Progressive Control Pathway for Foot and Mouth Disease (PCP-FMD)

Checklist Explanation

March 2013

Contents

Instructions for filling out the PCP checklist:

1. Please complete the checklist corresponding to your country's PCP Stage assignment at the most recent Roadmap meeting. If you believe that your country should be in a different PCP stage this year, then please fill in both checklists.

2. All questions, EXCEPT those shaded yellow, should be answered as either Yes or No, or Not applicable.

    a. If the answer is Yes, please indicate with the number 1.
    b. If the answer is NO, please indicate with a 0 (zero).
    c. If the question is not relevant to the country situation (eg relates to swine production when there is none in the country), please mark NA.

3. Cells shaded yellow should be answered with a number ONLY

4. Activities are either Required or Recommended.

    a. Required: These activities are indicated by the grey shading. Some activities or conditions are considered essential and fundamental to progression in the PCP, and so are required to complete the PCP Stage. A country can remain within the Stage without fulfilling all of these required activities...but they must be fulfilled in order to progress to the next stage.

    b. Recommended: These are not required to complete the Stage, but are suggested, and if completed generally indicate high quality or thoroughness

5. Words in **red** are included in the *Glossary* at the end of the document.

Checklist explanation – PCP Stage 1

Countries in PCP Stage 1 should be conducting activities that allow them insights into all aspects of FMD in the country (transmission and impact of FMD infection). Thus, they can define areas and practices of ***high risk*** *for FMD.*

A country is in PCP Stage-1 when:

It has fulfilled the minimum requirement to enter stage 1 AND results are available from activities working towards Outcomes 1 & 2 below.

OR

WHERE the Country has been previously recognized in PCP-Stage 1 following the most recent Regional Roadmap Meeting AND *results are available from activities working towards key outcomes 1 & 2 below.*

a. To enter Stage 1: To have a comprehensive plan to gain insights into the epidemiology and socio-economics of FMD

Such a plan indicates commitment to initiate the PCP-pathway. Having a plan in advance will assist a country to include all required elements of the Stage, and to conduct PCP-Stage 1 activities in an efficient and logical manner.

b. Outcome 1: All husbandry systems, the livestock marketing network and associated socio-economic drivers are well described for FMD susceptible species

FMD virus is primarily spread through the everyday activities that are part of raising and handling livestock, such as milk collection, buying and selling of livestock, feed, taking animals to and from grazing land etc. Therefore these activities (related to husbandry systems and animal movements) should be well understood by those responsible for FMD control, as well as the underlying socio-economic drivers, in other words the reasons why livestock are raised and marketed in the ways that they are (FAO, 2011).

Movement patterns: There should be a general understanding of movement patterns for the main FMD susceptible livestock in the country such as large ruminants (cattle and buffalo), small ruminants (sheep and goats) and pigs. For those species/husbandry types considered at higher **risk** of FMD, the information should be more detailed and include numbers, origin and destination, the purpose of the movements and any seasonal patterns.

Stakeholders: In order to reduce the transmission of FMD, some actions must be taken by the stakeholders who conduct these day-to-day activities. FMD control will be much more successful if most stakeholders comply with the control measures. At this point, all stakeholder categories (i.e. not individuals but groups) should be identified by the Veterinary Authority, and a representative for each category identified (name and address).

Both FMD and FMD control measures impact the business and livelihoods of the stakeholders. From the stakeholder's point of view, this impact of control measures may be positive (healthier stock, enhanced productivity, more markets to sell products) or negative (lose money due to movement

restrictions, loss of markets due to). If FMD is perceived to cause substantial losses, then stakeholders will be motivated to control it. However, if the FMD control measures cause large or ongoing losses, then stakeholders will be less likely to comply with the measures. It is therefore recommended that the Veterinary Authority work together closely with the stakeholders in order to understand their point of view with respect to FMD control.

The **incentives and constraints** that pertain to the behaviours and livelihoods of the stakeholders should be understood and taken into account in developing FMD control measures. These incentives and constraints will largely determine both motivation to control FMD and compliance with any control measures implemented.

In PCP-Stage 1, the most important sources of income for each stakeholder category should be identified, as well as their main expenses and reasons for financial losses. This will allow the Veterinary Authority to understand the level of importance of FMD to the particular stakeholder. Important constraints should also be described, and will include the regulations that govern each industry/stakeholder, for example the number of days per week markets are permitted to be open, which vaccines are licensed within the country, rules pertaining to carcass disposal, treatment of raw milk etc.

c. Outcome 2: The distribution of FMD in the country is well described and understood and a 'working hypothesis' of how FMD circulates in the country has been developed

In order to reduce the spread of FMD, the mechanisms of how FMD is passed from farm-to-farm, and region-to-region within the country must first be described and understood. Information about how livestock are raised in the country (Outcome 1) is combined with information about FMD occurrence to identify the common and important routes of FMD transmission. This is called a 'working hypothesis', and is a tentative explanation of the main reasons for FMD spread that should be reviewed for accuracy, refined and improved as more information becomes available. This working hypothesis is a critical tool in the development of a risk-based FMD control strategy.

To fulfil this outcome, the **incidence** of FMD in different regions of the country and in different husbandry systems should be estimated. 'Regions' might correspond to districts, provinces or husbandry areas (for example, if a group of districts constitute the main dairy-producing area then this might be defined as a 'region' over which incidence is estimated).

An estimation of FMD incidence is required to assess and compare FMD **risk** in different regions and production types, and also provides a baseline to determine if FMD control measures are reducing the risk over time.

A necessary first step is to define and count the number of **epidemiological units,** the denominator for the incidence calculation. FMD incidence (I) can then be calculated using the number of clinically confirmed cases (i.e. the number of epidemiological units which have animals with clinical signs of FMD) and/or the results from a **non structural protein** (**NSP) serosurvey**.

$$I = \frac{\text{the number of FMD infected epidemiological units in a given period of time (eg. 1 year)}}{\text{the total number of susceptible epidemiological units}}$$

The data used to calculate incidence should be **epidemiologically robust**, meaning as reliable and free from **bias** as possible . If incidence is estimated using reports of clinical signs compatible with FMD, the accuracy of the estimate can be affected by under-reporting and misdiagnosis. If non structural protein (NSP) serosurvey data is used, then the survey should be carefully designed and conducted to avoid bias (for examples, see Bayissa et al, 2011; Gelaye et al, 2009).

Outbreak investigations should be conducted regularly to describe the clinical presentation of FMD and identify the source and common mechanisms of spread, as well as the causative serotype. Ideally, there should be Standard Operating Procedures and standard data recording forms should be developed and used for these investigations.

Information about husbandry (Outcome 1), the distribution of and results of outbreak investigations can be used to generate a working hypothesis of how FMD virus circulates in the country [1].

d. Outcome 3: Socio-economic impacts of FMD on different stakeholders have been estimated.

The impact of FMD must be understood for 2 main reasons. First and foremost, the magnitude of the losses must be described in order to convince governments, stakeholders including industry and international organizations to invest in it. Secondly, the FMD impact should be measured in order to ensure that the control measures are reducing it (ie cost-benefit analysis).

In PCP-Stage 1, countries should identify and measure the impact of **direct losses** due to FMD in the key husbandry systems, such as the extent of decreased production (milk and meat), lost draught power and increased mortality caused by FMD.

e. Outcome 4: The most common circulating strains of FMDV have been identified.

Knowledge about the circulating serotypes and strains is needed to further understand how FMD virus is transmitted within the country, and also do design an effective, risk-based control program. There is little or no cross protection provided by immunity to different FMD serotypes, and so identification of circulating serotypes is required to design an effective vaccination program.
Full characterization of circulating strains (including sequencing and vaccine matching) is needed to ensure that the vaccines used offer protection. Strain characterization can also assist to pinpoint the origin of new viruses entering into the country, for example from cross border animal movements, wildlife, or trade. Threats posed by new viruses or antigenic drift should be identified as quickly as possible, to allow steps to reduce the associated risks, for example by enhanced border security in high-risk areas or changing the strains included in vaccines.

In order to get an accurate picture of circulating strains, samples should be collected from different geographic areas and husbandry types, and at regular intervals. It is recommended that countries submit 30 isolates per year to the Regional and/or the World Reference Laboratory for full characterization including sequencing and vaccine matching.

f. **Outcome 5: There has been progress towards developing an enabling environment for control**

activities.

This outcome continues through all PCP Stages and describes the setting in which FMD control must be applied, and whether or not the underlying conditions will aid or impede control. There are several factors included:

*FMD **surveillance** system:* In PCP Stage 1, FMD should be a notifiable disease and the reporting of suspect cases should not be discouraged. This is necessary to demonstrate commitment to FMD control.

Strengthening Veterinary Authority: This is a very broad area. In PCP-Stage 1, it is recommended that a unit in the official Veterinary Authority devoted specifically to FMD control be defined, to ensure that roles and responsibility for FMD control are clear. It is also recommended that training is provided in infectious disease control, outbreak investigation and surveillance for field veterinarians.

Supportive legal framework: Veterinary Authority need legal authority to pursue disease control. In this 1st PCP Stage, the veterinary legislation should be assessed with a view to future control measures, such as the right to enter premises for surveillance and control purposes, to impose movement restrictions etc.

Develop information systems: Decisions about FMD control should be based on information about the field situation, which in turn comes from data collected from reports of suspected clinical disease, outbreak investigations, laboratory results, surveys etc. Centralized, computerized information systems must be developed to hold these data and facilitate its analysis so that it can be used in decision making about FMD control.

g. **Outcome 6: The country demonstrates transparency and commitment to participating in regional FMD control.**

FMD is one of the most contagious diseases, if not the most, and as such FMDV often crosses borders to infect animals in neighbouring countries. Therefore, all countries are put at risk by the FMD situation in other countries, particularly neighbouring countries and trading partners. Further, a regional approach to FMD control is preferred and most likely to be effective.

h. **Outcome 7: Important risk hotspots for FMD transmission are identified**

Risk hotspots are specific point(s) in the production or marketing network at high **risk** for FMD (ie. that have a high probability of FMD infection, or where the consequences of FMD infection are great). For example, live animal markets are commonly identified as risk hotspots, because they represent a place where FMD-infected animals can mix extensively with and infect other animals, which in turn are sold and transported back to farms where they may infect yet more livestock. Another example of a risk hotspot might be milk collection, in which a vehicle travels from farm to farm without adequate biosecurity measures, sometimes carrying FMD virus with it.

To fulfil this outcome, risk hotspots are identified and described as precisely as possible; risk pathways are commonly used for this purpose (for example, see FAO, 2011). Further, important aspects of these

risk hotspots that are not fully understood should be identified and research activities planned to fill these knowledge gaps.

This step is critical to the successful completion of Outcome 8, and PCP Stage 1.

i. **A strategic FMD control plan that has the aim of reducing the impact of FMD in at least one zone or husbandry sector is developed.**

Results from Outcomes 1-7 should be used to develop this strategic plan, which should be endorsed by the Veterinary Authority and clearly based on the risks identified through other Stage 1 activities.

The plan should be developed with stakeholder input and carry their endorsement.

Monitoring and evaluation of the strategy should be built into the plan. Monitoring and evaluation should occur regularly and routinely, to determine if the strategy is effective at reducing the impact of FMD. Therefore, the plan should include measurable **targets and indicators** for both implementation of activities and for the effect of the activities on FMD impact. Examples of **implementation targets** might include the percentage vaccination coverage that should be attained in a sector or zone, the number of markets that are subject to surveillance, the number of training sessions conducted etc. Examples of **impact indicators** are percentage decrease in FMD incidence in a certain area or sector over 3 years, or the percent increase in profit or productivity in a given period of time.

Checklist explanation – PCP Stage 2

*Countries in PCP Stage 2 should be implementing a risk-based FMD control strategy designed to decrease the **impact** of FMD in at least one livestock sector or zone. The impact of the control strategy should be regularly assessed through measurable **indicators**.*

A country is in PCP Stage-2 when:

It has fully completed PCP-Stage 1 AND *results are available from activities working towards key outcomes 1 & 2 below.*

OR

WHERE the Country has been previously recognized in PCP-Stage 2 following the most recent Regional Roadmap Meeting AND *results are available from activities working towards key outcomes 1 & 2 below. In this case, to retain the PCP-Stage 2 recognition at the subsequent assessment (2013-), countries must adopt an official strategic FMD control plan that has the aim of reducing the impact of FMD in at least 1 zone or husbandry sector by the end of 2012.)*

(Note: this is intended to recognise that because the PCP-FMD is relatively new, some countries might be in PCP Stage 2 without fulfilling all of the criteria for Stage 1.

a. Outcome 1: Ongoing monitoring of circulating strains and FMD risk in different husbandry systems

FMD is an acute disease – animals become infected rapidly and also recover rapidly – and so the situation and risk can change very rapidly within a country or region. Waning natural immunity, changes in animal movement or trading patterns, a shift in circulating strains (due to viral evolution or incursion of new strains) are examples of factors that can alter the level of risk posed by FMD.

FMD **incidence** and circulating strains should be monitored regularly, at least annually. In PCP Stages 2 and higher, this serves a dual purpose: Firstly to be aware of the FMD situation in order to ensure that control measures are as effective as possible , and secondly to assess the impact of the control measures.

If the prevalence of FMD steadily increases in a particular region or husbandry type despite the implementation of control measures, than an investigation should be done to determine why they are not achieving the desired effect. Such an investigation may reveal a change to the underlying risk (eg. new FMD strain, change in trading patterns causing more frequent challenges) or that the control measures have not been applied with sufficient quality (eg. biosecurity procedures not properly implemented, insufficient vaccination coverage).

To fulfill Outcome 1, FMD **incidence** should be regularly monitored, through analysis of reports and

investigations of clinical FMD and/or through an **NSP serosurvey** (for examples, see Bayissa et al, 2011; Gelaye et al, 2009). Samples from outbreaks should be submitted to a laboratory (may be sub-national, national,) to confirm the clinical diagnosis and determine which serotype caused the outbreak. It is

recommended that countries submit 30 isolates per year to the Regional and/or the World Reference Laboratory for full characterization including sequencing and vaccine matching.

Veterinarians in the field should work together with laboratory specialists and epidemiologists to ensure that the samples submitted to the laboratory are representative of the various husbandry types and geographic regions in the country. Only through representative samples can a true picture of the FMD situation and risk be pieced together.

b. **Outcome 2: Risk based control measures are implemented for the sector(s) or zone(s) targeted, based on the FMD strategic control plan developed in Stage 1**

Activities designed to control FMD are the backbone of PCP Stage 2. The control measures implemented by a country should be those determined as most effective at reducing the **risk** of FMD, in other words reducing the probability of FMD entry and spread; and/or the consequences of FMD entry and spread.

Because every country and region of the world are different, the most effective and appropriate control measures might also be different. Therefore, *which* control measures are implemented is not specified by the PCP. However, it is recommended that countries employ several different tactics to control FMD, including enhanced biosecurity to reduce both the probability of infection and spread from any sites already infected, vaccination, movement controls and campaigns to improve awareness and knowledge about FMD.

c. Outcome 3: It is clearly established that the impact of FMD is being reduced by the control measures, at least in some livestock sectors/zones

This outcome can be divided into 2 parts: 1) that the **impact** of FMD is reduced compared to the impact in the past and 2) that the decreased impact is a result of the control measures.

For the first part, that the impact of FMD is reduced compared to the past, this is assessed through monitoring '**impact indicators'** such as the percentage change in FMD incidence in the past year compared to the average incidence in the previous 3 years. Impact indicators should be measured at different levels of scale, and according to the objectives of the control program. For example, the change in incidence might be measured at the national level, as well as by specific zones or husbandry sectors targeted by the control measures.

For the second, while not proof, **implementation indicators** provide supporting evidence that the decreased impact is a result of the control measures. Additionally, it is important to develop and monitor implementation indicators to ensure that the control measures are being applied to the expected level and standard, and that resources are being used appropriately and efficiently.

Outbreak investigation should be employed when FMD occurs despite control measures, to determine why the control measures failed to prevent disease and avoid further outbreaks. There are 3 general reasons for this:

- It could be that the challenge has increased so control measures that worked before are now not sufficient (eg increased animal movements from infected countries/regions),
- the nature of the disease has changed so that the measures are no longer effective (e.g. a new strain is circulating that the vaccines used do not protect against)

- control measures were not properly implemented (e.g. vaccination coverage not sufficient, cleaning and disinfection not properly applied...)

d. Outcome 4: There is further development of an enabling environment for control measures

This outcome continues through all PCP Stages and describes the setting in which FMD control must be applied, and whether or not the underlying conditions will aid or impede control. There are several factors included:

*FMD **surveillance** system and **stakeholder** support:* In PCP-Stage 2, the Veterinary Authority should be regularly informed about suspect cases of FMD by stakeholders. Public and private stakeholders should interact regularly regarding the implementation of FMD control measures, and the impact of these measures both on FMD and on the stakeholders' business and livelihoods. This is critical because it is unlikely that stakeholders will fully comply with the control measures unless they are involved and understand the rationale behind the control measures and benefits that they should bring.

*Strengthening the Veterinary Authority: M*any/most aspects of the effectiveness of Veterinary Authority relevant to FMD control are included in the OIE Evaluation of Performance of Veterinary Services (OIE PVS Tool) and PVS Gap analysis (www.oie.int/support-to-oie-members/pvs-pathway). Thus, in PCP Stage 2, it is recommended that a country request a PVS analysis if they haven't already done so.

Also in PCP Stage 2, there should be a unit in the Veterinary Authority responsible specifically for FMD control. Within the unit, specific people should be allocated roles and responsibilities with respect to:

a. Strategy development: On an ongoing basis, assess the available evidence regarding main FMD **transmission pathways**, high risk practices and areas (**risk hotspots**), and available control options to develop and continuously refine the strategy to mitigate the risk, in consultation with stakeholders
b. Implementation of control measures: Plans and administers issues relating the implementation of control measures, whether vaccination, biosecurity, movement restrictions, awareness etc
c. Decision making: The Veterinary Authority should be represented in the decision-making body, which will likely be composed of different authorities including Finance, Trade, Legal etc. This body should review the evidence and recommendations of others (in the FMD unit and beyond) and decide on the course of action that will be taken
d. Monitoring and evaluation: This group that defines the implementation and impact indicators, ensures that they are measured regularly and uses this information to assess if the FMD control strategy is meeting its' objectives. It is important that those people responsible for monitoring and evaluation are separate from the people that decided upon the strategy and are responsible for implementation as much as possible. Ideally, monitoring and evaluation would be in a separate unit altogether.

It is also recommended that training is provided in infectious disease control and surveillance for field veterinarians.

Supportive legal framework: In PCP Stage 2, control measures are being implemented and legislation must exist to support the Veterinary Authority to apply them. Typically, in PCP Stage 2 the Veterinary Authority should have the legal right to enter premises and examine animals as required for surveillance purposes. Further, they should have the legal ability to introduce and enforce regulations designed to reduce FMD spread through animal movements.

Develop information systems: Decisions about FMD control should be informed by information about the field situation, which in turn comes from data collected from reports of suspected clinical disease, outbreak investigations, laboratory results etc. Centralized, computerized information systems must be developed to hold these data and facilitate its analysis so that it can be used in decision making about FMD control. In PCP-Stage 2, laboratory results and surveillance data should be stored in a central information system. Further, these data should be regularly analysed and reported, including as implementation and impact indicators that inform FMD control. It is also recommended that epidemiological units be geo-referenced at this stage, to facilitate more detailed and useful data analysis.

e. Outcome 5: A revised, more aggressive control strategy that has the aim of eliminating FMD from at least a zone of the country has been developed

The objective of FMD control now shifts from controlling and minimizing the impact of FMD in one or more livestock sectors, to reducing and eventually eliminating FMD virus circulation.

In order to achieve this new objective, it will be necessary to control FMD in all susceptible domestic livestock in all sectors in the target country or zone; FMD elimination cannot be achieved if control efforts are limited to only one or a few sectors. Further, the FMD strategy must include measures to ensure that all cases of FMD are found as soon as possible, and actions are taken to prevent any further spread from that outbreak.

Stakeholders should be extensively consulted during strategy development, and endorse the final strategy.

Monitoring and evaluation of the strategy should be built into the Strategy, including the definition of **targets and indicators** for implementation and impact.

Checklist explanation – PCP Stage 3

Countries in PCP Stage 3 should be able to provide evidence that the control measures are effectively and progressively reducing the FMD incidence. By the end of Stage 3, FMD virus circulation is eliminated in at least 1 zone of the country.

A country is in PCP Stage-3 when:

It has fully completed PCP-Stage 2 AND *results are available from activities working towards key outcomes 1 & 2 below.*

OR

WHERE the Country has been previously recognized in PCP-Stage 2 following the most recent Regional Roadmap Meeting AND *results are available from activities working towards key outcomes 1 & 2 below. In this case, to retain the PCP-Stage 3 recognition at the subsequent assessment (2013-), countries must adopt an official strategic FMD control plan that has the aim of eliminating FMD virus in all susceptible livestock in at least 1 zone by the end of 2012.)*

(Note: this is intended to recognise that because the PCP-FMD is relatively new, some countries might be in PCP Stage 2 without fulfilling all of the criteria for Stage 1.

a. Outcome 1: *Ongoing monitoring of circulating strains and risk in different husbandry systems*

FMD is an acute disease – animals become infected rapidly and also recover rapidly – and so the situation and risk can change very rapidly within a country or region. Waning natural immunity, changes in animal movement or trading patterns, a shift in circulating strains (due to viral evolution or incursion of new strains) are examples of factors that can alter the level of risk posed by FMD.

FMD **incidence** and circulating strains should be monitored regularly, at least annually. In PCP Stages 2 and higher, this serves a dual purpose: Firstly to be aware of the FMD situation in order to ensure that control measures are as effective as possible , and secondly to assess the impact of the control measures.

If the prevalence of FMD steadily increases in a particular region or husbandry type despite the implementation of control measures, than an investigation should be done to determine why they are not achieving the desired effect. Such an investigation may reveal a change to the underlying risk (eg. new FMD strain, change in trading patterns causing more frequent challenges) or that the control measures have not been applied with sufficient quality (eg. biosecurity procedures not properly implemented, insufficient vaccination coverage).

To fulfill Outcome 1, FMD **incidence** should be regularly monitored, through analysis of reports and

investigations of clinical FMD and through an **NSP serosurvey** (for examples, see Bayissa et al, 2011; Gelaye et al, 2009). Samples from outbreaks should be submitted to a laboratory (may be sub-national, national,) to confirm the clinical diagnosis and determine which serotype caused the outbreak. As a rule

of thumb, countries should submit at least 30 samples per year to the Regional and/or the World Reference Laboratory for full characterization including sequencing and vaccine matching.

Veterinarians in the field should work together with laboratory specialists and epidemiologists to ensure that the samples submitted to the laboratory are representative of the various husbandry types and geographic regions in the country. Only through representative sampling can a true picture of the FMD situation and risk be pieced together.

b. Outcome 2: The FMD control plan developed at the end of PCP Stage 2 is implemented, resulting in rapid detection of, and response to, all FMD outbreaks in at least one zone in the country.

In order to reduce the incidence of FMD in an area, it is critical that all outbreaks are rapidly detected and onward spread of the virus is prevented through the implementation of control measures, usually including strict biosecurity measures, movement controls and possibly culling of animals on epidemiology units where FMD has been confirmed.

Reporting of suspect cases to the Veterinary Authority should be encouraged. In order for outbreaks to be detected and responded to rapidly, it is essential that there is a well-functioning system for notification of suspected cases. Farmers are most familiar with their animals, often seeing them on a daily basis , and so are the best placed to notice the clinical signs of FMD at an early stage. Awareness and educational campaigns can assist producers to rapidly recognize and report FMD cases.

By the end of PCP-Stage 3, every reported outbreak should be thoroughly investigated including identification of the most likely source of the virus. Units to which the virus might have spread should also be identified and subject to **surveillance** to ensure early detection of FMD.

c. Outcome 3: Incidence of clinical FMD progressively eliminated from domestic animals, at least one zone

NSP Serological surveys and clinical surveillance should demonstrate that the incidence of FMD is progressively and consistently decreasing over the course of at least 3 years. Due to the nature of FMD (acute, extremely contagious disease), there may be some periods when the number of outbreaks increases, but the trend over 3 or more years should be decreasing.

d. Outcome 4: There is further development of an enabling environment for control measures

This outcome continues through all PCP Stages and describes the setting in which FMD control must be applied, and whether or not the underlying conditions will aid or impede control. There are several factors included:

*FMD **surveillance** system and **stakeholder** support:* In PCP-Stage 3, the Veterinary Authority should be confident that stakeholders will report suspect cases of FMD should they occur. Public and private stakeholders should interact regularly regarding the implementation of FMD control measures, and the impact of these measures both on FMD and on the stakeholders' business and livelihoods. This is critical

because it is unlikely that stakeholders will fully comply with the control measures unless they are involved and understand the rationale behind the control measures and benefits that they should bring.

Strengthening Veterinary Authority: Many/most aspects of the effectiveness of Veterinary Authority relevant to FMD control are included in the OIE Evaluation of Performance of Veterinary Services (OIE PVS Tool) and PVS Gap analysis (www.oie.int/support-to-oie-members/pvs-pathway). Thus, in PCP Stage 3, it is required that a country conduct a PVS analysis if they haven't already done so.

In PCP Stage 3, there should be a unit in the Veterinary Authority responsible specifically for FMD control. Within the unit, specific people should be allocated roles and responsibilities with respect to:

a. Strategy development: On an ongoing basis, assess the available evidence regarding main FMD transmission pathways, high risk practices and areas, and available control options to develop and continuously refine the strategy to mitigate the risk, in consultation with stakeholders
b. Implementation of control measures: Plans and administers issues relating the implementation of control measures, whether vaccination, biosecurity, movement restrictions, awareness etc
c. Decision making: A body with the authority to review the evidence and recommendations of others in the FMD unit and decide on the course of action that will be taken
d. Monitoring and evaluation: This group that defines the implementation and impact indicators, ensures that they are measured regularly and uses this information to assess if the FMD control strategy is meeting its' objectives. It is important that those people responsible for monitoring and evaluation are separate from the people that decided upon the strategy and are responsible for implementation as much as possible. Ideally, monitoring and evaluation would be in a separate unit altogether.

It is also recommended that training is provided in infectious disease control and surveillance for field veterinarians.

Supportive legal framework: In PCP Stage 3, control measures are being implemented and legislation must exist to support the Veterinary Authority to apply them. Typically, in PCP Stage 3 the Veterinary Authority should have the legal right to restrict animal movement as part of FMD control. Further, the laws of the country should allow Veterinary Authority to cull animals to prevent the spread of FMD.

Develop information systems: Decisions about FMD control should be based on information about the field situation, which in turn comes from data collected from reports of suspected clinical disease, outbreak investigations, laboratory results etc. Centralized, computerized information systems must be developed to hold these data and facilitate its analysis so that it can be used in decision making about FMD control. In PCP-Stage 3, laboratory results and surveillance data should be stored in a central information system. Further, these data should be regularly analysed and reported, including as implementation and impact indicators that inform FMD control. Epidemiological units should be geo-referenced at this stage, to facilitate more detailed and useful data analysis.

e. Outcome 5: Body of evidence that FMD is not circulating endemically in domestic animals (in country or zone)

Outbreak investigations, results of **NSP serological surveys** and clinical surveillance should provide sufficient evidence to conclude that FMD circulation is no longer maintained within domestic animals in

the country or zone. Outbreaks may still occur, however, they should be sporadic and outbreak investigations should conclusively determine that the most likely source was a cross-border incursion or contact with infected wildlife.

Progressive Control Pathway (PCP) Glossary:

Bias (in epidemiology)**:** An error in the design or implementation of a study, which produces results that are consistently distorted in one direction. Bias should be considered at the level of data collection (i.e. sampling method), data recording and laboratory analysis. Some biases might be unavoidable, but these should be described and communicated transparently.

Biosecurity: Implementation of practices that create barriers in order to reduce the risk of the introduction and spread of disease agents. Three principle elements of biosecurity are segregation, cleaning and disinfection (from FAO Biosecurity for Avian Influenza Handbook)

Constraints: A constraint is a limitation or restriction. In this case, it refers to the regulations, investment in human capital and infrastructure that limit what a stakeholder is able to do. For example, only certain FMD vaccines might be licensed for use within a country; or washing transport vehicles might be constrained by lack of running water.

Critical risk control point: A risk hotspot where feasible control measures exist to mitigate the risk. Feasible control measures implies that they can be implemented from both the technical and socio-economic standpoint.

Direct losses: A loss that is the immediate result of the hazard of concern, in this case FMD infection. For FMD, direct losses include: lameness (especially impacts draught power), weight loss, increased mortality in young animals, abortion and decreased milk yield.

Enabling environment: The 'environment' refers to the underlying setting or context, in this case in which animal production occurs, FMD circulates and control measures are applied. The 'environment' includes the socio-economic status of the country, the laws and norms that govern all aspects of the country (including animal production and trade), the proficiency and resources of the Veterinary Services. An 'enabling environment' indicates that this underlying setting and conditions are favourable to the control of FMD.

Epidemiological unit (epi-unit): A group of animals with a defined epidemiological relationship that share approximately the same likelihood of exposure to a pathogen. This may be because they share a common environment (e.g. animals in a pen), or because of common management practices. Usually, this is a herd or a flock. However, an epidemiological unit may also refer to groups such as animals belonging to residents of a village, or animals sharing a communal animal handling facility. The epidemiological relationship may differ from disease to disease, or even strain to strain of the pathogen. (source: OIE Terrestrial Code)

Husbandry systems/livestock sector: the different methods used to breed, raise and care for livestock.

Extensive husbandry system: Characterized by low animal density, animals are grazing or scavenging and the producer may not see them regularly (e.g. cattle or sheep may graze on a pasture for several months without regular contact with the producer)

Intensive husbandry system: Characterized by high animal density, feed provided by the producer, producer has regular contact with livestock.

Impact: Measure of the consequences of one 'thing's' (here: FMD's) influence upon another. The impact of FMD refers to the magnitude of the consequences of FMD entry and/ or spread. In this case, the consequences may be epidemiological, environmental and/or economic, and may be direct or indirect.

Epidemiological consequences refer primarily to the probability and extent of onward spread, given FMD infection in an animal/sector/area.

Economic consequences include both direct losses (production losses, losses due to morbidity and mortality) and indirect losses (due to lost trade, costs of control measures etc).

Environmental consequences are foreseen to be primarily related to resultant control measures, such as large-scale disposal of carcasses (eg burial), construction of fences.

Incentives: Something, such as the fear of punishment or the expectation of reward, that induces action or motivates effort.

In this case, incentives are the factors that cause a stakeholder to conduct their business in the way that they do. The most important incentives are usually monetary gain and improved production. For example, a dealer (stakeholder) might choose to sell animals at a particular market because that is where they can get the highest price (monetary gain). Or a producer chooses to vaccinate their animals because they believe that they will be more productive (or chooses not to vaccinate because they believe it will reduce production). Or a veterinarian might re-use needles in different farms to save money. All these are incentives that impact FMD risk.

Incidence : The number of cases of FMD in a defined population within a specific period. It is calculated by:

$$I = \frac{\text{the number of FMD infected epidemiological units in a given period of time (eg. 1 year)}}{\text{the total number of susceptible epidemiological units}}$$

Indicators: Indicators are measurements that can be repeated over time to track progress toward achievement of objectives.

***I**mplementation indicators* "indicate" the extent to which planned activities have been conducted, for example the percentage vaccination coverage that was attained in a sector or zone, the number of markets that had surveillance visits, the percentage of outbreaks for which the serotype was identified etc.

Impact indicators measure whether the plan's objective is being achieved (e.g. percentage decrease in FMD incidence in a certain area or sector over 3 years, or the percent increase in profit or productivity in a given period of time).

Monitoring: Ongoing efforts directed at assessing the FMD status of a given population. This includes routine recording, analyses and distribution of information related to the disease.

Non-structural protein (NSP) serosurvey: Sampling a population to determine the prevalence of NSP antibodies. Antibodies to NSP will be usually present in animals naturally infected by FMD virus, but NOT those that are vaccinated by a purified vaccine. Therefore, a carefully designed NSP serosurvey can be used to estimate the incidence of FMD in a population.

Outbreak investigation: A thorough case-study that describes the clinical presentation of the disease, verifies the diagnosis through laboratory testing, identifies the source and common mechanisms of spread, as well as the causative serotype. Ideally, there should Standard Operating Procedures and standard data recording forms should be developed and used for these investigations.

Risk: measure of the combination of probability and impact of FMD entry and/or spread

Risk hotspot: Point in production or marketing network where there is a high probability and/or consequence of FMD entry/spread. It may or may not be possible to mitigate the risk associated with the hotspot.

Risk-based control: Control measures that are selected based on their effectiveness at reducing the probability and impact of FMD entry and/or spread. Usually these will be identified through risk analysis, and mitigate risk at 'critical risk control points'.

Risk pathways: The risk pathway describes all the stages in the biological process that lead to the unwanted outcome. A risk pathway is a series of conditions that must be met, or events that have to occur, in order for the unwanted outcome to occur (FAO. 2011. A value chain approach to animal diseases risk management.)

Robust epidemiological data: refers to data that are appropriate to generate the desired information and as reliable and free from bias as possible.

Stakeholders: A stakeholder is any person, group, or institution that—positively or negatively—affects or is affected by a particular issue or outcome. As such, stakeholders in FMD control can include producers of all types of susceptible livestock, vaccine suppliers, livestock transporters, veterinarians, dealers, animal health workers, consumers…

Socio-economic drivers: Social and economic factors that provide impulse or motivation; in this case the reasons behind the ways of raising and marketing (selling) livestock

Surveillance: The term *disease surveillance* is used to describe a more active system than monitoring and implies that some form of directed action will be taken if the data indicate a disease level above a certain threshold. Therefore, disease surveillance is made up by at least three components: (1) a defined disease monitoring system, (2) a predefined disease intervention strategy (directed action), and (3) a defined threshold of disease frequency.

Targets: A desired goal or aim to be achieved, in this case they should be measurable.

Implementation targets refer to goals set for the activities within the strategic plan, such as the vaccination coverage that should be achieved, number of surveillance visits that should be done within a year, the percentage of outbreaks for which the serotype should be identified.

Impact targets refer to the desired reduction in FMD incidence or FMD losses that occur because of the implementation of the strategy.

Transmission pathways: The routes and mechanisms by which a disease spreads from animal-to-animal, farm-to-farm and/or region-to-region.

Vaccination coverage (VC): Percentage of a target population that are immunized in a specified time period. Vaccination coverage is often reported in relation to a mass vaccination campaign, and may be reported at the animal level and/or epi-unit level.

$$\textbf{Animal level VC} = \frac{Number\ of\ animals\ that\ received\ at\ least\ 1\ dose\ of\ FMD\ vaccine}{total\ number\ of\ susceptible\ animals}$$

When calculating animal level VC, the target population must be specified and may refer to animals within an epi-unit, district, region, province or country. For primo-vaccinates, it may be appropriate to only count animals who receive both the initial vaccination plus a booster.

$$\textbf{Epi unit level VC} = \frac{Number\ of\ epi\ units\ that\ were\ vaccinated}{total\ number\ of\ susceptible\ epi\ units}$$

When calculating epi unit level VC, a 'vaccinated epi-unit' must be specifically defined and may include epi-units where the animal-level VC exceeds a specified minimum (e.g. epi-units may be considered "vaccinated" if at least 80% of susceptible animals in that unit have been vaccinated in the last 6 months).

Value chain: Description of all systems involving FMD susceptible species from input suppliers, through producers of animals, to the marketing system, processers and consumers. Importation of relevant animals and animal products as well as movements of animals associated with transhumance should also be described. It is important to describe the nature of the links between the components in the system, and to include consideration of *why* the network is structured as it is (economics, incentives, governance).

Working hypothesis: A tentative explanation for a set of observations, that is meant to be reviewed for accuracy, refined and improved as more information becomes available

References

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