Preparing to use emergency vaccination for Foot-and-mouth And Similar Transboundary animal diseases in European countries

Second meeting 14 June 2022

European Commission for the Control of Foot-and-Mouth Disease

Funded by the European Union
EuFMD’s programme, tools and initiatives

**FAST**
Foot-and-mouth And Similar Transboundary animal diseases

**Dt**
eufmd digital transformation

**vlearing**
eufmd virtual learning centre

**microLearning**
eufmd virtual learning

**vlc EA**
virtual learning centre for East Africa

**Tom**
eufmd training management system

**SimExOn**
simulation exercises online

**KnowBank**
eufmd knowledge bank

**GetPrepared**
eemergency preparedness toolbox

**RiskComms**
risk communications

**SQRA**
a method for spatial qualitative risk analysis applied to fmd

**Pragmatist**
prontization of antigen management with international surveillance tool

**EuFMDiS**
european foot-and-mouth disease spread model

**RMT-FAST**
risk monitoring tool for foot-and-mouth and similar transboundary animal diseases

**Vademos**
fmd vaccine demand estimation model

**GVS**
global vaccine security

**PQv**
vaccine prequalification

**PCP**
progressive control pathway

**PSO**
ppc practitioner officers

**VPP**
 veterinary paraprofessionals

**PPP**
public private partnership

Sustainable development goals, UN-SDGs. EuFMD’s programme has a focus on

Together against wasting resources, think twice before printing.
Contents

Abbreviations and acronyms ........................................................................................................................ iv
Background .................................................................................................................................................... v
Introduction ................................................................................................................................................... 1
Workshop planning ....................................................................................................................................... 1
  Scenario development ............................................................................................................................... 1
  Comparison of control measures .............................................................................................................. 2
Participants .................................................................................................................................................... 3
Workshop conduct ........................................................................................................................................ 3
Workshop outputs ......................................................................................................................................... 4
  Effect of vaccination on individual country outbreak scenarios ............................................................... 4
  Effect of livestock density, resourcing and control measures on FMD scenarios in Austria ................. 4
Discussion ...................................................................................................................................................... 5
Appendices .................................................................................................................................................... 7
  1 Agenda ........................................................................................................................................................ 7
  2 List of Participants ...................................................................................................................................... 7
  3 PowerPoint Presentations .......................................................................................................................... 7
Appendix 1: Workshop agenda ..................................................................................................................... 8
Appendix 2: Workshop participants ........................................................................................................... 9
Appendix 3: PowerPoint presentations ....................................................................................................... 10
## Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>EuFMD</td>
<td>European Commission for the Control of Foot-and-Mouth Disease</td>
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<tr>
<td>EuFMDiS</td>
<td>European Foot-and-Mouth Disease Spread model</td>
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<tr>
<td>FAST</td>
<td>Foot-and-mouth And Similar Transboundary</td>
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<td>FMD</td>
<td>Foot-and-Mouth Disease</td>
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<td>MN</td>
<td>Member Nations (of EuFMD)</td>
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<td>PPP</td>
<td>Public Private Partnership</td>
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Background

In 2020/2021, the EuFMD conducted scoping activities to better understand the state of preparedness for emergency vaccination for FMD and Similar Transboundary (FAST) animal diseases in EuFMD Member Nations (MN). The scoping work, using a survey and workshop with contingency planners/risk managers, identified specific needs in the preparedness for emergency vaccination as well as areas where EuFMD can offer support to Member Nations.

A workshop held on 10 March 2022 was planned as the first in a series of two workshops to improve preparedness to use emergency vaccination against FAST diseases in EuFMD Member Nations. The aim of the workshop was to identify criteria that could assist EuFMD Member Nations to decide whether to implement emergency vaccination as a control measure for FAST diseases. A report describes the conduct and outputs of this workshop, including the key decision criteria for vaccination as identified by participants.

A second workshop was held on 14 June 2022, in which selected decision criteria for emergency vaccination, identified during in the first workshop, were applied to FMD outbreak scenarios modeled in four countries of Europe.

The workshops form part of a programme of work by EuFMD to identify and address constraints to using emergency vaccination for FMD and similar Transboundary Animal Diseases (TADs) in Europe and its neighbourhood. Although the development of criteria initially focused on FMD, the intent is for this work to be adapted in future to apply to emergency vaccination for control of other FAST diseases.
Introduction
The decision to use emergency vaccination in response to a Foot and Mouth Disease (FMD) outbreak is based on many complex factors including:

- unique features of each outbreak.
- populations at risk.
- animal welfare issues that arise during outbreaks.
- resources (human, equipment, physical) to eradicate the disease and dispose of carcasses.
- economic factors, including the importance of export trade.
- social and political factors, including the attitude to culling livestock to control the disease.

The objectives of the second workshop were to:

- Present an example from Australia of how modeling key decision criteria has influenced the consideration of different response options (including emergency vaccination) for contingency planning for FMD.
- Compare how the decision to vaccinate, based on key decision criteria from workshop 1, affected simulated FMD outbreaks in selected European countries.
- Discuss the modelling outcomes of selected control measures, including emergency vaccination, in different FMD scenarios in a European country.

Workshop planning
The workshop was planned by a team from EuFMD with assistance from Tatiana Marschik from the University of Veterinary Medicine, Vienna and Beate Conrady from the University of Copenhagen. The agenda (Appendix 1) included a presentation, followed by breakout room discussions based on individual country scenarios. FMD outbreak scenarios were developed and control measures compared using the European Foot-and-Mouth Disease Spread model (EuFMDiS).

A second round of break-out discussions focused on more detailed consideration within a single country (Austria scenario). The workshop then finished with a plenary discussion on the potential role of emergency vaccination in European countries.

The key decision criteria, considered in modelling for the workshop were livestock density and resourcing for the response. Social and political factors were discussed but not included in modelling the scenarios.

The scenarios set in Bulgaria, Spain, Denmark and Austria, developed for workshop 1, formed the starting point for the first break-out discussions in the second workshop. These scenarios were used to illustrate the effect of emergency vaccination commencing at seven, 14 and 21 days, compared with baseline control measures (described below).

Scenario development

- The starting location, method of FMD introduction, and time of year were provided by representatives from Bulgaria, Spain, Denmark and Austria.

- The scenarios were developed using the EuFMDiS model for each affected country.

- There was a 21-day ‘silent spread’ period from the first introduction, with the confirmation of the outbreak occurring at the end of this period, followed by implementation of a control program.

- Each simulation included the following ‘baseline’ control measures:
REPARING TO USE EMERGENCY VACCINATION FOR FAST ANIMAL DISEASES IN EUROPEAN COUNTRIES

For Bulgaria, Spain and Austria, a 48-hour country-wide ban on livestock movements of susceptible species was declared following diagnosis. For Denmark, the movement ban was 72 hours, consistent with Denmark’s contingency plan for FMD.

All susceptible livestock on confirmed infected holdings were culled, followed by disinfection of the holding. No pre-emptive culling of animals in suspected, contact, or neighbouring herds was applied in the baseline scenario.

The model considered a 3 km protection zone and a 10 km surveillance zone around each infected holding, with continued movement restrictions and surveillance activities.

The control program included tracing of contact herds following movements onto and off infected holdings, reporting of suspect cases, and surveillance in the protection and surveillance zones around infected holdings.

- All scenarios involved infection in a single country only.
- Resources available for control were based on estimates provided by each of the four countries.
- For vaccination programs, the assumptions were that high potency vaccines (≥6 PD50/dose) were available for use, and that onset of immunity occurred between 4-6 days.
- Consideration of post-vaccination management of animals was not within the scope of this workshop.

Comparison of control measures

For comparison of control measures, the following parameter settings were used in the model.

<table>
<thead>
<tr>
<th>Baseline control measures</th>
<th>Vaccination</th>
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<tbody>
<tr>
<td>48–72 hours livestock movement ban</td>
<td>Baseline control measures plus:</td>
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<tr>
<td>Culling of susceptible livestock on infected holdings</td>
<td>3 km emergency ring vaccination around all infected holdings</td>
</tr>
<tr>
<td>Movement restrictions and surveillance activities in restrictions in 3 km protection zone</td>
<td>All susceptible species, all herds vaccinated</td>
</tr>
<tr>
<td>Movement restrictions and surveillance activities in restrictions in 10 km surveillance zone</td>
<td>Vaccination commencing at seven, 14, or 21 days</td>
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<tr>
<td>Tracing of contact herds</td>
<td>Vaccination commencing from outside – in</td>
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Second breakout discussions: Austria

The second break out discussions focussed on outbreaks in a single country (Austria). Additional scenarios were developed to compare the effects of FMD control measures in locations of differing livestock density, and with different levels of resourcing, in Austria.

Scenarios were modelled in two regions of differing livestock density: Region North, with a higher livestock density, and Region West with a lower livestock density. In each case, the outbreaks were initiated in a randomly selected large-scale commercial pig herd (median size 660 pigs) with a silent spread phase of 21 days. The various control strategies were modelled in both regions. In order to show the impact of the limited capacity of the resources for selected operational activities (surveillance, cleaning and disinfection), all scenarios were run with both sufficient and constrained resources respectively. 'Sufficient
resources’ was defined as the capacity of personnel that does not constrain the performance of operational activities such as surveillance, culling or disposal.

<table>
<thead>
<tr>
<th>Baseline control measures (stamping out infected herds)</th>
<th>Vaccination</th>
<th>Pre-emptive culling (Region North only)</th>
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<tbody>
<tr>
<td>• 48–72 hours livestock movement ban</td>
<td>Baseline control measures plus:</td>
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</tr>
<tr>
<td>• Culling of susceptible livestock on infected holdings</td>
<td>• 3 km emergency ring vaccination around all infected holdings starting at day seven OR</td>
<td></td>
</tr>
<tr>
<td>• Movement restrictions and surveillance activities in restrictions in 3 km protection zone</td>
<td>• Vaccination of all cattle within 3 km starting at day seven OR</td>
<td></td>
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<tr>
<td>• Movement restrictions and surveillance activities in restrictions in 10 km surveillance zone</td>
<td>• Vaccination of dairy cattle and breeding pigs within 3 km starting at day seven</td>
<td></td>
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<tr>
<td>• Tracing of contact herds</td>
<td>Baseline control measures plus:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• pre-emptive culling of susceptible livestock within 1 km of infected herds</td>
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Participants
Participants were invited from EuFMD Member Nations through the EuFMD contingency planning focal points network. Livestock industry participants were invited through the EuFMD Public-Private Partnership (PPP) Initiative for Anticipating FAST-Disease Outbreaks.

Fifty-six participants attended the workshop, including facilitators from EuFMD (Appendix 2).

Workshop conduct
The workshop was held online. A presentation on the use of modelling to inform contingency planning for FMD in Australia was followed by discussions in four breakout rooms.

Session 1: Each breakout room discussed an FMD scenario for one of the four countries (Bulgaria, Spain, Denmark or Austria). Participants were allocated to the breakout rooms based on their Member Nations and/or role, with the breakout room having participants from the scenario-country, neighboring countries, European private sector organizations and some with representatives from the European Commission.

Each scenario was run 100 times and the results were presented to participants as ‘box-and-whisker plots’ for comparison.

Comparisons between control measures was made on the basis of:

- Total number of infected holdings.
- Duration of the response.
- Total animals culled.
- Total animals vaccinated.

1 The PPP Initiative explores collaborations between private and public partners and academia in the prevention and control of FAST diseases.
Following breakout room discussions, representatives from the breakout rooms reported back on the effect of vaccination on the outcome of their scenario, and what factors may have contributed to this result.

Session 2: All four breakout rooms discussed the same Austrian scenarios. This was followed by a plenary discussion of the potential role of emergency vaccination for FMD control in Europe.

Workshop outputs
Effect of vaccination on individual country outbreak scenarios
The scenarios modeled in workshop 1 were selected on the basis that they would lead to discussion about the key decision criteria for implementing emergency vaccination. These scenarios were not necessarily typical of the outcome of FMD introduction and spread in the four countries.

For the Denmark and Spain scenarios, vaccination (all susceptible stock within 3 km) offered no clear benefit over the baseline control measures. For both countries, estimated response resources were adequate for culling and disposal of the infected holdings, even while livestock density differed greatly between the two countries.

In Bulgaria, resources available for the response were constrained. For this scenario, vaccination reduced the chance of very large outbreaks, but there was little clear benefit of vaccination over the baseline control measures.

For the Austrian scenario, in which resourcing was considered adequate for culling and disposal, emergency vaccination commencing at seven days resulted in a lower total number of infected holdings compared with the baseline and reduced the likelihood of a longer duration of outbreak response (Figure 2b).

Effect of livestock density, resourcing and control measures on FMD scenarios in Austria
The results of the conducted simulations in Austria showed that the epidemiological impact of an FMD outbreak strongly depends on the geographical location of the initial disease incursion, types of control measures chosen, and the availability of resources to control an outbreak. In general, the epidemic size (as measured by number of infected holdings and outbreak duration) was greater in the more densely stocked Region North than the sparsely stocked Region West.

In the presence of sufficient resources and under the stamping out policy, the median (5th and 95th percentiles) number of infected holdings was 86 (56-126) and the outbreak control duration 59 (45–100) days. To compare, the epidemiological results in Region West showed that the outbreak would most likely be relatively small and of short duration and would result in 14 (10-25) infected holdings and an epidemic control duration of 36 (28-53) days.

When simulating with sufficient resources in Region North, vaccination control strategies slightly reduced the number of infected holdings and thus the size of the outbreak, however, the effect was not significant. A significant reduction in the number of infected holdings was achieved only under the strategy with pre-emptive culling of premises within 1 km of infected holdings, including culling of dangerous contact herds, resulting in 64 (43-89) infected holdings. However, this efficacy comes at the cost of having to depopulate 73,065 (61,423-89,432) animals, seven times as many as under the stamping out policy.

In Region West, there was no clear benefit of vaccination in the presence of sufficient or constrained response resources, compared with baseline control measures. Thus, the control measures under the stamping out policy would be sufficient for bringing the outbreak under control in this region.
In more densely stocked areas (Region North), when resources were constrained, vaccination strategies reduce the dimension of the outbreak significantly (app. 30% reduction in the number of infected holdings). According to our findings, vaccination of targeted species (cattle only, or dairy cattle and breeding pigs) appeared to be as effective as vaccination of all susceptible species in reducing the total number of infected holdings and the outbreak duration. This might be of great importance when considering the post-outbreak management of vaccinated animals and the trade impact of vaccination strategies with the possibility of reduction of export losses.

Discussion

Participants discussed the potential role of emergency vaccination against FMD in the event of an FMD outbreak occurring in a previously free European country.

The early detection of an outbreak was considered key to being able to control FMD without the need for emergency vaccination. Some early indicators of a large outbreak might include number of infected premises, density of livestock, cumulative number of new infected holdings at certain time points, total area under control measures (Garner et al 2016). Livestock movements that have occurred early in an outbreak, before movement restrictions are imposed, may also be an important factor.

In the scenarios modelled for this workshop, emergency vaccination reduced the chances of a large outbreak in some circumstances (particularly if response resources were constrained). However, emergency vaccination was not the solution for all outbreaks. In three out of the four country scenarios there was no obvious benefit of vaccination over the baseline (stamping out only) strategy. The limited nature of the scenarios used here (which were selected for demonstration purposes only) means that no general conclusions on the effectiveness or otherwise of vaccination should be drawn from this work.

Emergency vaccination may be more important and effective if an FMD outbreak occurs in densely stocked areas and if resources for control are constrained. However, if vaccination is deployed, it may be necessary to identify a workforce which can administer vaccines, but does not impinge on resources available for other response activities, and which is acceptable to the authorities. In Austria, the use of veterinary students is considered for this purpose. In the past, farmers have provided emergency vaccination for other diseases, such as bluetongue.

Workshop participants agreed that realistic estimation of available response resources is important for contingency planning. Response resourcing is an important parameter for inclusion in any disease spread model. Availability of resources can have dramatic effects on model outputs, and therefore on policy or planning decisions made on the basis of pre-outbreak simulation modelling.

For countries that export livestock and livestock products, negative trade impacts, associated with a longer interval to regain recognition of FMD freedom, are a disincentive to considering emergency vaccination as an economically viable option control option for FMD.

The apparent complications of managing a vaccinated livestock population were also considered a constraint to using emergency vaccination, which might be mitigated if trade could continue from unvaccinated zones following completion of eradication activities. Post-outbreak management of vaccinated animals was not discussed in detail in this workshop.

While it may be technically feasible to manage an FMD outbreak in a previously free country with stamping out measures and pre-emptive culling, participants acknowledged that social and political factors may contribute to the decision implement emergency vaccination. It is therefore important that contingency plans take into account the potential role for emergency vaccination, when and how to best implement it, and the management of vaccinated livestock populations.
The use of scenarios based on simulation modeling of actual country data was an engaging way for participants to consider the pros and cons of emergency vaccination for foot-and-mouth disease. Use of modelling can provide a valuable means to develop and review contingency plans for FAST diseases before they occur.

**Next steps**

Further work on emergency vaccination will be presented at the EuFMD Open Session in October 2022. Emergency vaccination and response resourcing will continue to be a major part of the EuFMD work program.
Appendices

1 Agenda

2 List of Participants

3 PowerPoint Presentations
### Appendix 1: Workshop agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>10:00 - 10:15</td>
<td>Welcome, housekeeping, opening remarks</td>
<td>F. Rosso (EuFMD) K. Gibson (EuFMD)</td>
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<tr>
<td>10:15 - 10:30</td>
<td>Recap from workshop of 10 March 2022</td>
<td>K. Gibson (EuFMD)</td>
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<td>10:30 - 11:10</td>
<td>Modeling control measures, including emergency vaccination, to inform contingency planning for FMD - Australia</td>
<td>G. Garner (EuFMD)</td>
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<td>11:10 - 11:20</td>
<td>Coffee break</td>
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<tr>
<td>11:20 - 12:00</td>
<td>Breakout room discussions. Use of emergency vaccination in FMD scenarios in four countries</td>
<td>Breakout rooms with moderators</td>
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<tr>
<td>12:00 - 12:30</td>
<td>Plenary discussion</td>
<td>All</td>
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<td>12:30 - 13:15</td>
<td>Lunch break</td>
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<tr>
<td>13:15 - 14:15</td>
<td>Breakout room discussions. Comparison of control measures, including emergency vaccination, for different FMD outbreak scenarios</td>
<td>Breakout rooms with moderators</td>
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<tr>
<td>14:15 - 15:00</td>
<td>Plenary discussion. Potential role for emergency vaccination for FMD and other FAST diseases in European countries</td>
<td>All</td>
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## Appendix 2: Workshop participants

<table>
<thead>
<tr>
<th>Country/ Organization</th>
<th>Name</th>
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<th>Role</th>
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<tr>
<td>EuFMD</td>
<td>Fabrizio</td>
<td>Rosso</td>
<td>EuFMD Deputy Executive Secretary</td>
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<tr>
<td>EuFMD</td>
<td>Kathy</td>
<td>Gibson</td>
<td>Planning team/facilitator</td>
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<tr>
<td>EuFMD</td>
<td>Tsviatko</td>
<td>Alexandrov</td>
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<td>Koen</td>
<td>Mintiens</td>
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<tr>
<td>EuFMD</td>
<td>Shankar</td>
<td>Yadav</td>
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<tr>
<td>University of Veterinary Medicine, Vienna, Austria</td>
<td>Tatiana</td>
<td>Marschik</td>
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<td>University of Copenhagen, Denmark</td>
<td>Beate</td>
<td>Conrady</td>
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<td>EuFMD</td>
<td>Graeme</td>
<td>Garner</td>
<td>Speaker/Planning team</td>
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<tr>
<td>Spain</td>
<td>German</td>
<td>Caceres Garrido</td>
<td>Moderator/Participant</td>
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<td>EuFMD</td>
<td>Tiziano</td>
<td>Federici</td>
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<td>Austria</td>
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<td>Belgium (UECBV)</td>
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Appendix 3: PowerPoint presentations
PowerPoint presentations are available in SlideShare
EuFMD Committees
Executive Committee, Standing Technical Committee (STC), Special Committee for Surveillance and Applied Research (SCSAR), Special Committee on Biorisk Management (SCBRM), Tripartite Groups.

Hold-FAST tools
AESOP, Assured emergency supply options; EuFMDiS, FMD spread model; GET PREPARED toolbox, Emergency preparedness; GVS, Global Vaccine Security; Online Simulation Exercises; Outbreak Investigation application, Pragmatist. Prioritization of antigen management with international surveillance management tool; PCP-FMD, Progressive Control Pathway for foot-and-mouth disease; PCP-Support Officers; SAT, PCP Self-Assessment Tool; RTT, Real Time Training; SMS Disease reporting; SQRA toolkit, A method for spatial qualitative risk analysis applied to FMD; Telegram; TOM, EuFMD training management system; Global Monthly reports, VADEMOS, Vaccine Demand Estimation Model; VLC, Virtual Learning Center. Microlearning.

United Nations Sustainable Development Goals (UN-SDGs)
EuFMD’s programme has a main focus on

Animal Production and Health Division, NSHA / European Commission for the Control of Foot-and-Mouth Disease (EuFMD)

eufmd@fao.org

fao.eufmd.org
eufmdlearning.works
eufmdvirtual.com
eufmd-tom.com

Food and Agriculture Organization of the United Nations
Rome, Italy