National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

Public health-based risk ranking of (microbial) hazards in the food chain

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EFSA@10

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Risk ranking

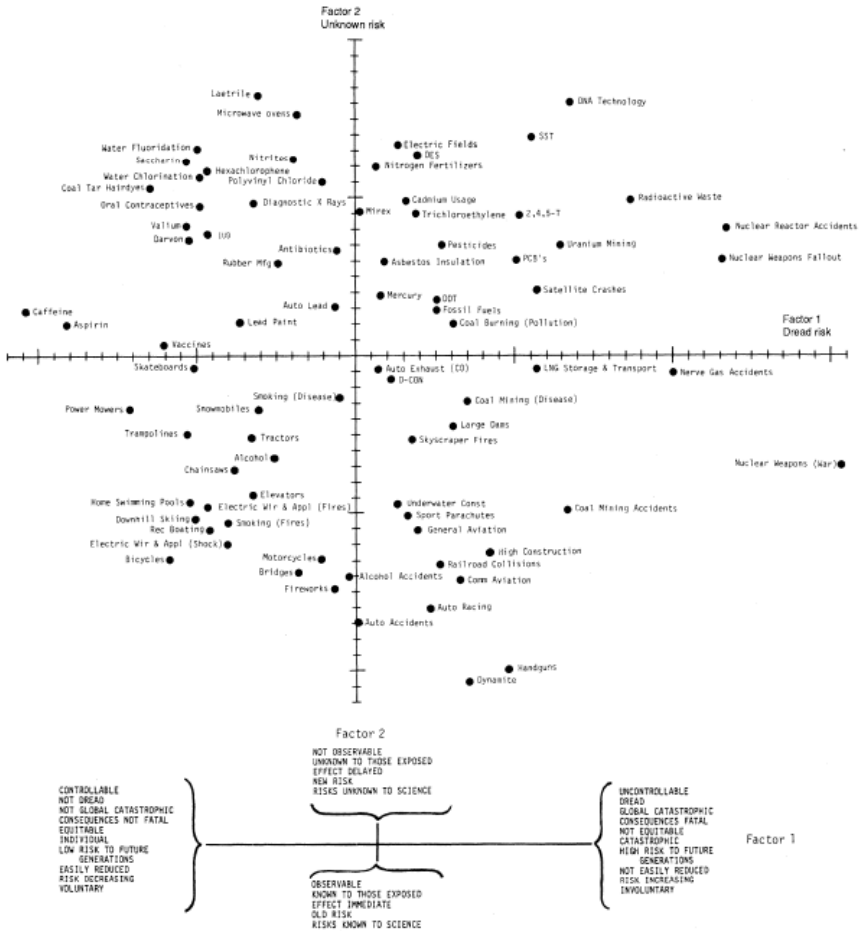
- Why?
  - Limited resources
  - 24/7 news cycle ↔ science based decision making
- Consequences
  - Helps define focus for risk management
  - Does not directly determine actions
    - Options, costs, stakeholder views
- Limitations
  - Different definitions of risk
- Multi-dimensional problem
- Technical information ánd value judgements
  - Interaction between researchers and policy makers c.q. general population

Definitions of risk

- Public health metrics

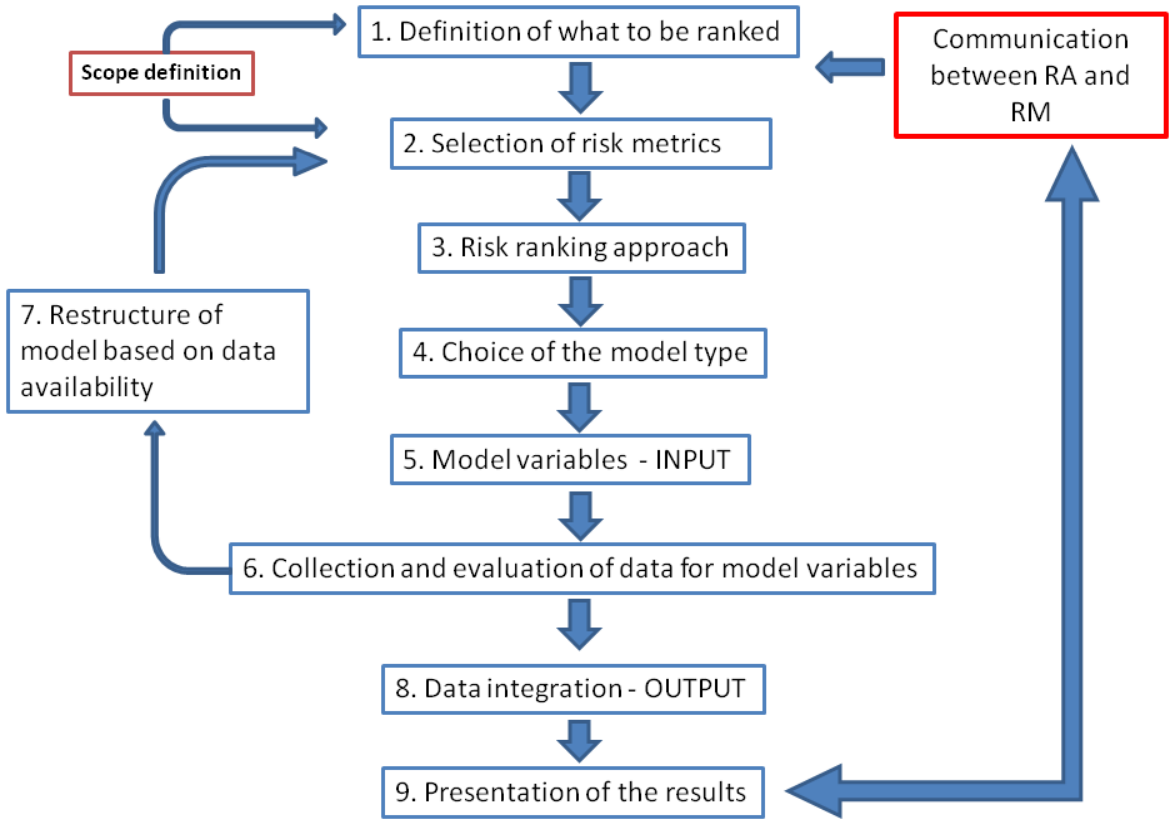
- Values
  - Voluntary
  - Equity
  - Dread
  - Control
  - Uncertainty
  - Immediacy
  - Novelty

Value-based risk ranking



Slovic, Science 1987;236:280-285

EFSA BIOHAZ Risk Ranking Framework



What to be ranked?

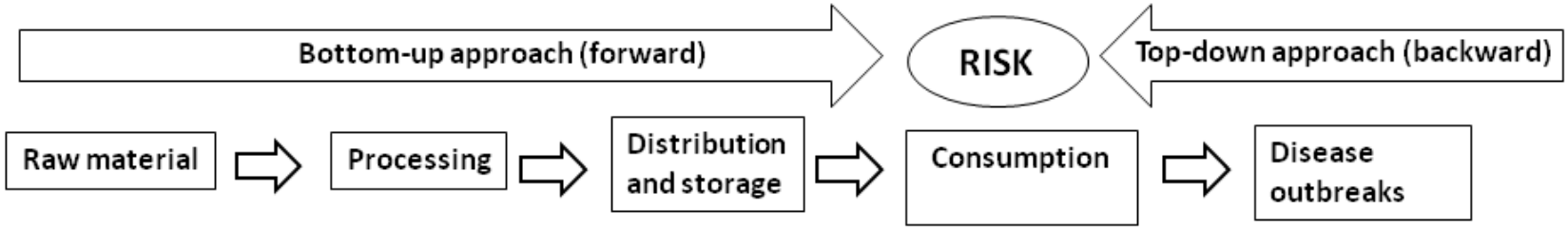
- Single hazard in multiple foods
  - Incidence
- Multiple hazards in single food
  - Severity
- Multiple hazards in multiple foods
  - Incidence and severity

Risk metrics

- Public health
  - Illness
    - › General population, consulting patients, hospitalisations
  - Deaths
    - › Catastrophic (identifiable) vs. chronic (statistical)
  - Years of life lost
  - Summary metrics of public health (DALY, QALY)
- Economic
  - Cost of illness
  - Willingness to pay (accept)
    - › Revealed or stated preferences

- Incorporation of value judgements inevitable!

Risk ranking approaches

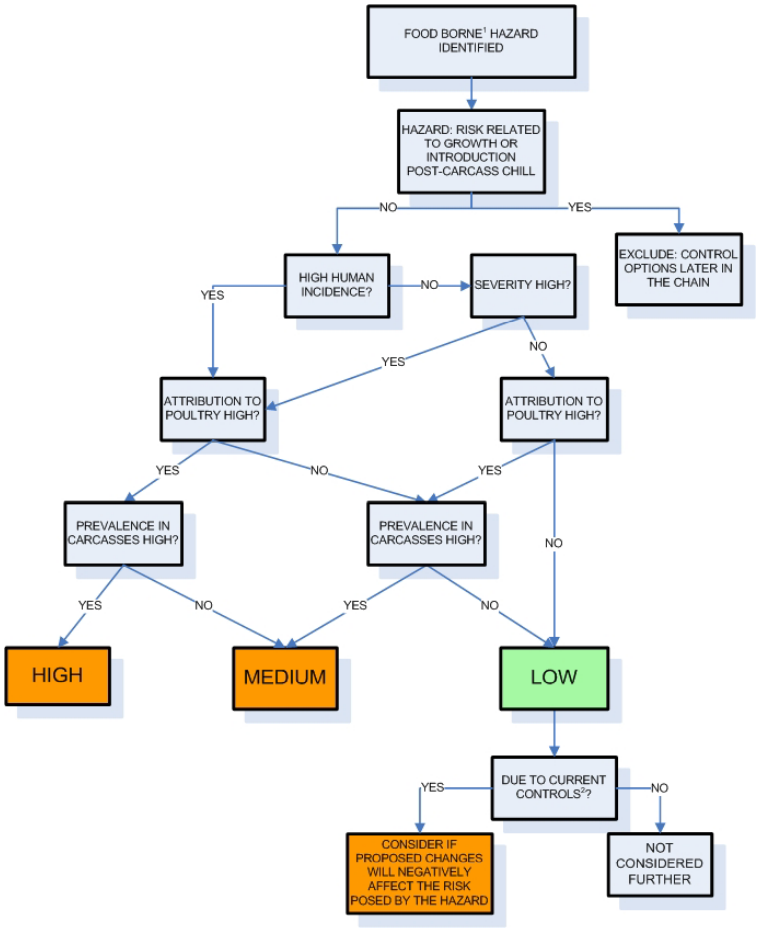


Modelling approaches

- Opinion based
- Qualitative
  - Decision tree
  - Matrix
- Semi-quantitative
  - Multi Criteria Decision Analysis
- Quantitative
  - Comparative risk assessment
  - Disease burden
  - Attribution

- One time or continuous?
- Resources, data, timelines
- Simplicity vs. Precision
- Reproducibility
- Resolution
- Transparancy
- Separate science and values
- Information management
- End user(s)

Decision tree for ranking hazards in poultry



BIOHAZ Panel, EFSA Journal 2012;10(6):2741

Qualitative risk ranking

How to define these terms?

		A	B	C	D	E
		Negligible	Minor	Moderate	Significant	Severe
E	Very Likely	Low Med	Medium	Med Hi	High	High
D	Likely	Low	Low Med	Medium	Med Hi	High
C	Possible	Low	Low Med	Medium	Med Hi	Med Hi
B	Unlikely	Low	Low Med	Low Med	Medium	Med Hi
A	Very Unlikely	Low	Low	Low Med	Medium	Medium

Is Minor x Very Unlikely really equal to Low??

- Rules of probability should be respected in qualitative matrices
- Some quantification of probabilities underlying risk qualifiers is necessary
- Marginal qualifiers should be different from those for the joint probabilities

http://herdingcats.typepad.com/my_weblog/2010/07/risk-matrix.html

Risk matrix proposed by ANSES

Probabilité d'exposition / *Exposure probability*			Probabilité d'émission / *Release probability*									
			N / *N*	QN / *NN*	M / *M*	EF / *EL*	TF / *VL*	F / *L*	PE / *NVH*	AE / *QH*	E / *H*	TE / *VH*
			0	1	2	3	4	5	6	7	8	9
	N / *N*	0	0	0	0	0	0	0	0	0	0	0
	QN / *NN*	1	0	1	1	1	1	1	1	1	1	1
	M / *M*	2	0	1	1	1	1	2	2	2	2	2
	EF / *EL*	3	0	1	1	1	2	2	2	3	3	3
	TF / *VL*	4	0	1	1	2	2	3	3	3	4	4
	F / *L*	5	0	1	2	2	3	3	4	4	5	5
	PE / *NVH*	6	0	1	2	2	3	4	5	5	6	6
	AE / *QH*	7	0	1	2	3	3	4	5	6	7	7
	E / *H*	8	0	1	2	3	4	5	6	7	8	8
	TE / *VH*	9	0	1	2	3	4	5	6	7	8	9

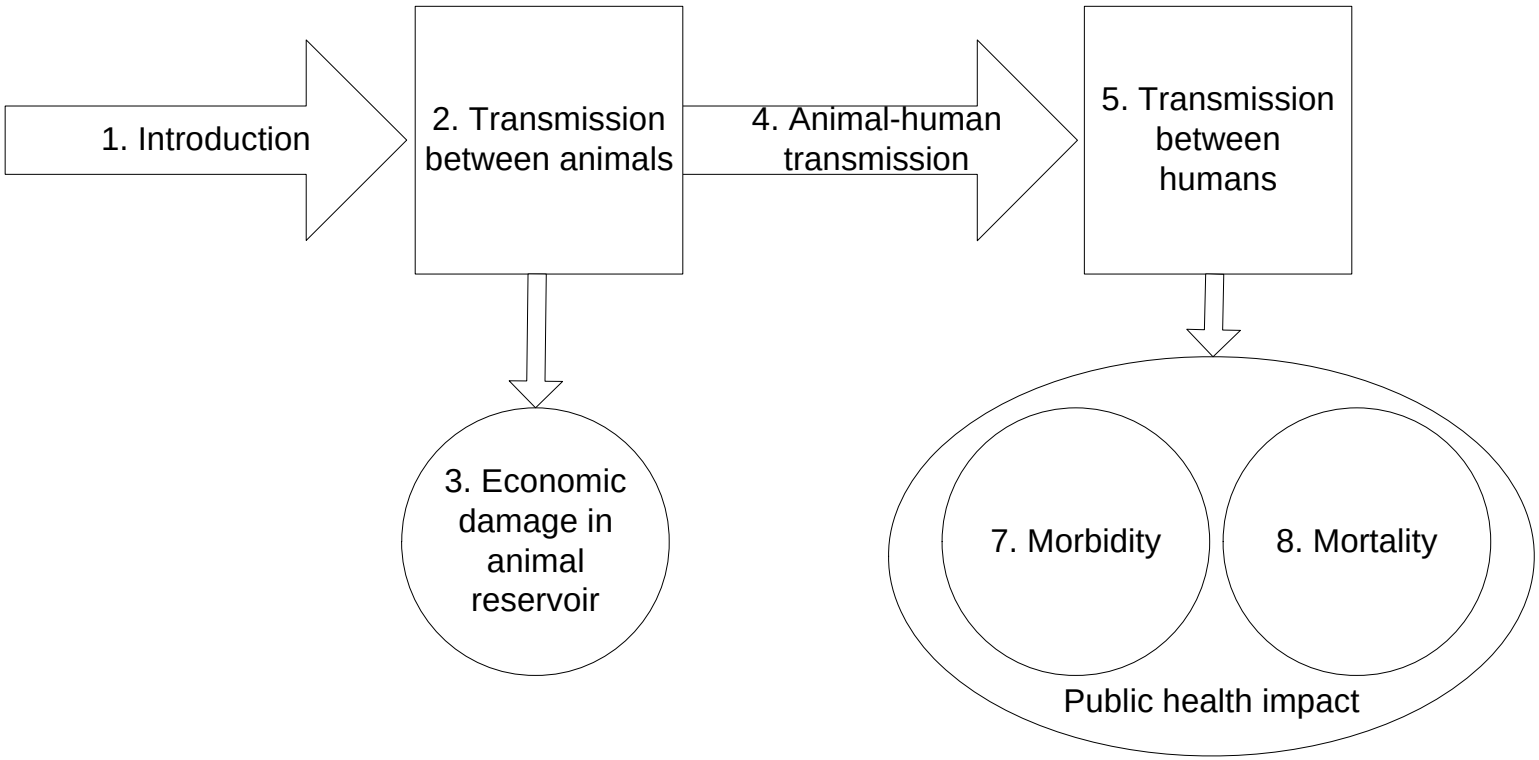
ANSES: A qualitative risk assessment method in animal health, November 2008

Semi-quantitative risk ranking - Discontools

Prioritisation model

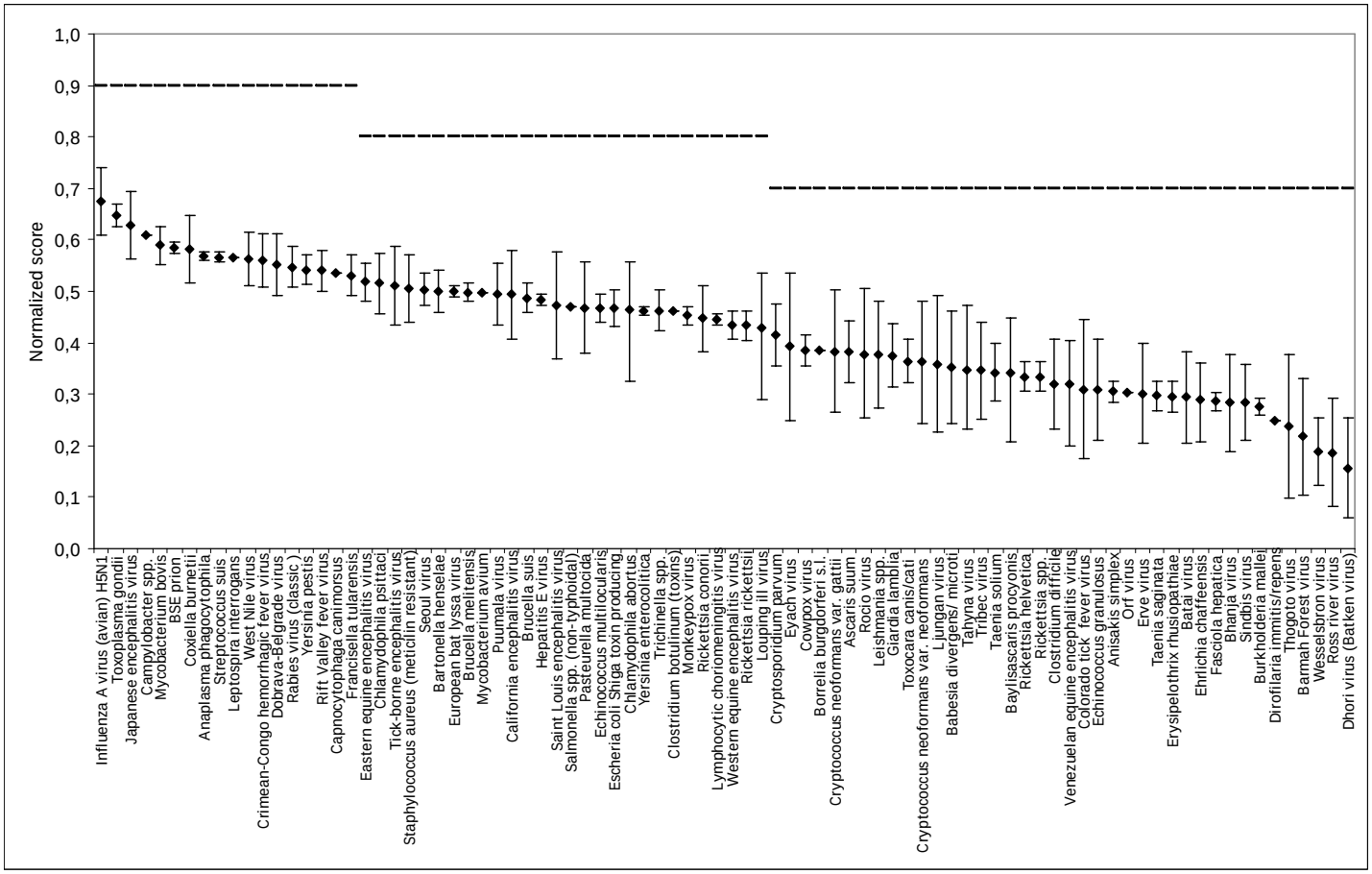
	Bovine Spongiform Encephalopathy			Campylobacter			Cysticercosis		
	Score	Co-eff	Total	Score	Co-eff	Total	Score	Co-eff	Total
DISEASE KNOWLEDGE - 10 criteria			42.50			77.50			17.50
Speed of spread	1	2.50	2.50	4	2.50	10.00	0	2.50	0.00
Number of livestock species involved	2	2.50	5.00	4	2.50	10.00	2	2.50	5.00
Persistence of the infectious agent in the environment	2	2.50	5.00	4	2.50	10.00	4	2.50	10.00
Risk of spread to susceptible populations	2	2.50	5.00	3	2.50	7.50	0	2.50	0.00
Potential for silent spread	4	2.50	10.00	4	2.50	10.00	0	2.50	0.00
Wildlife reservoir and potential spread	0	2.50	0.00	4	2.50	10.00	0	2.50	0.00
Vector reservoir and potential spread	0	2.50	0.00	0	2.50	0.00	0	2.50	0.00
Variability of the agent	1	2.50	2.50	4	2.50	10.00	0	2.50	0.00
Understanding of fundamental immunology	3	2.50	7.50	2	2.50	5.00	1	2.50	2.50
Host-Pathogen interaction	2	2.50	5.00	2	2.50	5.00	0	2.50	0.00
IMPACT ON ANIMAL HEALTH AND WELFARE - 3 criteria			49.98			0.00			0.00
Disease impact on production	1	8.33	8.33	0	8.33	0.00	0	8.33	0.00
Duration of animal welfare impact	2	8.33	16.66	0	8.33	0.00	0	8.33	0.00
Proportion of animal affected suffering pain/ injury/ distress as a result of the disease	3	8.33	24.99	0	8.33	0.00	0	8.33	0.00
IMPACT ON PUBLIC HEALTH - HUMAN HEALTH - 6 criteria			66.56			66.56			54.08
Impact of occurence on human health	4	4.16	16.64	2	4.16	8.32	3	4.16	12.48
Likelihood of occurence	2	4.16	8.32	3	4.16	12.48	2	4.16	8.32
Impact of occurrence on food safety	4	4.16	16.64	4	4.16	16.64	4	4.16	16.64
Transmissibility (spread from animal to human)	3	4.16	12.48	4	4.16	16.64	3	4.16	12.48
Spread in humans	2	4.16	8.32	2	4.16	8.32	0	4.16	0.00
Bioterrorism potential	1	4.16	4.16	1	4.16	4.16	1	4.16	4.16
IMPACT ON WIDER SOCIETY - 3 criteria			41.65			16.66			24.99
Economic direct impact (including cumulative costs (e.g. Enzoonotic vs Epizootic))	1	8.33	8.33	1	8.33	8.33	0	8.33	0.00

Criteria for ranking of emerging zoonoses



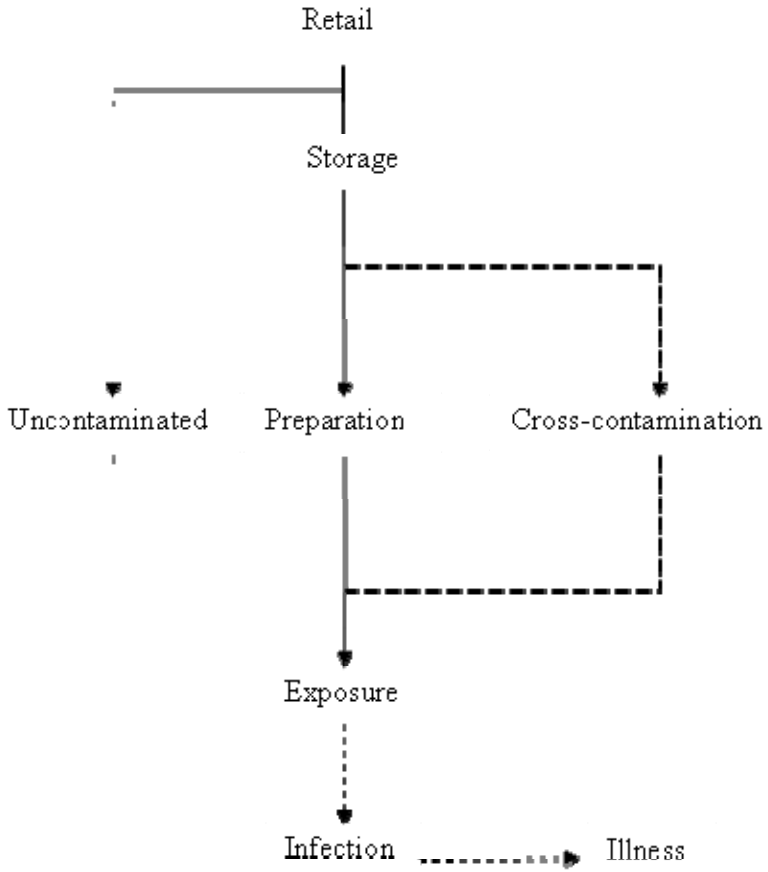
Havelaar et al., PLoS One 2010:e13965

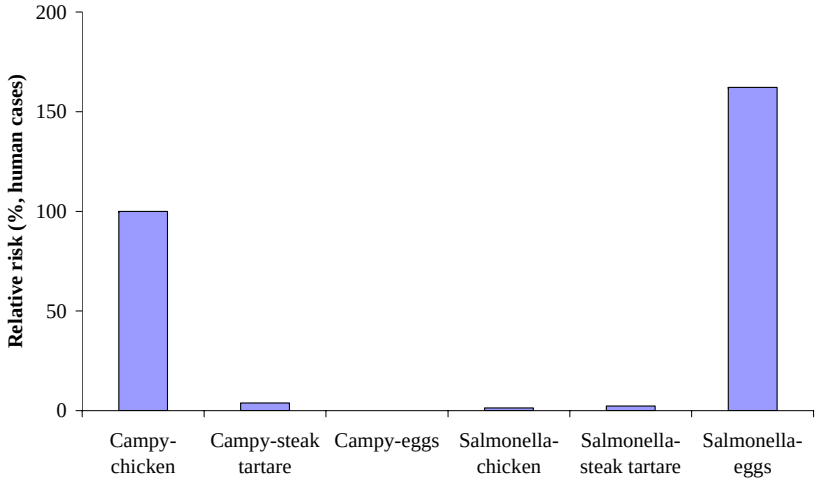
Ranking of emerging zoonoses in NL



Havelaar et al., PLoS One 2010:e13965

Risk ranking: comparative risk assessment

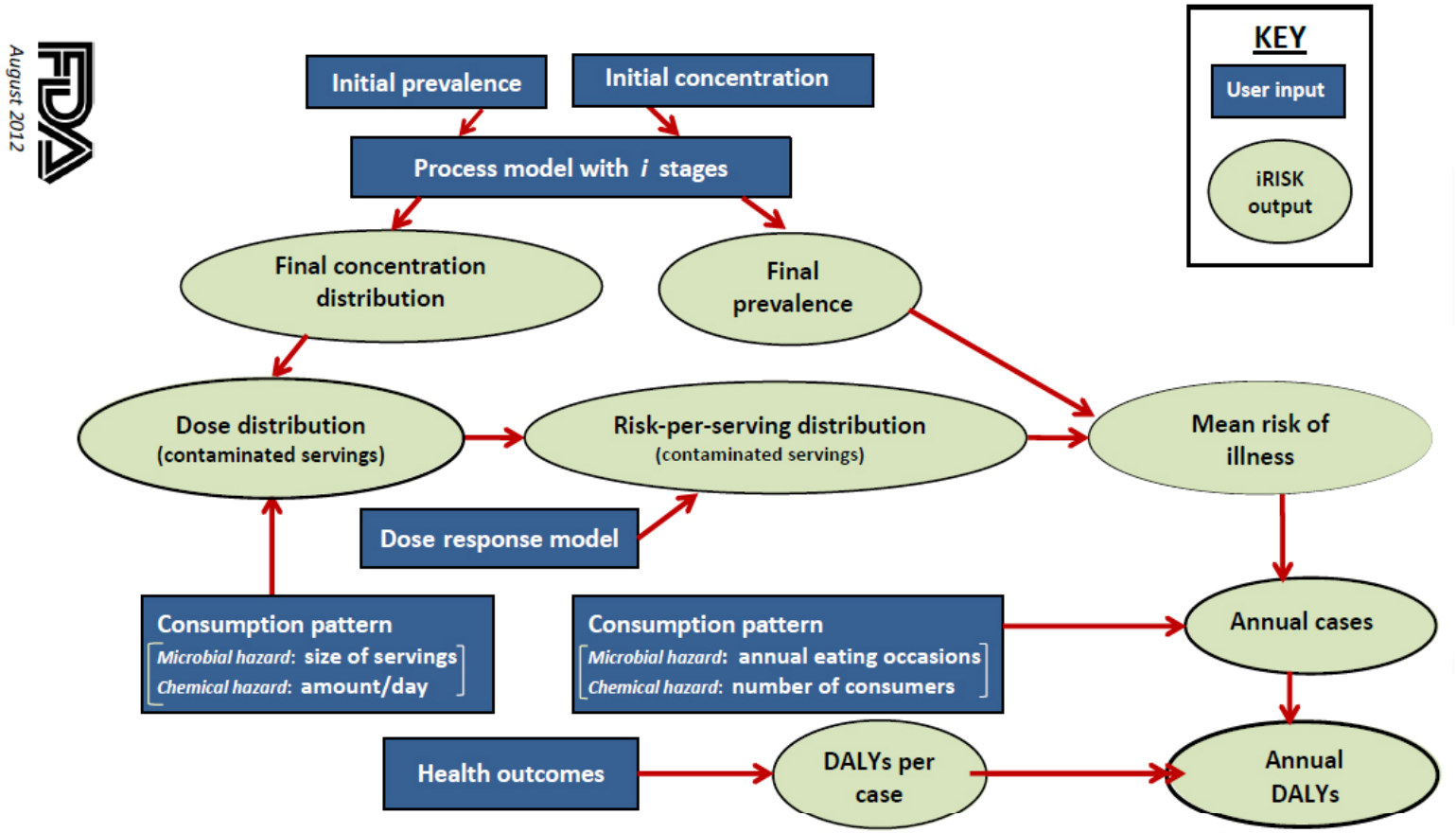




sQMRA tool

Evers et al. Food Control 2010;21:319-330
www.foodrisk.org

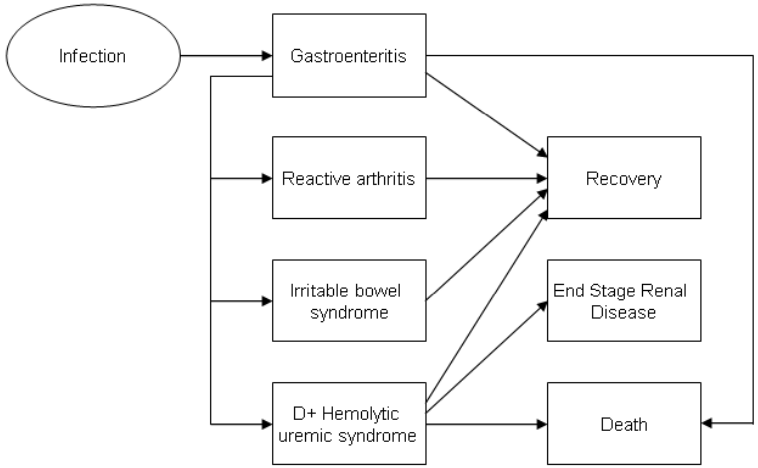
iRISK: an interactive, web-based system for risk ranking



http://foodrisk.org/exclusives/fdae28099s-irisk-a-comparative-risk-assessment-tool/

Burden of disease

- Outcome tree

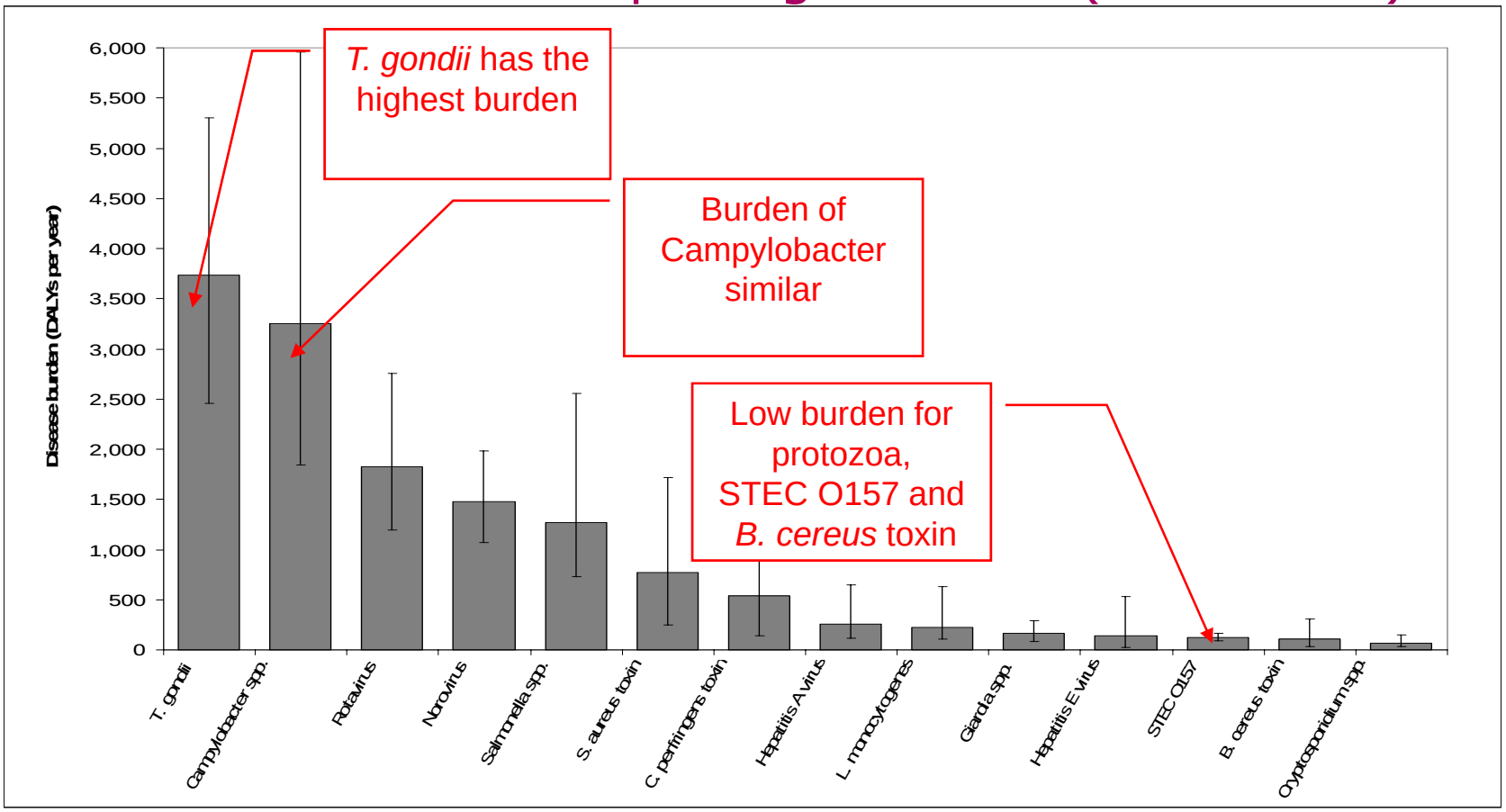


- DALY = YLL + YLD

$$YLL = \sum_{l} d_l \times e_l$$

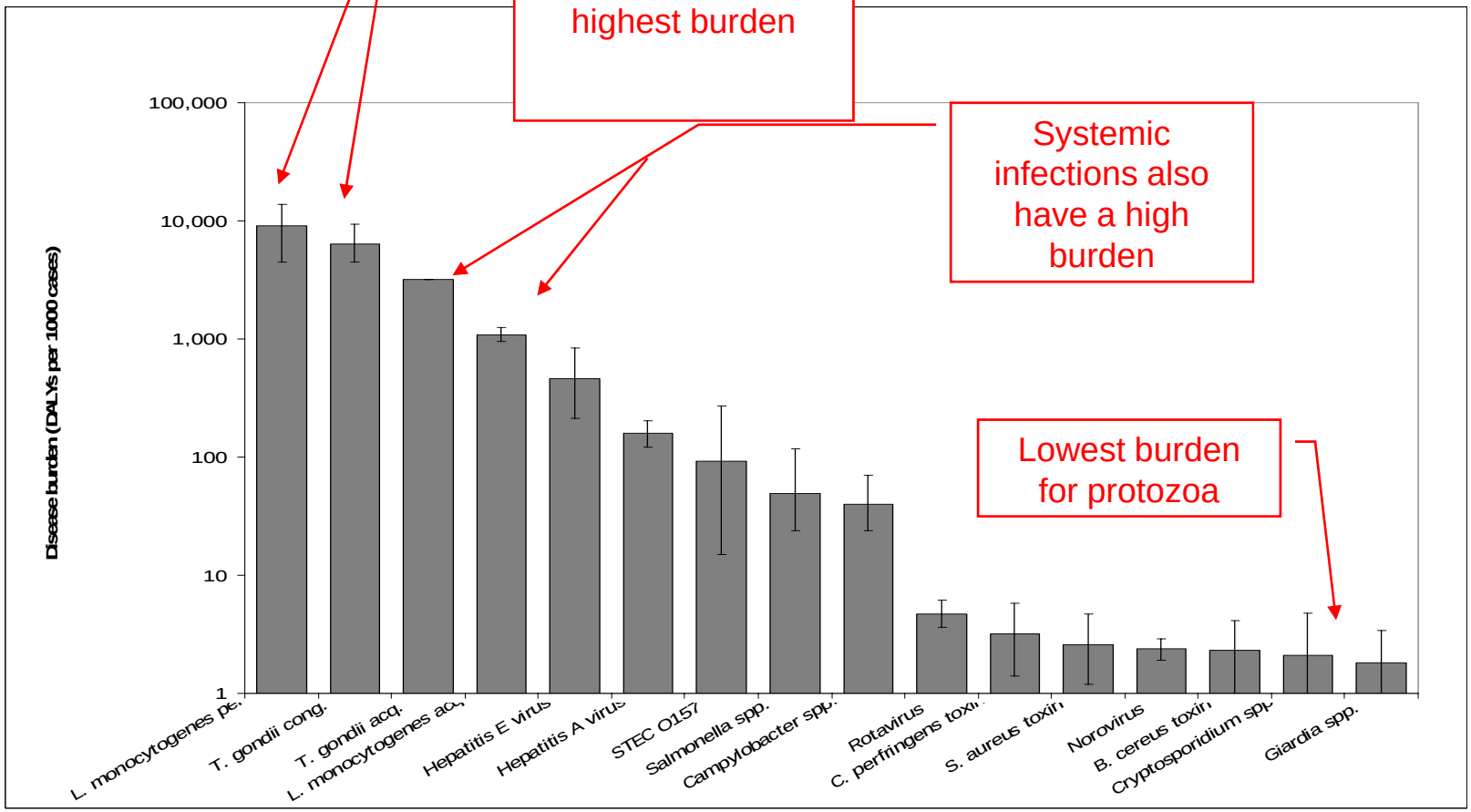
$$YLD = \sum_{l} n_l \times t_l \times w_l$$

Disease burden of enteric pathogens in NL (all sources)



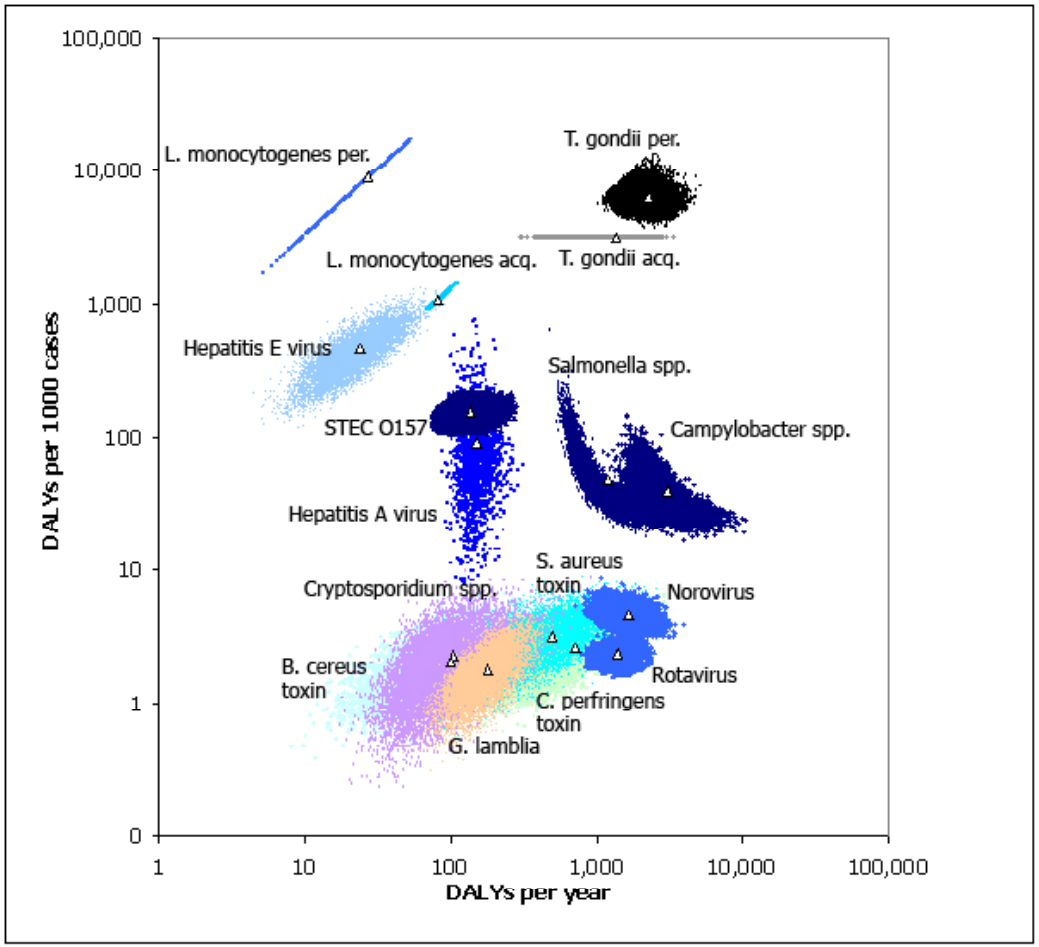
Havelaar et al., Int J Food Microbiol 2012; 156:231-238

Disease burden p



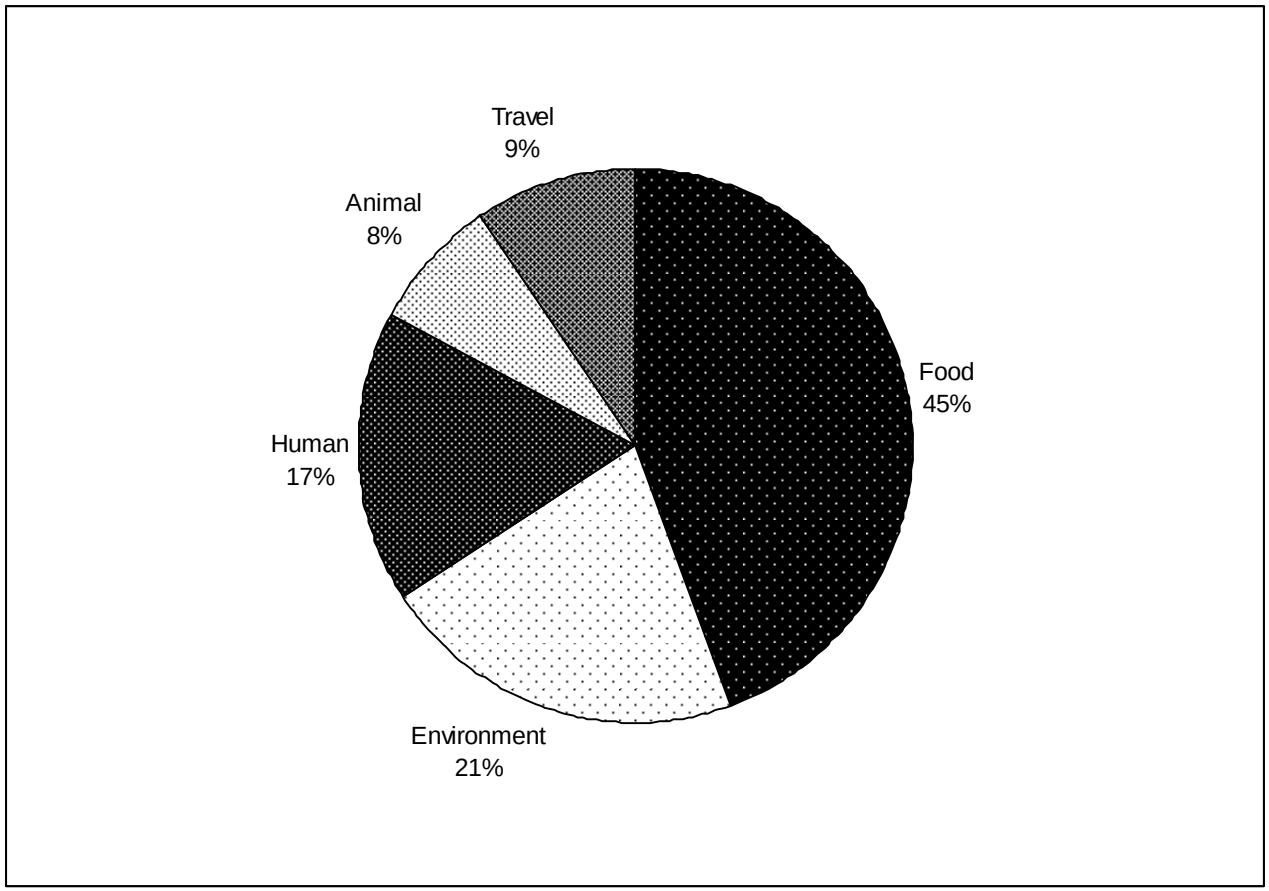
Havelaar et al., Int J Food Microbiol 2012; 156:231-238

Ranking of pathogens by population and individual burden



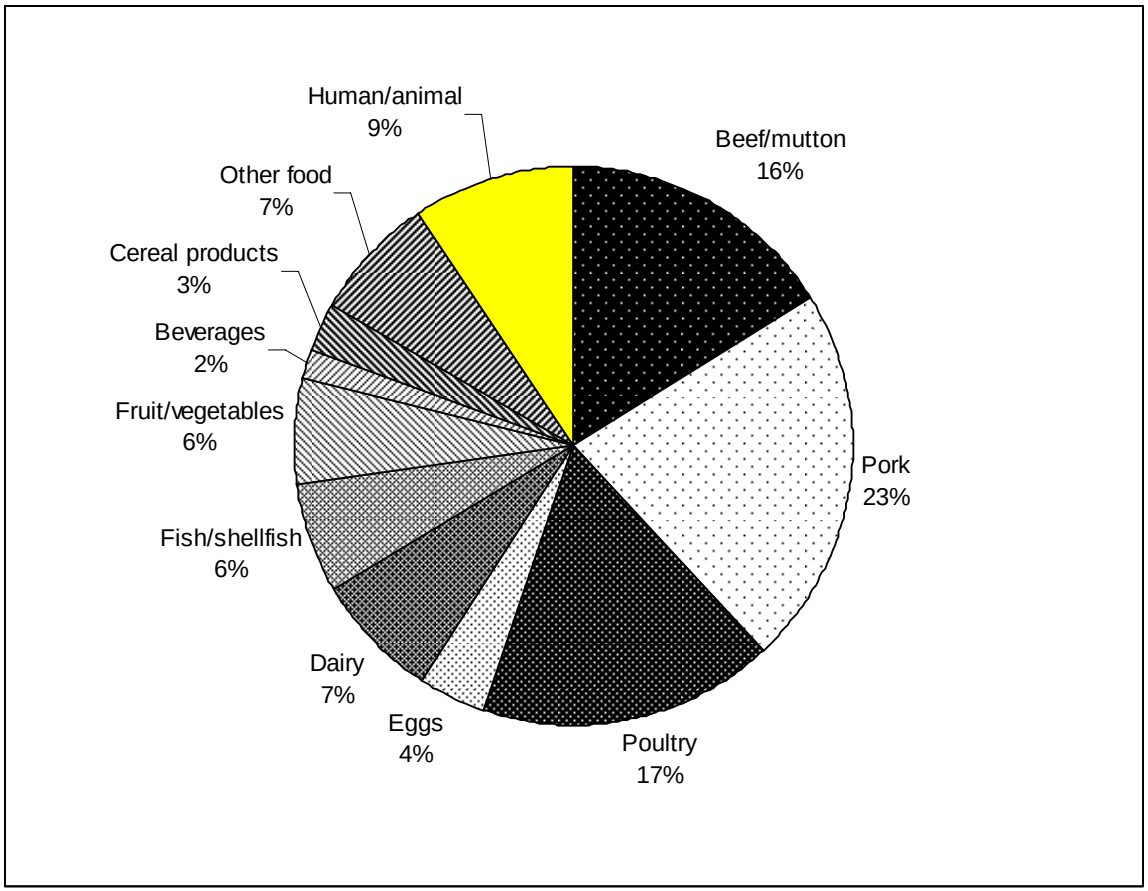
Havelaar et al., Int J Food Microbiol 2012; 156:231-238

Attribution of disease burden to major pathways



Havelaar et al., Int J Food Microbiol 2012; 156:231-238

Attribution of disease burden to food groups



Havelaar et al., Int J Food Microbiol 2012; 156:231-238

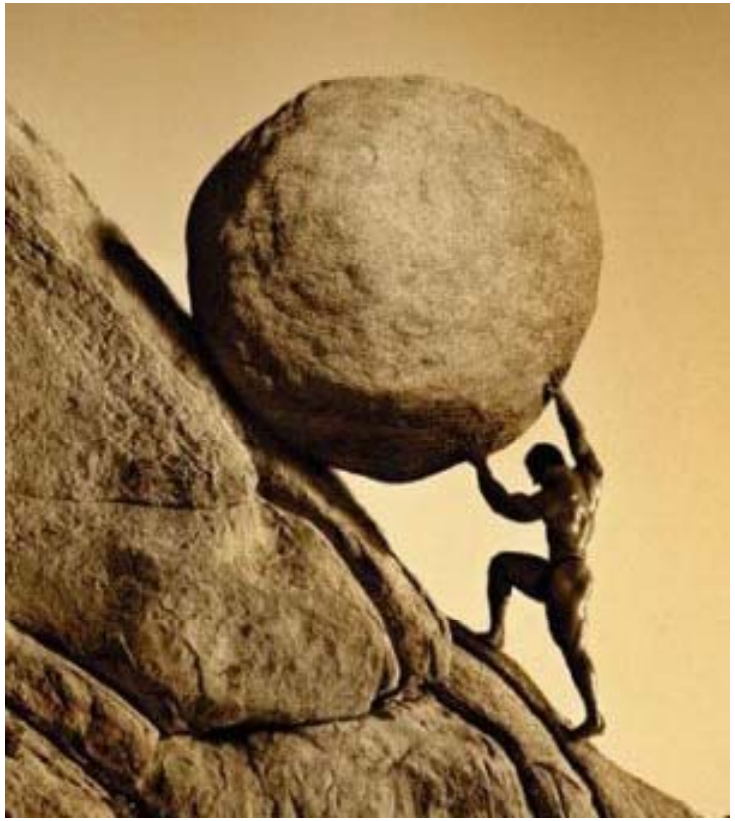
How to interpret results?

Our food is safer than ever

The health loss due to unhealthy diet is many times greater than that attributable to unsafe food

- Unfavourable dietary composition: 245,000 DALYs
- Overweight: 215,000 DALYs
- Microbiological infection by known pathogens: 1,000-4,000 DALYs
- Chemical constituents: 1,500-2,000 DALYs

⇒ No need for further action?



Van Kreijl et al., 2006. RIVM report number 270555009

Conclusions

- Comparing risks is not impossible or immoral, but it is very difficult; more so than either supporters or detractors of the practice seem to realize - Adam Finkel
- Risk ranking should take a structured approach
- Risk ranking approaches should be fit for purpose
  - Selection of risk metrics
  - Selection of risk ranking model
  - Resources and time vs. transparency and repeatability
- Whenever possible quantitative risk ranking approaches are preferable
- Good risk ranking models are simplified risk assessment models
- Interaction between risk managers and risk assessors is a critical success factor
- Risk ranking is only the beginning of a decision making process

Thanks to …

- EFSA BIOHAZ Panels, secretariat and WG on risk ranking, chair Kostas Kotsoumanis
- Floor van Rosse, Marieta Braks, Joke van der Giessen
- Eric Evers, Jurgen Chardon
- Juanita Haagsma, Marie-Josée Mangen, Wilfrid van Pelt, Ingrid Friesema, Yvonne van Duynhoven
- Roger Cooke