Listeria monocytogenes in smoked salmon

A case study to evaluate the suitability of available Belgian data for exposure assessment

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Scientific Committee FASFC and Scientific Committee Microbiology Working Group

1. Introduction

- FASFC Control program
  - Biological parameters
    - e.g. *Salmonella*, *Campylobacter*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Bacillus cereus*, ….
  - Chemical parameters
    - e.g. dioxins, PCB's, heavy metals, mycotoxins, ...
  - Animal diseases
   - e.g. tuberculosis, disease of Aujeszky, BSE, ….

- Sci Com case studies :
  - can these data be used for probabilistic exposure assessment/risk assessment ?

Microbiological case study :
How suitable are the available Belgian data for exposure assessment of *Listeria monocytogenes* in smoked salmon ?

DATABASE LABRESULTS FASFC CONTROL PROGRAM	+	DATABASE BELGIAN CONSUMPTION DATA (IPH)

EXPOSURE ASSESSMENT
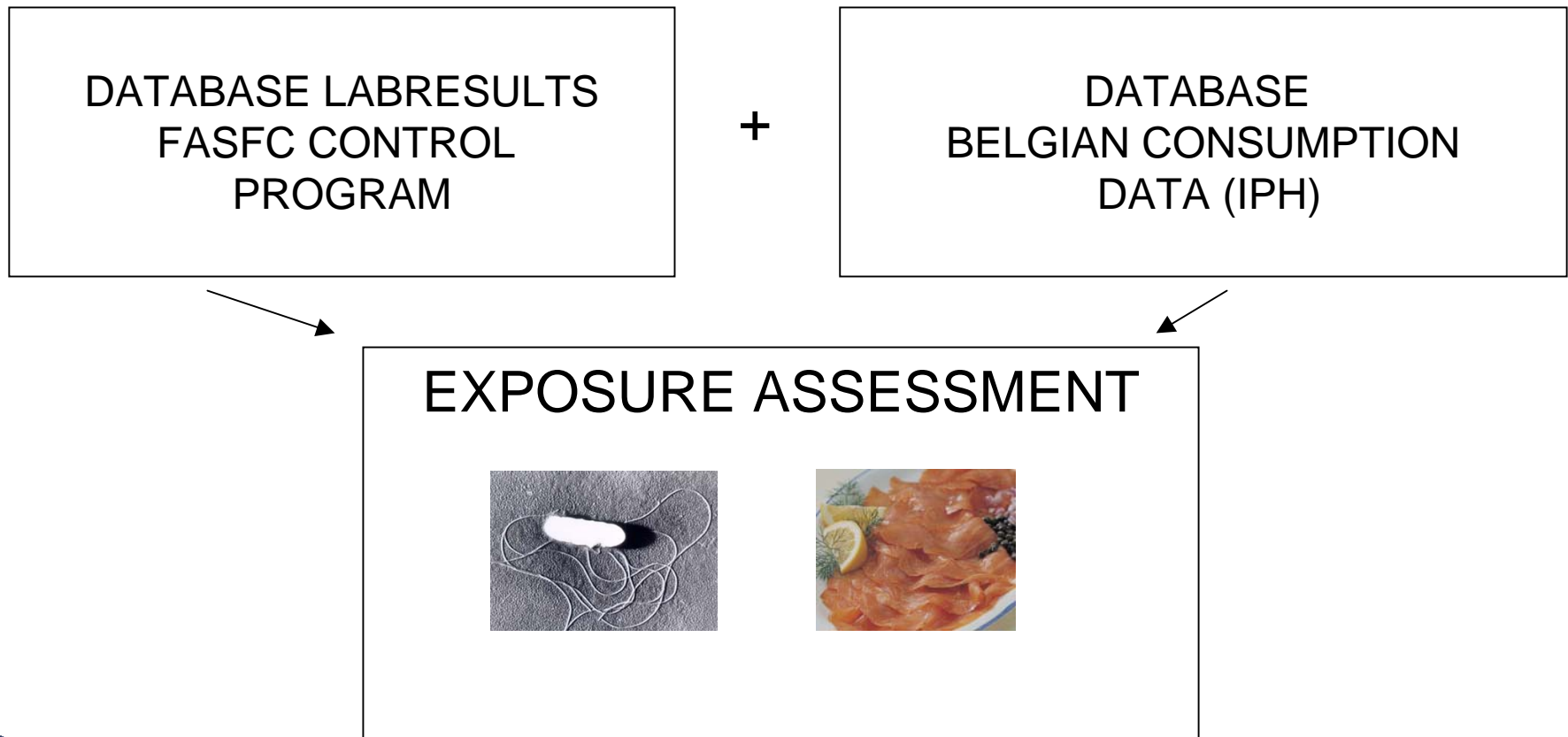
2. Exposure assessment : component of risk assessment

1. Hazard identification

2. Hazard characterization

3. Exposure assessment

4. Risk characterization

2.1. Hazard identification

Listeria monocytogenes

- Food pathogen (ubiquitous in the environment)
  - meat products : pâté, filet américain, minced meat
  - soft cheese and milk products
  - ready-to-eat meals
  - smoked fish, salads

- Can multiply at refrigeration temperature :
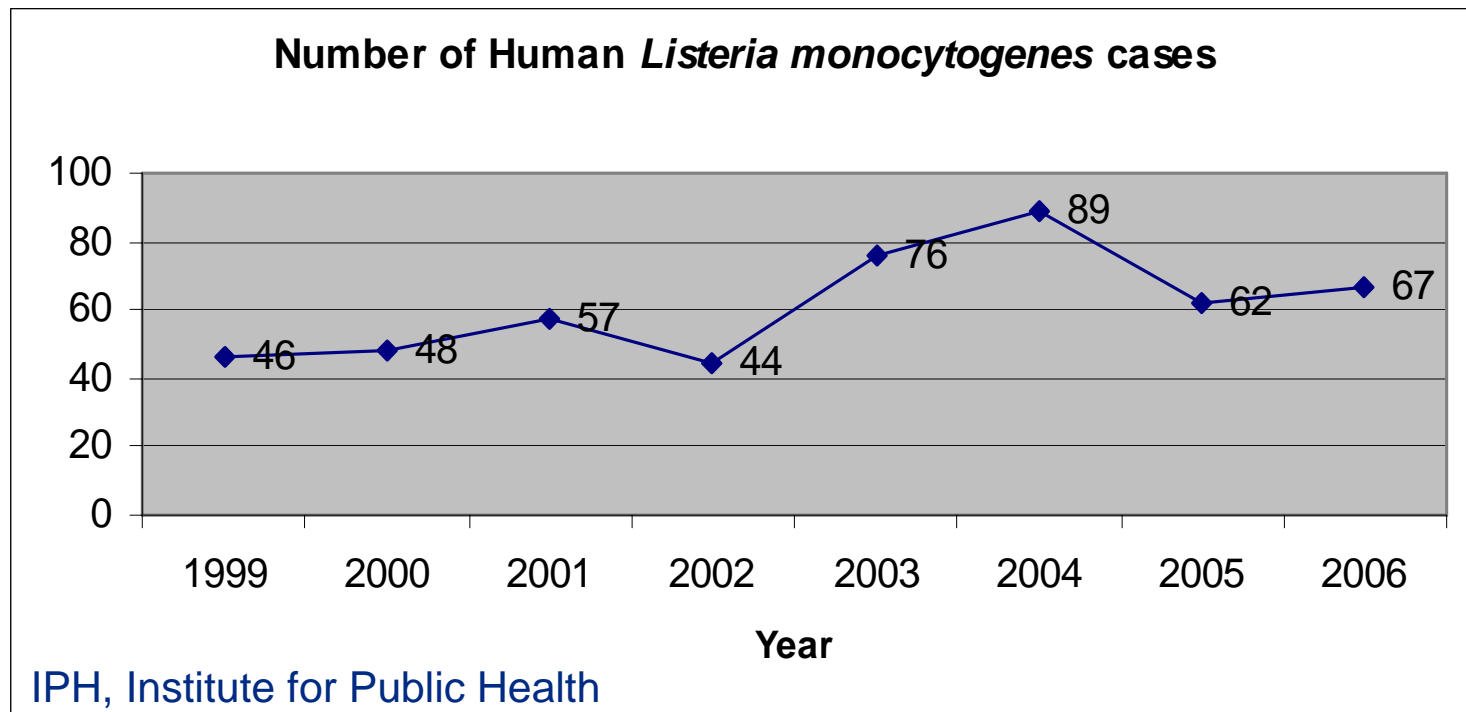 - growth possible > – 2 °C (T_{opt} : between 30-37 °C)

Human invasive listeriosis

– Severe disease, high mortality (till 30%)
– Food = major vector of infection
– Incubation period after ingestion : ± 20 - 30 days
– 4b, 1/2a en 1/2b, with 4b as most prevalent serotype

– **Susceptible groups :**
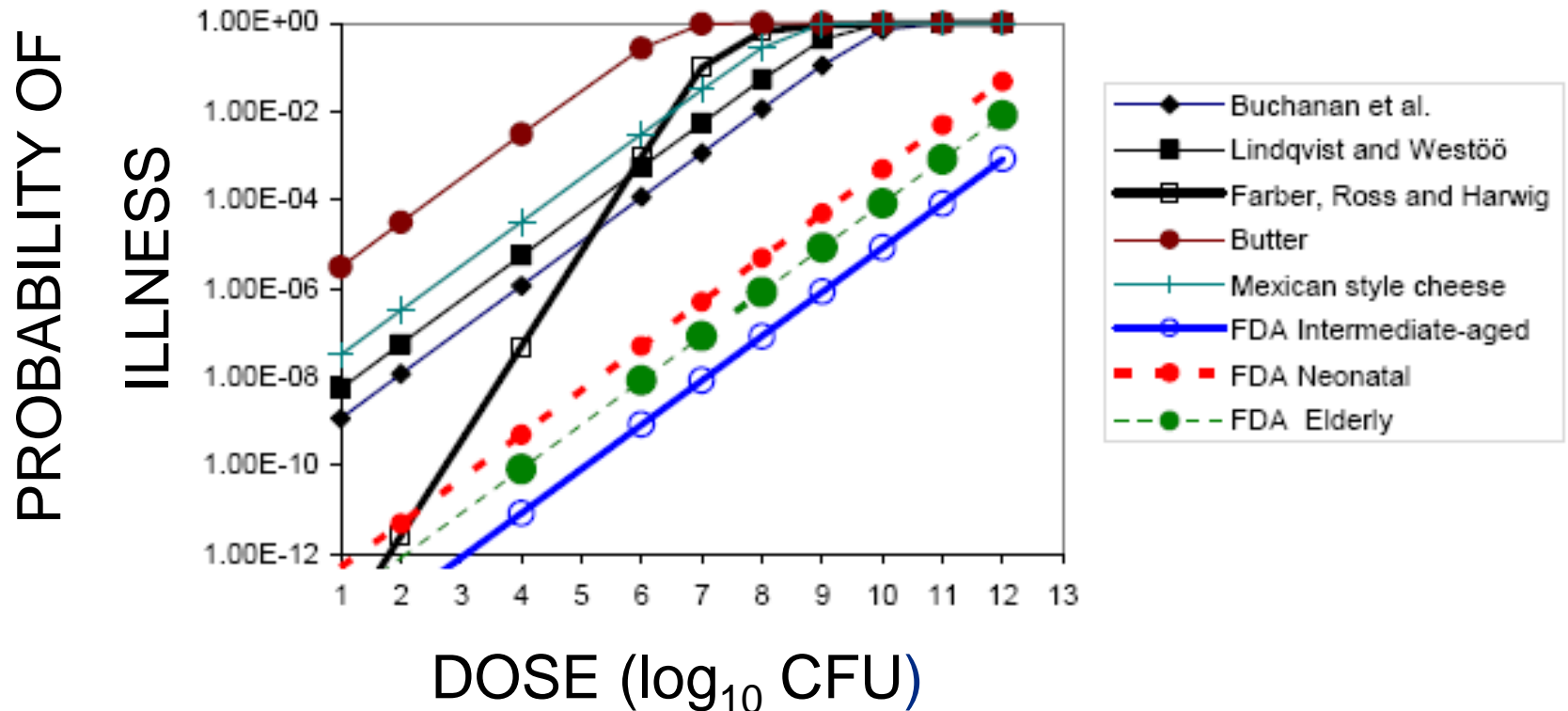 - Pregnant women
  - Immunocompromised persons
  - Older persons

Evolution of Belgian listeriosis cases

Number of Human *Listeria monocytogenes* cases

IPH, Institute for Public Health

2.2. Hazard Characterization

- Dose-respons curves, many different models available:

Legend:
- ◆ Buchanan et al.
- ■ Lindqvist and Westöö
- □ Farber, Ross and Harwig
- ● Butter
- + Mexican style cheese
- ○ FDA Intermediate-aged
- ● FDA Neonatal (red dashed)
- ● FDA Elderly (green dashed)

Y-axis: PROBABILITY OF ILLNESS

X-axis: DOSE ($\log_{10}$ CFU)

2.3. Exposure assessment

- Probabilistic approach

- Purpose of the exposure assessment = quantitative estimation of the probable intake of *Listeria monocytogenes* by consumption of a portion of smoked salmon

- Two types of information required
  - Level of contamination by *Listeria monocytogenes* on smoked salmon (cfu/g)
  - Portion size of smoked salmon consumed (g)

Level of contamination by *L. monocytogenes* on smoked salmon

- ## DATA Control Program FASFC 2002-2006

Analysis of *L. monocytogenes* in smoked salmon	Time of analysis		
	Production	**End of shelf life**	
Detection in 25 g			
Total number of analysis :	576	0	
Number of positives :	112 (19.4 %)	/	$\geq$ 0.04 cfu/g
Detection in 0.01 g			
Total number of analysis :	0	209	
Number of positives :	/	10 (4.8 %)	$\geq$ 100 cfu/g

➜ two different times of analysis

➜ semi-quantitative data

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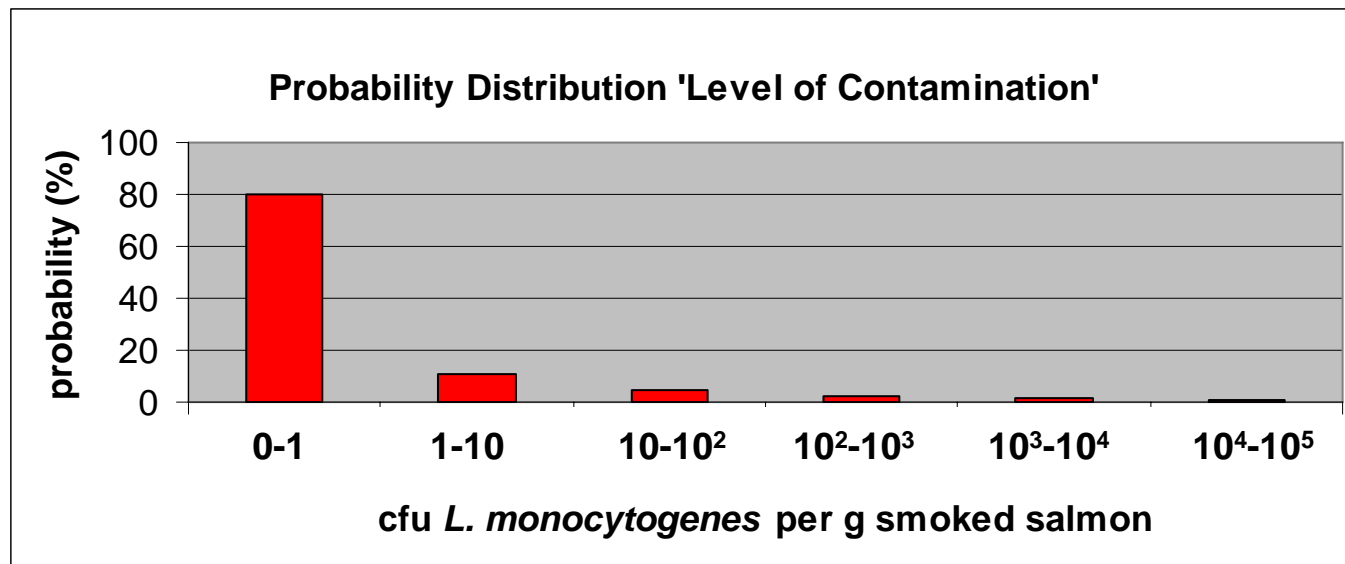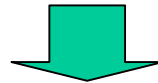$\geq$ 0.04 cfu/g

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→ two different times of analysis

→ semi-quantitative data

Level of contamination by *L. monocytogenes* on smoked salmon

ASSUMPTIONS on DATA FASFC :
1) Time of analysis : both end of shelf life
2) Semi-quantitative data ➔ quantitative data
   expert opinion : max. level 10^5cfu/g + exponential

Probability Distribution 'Level of Contamination'

cfu *L. monocytogenes* per g smoked salmon

Portion size smoked salmon (g)

- Data Belgian consumption survey 2004 (IPH)
  - Interview of 3245 Belgian citizens on 2 days
  - Classification in different age categories
  - Information on consumption of smoked salmon :

| Age category	Number of portions	Portion size smoked salmon(g)			
		Mean	St. dev.	Min.	Max.
15-59 year	61	38	32.1	3.8	150
59-99 year	53	44	30.0	1.9	115
15-99 year	114	41	31.1	1.9	150

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DATA CONSUMPTION (IPH)

Probability distribution 'Portion size'
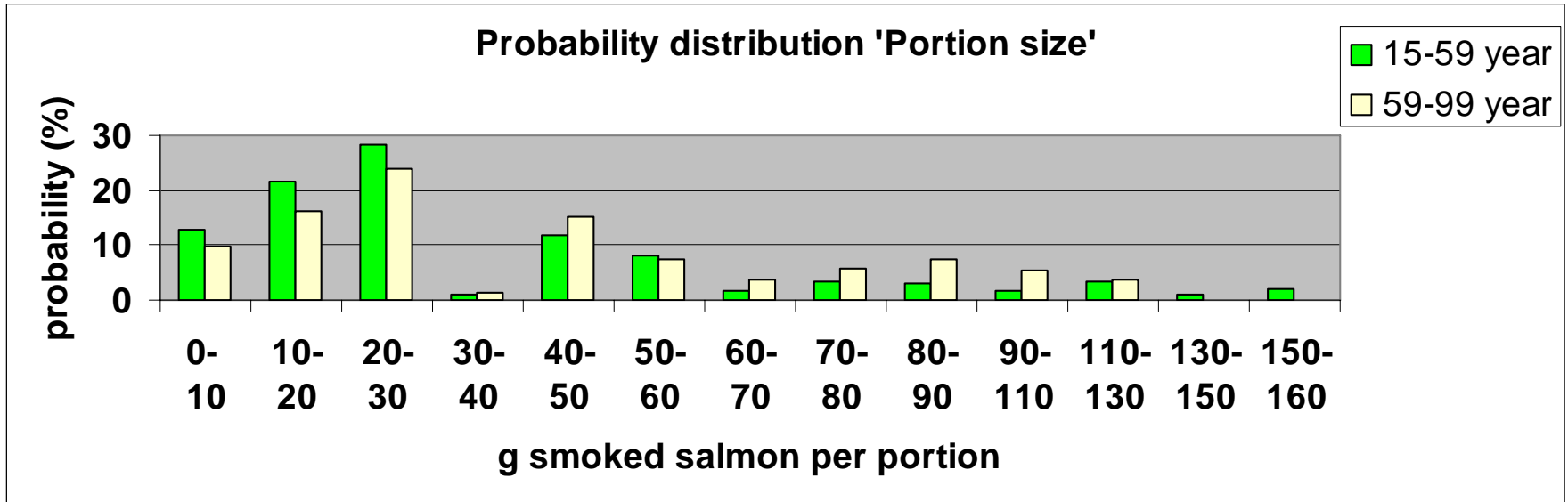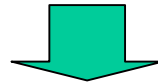
Exposure assessment :

Probability distribution of contamination level		Probability distribution of portion size

Monte Carlo Simulation

Probability distribution 'exposure assessment per portion smoked salmon'

Legend:
- 15-59 year (green)
- 59-99 year (pale yellow)

y-axis: probability (%) — 0, 20, 40, 60, 80, 100

x-axis categories: $0\text{-}1$, $1\text{-}10^2$, $10^2\text{-}10^3$, $10^3\text{-}10^4$, $10^4\text{-}10^5$, $10^5\text{-}10^6$, $10^6\text{-}10^7$

cfu *L. monocytogenes* per portion smoked salmon

Exposure assessment : percentiles

Percentiles (%)	cfu *L. monocytogenes* per portion smoked salmon		
	Age category 15-59 year	Age category 59-99 year	Age category 15-99 year
10	0	0	0
80	0	0	0
85	68	83	75
90	2.7×10^2	3.2×10^2	3.0×10^2
95	2.3×10^3	2.7×10^3	2.5×10^3
97.5	1.7×10^4	1.9×10^4	1.8×10^4
99	1.6×10^5	1.8×10^5	1.7×10^5
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2.4. Risk characterization

- Estimation of the number of listeriosis cases per year due to consumption of smoked salmon per million of immunocompromised people based on :

  – Dose-respons curve

  – Exposure assessment

  – Number of consumed portions smoked salmon per year

2.4. Risk characterization

Used Dose-Respons Model	Average number of listeriosis cases per year per million immunocompromised people due to consumption of smoked salmon
Lindqvist et. al (2000)	**40**
Buchanan et al (1997)	**8**
WHO (2004)	**0.5**

- Uncertainty is very large
  - Exposure assessment : assumptions (time/semi-quantitative data)
  - Large difference according to the used dose-respons model
- The number of reported cases in Belgium is in the same order of magnitude as the estimates

3. Conclusions

- The purpose of the study :
  - to evaluate the suitability of available Belgian data for exposure assessment : *L. monocytogenes* in smoked salmon

  - Scientific secretariat : acquire experience with probabilistic methodology

- Exposure assessment was performed
  - Large uncertainty

3. Conclusions

- Contamination data suitable ?
  - Semi-quantitative + different analysis time
  - Many assumptions required (increases uncertainty)
  - Recommendation to FASFC : <u>quantitative data required</u>

- Consumption data suitable ?
  - Data available for different age groups (not < 15 year)
  - OK for use for exposure assessment

- Other data ?
  - Information susceptible persons, e.g. number of Immuncompromised persons : difficult to acquire

3. Future perspectives

- Scientific Secretariat :
  - Experience with microbiological exposure assessment

- Next steps :
  - Perform exposure assessments for *L. monocytogenes* in different foods
    - New data in the framework of Reg. 2073/2005 : quantitative determination of *L. monocytogenes* at distribution
  - Ranking of different foods according to risk to the consumer

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