The gQMRA model used to explain the trend in listeriosis cases

MOEZ SANAA

French Agency for Food, Environmental and Occupational Health & Safety (ANSES), France; *Member of EFSA WG Listeria and BIOHAZ Panel member*

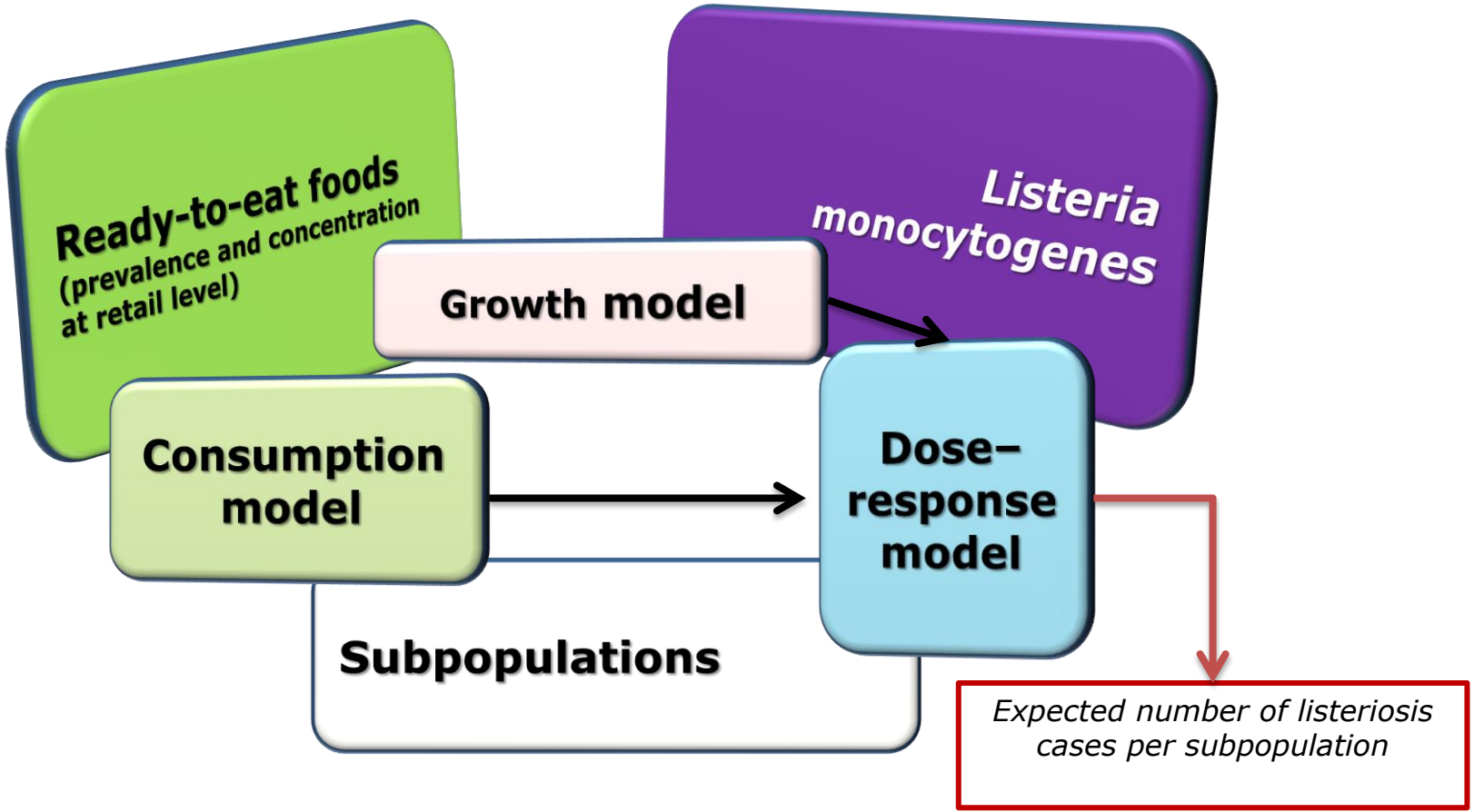
Stakeholder meeting, 19-20 Sep 2017

efsa
European Food Safety Authority

L. MONOCYTOGENES GENERIC QMRA MODEL

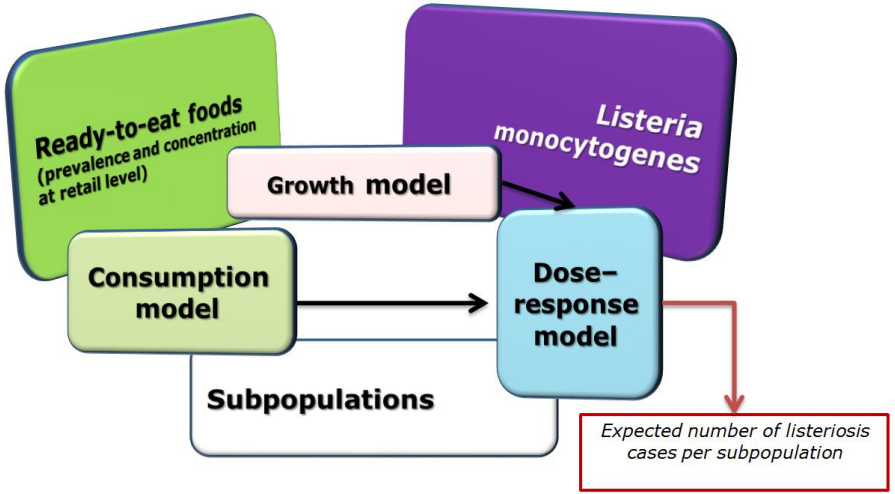
- Developed upon the model of Pérez-Rodríguez et al. (2017)
- Consistent with TSA analysis: same 14 age–gender groups
- Estimation of exposure used to assess a new DR model with parameters for the 14 age–gender groups
- *L. monocytogenes* concentration in RTE foods (EU and US data)
- Model implementation in R for more stability of model outputs (model convergence)
- Main inputs provided in structured Microsoft Excel tables
- The R code and model implementation allow an expanded evaluation of uncertainty when the uncertainty about the inputs are available
- Full inclusion of variability related to the DR model

MODEL ELEMENTS



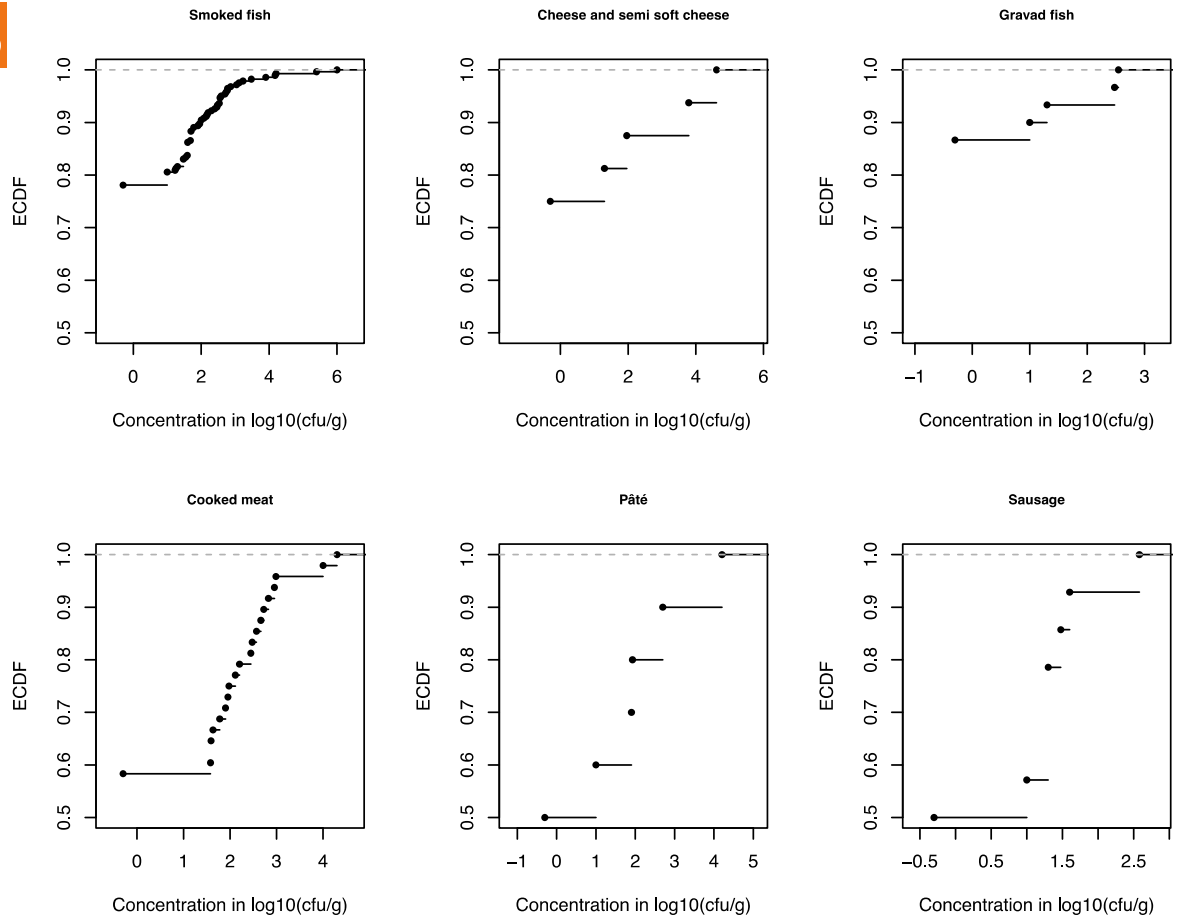
SEVEN RTE FOOD SUBCATEGORIES

- Cold-smoked fish
- Hot-smoked fish
- Gravad fish
- Cooked meat
- Sausage
- Pâté
- Soft and semi-soft cheese



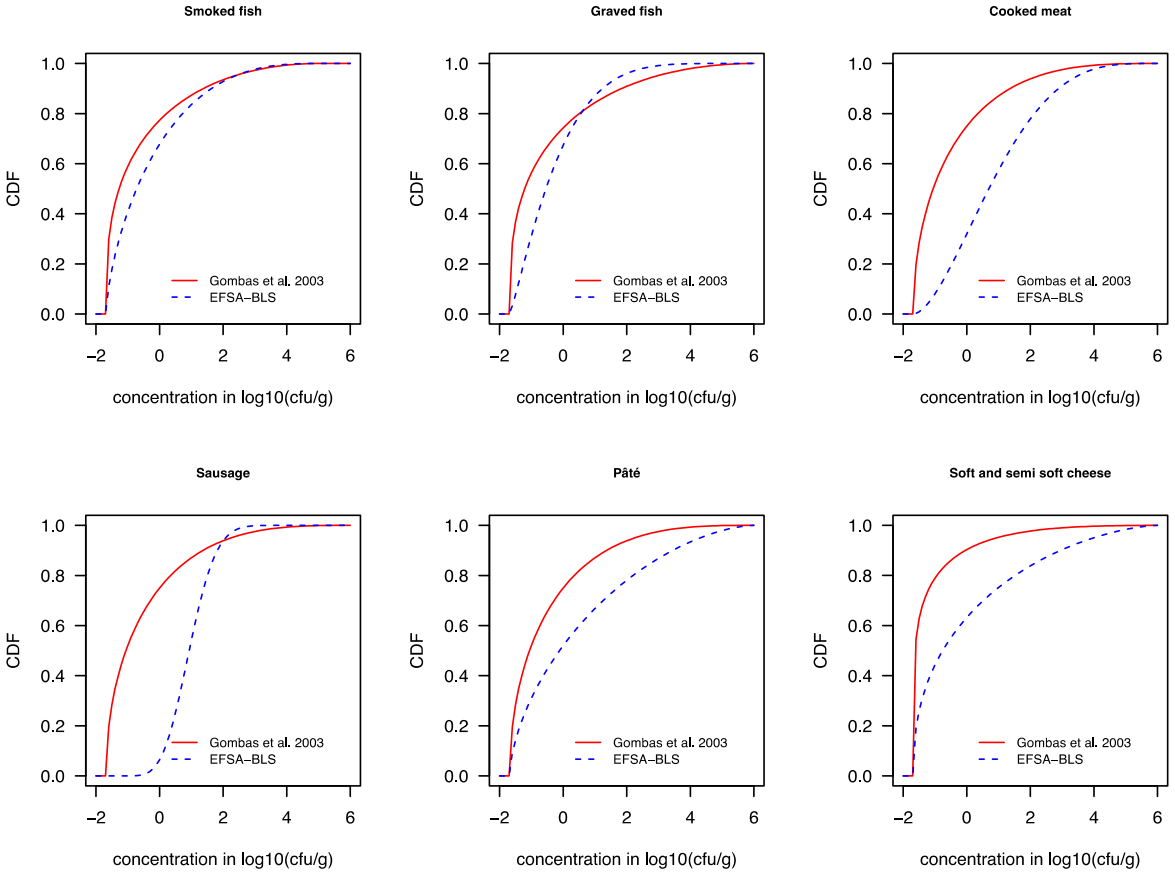
CONCENTRATIONS

Empirical cumulative distribution function of *L. monocytogenes* concentrations per RTE food category based on BLS data (EFSA, 2013, 2014)



CONCENTRATIONS

Fitted cumulative distribution functions of *L. monocytogenes* concentrations per RTE food subcategory obtained from the US (Gombas et al., 2003) and BLS data



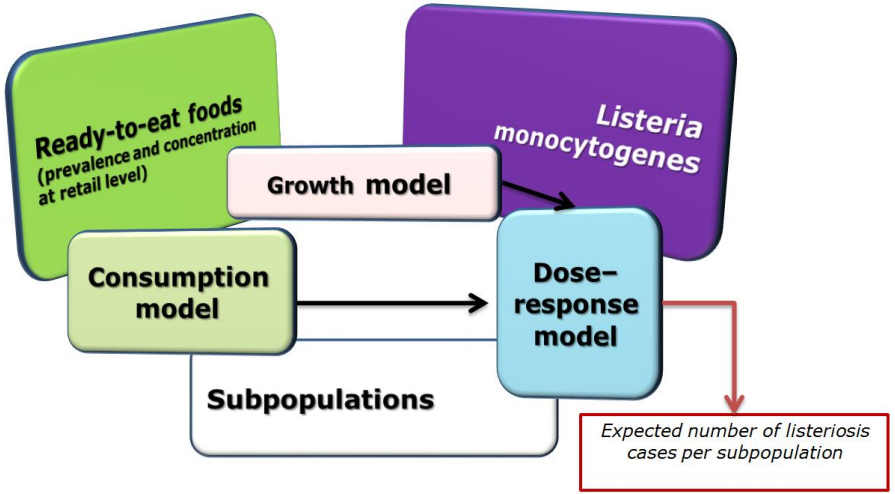
UNCERTAINTY ON INITIAL CONCENTRATIONS DISTRIBUTION

- Three options
  1. Use only the distributions estimated with BLS data
  2. Use only the distributions estimated with US data (Gombas et al., 2003)
  3. Use fish distribution from BLS data, and meat and cheese distributions from US data (Gombas et al., 2003)

considered the best and used as the baseline for the gQMRA model

CONSUMPTION MODEL PER RTE FOOD CATEGORY AND SUBPOPULATION

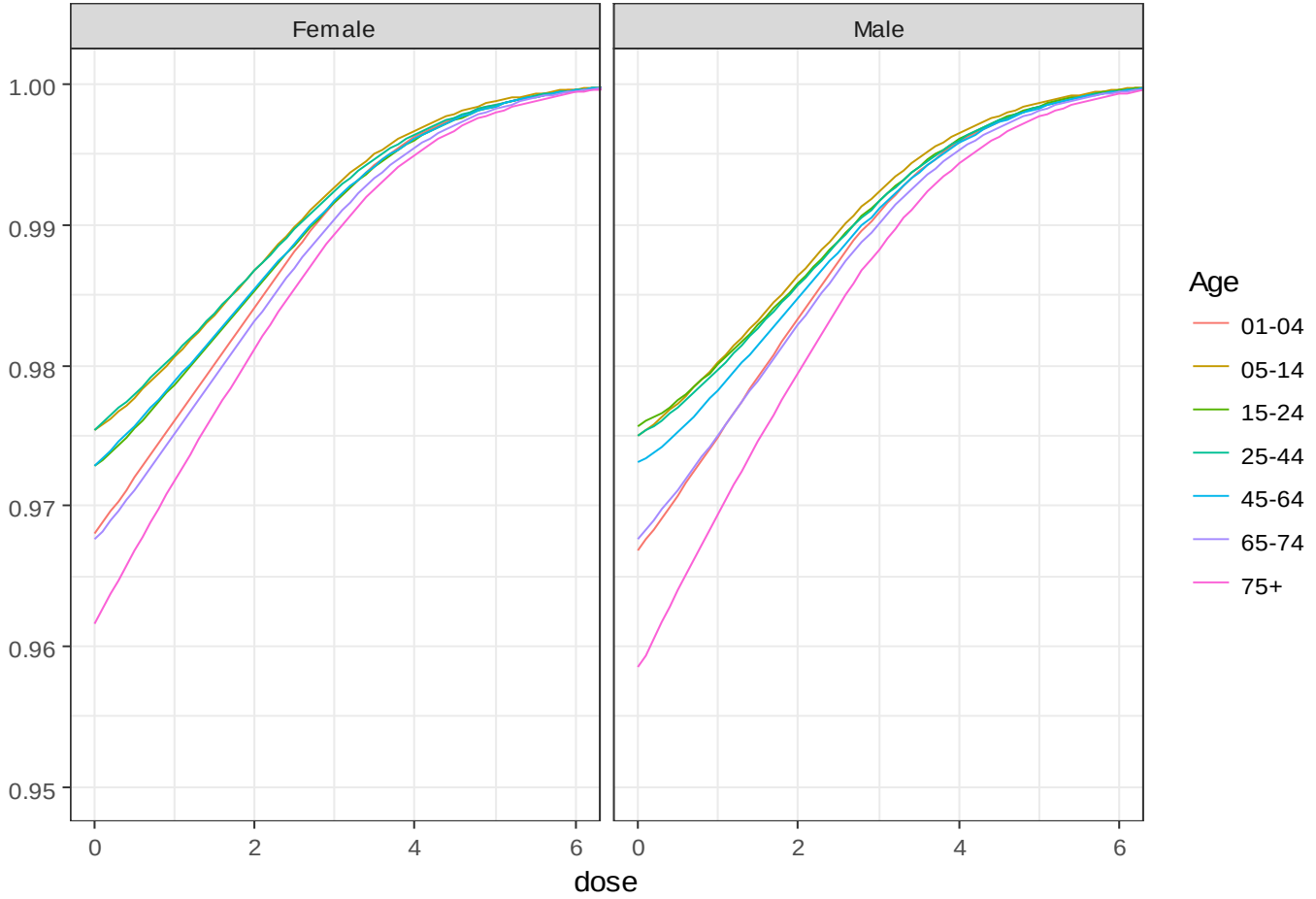
- average portion size (mass of RTE food ingested per meal)
- Total number of eating occasions per year (TEO)
- Estimated from the EFSA consumption database



GROWTH MODEL

- Specific EGR(5°C) distribution per RTE food sub-category and packaging type
- Temperature of storage variable
- Simple secondary model to assess EGR(T°C)
- Logistic Primary model (constant temperature during storage) without lag time
- Time of storage
  - Remaining shelf-life from BLS
  - RTE food can be consumed any time from immediately after purchase up to and beyond the remaining shelf-life of the product (10% more) but more likely after 0.30 of the remaining shelf life

SIMULATED DOSE DISTRIBUTION (LOG_{10} CFU) OF RTE FOOD



IMPORTANCE ANALYSIS

- Maximum population density of *L. monocytogenes* in RTE foods
- Time of storage at consumer level: mode and maximum of the proportion of the remaining shelf life
- Temperature of consumer refrigerator during storage: mean
- Initial concentration of *L. monocytogenes* in RTE foods: set of data (EU versus US)

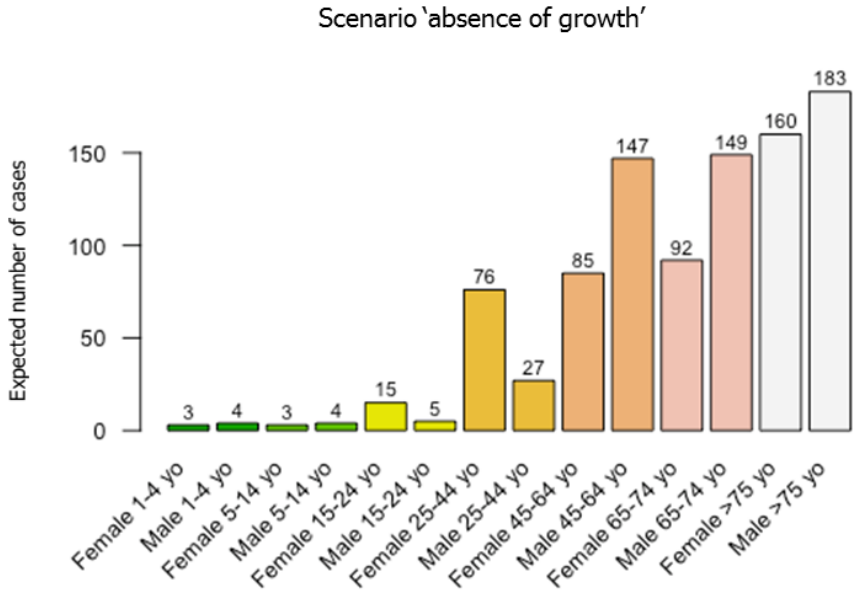
MODEL OUTPUTS

Population group (gender and age in years)	Prevalence[(a)]	Total number of eating occasions per year (A)	Risk per eating occasion (B)	Cases per year (A×B)
Female 1–4	0.03516	2.90E+09	1.73E-09	5
Male 1–4	0.03647	3.07E+09	2.37E-09	7
Female 5–14	0.02567	6.64E+09	8.29E-10	5
Male 5–14	0.02578	7.58E+09	7.62E-10	6
Female 15–24	0.02806	6.27E+09	3.86E-09	24
Male 15–24	0.02466	8.74E+09	9.39E-10	8
Female 25–44	0.02503	1.81E+10	6.49E-09	117
Male 25–44	0.02526	2.50E+10	1.72E-09	43
Female 45–64	0.02768	2.02E+10	6.60E-09	134
Male 45–64	0.02739	2.68E+10	8.65E-09	232
Female 65–74	0.03371	8.98E+09	1.65E-08	148
Male 65–74	0.03320	9.75E+09	2.40E-08	234
Female ≥ 75	0.04045	1.01E+10	2.58E-08	260
Male ≥ 75	0.04286	9.06E+09	3.31E-08	300

(a): The *L. monocytogenes* prevalence was calculated by weighting the prevalence observed in the 13 RTE food subcategories/packaging conditions by their consumption in each population group.

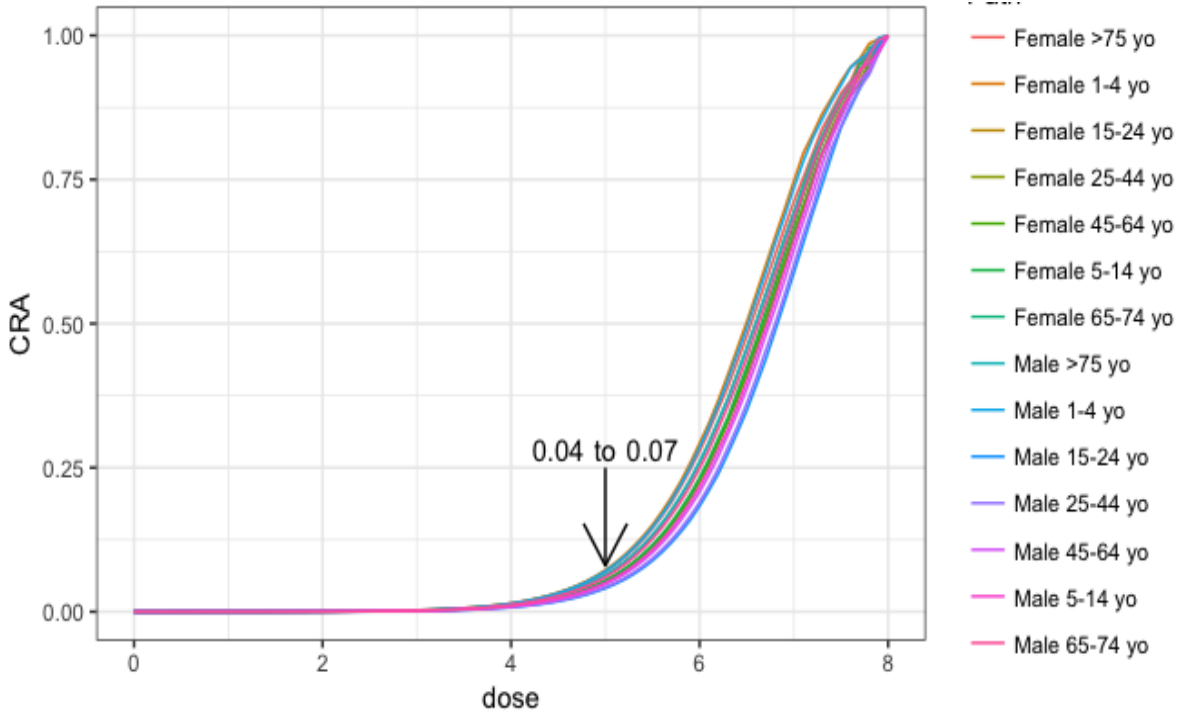
IMPORTANCE OF GROWTH

- Total number of cases 1,523 vs **953**
- Absence of growth from retail onwards may save, on average, **570** cases (**37%**, 570/1,523)

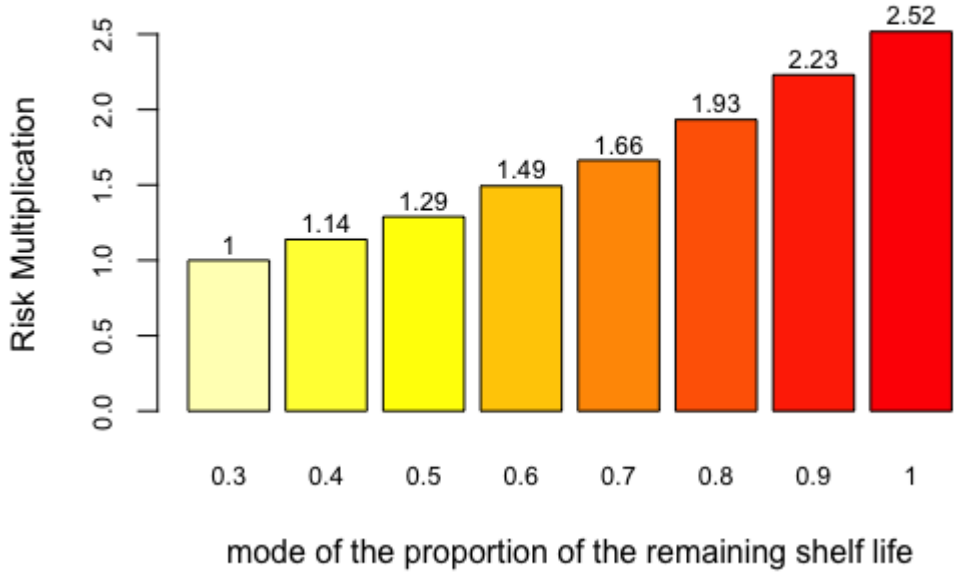


CUMULATIVE RISK ATTRIBUTION OF LISTERIOSIS PER SUBPOPULATION

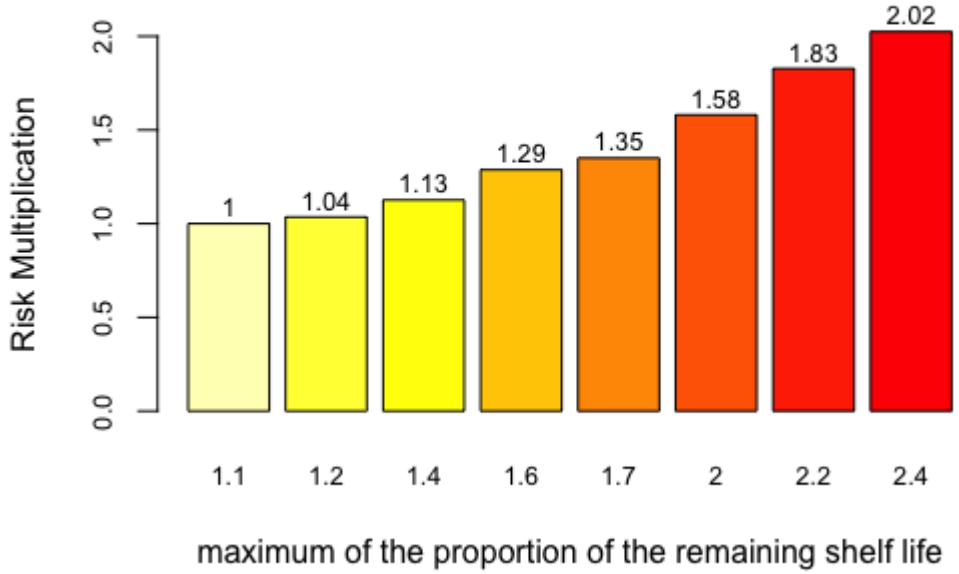
92.78% to 95.02% of cases are attributable to exposures with a dose > 5 $\log_{10}$ CFU



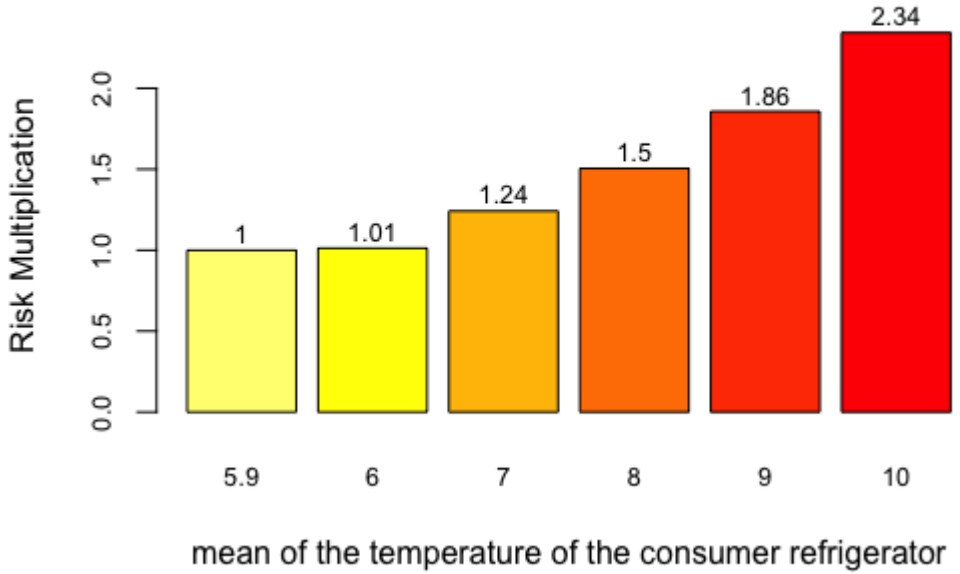
IMPORTANCE ANALYSIS



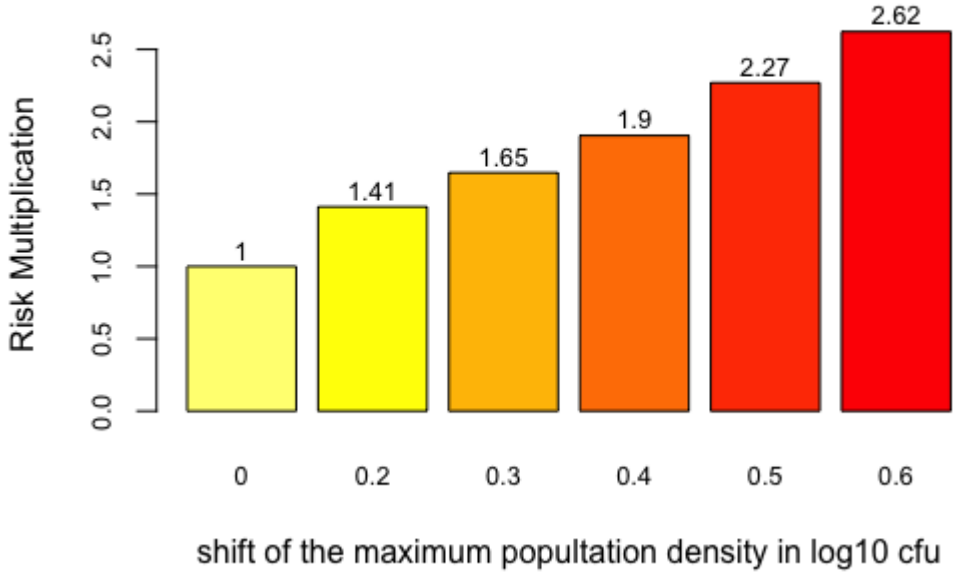
IMPORTANCE ANALYSIS



IMPORTANCE ANALYSIS



IMPORTANCE ANALYSIS



CONCLUSIONS

To double the risk

- Most common **time of consumption**:
  - mode of the proportion of the remaining shelf life needs to be shifted by 0.5 to around 0.8 (instead of the baseline of 0.3)
  - The **maximum remaining shelf lives** of RTE products needs to be 2.4 times (instead of the baseline of 1.1 times)
- The mean of **storage temperature** needs to be shifted (from 5.9°C in the baseline) to between 9 and 10°C
- The gQMRA model output was very sensitive to a shift in the *L. monocytogenes* **maximum population density**: a shift of < 0.5 $\log_{10}$ CFU/g would result in a doubling of the risk