**Food and Agriculture Organization
of the United Nations**

FAO Guide to Ranking Food Safety Risks

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- **Vision**: Safe food for all people at all times

- **Mission**: To support Members in continuing to improve food safety at all levels by
  - providing scientific advice and
  - strengthening their food safety capacities

  for efficient, inclusive, resilient and sustainable agrifood systems

- **If it is not safe, it is not food**

Food and Agriculture Organization of the United Nations

STRATEGIC OUTCOME 1

Inter-governmental and multi-stakeholder engagement in intersectoral coordination

Codex, one-health, communication

STRATEGIC OUTCOME 2

Sound scientific advice

Maintain and improve, advice and approach, foster understanding, emerging, database

STRATEGIC OUTCOME 4

Public and private stakeholder collaboration

Governments and food chain actors, tool and resources, lesson from national/regional level, training and curricula

STRATEGIC OUTCOME 3

National food control systems

Capacity development, Codex, standards and policy, data, new technology

FAO Strategic priorities for food safety

within the FAO strategic framework 2022–2031

Risk Analysis for Food Safety

- Risk analysis is internationally accepted as a key component to support decision-making around food safety.

- Risk analysis is defined by Codex Alimentarius Commission (CAC) as "a process consisting of three components: **risk assessment**, **risk management** and **risk communication**"

- Risk analysis can happen in multiple **scenarios** (food safety, environment, public health, etc) in different **level** (international, regional, national, even personal!).
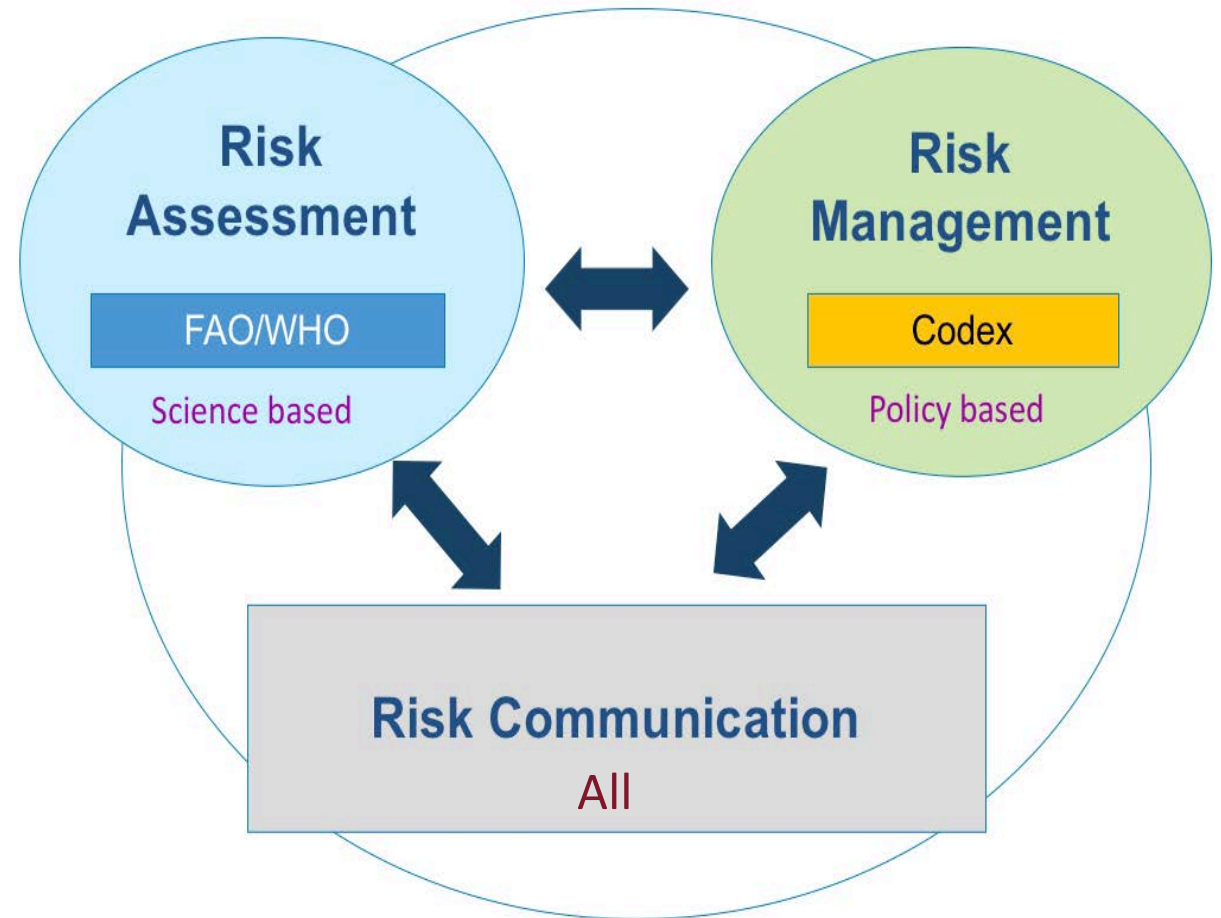
Generic Risk Management Framework

- **Preliminary risk management activities**
  - Identify food safety issue
  - Develop risk profile
  - Establish goals of the risk management
  - Decide on need for risk assessment
  - Establish risk assessment policy
  - Commission risk assessment
  - Consider resulte of risk assessment
  - **Rank risks**
- **Identification and selection of risk management options**
- **Implementation of risk management decision**
- **Monitoring and review**
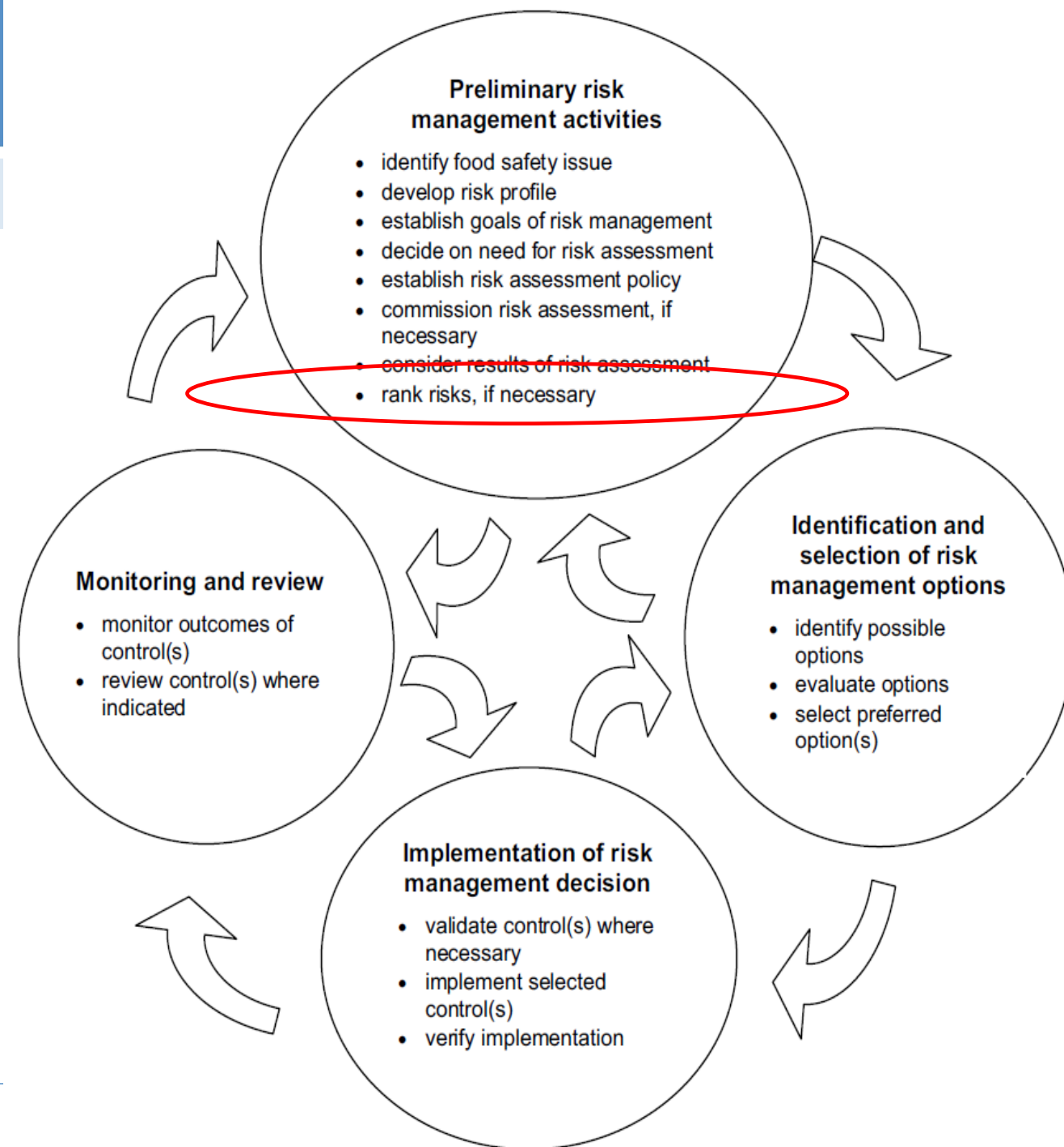
Food safety risk ranking
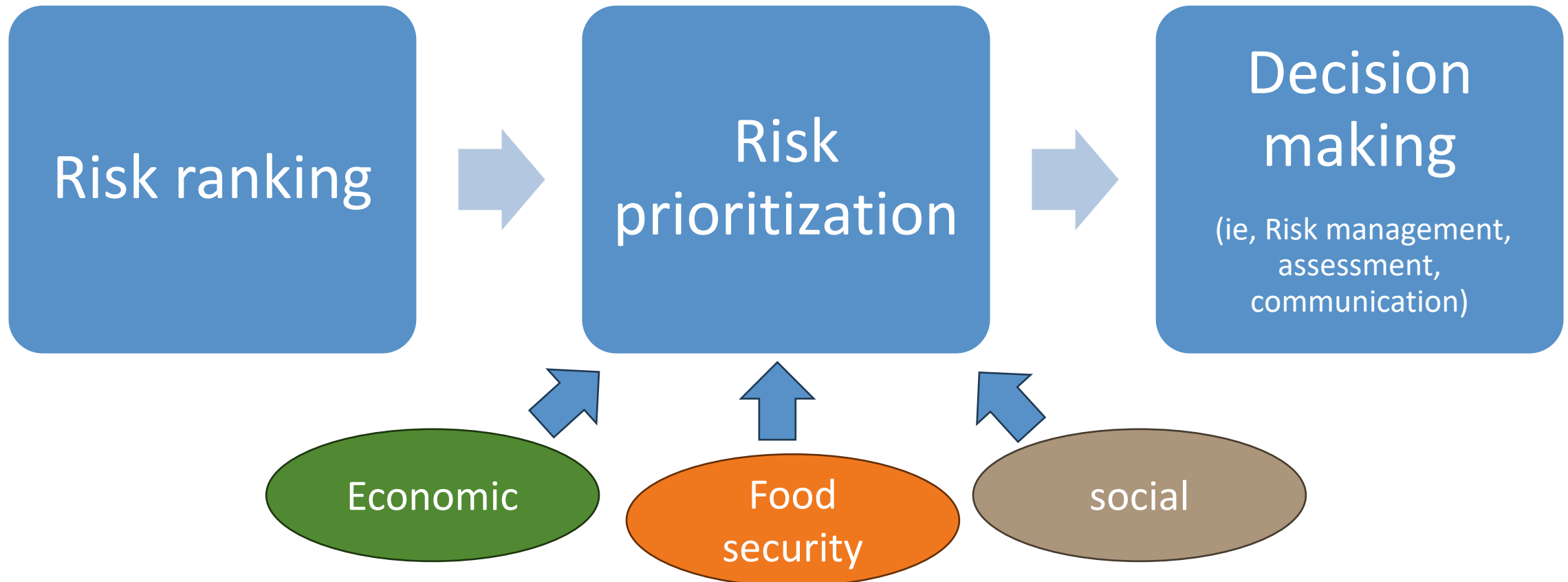
▪ **Food safety risk ranking** is the systematic analysis and ordering of foodborne hazards and/or foods in terms of public health risks, based on the likelihood and severity of adverse impacts on human health in a target population.
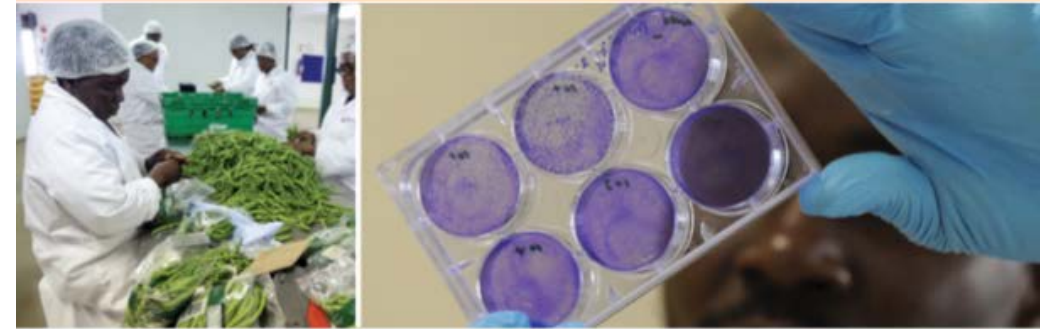
FAO GUIDE TO
RANKING FOOD SAFETY RISKS
AT THE NATIONAL LEVEL

http://www.fao.org/documents/card/en/c/cb0887en/

Risk Ranking ≠ Risk Prioritization

An approach to ranking risks in foods based on their public health impact

SELECT WHAT WILL BE RANKED

HAZARDS

FOODS

SCREENING

HAZARDS AND/OR FOODS TO BE RANKED

SELECT THE RISK RANKING METHOD

SELECT METRICS

COLLECT AND EVALUATE DATA

ANALYSIS

RESULTS

STEP 1
Define the scope

STEP 2
Develop the approach

STEP 3
Conduct the risk ranking analysis and report results
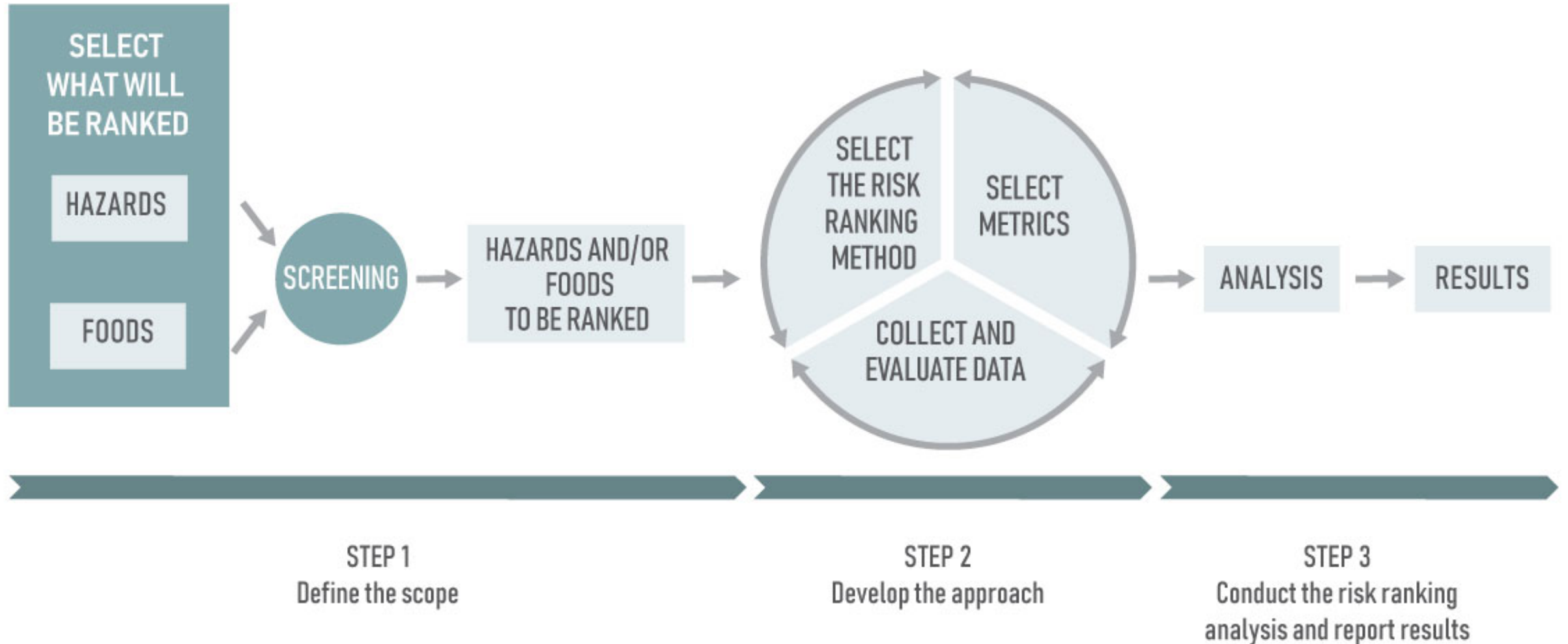
Why Risk Ranking?

- **Limited** resources, impossible to address everything;

- Identification of national and regional **priorities** is basis of any public health policy;

- Identify **most important** food safety policy goals;

- Make informed regulatory decisions, enhance disease surveillance;

- **Prioritize** risk mitigation options taking into consideration feasibility, efficacy, cost, etc.

Need to establish a 'priority' list of important food safety issues = Risk Ranking:

informs where to focus attention

Step 1. Define the Scope

The purpose

- risk management questions - **Statement of Concern**
- goals for the risk ranking - **Statement of Purpose and Objectives**
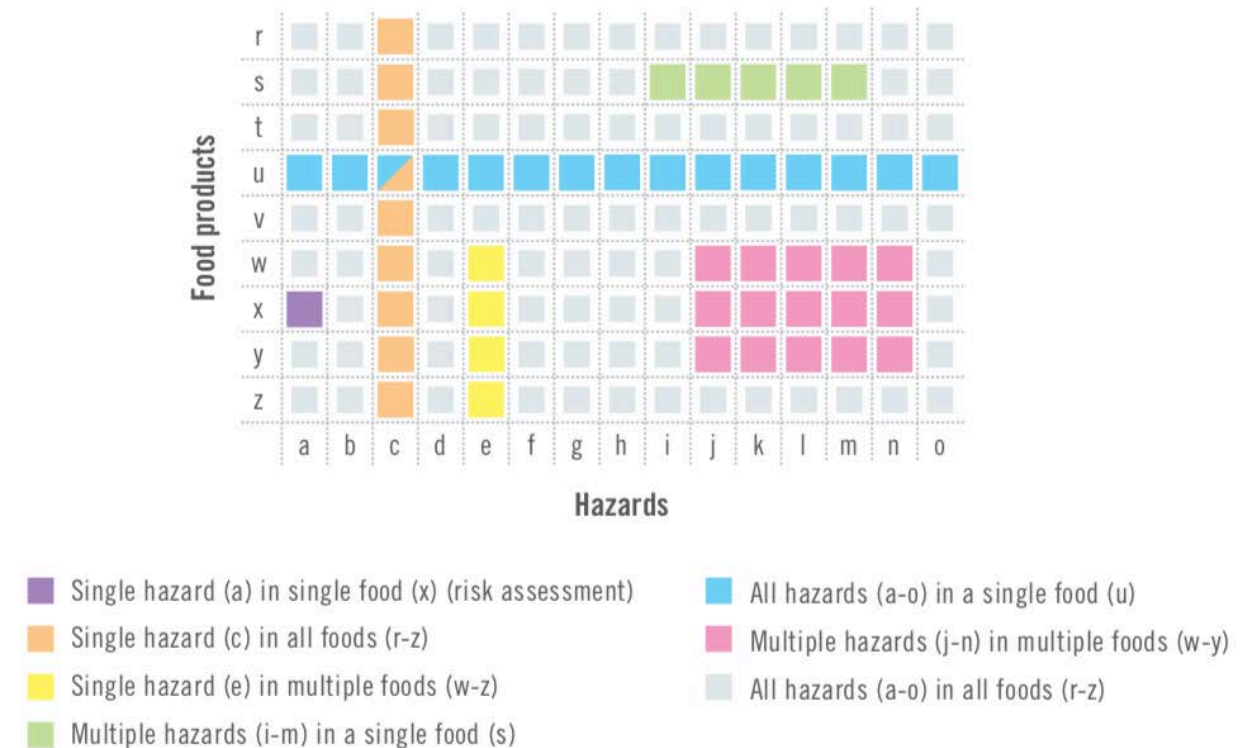
	Hazard	Food	Example
Why	outbreak	surveillance	• outbreak, recall, surveillance and/or new
Where	whole supply chain	domestic and international	• domestic and/or international; • whole supply chain, or just production, processing or consumption
Who	microbiological and chemical	all	• all, subpopulation, or specific • microbiological, chemical or others
What	general	general	• focus on likelihood and/or severity, or general
When	new	existing	• existing, new, or emerging • intention, legal, and/or changing by time

Select what will be ranked (hazard:commodities)

- Typically, a risk assessments focus on one hazard/one food, whereas risk ranking analyses typically consider **multiple hazards, multiple foods, or multiple hazards and multiple foods**

- Meat/bacteria vs beef/E.coli
- Chicken salad vs chicken

FIGURE 4. HYPOTHETICAL REPRESENTATION OF THE POSSIBLE FOCUS OF A RISK RANKING

Legend:
- Single hazard (a) in single food (x) (risk assessment)
- Single hazard (c) in all foods (r–z)
- Single hazard (e) in multiple foods (w–z)
- Multiple hazards (i–m) in a single food (s)
- All hazards (a–o) in a single food (u)
- Multiple hazards (j–n) in multiple foods (w–y)
- All hazards (a–o) in all foods (r–z)

Potential Microbiological Hazards

Bacteria		**Parasites**
Bacillus cereus	*Mycobacterium bovis*	*Anisakis* spp.
Brucella spp.*	*Salmonella enterica*—serotype Paratyphi A	*Ascaris* spp.
Campylobacter spp.	*Salmonella enterica*—serotype Typhi	*Clonorchis sinensis*
Clostridium botulinum	*Salmonella* spp.—non-typhoidal	*Cyclospora cayetanensis*
Clostridium perfringens	*Shigella* spp.	*Cryptosporidium* spp.
Coxiella burnetii	*Staphylococcus aureus*	*Echinococcus granulosus*
Cronobacter sakazakii	*Streptococcus* spp. group A, foodborne	*Echinococcus multilocularis*
E. coli—Enteropathogenic (EPEC)	*Vibrio cholerae*	*Entamoeba histolytica*
E. coli—Enterotoxigenic (ETEC)	*Vibrio parahaemolyticus*	*Fasciola* spp.
E. coli—Shiga-toxin producing (STEC)	*Vibrio vulnificus*	*Giardia* spp.
Francisella tularensis	*Yersinia enterocolitica*	*Intestinal flukes*
Leptospira spp.	*Yersinia pseudotuberculosis*	*Opisthorchis* spp.
Listeria monocytogenes		*Paragonimus* spp.
Virus		*Taenia saginata*
Hepatitis A virus		*Taenia solium*
Norovirus		*Toxoplasma gondii*
Rotavirus		*Trichinella* spp.
Hepatitis E virus		**Other**
		Prions

Potential Chemical Hazards

Metals
- Aluminium
- Arsenic**
- Cadmium**
- Chromium
- Lead**
- Selenium
- Silver, Colloidal
- Methylmercury*
- Tin

Other Inorganic Compounds
- Fluoride
- Nitrate/Nitrite compounds
- Perchlorate
- Sulfites

Other Chemicals
- Melamine
- Radionuclides and depleted uranium
- Pesticides
- Nicotine

Allergens
- Peanut, tree nut, egg, crustacea, milk, soy, cereal, fish, sesame

Toxins
- Azaspiracid shellfish poison
- Brevotoxins (NSP)
- Buffalo fish toxin
- Cassava cyanide*
- Curcurbitacin toxin
- Domoic Acid
- Escolar toxin
- Grayanotoxins
- Hypoglycin A toxin
- Marine Biotoxins –ciguatoxin
- Marine Biotoxins—muscle-paralyzing toxin
- Mycotoxins (Aflatoxin, Fumonisin, Ochratoxin)
- Mushroom toxins
- Okadaic acid (DSP)
- Patulin
- Puffer fish tetrodotoxin
- Saxitoxin (PSP)
- Tetrodotoxin
- Wax esters (from fish)

Vitamins/Proteins
- Niacin (over exposure)
- Lectins

Antibiotics and antifungals
- Aminoglycosides Antibiotics
- 2- and 4-methylimidazoles
- Flumequine

Organic Compounds
- Acrylamide
- Benzene
- Chloropropanols
- DDT
- Dioxin* (PCDDs)
- Ethyl Carbamate
- Furans (PCDFs)
- Heterocyclic amines
- Methanol
- Methomyl (insecticide)
- Organohalogens
- PAHs/PHAHs
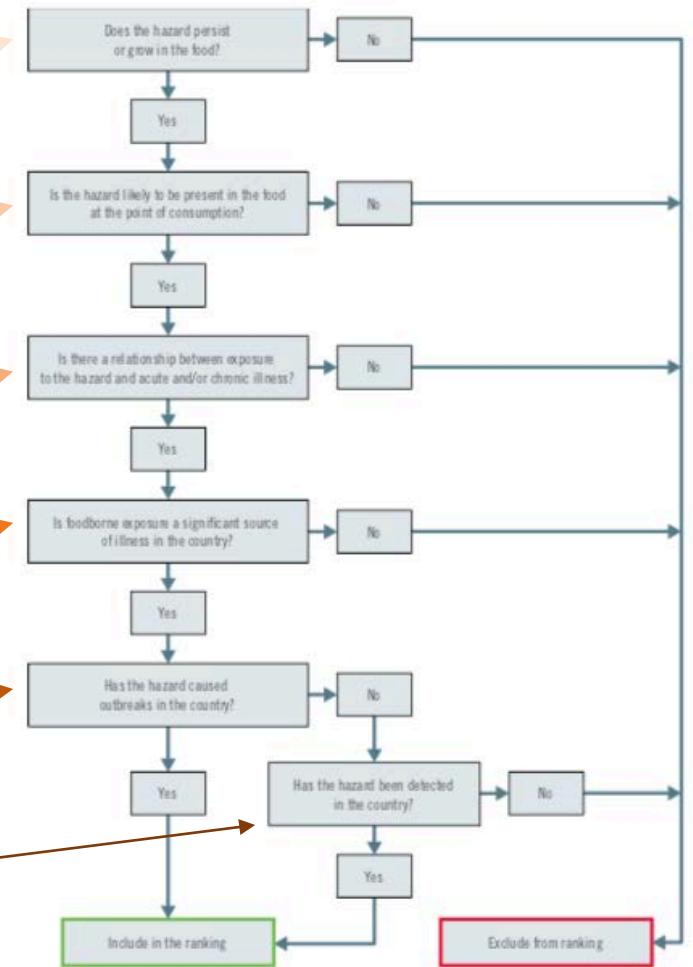- PBDEs
- PCBs
- Polydimethylsiloxane

Food Categorization (FAO)

- 1. Cereals and Cereal Products
- 2. Roots and Tubers and Derived Products
- 3. Sugar Crops and Sweeteners and Derived Products
- 4. Pulses and Derived Products
- 5. Nuts and Derived Products
- 6. Oil-Bearing Crops and Derived Products
- 7. Vegetables and Derived Products
- 8. Fruits and Derived Products
- 9. Fibres of Vegetable and Animal Origin
- 10. Spices

- 11. Fodder Crops and Products
- 12. Stimulant Crops and Derived Products
- 13. Tobacco and Rubber and Derived Products
- 14. Vegetable and Animal Oils and Fats
- 15. Beverages
- 16. Livestock
- 17. Products from Slaughtered Animals 18. Products from Live Animals
- 19. Hides and Skins
- 20. Other Livestock Products

**3) Screen foods and hazards for overall relevance and risk potential**

- Does the hazard persist or grow in the food?

- Is the hazard likely to be present in the food at the point of consumption?

- Is there a relationship between exposure to the hazard and acute and/or chronic illness?

- Is foodborne exposure a significant source of illness in the country?

- Has the hazard caused outbreaks in the country?

- Has the hazard been detected in the country?
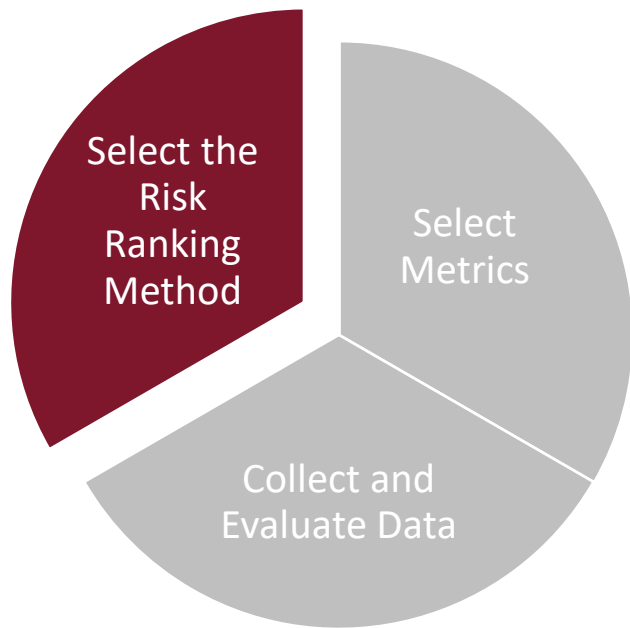
- **Qualitative**

  Outcomes without numerical values (e.g. low, medium, high)

- **Semi-Quantitative**

  Numerical outcome without a unit of measurement (e.g. ranking scores, risk ratios)

- **Quantitative**

  Numerical outcomes with specific units (e.g. DALYs, QALYs, COI)

1) Select the Risk Ranking Method

- **Qualitative Methods**
  - o Situations where time is critical
  - o Limited resources and data
  - o Could be first step in a long-term risk ranking strategy
  - o Outputs can be easily used by risk managers

  - o *Disadvantages*: Uncertainty, needs clear definitions, how to combine different pieces of evidence

  - o *Example*: Decision tree for foodborne hazards in poultry
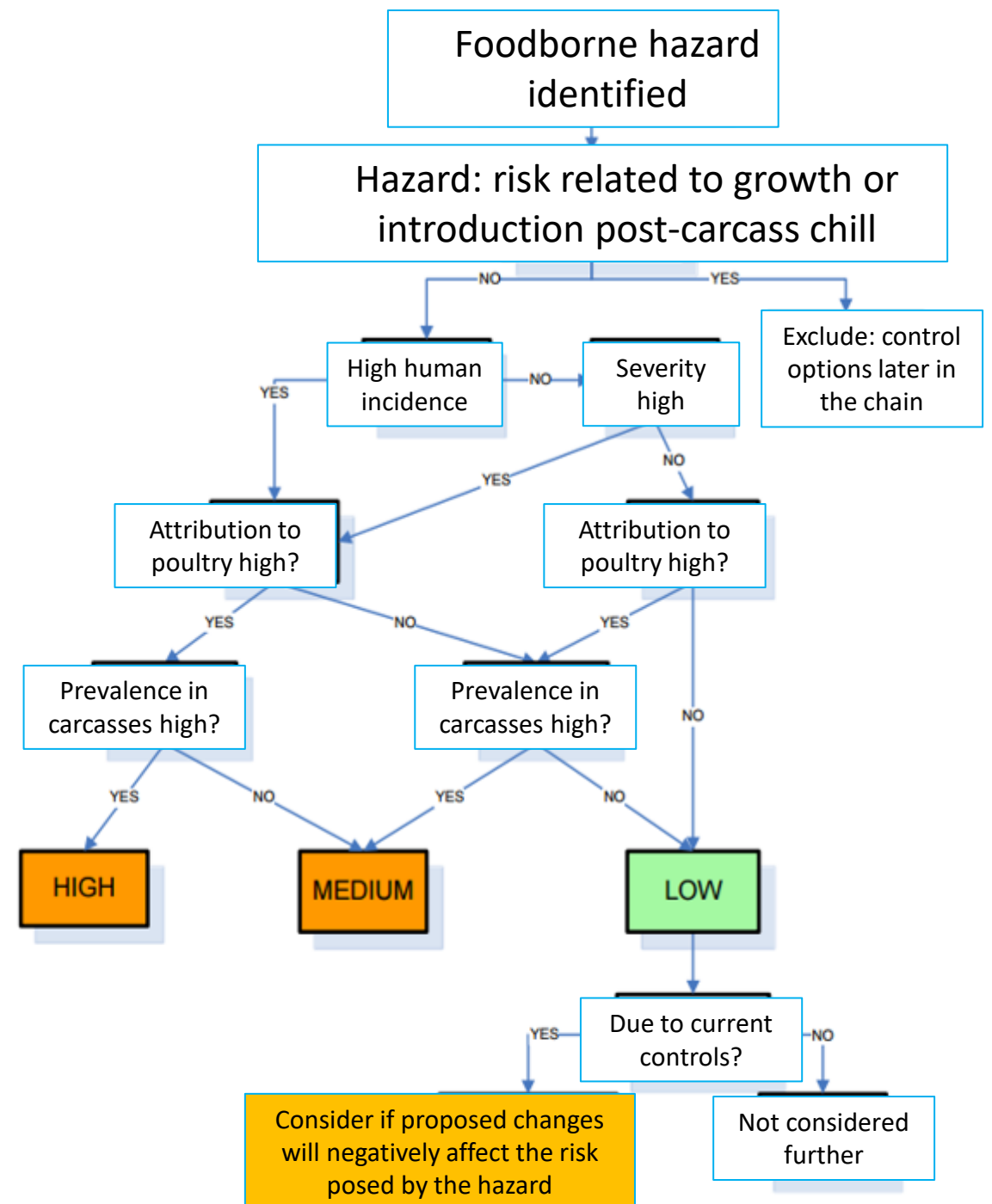
1) Select the Risk Ranking Method

- **Semi-Quantitative Methods**

  o Require moderate resource and data availability

  o Scores allow to rank items but do not provide a direct measure of the risk.

  o Considered to provide relative ranking outcomes.

  o Can be also qualitative

  o Risks are categorized based on their relative severity and likelihood
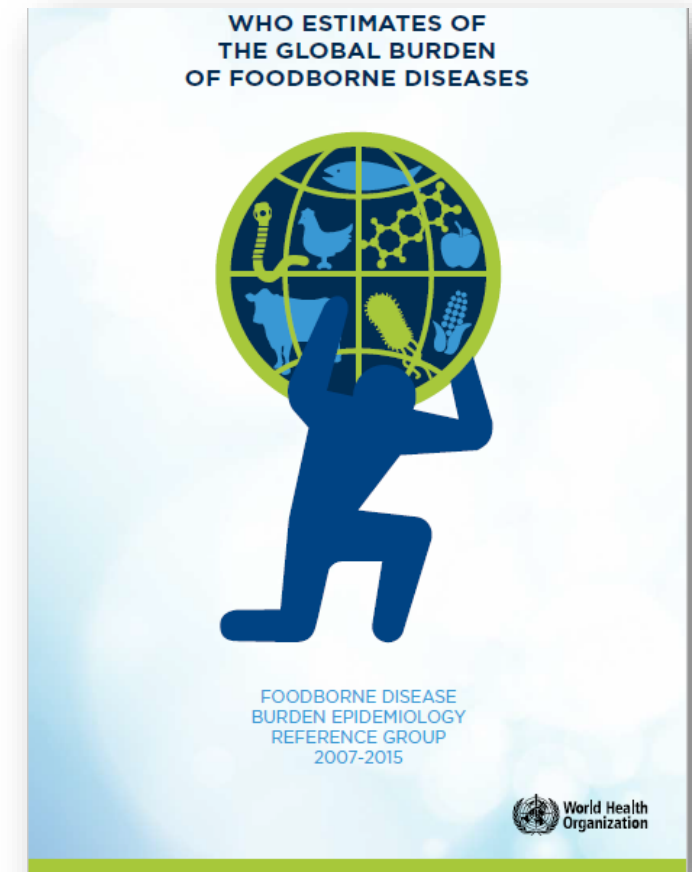
  o Can be implemented quickly

  o Risk matrix, Multi-criteria decision analysis, and risk ranger
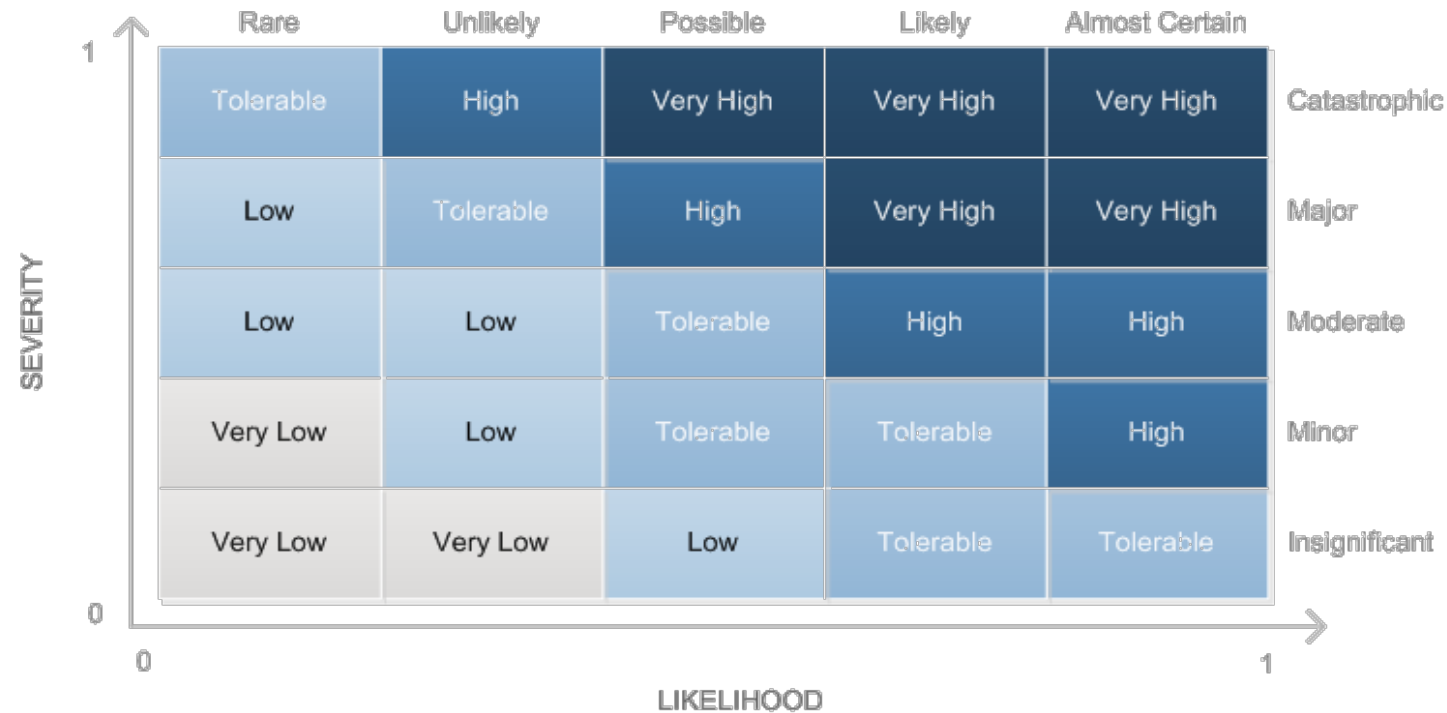
1) Select the Risk Ranking Method

- **Quantitative Methods**

  o Require the development mathematical methods

  o Are robust and able to provide estimates of risk and magnitude of difference between items being ranked.

  o However, more complex, require greater technical expertise and resources

  o Expert opinion can be incorporated to fill data gaps.

  o Burden of disease methods, quantitative risk assessment

FDA-iRISK®
food safety modeling tool

WHO ESTIMATES OF THE GLOBAL BURDEN OF FOODBORNE DISEASES

FOODBORNE DISEASE
BURDEN EPIDEMIOLOGY
REFERENCE GROUP
2007-2015

World Health Organization

Select the Risk Ranking Method

Is there data available on the hazards and/or food being evaluated?

Yes →

Is the intention to obtain results in a short period of time (< a year)?

No →

Do you have access to risk assessors able to conduct quantitative risk assessment?

Yes →

Is the intention to rank a large number of hazards and/or foods (>100)?

No/some ↓

Yes ↓

No ↓

No ↓

Yes ↓

No ↓

Qualitative

Semi-quantitative

Quantitative

2) Select the metrics for ranking risks

Question	Metric
Death	• mortality rates
Highest burden	• population health
Food risk	• sampling data
Microbial	• probability of sequelae from the published literature; or • hospitalization and mortality rates; or • **surveillance**
Chemical	• acceptable daily intake (ADI) or reference dose (RfD); or • **lethal dose for 50 percent** of the population (LD50); or **acute** toxicity endpoints

- Summary measures of population health, such as DALYs and quality-adjusted life years (QALYs), are often the preferred metrics for estimating risk because they incorporate **likelihood** (e.g. the number of cases) and **severity** (e.g. DALY/case).

Select the Risk Ranking Method

Select Metrics

Collect and Evaluate Data

Approaches to assessing risk

Select the Risk Ranking Method

Select Metrics
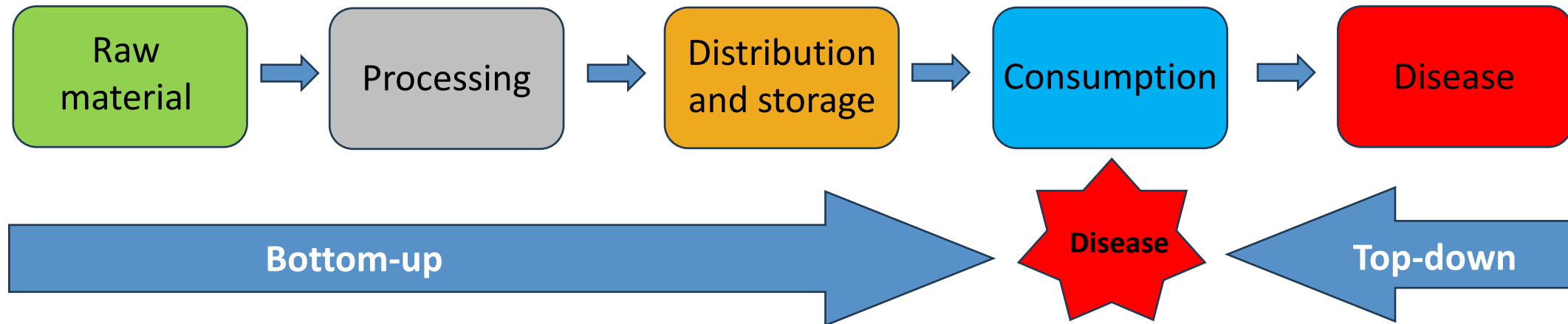
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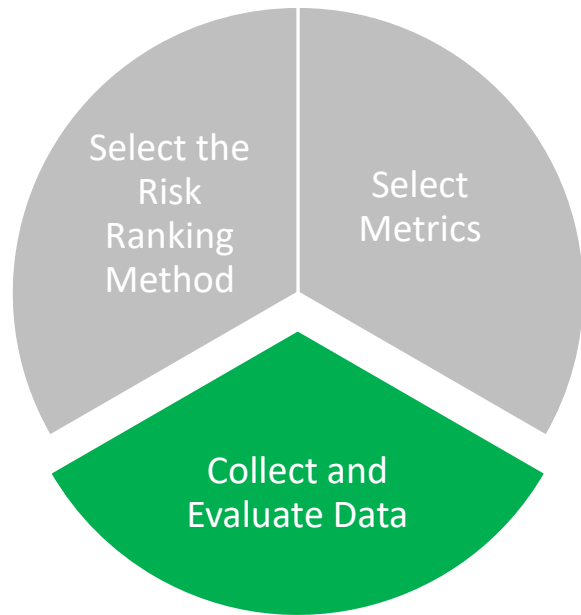
- Quality of data, reliable, scientifically valid, repeatable and transparent. Need representative data.

- The data requirements for a risk ranking vary according to the approach, the method, the hazards being considered, and the metrics selected.

- Accuracy and precision of the data. Uncertainty.

Sources of Data

- Country active surveillance systems

- Reported cases and published literature

- Sources attribution studies

- Modelling to estimate likelihood and severity

Addressing Data Gaps

- Use of regional or international data as surrogate

  - WHO FERG estimates of burden of diseases

- Expert elicitation

  - Expert-based estimate of concentration, prevalence, source attribution, etc…

Step 3. Conduct the risk ranking analysis and report results

- Results from a risk ranking exercise must be interpreted with **caution**, taking into consideration the bias, uncertainty and variability inherent in the metrics, the data and method used in the analysis.

- **Plotting** the severity and likelihood metrics into a two-dimensional graph is a very effective way to present results.

- Assumptions and limitations need to be clearly described.

E.coli							Salmonella spp			Shigella spp	Lm	S. aureus			Chloramphenicol			Tetracycline		
Goat	Sheep	Goat	Horse	Chicken	Pork	Cattle	Goat	Cattle	Pork	Goat	Goat	Sheep	Cattle	Chicken	Sheep	Cattle	Horse	Sheep	Cattle	Horse
														46.6						
																40.4				
	44.0		40.6	40.6		40.6														
40.4								46.1												
						43.8										39.8				
43.0						38.6	48.3		44.3	47.0	44.3	44.3	44.3						35.6	
	44.4																			
	43.0	40.2	42.0		42.0	42.0	49.4				48.7	46.0								
													41.3							
							41.7													

Thank you!