Version: 1.1.
Date: 14.02.2019
Drafted: Mark Hovari, Daniel Beltran-Alcrudo
Reviewed: Tsviatko Alexandrov, Nadav Galon and Eeva Tuppurainen

APPENDIX III – GUIDE TO SURVEILLANCE AND EARLY DETECTION OF LUMPY SKIN DISEASE

Purpose

The purpose of this document is to help central level veterinary services to increase their understanding of surveillance and early detection for lumpy skin disease (LSD) and to ensure that efforts to detect LSD are focused on surveillance components which have proven to be most effective based on current knowledge and experience.
The document is the third appendix to the Lumpy Skin Disease Contingency Plan Template.

SURVEILLANCE IN GENERAL

OIE defines surveillance as "systematic ongoing collection, collation, and analysis of information related to animal health and the timely dissemination of information so that action can be taken."

Surveillance is carried out for four main **objectives** (purposes) (RiskSur, 2015):

1) If disease is absent, to detect an incursion of the disease (as early as possible).
2) If disease is absent, to prove freedom from the disease (whether it has never been present or has been recently eradicated).
3) If disease is present, to monitor the prevalence, incidence and distribution of the disease.
4) If disease is present, to detect new cases of disease, in order to find new outbreaks.

Some of these objectives, depending on the disease situation, can overlap (thus becoming multi-objective). Surveillance can focus only on one disease (hazard) or several diseases (multi-hazard).

A surveillance system (for a certain disease) is a collection of different **surveillance components** (also termed activities), which complement each other and produce data about the disease with the aim to achieve the **surveillance objective(s).**

Type of data collection

Data for surveillance can be generated in two ways: "passively" and "actively". In case of passive data collection, the information originates not by the veterinary services directly, but by other stakeholders, most commonly animal owners, keepers and private vets. Therefore, because veterinary services passively wait for data to be sent to them, this is termed "passive surveillance". It should be noted that "passive surveillance" does not mean inaction from the veterinary side. Legal background (e.g. being

notifiable according to national legislation), raising awareness, building trust with animal owners, compensating in the event of culling or other losses due to trade restrictions, and having diagnostic capacity, are all key for effective and timely passive surveillance data.
In case of active data collection, the veterinary service obtains data directly (actively seeks it out), either through conducting clinical examinations, or by taking samples (which will be tested in a laboratory) to establish the health the status of an animal or herd.

There is a synergy between these two types, as by performing active data collection, veterinarians interact with animal owners and by explaining the reasons of their actions and/or handing out awareness raising materials, they increase the sensitivity of the passive data collection.

Surveillance components:
"Depending on the objective, the surveillance system will comprise one or more surveillance components, each focusing on a different target population or using a different study design, but all with the common objective and hazard described above" (Risksur 2015).
These components can be:

a) Passive disease reporting – where surveillance relies on the notification of clinical signs of a disease by animal owners and other personnel involved in animal production;
b) Risk-based survey – where clinical examinations or samples are taken from subpopulation(s) where the disease is most likely to occur;
c) Abattoir surveillance – where surveillance relies on detecting clinical signs or pathological lesions and/or obtaining samples at the slaughterhouse;
d) Sentinel herds/animals – where surveillance relies on repeated testing of animals at regular intervals in preselected herds, looking for changes in disease status;
e) Representative survey – where clinical examinations or samples are taken in a population in representative way;
f) Syndromic surveillance – the (near) real-time collection, analysis, interpretation and dissemination of health-related data (i.e. non-specific clinical signs and proxy measures for health that are usually collected for purposes other than surveillance and automatically generated (Triple-S).

Furthermore, to characterize a surveillance system or component, we have to look at three certain **characteristics** (Cameron, 2011):

1) **Timeliness**
   The amount of time until the surveillance generates data. This could occur, as an example, from once a year, once a month or in the best case continuously (all the time). In some cases, due to the nature of the disease, surveillance should only be carried out in specific time period (as for vector-borne diseases).

2) **Population coverage**
   This reflects how wide is the geographic (horizontal) and population (vertical) coverage of the surveillance. The geographic can be, as an example, a specific region, along the border, or the entire country. The population can be all susceptible species, specific susceptible species or certain subpopulation(s) (here referring to young vs. old; specific production systems, etc.).

3) **Representativeness**
   This looks at the relationship between disease found in the animals under the surveillance and the entire population. We can differentiate between:
   a) Representative: the disease in the animals under surveillance are similar as for the entire population;
   b) Risk-based: the disease is higher in the animals under surveillance then in the entire population);
   c) Biased: the disease in animals is not the same (could be lower) than in the entire population.

Within the context of lumpy skin disease

In this document will focus only on objective one: early detection, for a specific disease: lumpy skin disease (LSD) in a free, but usually at risk, country.

Early detection / early warning

Early warning surveillance is defined as: "surveillance of health indicators and diseases in defined populations to increase the likelihood of timely detection of undefined (new) or unexpected (exotic or re-emerging) threats. These are surveillance systems for the early detection of these threats" (RiskSur 2015).

The main aim is to find LSD before it has significantly spread. It might not be feasible to find the first incursion, but as early as possible.

MOST IMPORTANT FACTS TO NOTE ON LSD ON FACTORS INCREASING OR DECREASING EARLY DETECTION

The list below is a combination of two types of fact: the likelihood that animals will become infected, and how easy it will be to detect once infected:

- Mortality observed in the Balkans varied by country ranging from very low (0.7 and 1.5% in Greece in 2015 and 2016, respectively, or 1% of animals showing clinical signs in Bulgaria, where estimates are calculated before stamping out was applied) to moderate (6 and 12% in Albania in 2016 and 2017, respectively) (FAO, 2017);
- Morbidity is lower in buffaloes than in cattle;
- The production system will have an influence on the likelihood of detecting clinical signs, i.e. animals in pastures are not visually inspected as often as those indoors;
- Cows with high milk production are usually most severely affected;
- Pregnant cows may abort;
- High milk-producing European cattle breeds are highly susceptible compared to indigenous African and Asian animals;
- As a rule of a thumb, about one-third of the infected animals will not show clinical signs, one-third will show mild clinical signs and one-thirds will show severe disease
- Sometimes clinical signs are not easily detectable; e.g. long winter coats will cover nodules. Conversely, nodules in breeds/animals with thin skin and short hair will be much more apparent, e.g. Holstein cattle;
- Because LSD is a vector-borne disease, the rate of spread is mostly linked to vector abundance;
- There is no evidence that wildlife plays a role in the LSD epidemiology and spread in case of European fauna (based on the Bulgarian experience);
- Sheep and goats are likely not important in the epidemiology of the disease.
- When the first clinical signs are detected it is very likely that the disease has already been circulating for at least one or more.
- Animals infected by LSD will seroconvert.

Characteristic of an ideal LSD surveillance component for early detection and risk based approaches: Due to feasibility, the surveillance components should focus on finding the clinical disease (i.e. animals showing clinical signs), which will lead to the detection of the virus. The appearance of clinical signs is usually linked to passive disease reporting, when animal owners, vets or others close to cattle notice the clinical signs and report them directly or indirectly to the veterinary authorities.

Clinical signs of lumpy skin disease and postmortem findings *extracted from FAO's Lumpy skin disease - A field manual for veterinarians (Tupporainen et al., 2017)*

The incubation period in experimentally infected animals varies between four and seven days, but in naturally infected animals it may be up to five weeks. Clinical signs include:

- Lachrymation and nasal discharge – usually observed first.
- Subscapular and prefemoral lymph nodes become enlarged and are easily palpable.
- High fever (>40.50C) may persist for approximately a week.
- Sharp drop in milk yield.
- Appearance of highly characteristic, nodular skin lesions of 10-50 mm in diameter:
    - The number of lesions varies from a few in mild cases, to multiple lesions in severely infected animals.
    - Predilection sites are the skin of the head, neck, perineum, genitalia, udder and limbs.
    - Deep nodules involve all layers of the skin, subcutaneous tissue and sometimes even the underlying muscles.
    - Necrotic plaques in the mucous membranes of the oral and nasal cavities cause purulent or mucopurulent nasal discharge and excessive salivation, containing high concentrations of virus.
    - Typically, the centre of the lesion ulcerates and a scab forms on top.
    - Skin nodules may persist for several months.
- Sometimes, painful ulcerative lesions develop in the cornea of one or both eyes, leading to blindness in worst cases
- Skin lesions in the legs and on top of the joints may lead to deep subcutaneous infections complicated by secondary bacterial infections and lameness.
- Pneumonia caused by the virus itself or secondary bacterial infections, and mastitis are common complications.
- Subclinical infections are common in the field.

When an animal with multiple skin lesions is sent to a slaughterhouse, subcutaneous lesions are clearly visible after the animal is skinned. In a postmortem examination, pox lesions can be found throughout the entire digestive and respiratory tracts and on the surface of almost any internal organ. For further information, please visit: http://www.fao.org/3/a-i7330e.pdf

In order to maximize the probability to detect lumpy skin disease (LSD), surveillance should focus on locations, periods and subpopulations where there is a higher likelihood to find it, i.e. risk-based surveillance. These high risk populations must be defined through a risk assessment process.

Seasonality (temporal): In countries with long and cold winters like in Europe, one can be relatively certain that LSD will not be introduced during the colder months, i.e. when vector activity is negligible. This implies that veterinary services should conduct surveillance from early spring onward.

Location (spatial): In case of early detection, the aim should be to find LSD regardless where it first occurs within the country or zone, especially if there is no indication where disease is more likely to enter (i.e. through risk assessment) or in small countries. This would imply covering the entire geographic area of the country. When there is knowledge on the high risk areas (e.g. along the border with infected countries), efforts should focus there, without entirely neglecting low-risk areas.

Susceptibility: The aim should be to cover all susceptible species (cattle and water buffalo), but chances to find disease might be higher in some specific subpopulations. Also, surveillance does not need to be representative, as we do not intend to measure the disease frequency.

In summary, we are looking for surveillance components which are:

- Focusing on clinical signs of the disease;
- Involve other stakeholders, mainly animal owners, keepers and private vets
- Carried out all the time, or in high risk periods;
- Cover the entire country, or in high risk areas;
- Cover all types/breeds of cattle (and buffaloes) or high risk subpopulations;
- Are not representative;
- Have a high sensitivity.

We will look now at the various surveillance components which fit or come close to this description.

OVERVIEW OF SURVEILLANCE COMPONENTS

Except for passive disease reporting, all the other components can be considered active surveillance. In terms of relevance/importance, number one would be passive disease reporting, followed by risk-based surveillance. The rest can be useful in certain circumstances, but are less common, due to cost, logistics needs or efficiency.

PASSIVE DATA COLLECTION

Reporting disease suspicions by animal owners and others is very powerful. It is carried out nearly all the time when cattle owners (but also middlemen, private veterinarians, A.I. technicians, abattoir workers and meat inspectors) handle their animals. In some countries private veterinarians sample suspected cattle and send the samples to veterinary laboratories. It can cover the entire country and population (as every animal has an owner). The lack of representativeness is not a concern for early detection, but constrains can be:

- animal owners might not observe (all the time) their animals, e.g. when they are out in the pastures for prolonged periods;
- animals owners, veterinarians or other people involved in animal production might not recognize the clinical signs of the disease (due to lack of awareness on the risks and how clinical signs look like);
- animal owners, veterinarians or other may not be aware of the relevance of finding clinical signs and the importance of reporting promptly;
- animals owners might be afraid to report disease due to fear of consequences (e.g. stamping out with or without compensation, trade restrictions etc.), or lack of trust on the veterinary services;
- animals owners might be uninterested to report, if following notification no action is taken by the veterinary service;
- the veterinary service might not be able to correctly diagnose LSD and/or to take appropriate samples for laboratory confirmation;
- at the laboratory, samples are not properly analyzed, either because of lack of diagnostic equipment or reagents, lack of training on LSD diagnostic protocols, or failure to include LSD in the differential diagnosis.

Similarly to diagnostic tests, surveillance components (and systems) also have a sensitivity value i.e. the probability to correctly detect a LSD-infected animal). The sensitivity of passive disease reporting by animal keepers (and others in contact with cattle) can be assessed by constructing scenario trees and assigning probabilities to each step.

Example for the purposes of demonstrating the calculation:

1. Animal shows clinical signs → 50%
2. Clinical signs are noticed by the owner → 75%
3. Owner recognizes that signs are abnormal and seeks veterinary assistance → 85%
4. A clinical investigation is initiated → 95%
5. Investigator suspects LSD and collects appropriate samples that are sent to the laboratory → 95%
6. Laboratory tests samples for LSD → 99%
7. Samples test positive (PCR) → 99%

Sensitivity(Se) = 0.5×0.75×0.85×0.95×0.95×0.99×0.99 =
This means that the overall sensitivity of passive disease reporting is 28% (per infected animal).

In case of a herd with 1000 heads, with a 1% prevalence (i.e. 10 infected animals in the herd)
the surveillance sensitivity is:
$Se(\text{passive surveillance}) = 1-(1-(PxSe))^{n} = 1-(1-(0.01\times0.282))^{1000} = 0.94$

This means that the probability of detecting 10 infected animals (remember: one-third of the infected animals will not show clinical signs, one-third will show mild clinical signs and one-thirds will show severe disease) among 1000 with the passive surveillance component is94 %

Except for the first parameter (animals showing clinical signs), the value can be improved by raising the awareness of animal keepers of the risk of LSD and the nature of clinical signs. Factors that will decrease the sensitivity include the lack of compensation for culled animals (which will disincentive the reporting of suspicious animals), fear of trade restrictions and inefficient notification systems (where the animal owner has difficulty to pass on the information to the veterinary service). If private veterinarians are also part of the notification chain, their training and involvement is also crucial for success. Moreover, others along the cattle value chain should also made aware of the risk and nature of LSD, e.g. service providers (inseminators, milking staff, milk collectors, middlemen, abattoir workers or meat inspectors).

Naturally, the probability values will vary between countries, depending on their production systems, awareness programs, compensation and other policies, vet services and laboratory capacity, etc. Surveys and expert knowledge elicitations (EKE) are good methods to derive initial probability values for estimating the sensitivity of passive disease surveillance systems.

Benefits:

- Wide geographic and population coverage;
- Is carried out all the time;
- Relatively inexpensive.

Drawbacks:

- Highly depended on the knowledge, ability and willingness of animal keepers;
- Possibly dependent on the involvement of private veterinarians.

Details on this method can be found in FAO's Risk-based disease surveillance manual
http://www.fao.org/3/a-i4205e.pdf

Raising awareness – awareness campaigns

Awareness campaigns need to be intensified and targeted to all cattle sector stakeholders. They should be aware of the risk of entry of the disease, the consequences for an individual farmer and for the local community, the ways it spreads, the ways to prevent it, how to recognize it, why early detection is important, the benefits of prevention and eradication, penalties in case of non-notification and how to report it to the veterinary authorities immediately when suspected.

Cattle transport drivers in particular are in a key position to identify infected animals on farms, slaughterhouses, cattle collecting holdings and resting stations, and to notify the veterinary authorities of such clinical suspicions.

Awareness campaigns should also be targeted to consumers to regain their trust to consume cattle products during and after an outbreak.

Overall, while awareness should be increased over the whole territory, it makes sense to focus or prioritize awareness efforts in the areas perceived to be at higher risk.

ACTIVE DATA GATHERING

RISK-BASED SURVEYS

Risk-based surveys focus on sampling certain sub-population of animals with a higher risk of being exposed, infected or showing clinical signs within the population, thus increasing the probability of detection. The population will be therefore divided into high risk and a low risk groups. Examples of sub-populations showing clinical signs more likely in case of LSD are cattle kept outdoors, dairy cattle, large herd size dairy cattle, calves, etc. A more exhaustive list has been presented earlier on in the document (page 4). Two sampling approaches can be used in this case:

a) Targeted sampling, where only the high risk group is sampled;
b) Stratified sampling, where both high and low risk groups are included, but the number of high risk group samples is larger than the low risk group.

In case of early detection of LSD, a risk-based surveillance design would be very appropriate. Although it would not allow to cover the entire country and population, selecting high risk areas (bordering infected territories) and sub-population with higher chances of showing clinical signs and good accessibility can greatly enhance (early) detection. One must especially consider high consequence areas, like areas with high cattle density and/or intensive production (i.e. valuable animals). Another issue is that due to the cost of this activity, it is likely not feasible to carry it out all the time, but only in high risk periods, i.e. the warmer months when vectors are becoming more abundant and active.
As a recommendation for the area to be covered, if the risk of introduction comes from an infected neighboring country the absolute minimum is 20 km wide area along the border. Based on current experience, 50 km is highly recommended and 80 km would be ideal (EFSA, 2018b).

Due to the nature of this component the data is gathered and processed actively by the veterinary services. The veterinarians performing the surveillance visits should be trained in:

- the clinical signs and epidemiology of LSD;
- how to conduct a clinical examination including selection of animals to be examined (preferably based on SOPs);
- what samples to take in case of a suspicion (based on SOPs);
- how to pack, transport and where to bring the samples;
- how to fill in the reporting templates (manually or digitally) after the visits.

Veterinarians also need to be equipped with all materials needed to carry out the surveillance visits, ranging from vehicles, fuel, PPE (if requested), sampling equipment, disinfection equipment and products, reporting forms, awareness raising material for animal owners, etc.

An interesting auxiliary action, if animal movement through live-animal markets is common, is to undertake regular surveillance in markets where animals arrive from high risk area(s). This might not be the best method for early detection, but can be a valuable addition.

Sampling and diagnosis

In case of early detection, we rely on clinical diagnosis. Still, laboratory confirmation of LSD is needed, for which timely sampling and testing are crucial. The summary table below provides an overview and recommendations on which samples to take depending on the week since the infection. The table is based on EFSA, 2018b, which collated several sources.

Weeks post infection	**1**	**2**	**3 - 5**	**6 - 8**	**9 +**
Clinical signs	Maybe shows	Starts to show	Shows	Shows and starts to disappear	Scarring
Type of sample	EDTA blood for PCR	EDTA blood for PCR			
		Skin lesions and scabs	Skin lesions and scabs		
		Saliva or nasal swabs	Saliva or nasal swabs	Saliva or nasal swabs	
			Whole blood for serum sample	Whole blood for serum sample	Whole blood for serum sample
Diagnostic method	PCR	PCR ELISA	PCR ELISA	PCR ELISA	ELISA

Regarding packaging and shipping please refer to the sample collection and shipping section of FAO's Lumpy skin disease field manual for veterinarians (Tupporainen et al., 2017) available at http://www.fao.org/3/a-i7330e.pdf

ABATTOIR SURVEILLANCE

This type of surveillance component focuses on animals sent for slaughter (human consumption). As normally only clinically healthy animals should be sent for slaughter, it is unlikely to have animals showing severe or moderate clinical signs of LSD arriving at the slaughterhouse. Abattoirs have trained inspectors who perform ante- and post-mortem inspections of all animals. Still, since LSD-infected animals do not show always apparent clinical signs, blood samples from the animals sent for slaughter, coming from high risk regions, could be performed. Nevertheless, testing all the animals arriving from high risk areas would likely not be feasible and costs would steeply increase. Lesions may be detected during the dressing of the carcasses, particularly for animals with long hair or when the lesions are old and may have already partially resolved at the superficial level.

The coverage of this component depends on the location of the slaughterhouse and will not cover the entire country. Also the samples focus on a sub-population where the diseases are not likely to occur.

Overall, active abattoir surveillance is not a recommended approach for initial detection of LSD in a country. It may be useful to prevent with-in country spread. In countries where a large proportion of cattle slaughtering is not performed at abattoirs the value of this surveillance is reduced. In countries

having abattoirs-active-surveillance for endemic diseases like brucellosis and TB, it may be practical to incorporate LSD to the staff training and sampling routine.

Still, training of abattoir workers in recognition of the clinical signs of the disease and on how to report cases should be considered to further strengthen passive surveillance.

SENTINEL HERDS

Sentinel herds are a small number of pre-selected herds located in a high risk area(s). The herds are visited on regular intervals and animals are tested for disease. Individual identification of the animals is highly recommended. In case of LSD, this should include clinical examination, virology and serological testing. If the animals show clinical signs or are PCR-positive, this will raise an alert that LSD is already within the country. A seroconversion should be interpreted in context of the specificity and sensitivity of the diagnostic test used.

A main constraint is the geographic coverage and finding farmers willing to collaborate.
The timeliness to obtain surveillance data is very high as animals are tested regularly and animal owners will notify changes immediately.

The use of sentinel herds could be in theory a good method for LSD surveillance, but might be due to the logistics involved and costs burden.

REPRESENTATIVE SURVEY

This type of surveillance component will aim to measure disease in a population. As long as LSD is not present, this type of surveillance should not be used for early detection. This is not recommended for early detection as this component would become very costly and time-consuming if designed to find disease at a very low level of circulation.

SYNDROMIC SURVEILLANCE

This component relies on the detection of certain non-specific clinical signs, and proxy measures for health that are usually collected for purposes other than surveillance and automatically generated to act as an early warning tool. Signs could include: increased mortality, change in feed intake, drop in milk production, increase in antibiotic purchase, etc.

Syndromic surveillance requires advanced data-bases, GIS, information technologies, on-going interphase between different software and sources and epidemiology and risk-analysis skills. These are not common to find in many countries currently but are good future prospect for veterinary services.

Although, under the right circumstances this is a very strong early detection approach, due to the intense data gathering and analysis requirements and high number of false alarms this is not a feasible approach under all settings. On the other hand, this surveillance system will allow not just to detect LSD, but also other diseases of importance.

CONCLUSION

Based on the discussion of the various components, the main recommended approaches should be primarily passive disease reporting and secondarily risk-based surveillance based on detection of clinical signs, e.g. in high risk areas.

All of the components described above apply to the surveillance of susceptible hosts. Vector surveillance, particularly due to their role as mechanical (rather than biological) vectors fits more as a research activity to find out at the time of an outbreak which vectors are actually involved in the local spread of LSD. The same would apply to the surveillance of wildlife and small ruminants.

Serological surveillance can be used for retrospective analyses in affected areas.

CHECKLIST FOR LSD SURVEILLANCE:

Below is a simple checklist when planning/developing a surveillance system (based on OIE Terrestrial Code Chapter 1.4. Animal Health Surveillance and RiskSur adaptation). For some of the points, pre-filled examples are highlighted in italics.

1) Purpose and objective:
Early detection.

2) Target population, epidemiological unit, case definition and tests used:
Target population: cattle
Epidemiological unit: village or farm (based on local factors)

3) Description of surveillance components:
   a) Passive disease reporting.
   Please describe how to enhance sensitivity
   b) Risk-based surveillance in high risk areas.
   Please describe area and methods applied.

4) Time-frame of surveillance activities:
Please describe when the surveillance activities will be carried out.

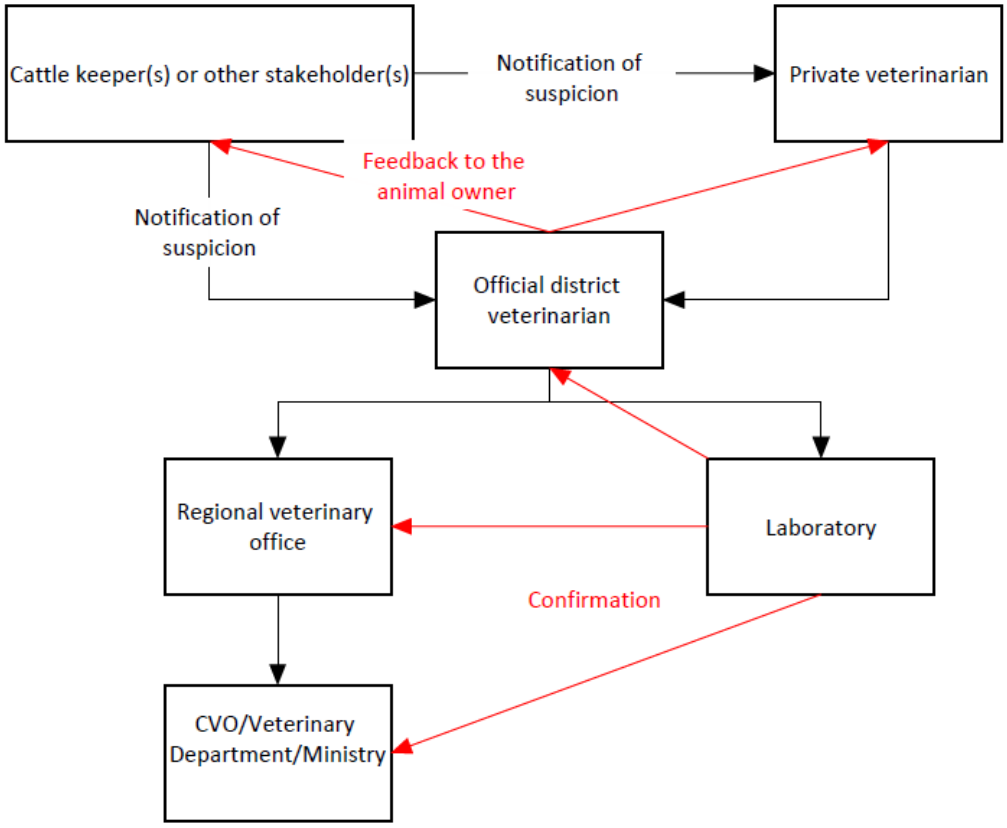
5) Role and responsibilities of each institution or participants in surveillance actions including producers and stakeholders:
Please describe the role of the veterinary services, the laboratory, the private veterinarians, farmer's organizations, etc.

6) Intended end-product of the activities
   a) LSD cases suspicions are notified, but the disease has been ruled out. Freedom status is unchanged.
   b) LSD case suspicions are notified, the disease has been confirmed and response measures have been taken.

7) Description of the information system supporting the actions and how surveillance information will be used or acted on by producers, industry and policy-makers or other authorities:
Please describe.

8) Reporting and dissemination actions: *Please describe notification/reporting chain. The red arrows depict the flow of information back up the chain once the laboratory has finalized the diagnosis, i.e. feedback to the farmer and/or control actions.*

Example (the diagram will depend highly on the structure of the given country):



9) Resources needed: Please describe, e.g. awareness tools, equipment for investigating suspected outbreaks, etc.

10) Criteria for evaluation of the surveillance system: If available, please describe.

References

Cameron A., 2012 (book). Manual of basic animal disease surveillance. African Union – Interafrican Bureau for Animal Resources, Nairobi, Kenya, 2012. ISBN: 978-9966-1659-1-6. Available at: http://www.au-ibar.org/component/jdownloads/finish/76-tmt/1546-manual-of-basic-animal-disease-surveillance

Cameron, A., Njeumi, F., Chibeu, D., Martin, T., 2014 (manual), Risk-based disease surveillance: Manual for veterinarians on the design and analysis of surveillance for demonstration of freedom from disease. Italy, Rome, FAO.

EFSA (European Food Safety Authority), Calistri P, DeClercq K, De Vleeschauwer A, Gubbins S, Klement E, Stegeman A, Cortinas Abrahantes J, Antoniou S-E, Broglia A and Gogin A, 2018. Scientific report on lumpy skin disease: scientific and technical assistance on control and surveillance activities. EFSA Journal 2018;16(10):5452, 46 pp. https://doi.org/10.2903/j.efsa.2018.5452

FAO. 2017. EMPRES-Animal Health 360, No. 47. Rome

RiskSur. 2015. Best Practices in Design, Implementation and Evaluation of Animal Health Surveillance Systems. Available at: https://www.fp7-risksur.eu/progress/best-practice-document

Thompson P.N., Etter E. 2015, Epidemiological surveillance methods for vector-borne diseases. Rev Sci Tech. 2015 Apr;34(1):235-47.

Triple S: Syndromic Surveillance Systems in Europe. Accessed on 2018.10.23. Available at: http://invs.santepubliquefrance.fr/content/download/139870/505218/version/1/file/Triple-S_FS1.pdf

Tuppurainen, E., Alexandrov, T. & Beltrán-Alcrudo D. 2017. Lumpy skin disease field manual – A manual for veterinarians. FAO Animal Production and Health Manual No. 20. Rome. FAO. 60 pp. *(En, Ro, Ru, Mk, Sq, Sr, Tr, Uk*). Available at: http://www.fao.org/3/a-i7330e.pdf

World Organisation for Animal Health (OIE). 2017. Terrestrial Animal Health Code. Chapter 1.4 Animal Health Surveillance [online] Available at: http://www.oie.int/standard-setting/terrestrial-code/access-online/