Generic risk assessment for animal disease incursion: Multiple models, one answer?

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Validation of generic RA tools

- Disease incursion = rare event in a changing world
- Uncertainty inevitable

- Parameter uncertainty
  - Sensitivity analysis

- Model uncertainty
  - Cross-validation
African swine fever
African swine fever

- ASF virus (Asfarviridae)
- Pigs and wild boar
- High morbidity and mortality (up to 100%)
- Clinical symptoms

Fever, listless pigs, lack of appetite, red skin, (bloody) diarrhoea, vomiting, bleeding, cyanosis (blue skin) and necrosis of parts of the skin (blackening)

Source: Pirbright Institute
African Swine Fever

How do wild boars become infected?

Carcass
Carcass or possibly blood from an infected wild boar

Materials
Contaminated materials, of hunters for example

Feed
Kitchen waste, food residues and meat products from infected pigs and wild boars

Soft tick
Ticks are a source of infection in Africa, but there are no indications of this in Europe.

Boar
Direct contact with infected wild boar

Pig
Direct contact with infected pig

Materials
Contaminated materials and livestock transport trucks

Feed
Kitchen waste, food residues and meat products from infected pigs and wild boars

Soft tick
Ticks are a source of infection in Africa, but there are no indications of this in Europe.
Case study on ASF for validation purposes

- Incursion risk for Finland and the Netherlands
- Base scenario: 2017 situation
31-12-2017

Infected countries
- Poland
- Latvia
- Lithuania
- Estonia
- Czech Republic
Case study on ASF for validation purposes

- Incursion risk for Finland and the Netherlands
- Base scenario: 2017 situation
- Two hypothetical scenarios
  - ASF cases in wild boar in Germany (~50 km from Dutch border)
  - ASF cases in wild boar and domestic pigs (1 mixed farm) in Germany
Case study on ASF for validation purposes

- Harmonization of input data
  - Disease occurrence worldwide: OIE WAHIS
  - Trade: Eurostat
  - Disease parameters: input parameters shared
Results

- Endpoint: entry, exposure, first infection
Results

- Endpoint: entry, exposure, first infection
- Output: quantitative, semi-quantitative, qualitative
- Output parameter: numbers, probabilities, risk score, risk level

<table>
<thead>
<tr>
<th>TOOL</th>
<th>Output</th>
<th>Step</th>
<th>Output parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPARE</td>
<td>Quantitative</td>
<td>Entry</td>
<td>Number per year</td>
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<tr>
<td>COMPARE</td>
<td>Quantitative</td>
<td>First infection</td>
<td>Annual probability</td>
</tr>
<tr>
<td>MINTRISK</td>
<td>Semi-quantitative</td>
<td>First infection</td>
<td>Annual rate, translated into risk score between 0 and 1</td>
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<tr>
<td>RRAT</td>
<td>Semi-quantitative</td>
<td>First infection</td>
<td>Probability-based risk score between 0 and 1</td>
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<tr>
<td>IDM</td>
<td>Semi-quantitative</td>
<td>Exposure</td>
<td>Risk score, translated into qualitative risk category</td>
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<tr>
<td>NORA</td>
<td>Semi-quantitative</td>
<td>First infection</td>
<td>Risk score, translated into qualitative risk category</td>
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<tr>
<td>SVARRA</td>
<td>Qualitative</td>
<td>Exposure</td>
<td>Qualitative risk category</td>
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Pathways included in the RA tools

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<tr>
<th>PATHWAY</th>
<th>SPARE</th>
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<th>MINTRISK</th>
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<th>SVARRA</th>
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<td>Products of animal origin</td>
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<td>Feed and bedding</td>
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<td>Airborne spread</td>
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Comparison of results
Comparison of results

- Relative risks → prioritization
- Countries
  - NLD : FIN
- Scenarios
  - HS1 : Base
  - HS2 : Base
- Pathways
  - Top rank
Relative risk for NLD compared to FIN

Live Animals

Relative risk (NLD:FIN)
Relative risk for NLD compared to FIN

Animal Products

Pathway not assessed in MINTRISK
Relative risk for NLD compared to FIN

Pathway not assessed in RRAT
Relative risk HS1 compared to Baseline

The Netherlands

Relative risk (HS1:Base)

SPARE COMPARE RRAT MINTRISK IDM NORA SVARRA

- Live animals
- Animal Products
- Wild Boar

Boar Cases within Munster, Germany

WAGENINGEN UNIVERSITY & RESEARCH
Relative risk HS2 compared to Baseline

The Netherlands

- **Relative risk (HS2:Base)**
- **Live animals**
- **Animal Products**
- **Wild Boar**
Relative risk HS1 compared to Baseline

Finland

Relative risk (HS1: Base)

- SPARE
- COMPARE
- RRAT
- MINTRISK
- IDM
- NORA
- SVARRA

Graph showing relative risk for different categories in Finland:
- Live animals
- Animal Products
- Wild Boar

Boar and Pig Cases within Münster, Germany

Map showing cases in Münster, Germany.
Relative risk HS2 compared to Baseline

Finland

- Relative risk (HS2:Base)
- Live animals
- Animal Products
- Wild Boar

MAP: Boar and Pig Cases within Münster, Germany
Pathways contributing most to ASF risk

The Netherlands

MINTRISK
SVARRA
COMPARE
RRAT
NORA
SVARRA

MINTRISK
SVARRA

The Netherlands

The Netherlands

MINTRISK
SVARRA
COMPARE
RRAT
NORA
SVARRA

MINTRISK
SVARRA

The Netherlands

MINTRISK
SVARRA
COMPARE
RRAT
NORA
SVARRA

MINTRISK
SVARRA

Finland
Message to risk manager

- Risk of ASF incursion for NLD higher than for FIN
- Trade in animal products contribute most to the risk for both countries
- ASF cases in Germany increase risk for NLD, not for FIN

Understanding and explaining of risk more important than absolute value/level obtained
Cross-validation of RA tools

- **Internal validation**
  - Check when risk estimate strongly deviates
    - Algorithms, input data
  - Some models already made changes based on case study

- **External validation**
  - Difficult → No golden standard !!
  - Historical data or use of models for long period
    - Adverse events have low probability of occurrence
    - Risk is not static over time
  - Comparison to tailor-made models
Relative risk for NLD compared to FIN

**Live Animals**

Relative risk (NLD:FIN) for Live Animals shows a significant difference between NLD and FIN.

**Wild Boar**

Relative risk (NLD:FIN) for Wild Boar also indicates a notable difference between NLD and FIN.
Relative risk HS2 compared to Baseline

The Netherlands

Relative risk (HS2:Base)

Finland

Relative risk (HS2:Base)
Multiple models, one answer?

- Large differences observed between generic RA tools
  → Different risks assessed in answering risk question
- Absolute outcome → NO !!
- Relative risks → YES ??
- Communication of results to risk manager

Action required ??

Prioritization !!
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