EUFMD
EUROPEAN COMMISSION FOR THE CONTROL OF FOOT-AND-MOUTH DISEASE

Elements and implementation of an epidemiological investigation in the case of FMD outbreaks

Carsten Pötzsch
EuFMD/FAO Consultant

REMESA
Mediterranean Animal Health Network

REPIVET–RESEPA workshop: Epidemiology and surveillance of animal diseases
Tunis 1-2 December 2015

Controlling FMD outbreaks:

→ **Prevent further transmission of the virus from infected to susceptible animals**

Outbreak investigations (OI)

Objectives

- Confirmation of FMD
- Identification of FMD introduction and spread during the outbreak
- Raising awareness and local outbreak response
- Improve understanding of FMD (risk factors and control)

What, **W**hen, from/to **W**here, **W**hy, **W**ho introduced & spread ?

  - by specifically trained veterinarians
  - on the basis of questionnaires

Disease events requiring OI

→ immediate notification (OIE, Code, Art. 1.1.3.)

Listed disease, infection or infestation in a country, zone or compartment:

- first occurrence or re-occurrence
- first occurrence of a new strain
- (the agent) causing a sudden and unexpected change in the distribution or increase in incidence or virulence, or morbidity or mortality
- occuring in an unusual host species

FMD confirmation – case definitions

Probable case: clinical signs

Suspected case: clinical, pathological and epidemiological evidence

Confirmed case: lab diagnosis ! (an animal infected with FMD virus (FMDV) - with or without clinical signs)

FMDV infection:

1. **FMDV** isolated and identified from an **animal/animal product** or

2. **FMDV antigen or serotype specific RNA** identified in a samples from an animal with **clinical FMD signs** or **epidemiologically linked** to a confirmed or suspected FMD outbreak, or suspicion of previous association or **contact with FMDV**; or

3. **antibodies to structural or nonstructural proteins** of FMDV, that are not a consequence of vaccination, identified in a samples from an animal with **clinical FMD signs**, or **epidemiologically linked** to a confirmed or suspected FMD outbreak, or suspicion of previous association or **contact with FMDV.**

FMD outbreak: occurence of one or more cases in an epidem. unit

OIE Code

Clinical investigation - objectives -

- **to confirm the presence of clinical signs of FMD**
- **to collect suitable samples for confirmation of FMD infection**
  - search for fresh/most recent cases, less than 6 days age !
- **to estimate the timing of entry of infection**
  - search for the oldest lesions in the unit!
    use serology if animals recovered and lesions healed

Confirmation of FMD virus

Event

information from farmers

Not confirmed

suspicion

confirmed by veterinary services

< 6 days

> 6 days

sampling
Swab, epithelium
blood

sampling
Swab (as epithelium may not be possible)
Probang
blood (for serum)

Laboratory:
- antigen detection ELISA (often negative over 6 days)
- PCR (needed)
- serology (NSP – can confirm exposure to FMDV)

Sampling
1. Blood
2. Tissue/swab
   incl. pen-side test
3. Probang

Animal examination and sampling form

no	animal ID	species and sex[1]	age[1]	clinical signs						type of lesions						samples taken[5]	vacci-nation status[1]	estimated age of the oldest lesions
				lameness	fever[2]	salivation	foot[3]	mouth[4]	teats	intact vesicle	recently rup-tured vesicle	raw eroded area	ulcer with fibrinous scab	ulcer with fibrosis	[illegible] break coro-			
1	12344567	bov / M	7 months	-	NT	-	-	-	-	-	-	-	-	-	-	B - S	not reported	
2	12324567	bov / M	not known	-	NT	-	-	-	-	-	-	-	-	-	-	B - S	not reported	
3	12234567	bov / M	7 months	-	NT	-	-	-	-	-	-	-	-	-	-	B	not reported	
4	12234567	bov / F	1.5 year	-	NT	+	-	LTD	-	-	-	-	+	+	-	B	not reported	6 to 7 days
5	12334567	bov / F	1.3 year	+	NT	+	C	G	-	-	-	-	+		-	B	10.2008	5 to 6 days
6	12344567	bov / F	1.3 year	+	NT	+	I	LG	-	-	+ (I)	-		+ (M)	-	B - E	10.2008	7 days
7	12345567	bov / F	1.5 year	+	NT	+	-	MLD	-	-	-	-	+		-	B - S - E	not reported	5 to 6 days
8	12345667	bov / F	1.3 year	+	NT	+	I	L	-	-	-	-	-	+	-	B	10.2008	7 days
9	12345677	bov / F	1.3 year	-	NT	+	-	ML	-	-	-	-	-	+	-	B	10.2008	7 days
10	12345678	bov / F	1.3 year	+	NT	+	I	LTD	-	-	-	+ (I)	+ (T)	+ (D)	-	B	10.2008	7 days
11	not identified	bov / M	not known	-	NT	-	-	-	-	-	-	-	-	+?	-	B - P	not reported	7 to 10 days

[1] information retrieved from the livestock information system
[2] NT: not tested (animals did not appear to have fever)
[3] foot: Coronary band – Inter-digital space / [4] mouth: Muzzle - Lips - Gums - Tongue - Dental pad / [5] samples: Blood - Saliva - Vesicle fluid - Epithelium - Probang sample

When? Timeline (from earliest to last event)

From where & how has FMD come *onto* farm?

→ ***Time*** **of contact - incubation period 1-14 days (OIE); most likely 2-5 days**

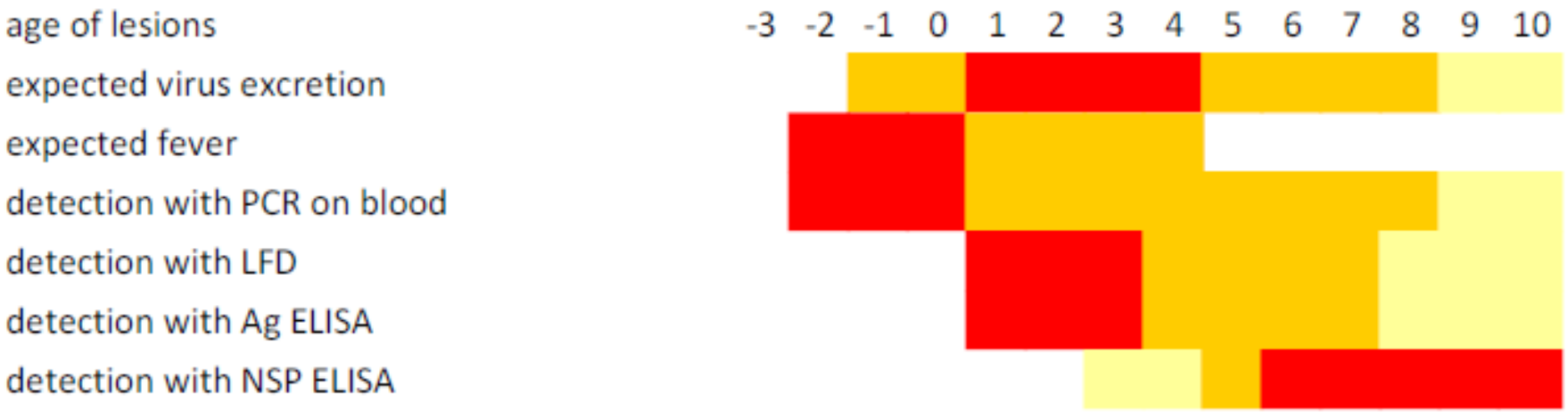
Where to and how has FMD gone *off* farm?

→ **virus excretion period**

Timeline:

1. First observation of clinical signs (date)(=day 0)
2. Start of possible and most common time window of introduction of FMDV (date and possibly risk factor of introduction of FMDV, dissemination of the disease) (possible: 1-14 days before first signs, most common: 2-5 days)
3. Notification of suspicion to veterinary services (date)
4. Date of sampling
5. Date of official investigation
6. Date of FMD confirmation

Timeline of events - Signs of FMD and diagnostic detection



Red = most likely time frame of detection
Yellow = likely time frame of detection
Pale yellow = less likely time frame of detection

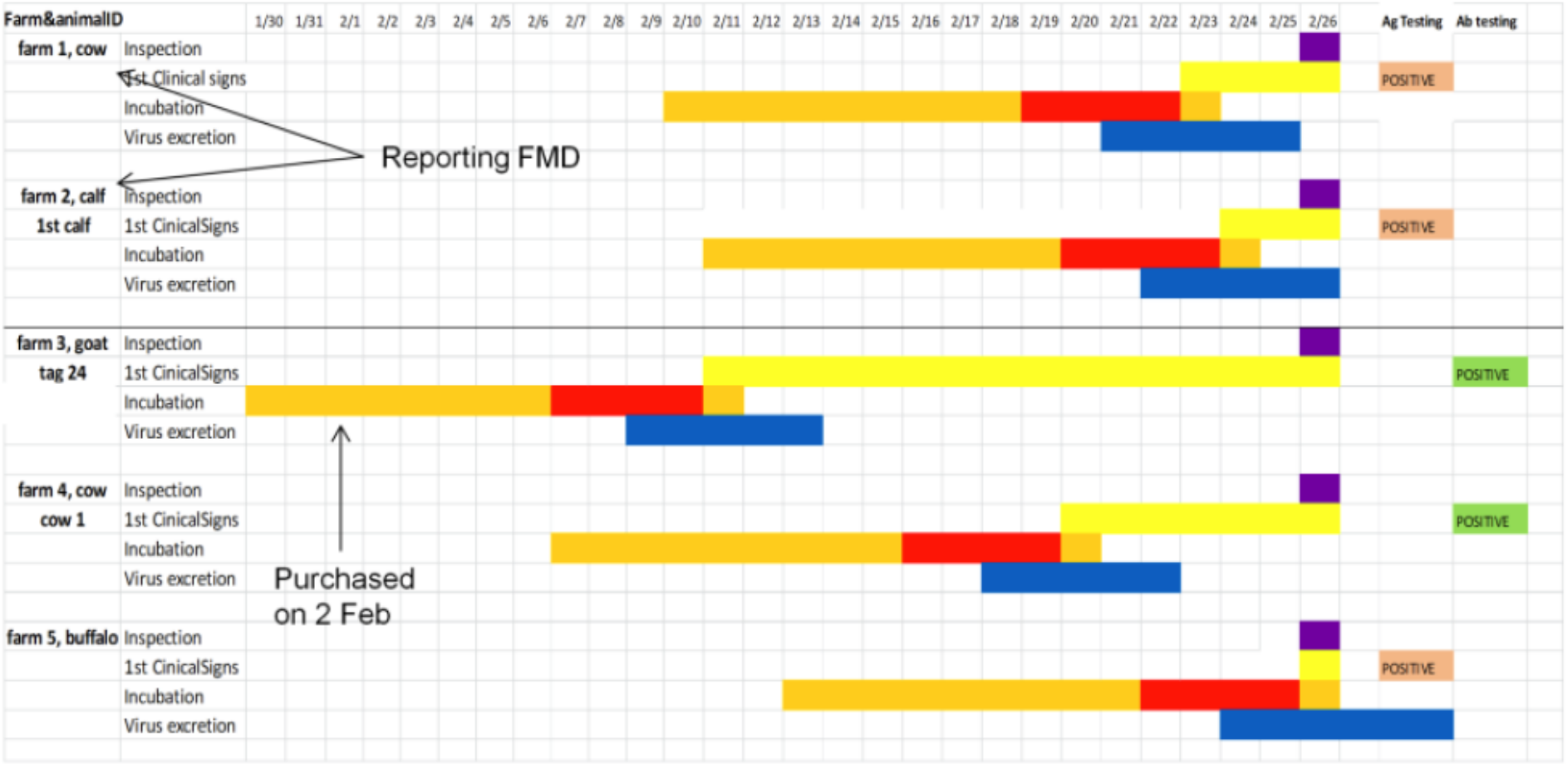
Timeline of events - Exercise

The following lesions were found on 1 Dec. 2015

animal 1 (introduction, start of spread)
animal 2 (lab diagnosis, spread)
→ On epi. unit level

Day 0

Example of combining timelines of animals from different holdings in a village



… from/to Where, Why, Who

- ✓ location and compartments of epi. units/farms/villages (e.g. intensive, extensive husbandry)
- ✓ species and animal numbers per owner, unit
- ✓ economic and other relations between units
- ✓ supply and disposal systems (feed, water, milk, manure, etc.)
- ✓ population and production data
- ✓ disease prevention/control & bio- security measures
- ✓animal movements
- ✓movement of people, vehicles and machinery

= Characterisation of the epidemiological unit !

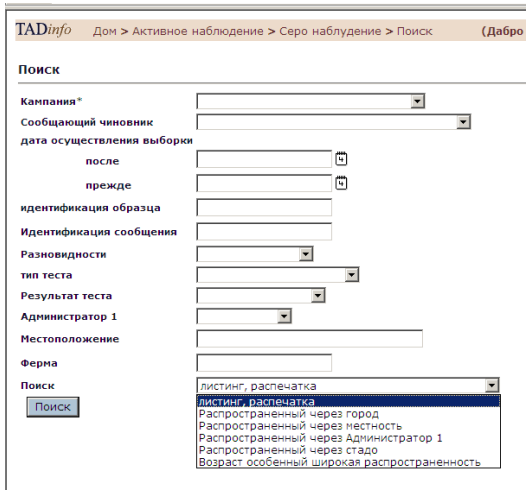
Information sources

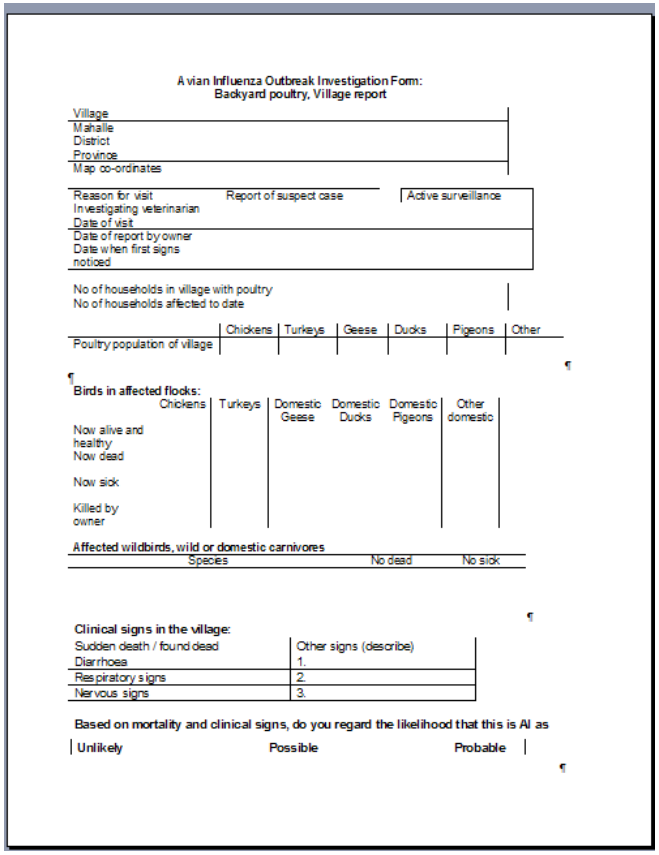
✓**Observation**

✓**Questionning and documentation** (owner, family or village members, vets, animals traders, …)

✓**Data bases**

✓**Lab findings**





Avian Influenza Outbreak Investigation Form:
Backyard poultry, Village report

Village
Mahalle
District
Province
Map co-ordinates

Reason for visit — Report of suspect case — Active surveillance
Investigating veterinarian
Date of visit
Date of report by owner
Date when first signs noticed

No of households in village with poultry
No of households affected to date

	Chickens	Turkeys	Geese	Ducks	Pigeons	Other
Poultry population of village						

Birds in affected flocks:

	Chickens	Turkeys	Domestic Geese	Domestic Ducks	Domestic Pigeons	Other domestic
Now alive and healthy						
Now dead						
Now sick						
Killed by owner						

Affected wildbirds, wild or domestic carnivores

Species	No dead	No sick

Clinical signs in the village:

Sudden death / found dead	Other signs (describe)
Diarrhoea	1.
Respiratory signs	2.
Nervous signs	3.

Based on mortality and clinical signs, do you regard the likelihood that this is AI as

Unlikely — Possible — Probable

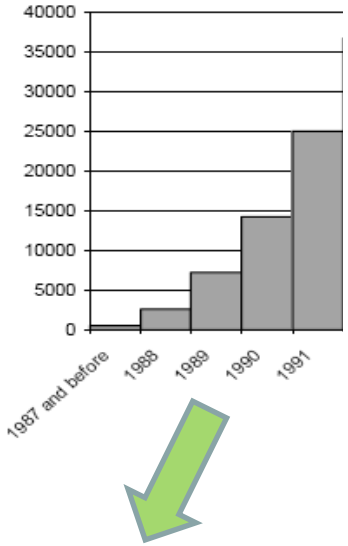
Outbreak investigation form

- Collection of a standardized set of data from all outbreaks
- Disease specific
- Format of a questionnaire (all the important questions are asked and answered)
- Know your outbreak investigation form before the investigation !

Useful OI measurements

Attack rate, case fatality rate, mortality rate

Epidemic curve



→to be determined for categories: e.g. species, age, husbandry system

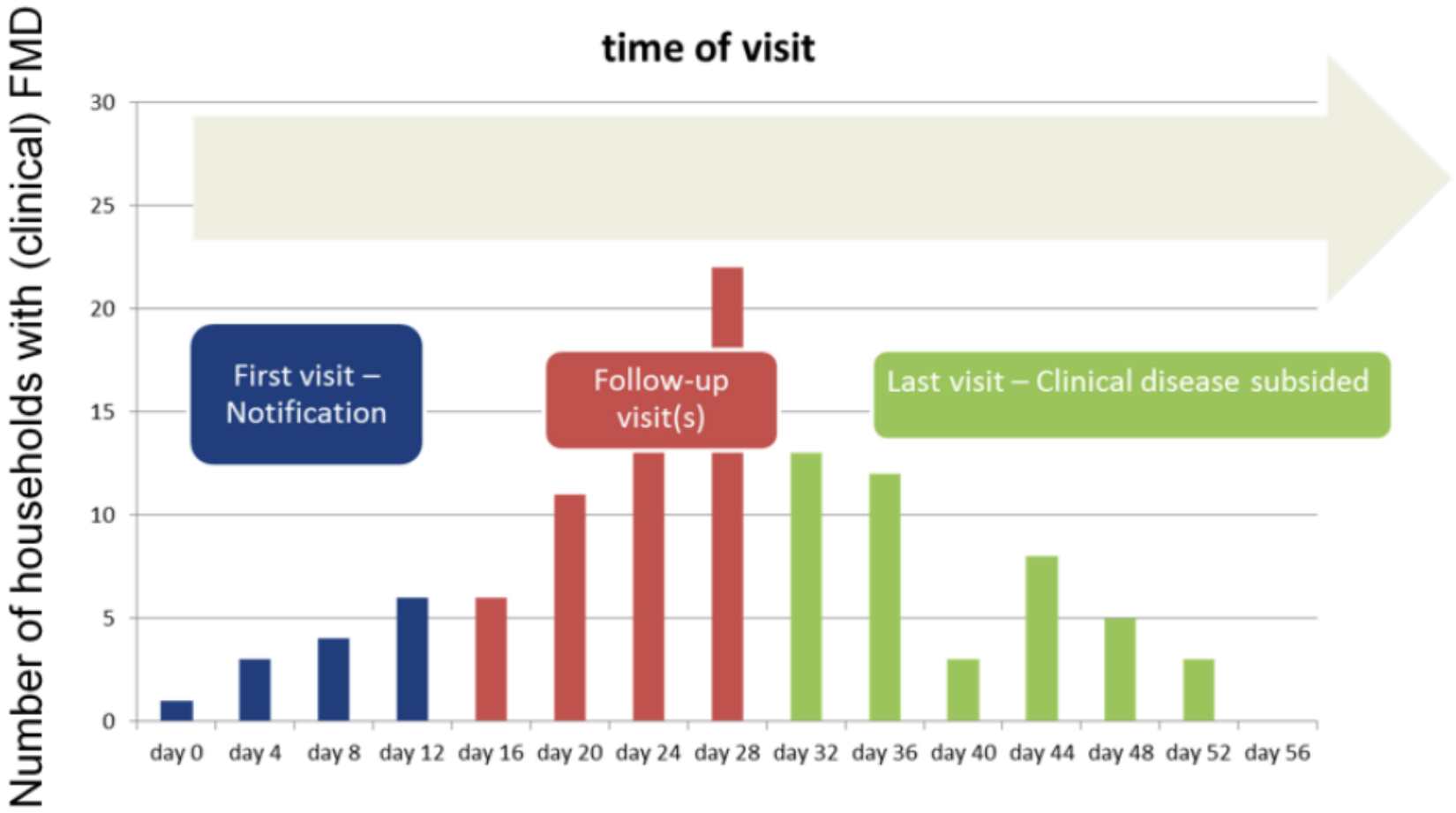
Temporal pattern of disease:

- when started
- current position in the course of the epidemic
- possibly project future course of the epidemic
- exposure: single, continuous, repeated [Incubation period (individual, population)]

Measure	*Numerator*	*Denominator*
Attack rate		
Mortality rate		
Case fatality rate		

Measure	*Numerator*	*Denominator*
Attack rate	No. of new cases in the outbreak	Initial/total population at risk
Mortality rate	No. of deaths per time (e.g. during outbreak)	Total population at risk
Case fatality rate	No. of deaths for a specific cause per time (e.g. during outbreak)	No. of cases with that particular disease

Follow-up visits required



Prioritising Dangerous Contacts

→ Need to prioritise "hot" contacts

- The number of contacts to be traced can become very large
- Resources for investigations limited & time can be critical

1. Species: cattle > sheep
2. Type of contact: animal movement > people in direct contact with FMD animals > vehicles in direct contact etc.
3. Time of contact in virus excretion window
4. Animals number on contact premises: as numbers increase, so does chance of infection and significance of outbreak
5. Type of enterprise:
   - Markets
   - Abattoirs
   - Farms owned by dealers

High risk contacts:

- **Animal movements during risk period**
- **Farms owned/worked on by workers from IP**
- **Farms visited by vet staff, AI techs, dealers, milk collectors after IP during risk period**
- **Contiguous herds or common grazing (nose-to-nose/close contact) with IP stock**
- **any market, dealer or abattoir connected to IP during risk period**

Medium risk contacts:

- Shared equipment/vehicles in direct contact with infected animals on IP
- Neighbouring/nearby farms with some distance between animals on IP and DC
- Personnel in contact with animals on IP and DC

Low risk contacts:

- Personnel and vehicles/equipment shared between farms but not in contact with animals
- Personnel visiting the IP and then other farms but not in contact with animals

Outbreak investigations can also help to:

Identify risk factors for FMD introduction and spread

- comparing cases and non-cases on household or village level (pasture use, common grazing/watering, vaccination, dangerous contacts [markets, dealers], etc.)

Understand subclinical spread of FMD

- NSP survey

Improve vaccination programmes

- Sampling: matching vaccine strain with field virus
- Education of animal owners
- Measure vaccination effectiveness
- improve vaccination coverage
- Measure duration of protection after vaccination
- Application of biosafety of vaccinators

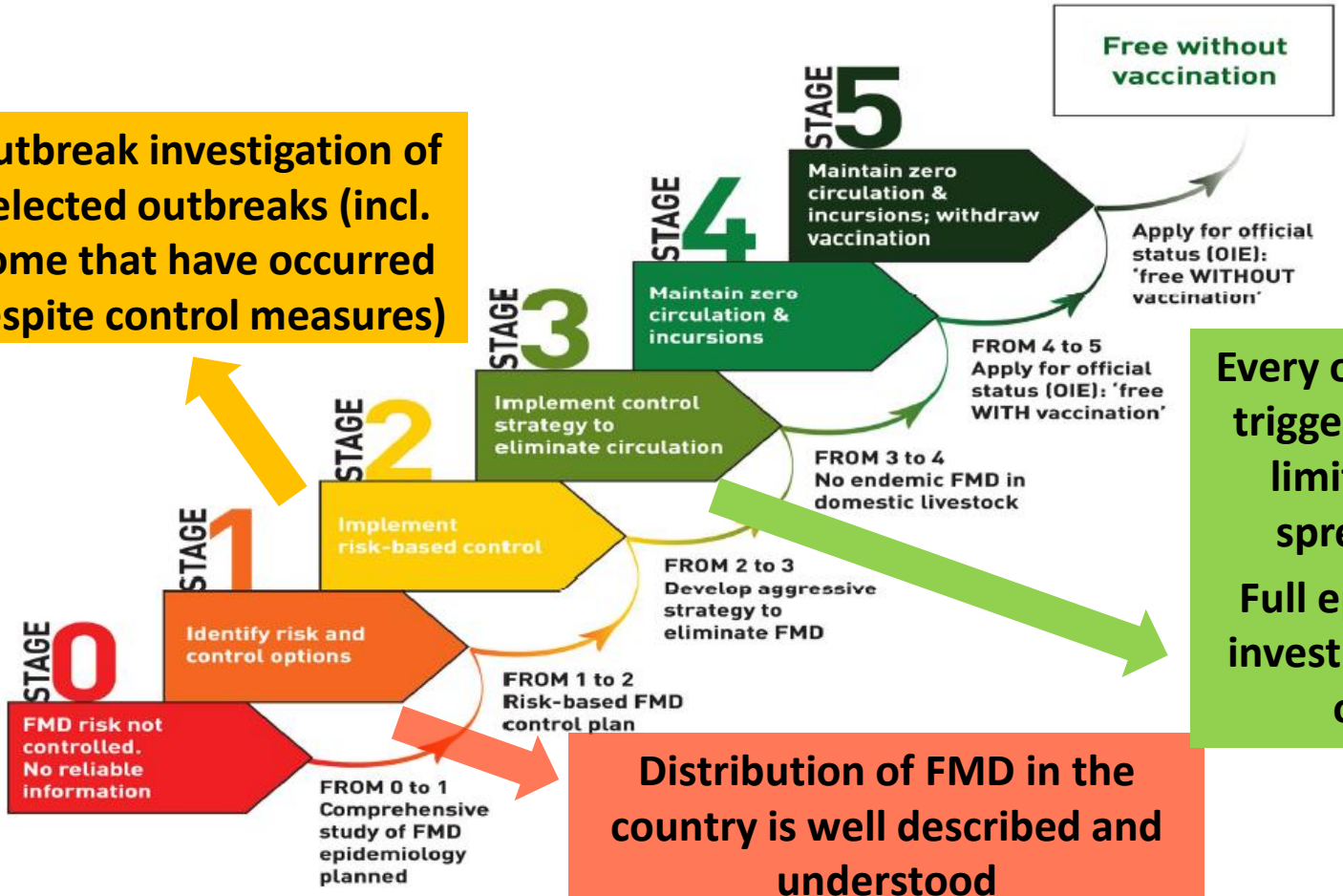
OI in FMD endemic countries?

YES!

- better **understanding of the epidemiology** of FMD and progressively **improve control** (risk based)
- identify **risk hotspots** (production systems, animal populations, main animal movements, seasons, etc.) - OI in systems where priority control is targeted
- identify **risk factors**, estimate effectiveness of **vaccination programs**, FMD morbidity and mortality, cost of vaccination
- OI can guide **serological surveys** and vice versa

Outbreak investigation and the FMD Progressive Control Pathway (PCP)

Outbreak investigation of selected outbreaks (incl. some that have occurred despite control measures)



Every outbreak should trigger a response to limit the onward spread of FMDV

Full epidemiological investigations into all outbreaks

Distribution of FMD in the country is well described and understood

Outbreak reporting

EuFMD webinars - proposed topics (FR, EN, AR)

- ✓Statistical thinking: principles and methods of epidemiology
- ✓Confidence in disease freedom: Risk based serosurveillance and early detection
- ✓Data collection: Construction of questionnaires for epidemiological surveillance, collection and analysis of
- ✓Cost-benefit analysis: economic risk factors and measures to mitigate the risk
- ✓Animal identification system and animal movements
- ✓Outbreak investigation and animal tracing: North Africa experiences
- ✓Spatial epidemiology and mapping systems
- ✓Early detection: awareness , primary surveillance and cooperation between stakeholders
- ✓Risk assessment and risk based surveillance: a regional approach
- ✓Biosecurity at farm level: what it is feasible and effective
- ✓Biosecurity and biosafety in the laboratories
- ✓Quality control in the laboratories
- ✓Emergency and preventive vaccination : how to plan, implement, evaluate
- ✓Vaccination programme auditing
- ✓Vaccine bank: how does it work, benefits and accessibility)
- ✓Communication at all levels and improvement of awareness: tools and methods
- ✓Emergency planning and simulation exercises

Resources:

E-learning material: https://eufmd.rvc.ac.uk/ (contact Fabrizio Rosso/EuFMD), incl.:

Vade Mecum for FMD Outbreak Detection and Investigation

Outbreak investigation webinar, by Ch. Bartels

Investigation Forms

Timeline templates

Acknowledgments

EuFMD team for support and training material (Ch.Bartels, M. McLaws, E. Ryan, N. Juleff, J. Maud, K. Sumption)