem an illogical decision. However, with almost 100% of epi-units being infected it may prove to make sense especially when considering that the application of ring vaccination is done without applying

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any kind of biosecurity measures. Effectively, vaccinators may pick up FMDv and spread it to sites with no clinical FMD. But more importantly, ring vaccination is compromising the routine vaccination (taking away vaccine supply, manpower and financial means) leaving other areas uncovered.

Monitoring and evaluation

As clinical FMD is a compilation of different FMDv serotypes, it requires ongoing monitoring of outbreaks to learn about emerging serotypes/strains. Similarly, as livestock production systems and value chains are dynamic, the effects of control measures need to be followed-up. This requires well-defined key performance indicators, working hypotheses and subsequently well-designed research studies to evaluate both the level of implementation as the impact on livestock in terms of health and production.

Vaccine effectiveness

One such key performance indicator, combining the evaluation of impact and implementation is vaccine effectiveness: percentage reduction in FMD incidence due to vaccination, measured in individuals in the field. It combines issues such as vaccine quality, duration of protection and correct application of the vaccine. Farm managers in Kenya maintain vaccination 3 times a year as it proved to be effective in preventing clinical FMD even in the presence of infected buffalo and sick wildlife in close contact.

For impact evaluation at the population level repeated sero-surveys are extremely useful comparing the level of FMD infection over time and between areas/productions systems. In addition, ongoing disease outbreak investigations will reveal possible routes of FMDv introduction and spread and changes over time. The same applies for continued value chain analyses to assess changes in trade patterns or socio-economic drivers. More indirect indicators for FMD control impact are milk production for dairy herds, weight gain for beef fattening and mortality rate for both.

Additional key performance indicators for implementation are vaccine coverage, studies into knowledge, attitude and practice (KAP) of farmers, changes in the veterinary laws and regulations, training of staff etc.

As long as vaccines suffer a number of shortcomings, control of FMDv can't rely on vaccination alone. Additional control measures related to biosecurity (at farms, animal markets, transport lorries, etc), quarantine measures at the borders and animal movement restrictions are important components of reducing both FMDv transmission and clinical FMD. Evaluation of implementation of the control measures and impact on FMD occurrence is necessary to adjust the FMD control strategy over time. Likewise, training of VS staff, new regulations to the Veterinary Law, awareness and advocacy are important conditions for FMD control.

NOTES

FAO/OIE PROGRESSIVE CONTROL PATHWAY (PCP) FOR FMD: PRINCIPLES, PRACTICE AND LESSONS LEARNT IN THE WEST EURASIA FMD ROADMAP

Keith Sumption[1] , Melissa McLaws[1], Chris Bartels[1], Peter de Leeuw[2] and Giancarlo Ferrari[3]
European Commission for the Control of FMD[1], Animal Health Service, FAO[2],[3] and Co-ordinator[3], GTFS/INT/907/ITA Project.

Introduction

The Progressive Control Pathway for Foot and Mouth Disease (PCP-FMD) has been developed by EuFMD and FAO in 2008-10 to assist and facilitate FMD endemic countries to progressively reduce the impact of FMD and the load of FMD virus. The PCP-FMD has been adopted by FAO and OIE in 2011 as a working tool in the design of FMD country (and some regional) control programs, and is expected to form the backbone of the Global FAO/OIE Strategy for the Control of FMD that is under development. In 2011, a strong connection between PCP progress and official recognition of control programmes was created when the OIE adopted procedures for "endorsement" of a country's FMD control program, at the higher Stages (PCP Stage 3).
The concept and criteria of the FMD-PCP are intended to provide guidance as to the appropriate levels of monitoring and surveillance (including control) for FMD in non-free countries, since these are not described in the OIE Terrestrial Code. The PCP-FMD is a set of FMD control activity stages that, if implemented, should enable countries to progressively increase the level of FMD control to the point where an application for official freedom from FMD with or without vaccination (the end of Stages 4 and 5, respectively) may be successful and the status sustainable.

PCP Principles

The PCP approach is based on the following principles:

1. active monitoring for FMDV circulation, and understanding of the epidemiology of FMD - as the foundations for any control program. Therefore activities to meet these requirements are common to all stages. The improved information generated is of benefit nationally and regionally. The monitoring of outcomes (indicators of control effectiveness), within a national FMD management system, is included at the higher stages;
2. activities in each PCP stage are appropriate to the required reduction in virus circulation and mitigation of disease risk to be achieved;
3. activities and their impacts in each stage are measurable, comparable between countries, and generate information and potential benefits to national as well as to international stakeholders;
4. the optimization of use of scarce resources for FMD control is achieved through the targeting of measures to the husbandry systems and critical risk points where the impact on disease control and/or virus circulation will be greatest.

Practice

FAO convened a meeting 2008 in Shiraz, Iran of 14 West Eurasian countries directly affected by FMD epidemics, to develop a long term (2020) vision for FMD control in the region. The FAO developed Progressive Control pathway (PCP-FMD) was utilized to develop national and regional actions plans and support, with most of the 14 having some donor funded technical assistance; several FAO projects (principally funded by Italy, EuFMD/EC but later also FAO and USDA) supported national PCP activities and regional activities, such as improved FMD laboratory networking (WELNET) and epidemiology support.

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NOTES

This paper illustrates how the Roadmap and PCP has assisted in the review and revision of national control programmes, to improve surveillance for threat identification, and the continued challenge of emergent FMDV in the region.

The progress at national level along the PCP-FMD was assessed at 3 regional meetings, in 2008, 2009 and 2010, at which country representatives could peer-review the evidence presented of national activities. Presentation of FMD monitoring results (particularly sero-surveillance) has provided evidence that FMD infections are far more frequent than previously recognized, and may provide a more useful indicator of impact of control measures than outbreak case numbers.

Lessons Learnt

The Roadmap assessment and peer review system has encouraged reporting of active monitoring of FMD, including serological findings, even by a few countries that usually do not officially report FMD outbreaks. This is important if confidence is to be built that countries will manage their own programmes, respond to epidemic events, and thereby reduce the risk to the region. However, FMD remains highly sensitive and the move towards open and transparent reporting of findings across the region is still a challenge.

The Roadmap process and regular and systematic review process has been popular and appreciated, and the PCP framework has assisted countries to review their national short and long term objectives. However, in a few countries, PCP stage assessments have indicated a downgrade, and national capacities to evaluate control programmes remain weak. A toolkit for assessment of PCP progress at national level has been developed in 2011, tested in South Asia and will be used to assist countries to "self-assess" their PCP compliance, and be used in the annual progress review of the West Eurasia countries. The Gf-TADS Global Working Group on FMD will ultimately review these PCP assessments to ensure comparability across regions, as part of Global FMD progress monitoring.

The rapidity of spread of FMDV across borders of the West Eurasian region highlight some difficult issues for FMD control, such as the limited use or impact of effective quarantine measures, the lack of control at animal exchanges/markets, and achievement of effective immunity in animals before short or long distance trade. Application of the PCP should assist countries to develop rational, risk based and feasible control strategies with clear objectives to either prevent disease in selected sub-populations or sectors (PCP Stage2), or to prevent circulation (PCP Stage 3).

The recent epidemic waves illustrate that institutional capacity and procedures for providing early warning of new epidemics remains weak and dependant on projects; in addition to national application of the PCP, Regional technical and policy support is needed to assist countries in their strategy development and to improvement management capacity. Appropriate integration of FMDV information systems for a region are needed to detect threats to national programmes, and funds are needed for support of responses at regional level, such as emergency vaccination, and for applied research to answer issues identified within the region.

NOTES

PROGRESSIVE CONTROL PATHWAY AND LONG TERM CONTROL OF FOOT AND MOUTH DISEASE (FMD) IN SOUTH ASIA

Mohinder Oberoi

Sub Regional Emergency Centre for Transboundary Animal Diseases Unit and Regional Support Unit for SAARC Countries

Introduction

Livestock are an important and regular source of income and often the only insurance against crop failure in SAARC countries. The predominant livestock population in the sub-region comprises ruminants viz., cattle, buffalo, sheep, and goat. Cattle and buffalo are mainly used as a source of milk, meat and draught power, while goats and sheep as a source of meat.

FMD is endemic and most important disease in all the countries of SAARC region and occurs throughout the year. Currently the serotypes prevalent are O, A and Asia 1. Out of these three serotypes Type-O accounts for about 85% of the outbreaks followed by types A (8%) and Asia 1 (7%). Sri Lanka has recorded only type O for more than 10 years now.

Disease control is sporadic and non-uniform. High-grade animals are routinely immunized, but the total vaccine coverage is less than 10%. With the low grade immunity, uncontrolled animal movement and informal trade in livestock and livestock products, the sub-region remains a major source of FMD. India has initiated a national program for the control of FMD using a zonal approach. The major commitment by the largest country in the sub-region for one disease signifies the importance of FMD.

FMD-Progressive control pathway (FMD-PCP) in South Asia

To develop a regional plan a series of workshops were initiated at the end of 2010 and first quarter of 2011 to sensitize policy makers and technical persons in Bangladesh, Bhutan, India, Nepal and Sri Lanka. Later a workshop to develop FMD-PCP for SAARC countries was held in November 2011 with the objective to draft the strategy (Roadmap) for regional FMD control in the SAARC countries between 2012 and 2020, using the principles of FMD-PCP. Through bilateral and regional discussions, countries were motivated to look across borders and envision bilateral and regional cooperation in addition to regional approaches. The expected outcome of this roadmap workshop was to have an agreed time frame for SAARC countries progressing national and regional FMD control between 2011 and 2020. Initial assessment of the current FMD situation highlighted the absence of an overall and comprehensive FMD control strategy for most countries but the countries supported the need for regional cooperation and need to establish a SAARC FMD-working group (FMD-WG) to safeguard a consistent approach for regional FMD control and to monitor regional progress of FMD control.

NOTES

FMD CONTROL IN SOUTHEAST ASIA: SCIENCE BASED APPROACH TO DEVELOPMENT OF ROADMAPS AND PVS TOOLS TO SUPPORT CAPACITY BUILDING

Ronello Abila [1]

[1]Sub-Regional Representative, OIE Sub-Regional Representation for South East Asia, c/o DLD, 69/1 Phaya Thai Road, Ratchathewi 10400, Bangkok, Thailand

The South East Asia Foot and Mouth Disease (SEAFMD) Campaign was launched in 1997 to coordinate a sub-regional control of FMD. Being a trans-boundary animal disease, control of FMD needs close collaboration among neighbouring countries and the involvement of relevant stakeholders such as farmers and livestock traders. In 2010, China joined the Campaign renaming it to South East and China Foot and Mouth Disease (SEACFMD).

To provide long-term guidance to the Campaign, a SEAFMD Roadmap 2020 was launched in 2007. The strategy was focused at progressive zoning approach to ensure effective use of limited resources from the donors and national governments. With the expansion of SEACFMD in 2010 and new developments in the socio-political arena in the region, new findings on the epidemiology of the disease in the economic and political, the SEACFMD 2020 Roadmap was revised. The strategy was expanded to reduce the overall FMD prevalence by targeting hotspots and critical nodes along movement pathways, pursue zoning in the most advance stage of FMD control and maintenance of FMD free countries and zones.

To strengthen the foundation to effectively control FMD, SEACFMD Epidemiology Network (EpiNet) and Laboratory Network (LabNet) were established to provide technical support to enhance SEACFMD member countries capacity for effective surveillance and diagnosis. Capacity building for early detection and response through training on Outbreak Investigation and Management have been successfully implemented involving district veterinary officers and veterinary para-professionals.

To enhance capacity of veterinary services (VS) to control and eradicate trans-boundary animal disease, including zoonoses, the OIE launched a global program called the *Performance of Veterinary Services* (PVS) Pathway. While the SEACFMD work as a vertical programme focused on one disease, the PVS Pathway comprising of PVS Evaluation, PVS Gap Analysis, and the succeeding interventions to overcome the gaps, serves as a horizontal programme to build generic capacities of VS to prevent, control and eradicate priority animal diseases.

NOTES

KEYNOTE: DYNAMICS OF FMDV EMERGENCE AND SPREAD WITHIN REGIONS; PROGRESS AND GAPS TO ACHIEVE RAPID THREAT DETECTION

Melissa McLaws[1], Chris Bartels[1], Nick J. Knowles[2], Daniel T Haydon[3], Mo Salman[4], Keith Sumption[1]

[1]European Commission for the Control of Foot-and-Mouth Disease (EuFMD), Rome, Italy
[2] FAO World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD), Institute for Animal Health, Pirbright, UK ;[3] Boyd Orr Centre of Population and Ecosystem Health, College of Medical, Veterinary and Life Science, University of Glasgow, Glasgow UK; [4] Animal Population Health Institute, Colorado State University

Introduction

Foot-and-mouth disease in endemic regions is often characterized by large fluctuations in numbers of outbreaks, with different serotypes predominating when outbreaks numbers are high (i.e. an "epidemic"). The cause of these fluctuations is multifactorial with factors including waning natural immunity, changes in circulating strains and/or changes in the environment that lead to increased transmission opportunities such as increased animal movements. The relative importance and interactions between these different factors are currently not well described; however, further depth of knowledge could enable improved threat detection and associated risk mitigation.

Materials and Methods

Recent epidemics in W. Eurasia were studied to better understand the dynamics and factors relating to emergence, detection and mitigation.

Results:

In W. Eurasia, epidemics of type O occur regularly, every 2-3 years. Epidemics caused by types A and Asia-1 are more sporadic, and the type A epidemics have been in close temporal proximity to the type O. In the case of types O and A, numerous strains and sublineages have emerged in the region, some of which thrive and others which fade away. In 2010 there was a large epidemic of type O (strain PanAsia-2) which reached Bulgaria and there is an Asia-1 epidemic currently ongoing in the region. In both cases, high meat prices in Turkey, resulting in increased animal movements from East to West, as well as questionable protection afforded by available vaccines have been implicated. Waning natural immunity from previous natural infection is also suspected to play a role in the timing of the 2010 type O epidemic.

These epidemics occurred despite ongoing surveillance and control programs in the region. Countries were on alert for Asia-1 since it was detected in Pakistan in December 2010, yet it was not possible to prevent westward spread into Iran and Turkey. Challenges to effective detection and control include delays in laboratory analysis and reporting, lack of effective control options (vaccine development is time-consuming, livestock marketing between and within countries is difficult to effectively restrict because of important implications to livelihoods) and there is sometimes reluctance to share information.

Discussion

These regional epidemics require a regional approach to reduce the spread and minimize the impact. Rapid threat detection is in the interests of the region and beyond, as the epidemics sometimes spread into countries normally free of FMD. Progress in improving threat detection is evident in the development of regional laboratory networks and the submission of samples from many countries to the WRLFMD. Information sharing and a regional approach to surveillance has been promoted in Eurasia by countries following the Progressive Control Pathway for FMD control (PCP-FMD) and attending associated Regional Roadmap meetings. However, gaps do remain. In order to reduce the threat of epidemic waves, the detection of the emergence of new strains must be timely and the strains must be monitored to determine if they thrive or fade. Epidemiological investigations and observational studies can be used to complement genetic analysis in order to arrive at sound conclusions about the source and the spread of specific FMDv strains. Resources for both surveillance and control are limited and so strategies must be risk based and efficient. Increased risk may be associated with the host, agent and/or environment and as such a holistic approach is required for improved threat detection and control.

NOTES

APPROACHES TO POST VACCINATION MONITORING

Samia Metwally
FAO-UN, EMPRES, Animal Production and Health Division, 00153 Rome, Italy

Introduction

Vaccination is one of the most important and costly component of FMD control and eradication. The current inactivated vaccines are used routinely as prophylaxis and in the face of an outbreak when an incursion of new virus strain occurs. Commercially-available inactivated vaccines proven to confer protection in 1-2 weeks but fail to provide long term immunity unless repeated vaccination is practiced. The quality of vaccines in the market is variable and difficult to evaluate before vaccine application. Thus post vaccination monitoring (PVM) to establish baseline herd immunity against circulating strains is prudent and key to timely improved control strategy.

Materials and Methods

Approaches to developing a universal PVM scheme for application in any given geographic and ecological settings will be developed as well as a targeted scheme to accommodate unique animal production and farming system.

Results and Discussion

Vaccine efficacy in the field is affected by several crucial elements including, but not limited to, vaccine performance characteristics in relation to circulating virus strains, vaccine coverage, age of vaccinates, maintenance of the cold chain during vaccine shipping and application, and training of vaccinators for proper vaccine delivery. Addressing these elements are prerequisite and essential in interpreting PVM data.

The design of PVM system entails direct measurement of protective immunity at herd level. This can be carried out by conducting serological surveillance in targeted population based on antibody titres to structural protein and ruling out virus circulation on the basis of antibody to non-structural protein. Pilot studies are to be conducted in candidate countries to accumulate data for establishing correlation between antibody titres and percent protection. Diagnostic assays for serological surveillance are to be harmonized to ensure confidence in PVM data.

Standardized PVM protocol and guidelines are to be established to accompany vaccination campaigns. PVM data can be a useful indicator for vaccine quality and critical in improving FMD control strategy.

NOTES

PERSISTENT INFECTION WITH FMD IN ASIAN SWAMP BUFFALO IN SOUTHEAST ASIA

(THE ROLE OF ASIAN BUFFALO IN EPIDEMIOLOGY OF FMD)

B.Verin[1,3,5], J.Edwards[1], T.Ellis[1], C.Benigno[2], M.Desport[1], R.Abila[4], S.Parida[1,3]

[1]School of Veterinary and Biomedical Science, Murdoch University, Australia
[2]FAO Regional Office for Asia and the Pacific, Thailand
[3]Institute for Animal Health, United Kingdom
[4]OIE SEAFMD Coordination office, Thailand
[5]Bureau of Animal Industry, the Philippines

Introduction

One important characteristic of FMDV is its capacity to establish persistent infection (carrier state) in ruminants after 28 days post-exposure to the virus irrespective of vaccination status. In the South East Asia (SEA) region, there have been very few studies on FMD persistence in Asian swamp buffalo (ASB) populations. This study has been carried out to investigate the presence and the role of FMD carriers in ASB.

Materials and methods

The study consisted of three longitudinal studies with field sample collections at six monthly intervals between September 2008 and June 2010. Five hundred ASB were randomly selected from specific areas in Lao PDR and Myanmar that had experienced confirmed outbreaks of FMD. Several tests to detect FMD carrier animals were used and results of the tests were compared.

Results

The performance of virus isolation (VI) and real time RT-PCR in ASB was validated using 101 OP fluid samples collected eight months PI. Results from VI showed that 14% of the 101 ASB were positive at eight months PI while only 10% of those were positive by real time RT-PCR. To maximize detection, a strategy of combining two independent tests, NSP and IgA ELISA was made and the samples that scored positive to both Priochek NSP ELISA and IgA ELISA were considered as persistently FMD infected. The results showed a higher detection rate (32.7%) of persistent animals compared to VI and real time RT-PCR (10% to 14%).

Discussion:

This study is the first to validate test performances of the different tests used to detect persistently FMD infected animals on ASB population in SEA. The study provided evidence for the presence of persistent infection (carrier state) in ASB for at least 20 months PI, which was the end of the study period.

NOTES

FMD: CARRIER STATE AND ROLE OF CARRIER BUFFALO AS SOURCE OF TRANSBOUNDARY SPREAD IN SOUTHEAST ASIA AND EASTERN ASIA

*B.Verin[1,2], A. Babu[1], J.Edwards[2],G.Hutching[1], T.Ellis[2], C.Benigno[3], M.Desport[2], R.Abila[4],J.Hammond[1],D J Paton[1], K.Sumption[5], S.Parida[1,2]**

[1]Institute for Animal Health, Pirbright, United Kingdom; [2]School of Veterinary and Biomedical Science, Murdoch University, Australia ; [3]FAO Regional Office for Asia and the Pacific, Thailand
[4]OIE SEAFMD Coordination office, Thailand; [5]European Commission for the Control of FMD (EuFMD) FAO,Rome

Introduction

In ruminants, irrespective of vaccination, an asymptomatic, persistent FMD infection (carrier state) can be established following recovery. African wild buffalo have been shown to transmit FMDV to impala in the Kruger national park and to livestock in close proximity although many experimental trials of transmission of FMD virus (FMDV) from carrier cattle to naïve cattle have been unsuccessful. In the South East Asia (SEA) region, there have been very few studies on FMD persistence in Asian swamp buffalo (ASB) and therefore we investigated the presence of FMD carriers in ASB, and considered their role in relation to transboundary spread of the disease.

Materials and methods

The capsid gene (P1) was sequenced of thirteen FMDV carrier viruses isolated from probang samples of swamp buffaloes (n=13) at Myanmar after 10-11 months of 2009 outbreak(Jan &Feb) and 59 FMDV from outbreaks of Myanmar, Thailand, Lao PDR, Vietnam, Cambodia, Hong Kong, South Korea and Democratic Republic of Korea, and compared with 110 capsid sequences available in genbank. The alignment for the capsid gene was used to construct distance matrices and neighbour-joining trees were constructed to test the robustness of the tree topology.

Results

A consistent non-synonymous transversion of the third codon in nucleotide position 1081 of P1 polyprotein (G to C/T) was identified in all the isolates (O Mya 1998 lineage) from the carrier buffaloes. This nucleotide change resulted in the substitution of glutamic acid to aspartic acid (E to D) at the amino acid position 58 of VP3 which is part of the major antigenic site IV. This substitution was neither seen in any of the parent outbreak isolates from Myanmar 2009 outbreak nor from any of the previous outbreaks caused by Myanmar 1998 lineages. Interestingly, this unique $VP3_{58}$ substitution was seen later on in one of the FMDV isolates from Vietnam outbreak during November 2009. Further this substitution was also noticed in the viruses isolated from the 2010 FMDV outbreaks in China, South Korea and Hong Kong and the 2011 outbreaks in South Korea and Democratic Republic of Korea.

Discussion

The identified genetic marker (changes from E to D at$VP3_{58}$) in carrier viruses which originated from Myanmar outbreak (Jan & Feb 2009) was present in the viruses isolated from the 2010 FMDV outbreaks in China, South Korea and Hong Kong and from the 2011 outbreaks in South Korea and Democratic Republic of Korea. This could suggest that the epidemic was initiated from one or more carrier animals persistently infected with viruses carrying this marker, or that this marker was spontaneously occurs in acute infections. Studies on animal movement (Polly Cocks' published data in SEA, OIE web) indicate that the animal movement pattern has changed in SEA and currently the major markets for livestock exist in Vietnam and China, where livestock attract a higher price and therefore drive movements from Myanmar, Lao PDR and Cambodia, towards Vietnam and China. This movement pattern may be one explanation for the rapid dissemination of an FMDV lineage across a wide region, or at least the initial transboundary spread. Further in vivo and field studies on genetic markers associated with carriage before firm conclusions can be reached on the transmission by carrier ASB.

NOTES

RISK BASED STRATEGIES FOR THE CONTROL OF EMERGING STRAINS OF FMD VIRUS IN BHUTAN

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FOOT AND MOUTH DISEASE AND ITS EFFECT ON MILK YIELD: A PRELIMINARY ECONOMIC ANALYSIS ON SMALL AND MEDIUM LIVESTOCK HOLDERS IN PAKISTAN

Giancarlo Ferrari[1], Luca Tasciotti[2], Ali Kiani[1], Ehtisham Khan[1]

[1] *Food and Agriculture Organization of the United Nations*
[2] *International Institute of Social Studies of Erasmus Rotterdam University (The Netherlands)*

Introduction

Although FMD is not a new disease, there are very few empirical studies assessing its economic impact and aiming at measuring the milk yield loss caused by the FMD outbreak. A longitudinal study has been conducted in Pakistan in the provinces of Sindh, Punjab and Islamabad capital Territory area to evaluate the impact of Foot-and-Mouth disease (FMD) on milk yield in cattle and buffalos. The study has been undertaken in the period November 2010 – May 2011.

Material and Methods

The sample studied consisted of 50 small-holders, where the presence of FMD virus was initially suspected on the basis of clinical signs and subsequently confirmed either through a field test device (penside) or laboratory tests. For each single lactating cow or buffalo data on milk production were collected up to 60 days following the onset of clinical disease with intervals at day 1, 3, 7, 15, 30 and 60 and was contrasted with the level of production before the onset of FMD. Data were obtained from 126 and 72 milking cows and buffaloes respectively.

Results

The average milk yield, estimated to be around 10 liters per animal before the onset of clinical FMD, decreases significantly in the 2 months following the onset of clinical signs. Milk production rapidly drops to 2.1-2.3 liters/day and the overall losses estimated in the 60 days following the onset of clinical signs amount to 307.65 (56.4%) and 284.39 (53.2%) liters in cattle and buffaloes respectively.

Discussion

This study represents an attempt to measure the likely consequences and immediate effects of FMD in lactating large ruminants. The results of this longitudinal study indicate that FMD undermines the livestock production in a serious way and for a prolonged time and may put significant pressure on the income generating capacity of the rural households.

NOTES

ECONOMIC IMPACT OF FOOT-AND-MOUTH DISEASE IN INDIA: A PILOT STUDY IN ANDHRA PRADESH[#]

B. Ganesh Kumar[1], G. Kathiravan[2], Karl. M. Rich[3], Brian D. Perry[3] and Aniket Sanyal[4]
[1]National Centre for Agricultural Economics and Policy Research, Pusa, New Delhi – 110 012;[2]Tamil Nadu Veterinary and Animal Sciences University, Namakkal – 637 002; [3]International Livestock Research Institute, South Asia Office, New Delhi – 110 012; [4]Project Directorate on Foot and Mouth Disease, Muktheshwar - 263138

Introduction This pilot study was conducted with the objectives of (i) estimating the costs and losses associated with Foot-and-Mouth Disease (FMD); and (ii) characterizing and quantifying the costs and benefits associated with FMD-Control Programme (FMD-CP). The direct economic losses caused by the disease are mainly due to loss in milk production and reduction in the working ability of work animals. The indirect losses are due to the non-acceptance of milk and milk products, meat and hide by countries free from the disease causing reduction in the export potential of livestock industry.

Materials and methods This study was conducted in the state of Andhra Pradesh during 2009-10 and the data from about 600 livestock farm households chosen randomly from four districts of the Andhra Pradesh, two from FMD-CP implemented districts (Chittoor and Medak) and two from FMD non-CP districts (Nellore and Mahbubnagar) were collected with the help of a well-structured and pre-tested interview schedule. The study tried to assess the direct impacts on the smallholder producers in the study area such as (i) loss due to reduced milk output, (ii) loss due to reduced draught power, (iii) loss due to treatment of sick animals, and (iv) loss due to mortality or culling. Since in India, about 75-85% of the recorded outbreaks are in cattle and buffaloes, it was decided to have an in-depth analysis of the impacts on these species only at farm level. Then, the factors influencing the compliance to vaccination against the disease were also found out.

Results FMD outbreaks persisted more number of days in the areas where there is no vaccination programme against FMD. Despite the FMD-CP, farmers reported that FMD outbreaks still persisted. Morbidity was higher than mortality and they were more in the areas where there is no vaccination coverage. The total economic loss per farm was found to be Rs. 41,482 and Rs. 63,768 due to FMD in an average CP and non-CP districts, indicating the impact of CP in the state of Andhra Pradesh to the tune of Rs. 22,286 per farm in an outbreak. Among the components of economic losses considered in this study, the loss due to the value of milk lost was the major factor, followed by value of draught power lost, loss due to treatment and the loss due to mortality of livestock. Factors such as education of the farmers, their experience in dairy farming and their total income positively influenced their urge to go for vaccination of their animals against FMD. Lower caste farmers, especially of OBC and ST, were found not getting covered completely by the vaccination programme. The major reason for not vaccinating their livestock, especially milk animals, against FMD was due to the notion that 'milk production might fall'. The total economic loss estimated could have been to the tune of Rs.1147.31 crores in a year in the state of Andhra Pradesh due to FMD outbreaks.

Discussion Expansion of FMD-CP to the whole of the state / region, ring vaccination, incentive system for the farmers to comply for vaccinating their animals, complete coverage of the susceptible animal population, quick response of the veterinary health care system in the event of outbreaks, regulation on movement of the animals across regions, etc. are suggested for effective control and ultimate stamping out of the disease from the country.

[#] This paper is written from the research study on 'Economic impact of FMD and its control in the dairy and meat value chains of selected high potential regions in India: A pilot study' sponsored by Indian Council of Agricultural Research, New Delhi

NOTES

THE CHANGING CONCEPT OF FMD DIAGNOSTICS: FROM CENTRAL TO LOCAL SERVICES

Mukteswar, India

AVAILABLE UPON REQUEST

NOTES

FMD DIAGNOSTICS: CURRENT DEVELOPMENTS AND APPLICATION IN THE CONTEXT OF FMD CONTROL IN ENDEMIC COUNTRIES

Wilna Vosloo

Australian Animal Health Laboratory, 5 Portarlington Road, Geelong, 3220, Australia

Accurate diagnosis of FMD is equally important in countries free of FMD and those where the disease is endemic and a control plan is in place. Information is needed regarding the prevalence of infection in various species, the serotypes and topotypes involved in outbreaks and in the case where vaccination is used, the immune profile of the animals as well as potential sub-clinical infection and carrier status. This information is also vital for countries embarking in the progressive control pathway to determine baseline epidemiological information and to act as incentive to progress along the pathway towards improved disease control and ultimately eradication. The specific need for diagnostic assays will change as countries move along the pathway.

FMD is currently endemic mostly in resource poor countries which implicate a need for cost effective, but accurate assays. Although maintaining laboratories and trained staff is expensive, their role is essential in ensuring diagnostics is delivered in an accredited and reliable manner. Experienced staff are also vital for test development, application, validation and as trainers where penside assays are deployed. The use of penside assays holds potential but various aspects need to be considered such as sensitivity and specificity of the assays, the training needed for the operator and the control under which results will be gathered and reported.

Cost is probably the determining factor in how widespread the use of diagnostic assays will be in assisting with FMD control. However, even inexpensive assays will be of less value if the costs for sampling and other control issues such as movement control and vaccination cannot be covered.

NOTES

DIAGNOSTICS SERVICES BY SUBNATIONAL FMD LABS: KITS AND QUALITY ASSURANCE, FUTURE NEEDS

WRL, Pirbright, UK.

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NOTES

STRUCTURE AND TRENDS OF INDIA'S LIVESTOCK SECTOR AND IMPLICATIONS FOR FMD CONTROL

J. Otte[*,1], *V. Ahuja*[1]

[1] FAO Regional Office for Asia and the Pacific, Bangkok 10200, Thailand

Introduction

Detailed knowledge of the structure and dynamics of the livestock sector and its associated value-chains are a prerequisite for sound disease control planning. The aim of this presentation is to provide an overview of the main characteristics of India's livestock sector with a focus on species susceptible to FMD

Materials and methods

The presentation draws on official statistical time series and published literature relating to India's agriculture and livestock sector as well as on literature describing, marketing, processing and value-addition to livestock products.

Results

With more than 300 million large ruminants (cattle and buffalo) and more than 200 million small ruminants (sheep and goats) India is home to the largest domesticated ruminant populations worldwide, while, at the national scale, the population of domestic pigs, around 10 million, is insignificant. This livestock population is distributed over some 120 million agricultural households, the majority of which operate on less than 2 ha and own less than 5 tropical livestock units. The main output / services of the large ruminant systems are milk, draught power and manure while meat is the major product stemming from small ruminants. Marketing and processing of livestock products is predominantly carried out by informal small-scale actors. Changes in the livestock sector comprise a decline in the use of draught power, replacement of 'non-descript' cattle by crossbreds and buffalo for milk production, the establishment of larger-scale specialized dairy operations and over-proportional growth of the formal dairy sector and vigorous growth of the goat population relative to sheep.

Discussion

Although the livestock sector is transforming relatively rapidly, small-scale informal actors will continue to constitute the vast majority of stakeholders to consider in animal disease control programs. Providing the right incentives to the latter to comply with disease control measures will be one of the major determinants of success in the control of contagious livestock diseases.

NOTES

FMD CONTROL IN DAIRY COLONIES MILK PRODUCTION SYSTEM IN PAKISTAN

M. Afzal[1], Manzoor Hussain[1], Ehtisham Khan[1] and Giancarlo Ferrari[2]

[1]FAO Project GCP/PAK/123/USA, FAO Office, NARC Premises, Islamabad, PAKISTAN and [2]FAO (Headquarters), Rome, ITALY

Introduction

Dairy colonies are located around all big cities to meet high demand for fresh raw milk. The biggest dairy colony is established at Landhi in Karachi having >300,000 animals. Due to high turnover of animals in the dairy colonies, FMD control offers special challenges. Studies were carried out in dairy colonies during last few years in coherence with activities foreseen to move Pakistan from stage 0 to 1 along the PCP-FMD.

Results

Studies indicated that dairy colonies serve as a hotspot for FMD virus infection. 96 to 98% animals leaving Landhi Cattle Colony (LCC) after completion of lactation had NSP antibodies. RT-PCR on oral swabs showed the presence of FMD in 19.2% clinically healthy animals at LCC. 27 of 39 FMD naive buffaloes entering LCC became NSP positive in the first month of their introduction. FMD detection in oral swabs from healthy animals was higher (almost twice) in samples from dairy colonies than live animal markets.

Current project outlines FMD control in selected dairy colonies as well as rural smallholder production system. The characteristics of new approach in dairy colonies is use of vaccine containing recently circulating FMD strains, early and consistent vaccination along with booster dose and sero-monitoring to assess herd immunity. Kinetics of immune response are also being studied to develop FMD vaccination schedule in dairy colonies.

Discussion

Activities being undertaken in the project are aimed at strengthening laboratory capability for FMD diagnosis, improving surveillance and response to FMD outbreaks and demonstrating benefits of early and consistent immunization practices for effective control. These activities will assist Pakistan to move to stage 2 of the PCP-FMD.

NOTES

THE ROLE OF OIE IN TRANSFORMING SCIENCE INTO PRACTICE AND POLICY MAKING

Joseph Domenech[1]

[1] *World Organization for Animal Health (OIE), 12 Rue de Prony, 75017, Paris, France*

Any policy and strategy for the control of animal diseases must be based on scientific evidences. The OIE norms and recommendations provide to Member Countries very clear guidance to prepare appropriate methods, strategies and policies as well as the necessary veterinary legislation to enforce the implementation of the control programmes. OIE has the mandate to edict standards and recommendations in the field of animal health and zoonosis. They are published in the "Terrestrial Code" and in the "Terrestrial Manual" and they represent real foundations to prepare control strategies. The OIE prominent role in transforming science into practice and policy making contributes to improving animal and public health situation, domestic production and trade, global food security and, in developing countries, income generation, small farmers livelihoods as well as poverty alleviation. The OIE standard setting is based on responsive, transparent and rapid procedures. The process starts with the involvement of the best recognized and independent experts who are invited to participate to small groups which reports to the Specialist Commissions. All draft texts are sent to member countries for comments prior to their presentation to the World Assembly for adoption. The normal cycle for the adoption of new norms is two years and shorter procedures can be developed in the case of emergency situations. The OIE also plays a role in defining, supporting and implementing national, regional and international policies and strategies which have been elaborated using scientific based norms and recommendations through various activities such as organizing international conferences, publishing scientific and technical journals, developing and implementing partnership and capacity building programmes for example in the field of veterinary services capabilities, laboratories or education.

NOTES

PUTTING IT TOGETHER: THE POTENTIAL ROLE OF MODELING TO EXPLORE THE IMPACT OF FMD CONTROL OPTIONS IN ENDEMIC COUNTRIES

Mo Salman, Melissa MLaws
Animal Population Health Institute, CSU, USA

Several countries and regional offices have been engaged in collection of filed data from FMD-related activities whether surveillance programs, outbreak investigation, and/or routine vaccination tasks. Data, however, should not be collected for the sake of obtaining records and figures. Data should lead to information so that decisions and policies can be influenced by specific facts and figures. Therefore data should be described and analyzed with the aim to derive conclusions about the observed events and procedures. Disease measurement (epidemiological indices) can be used for assessing specific intervention strategies in terms of effectiveness. Specific disease measurements can also be used to determine the source of a disease and if a trend change has occurred. Disease measurements, however, require careful assessment of the available data in order to derive the appropriate conclusion. Techniques in modeling and simulation can be utilized for assessing and/or supporting specific strategies particularly when various options are available. The modeling concepts however should mimic natural occurrence occurring of the disease as much as possible. Thus modeling would require reliable data and other information to reflect the actual situation in the field.

The North American Animal Disease Simulation Model (NAADSM) is a collaborative effort from various research and regulatory animal health agencies in North America with the aim to assess the implication of FMD control strategies in case this infection was introduced to the region. NAADSM is a computer program designed to simulate the spread and control of Transboundary Animal Diseases in a population of susceptible livestock herds. Among the goals of the NAADSM project are:

- To produce a practical, user-friendly modeling application suitable for the study of disease spread in the absence of an actual outbreak;
- To offer a tool for the assessment and evaluation of proposed disease control strategies and preparedness planning purposes;
- To provide support for researchers who will incorporate disease modeling in their work;
- To offer outreach and training in the use of disease models in general and of NAADSM in particular to the scientific and veterinary medical communities in North America and abroad.

The NAADSM is a combination of a disease spread model in which both temporal and spatial conditions are considered with a simulation process that utilize disease parameters that can reflect the actual field situation with livestock parameters obtained from available field data for the specific region under consideration. NAADSM however, was structured with the assumption that the region is free from the disease. Currently this simulation model is under revision to fit a region where the disease is known to occur.

The aim of this presentation is to demonstrate the value of a specific model as a platform for utilizing field data as the future direction of assessing specific strategies for mitigation of the spread and introduction of the FMD viruses.

Field data from current activities can be used to estimate specific required parameters for NAADSM. NAADSM then can be used by local technical support offices with the aim to assess the options for controlling FMD.

NOTES

THE GLOBAL FMD RESEARCH ALLIANCE (GFRA): CURRENT ACTIONS AND FUTURE PERSPECTIVE

Luis Rodríguez
ARS, USDA, USA

Despite over 100 years of research to find solutions to the devastating disease it causes, foot and mouth disease virus (FMDV) remains one of the biggest challenges to animal health scientists today. Although FMD vaccines have been available for decades and the disease has been eradicated or largely controlled in some parts of the world, FMD is still rampant particularly in regions of Asia and Africa where animal protein demand is increasing. Investment on FMD research worldwide represents only a small fraction of the USD$ billions spent in vaccination and control. Due to this small investment in FMD research there are few laboratories worldwide with the adequate biosafety level to safely study this virus. These facilities, some of them over 50 years old, have limited capacity for large animal work. This combined with chronic underfunding resulted in fragmented and duplicative research efforts of limited scope and low impact that often failed to translate into useful tools for control and eradication. Seeing this reality, a group of scientists, mostly from FMD laboratories in FMD-free countries, decided to establish a global alliance focused on FMD research (GFRA) and through this alliance promote research coordination and collaboration, to optimize the limited resources available at each site and to jointly seek collaborations with endemic countries where research resources are limited and the need for better control measures is great.

Since its establishment in 2003, the GFRA has grown to 35 partners (as of January 2012), including public, private, academic, non-profit, government and international institutions distributed in five continents. Combined research resources and new resources obtained through alliance collaboration total several million US$ for research that would otherwise not be available to individual laboratories. Many research collaborations involve two or more GFRA partners from the different sectors, thus enhancing the connection between basic and applied research with development and application of the knowledge to solving real-life problems. The vision and mission of the GFRA are concentrated in (i) coordinating a global alliance of scientists producing scientific evidence and innovation on FMD research, and (ii) establishing and sustaining global research partnerships in order to generate scientific knowledge and discover the tools to successfully prevent, control and eradicate FMD (http://www.ars.usda.gov/gfra/). Several GFRA research programs are currently active in Europe, North America, South-East Asia, Australia, South America and South Africa. GFRA programs will continue to expand the alliance in these regions and will actively reach out to new areas of the world that have a stake in the progressive control and eradication of FMD.

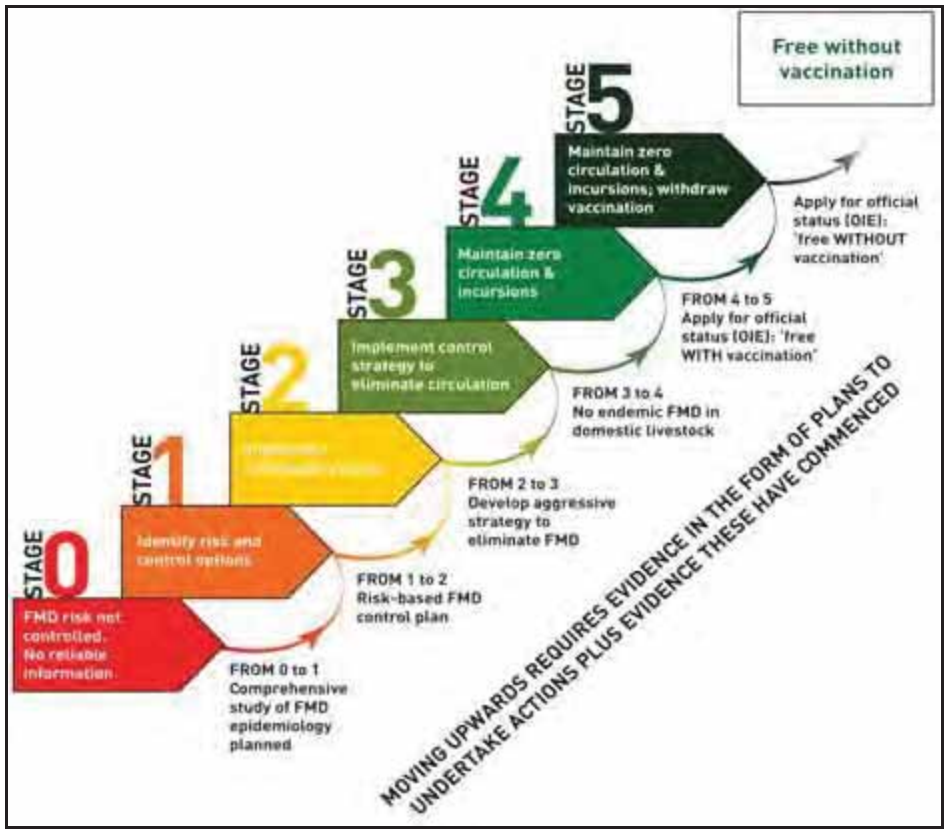
How? Collaborative research is central to the fulfillment of GFRA's vision and mission. GFRA members act as focal points in putting together strong teams, drawing in other institutions with the specific skills required to achieve the aims of a particular project. Five strategic goals, encompassing 18 objectives, give structure to the overall process. Members can easily join in three membership modalities; full members, associate members and collaborating members.

What next? GFRA will continue to build the Alliance by adding new members and reaching out to partners and stakeholders worldwide. It will hold and organize regular meetings, will further develop its website and other outreach media, and will pursue funding opportunities in its fight to combat FMD.

THE PROGRESSIVE CONTROL PATHWAY FOR FOOT AND MOUTH DISEASE CONTROL

PCP - FMD

PCP-FMD PRINCIPLES AND APPLICATION



Stage progression in the Progressive Control Pathway

The Progressive Control Pathway for Foot and Mouth Disease (**PCP-FMD)** has been developed by FAO to assist and facilitate countries where FMD is still endemic to progressively reduce the impact of FMD and the load of FMD virus. The PCP-FMD has been adopted by FAO as a working tool in the design of FMD country (and some regional) control programs, and following appropriate consultation it has become a joint FAO/OIE tool. The PCP-FMD is expected to form the backbone of the **Global FAO/OIE Strategy for the Control of FMD** that is under development.

The PCP-FMD is a set of FMD control activity stages (*Figure 1*) that, if implemented, should enable countries to progressively increase the level of FMD control to the point where an application for OIE-endorsement of a national control programme vaccination (in an advanced phase of **Stage 3**) or official freedom from FMD with or without vaccination (end of Stages 4 and 5, respectively) may be successful and the status sustainable.

PCP Principles
The PCP approach is based on the following principles:

Active monitoring for FMDV circulation and understanding the epidemiology of FMD are the foundation of a control program, and therefore activities to meet these requirements are common in all stages. The improved information generated is of benefit nationally and regionally. The monitoring of outcomes (indicators of control effectiveness), within a national FMD management system, is included at the higher stages;
Activities in each PCP stage are appropriate to the required reduction in virus circulation and mitigation of disease risk to be achieved;
Activities and their impacts are measurable in each Stage, comparable between countries, and generate information and potential benefits to national as well as international stakeholders;
The optimization of resource use for FMD control is achieved through the targeting of measures to the husbandry systems and critical risk points where the impact on disease control and/or virus circulation will be greatest.

PCP and alignment with current regional FMD Control initiatives
In some regions, there are already existing bodies and programs established to promote and harmonize regional FMD control efforts. The main examples are the EuFMD Commission, involved with the European neighbourhood and the West Eurasia Roadmap, the 2020 Roadmap for Foot and Mouth Disease Control in South-East Asia and China (SEACFMD) and the Plan Hemisférico de Erradicación de la Fiebre Aftosa (PHEFA) for South America. The PCP is intended to assist those regions without such current programmes, but could also be used in relation to the current regional programs by the GF -TADs Steering Committees to report on the regional progress. The concepts and assessment indicators may also have their application within these existing programmes, for example to progress towards the development of control zones as used in some regions and improved understanding of critical control points as well as risks.

PCP and stakeholders
It is fully recognized that true progress in FMD control is not feasible without the support of the owners of the animals and the other stakeholders in all steps from production to marketing. Therefore strong and continuous efforts will have to be made to get and maintain such support. Particularly for the higher stages of the PCP-FMD pathway, evidence that the national FMD Control Plan is backed by stakeholders will be necessary for a proper assessment of what has been achieved and the potential sustainability thereof.

PCP and use of information
The gathering of data in the framework of the FMD-PCP is subject to the privacy rules of FAO and OIE.
Countries taking part in the PCP accept that the data they provide will be used by FAO and OIE and their experts for an assessment to classify the country in one of the PCP-FMD Stages. The result of this process is in the public domain and will be published on the website of the FMD-WG. The underlying data, however, will not be freely available unless agreed to by the country concerned.

The FAO and the Indian Council of Agriculture Research (ICAR) of the Ministry of Agriculture of India have called this meeting to gauge how scientific progress on foot-and-mouth disease (FMD) is changing the potential for control of the disease in South Asia and potentially, in areas with similar disease risk.
The main themes are the potential of current FMD research for the development of improved vaccines and vaccination programmes; the optimization of control programmes based on comprehensive assessments of FMD epidemiology and of control options; regionally co-ordinated FMD programmes; and the growing FMD scientific output from Eurasia, which has the potential to create new and greater levels of control if public policy makes good use of the best science.
This book of abstracts provides a guide to the main papers presented during the meeting.