Foot-and-Mouth Disease Control in Asia: Meeting Unique Challenges

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As Swine veterinarians and members of the agricultural sector we all have a vital stake in the future of animal health especially in the production animal segment. Underlying this philosophy is need for “better solutions” to some of the problems affecting livestock generally and swine industry specifically. In this context, foot-and-mouth disease (FMD) has been an enduring disease control priority globally and today presents the fastest growing challenge facing Asia.

Few here have not known the effects of this disease in their countries; in fact many of you have had first hand experience, some are even experts that have taken on roles in furthering the understanding and implementation of effective disease control. For the foreseeable future, improving control of FMD will be a key aim for our Regional governments, National animal health services and livestock industries. We are tasked to find control approaches and solutions that will make a difference.

Efforts in pursuit of FMD control have had enormous political, financial and emotional impacts. We need not look further than the recent disease incursions in South Korea and Japan to see the scale of response, fiscal impacts and horrendous emotional costs that controlling outbreak have required. The current Type O outbreak being experienced in South Korea is the worst in the country's history and the most significant in the world since the UK outbreak in 2001….our heart felt sympathies go to many that are affected by these tragedies. Many will remember the media images and public response to the crisis evolution and handling of the 2001 UK FMD outbreak…this event more than any before gave the general public an unprecedented close up on the implementation of large scale “stamp-out” control. It is obvious:- when animal suffering & destruction is numbered in millions of head; the financial impact measured in billions of $US; and where the social and emotional costs are inordinately high; the quest to improve control efforts and minimise FMD’s destructive impacts are worthy priorities.

The ease and often “explosive” spread, the direct losses incurred and the negative effect on market access or trade impact, make FMD one of the most serious and important livestock diseases globally. Its significance in Asia is undoubtedly growing due to several factors, not the least being that:-

- the disease has greater negative effects on growing populations of improved and more efficient production animals;
- there is greater risk of virus spread due to increased people movements and livestock product trade;
- there is an increasing gap between developed and developing countries in this region;

The result is that we are faced with a situation where increased populations of concentrated and highly susceptible animals are having greater risks of being exposed to FMD virus (FMDV).

FMDV (Aphtae epizooticae) is a highly variable and transmissible virus, usually capable of infecting a range of ruminants and swine. The virus has a discrete range of serotypes (7 are known to exist) and several subtypes, each with an ability to continually evolve and mutate contributing to wide genetic and antigenic variation. Different host species may (and even different breeds) exhibit varying disease susceptibility during any prevailing outbreak/epizootic. Viral transmission occurs in a number of ways:- animal to animal (including through semen and milk); aerosol “wind borne” spread; by non-affected host animals (including humans); as well as by animal products. Contaminated housing, material, clothing, water, soil and inanimate objects (such as fodder and vehicles), as well other mechanical vectors can also be responsible for disease spread.

The epidemiology of FMD in Asia is influenced by a combination of factors. This includes:- variation in the virus strain; the consistency of effective control measures; and new strain introductions (originating from distant outbreaks that are transmitted via animal movement or other mechanisms) to susceptible populations. Seasonal and cyclic periods of increased disease prevalence are observed, suggesting that there factors that favour periods of increased transmission or host susceptibility that predispose epizootic risk.

Although there are still gaps in our understanding of the FMD epidemiological situation in endemic Asia today, over recent years there has been an increase in the volume and quality of information being collected and shared. The significant advances in the tools and techniques being used to analyse virus samples, investigate outbreaks, interpret data are more readily available and used. The independent and collaborative works of various National animal health services, key control initiatives (e.g. those of OIE-SEAFMD, FAO, and facilitators), laboratory networks (regional and global), and the many other groups involved in related extension/research projects, are responsible for much needed improvements in our knowledge. The following is an attempted summary of the prevailing state of play in Asia;
Distribution of FMD viruses:

Today, serotypes O, A & Asia 1 are considered endemic in one or more of the FMD affected countries in Asia, with Type C having last been reported in the Philippines in 1995. Although in recent years there has been a general increase in disease reporting transparency, field surveillance, outbreak investigation and field isolate studies, the submission of virus samples for processing and analysis by central reference bodies such as the World Reference Laboratory (WRL) or South East Asian Regional Reference Laboratory (RRL) have been irregular. Consequently available information may not be comprehensive or complete.

Serotype O: Over the past 15 years, there have been 3 distinct groupings (“topotypes” or “lineages”) of Type O identified in Asia. They are Southeast Asia (SEA), pan-Asia, and Cathay (“pig-adapted”) strains. Sub-families exist for both the SEA and pan-Asia topotypes. In recent years, Type O strains have been responsible for the most severe epidemics experienced in Asia:- Cathay strain Philippines 94’, and Taiwan 97’; Asian/UK epidemic viruses of O pan-Asia in 2000’/01’; and SEA strain Indochina 97’ & HK, Japan, Korea 2009’/10’. While O1 Manisa vaccine has proven to be a robust “immunodominant” strain found to be very useful for many of the different Type O outbreaks, this is not always the case. As efficacy will vary dependant on prevailing outbreak topotype, several other Type O vaccine strains are used appropriately to improve vaccine efficacy. Some epidemiological situations are complicated due to the concurrent presence of several antigenically different Type O virus strains (e.g. different topotypes)...in such situations inclusion of multiple Type O vaccine strains in a single vaccine have been used to assure required efficacy.

Serotype A: Is potentially the most variable of all the FMD serotypes, and although historically outbreaks have occurred in many Asian countries, they are more common in Thailand and Malaysia where endemic virus circulation in ruminant populations is likely to occur. Recent outbreaks are restricted to the SEA topotype which has exhibited some antigenic drift. The most recent epidemic occurred in 09’/10’ and included a disease incursion into then FMD free Sth.Korea which was successfully controlled / eradicated. Ongoing vigilance for new A strains introductions or strain variants is important due to relatively higher risk of antigenic changes/differences being encountered. Currently there are several different Type A vaccine strains being used in Asia. They confer variable protection against circulating isolates, however SEA topotype vaccine strains have been found to be particularly use in recent years.

Serotype Asia 1: Is the most antigenically stable of the 3 endemic serotypes and has been shown to exhibit relatively low levels of antigenic variation however is still capable of antigenic drift. Various historical epizootics have been reported, mainly affecting some SEA countries. Cases appear to have cyclical prevalence pattern, with the most recent epizootic affecting the SEA & Greater China geographies in the 2004-2006 period. For many years the “immunodominant” Asia 1/Shamir vaccine strain has proven to be valuable in outbreak control and is still appropriately recommended for use.

Virus spread: It is accepted that the most important endemic mechanism of virus spread in Asian countries is by live animal movement, both within disease affected countries and across borders. This is largely driven by the economics of trade. Cattle, buffalo or pigs movements are the source (or implicated) in most cases, and well documented trading patterns that reflect local demand have a high correlation to outbreak risk factors and disease “hotspots” in the Indochina Region. Although not definitive, there are instances where genetic analysis of outbreak isolates has implicated animal products (meat) as the likely source of new strain introductions into this Region, and between countries. In the absence of other possible sources, the many bio-security failures observed over recent years suggests that people have been responsible for transferring FMD between farms; this may prove to be an important & underestimated transmission risk within this region. The long distance spread of FMD on the wind doesn’t appear to be an important source of transmission, although aerosol transmission in cases of neighbouring farm-to-farm spread is likely, especially in areas of high animal densities where pigs are involved.

Country/Zone FMD status:

Insights into National veterinary service prioritisations, control activities and prevailing needs are broadly related to country or zone FMD status. These can be distinctly grouped:

- Most FMD free countries enjoy the benefits of maintaining such a status, however as they can have large populations of naive livestock (i.e. vaccination is not routinely practiced), the potential impact of a large or lasting disease incursion on animal populations, the society and fiscally can be very significant. Primary challenges are on reducing disease introduction risks, and ongoing “peace time” development of appropriate incursion response preparedness and veterinary service capabilities. Attention is paid to: - required regulatory and legal framework which facilitates quick and efficient disease identification and appropriate control responses; and the subsequent FMDV eradication validations that would be required to regain official Disease Free status, in the event of an outbreak.

- For FMD endemic countries or zones, there can be two general groupings:
  (a) One includes those countries where commercial livestock sectors and external trade opportunities are not well developed, veterinary services may be weak and FMD...
and expense), and today more than 95% of pigs in commercial herds (usually at the producer motivation vaccines are routinely used in the vast majority of vaccination coverage. In Asia, available FMD generally correlated to increases in National herd decreases in National FMD outbreak rates are ensure appropriate quality vaccines are used. regulated to aid vaccination compliance aims and to initiatives. This is the case in both disease endemic settings or when used strategically as an aid to initiatives; and building capabilities that support transition to successful and sustainable FMD eradication.

(see ppt. presentation details & current requirements/status officially recognised by Office International des Epizooties “OIE”);

Vaccination:

As a part of disease prophylaxis, vaccines are recognised as an important tool and play an increasingly important role in FMD control both endemic and non-endemic settings. Use of vaccines that achieve relevant “herd immunity” levels of >80% in susceptible animal populations are the basis of virus transmission and disease reductions necessary to effectively aid outbreak control. Dramatic and almost complete reductions in FMD prevalence are consistently observed when appropriate vaccines are correctly employed as part of comprehensive control initiatives. This is the case in both disease endemic settings or when used strategically as an aid to outbreak control & eradication efforts.

In endemic countries, FMD vaccines are often regulated to aid vaccination compliance aims and to ensure appropriate quality vaccines are used. Decreases in National FMD outbreak rates are generally correlated to increases in National herd vaccination coverage. In Asia, available FMD vaccines are routinely used in the vast majority of commercial herds (usually at the producer motivation and expense), and today more than 95% of pigs in commercial production settings are vaccinated. National Animal Health bodies use several mechanisms to increase overall National herd vaccination coverage, they include implementation of: - mandatory vaccination; vaccine subsidies; and mass vaccination initiatives that target small land holder animal populations, specific host species or strategic ‘high risk’ geographies. Having said this, the approach to vaccination as control tool is not uniform between countries and the role and use of vaccines varies. Even when routinely used, there is a wide range in vaccination rates being achieved in susceptible populations between different disease endemic countries.

In FMD free countries, routine use of FMD vaccination is banned (in compliance to OIE Disease Free status requirements). However many (but not all) disease free countries have established contingency plans that include provisions for strategic emergency vaccine use in the unfortunate case of disease incursion. To help assure timely availability of vaccines (should they be required in an emergency situation), strategic vaccine &/or cryostored FMD Ag Bank inventories are maintained, and relevant service/supply agreements made with vaccine provider/s. The high quality requirements for such vaccines favour safe, high potency, and highly purified products. A feature of high purity vaccines is that do not interfere modern FMDV “Non-structural proteins” antibody assays, this has enabled helpful serological survey tools that identify infected/carrier groups of animals, to be used even in vaccinated populations (i.e. DIVA).

FMD vaccine limitations exist; vaccination with one FMD serotype does not confer cross protect against other serotypes; additionally vaccine efficacy may vary between isolates of the same FMD serotype if antigenic diversity is great. Having said this, current vaccine technology has played a central role in many successful FMD control and eradication in Asia and globally...continued improvements in vaccine quality and services are being made, and research into new technologies explored in the ongoing quest to deliver more effective vaccine tools & alternatives. Understanding and mitigating limitations and utilise available tools appropriately are important in the context of Asian endemic and disease free situations. Use of appropriately matched vaccine strains (be they homologous or heterologous), relevant to prevailing field epidemiology, and formulation of fit-for-purpose vaccines has been used to great advantage in Asia. The ongoing activities and collaborations between National veterinary service and regulatory bodies; vaccine manufacturers; and independent bodies such as the WRL or RRL are playing vital roles to ensure aims are being addressed and ensure adequate supply of vaccines to meet current and anticipated needs.
Experiences and challenges:
Recent years have seen several Regional countries secure “Disease Free” recognition that have required validation of disease freedom after disease (e.g. South Korea & Japan), eradication from an established endemic or outbreak situations (e.g. Philippines & Indonesia). Others, although not disease free, have reduced outbreak prevalence to sporadic outbreaks (e.g. Taiwan, Vietnam, & Thailand), after successful implementation of comprehensive disease control initiatives.

However the Region has unique diversity that is relevant to trans-boundary (crossing country borders) disease movement risks - they include;
• geographical (island nations, peninsulas, and a large multi-nation ‘mainland’) and cultural practices.
• countries with different disease endemic/free status.
• wide range of farming systems and levels of industry development (from subsistence, backyard, to fully integrated production).
• trans-boundary animal and animal product trade movement pathways.
• differences in National disease control capabilities, motivations, priorities and resources.

Add to this, the dynamic socio-economic and urbanisation changes that can influence disease epidemiology, and it could be viewed as inevitable that there will be FMD movement from endemic ‘hotspots’ or outbreak areas to neighbouring geographies.

Fundamental questions are being posed. The trans-boundary nature of FMD suggests that significant and sustainable improvements in FMD control is dependant, or even reliant, upon the success (or otherwise) of disease control in neighbouring countries. Although not a new concept, implementation of collaborative and robust multi-country disease control initiatives are today being viewed as fundamental to meeting the challenges that sustainable FMD control present in Asia. By example, the member Nations of the “SEAFMD” group (co-ordinated by the members of the OIE Sub-Commission for FMD in SEA, now in it’s 17th year) have over recent years developed and embarked on “progressive zoning” approach to facilitate FMD control. National animal health services and key stakeholders develop agreed objectives and initiatives that deliver co-ordinated activities support of FMD control (often in National and industry self interest). Communication is an important component, so I encourage you to visit the SEAFMD website for relevant insights into their activities, updates on FMD situation, reports on FMD epidemiology, and control progress.

There are still so many insights to be gained that are largely specific to Asia. From the “science” represented by the many investigations into FMD epidemiological roles played by different host species, through to “soft skills” represented by effective communication and advocacy initiatives that sustainable control requires. So many fresh and different approaches need to be considered, tried, and adapted…then used to improve the results of our individual and collective efforts. I am confident that this quest will bring solutions that will make a vital difference.

It’s a dynamic and challenging time to be involved in FMD control in the Asian region – a great time to be among veterinarians, allied professionals and many others who are involved in this journey of endeavour, collaboration and discovery – which is as much about the disease as ourselves.