Risk-based Surveillance: approaches to practise

Chris Bartels
EuFMD consultant

Objective and expected outcomes

AIM: to <u>discuss approaches to strengthening surveillance</u>
in each of the countries and in relation to their current FMD statuses

EXPECTED OUTCOMES:

- To have an analysis of strengths and weaknesses of surveillance approaches currently applied in the participating countries
- For participants to start modifying the surveillance approaches currently included in the National FMD plans, based on the discussions and experiences shared in this workshop

Defined by the FMD TASKFORCE

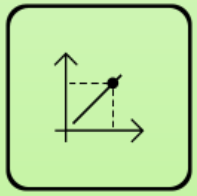
Surveillance starts with

Question

To support decision making on disease control

Emerging disease

Changing trend



Understanding a relation

Proving freedom

Key messages

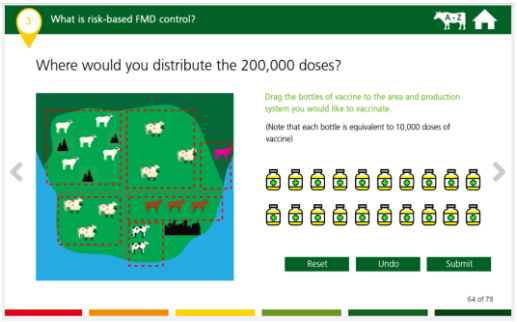
- Surveillance objectives change with progressive FMD control
- Consider difference between Disease versus Infection
- Generic versus risk-based and targeted surveillance
- Strength of Surveillance is the sum of surveillance components

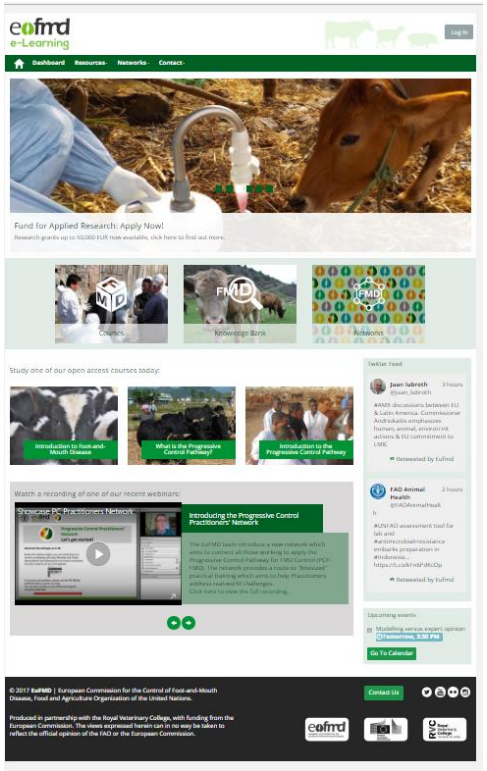
eofmd
e-Learning

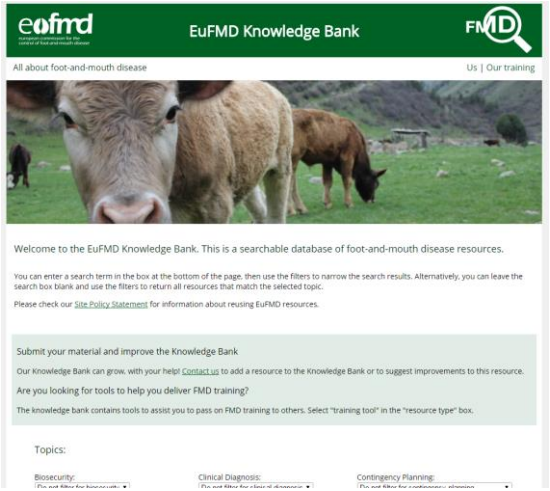
3 PILLARS of the EuFMD

European Commission for the control of FMD

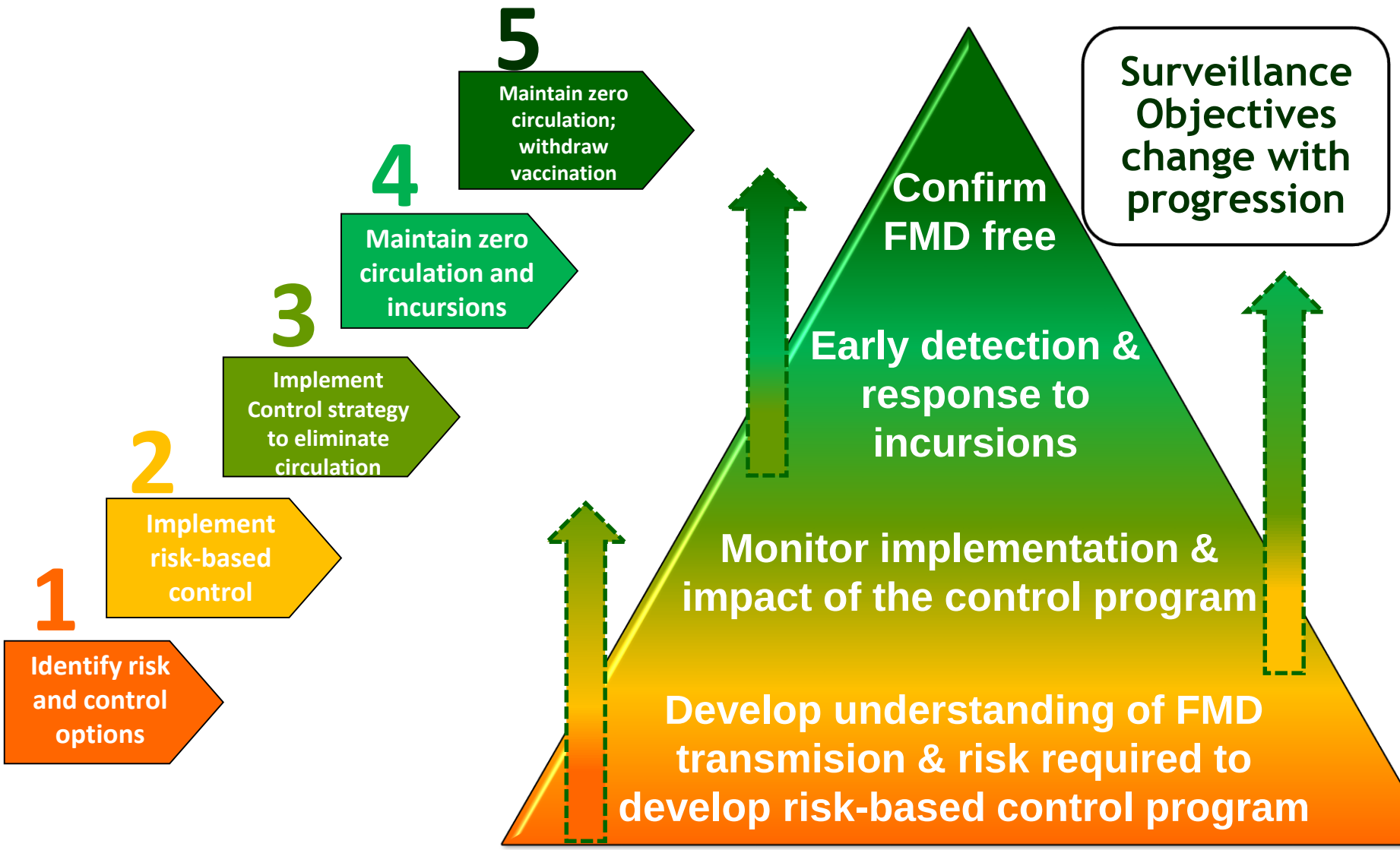
EuFMD Online Training in support of the Progressive Control Pathway







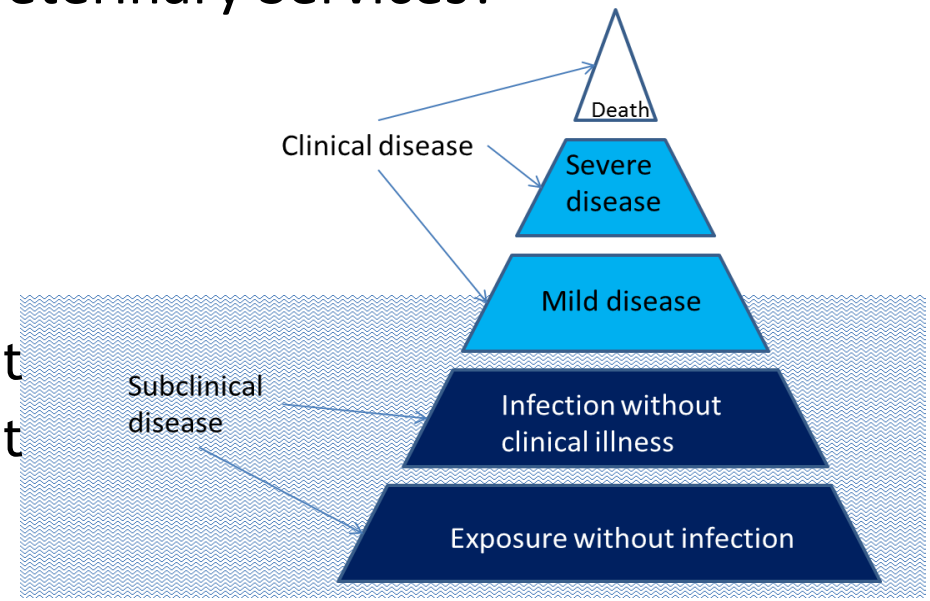
Ongoing Surveillance is a important principle



Question

What percentage of occurrence of FMD in livestock do you think is reported to the Veterinary Services?

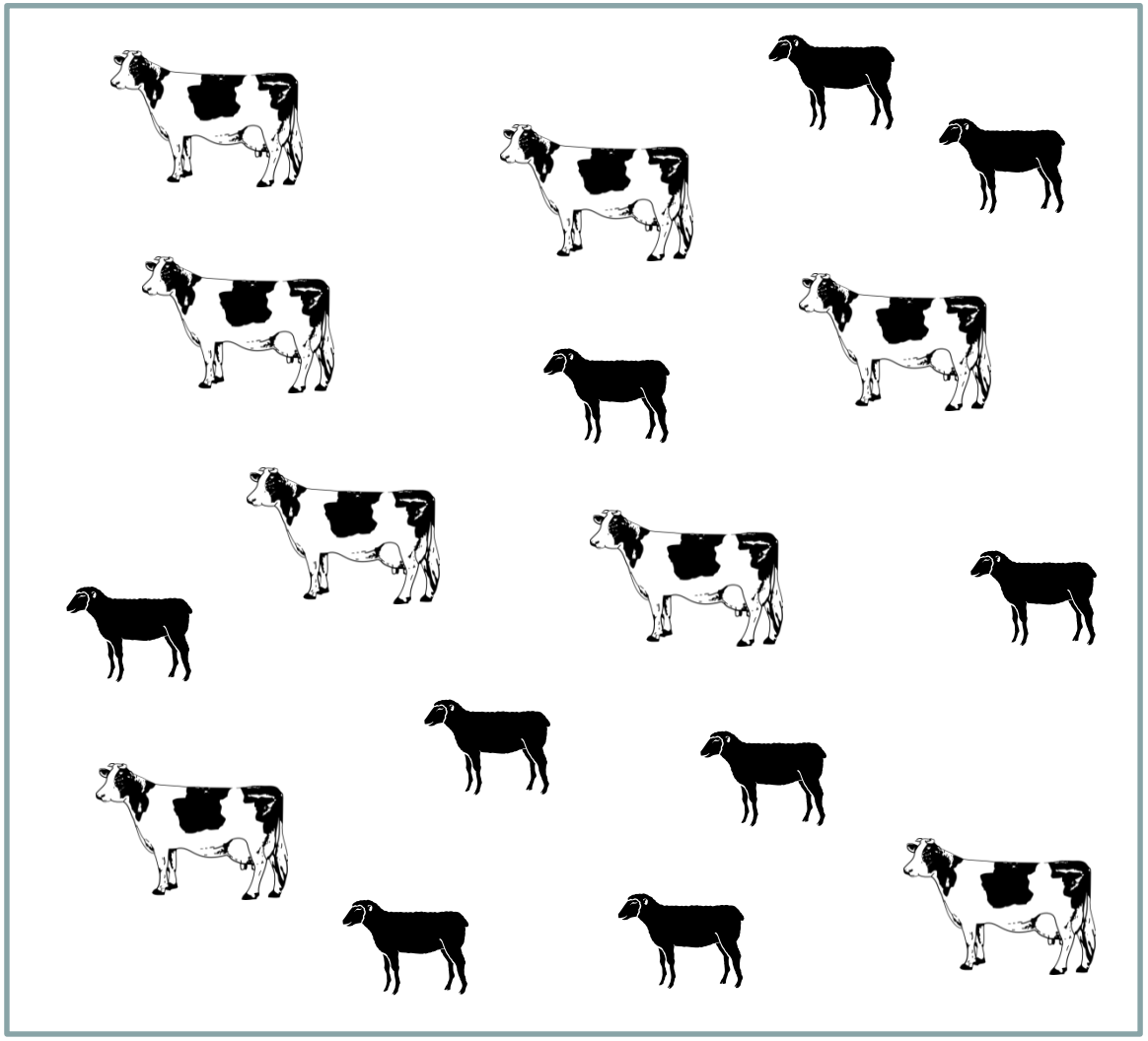
1. Between 1 – 5 per cent
2. Between 6 and 10 per cent
3. Between 11 and 20 per cent
4. Between 21 and 40 per cent
5. More than 40 per cent



Outbreak reporting – being lucky to see

Sero-survey: actively searching the unseen

Key issues for surveillance



Heterogeneity in populations

- Species
- Production systems
- Age-categories
- Location
- Season
- etc

That heterogeneity also applies to **Risk of FMD**

- Probability of infection
- Consequence of infection

These issues often apply more to level of **epi-unit** than to animal level (animals within are kept under same management)

RISK: the probability of the event occurring **times** the consequence of the event given that it has occurred

Risk-based surveillance

Surveillance

the systematic, ongoing collection, collation and analysis of information related to animal health, and the timely dissemination of information to those who need to know, so that action can be taken (OIE, 2012)

➔ **to support informed-decision making**

Risk-based Identifying **sub-populations** at greater risk of being infected and ensuring these are represented in a proportion greater than in the general population

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RISK: the probability of the event occurring **times** the consequence of the event given that it has occurred

Risk-based surveillance

Risks such as

- Species (susceptibility, infectiousness)
- Age-categories (susceptibility)
- Production system (high turnover, density)
- Markets (contacts)
- Trading/dealing (contacts)
- Border areas

Risk-based	Identifying sub-populations at greater risk of being infected and ensuring these are represented in a proportion greater than in the general population	Surveillance	the systematic, ongoing collection, collation and analysis of information related to animal health, and the timely dissemination of information to those who need to know, so that action can be taken (OIE, 2012)

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Risk-based surveillance

Principles of Risk Analysis apply here	Tool to improve efficiency of surveillance ➔ An important goal is to achieve a higher benefit-cost ratio with existing or reduced resources	Intentionally introducing bias in sample
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Risk-based surveillance

Risk-based

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RISK: the probability of the event occurring **times** the consequence of the event given that it has occurred

1) Disease or Infection is present or it is unknown
- Change of prevalence/incidence over time
- Detecting cases
- Proof of absence

2) Disease or Infection is absent
- Detection of new incursion
- Demonstrate freedom

Principles of Risk Analysis apply here

Tool to improve efficiency of surveillance
➔ An important goal is to achieve a higher benefit-cost ratio with existing or reduced resources

Intentionally introducing bias in sample

Risks such as

Species (susceptibility, infectiousness)
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RISK: *probability of an adverse event occurring, in contrast to its use in risk analysis, where it is likelihood combined with consequences*
the probability of the event occurring **times** the consequence of the event given that it has occurred

Risk-based surveillance

1) Disease or Infection is present
   - Detecting cases
2) Disease or Infection is absent
   - Detection of new incursion
   - Proof of absence

Principles of Risk Analysis apply here	Tool to improve efficiency of surveillance ➔ An important goal is to achieve a higher benefit-cost ratio with existing or reduced resources	Intentionally introducing bias in sample	
Risks such as	Species (susceptibility, infectiousness) Age-categories (susceptibility) Production system (high turnover, density) Markets (contacts) Trading/dealing (contacts) Border areas	Passive	Data collection method is passive: Farmer notification Rumour, media == awareness, willingness to report and level of diagnostics
		Active	information collection is systematic, regular often for a specific disease: Sero-survey Abattoir-based Risk-based Negative reporting

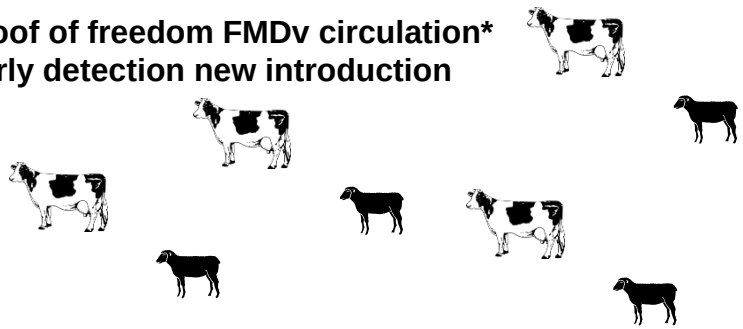
Imagine 3 country situations

Country situation

Objective or (risk-based) surveillance

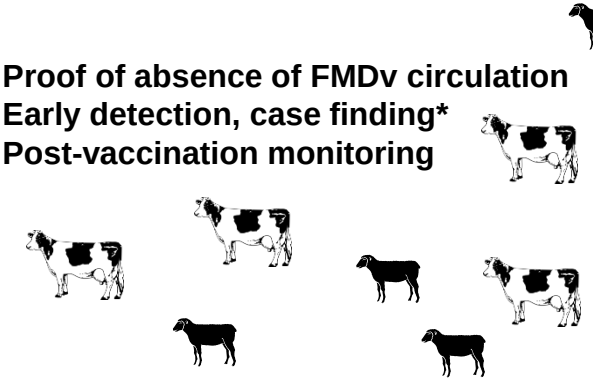
FMD free without Vaccination

Proof of freedom FMDv circulation*
Early detection new introduction

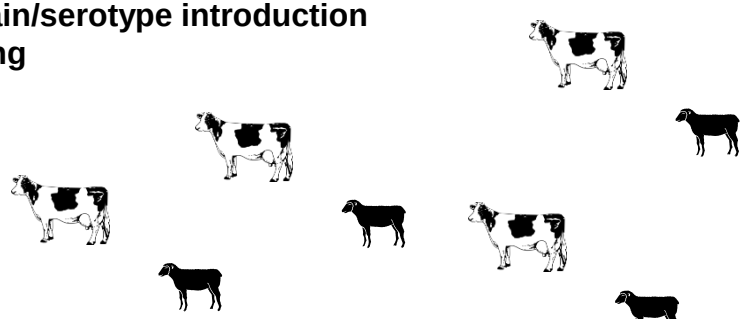


PCP-3: Elimination of virus circulation

Proof of absence of FMDv circulation
Early detection, case finding*
Post-vaccination monitoring



Change of prevalence/incidence over time (effect control measures)*
Early detection of new strain/serotype introduction
Post-vaccination monitoring



PCP-1: FMD endemic with some vaccination

Risk-based surveillance endemic situation

Change of prevalence/incidence over time (effect control measures)

Small holding

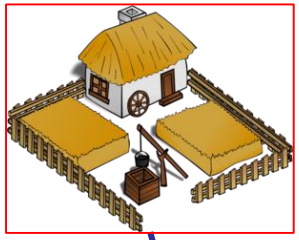
Initial random NSP-Ab sero-survey (PCP-FMD stage 1):
seroprevalence in beef 3 times higher than in small holders

Beef farm

Risk-based surveillance endemic situation

Change of prevalence/incidence over time (effect control measures)

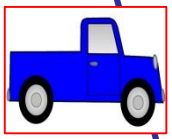
Small holding

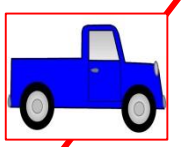


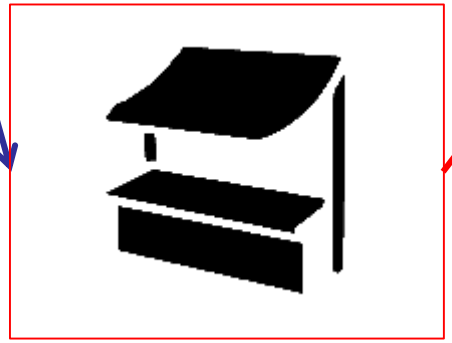
Risk hotspots identified:

- Insufficiently vaccinated young stock
- Traders, dealers, service providers
- Animal markets
- Intensive production systems (Beef, Dairy)

Beef farm







Animal market

Control measures put in place

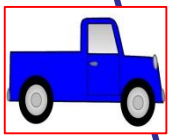
1. Timely and sufficient vaccination youngstock for markets and fattening
2. Improving biosecurity with traders and trucks
3. Establishing biosecurity at animal market
4. Allowing beef farmers to vaccinate upon arrival

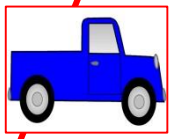
Where to conduct subsequent NSP-Ab survey

with objective to evaluate effectiveness of the control measures?

Beef farm **2**

Small holding **1**





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ABATTOIR

Abattoir **3**

Where to conduct subsequent NSP-Ab survey with objective to evaluate effectiveness of control measures?

Small holding

Will only be informative about vaccination of youngstock

Control measures put in place

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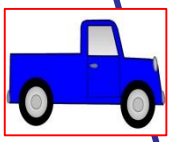
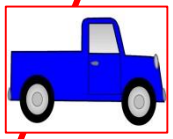
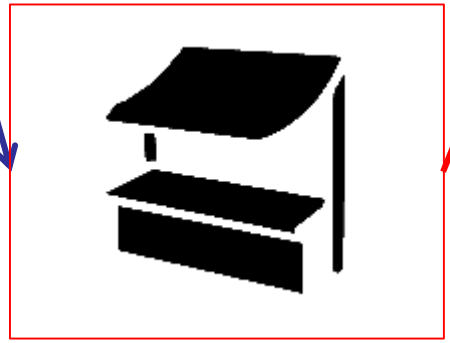






Animal market

Beef farm

If in calves purchased
2-3 weeks after introduction,
it will evaluate measures including
traders and markets
Sampling older beef cattle may be hazardous

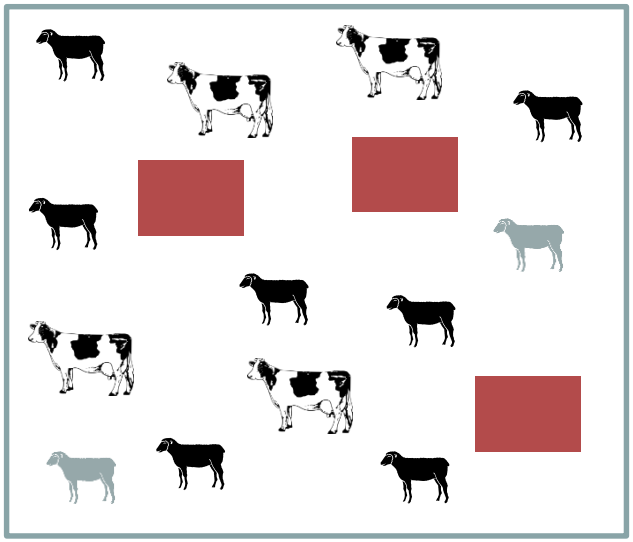
Monitoring over time
at slaughter
Evaluating vaccination
at beef farms as well

Abattoir

Comparison

Representative

- Measure disease/infection in population avoiding bias
- Detect changes over time
- Describe distribution of FMD in population and its subpopulations



Risk-based

- Not a good approach to measure FMD infection in general population
- Needs knowledge on risk-factors to increase probability of finding. This knowledge is based upon prior studies or expert consultation
- More efficient to find Disease or Infection compared with representative
  - Fewer samples needed overall
  - Creating higher sensitivity of surveillance

➔ These investments yield higher benefit-cost ratios of surveillance

Risk-based surveillance to eliminate FMD virus circulation

Very few clinical report, however there maybe unknown virus circulation

Imagine a situation where control measures include intensive vaccination of
cattle but little vaccination of small ruminants (limited resources and epidemiologic argument)

With high vaccine coverage in cattle, virus circulation is limited and clinical expression may be reduced in cattle.

Surveillance of virus circulation may therefore be (best) focused on small ruminants:

- Clinical detection
- Sero-survey

Passive surveillance in small ruminants
How to make it a useful surveillance component?

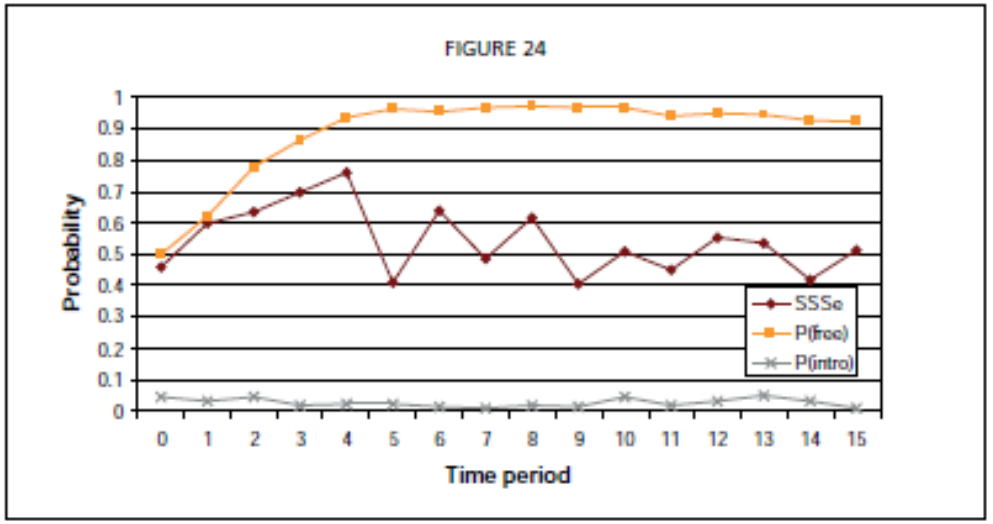
New case definition:
Typical clinical signs of FMD difficult to distinguish. Instead

syndromic surveillance using

- Mortality in lambs/kids
- Limping in adult stock

Requires sensitisation with farmers and SOPs for vets (examination sufficient number of animals, make flock run, history of contacts with other flocks and NSP testing of younger stock if suspected)

- Passive surveillance builds up evidence constantly
- Even with low sensitivity, the use of many observations (farmers) increases the overall surveillance performance



Risk-based surveillance – FAO guidelines 17

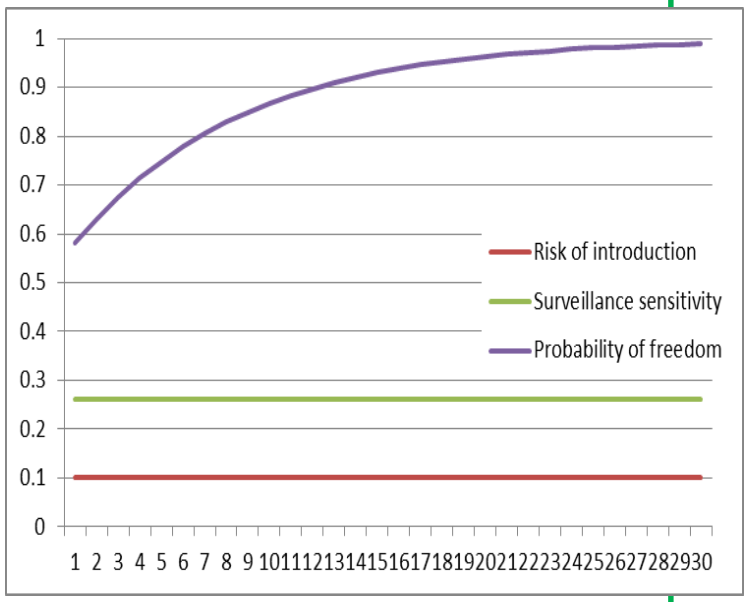
Probability of freedom of FMD virus circulation

Making use of:

1. **Historical evidence**
2. **Probability of introduction**
3. **Multiple surveillance activities**

Ad 1. Surveillance sensitivity in multiple time periods. Use of Bayesian approaches to combine data over time, or incorporate historical evidence of freedom:

- **Passive surveillance** (such as discussed for syndromic surveillance in sheep) evidence builds up constantly and even with a low sensitivity of a single sampling unit, many units together increase sensitivity of this surveillance



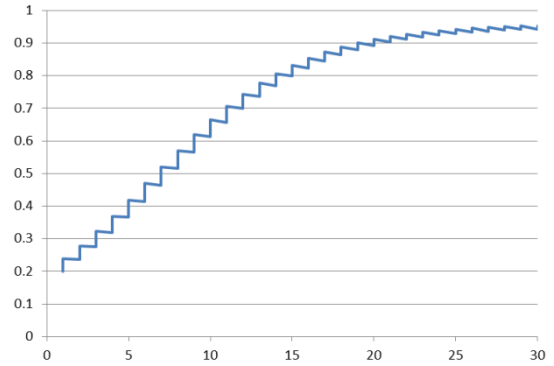
Probability of freedom of FMD virus circulation

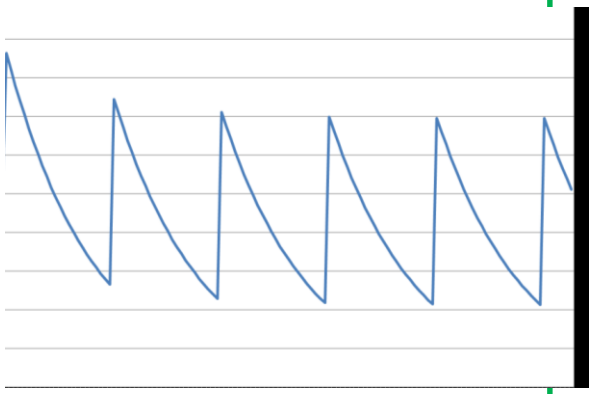
Making use of:

1. **Historical evidence**
2. **Probability of introduction**
3. **Multiple surveillance activities**

Ad 2. Probability of introduction over multiple time periods

- Constant risk that will lower the probability of freedom that was established over time
- Based on historical data or using risk-analysis
- Indicates that surveillance system needs to fed regularly to counterbalance this decrease





Probability of freedom of FMD virus circulation

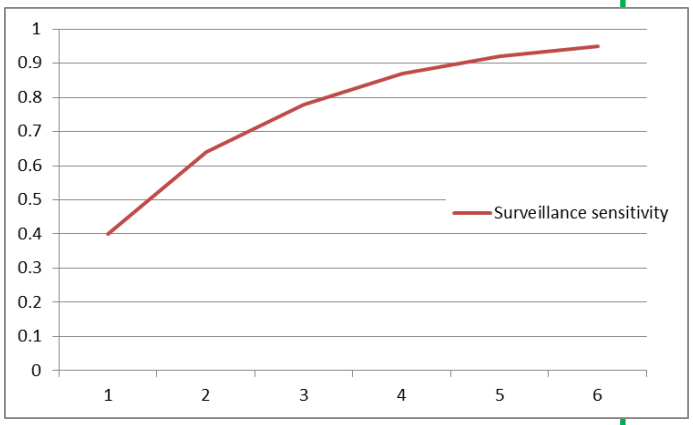
Making use of:

1. **Historical evidence**
2. **Probability of introduction**
3. **Multiple surveillance activities**

Ad 3. Multiple surveillance activities combined will increase the surveillance sensitivity

- Layers of surveillance, starting with the most widespread and least expensive (passive surveillance), and progressively adding other surveillance components that have higher sensitivity, better degree of targeting at-risk populations and may be more costly (risk-based sero-survey)

- **Accumulation of surveillance evidence** means that once free status has been achieved, the level of ongoing surveillance to maintain confidence in free status can be much lower than the initial surveillance



What is sensitivity of passive surveillance

Roles and responsibilities of private and public sector

PASSIVE SURVEILLANCE

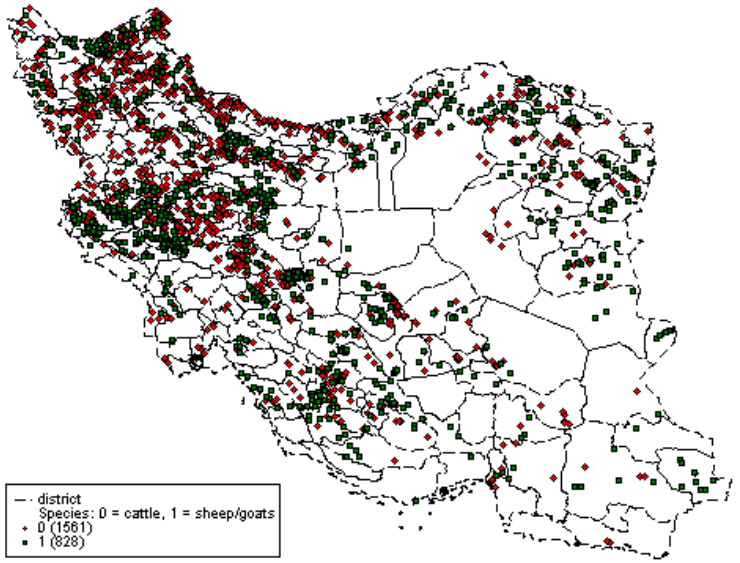
Passive surveillance

<u>Major advantages</u> of a passive system are:

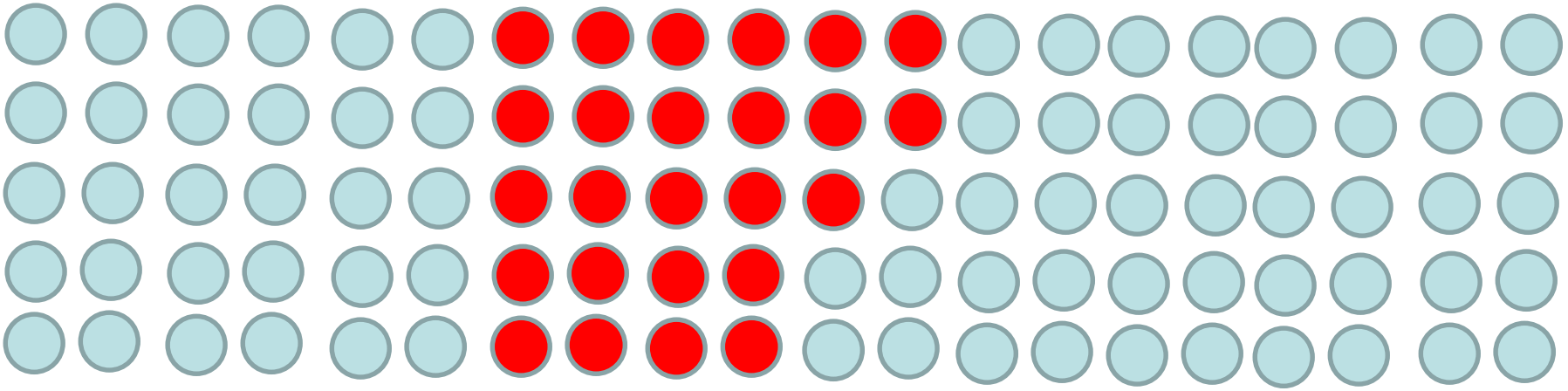
- low cost per case detected
- Widespread coverage of population

<u>Major disadvantages</u> are

- poor compliance and
- underreporting of potential cases …BIAS



Imagine 100 herds in which 25 infected



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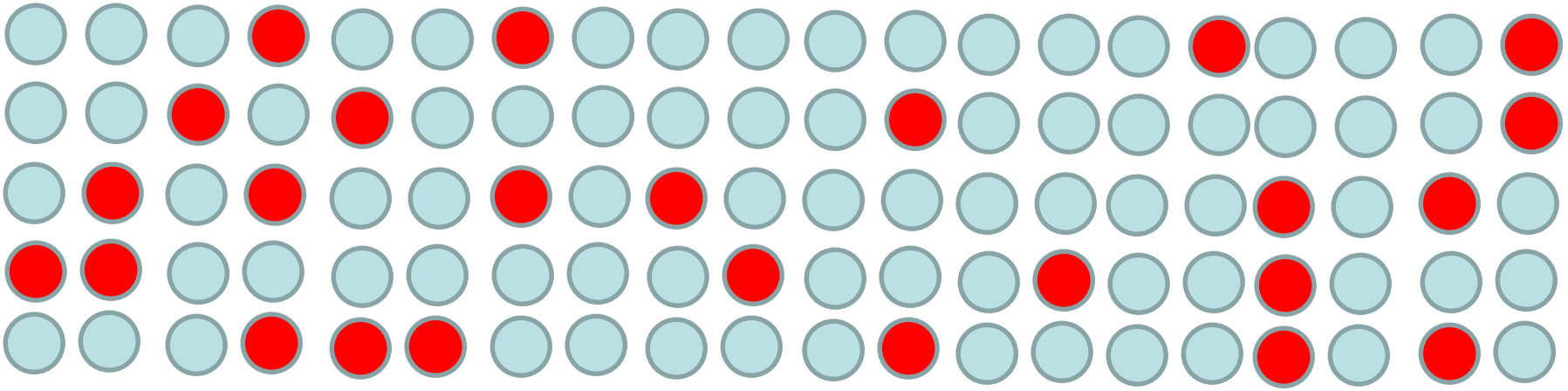
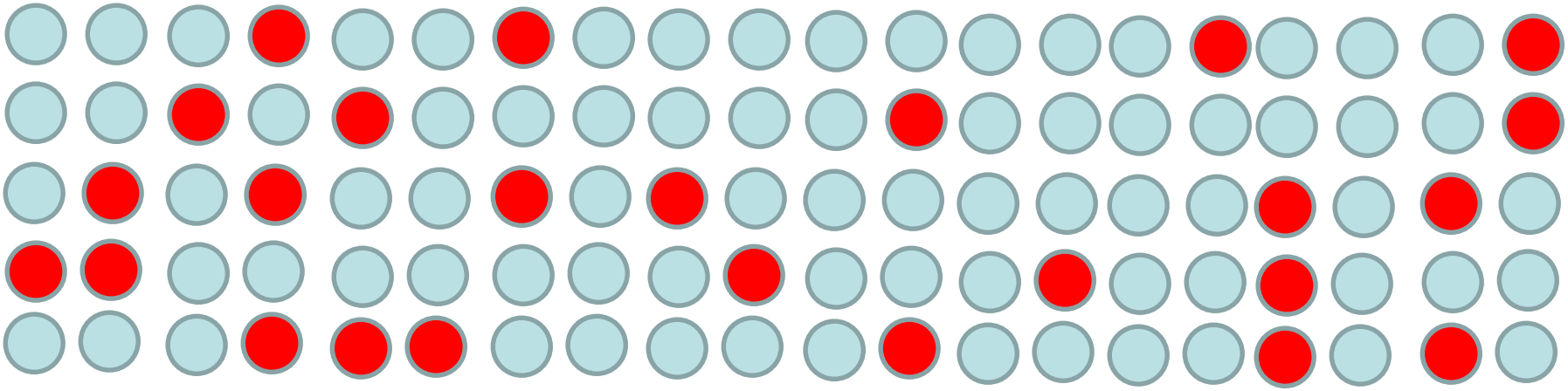


How many will be reported?

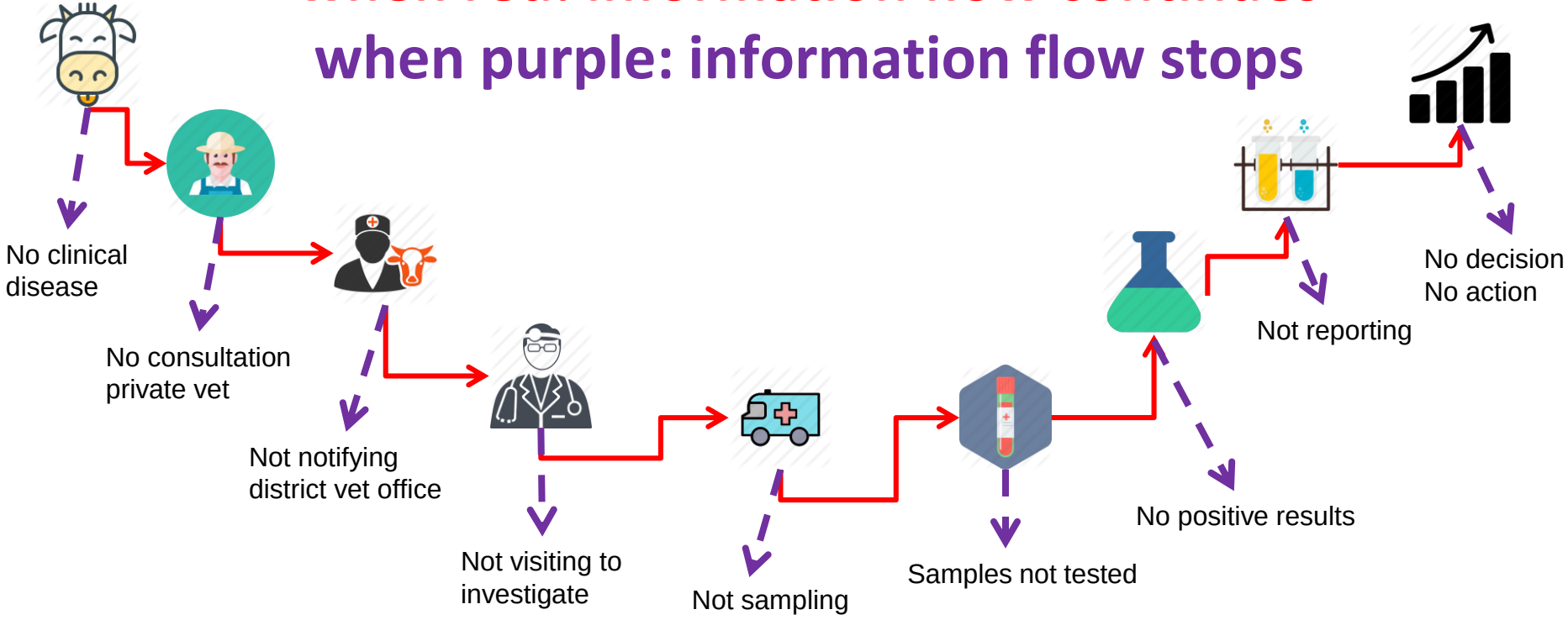
Imagine 100 herds in which 25 infected

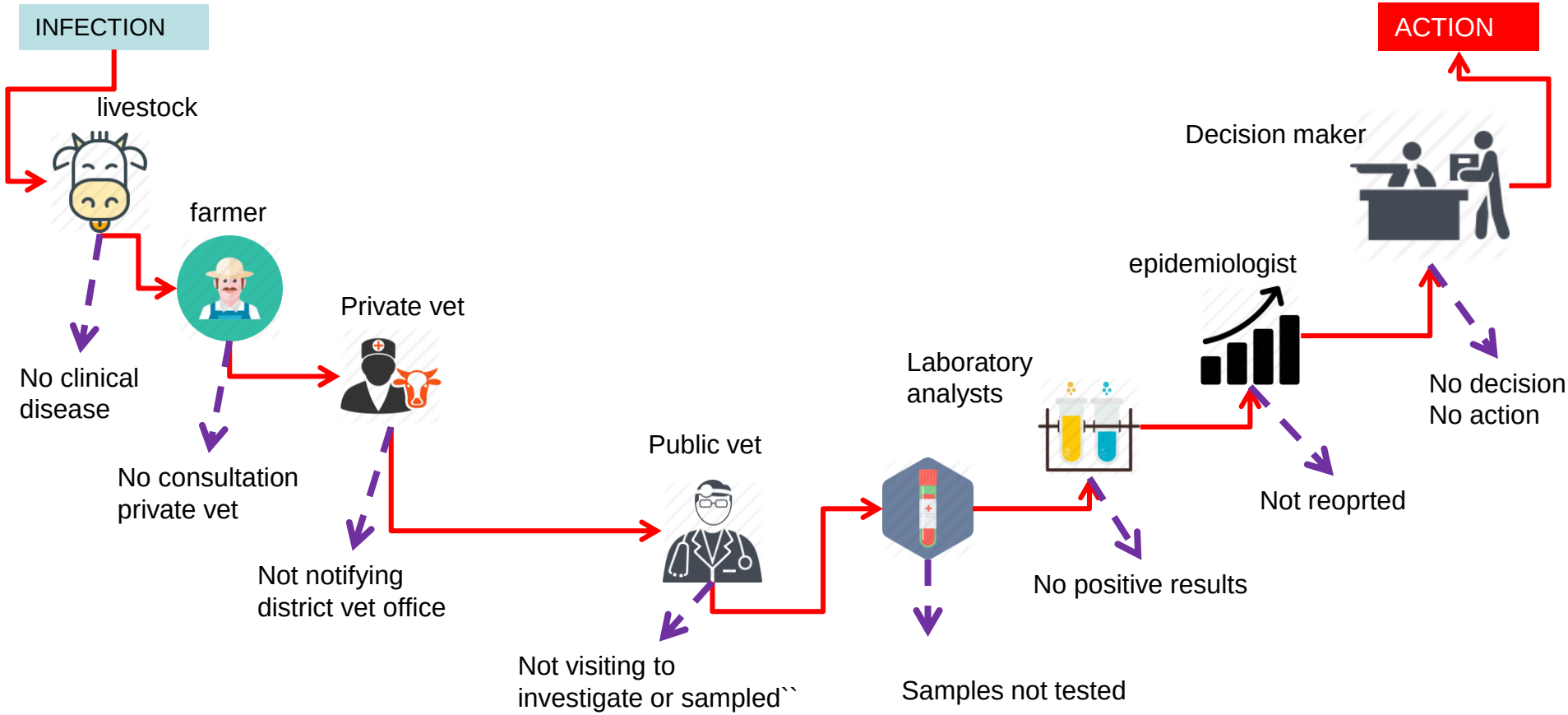


In each step there are two possible routes

when red: information flow continues

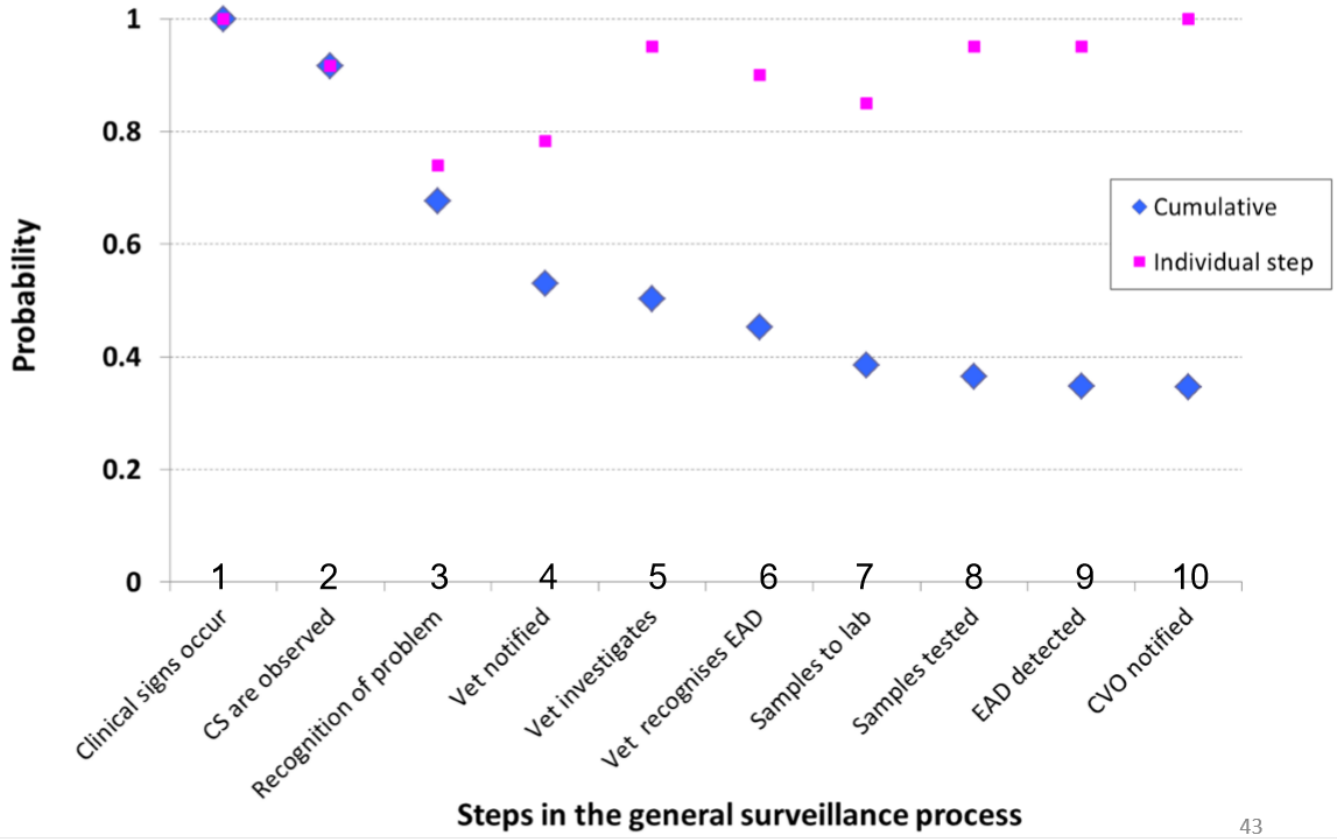
when purple: information flow stops





Step	infection	Clinical signs	Farmer observes	Consultation private vet	Notification to public vet	Investigation and sampling	Samples tested	Samples testing negative (lack of sensitivity)	Data loss to reporting	No action taken
Probability	100	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Cumulative		90	81	73	66	59	53	48	43	39

Mean step probabilities – FMD in Region 9



EuFMD Webinar

Tony Martin

Assessing sensitivity of each step in passive surveillance (pink dots) and cumulative sensitivity (blue diamonds)

How does active surveillance complement passive surveillance

Examples of active surveillance

Roles and responsibilities of private and public sector

ACTIVE SURVEILLANCE

Active surveillance

Major advantages:

- less biased (with careful study design)
- increased certainty of disease freedom if no cases are found;
- lower likelihood of underreporting;
- more credible system for international trade

Major disadvantages:

- high cost per case detected especially if prevalence is low;
- for maximum value must have clear description of purpose.

Active surveillance

Active surveillance: going out to get the information

1. Surveys: serological or clinical
2. Slaughterhouse, watering points, dip-tanks survey
3. Syndrome surveillance
4. Sentinel herds (vector-borne)
5. Negative or zero reporting
6. Participatory disease surveillance (PDS)

Options include:

Population-based without regard to risk grouping (random survey)

Risk-based sampling where population is categorized as **high-risk** or **low-risk**

Slaughterhouse surveillance

early detection, monitoring progress disease control

Inexpensive

Large number, large coverage, continuous supply

Various specimen available

Non-representative = bias

- Younger, healthy

Lack of associated data

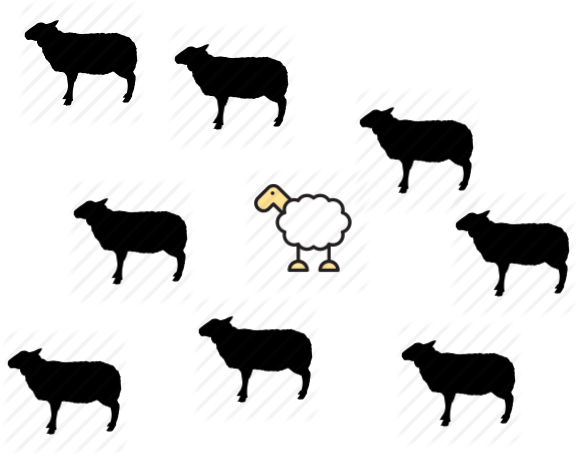
- Age, origin, vaccination history

Sentinel herds

early detection in area,

`proof freedom of disease

effectiveness of control programme



Expensive, logistical difficult

- Start with proven sero-negative animals in herds,
- Replacements to be negative
- Individual identification
- Use small herd

Use for infection that spread in wave (vector-borne)

Monitoring over time

Can also apply to some animals within a farm (unvaccinated) amongst vaccinated animals to monitor virus circulation

Low sensitivity

- Only for disease with clear signs
- Vets will become lax

Needs reporting

Needs vet and farmer awareness

Reporting needs fast, solid system

Needs audit in place

Negative or
zero reporting
proof freedom of disease

Vets visiting farms (for treatment, vaccination, inspections) check and chat

Large coverage possible, continuous – brief reports of each visit

Syndromic surveillance

early detection

Large coverage, continuous supply

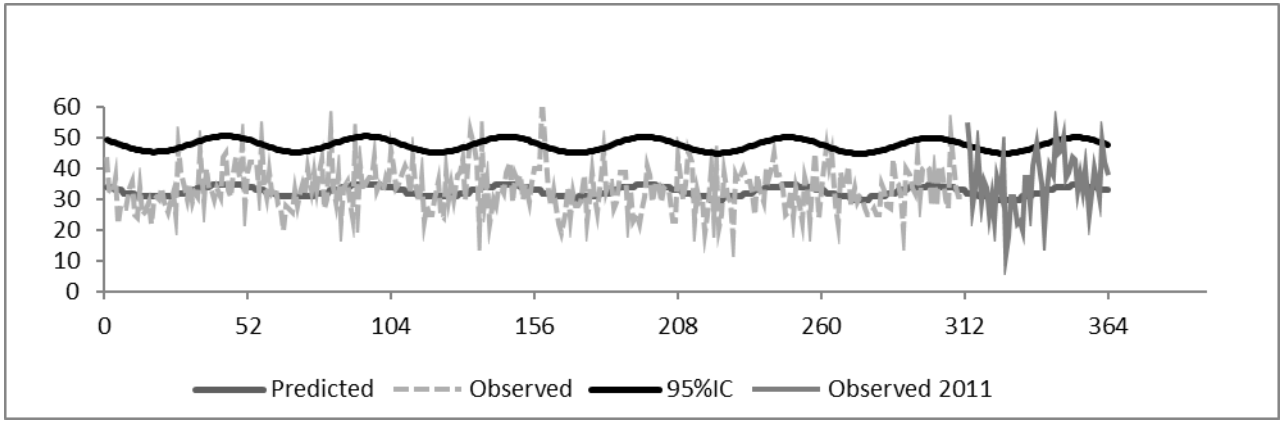
Cheap?

Large quantities of data needed

Solid data management system

Algorithms

- False positives versus false negatives
- Need for follow up



Participatory disease surveillance (searching)

Use of 'participatory approaches' in surveillance

- Places value on local knowledge
- Flexible approach
- Community strongly involved, responds to communities needs

Participatory methods:

- Mapping,
- Proportional piling
- Seasonal calendars

May be combined with traditional approaches

Has been used for rinderpest (Africa, Asia), FMD (Turkey) and HPAI (Asia, Egypt)

Villagers mapping an active HPAI outbreak to identify households with infected chickens, document the spread of the disease, and identify risk factors, Indonesia, courtesy J. Mariner

Acknowledgement

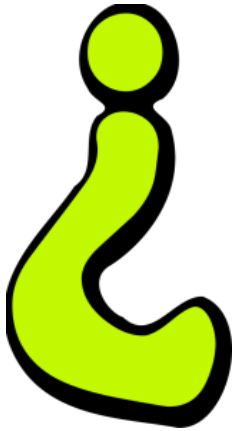
Angus Cameron - AUSVET

EuFMD consultants

References

Risk-based surveillance - FAO guidelines 17

EpiTools (http://epitools.ausvet.com.au

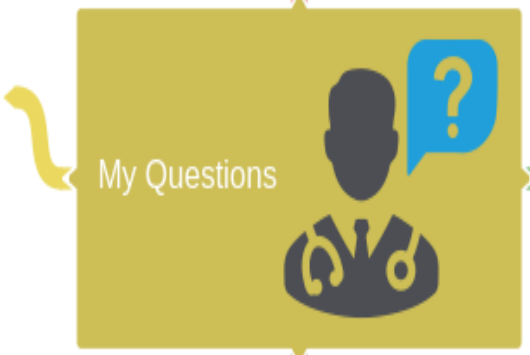


Workshop on improving FMD monitoring and surveillance

Questions for different stages of FMD control (PCP-FMD 1, PCP-FMD 3, FMD free)

Break out groups by level of FMD control

- 2-3 questions each group
- 1 moderator
- 1 reporteur



6. WHAT is the **progress** of your FMD control program?

4. WHAT is **role of small ruminants** in FMD transmission?

2. WHAT is **reason** for low reporting while high sero prevalence?

1. WHAT **active surveillance approach** to take for early detecting ASIA-1 or A/GVII

3. WHAT is the **effectiveness** of the vaccination campaign?

5. WHAT is the **evidence** for absence of circulation?

Scenario 1 – Active surveillance for detecting circulation of Asia-1 or A/GVII (all countries)

- What **active surveillance** components will you establish to detect the circulation of Asia-1 or A/GVII?
- When your initial surveillance is demonstrating absence what will your country do to monitor (provide evidence) the absence of these viruses?
  - Use of serology, clinical inspection, syndrome surveillance
  - Where and when to apply?
  - Locations, species, age-categories, production systems
  - Who to involve, under what mechanism/agreements?

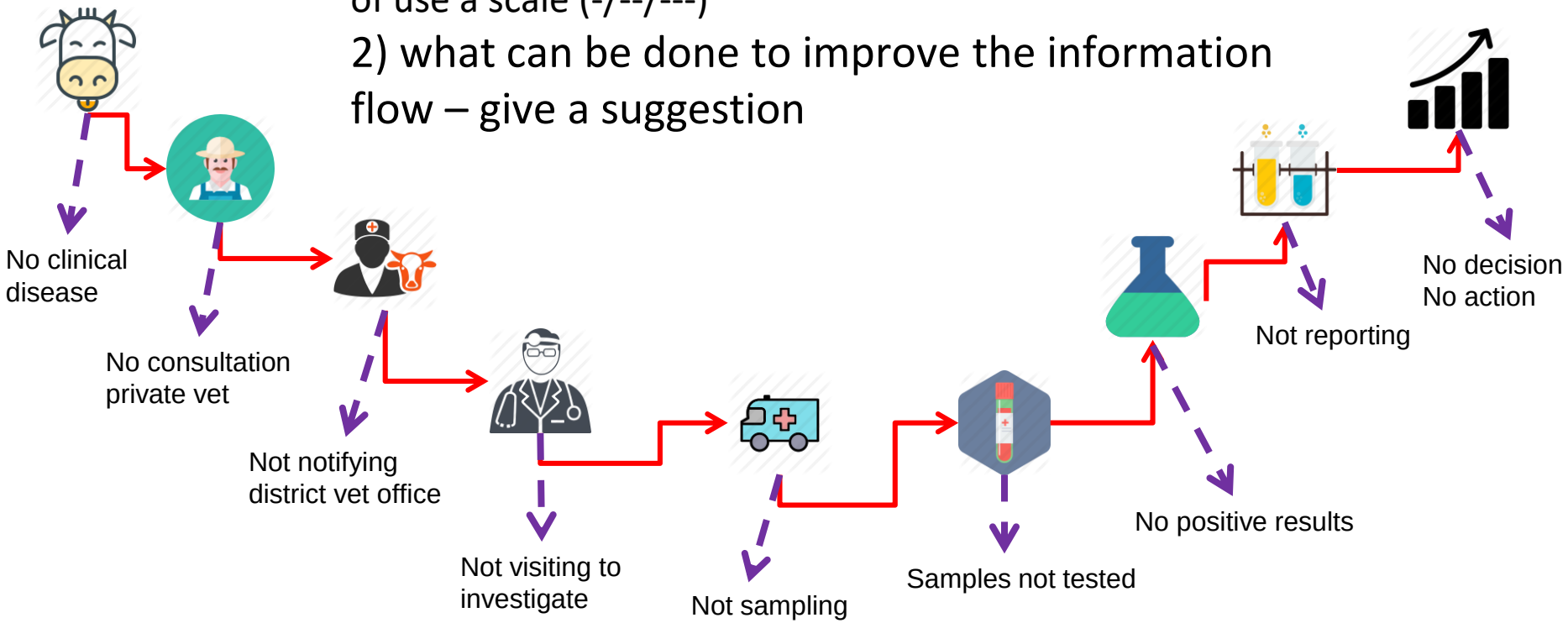
Scenario 2 – Sensitivity of FMD reporting (PCP-1 countries)

- How will you assess/evaluate the steps in the FMD reporting systems to better understand the sensitivity of passive surveillance?
  - Locations, species, production systems
  - Who to involve, under what mechanism/agreements?
- What are alternatives to your current passive surveillance, or what are actions you will take to improve passive reporting (increase the sensitivity)?

In each step:

1) for each what is the likelihood that the information doesn't flow (indicate using a proportion of use a scale (-/--/---)

2) what can be done to improve the information flow – give a suggestion



Step	infection	Clinical signs	Farmer observes	Consultation private vet	Notification to public vet	Investigation and sampling	Samples tested	Samples testing negative (lack of sensitivity)	Data loss to reporting	No action taken
Probability	100									
Cumulative										
Action to improve										

Scenario 3 – Post-vaccination monitoring (PCP-3 countries)

- What are **the specific objectives** for post-vaccination monitoring
  - Population immunity induced by vaccination campaign
  - Performance of your vaccination teams
- What **active surveillance activities** will you establish to quantify the vaccination effectiveness?
  - Use of serology, clinical inspection, syndrome surveillance
  - Where and when to apply?
  - Locations, species, production systems, age-categories
  - Who to involve, under what mechanism/agreements

Scenario 4 – Role of small ruminants in FMD virus transmission (all countries)

- To understand the role small ruminants play in maintaining FMD virus circulation, what surveillance your country will establish?
  - Use of serology, clinical inspection, syndrome surveillance
  - Where and when to apply?
  - Locations, species, production systems, age-categories
  - Who to involve, under what mechanism/agreements

Scenario 5 – Evidence for absence of FMD virus circulation (FMD free and PCP-3 countries)

- What **surveillance activities** will you establish prove absence of FMD virus circulation in a region, zone or production system?
  - Use of serology, clinical inspection, syndrome surveillance
  - Where and when to apply?
  - Locations, species, production systems, age-categories
  - Who to involve, under what mechanism/agreements
- Once established, how will you keep monitoring this situation?

Scenario 6 – Progress of your FMD control program

The control of FMD is supposed to result in lower levels of FMD virus circulation

Objective: to measure quantitatively the effectiveness of FMD control measures over time?

- What approach to surveillance
  - Serology, clinical inspection, syndrome
- Where and when to apply?
  - Differences for different species, production systems, regions
  - Locations, time of the year
- Who to involve, under what mechanism?