Control of Foodborne Virus Risk in the Context of Risk Assessment

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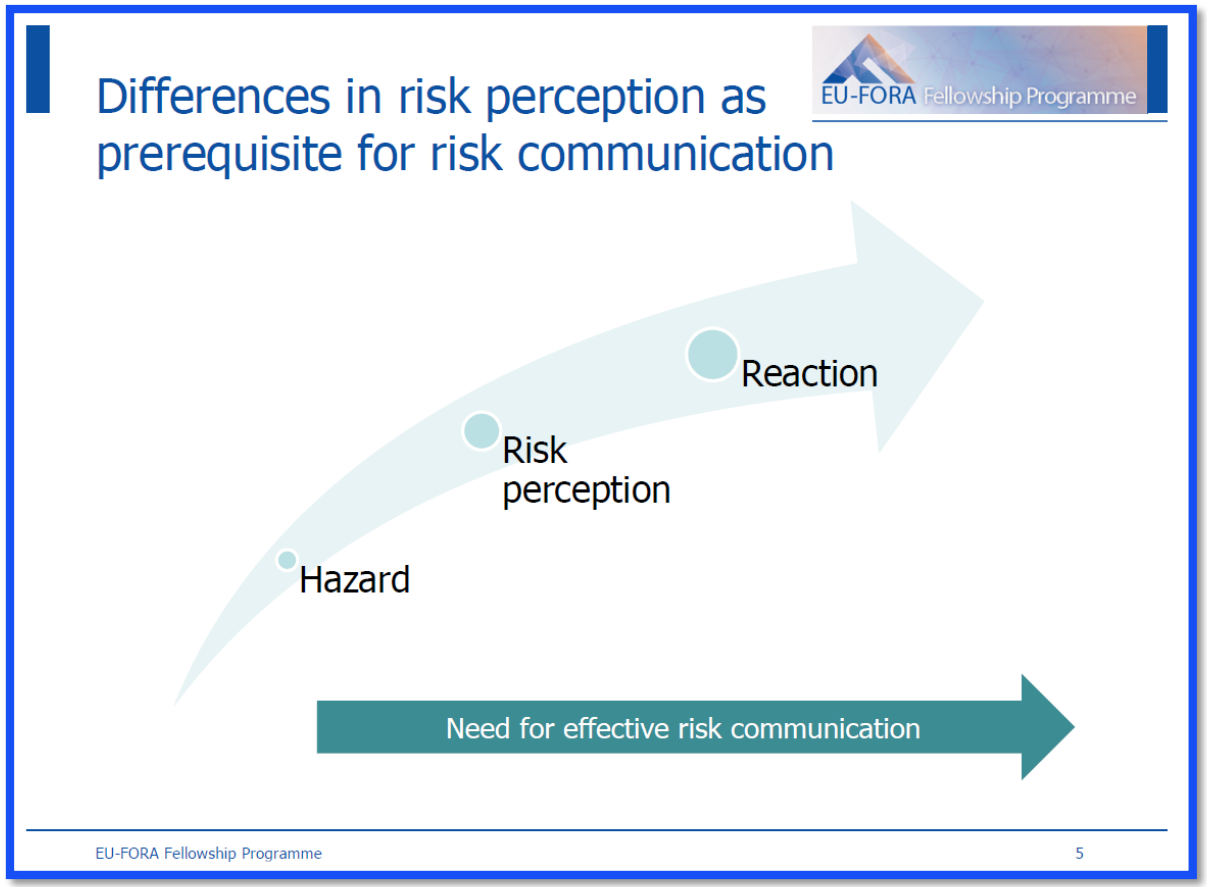
Objective

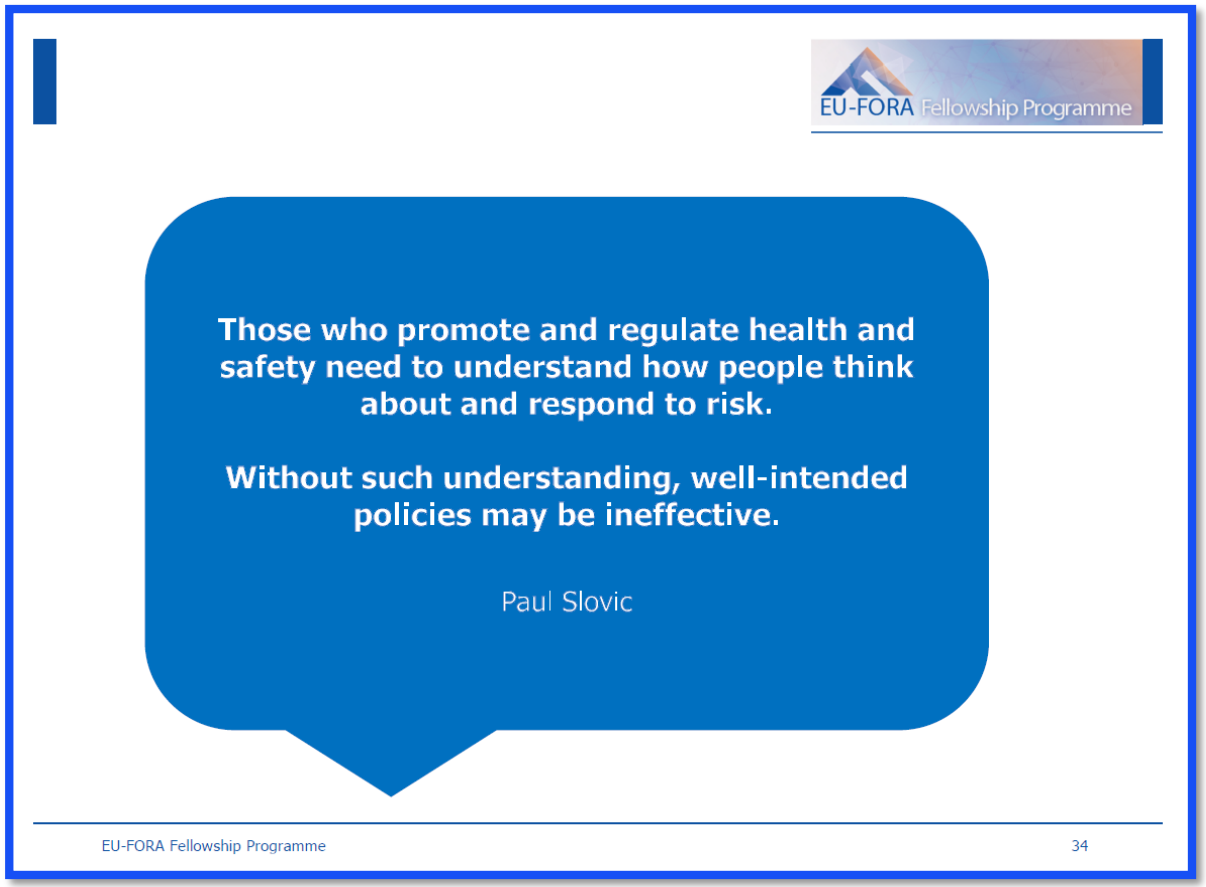
- Addressing the use of risk assessment methodology or outputs in food processing.

Outline

1. Introduction.
2. Control of foodborne virus risk in the context of risk assessment, including answers to the following questions:
   - Why use a risk assessment methodology/outputs to control the risk of foodborne viruses in food processing?
   - Which elements of the risk assessment methodology/outputs can be applied during the food production process?
3. Conclusions.
4. Summary of the symposium.

The perception of risk assessment



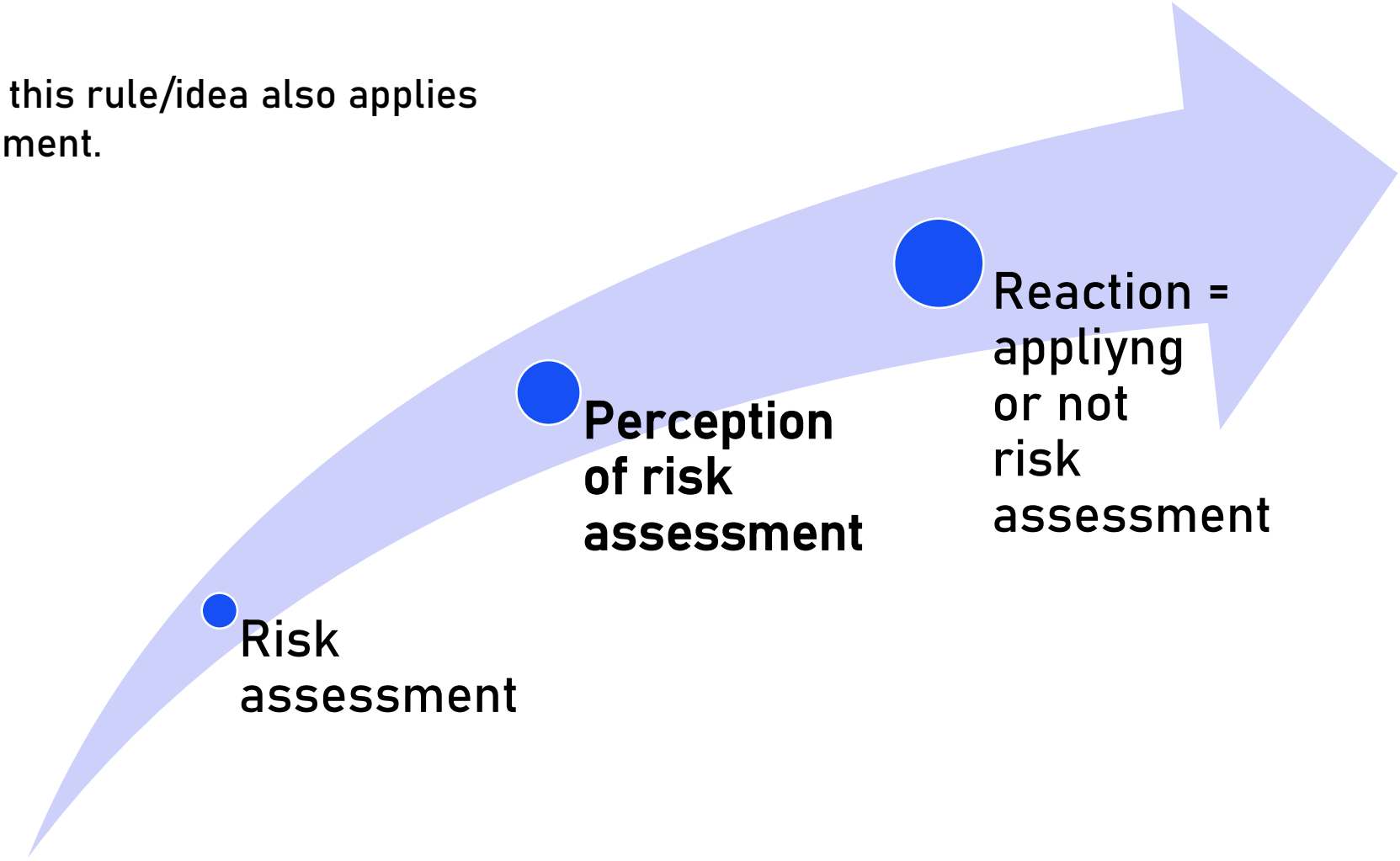


When communicating risk effectively, we need to take into account the perception of risk.

(Koch and Berger, 2022)

The perception of risk assessment

In my opinion, this rule/idea also applies to risk assessment.



The perception of risk assessment

- To paraphrase the above quote:

  Those who promote and regulate risk assessment need to understand how people think and respond to risk assessments. Without this understanding, all a benefits of risk assessment could be 'wasted'.

- Risk assessment is an advanced method of ensuring food safety and can be perceived as difficult and inaccessible.
- It is obvious that above mentioned perception limits its application.

Control of Foodborne Virus Risk …

- A control measure is **„any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level"** (FAO and WHO, 1969).

Control of Foodborne Virus Risk …

Destroying

- Physical
  - Thermal
  - Non-thermal
- Chemical
  - Alcohol
  - Oxidizing agents
  - Quaternary Ammonium Compounds
- Plant-based antiviral natural compounds
- Fermentation (biological processes and metabolites)

Control of Foodborne Virus Risk …

- By preventing we mean:
  - avoiding food products with a substantiated history of contamination,
  - **preventing contamination and/or introduction of viruses at any stage in the food chain,**
  - **establishing regulatory requirements and/or creating incentives for changes in attitudes that will contribute to risk reduction,**
  - **establishing microbiological standards or other criteria and enforcing compliance,**
  - labelling products with information regarding safe handling,
  - educating/informing the population about the steps they can take to reduce risks connected with viruses in food.

We can apply the risk assessment methodology mainly to these

(Schothorst, 2002)

Control of Foodborne Virus Risk …

- These preventing control measures are expesed mainly in:
  - Food law (in Europe Regulation 178/2002 and related)
  - Good Practices (i.a. Good Agricultural Practice, Good Manufacturing Practice, Good Hygienic Practice)
  - Hazard Analysis and Critical Control Point

… in the Context of Risk Assessment

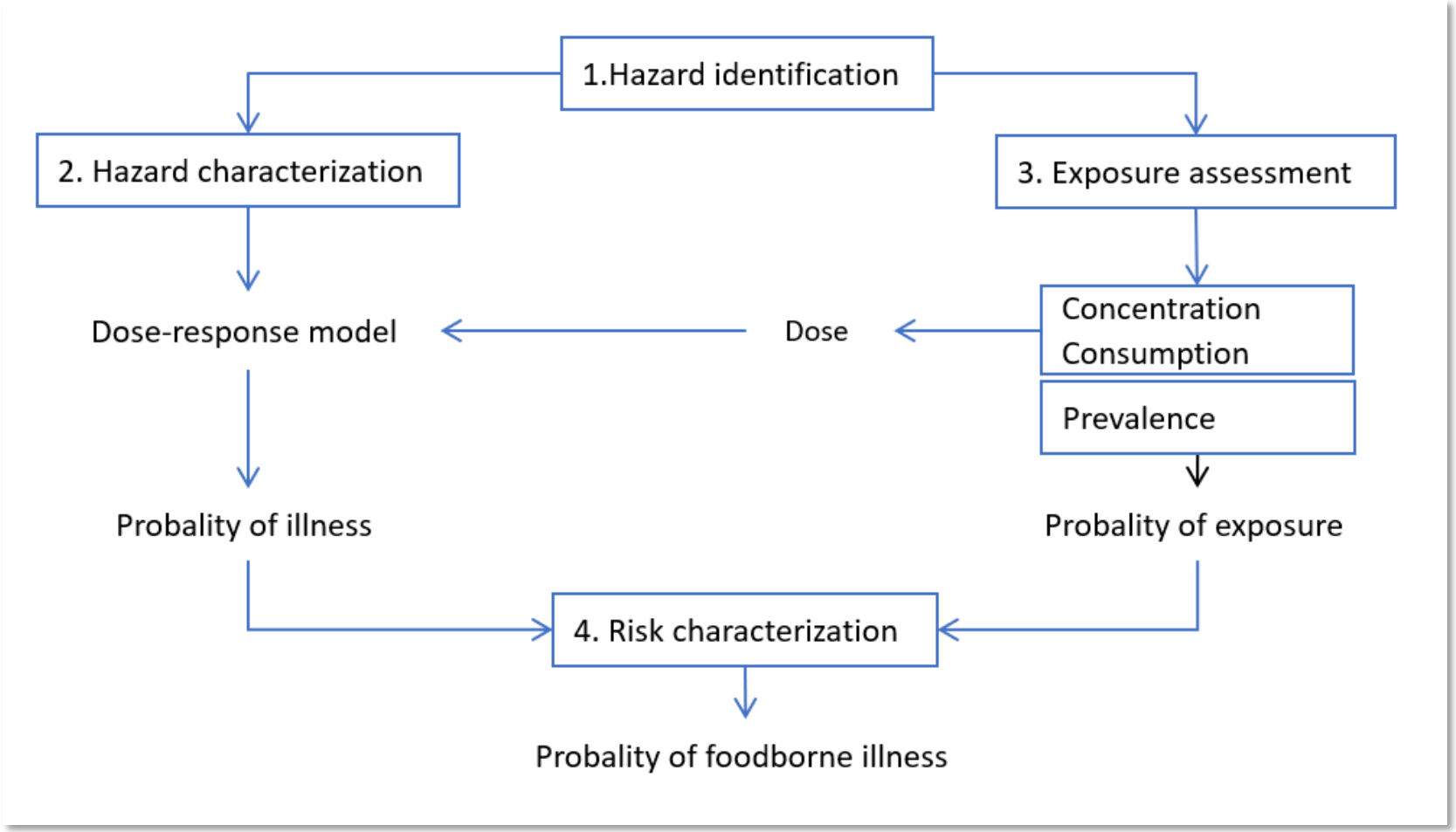


Figure 1. Flow diagram of four-step risk assessment (Ruchusatsawat et al., 2021)

… in the Context of Risk Assessment

A governmental risk assessment:

- it is usually an estimation of the number of people that may get a type of illness as a consequence of consuming a particular food containing a (certain level of a) certain microorganism.

Risk assessment in the food industry:

- food safety managers are more likely to estimate the level of a certain microorganism in the food to be marketed.
- **the target is to prevent illness which could be caused by consumption of manufactured food.**

… in the Context of Risk Assessment

A governmental risk assessment:

- The appropriate level of protection (ALOP)
- The food safety objective (FSO)

Risk assessment in the food industry:

- Performance Objective (PO)
- Performance Criterion (PC)

(FAO and WHO; 2006, 2019)

… in the Context of Risk Assessment

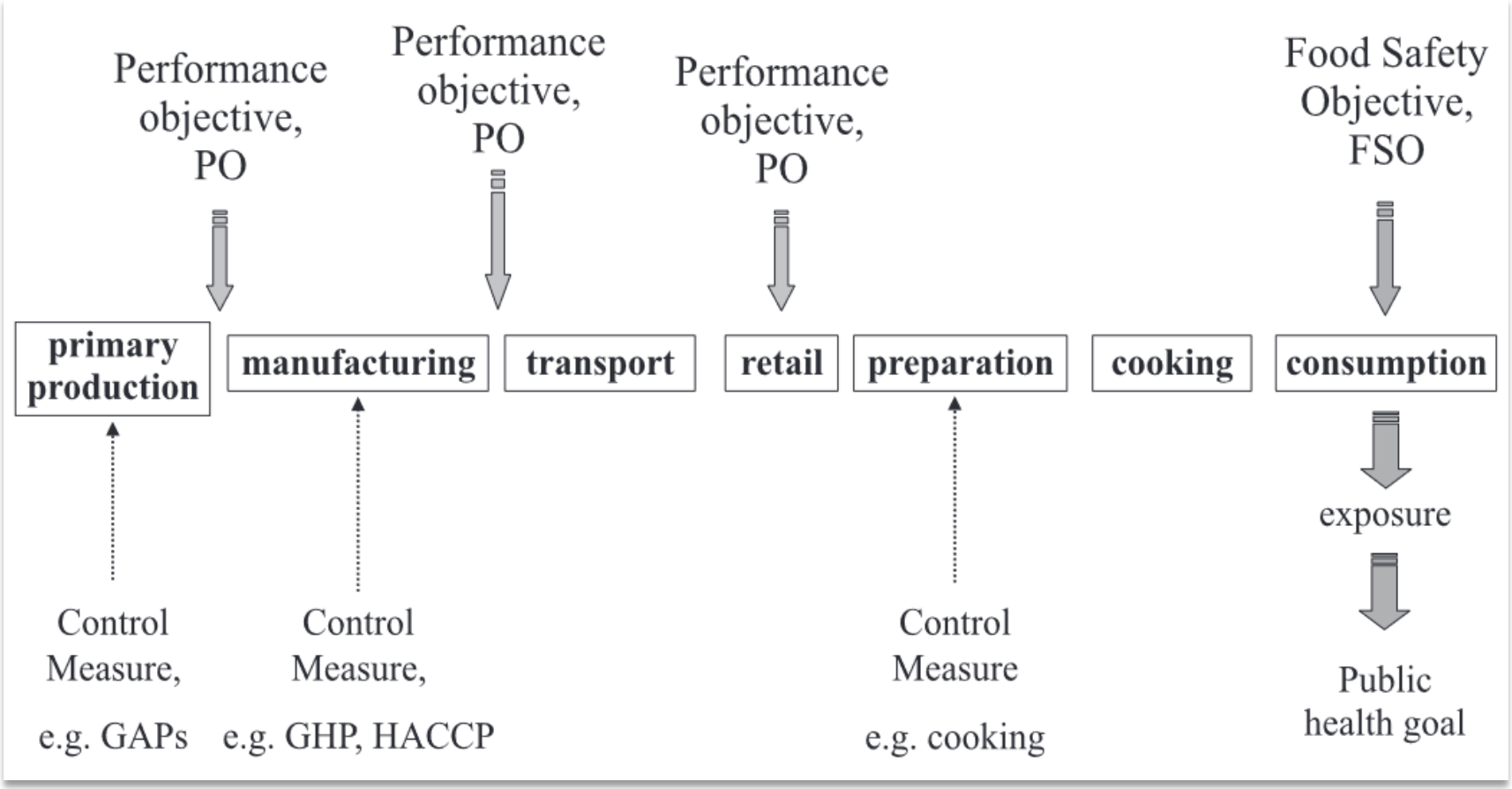


Figure 2. Model food chain indicating the position of a Food Safety Objective and derived Performance Objectives (ICMSF, 2010)

… in the Context of Risk Assessment

- Performance objective and criterion can be clasified as a preventive control measures.

Why use a risk assessment methodology/outputs to control the risk of foodborne viruses?

- Having in mind characteristic of the foodborne viruses, that is they are highly infectious and difficult to detect. Very often, they are resistant to measures intended to destroy them.
- Therefore, the risk assessment methodology/outputs allows to define action, that effectively ¨***prevent or eliminate a food safety hazard or reduce it to an acceptable level***¨.

… in the Context of Risk Assessment

Which elements of the risk assessment methodology/outputs can be applied during the food production process?

1. Risk question/s
2. Detailed description of the product/pathogen pathway
3. Risk ranking
4. Risk estimates
5. „What-if" scenarios
6. Information on uncertainty and variability around data inputs and/or outputs
7. Validation, reality check

(FAO and WHO, 2006)

… in the Context of Risk Assessment

- Risk question/s
  - General (Lammerding, 1997):

    “What can go wrong?”,
    “How likely is that to happen?”, and
    “What would the consequences be if it did go wrong?”
  - And specified: what we want to do and achieve during the risk assessment.

… in the Context of Risk Assessment

- Detailed description of the product/pathogen pathway

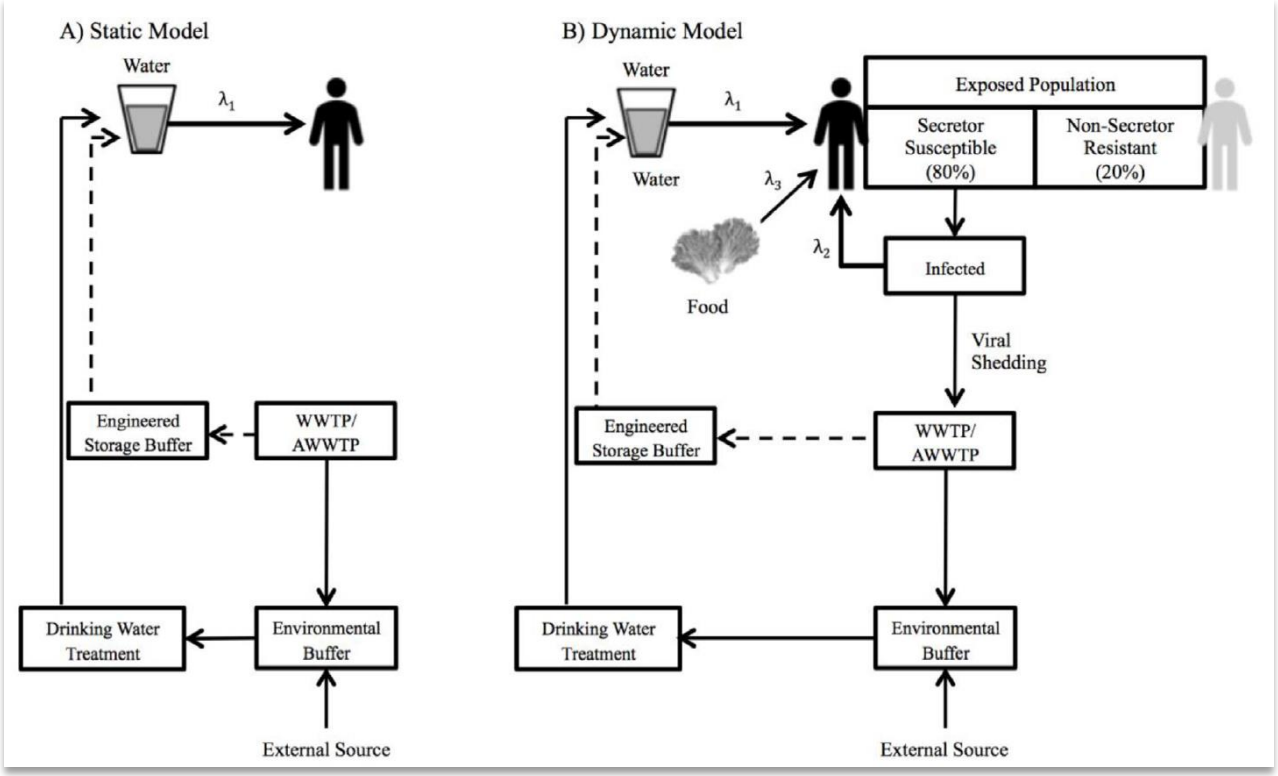


Figure 3. A conceptual comparison of a static QMRA and the dynamic QMRA of NoV transmission in drinking water (Amoueyan et al., 2020)

… in the Context of Risk Assessment

- Risk ranking

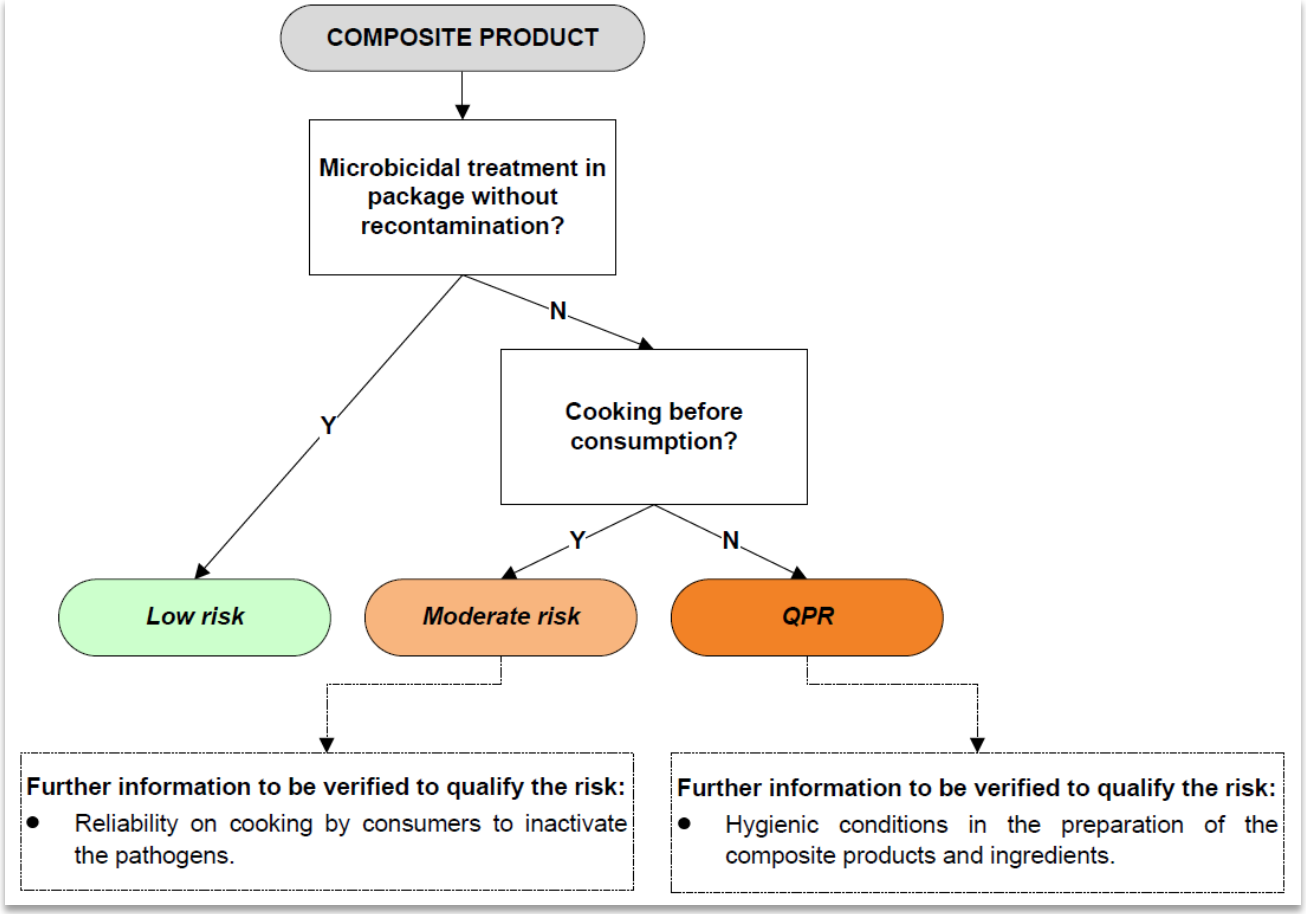


Figure 4. Decision tree for categorization of risk in composite products due to pathogens whose growth may not be needed in the food in order to cause illness (EFSA Panel on Biological Hazards (BIOHAZ), 2012)

… in the Context of Risk Assessment

- Risk estimates

Examples of different individual risk estimates include (FAO and WHO, 2021):

1. The probability per year that a random individual will suffer illness X from exposure to bacteria Y in food Z.
2. The probability per year that a random individual will suffer any deterioration in health X from exposure to bacteria Y in food type Z.
3. The probability that a person will suffer some adverse health effect in their lifetime from exposure to bacteria Y in foods.
4. The expected number of foodborne-related adverse health events for a random individual from consuming food type Z in a year.
5. The distribution of the number of foodborne-related adverse health events for a random individual from consuming food type Z in a year.
6. The per capita expected incidence of health impact X from food type Z.
7. The expected incidence of health impact X per kg consumed of food type Z by the nation.

… in the Context of Risk Assessment

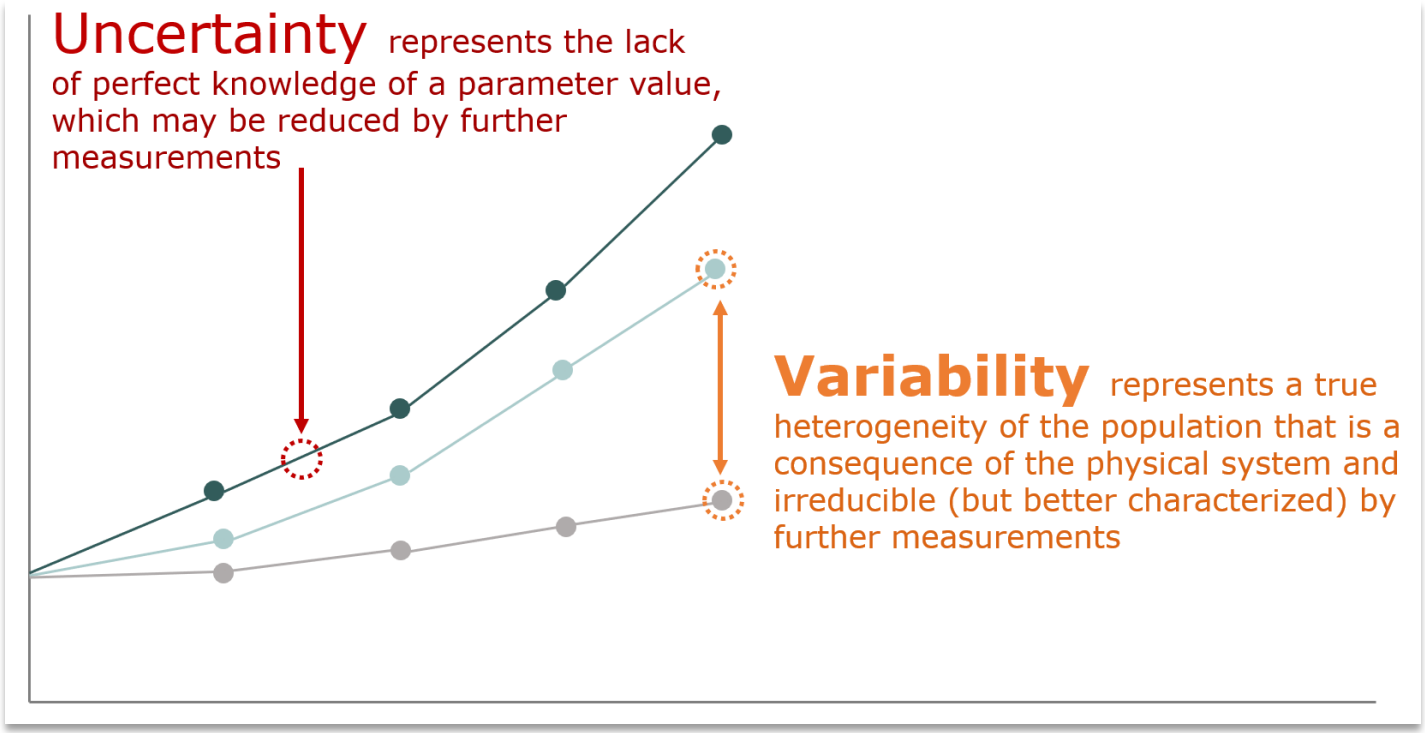
- „What-if" scenarios

What if scenarios [b]	No. of illnesses per year (in millions)		Probability of illness per serving		Fold change[#]
	Mode	5th, 95th Percentile	Mode	5th, 95th Percentile	
Baseline/ Route 1[a]	12.1	6.96, 32.6	0.100	0.0572, 0.169	-
Improving washing and sanitization at FSEs	10.63	2.13, 27.8	0.1039	0.0151, 0.156	1.14
Route 3	6.26	0.828, 17.3	0.0535	0.0395, 0.0057	1.93
Farm Interventions	1.13	0.517, 3.101	0.01029	0.00395, 0.0165	10.71
Introduction of cold chain	0.288	0.218, 15.1	0.00042	0.0015, 0.1016	42.01
Route 2 (market step skipped)	0.139	0.195, 10.87	0.000455	0.0013, 0.0728	87.1
No contamination and cross contamination along the supply chain	0.00272	0.00339, 9.4	0.0000183	0.0002, 0.0564	4 449
Farm to fork measures and interventions	0.00001108	0.0000144,0.694	7.33×10^{-8}	0.000, 0.00494	1.1×10^{6}

Table 1. Number of illnesses per year and probability of illness per serving after 100 000 iterations of the baseline model and the what if scenarios (FAO and WHO, 2021)

… in the Context of Risk Assessment

- Information on uncertainty and variability around data inputs and/or outputs



(Balbo and Stefanou, 2022)

… in the Context of Risk Assessment

- Validation, reality check
  - This can be achieved by comparing the output of the risk assessment with independently obtained data and can provide the food safety manager with information on how closely the risk assessment reflects reality.

Conclusions

- There are elements and outputs of risk assessment that can be used more widely and succesfully in food processing.
- Correct applications will facilitate production and contribute to better food safety assurance.
- A better understanding of risk assessment among food producers will contribute to a better cooperation with the government on ensuring food safety.
- This is of particular importance in the field of foodborne virus control, as **preventive measures** play a significant role in ensuring protection against them.

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Summary of the symposium *New Hazards and Old Threats; Foodborne Viruses and Risk Assessment in Food Safety*

- Foodborne Viruses are a notable foodborne hazard.
- Limited QVRA have been carried out.
- VRA faces unique challenges.
- Microbial risk assessment is an important tool for reducing foodborne illness from viral hazards.
- Challenges in detection and data gaps have meant less focus on viral hazard.
- Recent methodological developments show the next steps for Quantitative Virus Risk Assessment.
- Future developments and new tools will allow for progress in the field.
- The morphological and physiological characteristics of viruses, including difficulties in testing their presence and infectivity, ultimately show the need for **preventative measures**, rather than relying solely on control measures to destroy viruses.

New Hazards and Old Threats; Foodborne Viruses and Risk Assessment in Food Safety

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