**GUIDELINES TO SELECT RISKS CRITERIA in RISK-BASED DESIGN SURVEILLANCE: METHOD SELECTION AND PROTOCOL VALIDATION**

Mention surveillance component name:……………………………………………………………………………………..

Mention objective of the risk study:………………………………………………………………………………………......

# SELECTION OF ADAPTED METHOD

**This step aims to validate the selection of the adequate method for risk study. The Selection of the most adequate method is done according to objectives of the risk study and the available data and capacities.**

## 1- SELECT HIGH RISK POPULATION STRATA BASED ON THE HETEROGENEITY OF HARBORING THE DISEASE

***This type of risk studies aims to identify holdings or zones of high risk of incidence and to map the risk distribution.***

Different **approaches** can be considered to reach this objective:

1. Risk factors identification

*Identification of the factors associated with the incidence or the disease of interest*

1. Spatial risk analysis

*Identification of the high risk zones of incidence for the disease of interest*

1. Risk assessment

### Risk factors identification

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| Methods of risk factors identification 🡺 Selection according to objectives and available data and capacities | | |
| METHOD | DESCRIPTION | REQUIRMENTS AND CONDITIONS FOR APPLICATION |
| Identify risk factors by Odd Ratios/ relative risks evaluation based on multivariate analysis | By case-control study  *Identify risk factors by*  *comparing the frequency of exposure in cases of disease to the frequency of exposure in controls.*  *It is a retrospective study; past data is used.* | REQUIRMENTS AND CONDITIONS FOR APPLICATION  The application of this method needs accurate spatial data about a number of factors:  Environmental factors  Anthropogenic factors  It needs a good mastery of statistical tools |
| By cohort study  *Identify risk factors by comparing disease incidence in case of presence or absence of the factor*  *It consists of monitoring a population over time* |
| Identify risk factors by literature review | *Carrying on of a systematic review for the studies dealing with risk factors of a specific disease to identify the most important factors* | REQUIRMENTS AND CONDITIONS FOR APPLICATION  Taking into account context specificity |

### Spatial risk analysis

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| Methods of high risk zones identification🡺 Selection according to objectives and available data and capacities | | |
| METHOD | DESCRIPTION | REQUIRMENTS AND CONDITIONS FOR APPLICATION |
| spatial risk analysis based on multivariable analysis |  | The application of this method needs accurate spatial data about a number of factors:  Environmental factors  Anthropogenic factors  It needs a good mastery of statistical tools |
| spatial risk analysis based on geo-statistical methods |  | The application of this method needs accurate spatial data about a number of factors:  Environmental factors  Anthropogenic factors  It needs a good mastery of geostatistical tools |
| spatial risk analysis based on bayesien modelling |  |  |
| spatial risk analysis based on application of multiple-criteria decision analysis methods |  |  |

## 2- SELECT HIGH-RISK POPULATION STRATA BASED ON THE HETEROGENEITY OF SPREADING THE DISEASE

***The study aims to identify holdings or zones playing an important role in disease spread and dissemination to other holdings or zones.***

Different approaches can be considered to reach this objective:

Social network analysis

Disease spread modelling

### Social networking analysis

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| DESCRIPTION OF THE METHOD | REQUIRMENTS AND CONDITIONS FOR APPLICATION |
| *SNA is a method that can be applied to livestock movements studies. A network is built by considering livestock holdings (a trader, a market, a farm or a geographic area) as the nodes of the network and movements among holdings as links among nodes. When these links between farms are reciprocal or*  *undirected they are called edges. When these links are unidirectional or directed, they are called arcs.*  *Social networks analysis enables the study of the network as a whole, exploring all the relationships among pairs of holdings. Highly connected livestock holdings in the network can be identified, which can help surveillance and disease prevention activities* | The application of this method needs accurate data about:   * The nodes * type of species they contain * geographical location * size in terms of number of animals * The links * Source and destination of the moved animals * Size of the shipment in terms of number of animals * frequency of the movements |

# PROTOCOL VALIDATION

**Ensure that key steps of the selected method were properly carried out.**

## **Social network analysis (SNA)**

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| Data collection | |
| Source of data |  |
| *Data on holdings characteristics and movements of animals between the different holdings can be obtained from farms or from the concerned governmental bodies in countries were holding records about farm activities is mandatory.*  *In situation where records are not available, carrying on a survey can be the only way for gathering such type of data. Snowball sampling techniques can be helpful in holdings identification when the holdings are not all known of the concerned governmental bodies. Interviews can be held with the network actors (producers; traders; middlemen) to gather the required data.* |
| Type of data |
| *To built an animal markets network for example, the following data will be required:*   * *the quantity of animals purchased and sold;* * *the origin of animal purchased and final destination the animal sold;* * *frequency and mode of transit;* * *seasonality of trading activities.* |
| Data analysis | |
| Centrality measures(node level measures) are to be applied; selection of specific types of measures is done according to the objectives |  |
| * Centrality measures |
| **Degree centrality**   * node degree   *number of contacts per node in a undirected network*   * *out-degree*   *number of arcs that originate from each node in a directed network*   * in-degree   *number of arcs that each node receives in a directed network*  specific purpose of the measure: Identification of livestock holdings with high out-degree and in-degree values (hubs)  🡺 Are of high risk of becoming infected and infecting a large number of other holdings in the network. |
| **Betweenness centrality**  *the frequency with which a node is on the shortest ‘path’ between pairs in the network.*  specific purpose of the measure: : Identification of livestock holdings with high betweenness  🡺 important in the maintenance or closure of disease transmission between the other nodes in the network and thus a potential focus for control of disease transmission. |
| **closeness centrality**  *Expresses how closely connected a node is to all other nodes in the network.*  Farness centrality is mathematically the inverse of closeness.  Specific purpose of the measure: : Identification of livestock holdings with high closeness.  🡺 Give information on which holding is more likely to receive and disseminate infection in a worst case scenario, where infections would follow the shortest paths and thus the fastest possible spread. An epidemic starting in a holding with a high out-closeness will spread further and faster throughout the network than if it started from a node with low out-closeness. |
| Mention the high risk zones identified for the disease of interest | - …  - …  - …  - …  - … |

## **dentify risk factors by Odd Ratios/ relative risks evaluation based on multivariate analysis**

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| Establish a list of candidate factors | |
| *Establish a list of candidate factors from literature or experts opinions* |  |
| Calculate odd ratio/relative risk | |
| Calculate odd ratio: Case-control study  *For each factor, identify holdings where the factor is present and holdings where the factor is absent.*  *In these two groups of holdings, identify the ones where at least one outbreak was reported and the ones that remained disease-free.*  *Calculate* ***odd ratio*** *for each factor between the holdings were the factor is present with the the holdings were the factor is absent* |  |
| Calculate relative risk: cohort study  *For each factor, identify holdings where the factor is present and holdings where the factor is absent.*  *Compare the proportion of incidence between these two groups of holdings, by*  *calculating* ***relative risk*** *for each factor*  *🡺 divide the proportion of incidence in holding were the factor is present with the proportion of incidence in holding were the factor is absent* |
| Univariate analysis | |
| *Association of each variable with the disease was assessed* |  |
| multivariate model | |
| *Build a multivariate model to identify factors significantly associated with the incidence of the disease by discarding confounding factors🡺 best fitting model* |  |
| Mention the risk factors identified for the disease of interest | - …  - …  - … |

## **Identify risk factors by literature review**

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| key words selection and research algorithm build up | |
| *Select key words allowing to build a research algorithm to identify published studies on risk factors of a specific disease* |  |
| Publications screening | |
| *Discard studies not dealing with the risk factors of interest* |  |
| Risk factors ranking | |
| *Count the number of studies mentioning each factor and table all the factors in an hierarchical manner based on the number of studies dealing with each of them*  *🡺 factors identified in a large number of studies are considered as important risk factors for the disease of interest* |  |
| Mention the risk factors identified for the disease of interest | - …  - …  - …  - …  - … |

## **Spatial risk analysis by application of multiple-criteria decision analysis methods**

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| Define decision problem (objective of the analysis) | |
| *MCDA is used in spatial prediction to assess suitability or risk of a specific zone to harbor a disease* |  |
| Define criteria associated with the disease (risk factors) | |
| *A systematic review of factors associated with the disease of interest should be carried out. Specificity of certain factors to specific contexts should be considered.* |  |
| Mention the risk factors identified for the disease of interest | - …  - …  - …  - …  - … |
| Estimate heterogeneity of importance among the different criterias | |
| *Not all the risk factors have the same importance in term of influence on the disease incidence. A score (weight) should be attributed to each factor, which represents an estimation of its importance.* |  |
| Methods used in score attribution | |
| 1. Proportional weight calculation   *The number of studies included in the systematic review results identifying a certain factor gives an estimation of its importance. The proportion of studies mentioning a specific factor by the total number of studies dealing of factors of the disease of interest.* |  |
| 1. Qualitative weight   *Taking experts opinions can also by a way to estimate the factor importance. A qualifier (low-medium-high) is attributed to the factor importance estimate. A number of numerical approximation systems have be proposed to systematically convert linguistic terms to their corresponding fuzzy numbers (see annex)* |  |
| Factors standardization | |
| *Factors should be standardized in a way allowing factors maps superposition; comparable scales should be established* |  |
| Factors combination | |
| *Weighed linear combination is a method allowing factors combination by map superposition, taking account of factor importance heterogeneity. Some programs such as IDRISI can be used.* |  |
| Mention the high risk zones identified for the disease of interest | - …  - …  - …  - …  - … |
| Sensitivity analysis | |
| *It consists of varying the weighting values of the MCDA model parameters and measuring the average change in suitability scores at a number of randomly selected locations on the map to assess the robustness of the model.* |  |
| Validation | |
| *Obtained estimation map should be compared to data maps to ensure about validity of the prediction* |  |