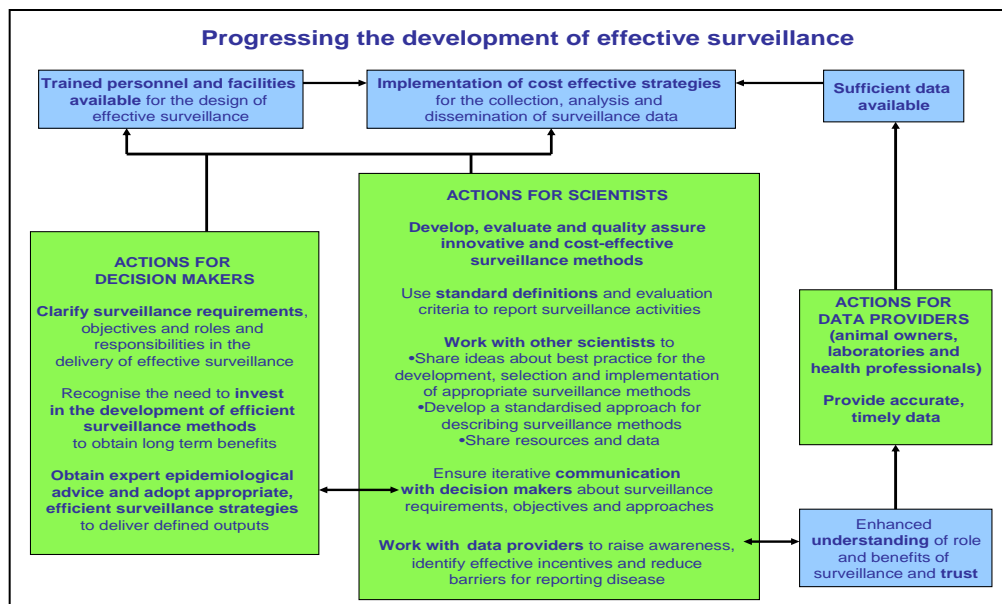


# Discussing the Development and Application of Methods for Effective Surveillance in Livestock Populations

Summary extracted from the report of a workshop held prior to the ISVEE conference, Durban, South Africa, August 2009



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## Executive summary

This report presents the content and outcomes of an international workshop to discuss the surveillance of livestock animal health held in Durban, South Africa in August 2009. The main objectives of this workshop were to discuss the development and application of effective surveillance methods, and how to overcome any constraints limiting their use.

It was attended by 29 participants from 16 different countries including many delegates from Europe, but also a number from North and South America, Africa and Australasia. There were a number of separate sessions, each of which started with a series of short presentations given by the workshop organisers and participants; these were followed by small group and then plenary discussions.

The main achievements and recommendations are summarised below and described in more detail in Chapter 2 of this report. Two of the appendices provide reference documents which it is hoped will be useful to those designing and implementing surveillance activities;

- appendix 7 provides an action list to facilitate the implementation of effective surveillance
- appendix 2b is a summary of definitions and criteria that can be used to describe surveillance activities.

The main **achievements** of this workshop were to:

1. Initiate the **development of a standardised system for the description of surveillance activities**. The proposed definitions and criteria for describing and evaluating surveillance activities are summarised in appendix 2b, which is intended to provide a reference document for those designing, reporting and assessing surveillance activities.
2. Explore the **selection of appropriate surveillance methods** for different objectives. There was considerable discussion about the methods that could be used for the detection of new (emerging) diseases, and the possibility of adopting a global standard for the detection of these diseases was raised.
3. Develop ideas about **how the efficiency of surveillance methods might be enhanced**. These discussions focussed on the development of innovative approaches for surveillance and making best use of available data and existing activities. Examples of innovative approaches discussed during the workshop include the use of alternative data sources and anecdotal evidence, proxy species and participatory methods. It was noted that these innovative methods had often been developed in resource constrained situations. Other ideas for enhancing the efficiency of surveillance methods included:
  - applying social network analysis to facilitate the design of surveillance systems,
  - integrating the capture and/or analysis of public health and veterinary data,
  - combining surveillance for multiple pathogens and
  - improving case reporting.

Further development of technology for the collection of data, analytical methods and of risk-based strategies could also contribute to enhancing the efficiency of surveillance. Regular and routine evaluation of surveillance activities in order to identify how effective they are and how their efficiency could be enhanced were also discussed.

4. Identify means to **encourage the implementation of appropriate and efficient surveillance methods**. The critical importance of effective communication between scientists and decision makers was highlighted (see appendix 7 for an action list to facilitate these discussions). Discussions between these parties need to clarify whether surveillance is required and if so, why. The benefits of using output based standards, and the requirement for quality assurance of the outputs from surveillance systems designed to meet these standards, need to be emphasised. It is also important for decision makers to recognise the value of expert epidemiological advice in designing surveillance activities and setting appropriate scientific objectives. Such advice can substantially reduce the costs of surveillance and improve the likelihood that data collection will be effective and efficient. Investigating and quantifying the benefits of surveillance is also necessary so that decision makers recognise the reward to be gained from spending a small amount on the development and implementation of effective surveillance. Finally, the need for integration of surveillance and risk management activities was discussed.
5. Clarify the importance of communication between scientists and data providers in order to build trust and **encourage participation in surveillance systems**. The need to involve stakeholders in the design of surveillance systems to facilitate the provision of accurate and timely data was discussed. Scientists need to provide information to data providers about the diseases that may occur and the wider benefits of surveillance activities. The key role of data providers, particularly for the identification of new (emerging) diseases, should be discussed. Scientists also need to obtain information from data providers to clarify the factors influencing participation in surveillance and identify incentives that will encourage the provision of data.
6. Identify the need for **enhancing communication and co-operation within the scientific community** to facilitate the development and implementation of efficient methods for surveillance. This includes the need to share resources and data and to adopt a multidisciplinary approach to the design of surveillance systems.

Recommendations for actions to progress the development and application of effective surveillance were to:

7. Encourage the **engagement of those providing surveillance information with the decision makers** in their countries or organisations to encourage the adoption of appropriate methodologies. Surveillance providers from different countries also need to work together to influence international regulatory bodies to adopt the principles and approaches described here, to underpin international rules on surveillance. This would include the use of output based standards and the development of a sustainable process for quality assurance of the technical basis for internationally acceptable declarations of disease status.

8. Continue **discussions between scientists** including the planning of future workshops or conferences to:
- Develop a **standardised system for describing surveillance activities**
  - Develop **advice on appropriate surveillance methods** for different objectives, particularly those aimed at detecting new (emerging) diseases
  - Develop processes for **effective communication between scientists and decision makers**
  - Progress the investigation of incentives, factors influencing disease reporting and the involvement of stakeholders in the design of surveillance systems in order to **encourage the participation of data providers in surveillance activities**
  - Establish processes for **effective communication and collaboration between scientists**, to facilitate the sharing of resources, data and the development of a multidisciplinary approach to surveillance activities
  - Establish a **system for documenting surveillance activities, and a quality assurance system** to facilitate the adoption of output based standards.

Overall the workshop was well received by participants, achieved the objectives set, and has stimulated ideas for further work on the development and implementation of effective methods for animal health surveillance. The feedback provided by participants (presented in appendix 4) will help in planning future discussions.

## Appendix 2b

### Summary of surveillance definitions and criteria for describing and evaluating surveillance activities developed after the workshop

This document has been produced by the conference organisers based on the suggestions made by participants during the workshop and subsequent investigations and discussions. It is intended to provide a reference document for those designing and reporting surveillance activities. It clarifies some of the issues causing confusion about surveillance terminology and summarises the agreement reached so far about how to describe surveillance activities. The contents may be refined following further discussion at future workshops. Explanatory notes about the development of these definitions and criteria are included in the notes in appendix 2c, these numbered notes are referred to in this document.

This document has three sections:

1. Updated definitions of surveillance related terms
2. Criteria that could be used to **describe** surveillance activities
3. Criteria that could be used to **evaluate** surveillance activities

#### 1. Surveillance definitions

**Surveillance**<sup>1</sup> - The systematic, ongoing measurement, collection, collation, analysis, interpretation and timely dissemination of animal health related data, essential for describing disease occurrence and for the planning, implementation, and evaluation of disease control measures.

**Scanning surveillance**<sup>2</sup> - Surveillance to monitor the health of defined populations in order to increase the likelihood that there will be timely detection of undefined or unexpected diseases, or of changes in the occurrence of endemic disease.

**Targeted surveillance**<sup>3</sup> – Surveillance to address specific questions about the occurrence or epidemiological features of a defined disease or condition, in a defined population, using an agreed protocol, often using specific diagnostic tests (e.g. ELISA or PCR). (See notes about confusion between targeted and risk-based surveillance in appendix 2c).

**General surveillance**<sup>4</sup> - Surveillance that is not focused on a particular disease or health issue and can detect any disease or pathogen, including new (emerging) and exotic diseases (see definitions of disease types below), using non-specific diagnostic investigations such as clinical information or indirect indicators.

**Syndromic surveillance**<sup>5</sup> – Surveillance that uses health-related data (clinical signs or indirect indicators) that precede formal diagnosis, and indicate sufficient probability of a change in the health of the population resulting in further investigation.

**Risk-based surveillance**<sup>6</sup> - A surveillance strategy in which efficiency is increased by including sample units that are more likely to:

- be infected with the disease of interest;
- detected as infected with the disease of interest;
- become infected with the disease of interest;
- transmit the disease of interest to other units in the population.

(See notes about dependence of risk based strategy on purpose of surveillance in appendix 2c.)

**Active surveillance**<sup>7</sup> - Investigator initiated collection of surveillance information, when the decision about which information should be included from a farm / animal/ observer , is made by the investigator (see notes about alternative definition of active and passive surveillance in appendix 2c).

**Passive surveillance**<sup>7</sup> - Observer initiated provision of surveillance information, or the use of existing data, when the decision about which information is included from a farm or animal is made by the data provider (see notes about alternative definition of active and passive surveillance in appendix 2c).

**Sentinel surveillance**<sup>8</sup> - The regular collection of information from selected sites (e.g. herds or animals) about the occurrence of infection, disease or the health of a specified population.

### Definitions of surveillance component, system and program

**Surveillance system component (SSC)**<sup>9</sup> - A single surveillance activity that generates data about a particular disease.

**Surveillance system**<sup>9</sup> - The range of different surveillance activities that are able to produce data about the status of a particular disease in a population. A surveillance system may have one or more components.

**Surveillance program** – The range of surveillance systems used to investigate the health of the animal population in a particular area.

### Definitions of disease types

**Endemic diseases** are known to be present in the population.

**Exotic diseases** are previously defined (known) conditions that cross political boundaries to occur in a country or region in which they are not currently recorded as present.

**Re-emerging diseases**<sup>10</sup> are previously defined (known) conditions that are currently either absent, or present at a low level, in the population in a defined geographical area that re-appear or significantly increase in prevalence.

**New (emerging) diseases**<sup>10</sup> are new, previously undefined (unknown) conditions, not currently recorded as present, which may result from the evolution or change in an existing pathogen or parasite causing a change of strain, host range, vector, or increase in pathogenicity; or may be the occurrence of any other previously undefined condition.

## 2. Criteria for describing surveillance activities

There are many different methods for the collection of surveillance information. It is important that these methods can be described clearly to facilitate the selection of the most appropriate ones to achieve different surveillance objectives in different situations. A full understanding of the surveillance approach used can only be achieved using a number of different criteria. The reason for carrying out a surveillance activity can be described using the **surveillance purpose**, which is determined by the nature and type of disease being investigated. The purpose of surveillance and nature of the disease determine the most appropriate methods to use for surveillance investigations.

The options for **surveillance purpose** include:

- Early detection / early warning of:
  - known (previously defined) exotic or re-emerging diseases or
  - unknown (previously undefined) new (emerging) diseases.
- Demonstrate freedom from disease.
- Describe the level and distribution of specified diseases in order to prioritise disease control activities.
- Detect cases to facilitate control (e.g. zoonoses).
- Describe changes in the health of the population, or changes that threaten the health of the population, in order to monitor progress in control programs or respond to changing disease priorities.

Data collected in surveillance systems may be used to identify risk factors for disease, but this is not usually the primary purpose of the surveillance activity.

The **disease of interest** can be described using a number of different criteria summarised here:

### Disease of interest

Classification	Options
Disease status	Present, absent
Disease type	Endemic, re-emerging, exotic, new (emerging)
Stage of disease control <sup>11</sup>	Investigation, Implementation, Confirmation

The surveillance methods used can be described using criteria relating to the population included, the data collection mechanism, and the information collected. The criteria that can be used are summarised in the following three tables.

### Population included

Classification	Options
<b>Population selection</b>	Specify – geographical location, species (whether proxy or not), breed, age, livestock sector, herd type, unit of interest (e.g. region, village, farm, batch, animal)
<b>Risk-based sampling<sup>6</sup></b>	Yes (specify which units are included and why e.g. risk of being infected or risk of transmitting infection), No
<b>Sampling<sup>12</sup> strategy</b>	Census, random, systematic, convenience, haphazard, volunteer, event-based, social networking

### Data collection mechanism

Classification	Options
<b>Origin of information<sup>7</sup></b>	Active, passive
<b>Study design</b>	Case reporting (voluntary or mandatory), existing data (remote sensing, veterinary surgeons, laboratories, farmers, drug sales, abattoirs, media) survey, continuous monitoring, sentinel
<b>Data collection method</b>	postal, focus group, telephone, visit, internet, participatory methods, workshops (for some of these data can be recorded manually or electronically)
<b>Data source</b>	farm, household, village, market, auction, agricultural show, livestock collection centres, watering or treatment point, abattoir, AI centre, laboratory, fallen stock centres, public, media, drug sales outlet, agricultural product outlet, biotechnology industry, vet, paravet or health worker, livestock transporter, industry organisation (e.g. breed society), government or other authority (e.g. OIE)

### Information collected

Classification	Options
<b>Disease focus</b>	Targeted, General
<b>Case definition</b>	Risk factor, clinical signs, clinical syndrome (including death), indirect indicators (e.g. drug sales, production or performance information, abattoir submissions), gross pathology, laboratory test for pathogens or toxins, laboratory test for host response (e.g. serology), specific diagnosis, negative reports

### 3. Criteria for evaluating surveillance activities

Having described the approach taken to surveillance there are a number of criteria that can be used to evaluate the effectiveness of the surveillance activity. These can be divided into those that evaluate either:

1. The surveillance process;
2. The evidence provided;
3. Or the performance of the surveillance system i.e. its ability to achieve its objectives.

These evaluation criteria are interrelated. The effectiveness of the surveillance process determines the quality of the evidence produced, and both the surveillance process and the evidence quality determine the ability of a surveillance activity to achieve its objectives i.e. the performance of the system. The evaluation of a surveillance system will require the use of a number of these evaluation criteria; the relative importance of different criteria will depend on the nature of the disease and the purpose of the surveillance. The information provided by these evaluation criteria can be used to determine whether the data collection, testing and analysis methods employed are appropriate to achieve the surveillance objective and, if necessary, to make recommendations about how these could be changed.

#### 1. Evaluation criteria for the surveillance process

- **Simplicity**<sup>13</sup> – refers to the system structure and ease of operation and flow of data.
- **Acceptability**<sup>13</sup> – willingness of data contributors and data managers (persons and organisations) to participate in the surveillance system.
- **Flexibility**<sup>13</sup> – ability to adapt to changing information needs or operating conditions with little additional time, personnel or funds required.
- **Stability**<sup>13</sup> – includes the reliability (ability to collect, manage and provide data without failure) and availability (ability to be operational when needed) of the system.
- **Sustainability**<sup>14</sup> – ability to continue into the foreseeable future.
- **Multiple utility**<sup>15</sup> – ability of system to provide information about multiple diseases or conditions.
- **Portability**<sup>13</sup> – how well the system could be duplicated in another setting.
- **Timeliness**<sup>13</sup> – reflects the speed between steps in a surveillance system. This can be sub-divided to assess time between different events in the surveillance process, as required. These events could include exposure to infection, onset of symptoms, capture of data, processing of data, generation of an alert, further investigation of an event, and initiation of control. For outbreak detection, timeliness has been defined as the time between exposure to the disease agent and the initiation of control measures.
- **Representativeness**<sup>16</sup> – how well the population included in the surveillance activity reflects the population of interest (e.g. herd type, age, location).
- **Coverage**<sup>17</sup> – the proportion of the population of interest that is included in the surveillance activity.

- **Data quality**<sup>13</sup> – reflects the completeness<sup>18</sup> and validity of data recorded.
- **Resources required**<sup>13</sup> – an assessment of financial costs and resources required, including personnel and equipment.

## 2. Evaluation criteria for the evidence provided by a surveillance system

- **Sensitivity**<sup>13,18</sup> - this can be considered on two levels:
  - **Unit level** - proportion of health related events of interest detected by surveillance activity.
  - **Population level** - percentage of outbreaks occurring that are detected by surveillance activity, or probability that disease will be detected if present at a certain level in the population.
- **Specificity**<sup>19</sup> – this can also be considered on two levels:
  - **Unit level** - proportion of true non-events correctly classified as non-events.
  - **Population level** – percentage of non-outbreak periods correctly classified as non-outbreaks, or probability that the population will be classified as disease free if disease is not present.
- **Positive predictive value**<sup>13,20</sup> – probability that a health event detected by the surveillance system is actually a true health event of interest (proportion of reported cases that have the health-related event under surveillance).
- **Negative predictive value**<sup>13</sup> – probability that no health event is present given that no health event is detected.
- **Bias**<sup>21</sup> – extent to which the estimate obtained in the study population differs from the true value in the target population (allowing for variation due to sampling error) i.e. systematic deviation of estimate from true value.
- **Precision**<sup>21</sup> – how closely defined the estimate obtained in the study population is and how consistently the study results can be reproduced.

## 3. Evaluation criteria for the performance of the surveillance system

- **Usefulness**<sup>13</sup> – ability to contribute to the prevention and control of adverse health-related events, including effective intervention to control outbreaks.
- **Effectiveness**<sup>22</sup> – how well the surveillance system achieves its intended results (e.g. does it detect cases of disease).
- **Efficiency**<sup>22</sup> - whether the surveillance system produces the desired effect, with minimum use of resources, the aim being to maximise the effectiveness of outcomes relative to cost (e.g. cost-benefit or cost-effectiveness).

## Appendix 7

### Actions to progress the implementation of effective surveillance

1. Engage with colleagues who make surveillance policy decisions or represent national interests in the EU or OIE to influence the (inter)national requirements for surveillance to focus on explaining the benefits of:
  - a. Defining the outcome needed from surveillance activities, to allow different data sources and approaches to be used to achieve the same level of confidence in disease status (i.e. move away from defining processes).
  - b. Using expert epidemiology advice to develop cost effective approaches to achieve these outcomes.
2. Engage with colleagues in the livestock industries and veterinary profession to:
  - a. Explicitly characterise the benefits of surveillance explaining their key role in the provision of surveillance data.
  - b. Identify incentives for data provision and participation.
3. Establish strategic surveillance contacts in each organisation with whom collaborative surveillance work is carried out. Work with them to promote the application of the principles and approaches outlined in this report when surveillance work is designed and carried out including the use of standardised terminology (appendix 2b).
4. Introduce the principles and approaches described here including the use of standardised terminology (appendix 2b) when presenting or teaching about animal health surveillance.
5. **Check list** for use when considering, designing or reporting surveillance:
  - a. Is the policy objective that this surveillance activity is being used to address clear?
  - b. Question the value of surveillance, is surveillance the most appropriate use of resource, particularly for emerging (new) diseases, or would alternative methods of risk mitigation/disease control be more appropriate?
  - c. Is the scientific objective well defined and limited to that needed for effective risk management?
  - d. Have the risk management decisions that will be informed by the surveillance been identified?
  - e. Is there existing data that can fulfil all, or part of, the surveillance objective?
  - f. Are there existing surveillance activities that could provide data or samples?
  - g. Are data providers engaged in the design of the surveillance, to ensure that they understand the benefits, and that it is practical for them to participate?
  - h. Has expert epidemiological advice been taken to ensure that:
    - Existing data or activities are used to maximum effect?
    - The sample size, or other costly parts of the design (e.g. length of questionnaire), have been limited to the maximum necessary for the objective?
  - i. Is the language and description of the activities clearly defined? Where possible that presented in this report (appendix 2b), or proposed from the follow-on work, should be used.

- j.** If the risk is global, is the level of surveillance proposed, and resultant probability of detection of disease, coherent with that in other countries, and proportionate to the risk?
- k.** Are cheaper approaches possible, such as surveillance of proxy measures or joint activities with colleagues in e.g. public health or industry?
- l.** Will delivery of surveillance results be sufficiently timely for the objective?
- m.** Have communication mechanisms for the surveillance outcomes and resultant risk management measures been planned, with particularly consideration given to obtaining the trust of all those effected by these measures.