AFRICAN UNION

INTERAFRICAN BUREAU FOR ANIMAL RESOURCES

A TRAINING MANUAL

ON

DISEASE SURVEILLANCE

Promoting the use of Standard Methods and Procedures in the management of Transboundary Animal Diseases

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1.0 DISEASE SURVEILLANCE

1.1 Introduction

An essential part of disease control is the ability to document the occurrence of disease with the goal of developing effective control and eradication strategies; this is surveillance

1.2 Definitions

There is no standard definition of surveillance. Some authors describe it in terms of *monitoring* while others have used ó*monitoring*ô and ó*surveillance*ô synonymously and interchangeably. However, there is a contemporary consensus that, although the two terms are closely interdependent, they now have separate and distinct meaning. For our purposes, we are going to define **Surveillance** as ó*Ongoing systematic and continuous collection, analysis and interpretation of health data (often designed to detect the appearance of specific diseases) allowing epidemiologists to follow in time and space the health status and some risk factors associated with diseases for a given population, for use in the planning, implementation, and evaluation of disease control measures*ô.

Monitoring is the routine collection of information on disease, productivity and other characteristics possibly related to them in a population. **Surveillance**, in contrast, is a more intensive form of data recording than monitoring, and has three distinct elements:

1. Gathering, recording and analysis of data;
2. Dissemination of information to interested parties, so that
3. Action can be taken to control disease.

1.3 Goals of surveillance

The broad aim of veterinary surveillance follow the goals of veterinary medicine in general, namely, maintenance of high standards of animal health and welfare and protection of public health by the control of zoonoses and food-borne infections. Several specific objectives can be identified:

- Rapid detection of disease outbreaks;
- Early identification of disease problems (endemic and non-endemic);
- Assessment of health status of a defined population;
- Definition of priorities for disease control and prevention;
- Identification of new and emerging diseases;
- Evaluation of disease control programs;
- Provision of information to plan and conduct research;
- Confirmation of the absence of a specific disease.

1.4 Role of epidemiology in surveillance

Modern concepts of surveillance were shaped by programs to combat infectious diseases, which depended heavily on reporting of ñnotifiableò diseases. The public health problems now monitored by surveillance reflect the diversity of epidemiologic inquiry and public health responsibilities, including acute and chronic diseases, reproductive health, injuries, environmental and occupational hazards, and behaviors. An equally diverse array of methods are used to obtain information for surveillance, ranging from traditional case reporting to analyses of data collected for other purposes, such as computerized medical care records.

While the epidemiologic role of surveillance reflects this diversity, surveillance systems are generally called upon to provide descriptive information regarding when (**temporal distribution**) and where (**spatial distribution**) health problems are occurring and who is affected (**host**) ï the basic epidemiologic parameters of time, place, and person (animal). The primary objective of surveillance is most commonly to monitor the occurrence of disease over time within specific populations. When surveillance systems seek to identify all occurrences of a specific health event within a defined population, data from surveillance can be used to calculate incidence or prevalence rates. Surveillance systems can also characterize individuals who are affected by health problems and to identify groups at highest risk for these problems. Surveillance can be used to describe health problems themselves, including their manifestations and severity, the nature of etiologic agents (e.g., antibiotic resistance of microorganisms), or the use of treatments.

All forms of epidemiologic investigation require a balance between information needs and the limits of feasibility in data collection. For surveillance, this balance is often the primary methodologic challenge, assuming an importance that is analogous to the selection of controls in a case-control study or the definition of exposure in a cohort study. As an ongoing process, surveillance depends on long-term cooperation among persons at different levels in the animal health delivery system and coordinating agencies. Asking too much of these participants or failing to demonstrate the usefulness of their participation will threaten the operation of any surveillance system and wastes resources. Another dimension of this balance lies in the interpretation of surveillance data, regardless of whether surveillance depends on primary data collection or adaptation of data collected for other purposes. Compared with data from targeted research studies, the advantage of surveillance data is often their timeliness and their breadth in time, geographic coverage, or number of individuals represented. To be effective, surveillance must be as streamlined as possible. As a result, surveillance data may be less detailed or precise compared with those from research studies. Thus, analyses and interpretation of surveillance data must exploit their unique strengths while avoiding overstatement.

1.5 Use of surveillance in disease management – historical perspective

The modern concept of surveillance has been shaped by an evolution in the way health information has been gathered and used to guide health practice. Beginning in the late 1600s and 1700s, death reports were first used as a measure of the health of populations, a use that continues to be important in assessing the extent and impact of diseases and injuries. In the 1800s, Shattuck used morbidity and mortality reports to relate health status to living conditions, following on the earlier work of Chadwick, who had demonstrated the link between poverty and disease. Farr combined data analysis and interpretation with dissemination to policy makers and the public, moving beyond the role of an archivist to that of a public health advocate.

In the late 1800s and early 1900s, health authorities began to require that physicians report specific communicable diseases to enable local prevention and control activities, such as quarantine measures. Eventually, local reporting systems coalesced into national systems for tracking certain endemic and epidemic infectious diseases, and the term ñsurveillanceò evolved to describe a population-wide approach to monitoring health and disease.

Important refinements in the methods of notifiable disease reporting occurred in response to specific information needs. In the late 1940s, concern that cases of malaria wee being over-reported in the southern United States led to a requirement that case reports be documented. This change in surveillance procedures revealed that malaria was no longer endemic, permitting a shift in public health resources and demonstrating the utility of specific case definitions in surveillance. In the 1960s, the usefulness of aggressive measures to identify and report cases (active surveillance) was demonstrated during the implementation of a national poliomyelitis immunization program in the United States. Cases of vaccine-associated poliomyelitis were shown to be limited to recipients of vaccine from one manufacturer, enabling a targeted vaccine recall, calming of public fears, and continuation of the program. The usefulness of active surveillance was most effectively during the smallpox elimination campaign, when surveillance led to a redirection of vaccination efforts away from mass vaccinations to highly targeted vaccination programs.

Throughout the 1900s, alternatives to disease reporting were developed to monitor diseases, including the use of health surveys, disease registries, and networks of ñsentinelò physiciansô practices. In the 1980s, the advent of microcomputers began to revolutionize surveillance systems, enabling decentralized data analysis and the electronic linkage of participants in surveillance networks.

In 1988, the Institute of Medicine defined three essential functions of public health that emphasized the central role of surveillance: assessment of the health of communities, which depends largely on surveillance; policy development based on the ñcommunity diagnosisò and

prognosis established through surveillance; and assurance that necessary services are provided, using surveillance as one measure of the impact of programs.

1.6 Types of surveillance

There are several types of surveillance, defined by function and method.

Disease surveillance ï This addresses aspects of the occurrence and spread of disease that are pertinent to disease control. Thus, during outbreaks of contagious bovine pleuropneumonia (CBPP), sources of infection must be traced, isolated, and removed. Disease surveillance is therefore more focused than surveillance in general, which, for instance, may include recording of the distribution of agents and vectors.

Epidemiological surveillance ï This is a fuller description of surveillance, as generally and variously defined. Some authors relate it to monitoring.

Sentinel surveillance ï Surveillance can include the entire herd (e.g. testing for bovine tuberculosis). Alternatively, a few farms, abattoirs, veterinary practices or laboratories may be selected; these are then referred to as ósentinelô units, because they are designed to ókeep watchô on a disease. Thus, sentinel equine premises can be used to investigate persistence of vesicular stomatitis virus, using previous history of the disease as the selection criterion. Alternatively, attention may be focused on a species in general. Horses can be used as sentinels for Venezuelan equine encephalitis virus infection and stray dogs as sentinels for canine parvovirus infection, the infections being identified serologically. Domestic animals can also be used as sentinels of human environmental health hazards such as carcinogens and insecticides. Thus, ósentinelô can refer to either a specific unit of observation or a species of animal.

Serological surveillance (*serosurveillance*) ï This is the identification of patterns of current and past infections using serological tests.

Passive and active surveillance ï Passive and active surveillance have been given different meanings. First, passive surveillance has been defined as the examination of only clinically affected cases of specified diseases; this contrasts with active surveillance which involves the sampling (including post mortem examination) of clinically normal animals in the population, therefore being important in the surveillance of diseases in which subclinical cases and carriers predominate.

Secondly, and most common in veterinary medicine ï passive surveillance has been described as the continuous monitoring of the existing disease status of the populations that are surveyed using routinely collected data to produce contents that can fed into policy decisions. Examples include reports of laboratory diagnosis, routine meat inspection findings and statutory notification of disease. Passive surveillance is therefore essentially monitoring with the intention

of acting on its findings. Active surveillance, in contrast, involves the committed effort of veterinary authorities to collect information commonly by undertaking surveys of specific diseases.

Targeted and scanning surveillance ï A new vocabulary is evolving to replace ópassiveô and óactiveô surveillance. **Targeted surveillance** collects specific information about a defined disease so that its level in a defined population can be measured and its absence monitored. It is often planned using appropriate statistical sampling theory, and mostly focuses on populations that are at increased risk of being affected, thereby increasing efficiency of detection. Example of this approach is the targeting of equine colic cases for nosocomial *Salmonella* species.

Scanning (Global) surveillance ï This maintains a continuous watch over endemic disease. Questionnaires distributed to veterinarians in a country may provide a regional picture of calf pneumonia and enteritis. Therefore unexpected changes can be recognized. If scanning surveillance identifies an unusually high frequency of similar, undiagnosed cases (e.g., respiratory disease), it may trigger a more detailed investigation to explore the likelihood of a new disease occurring; this is **syndromic surveillance**.

1.7 Some general considerations

Nature of data ï The data collected should be accurate, the right type, and unbiased.

Cooperation ï The lack of cooperation can pose a problem to surveillance and other epidemiological investigations. The **reasons** for collecting information may not be clear to potential suppliers of data and so they may be discouraged. Thus, it is very important that the objectives of data gathering should be explained to all who are involved in it. **Motivation** may be difficult to maintain in long-term data collection. This is of relevance not only to surveillance but also to prospective epidemiological studies (e.g. cohort studies). The collection of information may breach of confidentiality; for example, if practitionersô records that contain details of financial transactions of practice are examined. This, too, may prevent cooperation. Cooperation is also unlikely if data collection is **laborious** or **time-consuming**, for example completing a complex or cumbersome questionnaire. Thus, the method of data collection should be as simple as possible within the constraints of the requirements of the data collection program.

Cost of data collection ï the collection of data always incurs a cost, and this is particularly relevant to active surveillance. Costs include laboratory examination charges and postal charges when the data are collected by postal questionnaire. The value of data therefore has to be judged in the context of the costs of collecting them.

Traceability ï Refers to the ability to trace the history, application, or location of an item by recorded identification. Tracing systems have become a priority for national and international veterinary services. The starting point for a tracing system is animal identification which has

increased in sophistication with the development of electronic ómicrochipô implants both in livestock and companion animals, ruminal boluses, electronic ear tags, and genetic markers. Individual-animal identification, linked to details of diagnostic tests, movements and livestock holdings then forms the basis of a system for documenting an animalôs history and current location.

Increased world trade also means that there is a requirement for minimum standards in animal health, including the need to track animals and their products between countries. This is because one needs to know the origin of animals and the places in which they have stayed because for trade, health status is linked to location (e.g., some types of farm in some countries are known to be disease-free and therefore animals on such farms need not be proved to be individually disease-free).

1.8 Sampling to Estimate Disease Frequency

Knowing the frequency of disease in a population is a prerequisite to establishing disease control programs, hence, sampling populations in order to estimate disease frequency is a common task for epidemiologists.

In sampling, we usually wish to make sure the animals are ñtypicalò of the target population, that the estimate of disease frequency, or level of production, is unbiased, and that the estimate is precise (i.e. has a small standard error). Sampling methods in which the animal is the sampling unit (simple, systematic, or stratified random samples) provide the greatest precision. However, since they require a list of all animals in the population (the sampling frame) they are often impractical. Frequently, herds, or other aggregates such as litters or pens, are selected initially, and some or all individuals chosen thereafter in order to minimize potential problems (e.g., obtaining a sampling frame of individuals) and costs. Although practical, it has been observed that for a fixed number of animals in the sample, these latter methods (cluster, or two-stage sampling) are less precise than when the animal is the primary sampling unit. Why is this? Well, most of the diseases we are concerned with tend to cluster within aggregates either because the animals in an aggregate are managed similarly, or because infectious/toxic agents tend to affect the majority of animals in a group. Thus, animals within a group are more alike than randomly selected animals.

Exercise

1. Define ñprecisionò as it relates to the estimates of prevalence. Which sampling method(s) are the most precise and why? Note: this principle is basic to understanding the application of sampling strategy.

As well as deciding on the sampling method, determining the sample size is an important step in designing a sample since it affects the confidence (statistically speaking) one can have in the

results. To gain some insight into the process of sample size determination, answer questions 2 to 3 below. In both questions 2 and 3, the sampling unit is the individual and the S^2 (variance) describes the variability of individual outcomes about the mean. If farms were the sampling units, the S^2 would change numerically and would describe the variability of farm outcomes about the mean.

2. You wish to select some chickens from a flock to determine the prevalence of infectious laryngotracheitis. Your initial guess is the prevalence will be about 20% (P) and you wish your estimate to be within 2% (L) of this 95% of the time. 2.1 Assume you are taking a simple random sample of chickens, how many chickens are required? [The formula is $n = (1.96)^2PQ/L^2$

2.2 How many should be tested if there are only 1000 birds in the flock? [If n>0.1N adjust n using $n^* = [(1/n + 1/N)^{-1}]$.

3. You wish to estimate the open interval (calving to conception period) in a herd of 120 cows. In a journal article describing a similar herd the standard deviation of this parameter was 20 days. You want your estimate to be within 5 days of the true herd interval, 95% of the time.

3.1 Assuming you use simple random sampling, how many cow records would you need to review? [The formula is $(1.96)^2S^2/L^2$, remember the variance (S^2) is the square of the standard deviation, and adjust n as above if necessary].

3.2 You donôt really have enough time to look at more than 20 records. If you randomly selected 20 records, and given the above estimate of the variance, how close would you expect your estimate to be? (Use your calculator!).

3.3 After rereading the article mentioned above you realize that the study herd was probably much better managed than your clientôs herd, and you feel that the herd interval in your clientôs herd probably has a larger standard deviation than the parameter in the study. If this was the case, what effect would this have on your estimate (based on 20 records)?

1.9 Sampling to Detect Disease

Sometimes the question is not the level of disease but whether or not the disease is present. For example if a producer is buying replacement animals, he/she may wish to be certain that the disease is unlikely to be present. In other circumstances it may be useful to know if the products of a farm are free of disease/residues. To be certain of results requires testing all animals or products; frequently an acceptable level of certainty can be achieved by testing only a subset of the animals/products.

Exercise

4. A swine producer ships market hogs in groups of 100. You wish to examine the lungs for enzootic pneumonia and believe that if it is present at all at least 8% of pigs will be affected.

4.1 Using the formula n = [1 - (1 - Ŭ)$^{1/D}$][N - ((D -1)/2], how many of the 100 should you examine to be 95% sure that enzootic pneumonia is absent if all lungs in the sample are ñhealthyò?

4.2 You are sampling a herd of 100 beef cows to see if Anaplasmosis is present. You test 10 cows and all are negative. What is the expected maximum number of cases in the herd? (use the formula D = [1 - (1 - Ŭ)$^{1/n}$] [N - ((n-1)/2).

1.10 Sampling for Hypothesis Testing, Sample Size

A major consideration in sampling for hypothesis testing is the number of observational (or experimental) units required to detect a biologically, or economically, significant effect of a treatment or procedure. Too many units are wasteful of time and money, too few units reduce the likelihood of declaring an important effect to be significant (i.e. at the end of the study the likelihood of committing a type II error is increased). In order to give insight into factors influencing the required sample size, answer questions 5 to 7. Set the type I error probability at 5% and the type II error probability at 20% for questions 5 to 7.

5. On average, 30% of feedlot calves are treated for respiratory disease. In order for a vaccine to be effective (cost-wise and biologically) it must reduce this by 50% (reduce by 0.5X 30% = 15 ñ%-units). Assuming individual animals are the experimental units, how many are required in each group? [Use the formula n = [$Z_{Ŭ}$ (2 PbarQbar)^{½} - $Z_{ƀ}$ (PeQe + PcQc)$^{1/2}$]^2 / (Pe - Pc)^2].

6.1 On average, 2% of feedlot calves are treated for the neurologic form of thromboembolic meningoencephalitis (TEME), and most die. If Somnugen (TEME vaccine) is at least 50% effective in preventing this form of TEME, how many animals are required in each group?

6.2 If you performed the experiment with 500 calves per group, what impact would this have on type II error. Explain briefly.

7. You are conducting an experiment which consists of infusing all postpartum cows to reduce RP/metritis and improve reproductive efficiency. If the current average open interval is 130 days, and you believe your proposed treatment will reduce this to 110 days, how many cows are required in each group? Assume the variance of the calving-to-conception interval is 700 days.[Use the formula n = 2[($Z_{Ŭ}$ - $Z_{ƀ}$)S / (X_e bar - $X_c$bar)]^2]

Study designs

8. You are the veterinarian in a large swine herd and are asked to assist in solving a ñdiarrhoeaò problem in young pigs. As part of your investigation, you submit faecal samples from 30 diarrhoeic pigs and from 30 ñnormalò pen mates. The following are the results for a particular virus:

	Diarrhoeic pigs	Normal pigs
Virus Present	24	25
Virus present	6	5
Totals	30	30

1. Based on the sampling strategy, what type of analytic study is this?
2. What rates or proportions in the population of pigs can be calculated? (calculate them!)
3. Calculate the odds ratio.

2.0 SURVEILLANCE METHODS AND APPROACHES

2.1 Introduction

Surveillance is the process of systematic collection, orderly consolidation and analysis of data with prompt dissemination and feedback of the results to those who need to know particularly those who are in a position to take action in a given animal population. It has three distinct elements: Sampling, recording and analyzing data. The main aim of surveillance is the early detection and control of animal diseases of importance to national economies, food security and trade. Actors include farmers, Animal Health Service providers (AHSP) and Policy makers.

Surveillance is distinct from **monitoring** which is the routine collection of information about a health event, characteristic or state in an animal population with the purpose of detecting changes in disease characteristics that affect the population. Monitoring lacks the active component of surveillance and does not necessarily result in action.

2.2 Epidemiological surveillance

Epidemiological surveillance is a **systematic** and **continuous** collection, analysis and interpretation of health data (often designed to detect the appearance of a specific disease), It allows the **health status** and **associated factors** of given populations to be followed in space and time it is used in generation of information on livestock.

2.3 Surveillance Objectives and uses

Objectives

1. To Detect the occurrence of disease (exotic disease) The choice of diseases under surveillance is based on the importance to national economy, food security and trade
2. As an early warning system this will lead to early reaction
3. To demonstrate the ñdisease-freeò status for a region or a country
4. To determine trends over time (endemic disease)

Uses

Surveillance will results in generation of disease information. The information can be used for:

- Å Prediction of the source and progression of the disease outbreaks
- Å Planning and monitoring of disease control programs; provision of sound animal health advice to farmers
- Å Emergency preparedness *(Early Warning systems)*. This enables the rapid detection of the introduction of or sudden increase in, the incidence of priority livestock diseases (those of socio-economic& public health importance)
- Å Certification of livestock and livestock products for export

- Facilitation of risk assessment by international trading partners who wish to carry out trade in livestock and livestock products and require regular credible reports on a countryôs disease status.
- International reporting and providing proof of freedom from diseases for accreditation by the OIE.

Information regarding prevalence and trends help to design control measures (goals and targets to be set up) and to assess whether animal health goals and targets are being reached adapt control measures

2.4 Surveillance Approaches

There 2 main approaches

a. Random Surveillance: This Random selection of a population to look for a disease parameter or condition. It can also be described as a specific form of probability sampling.

b. Targeted Surveillance It is based on the increased likelihood of infection in particular localities or species. It targets particular species likely to exhibit clear clinical signs (e.g. chickens for AI) and takes into account other historical population information.

2.5 Types of surveillance

There are two main types of surveillance used for data collection: passive and active surveillance.

2.5.1 Passive surveillance

No active effort is made to collect disease information. Note that this does not mean ñinactiveò animal health service. The animal health providers collect reports in the course of their routine activities. The system must be well managed and permanently ñactivatedò for it to be effective. Passive surveillance is a key part of the veterinary departmentôs early warning system to detect disease outbreaks. The activity Is not restricted to a specific disease and it identifies which diseases are present in country and where disease is. It is a continuous activity and a basic requirement of the World Animal Health Organization (OIE).

The reporting or transmission of Passive Surveillance data is done through a number of channels which include:

i) Narrative monthly reports- the disadvantage is that it leave out important epidemiological information.

ii). Notifiable Disease reporting forms (ND1) forms. These are GIS compatible, very detailed. Important epidemiological Information is included. They are used for reporting suspected and confirmed cases of Trans-boundary Animal Diseases (TADS) and other notifiable diseases

iii). Telephones-land lines

iv). Digital Pen Technology -uses a combination of digital pen, phone and computer connected to the internet.

v). Mobile phone.

Disease reporting is an important component of the passive surveillance. Notifiable disease reporting is mandatory in Kenya under the Animal Diseases Act Cap 364). Notifiable diseases have been gazetted and are those diseases whose presence or suspicion must be reported to the Director of Veterinary Services.

vi). Abattoirs Surveillance - forms an important part of passive surveillance system employing ante and post mortem inspection methods. It can pick up disease incidences at abattoir level thereby triggering active disease search through trace-back of the animals. It is suitable for detecting non-fatal chronic diseases that are difficult to detect in live animals e.g. Parasites e.g. Cysticercosis, hydatidosis, CBPP, TB etc. Animal welfare issues can also be detected at ante-mortem inspection. Weaknesses of abattoir surveillance include. Under-reporting especially during high speed slaughter where conditions may be missed by inspectors

Also some conditions require a certain degree of expertise to detect them and laboratory confirmation is often not there to support the diagnosis.

vii). Rumor register

This are mmaintained at the all level and forms a record of the reports received by the office from livestock keepers, front line personnel (including Meat Inspectors) etc. They also record actions taken and time taken for response by AHSP at different levels. They also show the conclusive findings of the investigation.

2.5.2 Active surveillance

Definition: active collection of data to detect and measure the presence of a specific disease (infection) or diseases in populations or individual animals

It is based on disease search by animal health service providers (stock route/livestock market inspection, farm visits and border point inspection). Data for active surveillance is generated through:

1. Surveys

This are conducted to detect and measure the presence or absence of a specific disease (infection) or diseases in populations or individual animals.

2. Participatory Disease Searches

It involve engaging the communities to identify and prioritize animal health issues in their livestock

3. Disease investigations

They can be designed to generate information about disease which occur in livestock populations

4. Zero reporting

Zero reporting is done for specific notifiable diseases such as Rinderpest, HPAI, Rift Valley fever, CCPP, CBPP. Normally the field personnel can carry out inspection of animals at market places/stock routes/poultry farms/border points etc. Any clinical evidence of disease is documented and a zero report for that particular disease when they do not come across it. Zero reporting is important when giving evidence of proof of absence of a particular.

5. Participatory disease search (PDS)
It is the qualitative search of diseases using rapid and participatory rural appraisal approaches. The specific methods include: questionnaire design technique for individual household and key informant interviews. It involves cross-checking information from different sources
Other methods include: group interview techniques (community interview, focus group discussions, venn diagrams, ranking, scoring, seasonal calendars and mapping), methods of direct observation at site level including transect walks and use of secondary data

2.6 Methods of Surveillance

This is the classification of surveillance according to the objective:

1. Clinical/syndromic surveillance
Stakeholders should know the signs and lesions of the disease of interest. It should be used with caution since some diseases can share the same clinical signs e.g. it is impossible to distinguish clinically between HPAI and velogenic viscerotropic Newcastle disease.

2. Aetiological surveillance
It involves Identification of the causative agent by different tests and using this to quantify disease level and take action. RT-PCR is among the most rapid and most accurate tests available and are frequently used to screen large commercial herds or flock of livestock population. Virus or bacterial isolation, although time consuming, remains the gold standard method, and should only be done in a laboratory with comprehensive bio-safety safeguards. Rapid on-site diagnostics (lateral flow antigen ELISA).

3. Serological (serosurveillance)
Sera are drawn from targetted animal population and positivity is used to quantify the level of disease. The following are limitations of the method:

- Sometimes, infected animals do not develop antibodies.
- Some animals do not survive long enough after an infection.
- Some species,, donôt always seroconvert.
- Non-infected animals may also have antibodies: antibodies are produced in response to vaccination

4. Sentinel surveillance
Animals are recruited where the risk factors for the disease are highest. The vital parameters of the animals are closely monitored and any signs related to the case definition of the disease are reported. One can check for infection by routine serological analysis. This act as an early warning system for e.g. RVF

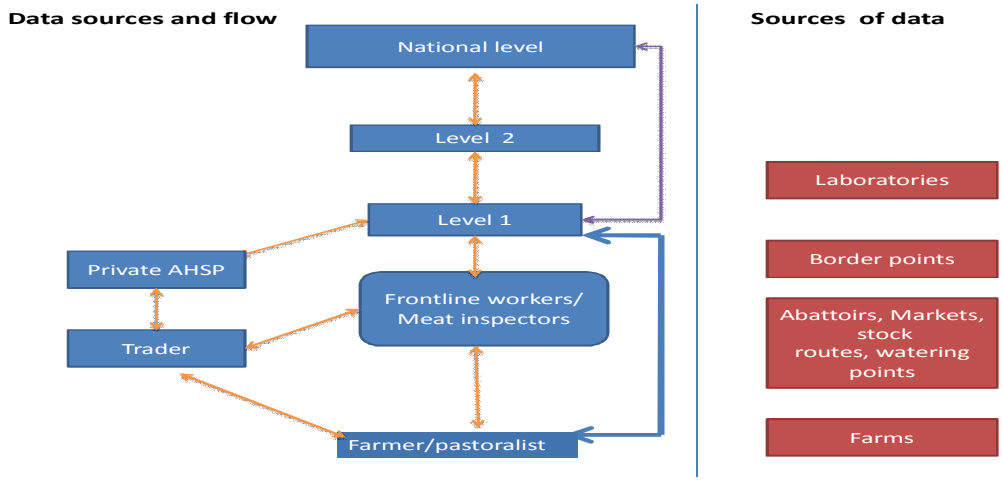
2.7 Indicators of Effective Surveillance

These include: timeliness, representativeness, cost Sensitivity, simplicity, acceptability and sustainability.

2.8 Laboratory diagnosis

All diseases detected during passive and active surveillance should be confirmed by analysis in the laboratory surveillance usually involves the use of diagnostic tests/measure for a disease/condition in question. In deciding on the test to be used in surveillance studies, some compromise in regard to accuracy for the sake of ***simplicity***, ***cost*** and ***acceptability*** of the test have to be made. However, there is little point in conducting a large scale surveillance involving a considerable effort in obtaining data if it is not known what the best results means in terms of true disease situation. The inferences that can be drawn about the disease situation depend on the characteristics of the diagnostic test being used. These characteristics can be defined in terms of repeatability (precision), accuracy (validity), sensitivity and specificity.

Fig 1: Information processing



Reporting forms (e.g. ND1, PP1, ZR) reports are submitted by administrative level 1 to level 2.Level 2 enter the data and transmit it to national level. National level analyzes the data from the whole country and prepares country reports and feedback to level 1 and 2.National report shared with neighbouring countries, AU/IBAR and OIE.

2.9. Quality control of data

The data manager is responsible for controlling the respect of the standardisation rules.

He needs to check sometimes on the field how is the data collection done and to organise regular meetings to get feedback from the actors and adjust their methodology.

2.10 Data standardisation

The standardisation is used to make comparable, different data sets related to animals which differ from each other for one or more parameters statistical standardisation. In epidemiology, standardisation concerns the tools and the surveillance methods in order to limit bias related to the data selection or collection. Standardisation is important because many actors are involved in the data collection and the data collected must be similar also because the data collection is spread out over a long period, so there is a risk of modification in the way the data are collected, analysed and interpreted if no clear procedures are available for each step of the surveillance system. Information derived from data is distributed to contributors, users, policy makers, the public, AUIBAR, FAO and OIE

Practical exercise

It is one month before the rains: you would like to establish the current performance of the herd so as to know the effect of rains on the herd and advice the farm manager

- Randomly form 4 groups each made of 7 members
- Travel to the epidemiological unit (farm)
- Select a species of animal
- Select appropriate surveillance approach
- Select appropriate surveillance method
- Develop appropriate tool(questionnaire) to collect data on:
  - -herd structure
  - -herd composition
  - -body condition
  - -production level
  - -one external disease observable (e.g. nasal discharges)

- Use the questionnaire to collect the data, enter into database and analyze
- Generate a one page abstract of the surveillance activity
- In the report, evaluate the surveillance activity carried out using indicators of a surveillance system

3.0 DESIGNING AN ACTIVE SURVEILLANCE PROGRAM (SURVEYS AND INFERENCE)

3.1 Principles of Survey

- Why do veterinary authorities need animal health information?
  - ✓ Identify what diseases exist in the country
  - ✓ Determine the level and location of diseases
  - ✓ Set priorities for the use of resources for disease control activities
  - ✓ Plan, implement and monitor disease control programs
  - ✓ Respond to disease outbreaks
  - ✓ Meet reporting requirements of international organisations (OIE, AU-IBAR & FAO)
  - ✓ Demonstrate disease status to trading partners

- What is/ are the main method(s) of collecting information on livestock diseases used in your country?
  - ✓ Passive surveillance or passive disease reporting

- What is passive reporting system or passive surveillance?
  - ✓ Is a system in which veterinary authorities make no active efforts to collect disease information; they just wait for disease reports to come to them

- What are the main weaknesses of passive surveillance?
  - ✓ Not able to provide information on the total amount of disease because of under-reporting
  - ✓ Usually cannot provide representative information on the level of disease in the population, or the geographical pattern of disease. More reports may come from one part of the country or population than another
  - ✓ Passive disease reports are not reliable enough to be used to calculate proportions or rates

- How can passively acquired information be used?
  - ✓ Identify which diseases are in a country (but not prove that some diseases is not in the country) if diseases are correctly diagnosed
  - ✓ Identify where the disease is located (but not identify where there is no disease)
  - ✓ Respond to disease outbreaks
  - ✓ Meet the basic disease reporting requirements to the OIE etc

- What passively acquired information can't be used for
  - ✓ Determine the level and geographical pattern of disease
  - ✓ Determine the importance of disease
  - ✓ Set priorities for the use of resources for disease control activities
  - ✓ Plan, implement and monitor disease control programs
  - ✓ Demonstrate disease status to trading partners

- How can we overcome the weaknesses of passive surveillance?
  - ✓ Through active surveillance that uses properly structured disease surveys. Structured surveys have two extra advantages, namely:
    - Can be quick to conduct
    - Relatively inexpensive (compared with the cost of running an effective passive reporting system)

- What is active surveillance?
  - ✓ The main users of information (veterinary authorities) make active efforts to collect the information needed
  - ✓ Information collection is controlled by the users, therefore it is possible to ensure/ control its quality
  - ✓ Active surveillance uses structured surveys to collect high quality disease information quickly and inexpensively

- Why has active surveillance not been used widely?
  - ✓ Limited resources
  - ✓ Limited skills and techniques

3.2 Survey versus Census

- A **census** examines every member of the population
- In order to produce a complete reporting (and accurate measures of frequency), a passive disease reporting system needs to gather information about every single case of important diseases in the country by regularly examining every single animal (farmers have little or no training to do this and lack motivation)
- A **survey** examines only a small part of the population
- Surveys are able to gather reliable information quickly and inexpensively because instead of requiring the whole **population** to be examined by untrained livestock owners, only a small proportion (**sample**) of the population is examined by trained veterinary staff

3.3 Population and Sample

- **Population:** Consists of all things in a particular area that we want to know about

- Population usually consists of animals, but may consist of other things (villages, farms, livestock owners). The things making up the population are known as the **units of interest**
- **Sample:** Is a small group of units of interest (animals, people, and villages) that have been selected from the population. Each element in the sample is the examined to collect disease information

A survey involves the examination of a small group (a sample) of elements (units of interest) drawn from all elements of interest (the population). One gets to know what the disease status of the sample is but not the rest of the population not examined

3.4 Inference

- How can we use the results of a survey to learn something about the animals that haven't been examined?
- Inference is the process of estimating the true value of the disease status of the population based on the results observed in the sample.
- Assumes that the animals that were not tested were the same as the ones that were tested
- Is the process of assuming that the disease status of the population is similar to the disease status of the sample

Danger with inference is that the assumption can be wrong. Thus, inference always runs the risk of being wrong, but this risk can be minimized

3.5 Representative Sample and Bias

- The risk of being wrong in our assumption can be minimized by ensuring that the sample selected is as similar to the rest of the population as possible (with respect to the characteristic of interest, or disease being measured)
- Thus, if the sample and population are essentially the same: the sample is said to be **representative**

Inference is only valid when a representative sample has been chosen.

A representative sample is one which is similar to the population

- When on average the estimate from the sample is different from the true value in the population, the estimate is said to be biased

- A single estimate from a survey will usually be slightly different from the true value, due to **chance**
- If identical survey is repeated many times, and the average result of the many is different from the true value, the survey technique is said to produce **biased results**
- **Bias** if from many different problems in a survey, most of which can be avoided through **careful design**
- **Systematic error**: an error that predictably causes the same type of error for each observation, e.g, weighing scales that are incorrect **(measurement bias),** while in **selection bias**, the sample selected is not representative due to selecting animals which are systematically different from the rest of the population.

Bias is the difference between the average estimate from a survey and the real value in the population, caused by systematic error

Selecting a representative sample is one of the more difficult tasks in any disease surveys

3.6 Random Sampling

- Is the only way to be confident that the sample chosen is representative of the population
- To select a representative sample, it is necessary to ensure that every animal/ unit of interest in the population has the **same** chance of being chosen in the sample, regardless of its owner, location, size or any other characteristic (**simple random sampling)**

Random sampling means that every element (unit of concern) in the population has the same probability of being selected in the sample

Simple random sampling is just one of a group of probability sampling techniques. These techniques share the feature that each element in the population has a **known, non-zero** (**but not necessarily equal**) probability of selection.

Probability sampling is the only reliable way to avoid selection bias, and is required if estimates of the population are to be valid

- Such samples may still be unrepresentative due to chance, but on average, they will be similar to the population in all ways

3.7 Estimation and Precision

- The aim of a survey is to determine some characteristic of the population, e.g. the proportion of animals with antibodies to FMD
- Random sampling is used to minimize the risk that the value measured from the sample will not be the same as the real value in the entire population
- We cannot know the real value, we therefore use inference to estimate
- But there is need to know how good our estimate is/ or have some idea

- **Sample size** is one of the most important factors that determines how close our estimate is likely to be to the true population value

Surveys with large sample sizes produce more precise estimates

It is possible that samples of different sizes (20/4500; 100/4500 and 2000/4500) could produce an estimate of 75%. However, we could be more confident that the true population value was closer to 75% if we used a sample size of 2000 rather 20

3.8 Confidence interval

- Tells us how precise the estimate is, or how much confidence we have in the results
- Is usually calculated when using random sampling
- CI Indicates how close to the real population value our estimate is likely to be. Thus, all estimates from surveys should be reported with CIs so the users know how reliable the results are.
- The CI of a population is a range of values that we are confident that the real value is likely to be in. For example, with 20 chickens with estimated NCD antibody prevalence of 75%, the 95% CI is 51%-91%
- It means our best guess of prevalence is 75%, but we are 95% confident that even if we are wrong, it lies between 51% and 91%
- 95% confident means that if we did the same survey the same way 100 times, even though we would probably get different estimates each time, the true value would lie in our CI 95 out 100 times

By convention, the precision of an estimate is described by the 95% CI. Others are 90% and 99%

A CI indicates how confident we are that the estimate is correct. We can be 95% sure that the true value lies within a 95% CI. The smaller the CI, the better the survey.

3.9 Survey Accuracy

- Accuracy of an estimate from a survey is determined by 2 factors: **precision and bias**
- **Precision**- Is a factor of random error. It is determined by sample size. Large sample sizes will have less random error, and will therefore be more precise.
- **Bias**- is systematic error due to measurement and selection. Are controlled through design.

Summary

- Surveys examine only a small portion (sample) of the population
- The sample is used to make inferences about the population
- Inference can be wrong, giving biased result
- Representative samples ensure that inference is not wrong
- Representative samples are obtained through random sampling (probability sampling)

ACTIVITIES

Activity 1: Census and survey

Objective: differentiate between a complete count (census) and a sample (survey)

Description of activity: the aim is to determine the average age of all participants in the room- this to be done in two ways.

1. Ask a sample of a small number of people, record their ages in a column on the board. Have the participants calculate the average of the ages.
2. Ask everyone in class in turn and record their ages- calculate the average and compare with the first one.

Questions for discussion

1. Which way took longer?
2. If there were 3000 people in the room, which way would be best?
3. Was the answer from the survey right?
4. Was the answer from the census right?

GROUP WORK

1. **How are samples selected now?**
2. **Are the samples representative?**
3. **List the different ways you have selected samples in previous work**
4. **Consider the potential for bias in 3 above**

4.0 CREATION OF EFFECTIVE EPIDEMIOLOGICAL SURVEILLANCE NETWORK AND PARTNERSHIPS

4.1 Epidemiological surveillance

Epidemiological surveillance is a systematic and continuous collection, analysis and interpretation of health data (often designed to detect the appearance of a specific disease), allowing the health status and associated factors of given populations to be followed in space and time for use in the planning, implementation, and evaluation of disease control measures.

In epidemiological surveillance, three notions are implied that must co-exist:

- Descriptive epidemiology- gives reliable picture of the epidemiological situation
- Long term action- continuous and not limited in time
- Perspectives for action- aims to control/ manage disease

4.2 Epidemiological Surveillance Network (ESN):

A network is an interconnected system of things, institutions, and/or people (web definition). Epidemiological Surveillance Network (ESN): All individuals or agencies organized to ensure surveillance of one or more pathological entities in a given region.

Network implies the circulation of information is in all directions, including transversely. The relationships among those involved must be organized and formalized. Implications: Sense of collaboration, Distribution of work between members, Existence of a coordination mechanism and Joint implementation of tasks in an interdependent manner

4.3 Purposes of networks

1. Collection and exchange of information
2. Harmonization and coordination of actions

4.4 Outcomes of effective networks

1. Generation of timely and quality data and information
2. Improved early warning systems
3. Rapid response to disease emergencies
4. Pooling of resources including expertise
5. Create research agenda and knowledge
6. Effective disease management system

4.5 Network operation check points

Specific points to be checked:

1. Definition of scope and objectives of the surveillance
2. Standardisation of the data to be collected
3. Information dissemination
4. Monitoring and evaluation of network operation

Definition Scope and Objectives

Scope

It is necessary to define scope because it is neither possible, nor indeed necessary, to monitor all diseases. The choice of diseases to be included depends on: severity, potential for spread, mortality, their economic impact, possibilities concerning preventive & curative intervention, regulations in general, and national & international requirements

Objectives

- Must be very precise because the general functional organisation of the network depends on them, as does the type and frequency of data to be collected and processed
- Must be defined in collaboration with the different participants in the network (if a sample is targeted, then the representatives of the sample must be ensured- to ensure accuracy of the results)
- Examples of surveillance objectives:
    - Early detection, substantiate freedom, describe baseline level, distribution and impact, describe health changes, describe changes that threaten health, detect cases
    - Manage outbreak, inform trade, prioritisation, inform control

Standardization of data

Standardisation is necessary to ensure comparability of the data collected. In serological surveillance of disease X, ensure to specify in advance the type of tests to be used (VNT, ELISA), and the threshold of detection. Procedures for actual data collection, transmission must be agreed upon and tested before the network becomes operational. Specify the site of collection of all data (farm, vet office, abattoir, natural environment, laboratory, etc). Data mgt and processing- must be organised in advance and should meet the networkôs objectives.

Interpretation of processed data depends on the expertise of epidemiologists/ technicians (need for training)

Å

Information dissemination

Å Internally to members of the network

- ï Necessary for efficient operation.
- ï Is important for commitment of all actors and network sustainability

Å Externally to partners who do not participate directly in the network

- ï This necessary for the networkôs ultimate purpose (action)

Monitoring and evaluation of Network Operations

Å M&E of network operation must be planned and carried out on a regular basis

- ï Helps to limit any lapses in procedures inherent to the duration of operation of a network (continuous collection)

Specific cases

1. ESNs for exotic diseases
   - ï Must have the following in addition to ESN for diseases present in a region:
     - Å High level of awareness among vets and farmers
     - Å The involvement of one or more labs capable at any time of diagnosing the disease. May require heavy investment in infrastructure (a protected laboratory for highly infectious disease) and/or maintenance of special links with experts in foreign labs
     - Å A certain number of experts should be available who are capable of providing scientific and technical support
   - ï Important to clearly categorize the exotic diseases which need to be monitored in a given country- (due to resource requirements)

2. ESNs that seek to demonstrate the emergence of new pathological phenomena

- ï Aim is to abnormalities (Not to monitor a known pathological entity)
- ï Use indices such as breeding, health or environment
- ï Have set thresholds which if exceeded, must trigger further investigation

Participants in ESNs: farmers, pastoralists

4.6 Role of Management

- Å Management is an essential factor in the quality and durability of network operation
- Å Requires considerable time and excellent communication
- Å Management functions include:
  - ï Organisation of multidisciplinary team necessary for each network
  - ï Ongoing training of different actors
  - ï Internal & external dissemination of information
  - ï Monitoring and evaluation
  - ï Day-to-day mgt
- Å Therefore, appropriate mgt skills are a high priority
- Å Importance of mgt justifies its central position in the institutional architecture of any network

4.7 Institutional organization of networks

- Å Defines the distribution of tasks within the network, responsibilities, and the decision-making process
- Å Structure is based on 4 principal levels
  - ï Level 1: ñfieldò, the source of data (farms, abattoirs, frontier posts etc)
  - ï Level 2: ñlocalò, corresponding to the surveillance units that collect data
  - ï Level 3: ñintermediateò, supervisory and validation bodies (regional, provincial, mobile teams etc)

- Level 4: ñcentralò, where network mgt is based

5.0 COMPONENTS OF REGIONAL OR NATIONAL SURVEILLANCE SYSTEM

5.0 Introduction

This information is intended to assist epidemiologists and surveillance experts who may be developing new surveillance systems or evaluating and improving existing systems. The guidelines provide an overview and generalized framework for details likely to be considered for comprehensive and efficient surveillance. The guide is not intended to be prescriptive or to define mandatory items for inclusion by surveillance architects, but instead to provide a useful tool to expedite development and review processes.

5.1 The disease description

The surveillance planning documents include current and relevant supporting information about the disease under surveillance. Information included in the disease description is used to develop the case definitions. The following classes should be included in the disease description section of the surveillance planning documents, or in documents describing the rationale of the surveillance system.

- Transmission of the pathogen (horizontal and/or vertical)
- Sources of the pathogen (food, animal products, infected animals, material) and resistance in the environment
- Which species are potential hosts (susceptible animals, asymptomatic carriers)
- If the disease transmitted by a vector:
- Vector species?
    - Role in the pathogen cycle?
    - Ways of contamination/transmission by/to hosts
    - Activity period (day, season)
    - Biology and ecology: place where immature and adults stages can live, reproduction, latency
- Global and national situation
    - History and distribution of the disease in the world
    - History and current profile of the disease (incidence, prevalence, distribution) in country
    - Disease notifiable
    - Epidemiological characteristics of the disease: number of susceptible species, contagiousness, endemic potential, infectivity and lethality rate
    - Regulation regarding the diseases and related animal productions
    - Existing surveillance and response plans in the country and in the region
    - Prophylaxis: information (frequency, broadcasts, pamphlets) and vaccination campaigns (% population covered, vaccination efficiency testing)
    - Practices, traditions at risk (consumption of raw milk, cock fights)
    - Political context
- Importance
    - Economical impact

        - Direct: losses of production and animals
        - Indirect: trade limitation (international regulation), cost of control measures (emergency plans, treatment, compensation)
    - Public health impact: zoonosis and food safety
    - Socio-cultural impacts of the disease (food security, importance for rural populations, unemployment, traditions)
- Existing control measures - defining the objectives of the surveillance
    - Treatment, vaccination, quarantine, isolation of infected animals, disinfection, depopulation, repopulation (genetic resistance)
    - Control of vectors (insecticides, limitation of contact with vectors)
- Diagnostic
    - Incubation period
    - Clinical signs and post mortem lesions
    - Differential diagnosis
    - Seroconversion and length of detectable antibodies in the blood
    - Type of samples required and conservation
    - Diagnostic tests (field and laboratory) availability, reliability and cost
- Regulation
    - Regulation concerning this disease surveillance and control in the country (vaccination, sanitary inspection, control by farmers)
    - Compulsory notification at the national level and to OIE (check last yearôs OIE reports)
    - Importation of animals: quarantine length, certificate required, anti-parasites treatment, clinical inspection, laboratory tests
    - Movement of animals within the country: screening before / after movement, quarantine at the entrance, notification of movement
    - Identification of animals (% for the different species)
    - Animal welfare
    - Slaughtering policy

5.2 Objectives

The purpose and rationale describe the need and reasoning for the surveillance system, and provide justification for the type of surveillance planned. They are clearly described in the surveillance plan or equivalent program planning documents.

General objectives:

- Protection of animal and public health

Reasons:

- Detect and monitor the disease
- Access to international market
- Support decision making (immediate response and long term strategy)

Specific objectives:

- Facilitate disease control measures: provide harmonized and exhaustive information to target infected population, justify funding for these operationsé
- Assess control measures efficiency: vaccination cover, prevalence decrease
- Early detect exotic diseases in domestic animals: allow a rapid response
- Establish a disease profile: distribution, occurrence, prevalence, and incidence
- Monitor the disease (and its vectors): identify trends
- Provide data for epidemiological studies (definition of risk factors, risk analysisé)
- Support claims for disease freedom: conformity with regulation for international trade
- Detect the disease in wildlife

5.3 Institutional organization of the network

- Inventory of the surveillance network actors regarding the disease
    - Field: farmers, animal industry groups, farmers association, private vets, animal health assistants, quarantine officers, customs, importers, abattoir managers and employees
    - Technical resources: laboratory directors and employees, research centres, universities
    - Public health: chief officers and officers, physicians
    - Pharmaceutical firms and medicines/vaccines providers
- Formalization of a steering committee (deciders) and a technical committee (surveillance plan writing and analysis)
- Formalization of the role of the different actors on the field

5.4 Study population

The population under surveillance is well defined in system planning documents and in system reports and publications. The population description inherently describes the scope or reach of the system (i.e., National, State, regional, local, and neighborhood.)

- Populations under surveillance - The population from which the sample is to be drawn should be identified and clearly defined. In most cases, should be same as target population.
    - Sensitive species
    - Reservoirs and vectors (wildlife, insects)
- Targeted population: accessible and/or at risk - Population about which statistical inference will be made (general population at-risk) should be identified and clearly defined or estimated.
    - species, breed, age, sex
    - Type of production, herd size
    - Markets (suppliers, buyers), slaughterhouse
    - Areas, population or period at risk (proximity from markets, animal densityé)

5.5 Type of surveillance

- Active surveillance: investigation
    - Type of sampling:
        - random sampling (definition of the confidence level), systematic sampling (abattoir) or exhaustive surveys (whole population)
        - Stratified, cluster, multi-stages sampling
    - Epidemiological unit: village, herd or animal
    - Sample size
    - Frequency and period of surveys
    - Collection of sample and/or data (questionnaire)
    - Procedure (contact the farmers, observation of animals, sensitization, reporting)
- Passive surveillance: reporting (veterinarians, farmers, hunters, hospital, public, butchers)
    - Activation of passive surveillance: sensitization by visits, meetings, pamphlets, broadcasts
    - Definition of roles (observation, reporting)
    - Cerification of private veterinarians

5.6 Case definition

- Suspected case definition:
    - General case for animal or farm: clinical signs and rapid test kits
    - More sensitive case for population at risk
- Confirmed case definition :
    - Clinical signs and confirmation laboratory test

5.7 Data and sample collection

- Persons in charge of sampling
- Data to be collected: for samples traceability (sample labelling, sample form) and results interpretation (questionnaire)
- Sample to be collected
- Field tests (TB inoculation test, AI test kits)
- Preservation and sending to the laboratory
- Transportation - Biosecurity
- Timeframe between collection and reception by laboratory

5.8 Diagnostic tests

- Test of choice regarding surveillance objectives (rapidity, reliability, number of samples) and laboratory capacity (cost, equipment, staff availability and skills)
- Storage and data management in the laboratory
- Biosecurity

- Timeframe between reception and feed-back of results

5.9 Data management

- Centralization: how, who and where?
- Validation: which level?
- Database adapted to data collected and objectives
- Data analysis (methodology, software)
- Expected results: prevalence, maps, incidence
- Interpretation
- Feed back of information to the field (vet, farmers)
- Confidentiality
- Diagram of the flow of information: actors, means, timeframes

5.10 Communication

- Internal and external of the network
- Means: telephone, bulletin, internet, broadcasts
- By whom: sensitive information; regular bulletin
- Frequency predetermined

5.11 Training

- Basic training of staff: education
- Training of staff (for quality and standardization):
    - data and samples collection
    - case definition (veterinarians, AHA)
    - diagnostic methods
    - data recording and transmission to higher level (data clerk)
    - data analysis
- Sensitization of farmers and general public
- Which way: international workshops, national meetings, field sensitization, practical exercises, books, internet
- Who is in charge of the training?
- For which public?
- Refreshing courses frequency

5.12 Diary

- Agenda on 3 years for the progressive implementation of the surveillance plan: priorities of the surveillance
- When do we plan to obtain the first results?

5.13 Evaluation - This step is crucial for the validity and sustainability of the surveillance

- Internal: elaboration of performance indicators and frequency
- External: experts mission and frequency
- Planning of correction measures

5.14 Estimated budget

- Human, material, training, communication needs for each network sector
- Yearly cost
- Origin of funds for the first years and for the sustainability of surveillance

Reference

1. Surveillance and Data Standards for USDA/APHIS/Veterinary Services, version 1.0 (July 2006)
2. Guide for Development of Surveillance Plan: https://www.google.com/#q=Guide+for+the+development+of+surveillance+plan&safe=active
3. Manual of Basic Animal Disease Surveillance: AU-IBAR

6.0 AN OVERVIEW OF STANDARD METHODS AND PROCEDURES FOR DATA COLLECTION, STORAGE AND QUALITY CONTROL

6.1 Introduction

Standard Methods and Procedures in Animal Health is a Plan for Regionally Coordinated Prevention and Control of Trade-Related Transboundary Animal Diseases. This is an animal health programs, harmonized and coordinated among multiple nations (Greater Horn of Africa), designed on a regional basis for trade-related TADs. It is a disease control program that is an umbrella design, to provide regional uniformity coordinated through IGAD. This design has been agreed to by both exporting and importing nations, subscribed to by all concerned parties, focused on trade-related TADs and executed according to OIE recommendations. The SMP concept:

1. Begins with reality of present situation
2. Accepts what is currently being done as baseline
3. Can be built upon as needs arise
4. Can be designed to deal specifically with any relevant disease
5. Addresses both live animals and provides SPS background for trade in animal commodity products
6. Addresses both breeding and slaughter livestock
7. Flexible - can meet changing realities and new developments.
8. Coordinates animal health activities region-wide
9. Enhances negotiation between trading partners, using OIE recommendations as basis for discussion (OIE Terrestrial Code SPS & Judgment of Equivalence)

The SMP will start by identifying the gaps in the systems and addressing them. The SMP forms the framework for uniform surveillance, epidemiology, laboratory procedures, disease prevention, disease control, quarantine; works within OIE recommendations and is flexible. It is tailored to relevant TAD diseases; can be changed to fit changing situations, scientific advances, disease dynamics, and can accept different approaches by different Directors of Veterinary Services.

6.2 Objectives of Standard Methods and Procedures (SMP)

The goal of SMP is safe, stabilized trade that leads to safe, stable livelihoods of all actors along the value chain, regionally. The objectives are:

1. Facilitate regionally coordinated disease control programs
2. Facilitate the ability to do surveillance and epidemiology that clearly determines outbreak areas
3. Clarify laboratory procedures and testing of trade livestock to ensure OIE compliance for Health Certification
4. Provides the basis for uniform and unified SPS for livestock trade
5. Facilitates trade *within* and *between* Regional Economic Communities
6. Provides strengthened bargaining power with importers
7. Ensures no more bans on export livestock from Eastern Africa!

6.3 Status of Implementation of SMP

We need to know that we are already doing a lot of what needs to be done. What is required is to coordinate and collaborate better what we are already doing right and figure out what we need to be doing more of or doing differently to be better at it. The concept has been working for more than 40 years already in the United States with hundreds of millions of livestock having gone through these programs. Major diseases like brucellosis and tuberculosis have been eliminated through these programs.

In the US, there are 50 states, each with a CVO called the State Veterinarian. The U.S. Department of Agriculture, Veterinary Services (USDA/VS) creates a national program (the State-Federal Cooperative Disease Control Program) for each disease to be controlled. For each disease, there is a ñUniform Methods and Rulesò that specifies how the disease is to be controlled and/or eradicated. Each state subscribes to that program, managed by the State Veterinarian, and a uniform national approach to each disease is thereby implemented. USDA/VS monitors performance and compliance and assigns a status grade to each state, i.e. Class Free, Class A, Class B etc. Livestock moves freely between Class Free states, but in lower status states there must be further testing before movement of animals.

In Eastern Africa we have nine nations (Greater Horn of Africa), each with a DVS /CVO. AU-IBAR and IGAD, working with member states, designed a regional program (the SMP-AH) for each livestock disease to be controlled. For each disease, there is a ñStandard Methods and Proceduresò that specifies how the disease is to be controlled and/or eradicated. Each nation subscribes to that program, managed by the CVO, and a uniform regional approach to each disease is thereby implemented. IGAD and IBAR monitor the program and coordinate any needed tuning and changes. The program facilitates certification for international and intercontinental movement.

Essentially, SMP is about two things: detection and response. Detection is about Surveillance and Epidemiology. Laboratories support both Surveillance and Epidemiology. Response is about disease control. Surveillance, epidemiology and laboratories all support the disease control. All of these units must work with coordination and cooperation to operationalise the SMP concept.

6. 4 Diseases targeted for SMP

The diseases selected are trade-related and are of regional priority. The sanitary concerns of the livestock importing countries were also a major consideration.
The trade-related priority regional diseases are:

1. Brucellosis,
2. Rift Valley Fever,
3. Foot and Mouth Disease,
4. Peste des Petits Ruminants,
5. Contagious Bovine Pleuropneumonia,
6. Contagious Caprine Pleuropneumonia,
7. Sheep and Goat Pox,
8. Camel Pox and
9. Lumpy Skin Disease

A technical working group to write the SMPs was formed with members coming from the project Member Countries. Out of the nine diseases, one SMP is complete awaiting validation and SMPs for the remaining diseases are on draft form. Peer review has already been carried out.

6.5 Steps for writing Standard Methods and procedures

The following are suggested steps for writing standard procedures for data collection, storage and quality control. They are not exhaustive in any way.

1. Data collection
    a. Active Surveillance
        - Sampling methods should be clearly defined. These may include simple random, systematic, cluster, stratified, or complex sampling, convenience or probability sampling, wildlife surveillance and participatory disease surveillance.
        - Define the method of collection of data (questionnaire, semi-structured interviews)
        - Describe the procedure of administering the questionnaire and conducting the SSI
        - Describe the capture of collected data in the databases
    b. Passive Surveillance
        - Define the sources of data
        - Define the roles of the various actors in surveillance
        - Define the role of public veterinary services
        - Notification of the CVO on a disease event (notifiable disease, emerging/re-emerging disease)
        - Describe the data collection methods (pen & paper, mobile phone, DPT, etc)
        - Mention the data collection tools (standard reporting formats?)
2. Data Storage
        - Describe how and where the data collected will be stored (Central database, district/county/provincial databases)
        - Confidentiality
3. Data Quality control
        - Editing (cleaning) level
        - Validation: which level?
        - Confirmation level
        - Data analysis (methodology, software) and interpretation
        - Reporting to end users & feedback of information to the field

7.0 EVALUATION OF ANIMAL DISEASE SURVEILLANCE SYSTEMS: CRITERIA USED IN EVALUATION

7.1 Introduction

Surveillance for animal diseases has been extensively used by epidemiologists and other animal health professionals to assist in monitoring and controlling health-related events in animal populations. A reliable surveillance system is the key to early warning of a change in the health status of any animal population. It is also essential in providing evidence about the absence of diseases or in determining the extent of a disease which is known to be present. The two terms ósurveillanceô and ómonitoringô are often used interchangeably in animal health programs. Animal disease surveillance involves watching an animal population closely to determine if a specific disease or group of diseases enters that population. Monitoring of animal diseases focuses on identifying a disease or group of diseases to ascertain changes in prevalence and determine the rate and direction of disease spread.

Monitoring and surveillance are essential activities for official Veterinary Services. However, in recent years, increased trade in animals and animal products has increased the importance of international disease reporting. The Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organization (WTO) recognizes the OIE (World organization for animal health) as the international organization responsible for drafting international animal health standards. The SPS Agreement requires that animal health decisions be scientifically based which in turn is dependent on quality assurance being applied to animal disease surveillance systems.

7.2 Evaluation Criteria for Animal Disease Surveillance Systems

Established surveillance systems should be regularly reviewed on the basis of explicit evaluation criteria inclusive of usefulness, cost and quality. Attributes of quality include (i) sensitivity, (ii) specificity, (iii) representativeness, (iv) timeliness, (v) simplicity, (vi) flexibility (vii) acceptability, (viii) quality of data (ix) predictive value and (x) Stability

Table 1. Criteria used to Evaluate the Performance of a Surveillance System

Criterion	Function
Usefulness	Describes the contribution of the system to the prevention and control of diseases
Cost	Includes indirect as well as direct costs and should be measured in relation to the benefits obtained, such as improved productivity, reduction in trade barriers and protection of public health.
Sensitivity	Refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system [true positives].
Specificity	Inversely proportional to the number of false positives being reported.
Representativeness	Describes the occurrence of a health-related event over time and its distribution in the population by place and species
Timeliness	Reflects the speed between steps in a surveillance system
Simplicity	Describes the ease of operating the system. Surveillance systems should be as simple as possible while still meeting their objectives
Flexibility	Describes the ability of the system to adapt to changing information needs or operating conditions with little need for additional time, personnel or allocated funds
Acceptability	Reflects the willingness of people and organizations to participate in the surveillance system
Quality of data	Refers to the completeness and validity of the data recorded by the surveillance system
Predictive value	Proportions of reported cases that actually have the health positive related event under surveillance
Stability	Refers to the reliability (the ability to collect, manage and provide data properly, without failure) and availability (the ability to be operational when it is needed) of the surveillance system

i] Usefulness. The usefulness of a surveillance system is measured by whether it leads to prevention or control or a better understanding of adverse health events. The measure can be qualitative, in terms of the subjective views of those using the system, or quantitative in terms of the impact of surveillance data on policies, interventions or the occurrence of a health event.

A surveillance system is useful if it generates an effective and informed response leading to the control and prevention of adverse disease events or to a better understanding of the process leading to an adverse outcome. An additional consideration is the extent to which the knowledge obtained from surveillance data about the epidemiology of a disease event leads to better understanding of the problem [eg risk factors in disease transmission)

The simplest way to assess usefulness is to ask those involved in the animal health system such as public and private veterinarians at the state and local level. A more rigorous approach to defining usefulness is through assessment of the impact of surveillance data on policies and interventions, and ultimately their impact on the occurrence of a disease event. Such policy analysis requires both observation and understanding of the decision making process and quantification of the impact of surveillance information on the measures of interest (i.e. morbidity, mortality, impact on productivity).

Although surveillance data may be important to disease control decision making and policy formation, decisions affecting surveillance are often based on changes in more general programme directions rather than detailed analysis of a particular system (e.g. directing resources away from rinderpest surveillance to the prevention and control of peste des petits ruminants)

It is recommended that the evaluation of the usefulness of a surveillance system be based on answers to the following questions.

Does the system:

Ådetect trends signaling new problems and lead to control and prevention activities?

Ådetect epidemics leading to control and prevention activities?

Åprovide quantitative estimates of the magnitude of morbidity and mortality related to the disease event under surveillance?

Åidentify factors involved in disease occurrence?

Åfacilitate research likely to lead to control or prevention?

Åpermit assessment of the effects of control measures?

The usefulness of a surveillance system should be reviewed periodically as disease patterns change and new priorities emerge. Surveillance can be costly, particularly in the development of new systems or the enhancement of current ones.

ii] Cost .The cost of a system includes indirect as well as direct costs and should be measured in relation to the benefits obtained, such as reduction of medical-care expenses and of time lost from work. All elements of the system should be included in the cost data collection, analysis and dissemination.

One can assess current systems in terms of costs and benefits and can apply the lessons from these efforts to further surveillance activities. To assess direct and indirect costs, all elements of a surveillance system, including data collection, analysis and dissemination, must be identified and costs assigned to them. To calculate a benefit/cost ratio, the benefits obtained should be well covered including improved productivity, reduction in trade barriers and protection of public health.

iii] Sensitivity. The sensitivity of a surveillance system is its ability to detect true disease events. Quantitatively, sensitivity is the ratio of the total number of disease events detected by the system over the total number of true disease events as determined by an independent and more complete means of ascertainment (Fig. 1). In published reports, sensitivity has been termed completeness of reporting and has been studied more than the other six attributes.

Figure 1. Quantitative Assessment of Sensitivity and Specificity

		Disease Event Present		
		Yes	**No**	
Disease Event identified by surveillance	**Yes**	**A** **True Positive**	**B** **False Positive**	**A+B**
	No	**C** **False Negative**	**D** **True Negative**	**C+D**
		A+C	**B+D**	

Sensitivity of the surveillance system is A / [A+C] and the Specificity is D / [B+D]

A variety of activities and circumstances will have an impact on sensitivity. For example, an uncommon, highly virulent disease for which there is an intervention (e.g. RVF) is more likely to be reported than a common condition which is rarely fatal (e.g. Orf). A surveillance system monitoring a large number of events can be very useful even with a low sensitivity if the reports are representative (see below). Alternatively, veterinary department initiated (active) disease-reporting systems are also likely to increase reporting over service provider-initiated (passive) systems. The level of sensitivity can also vary to address specific program goals. When control activities are contingent upon the identification and reporting of every case (e.g. the late stages of the rinderpest eradication campaign,) sensitivity is the critical criterion for assessing the surveillance system deployed.

iv] Specificity. The specificity of a surveillance system is inversely proportional to the number of false positives it reports. Reports of a disease that do not meet the case definition are false

positives and may result in resources being wasted in investigating them. However, in circumstances where it is extremely important not to miss a single true case a certain level of false positives may be acceptable.

v] Representativeness. Representativeness can be measured by comparing surveillance data covering part of the population to either nationwide data, where available, or to random sample survey data. A source may be representative for one particular disease or condition but not for another. Representativeness involves such factors as age, sex, ethnic group, socioeconomic status and residence.

vi] Timeliness. Timeliness involves not only the interval between the occurrence of the event and the receipt of the report at the health agency, but also the time subsequently required for identifying a problem or epidemic and the initiation of control measures. Timeliness is relative to the event concerned; for example, for most infectious diseases, the response should be made in a matter of days, whereas for cancer surveillance annual reporting may be adequate.

vi] Simplicity. The simplicity in a system means it is easy to understand and implement and is therefore usually relatively cheap and flexible. A flexible system is easily adapted by adding new notifiable diseases or conditions or extending it to additional population groups. However, care should be taken that the reporting burden is not thereby increased to an unacceptable level, leading to loss of data quality or timeliness.

vii] Acceptability. The acceptability of a system depends on the perceived public health importance of the event under surveillance, recognition of the contribution of individuals to the system and the time required to make the reports. The surveillance method must be acceptable not only to the collectors of the data, for the reasons just mentioned, but also to the providers (both ill and well persons) in terms of confidentiality and cultural sensitivities Thus acceptability can be measured by the proportion of persons asked who actually complete a questionnaire.

viii] Quality of data. The quality of data refers to the completeness and validity of the data recorded by the surveillance system

ix] Predictive value. The proportions of reported cases that actually have the health positive related event under surveillance

x] Stability. Refers to the reliability (the ability to collect, manage and provide data properly, without failure) and availability (the ability to be operational when it is needed) of the surveillance system

7.3. Conclusion

The attributes of surveillance discussed are interdependent, increasing the sensitivity of a system to detect a greater proportion of a health event may improve representativeness and usefulness, but also increase the cost and lead to the reporting of more false positives. Paradoxically, the less

frequent the event, the more expensive it may be to keep under surveillance. It is also necessary to bear in mind that changes in representativeness or sensitivity can occur with time and lead to misinterpretation of the data, such as when improved diagnostic facilities lead to increased case reporting.

A reliable surveillance system is the key to early warning of a change in the health status of any animal population. Such a system is also essential for providing evidence about the absence of diseases or in determining the extent of a disease which is known to be present. The authors discuss a set of methods and approaches for evaluating the quality of surveillance and survey systems. Certain steps are required when assessing the quality of a service or product. Various approaches for quality assessment are available and the suitability of each method depends on the objective of the evaluation.

Quality control of the system should go beyond spot checking of questionnaire completeness to periodic checking against the source data. Evaluation of surveillance systems is an essential prerequisite to improving their efficiency and effectiveness.

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