Brucellosis risk assessment

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An integrated Approach to Controlling Brucellosis in Africa
RISK ANALYSIS
INTRODUCTION

Tool to provide decision makers with an objective repeatable and documented assessment of the risk posed by a particular course of action

« Hazard identification »
What can go wrong?

« Risk assessment »
How likely is it to go wrong?
What would be the consequences of it going wrong?

« Risk management »
What can be done to reduce the consequences?

For Brucellosis . Import Risk
. Brucellosis surveillance
. Microbiological risk assessment
IMPORT RISK ASSESSMENT

Hazard identification

Imported Commodity
- Semen
- Embryo transfer
- Milk products (human contamination)
- Breeding female

1. Is the commodity a potential vehicle for the pathogenic agent?
   - No → Not a hazard
   - Yes → 2.

2. Is the pathogenic agent present in the exporting country?
   - No → Is their sufficient confidence to satisfactorily substantiate the claim the agent is absent?
     - Yes → Not a hazard
     - No; Go to Q4 Assume present
   - Yes → 3.

3. Are there zones from which the commodity within the exporting country are derived that are free of the agent?
   - Yes → Is their sufficient confidence to satisfactorily substantiate the claim the agent is absent in these zones?
     - Yes → Not a hazard
     - No; Go to Q4 Assume present
   - No → 4.

4. Is the pathogenic agent present in the importing country?
   - No → Is their sufficient confidence to satisfactorily substantiate the claim the agent is absent?
     - Yes → A hazard
     - No; Go to Q4 Assume present
   - Yes → Might classify as a hazard*  

*If pathogen subject to an official control programme in importing country OR There are zones of different animal health status OR Local strains are likely to be less virulent than those reporting internationally

Steps to determine whether a pathogenic agent is a hazard
IMPORT RISK ASSESSMENT
(2)

Risk assessment
Example of importation of Brucellosis via breeding cattle

Entry assessment
Release of Brucellosis via imported potentially infected cattle

Exposure assessment
Exposure of cattle to Brucellosis via imported potentially infected cattle
IMPORT RISK ASSESSMENT (3)

Risk assessment (2)

Consequence assessment
Several different outcomes possible:
- No sufficient quantities to result in an infection with no infection or disease established
- Infection
- Outbreak (within the herd, between herds)

Risk estimation
Qualitative or quantitative
Combination of preceding probabilities

Quantitative results
1. Annual probability of importing brucellosis
2. Expected number of infected imports

Acceptable risk
EXAMPLE: A quantitative risk assessment for the importation of brucellosis-infected breeding cattle into Great Britain from selected European countries (Jones et al., 2004)

• GB (OFB since 1991) import breeding cattle from OFB herds in Northern Ireland and Republic of Ireland (Non OFB)

• Results of the risk assessment
  Prediction to import brucellosis from
  • Northern Ireland every 2.63 years
  • Republic of Ireland every 3.23 years

Risk management
  Introduction of post-calving testing for all imported animals apart from the routine testing
DECISION TOOL FOR BRUCELLOSIS SURVEILLANCE

EXAMPLE: A simulation model of brucellosis spread in British cattle under several testing regimes (England et al., 2004)

- High costs associated with *Brucella* routine testing in GB
- Issue of reducing the level of testing raised

Following predictions, Policy-makers decided:
- Abortions notification very important
- No testing level reduction
**MICROBIOLOGICAL RISK ASSESSMENT**

- Historical reputation of safety of Fermented foods
- Many outbreaks reported due to fermented food consumption (Memish and Balkhy, 2004)

- Quantitative microbiological risk assessment (QMRA): scientific bases for the control and management of food-borne diseases

- 2 examples or studies

General schema of risk assessment (Adapted from Sanaa and Cerf, 2002)
HUMAN INFECTION RISK ASSESSMENT

Risk assessment of human brucellosis infection from consumption of raw cow milk sold by vendors in The Gambia

- **Hazard identification**
  - Brucellosis present in Gambia and *Brucella* isolation (HF)
  - Isolation from milk reported by many authors (Hamdy and Amin, 2002; Ocholi *et al.*, 2004)
  - Associated with disease in humans (Jennings *et al.*, 2007)

- **Hazard characterization**
  - 10-100 *Brucella* = dose by aerosol through inhalation sufficient to initiate infection (Bossi *et al.*, 2004).
  - Oral route: no definite knowledge, 1 CFU/g or ml in foods might initiate infection (Kuplulu and Sarimehmetoglu, 2004). 15 to 30 % survive after ingestion (Pappas *et al.*, 2005)
HUMAN CONTAMINATION RISK ASSESSMENT (MILK)

Exposure assessment
Probabilities at ≠ levels

Dose-response assessment
✓ Concentration of *Brucella* in 1 serving (50-100ml)

Concentration at ≠ levels
Variation in *Brucella* conc T and pH Growth model

✓ Dose-response Model from Binomial distribution (no treshold)
### HUMAN CONTAMINATION RISK ASSESSMENT (3)

#### Risk characterization

Probabilities of infection when exposed to contaminated serving and unknown status serving

<table>
<thead>
<tr>
<th>Types of products at herd and vendors’ levels</th>
<th>Mean Concentration (CFU/serving)</th>
<th>Percentage of concentrations &lt; 10 CFU (%)</th>
<th>Probability of infection (CI) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh milk (herd)</td>
<td>1179</td>
<td>36.29</td>
<td>63.70</td>
</tr>
<tr>
<td>Fresh milk</td>
<td>1614</td>
<td>36.29</td>
<td>63.70</td>
</tr>
<tr>
<td>Milk: fermented by vendors</td>
<td>4110</td>
<td>36.94</td>
<td>63.47</td>
</tr>
<tr>
<td>Milk: fermented by collector</td>
<td>3169</td>
<td>37.32</td>
<td>63.31</td>
</tr>
</tbody>
</table>
HUMAN CONTAMINATION RISK ASSESSMENT (4)

Raw milk after Overnight fermentation contains more \textit{Brucella} than fresh milk (Plommet, 1988).

Sensitivity analysis: if 50\% reduction of the probability of \textit{Brucella} shedding in milk:

- 30\% reduction of the probability of infection by contaminated serving

\textbf{Control options}

Action to be undertaken apart from boiling the milk and reducing the prevalence (control measures):

- Reduction of \textit{Brucella} shedding (farmers’ practices in Gambia)
HUMAN CONTAMINATION RISK ASSESSMENT (5)

How Human Brucellosis Incidence in Urban Kampala Can Be Reduced Most Efficiently? A Stochastic Risk Assessment of Informally-Marketed Milk (Makita et al., 2010)

Design stochastic risk models to

- assess the risk of human brucellosis infection through consumption of informally marketed raw milk potentially infected with *Brucella abortus* in Kampala
- Identify the best control options

Results

- 12.6% of informally marketed milk in urban Kampala contaminated at purchase
- annual incidence rate estimate: 5.8 per 10,000 people
Recommendations from the control options assessment

Assessment of control options by simulations assuming 90% of enforcement was achieved

<table>
<thead>
<tr>
<th>Control options</th>
<th>Reduction rate (percentage)</th>
<th>Incidence avoided</th>
<th>Inputs</th>
<th>Feasibility</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct boiling centres in peri-urban Kampala</td>
<td>82.0 (71.0–89.0)</td>
<td>825</td>
<td>Boiling centres, legislation, fuel</td>
<td>Middle</td>
<td>Price up, peri-urban soon becomes urban</td>
</tr>
</tbody>
</table>

Risk reduction
Anually avoided incidence
CONCLUSION

Risk analysis

• Important tool in *all decision-making in the face of uncertainty*
  – Animal and animal products import
  – Surveillance programs (choice between different options)
  – Food borne brucellosis control options

• Need of good risk communication and commitment of policy and decision makers