**WP5 Milestone 5.2**

Case study selection

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# Introduction/Executive Summary

Milestone 5.2 refers to the selection of at least three exotic animal health diseases to be used throughout the SPARE project which represent different modes of hazard transmission of relevant to Europe. This action has been completed according to the project work-plan through the development of a pathogen prioritization framework. The following three pathogens were selected as case studies for the SPARE project: classical swine fever, blue tongue and classical rabies.

The case studies were selected using a two stage approach with (1) the identification of a preliminary list of 11 potential candidates for the case studies, and (2) the subsequent final selection of the three case studies.

In the first stage, 33 pathogens (previously identified in the Hazard Characterization task in WP1) were qualitatively assessed against relevant criteria: general information about each disease, expected probability of entering EU, potential impact on production at EU level, impact on international trade and whether the pathogens were targeted by other projects in EU (currently on-going). The sources of information enabling the assessment of these criteria were literature references, access to the ranking system developed by the Discontool project, the OIE-WAHID and Empres-i databases and the D2R2 Decision Support Tool used in APHA-UK. Pathogens were ranked from these qualitative assessment scores and the top 11 selected for further investigation. In the second stage, the 11 pathogens were assessed considering the interest expressed by funding countries (UK, Italy and Switzerland), different modes of transmission and taking into account the available data to support a spatial risk assessment framework to select the final three case study pathogens.

The final selection combined the objective assessment scores generated by the framework with a more subjective judgment about the needs and objective of the SPARE project.

# WP 5 Communication and Information Networks

# Case study selection

**Development of framework to select case studies**

To achieve this objective, SAFOSO, in collaboration with IZSTO and APHA, developed an Excel based prioritization disease framework. The framework gathered general information about each pathogen (i.e. etiology, species susceptibility, transmission pattern etc.) and provided the foundation to assess each disease against selected assessment criteria.

The assessment process was applied to an initial list of 33 pathogens (not endemic in EU) that were explored and presented in Task 1.1 (Hazard identification) of the project. The full list is shown in Appendix 1 of this report. Based on this initial list, the final three case studies were identified using a two stage approach with the selection of a preliminary list of 11 candidates (stage 1) and the subsequent final selection (stage 2) of the three case studies (Figure 1). The threshold of the highest ranked 11 pathogens was selected as the lowest number of pathogens which included each of the major transmission routes in Europe.



Figure 1: Two stage process to select the project case studies

Information about pathogens was gathered according to nine criteria:

* General information about each disease
	+ Etiology
	+ Zoonotic status
	+ Number of domestic species susceptible
	+ Domestic species susceptible
	+ Wildlife reservoir
	+ Endemic in EU
	+ Notifiable
	+ Reference
* Weighting of transmission routes with regards to their potential to contain pathogen
* Expected probability of entering EU
* Potential impact on production at EU level
* Impact on international trade
* Pathogens targeted by other projects in EU (currently on-going)
* Diseases covered in Empres-i
* Expression of interest for a specific disease from the funding body
* Expected data availability

The description of the different criteria of the framework and the sources of information are presented in Appendix 2. Description of the “expected data availability” criteria is presented below.

Varied key assessment criteria were identified as relevant to ranking the significant of exotic animal health pathogens in Europe.

In the first stage, all 33 pathogens were assessed against the following criteria:

* Zoonotic potential
* Number of domestic species involved
* Wildlife reservoir
* Expected probability of entering EU
* Potential impact on production at EU level
* Impact on international trade
* Pathogens targeted by other projects in EU (currently on-going)

In the second stage, the 11 preselected pathogens were assessed against the following criteria:

* Expression of interest for a specific disease from the funding body
* Expected data availability

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**Expected data availability**

To assess the availability of the data necessary to parameterize the release model (WP1) and the exposure and consequence models (WP2) a specific dataset was developed. Firstly, each parameter of the models was categorized according to their relative importance as “*necessary for the model*” or “*not necessary (but would improve the model)*”. For each parameter so classified, and for each of the 11 preselected diseases, APHA and IZSTO were asked to provide information about; a) the potential data source, and b) to assess the data availability (0=very good, 1=good, 2= fair, 3=poor- (data gap), 4= no data (significant data gap)). Therefore, for each of X parameters classified as “necessary for the model”, a release score ($R\_{score})$, exposure score ($E\_{score}) $and a consequence score ($C\_{score}$) was estimated as medians of the scores of all parameters assessed. An estimate of the uncertainty of the assessment was also provided (0=no uncertainty, 1=low, 2= medium, 3=high) for each parameter.

**Scoring system** (see also Appendix 2)

In Stage 1, a group of five experts from the consortium (SAFOSO, APHA and IZSTO) were involved in the qualitative scoring of the criteria “Expected probability of entering EU”, “Potential impact on production at EU level” and “Impact on international trade”. For each of these criteria, each member’s score was summed up and quartiles were calculated and used to express the final score. The assessment was revisited in a few cases as new evidence emerged during the evaluation process (e.g. an outbreak of LSD occurred for the first time in Europe while the assessment was being completed).

Source of information enabling the assessment of these criteria were varied and included: literature references, Discontool (<http://www.discontools.eu/> ); OIE-WAHID ; Empres-i (<http://empres-i.fao.org/eipws3g/> ); the D2R2 Decision Support Tool for the assessment (see also Appendix 2). Each evaluation was carried out independently and results compared.

The agreement between experts and the outputs from the D2R2 Decision Support Tool was remarkable as shown by the heat-maps generated (see snapshots of heat maps, Figure 1a-3a in Appendix 3).

Each assessment criteria was assigned a weight taking into consideration expert’s feedback on the significance of that criteria in the overall evaluation. Final weights applied to each assessment criteria are shown in Table 1.

Table 1: Weights assigned to each criteria assessed

|  |  |  |  |
| --- | --- | --- | --- |
| **Selection Stage** | **N.** | **Assessment criteria** | **Weight****(*W*)** |
| **First stage** | *N1* | Zoonotic potential | *2* |
| *N2* | Number of domestic species involved | *2* |
| *N3* | Wildlife reservoir  | *3* |
| *N4* | Expected probability of entering EU  | *4* |
| *N5* | Potential impact on production at EU level  | *2* |
| *N6* | Impact on international trade | *1* |
| *N7* | Pathogens targeted by other projects in EU (currently on-going)? | *2* |
| **Second stage** | *N8* | Expression of interest for a specific disease from the funding body  | 3 |
| *N9* | Expected data availability  | 5 |

The formula used in stage 1 to calculate the final score assigned to each of the 33 initial pathogens was as follows:

$$Score1=\left(N1\*2\right)+\left(N2\*2\right)+\left(N3\*3\right)+\left(N4\*4\right)+$$

$$\left(N5\*2\right)+\left(N6\right)-(N7\*2)$$

For each of the 11 pathogens taken forward from 1st stage to the 2nd stage the final score was estimated by:

$$Score2=Score1+\left(N8\*3\right)-(N9\*5)$$

Where:

*N9 =* $\left(R\_{score}\*U\_{R}\right)+\left(E\_{score}\*U\_{E}\right)+(C\_{score}\*U\_{C})$

Where $U\_{R}$, $U\_{E}$, and $U\_{C}$ represents the uncertainty associated with each parameter evaluated in the release, exposure and consequence models respectively, and the *R, E* and *C* scores are expressed , for each disease, as median of the scores of all parameters assessed . The “data availability” criterion ($N9$) was assigned the maximum weight of 5. However in the calculation of the data availability scores for each disease, the higher weight is balanced by the uncertainty in the assessment of the availability of data necessary for parameterizing the release, exposure and consequence models. The uncertainty is added multiplicatively, before each score (release, exposure, consequence) are summed up. Finally, the final score *N9* is expressed as quartile to calculate the *Score2*.

**Results**

The scores from the pathogen prioritization exercise were ranked with the highest pathogens selected. The threshold for those pathogens selected was set as the lowest number of pathogens which included each of the major transmission routes in Europe. As a result of the 1st stage ($Score1$), the following diseases were selected:

1. Blue Tongue (23)
2. Classical Swine Fever (22)
3. Newcastle Disease (22)
4. African Swine fever (20)
5. Aujeszky’s disease (19)
6. Foot and Mouth Disease (18)
7. Sheep pox and goat pox (18)
8. Enzootic bovine leucosis (17)
9. Equine infectious anaemia (17)
10. West Nile Fever (17)
11. Classical Rabies (15)

Avian Influenza (HPAI and LPAI) ranked first and second respectively (not shown here). The consortium agreed to not take these two diseases forward to the final stage as avian influenza is already being covered by multiple projects and a number of spatial risk models targeting Influenza virus already exist (e.g. FLURISK models).

As a result of the 2nd stage ($Score2$), diseases ranked as follows:

1. Classical Swine Fever (25)
2. FMD (21)
3. Blue Tongue (20)
4. Sheep and Goat pox (20)
5. Aujeszky’s disease (15)
6. West Nile Fever (14.5)
7. Newcastle Disease (12)
8. African Swine fever (8)
9. Equine infectious anaemia (7)
10. Enzootic bovine leucosis (3)
11. Classical Rabies (3)

To select the final three diseases we combined the objective assessment scores generated by the framework with a more subjective judgment about the needs and objectives of the SPARE project. The SPARE project requires distinct mode-of-transmission pathways to be developed and therefore, the case study pathogens need to cover as many relevant and different pathways as possible. Taking into account this requirement and the criteria “Weighting of transmission routes with regards to their potential to contain pathogen”, the following three diseases were selected as case studies for the SPARE project:

1. **Classical Swine fever**
2. **Blue tongue**
3. **Classical rabies**

The three selected diseases include different host species and varied transmission patterns (vector; live animal imports; wildlife; imported animal products; people movement and pets).

Despite being ranked as 2nd, we excluded FMD as it overlaps with CSF for the key modes-of-transmission and, similarly to AI, it is an already well-studied disease.

Rabies ranked very low (partly due to the zero impact on production and trade). However, by including rabies, the project will target a very important and neglected zoonosis and will target a transmission pattern (people movement and pets) not covered by the other diseases.

Despite the fact that blue tongue severely affects small ruminants, it can also infect cattle (with no or very weak clinical signs). Cattle are epidemiologically important as a reservoir of the disease as they can carry the virus for long period of time and transmit it to other ruminants. So, by including BT, the role of cattle will not be excluded.

# Appendix 1

**List of pathogens (not endemic in EU) as per M 1.1 (WP1)**

1. African Horse Sickness
2. African Swine fever
3. Aujeszky’s disease
4. Avian influenza HP
5. Avian Influenza LP
6. Blue Tongue
7. Brucella ovis (Contagious Epididymitis)
8. Burkholderia mallei (Glanders)
9. Classical Rabies
10. Classical Swine Fever
11. Crimean Congo Haemorrhagic Fever
12. Ehrlichia ruminantium (Heartwater)
13. Enzootic bovine leucosis
14. Epizootic haemorrhagic virus
15. Equine encepahalomyelitis – Eastern and Western
16. Equine infectious anaemia
17. Equine influenza
18. Foot and Mouth Disease
19. Japanese encephalitis
20. Lumpy Skin Disease
21. Mycoplasma capricolum subsp. Capripneumoniae (Contagious Caprine Pleuro Pneumonia CCPP)
22. Mycoplasma mycoides subsp mycoides (small colony) (CBPP)
23. Nairobi sheep disease
24. Newcastle Disease
25. Nipah Virus
26. Peste des petits ruminants
27. Rift Valley fever
28. Sheep pox and goat pox
29. Swine vesicular disease
30. Transmissible gastroenteritis
31. Venezuelan equine encephalomyelitis
32. Vesicular stomatis
33. West Nile Fever

# Appendix 2

**Assessment criteria and sources of information.**

**1) General information about each disease:**

* Etiology
* Zoonotic status (yes, no)
* Number of domestic species susceptible (unique specie; more than 1 species)
* Domestic species susceptible (specie identification)
* Wildlife reservoir (yes, no)
* Endemic in EU (yes, no)
* Notifiable (EU/OIE)
* Reference (references consulted)

**Sources:** OIE-WAHID database (<http://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home>), published literature, DEFRA /OIE/FAO disease factsheets, EFSA opinions). For those diseases where incursions into the EU have occurred, we highlighted those countries with outbreaks in the last 10 years (WAHID data).

**2) Weighting of transmission routes with regards to their potential to contain pathogen**

This parameter was assessed and presented in Task 1.1 (Hazard identification).

**3) Expected probability of entering EU**

The expected probability of entering EU was defined as Negligible, Low, Medium or High (0 = Negligible; 1 = Low; 2 = Medium ; 3 = High) according to the following definitions for high and medium risks:

*High* – defined as an incursion that the EU has had in the last 10 years

*Medium* – defined as a pathogen occurring regularly in a country where there may be frequent transmission into EU by the key transmission mode

**Sources:** literature references, Discontool (<http://www.discontools.eu/>) ; OIE-WAHID ; Empres-i (<http://empres-i.fao.org/eipws3g/>); APHA used a UK based Risk of incursion tool (D2R2 Decision Support Tool, Roberts et al. 2011) but considered the response in terms of the whole of the EU.

**4) Potential impact on production at EU level**

The potential impact on production at EU level was defined as Negligible, Low, Medium or High (0 = Negligible; 1 = Low; 2 = Medium ; 3 = High).

Some of the parameters considered for the assessment were the species affected (single/multiple) and the value of the industry at EU level.

**Sources:** literature references, Eurostat ([http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Livestock\_numbers\_per\_EU\_Member\_State,\_2013.png](http://ec.europa.eu/eurostat/statistics-explained/index.php/File%3ALivestock_numbers_per_EU_Member_State%2C_2013.png); Discontool; UK-D2R2 tool with estimated costs to the Producing Sector).

**5) Impact on international trade**

The potential impact on international trade was defined as Negligible, Low, Medium or High (0 = Negligible; 1 = Low; 2 = Medium ; 3 = High).

**Sources:** literature references; Discontool; UK-D2R2 tool with estimated costs to the Exchequer and Global Environment.

**6) Pathogens targeted by other projects in EU (currently on-going)**

We evaluated whether the pathogens were already being targeted in projects funded by EU or other sources. PhD studies or national research projects were not considered in this evaluation.

**Sources:** literature, web, CORDIS EU (<http://cordis.europa.eu/project/rcn/189912_en.html>)

**7) Diseases covered in Empres-**i

For purposes of data collection, we evaluated whether epidemiological information about the diseases were gathered in empres-i.

**Sources:** empres-i

**8) Expression of interest for a specific disease from the funding body**

Authorities in the United Kingdom, Italy and Switzerland were asked to provide feedback about their general interest toward specific diseases to be considered in the SPARE project. Table 1a shows the interest expressed as binary code (yes-no interest) on a subset of 11 diseases (preliminary list from the first stage of the case-studies selection process). UK authorities did not express the evaluation as binary code as requested (as they claimed interest in all preselected diseases) but scored their interest according to a continuous scale from 3 (low interest) to 9 (high interest) (Table 2a). To be consistent with the other countries, we arbitrarily transformed this evaluation into a binary categorization (Low=0; Medium or High =1) which, when compared to other methods of combining results, did not affect the overall pathogens selected by the process.

**Table 1a**: Expression of interest from Swiss (CH), British (UK) and Italian (ITA) authorities with regards to the selection of specific diseases as case studies for the SPARE project

\*: BLV and VPHI (Veterinary Public Health Institute which collaborates with BLV) expressed opposite opinions with regards to WNV, respectively positive and negative. It was decided to express Swiss evaluation as the mean of both scores.

|  |  |  |  |
| --- | --- | --- | --- |
| **Diseases** | **CH** | **UK** | **ITA** |
| Blue Tongue (BT) | 0 | 1 | 1 |
| Classical Swine Fever (CSF) | 1 | 1 | 1 |
| Newcastle Disease (ND) | 0 | 0 | 0 |
| African Swine fever (ASF) | 1 | 1 | 1 |
| Aujeszky’s disease (AD) | 1 | 0 | 0 |
| Foot and Mouth Disease (FMD) | 1 | 1 | 1 |
| Sheep pox and goat pox (SPGP) | 0 | 1 | 1 |
| Enzootic bovine leucosis (EBL) | 0 | 1 | 0 |
| Equine infectious anaemia (EIA) | 0 | 0 | 0 |
| West Nile Fever (WNF) | 0.5\* | 1 | 1 |
| Rabies  | 1 | 1 | 1 |

**Table 2a:** Expression of interest from UK authorities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Diseases** | **Expert1** | **Expert 2** | **Expert3** | **Binary transformation** |
| African Swine fever (ASF) | High | High | High | 1 |
| Foot and Mouth Disease (FMD) | High | High | High | 1 |
| Classical Swine Fever (CSF) | High | Medium | High | 1 |
| Sheep pox and goat pox (SPGP) | High | Medium | Low | 1 |
| Blue Tongue (BT) | Low | Low | High | 1 |
| Enzootic bovine leucosis (EBL) | Low | Medium | Low | 1 |
| West Nile Fever (WNF) | Low | Low | Medium | 1 |
| Rabies | Low | Low | Medium | 1 |
| Newcastle Disease (ND) | Low | Low | Low | 0 |
| Aujeszky’s disease (AD) | Low | Low | Low | 0 |
| Equine infectious anaemia (EIA) | Low | Low | Low | 0 |

# Appendix 3

**Heat-maps**

The heat maps have been provided to assist with the visual presentation of the evaluation scores of 5 experts for the following criteria:

* Expected probability of entering EU
* Potential impact on production at EU level
* Potential impact on international trade

Each colour corresponds to a score as follows:





**Figure 1a**: Heat-map of criteria “**Expected probability of entering** **EU”** (outputs from the D2R2 Decision Support Tool are shown in the last column on the right.



**Figure 2a**: Heat-map of criteria” **Potential impact on production at EU level”** (outputs from the D2R2 Decision Support Tool are shown in the last column on the right.



**Figure 3a**: Heat-map of criteria “**Potential impact on international trade” (**outputs from the D2R2 Decision Support Tool are shown in the last column on the right).