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Introduction to Risk and Risk Based Surveillance

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Regional Workshop on FMD and other TADs

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Foot and Mouth Disease

We will be talking about

- Definition of risk
- Surveillance
- Risk Based Surveillance
- Probability of freedom

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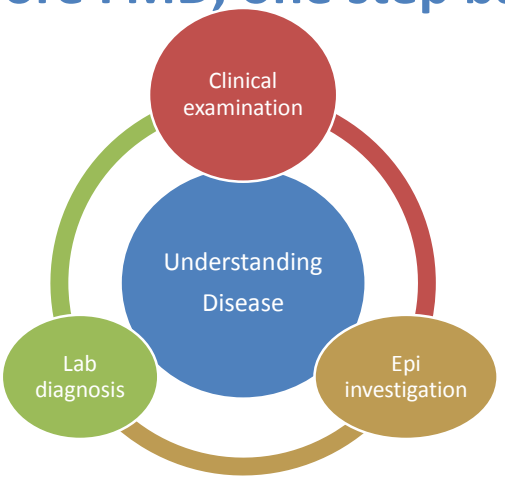
Before FMD, one step back



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To understand Risk, there are two aspects to consider

- The chances unfavourable outcome will happen
  = **probability, likelihood**
- The outcome if it happens = **consequences**

Example: Premises/husbandry practises may be considered **High Risk if**

- **They are associated with a high incidence of FMD (high probability)**

OR

- **They are located in an area usually FMD free (high consequences)**

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Day-to-day risk: crossing the road

- How do you manage this risk?
  - What measures to reduce this risk do you take?

What is the greater risk?

- On foot?
- By bike?

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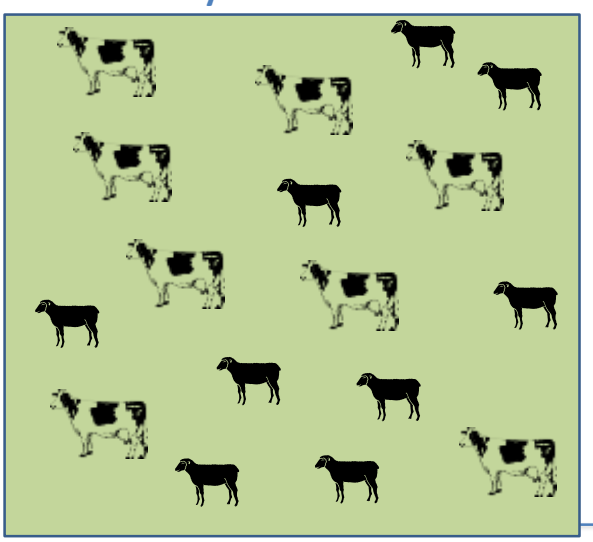
Key issues for control and surveillance



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)

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

Risk-based surveillance

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Risk-based

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

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Risk-based surveillance

Risks such as

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

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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-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

Risks such as
- Species (susceptibility, infectiousness)
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Risk-based surveillance

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

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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)
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

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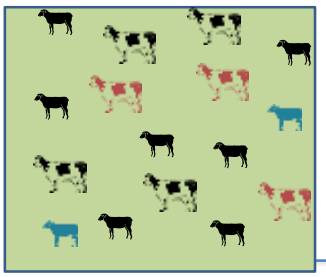
Comparison

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

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Example RBS

- Surveillance Sensitivity = $1-(1-(P*Se))^n$

- P – prevalence
- Se – Sensitivity of the test used
- N – number of samples

- 1) In the population the disease is at a 5 % prevalence
  P = 0.05 (5%); SE=0.9; n = 20 animals => 60,2%

http://www.fao.org/3/a-i4205e.pdf

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Example RBS

Surveillance Sensitivity = $1-(1-(P*Se))^n$

1) In the population the disease is at a 5 % prevalence
   P = 0.05 (5%); SE = 0.9; n = 20 animals => 60.2%

2) Now lets imagine this:

- a) Imagine: 20 % of population is young and 80 % is older
- b) P(old)=3.6% P(young)=10.8% - 3x the risk!

c) If I only sample young animals:

- P = 0.108 (10.8%); SE = 0.9; n = 20 young animals => 87,1 %

http://www.fao.org/3/a-i4205e.pdf

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Risk-based surveillance to regain FMD freedom

Assessing virus circulation in small ruminants through sero-surveillance

What would have your preference?

1. Assess the prevalence of infection in flocks that were surveyed in the previous round. If the prevalence has increased, it is most likely to be due to within-flock transmission
2. Assess the status of flocks that tested negative in the last round. If any test show evidence of infection, this must have occurred since the last sampling
3. Assess only young animals – kids and lambs born since last lambing season. If any show antibodies, these must have been acquired this year indicating active infection

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Risk-based surveillance to regain FMD freedom

Assessing virus circulation in small ruminants through sero-surveillance

What would have your preference?	Reflection
1. Assess the prevalence of infection in flocks that were surveyed in the previous round.	1. Requires a (very) large sample size to determine change in prevalence (power)
2. Assess the status of flocks that tested negative in the last round.	2. Random error makes flock status uncertain and animal movements (exits/introductions) may easily change status
3. Assess only young animals –	3. Most practical, no issues of previous herd status

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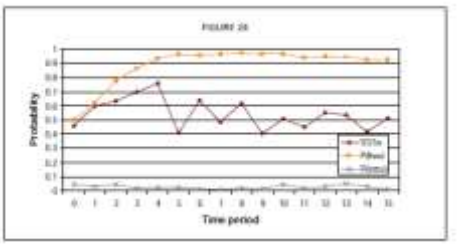
Passive surveillance in small ruminants
How to make it a useful surveillance component?

- 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

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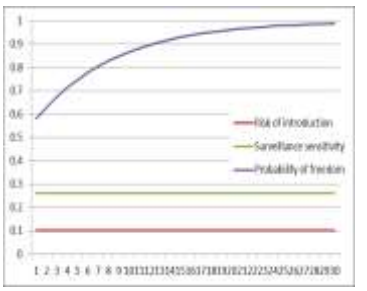
Probability of freedom of FMD virus circulation

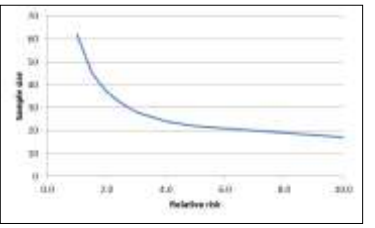
Making use of:

1. Historical evidence

2. Probability of introduction

3. Multiple surveillance activities





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
- When Relative Risk is higher, sample size can be lower to achieve similar level of surveillance sensitivity (lower graph)

Surveillance Sensitivity = $1-(1-(P*Se))^n$

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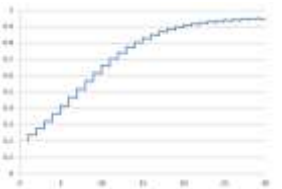
Probability of freedom of FMD virus circulation

Making use of:

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



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

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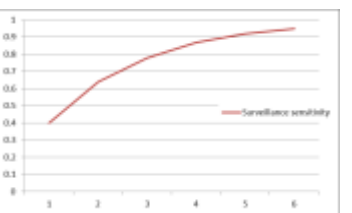
Probability of freedom of FMD virus circulation

Making use of:

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



Multiple surveillance activities combined will increase the surveillance sensitivity (upper graph)

- 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

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