

Introduction to animal disease risk analysis

Animal Disease Risk Assessment and Risk Management & Simulation Exercises
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Learning objectives and session outline

Understanding the systematic process for gathering, assessing and summarizing disease information to estimate the risk level for a specific time period and location.

Session outline

- Background
- Key concepts: Risk, Risk Assessment, Risk Management
- Risk assessment:
 - qualitative vs. quantitative
 - steps
 - relationship with risk management



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Background

Assessment and management of disease risk in animals are not new concept but the adoption of structured frameworks is more recent.

1980s: Guidelines and standards for risk analysis and risk assessment.



1995: WTO SPS agreement → recognizes the role of science-based risk analysis in formulation and implementation of sanitary / phytosanitary measures.



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Background



The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)

Article 5

Assessment of Risk and Determination of the Appropriate Level of Sanitary or Phytosanitary Protection

1. Members shall ensure that their sanitary or phytosanitary measures are based on an assessment, as appropriate to the circumstances, of the risks to human, animal or plant life or health, taking into account risk assessment techniques developed by the relevant international organizations.



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Key concepts: Risk, Risk Assessment, Risk Management

Risk

means the likelihood of the occurrence and the likely magnitude of the biological and economic consequences of an adverse event or effect to animal or human health (WOAH Terrestrial Animal Health Code Glossary, 2022).



Note that “risk” is not the same as “hazard”:

Hazard means a biological, chemical or physical agent in, or a condition of, an animal or animal product with the potential to cause an adverse health effect (WOAH Terrestrial Animal Health Code Glossary, 2022).

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Key concepts: Risk, Risk Assessment, Risk Management

Example: Risk of introduction of lumpy skin disease in a country that is currently disease-free

- Risk: likelihood of introduction of lumpy skin disease and likely consequences if introduced.
- Hazard: lumpy skin disease virus.



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Key concepts: Risk, Risk Assessment, Risk Management

Risk Assessment

means the evaluation of the likelihood and the biological and economic consequences of entry, establishment and spread of a hazard (WOAH Terrestrial Animal Health Code Glossary, 2022).

Systematic process to comprehend the nature of risk, express and evaluate risk, with the available knowledge (Society for Risk Analysis Glossary, 2018).



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Key concepts: Risk, Risk Assessment, Risk Management

Risk Management

means the process of identifying, selecting and implementing measures that can be applied to reduce the level of risk (WOAH Terrestrial Animal Health Code Glossary, 2022).

Activities to handle risk such as prevention, mitigation, adaptation or sharing. It often includes trade-offs between costs and benefits of risk reduction and choice of a level of tolerable risk (Society for Risk Analysis Glossary, 2018).



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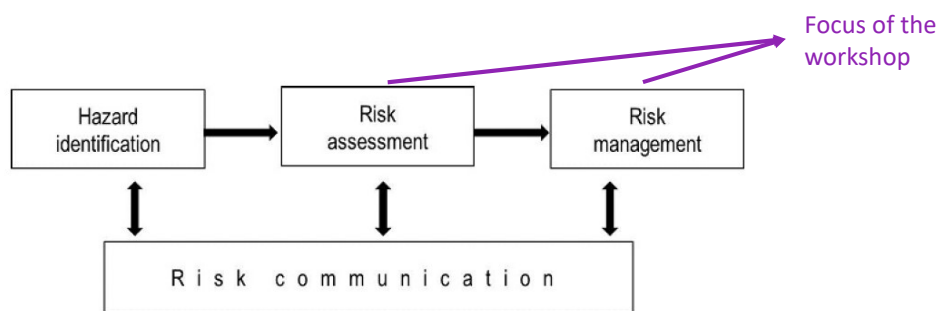
Zero risk?

Appealing, but often not possible or not desirable. Therefore, we should try to identify a level of practical and achievable control of risk.



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Components of risk analysis



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Risk assessment

Risk assessment is the process of evaluating the risk resulting from a hazard:

Based on how the risk estimate is presented:

- Qualitatively: the evaluated risk is described in words. The estimate of risk is ranked or separated into descriptive categories (negligible, low, high...).
- Quantitatively: the evaluated risk is estimate numerically; numerical expressions of risk are provided.



For diseases for which there are international standards and risks are broadly agreed, qualitative assessment is usually enough.

Quantitative assessments are not always feasible or justified and normally followed a qualitative assessment which concludes that a quantitative assessment is needed and feasible (e.g., necessary data likely to be available).

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Qualitative risk assessment: example

Moutou F, Dufour B, Ivanov Y. A qualitative assessment of the risk of introducing foot and mouth disease into Russia and Europe from Georgia, Armenia and Azerbaijan. Rev Sci Tech. 2001 Dec;20(3):723-30. doi: 10.20506/rst.20.3.1307. PMID: 11732414.

A qualitative risk assessment was performed to evaluate the risk of introducing foot and mouth disease (FMD) virus into Russia and the rest of Europe from the countries of Transcaucasia (Armenia, Azerbaijan and Georgia). The assessment was based on data collected during a three-week mission to these countries by the Food and Agriculture Organization, the European Union and the Office International des Epizooties in March 1999. Due to the strong involvement of the local veterinary services, much information was obtained. Although the data were not sufficient to allow a quantitative risk assessment to be performed, the investigation served as a useful initial approach, prior to undertaking a quantitative risk assessment. The risk of FMD virus infection is a function of two elements, namely: the probability of the hazard (virus infection) occurring, and the magnitude of the consequences. The probability of the hazard occurring is the product of the probability of entry of the virus and the probability of exposure to the virus. These elements were assessed using the following parameters: prevalence of infection; volume of trade; capacity of the virus to survive; and potential for infection. The magnitude of the consequences is derived from the probability of transmission and spread. Combining these parameters, the probability of occurrence of the hazard was rated as 'moderate'. Economic consequences of potential transmission and spread of FMD, in the local context, were rated as 'negligible'. As a result, the overall risk of introducing FMD virus into Russia and the rest of Europe from Transcaucasia was rated as 'low' at the time of evaluation. The method and results are presented to serve as a basis for further discussion.



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Quantitative risk assessment: example

Wongsathapornchai K, Salman MD, Edwards JR, Morley PS, Keefe TJ, Van Campen H, Weber S. Assessment of the likelihood of the introduction of foot-and-mouth disease through importation of live animals into the Malaysia-Thailand-Myanmar peninsula. *Am J Vet Res.* 2008 Feb;69(2):252-60. doi: 10.2460/ajvr.69.2.252. PMID: 18241023.

Objective—To assess the likelihood of an introduction of foot-and-mouth disease (FMD) into the Malaysia-Thailand-Myanmar (MTM) peninsula through *terrestrial* movement of livestock.

Results—The simulation yielded an average consignment prevalence of 10.95%. Typically, each animal in a quarantine facility had a 2.7% chance of having an inapparent form of FMD infection; hence, it was likely an animal would not be identified as infected. Findings revealed that the mean probability of an animal accepted for import having FMD was 2.9%, and the risk was as high as 11%.



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Principles of risk assessment

Principles of risk assessment

- 1) *Risk assessment* should be flexible to deal with the complexity of real life situations. No single method is applicable in all cases. *Risk assessment* should be able to accommodate the variety of animal *commodities*, the multiple *hazards* that may be identified with an importation and the specificity of each disease, detection and *surveillance* systems, exposure scenarios and types and amounts of data and information.
- 2) Both qualitative risk assessment and quantitative risk assessment methods are valid.
- 3) The *risk assessment* should be based on the best available information that is in accord with current scientific thinking. The assessment should be well-documented and supported with references to the scientific literature and other sources, including expert opinion.
- 4) Consistency in *risk assessment* methods should be encouraged and transparency is essential in order to ensure fairness and rationality, consistency in decision making and ease of understanding by all the interested parties.
- 5) *Risk assessments* should document the uncertainties, the assumptions made, and the effect of these on the final *risk* estimate.
- 6) Risk increases with increasing volume of commodity imported.
- 7) The *risk assessment* should be amenable to updating when additional information becomes available.



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Steps

1. Entry assessment
2. Exposure assessment
3. Consequence assessment
4. Risk estimation



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Entry assessment

Entry assessment consists of describing the biological pathways necessary for an importation activity to introduce pathogenic agents into a particular environment, and estimating the probability of that complete process occurring, either qualitatively (in words) or quantitatively (as a numerical estimate). The entry assessment describes the probability of the “entry” of each of the hazards (the pathogenic agents) under each specified set of conditions with respect to amounts and timing, and how these might change as a result of various actions, events or measures.



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Exposure assessment

Exposure assessment consists of describing the biological pathways necessary for exposure of animals and humans in the importing country to the hazards (in this case the pathogenic agents) from a given risk source, and estimating the probability of the exposures occurring, either qualitatively (in words) or quantitatively (as a numerical estimate). The probability of exposure to the identified hazards is estimated for specified exposure conditions with respect to amounts, timing, frequency, duration of exposure, routes of exposure, such as ingestion, inhalation or insect bite, and the number, species and other characteristics of the animal and human populations exposed.



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Consequence assessment

Consequence assessment consists of describing the relationship between specified exposures to a biological agent and the consequences of those exposures. A causal process should exist by which exposures produce adverse health or environmental consequences, which may in turn lead to socio-economic consequences. The consequence assessment describes the potential consequences of a given exposure and estimates the probability of them occurring. This estimate may be either qualitative (in words) or quantitative (a numerical estimate).



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Risk estimation

Risk estimation consists of integrating the results from the entry assessment, exposure assessment, and consequence assessment to produce overall measures of risks associated with the hazards identified at the outset. Thus risk estimation takes into account the whole of the risk pathway from hazard identified to unwanted outcome.



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Risk Assessment & Risk Management

Based on the results of the risk assessment and the judgement of the 'risk managers' decisions are taken, and policy is formulated.

Risk management is the process of weighting policy alternatives in consultation with all interested parties considering risk assessment and other factors.

Risk management should be functionally separated from risk management so that the assessment is conducted as a scientific activity that is only affected by scientific values / considerations, however, risk assessors and risk managers have to interact and there are potential problems that may arise if separation between assessment and management is too strict.



More on risk management tomorrow

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Additional documents and reading

- WOAH Terrestrial Animal Health Code. Section 2. Risk Analysis. Chapter 2.1. Import Risk Analysis.
- Qualitative Risk Assessment example: Moutou F, Dufour B, Ivanov Y. A qualitative assessment of the risk of introducing foot and mouth disease into Russia and Europe from Georgia, Armenia and Azerbaijan. *Rev Sci Tech*. 2001 Dec;20(3):723-30. doi: 10.20506/rst.20.3.1307. PMID: 11732414.
- Quantitative Risk Assessment example: Wongsathapornchai K, Salman MD, Edwards JR, Morley PS, Keefe TJ, Van Campen H, Weber S. Assessment of the likelihood of the introduction of foot-and-mouth disease through importation of live animals into the Malaysia-Thailand-Myanmar peninsula. *Am J Vet Res*. 2008 Feb;69(2):252-60. doi: 10.2460/ajvr.69.2.252. PMID: 18241023.

