An exposure model on *Campylobacter* concerning crosscontamination in Austrian private kitchens

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1th Croatian Food Safety Risk Assessment Conference
6 -7 October 2015
Faculty of Agriculture, Osijek, Croatia

1. Introduction
    1. Campylobacter in numbers
    2. Activities Austria
2. Exposure model
    1. Overview
    2. Results
3. Significance

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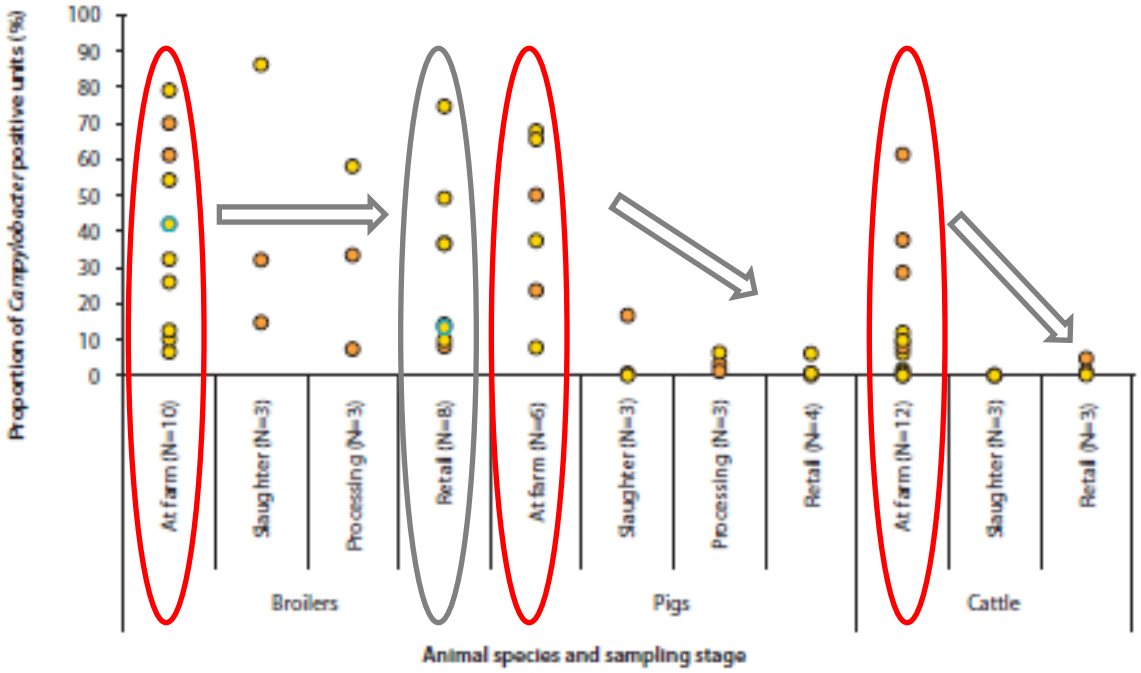
Campylobacteriosis

- Symptoms: fever, diarrhea, abdominal cramps, vomiting…
- Sequelae: GBS, RA, etc.
- Major source of infection: broiler meat



Source: EFSA (2008)

Campylobacteriosis

- Symptoms: fever, diarrhea, abdominal cramps, vomiting…
- Sequelae: GBS, RA, etc.
- Major source of infection: broiler meat

- public health impact of broiler meat (carcase)[1)]

Threshold on carcase	**Public health risk reduction**	**Baseline survey[2)] (AT)**
1000 CFU/g	> 50%	23% of tested carcases
500 CFU/g	> 90%	29% of tested carcases

1) source: EFSA 2015; 2) source: EFSA 2014

Campylobacter: numbers…

2013[1)]	AT	HR	EU
Reported cases	5,726	1,379	217,242
Human population	8,6 Mio	4,3 Mio	507,4 Mio
In broilers	55,79%	24,46%	19,9%
In fresh broiler meat	70,7%-88,5%	50,99%-81-51%	31,22%-52,33%

Fresh broiler meat at retail, Austria						
		Qual. results		Quantitative results (x)		
year	n	pos	% (CI)	CFU/g	n	% (CI)
2013[2)]	153	135	88,2% (82%;92%)	x>1.000	5	3,3% (1%;7%)
				500<x<1.000	5	3,3% (1%;7%)
2014[3)]	97	67	69,1% (59%;77%)	x>1.000	1	1% (0%;6%)
				500<x<1.000	5	5,2% (2%;12%)

1) source: EFSA 2015; 2) source: Anonym 2014 3) source: Anonym 2015

Campylobacter

Comparing numbers

- Matrix:
  - Animal species (broiler, turkey, pig, …)
  - Meat (fresh, frozen, modified atmosphere packaging, dressing)
  - Fecal content (fresh droppings, boot socks)
  - Cecal content (number of ceca sampled)
- Sampling stage (carcase after chilling, at processing, at retail, …)
- Detection method (quantitative-qualitative; WGS, etc.)

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Activities

- Zoonosis monitoring
- Campylobacter events, specific training, etc.
- Nationwide Campylobacter-Platform
  - "Konsensuspapier": consensus on possible control options
  - Awareness
- Projects
  - International (e. g. CamChain)
  - National (e. g. transport crates, risk priority number)
  - AGES:
    - Exposure model
    - Predictive tool (risk priority number "predicts" Campylobacter status of the farm)
    - Pet dogs

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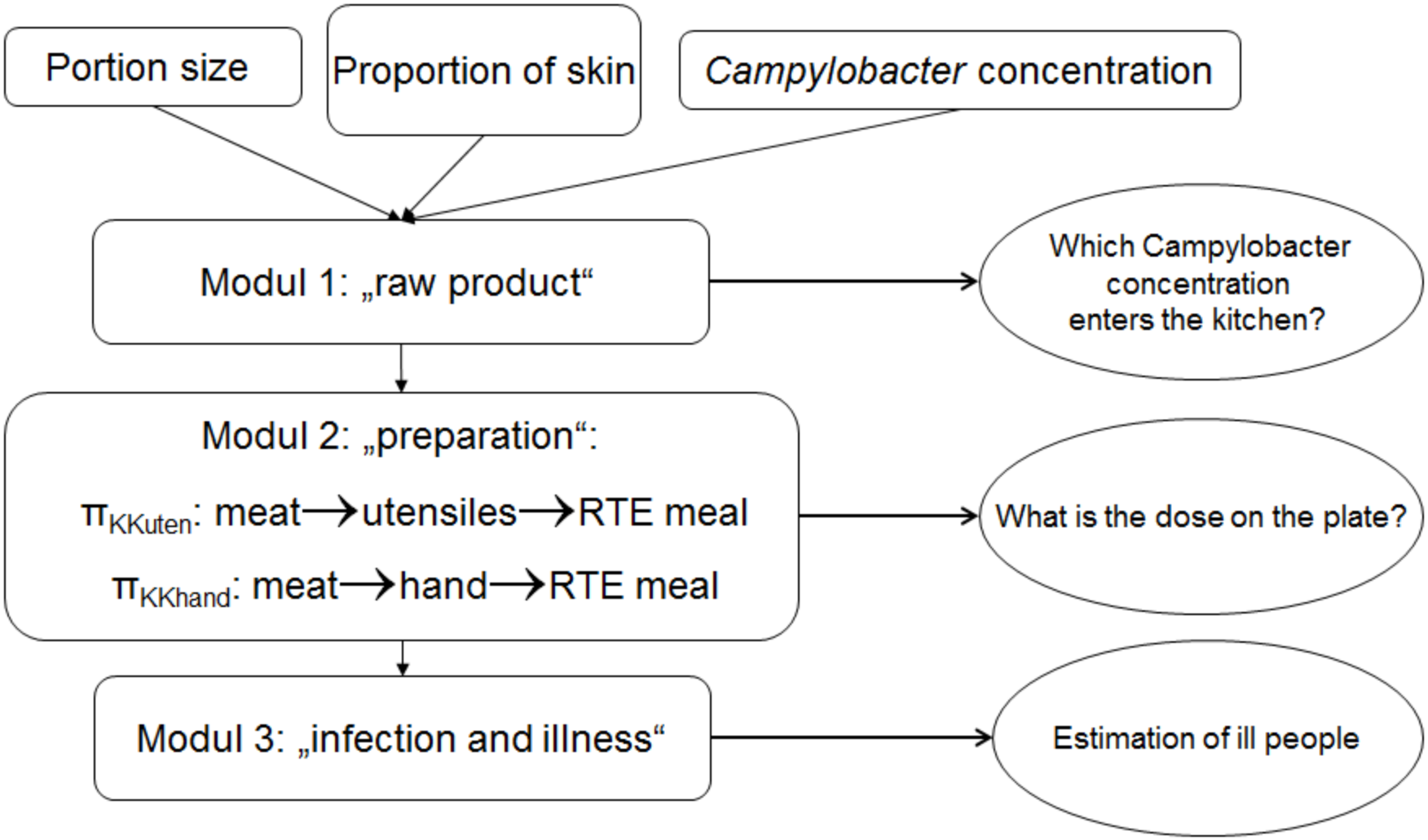
Campylobacter exposure model: probability of illness due to cross-contamination given 1.000 CFU/g on broiler meat in Austria

What is the probability of illness, caused by **cross contamination**, considering average hygiene practice of the cook, for 1.000 CFU *Campylobacter* per gram broiler skin?

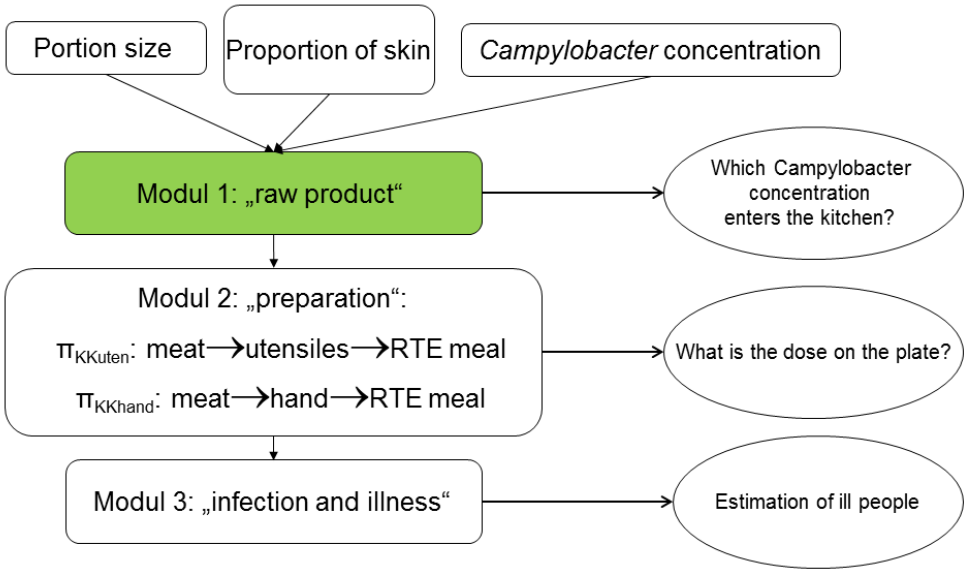
- Level of hygienic behaviour of a "typical" Austrian cook
- Plain model (no input-distribution: just point estimate)
- Show: 1.000 CFU/g of Campylobacter leads to illness due to cross contamination only (NO undercooking modelled)
- Second Order Monte Carlo simulation
- Assumptions (see appendix of presentation)

Model overview

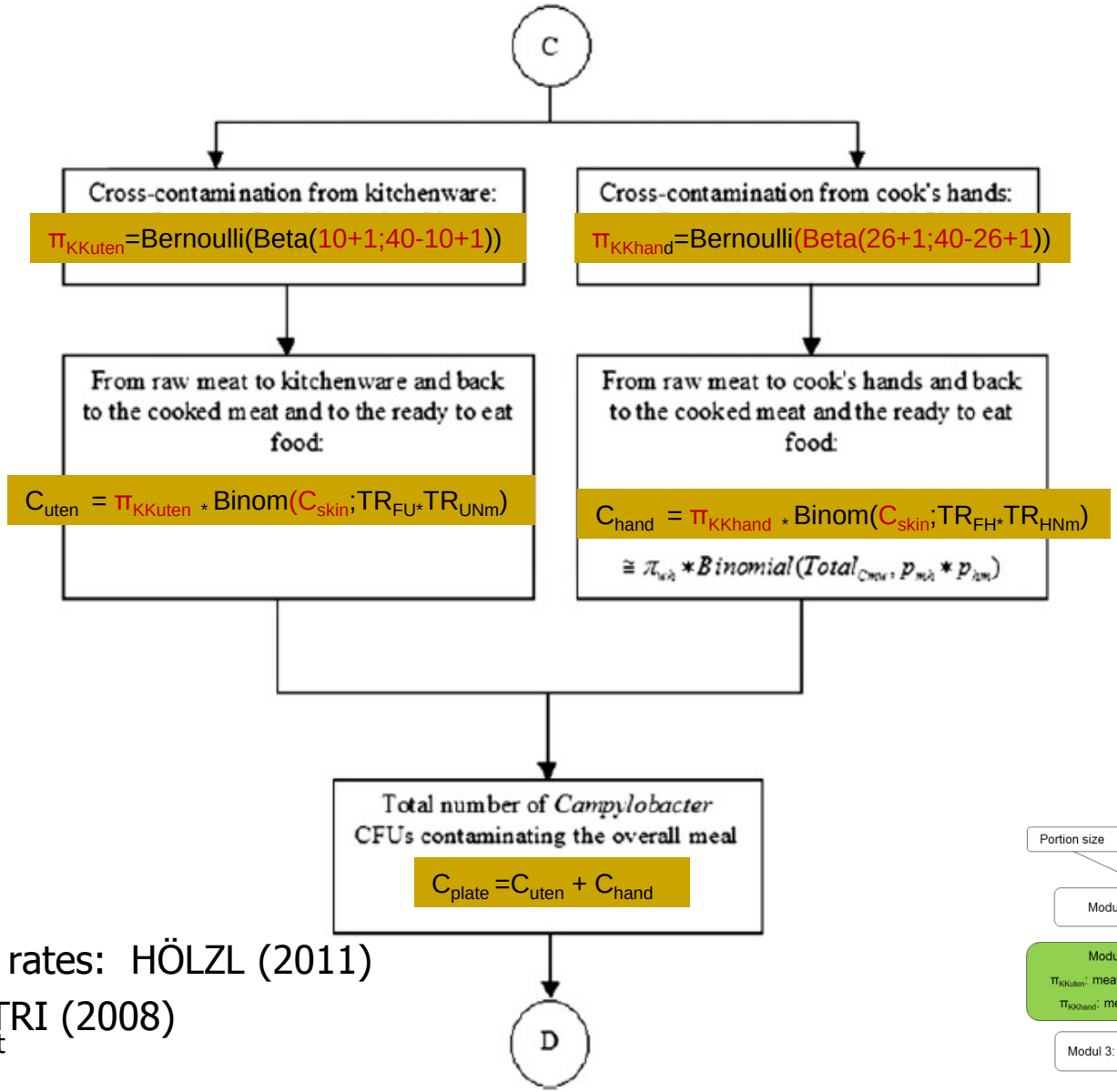


Module 1 „raw product“

C_{skin}=portion size*propotion of skin*concentration

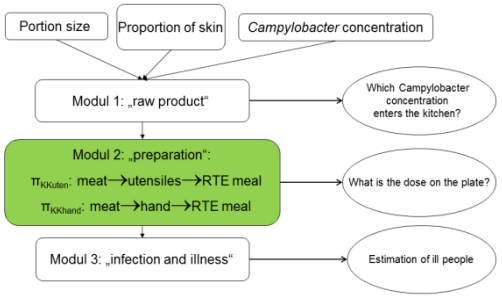


Module 2 „preparation“



Data: transfer rates: HÖLZL (2011)

Model: CALISTRI (2008)



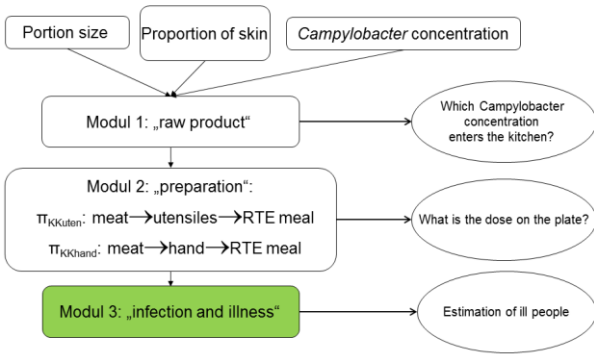
Module 3 "infection and illness"

Dose-response-model:

beta binomial (α= 0.145, =7.59) (Nauta, 2009)

$$P_{Inf}(D) = 1 - \frac{\Gamma(\alpha+\beta)\Gamma(\beta+D)}{\Gamma(\beta)\Gamma(\alpha+\beta+D)}$$

$$P_{\text{ill}}(n) = P_{\text{inf}}(n) \times P_{\text{ill}|\text{inf}}(n).$$



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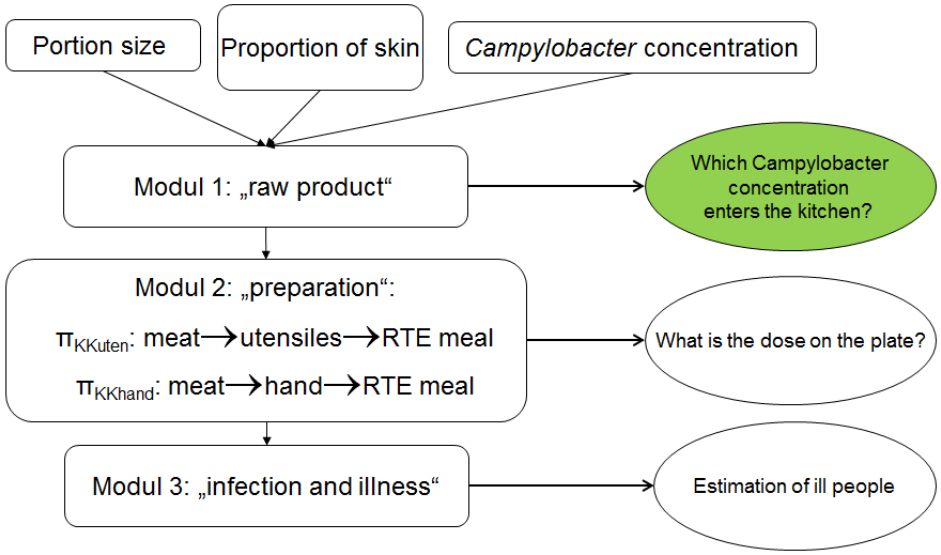
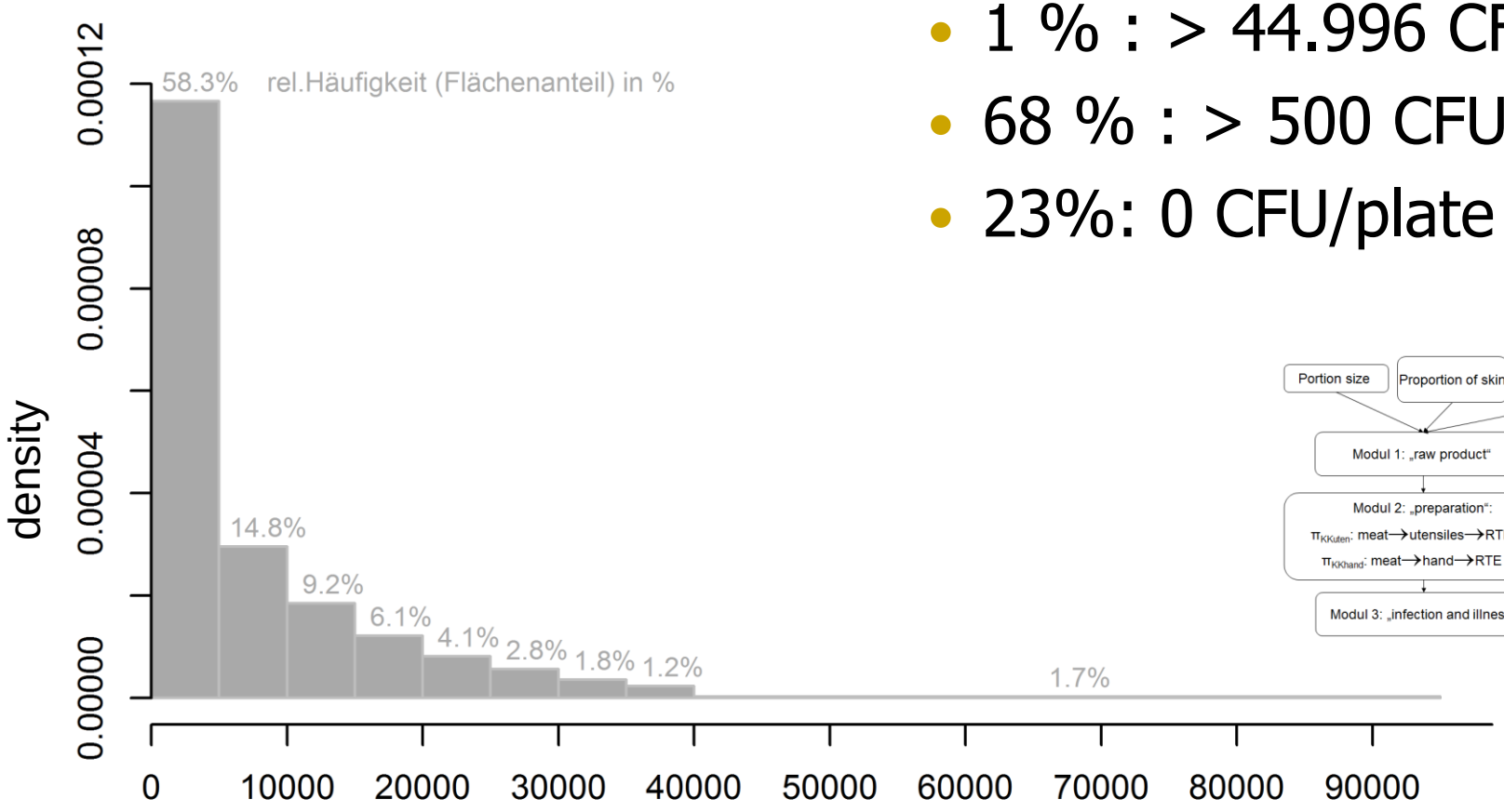
Module 1 „raw product“

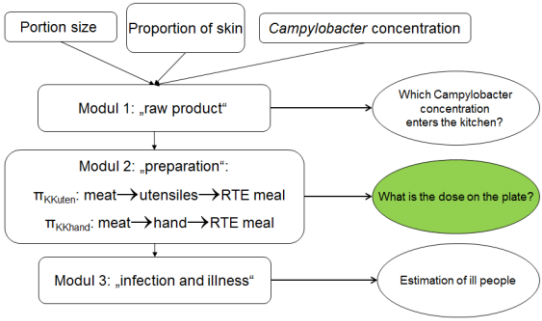
C_{skin}=portion size*propotion of skin*concentration =
500g * 0.145 * 1.000 CFU/g
= <u>72.500 CFU</u>



Module 2 „preparation“: results

- Mean 7.465 [6.076; 9.175]
- 1 % : > 44.996 CFU/plate
- 68 % : > 500 CFU/plate
- 23%: 0 CFU/plate

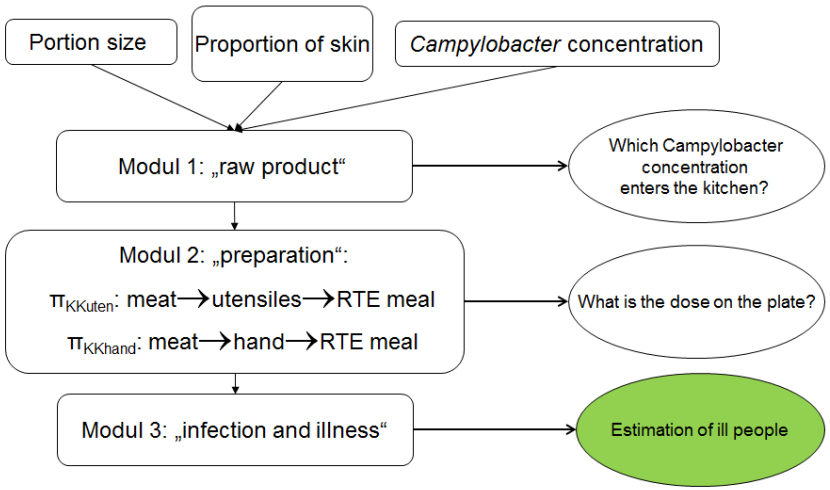




Module 3: results

Ill people: mean: 32,6 % [27,1 %; 37,6 %]

Concerning a treshhold theory (500 CFU): 15fold exceedance



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Significance

Most important results:

- An <u>average</u> Austrian cook has <u>plenty of</u> *Campylobacter* on the meal, **even without undercooking** (given an contamination of >1.000 CFU/g).
- People get ill due to cross contamination "**only**".

<u>Consequence:</u>

- High positive meat samples should/could/must be avoided at retail (in AUT: e.g. 3,3% >1.000 CFU/g).
- EVEN >500 CFU/g at retail should be possible (6% of production

Literature

Anonym (2014): Trends and Sources of Zoonoses and Zoonotic Agents in Humans, Foodstuffs, Animals and Feedingstuffs in 2013, Austria.

Anonym (2015): Trends and Sources of Zoonoses and Zoonotic Agents in Humans, Foodstuffs, Animals and Feedingstuffs in 2014, Austria.

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EFSA & ECDC (2015): The European Summary Report on Trends and Sources of Zoonoses , Zoonotic Agents and Food-borne Outbreaks in 2013.

Hölzl, C., U. Aldrian (2011): Lebensmittelsicherheit und Hygiene im Privathaushalt. http://www.ages.at/uploads/media/Lebensmittelsicherheit_und_Hygiene_im_Privathaushalt.pdf

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Nauta, M., A. Hill, H. Rosenquist, S. Brynestad, A. Fetsch, P. van der Logt, A. Fazil, et al. (2009): A Comparison of Risk Assessments on Campylobacter in Broiler Meat."*Int J Food Microbiol* 129, no. 2. 107–123.

Pouillot, R., M.L. Delignette-Muller (2010): Evaluating variability and uncertainty separately in microbial quantitative risk assessment using two R packages. Int. J. Food Microbiol. 142(3): 330–340.)

R-expert: Karin Weyermair

And for valuable inputs of
Günther Kraus
Daniela Mihats

and for email-discussions on DR-models
Maarten Nauta

Thank you
for your attention

Contact us:
statistik@ages.at

APPENDIX: Assumptions

- Broiler meat with skin (drumsticks, whole chicken, etc.).
- Each prepared meal is served and eaten with a ready-to-eat side dish (e. g. salad, bread, etc.).
- No difference in portion size (age, sex).
- Preparation and consumption by one person only.
- Only way of infection: corss contaminated RTE-side dish or cross contaminated broiler meat.
- Cooked broiler meat dose not contain any *Campylobacter*.
- Route of contamination modelled
  - raw broiler meat (skin) → kitchen utensiles (e. g. cutting board, knife, …) → cooked broiler meat (surface) or RTE side dish
  - raw broiler meat (skin) → hands of the cook cooked broiler meat (surface) or RTE side dish

APPENDIX: Assumptions

- No heating (reduction step) after cross contamination.
- Handwashing ahead of meal consumption.
- The whole meal is eaten including the total amount of *Campylobacter*.
- *Campylobacter* is defined as all human pathogene species of *Campylboacter* (no distinction in C. jejuni or C. coli).
- Variability in *Campylobacter* pathogenicity: neglected.
- Hand washing, cleaning of utensiles: 100% effecient.

APPENDIX: Software

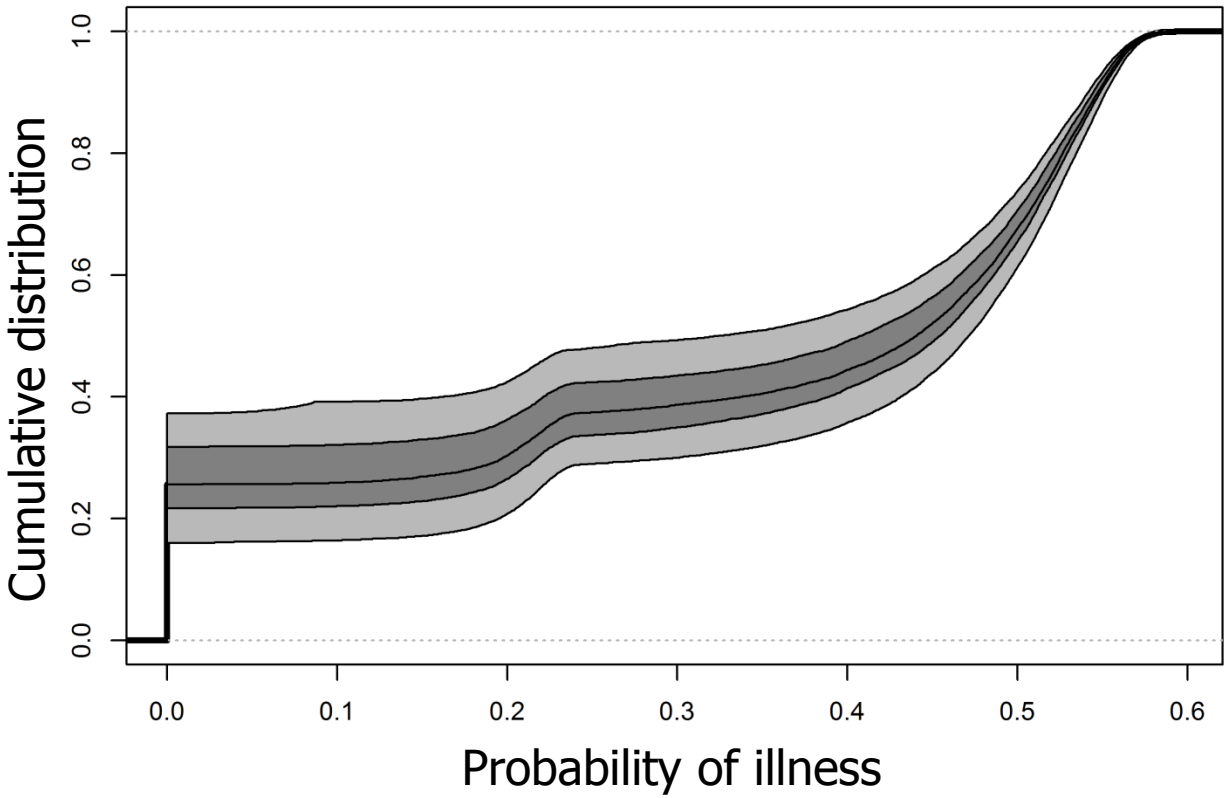
- second order Monte Carlo simulation
- software: R 3.0.2

  (R Core Team. 2013. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. URL http://www.R-project.org/.)

  - R package „mc2d" Tools for Two-Dimensional Monte-Carlo-Simulation

    (Pouillot, R., and M.L. Delignette-Muller. 2010. Evaluating variability and uncertainty separately in microbial quantitative risk assessment using two R packages. Int. J. Food Microbiol. 142(3): 330–340.)

APPENDIX: Module 3: further results



Estimated cumulative distribution: probability of illness (credibility intervals: dark grey: 25 % and 75 % percentiles, light grey: 2,5 % and 97,5 % percentiles)

Nationwide Campylobacter-platform: aim, participants

AIM: „Konsensuspapier“: consensus on possible reduction options for Campylobacter along the food chain in Austria;

PARTICIPANTS: approx. 80 persons

AGES experts (human medicine, veterinary medicine, food safety), public authorities (human medicine, veterinary medicine, food safety), ministries, chambers (veterinarians, agriculture, economy), Austrian poultry health service (e. g. slaughtherhouse owner, etc.), poultry veterinarians, universities;

Not invited: trade organisations, press;

Nationwide Campylobacter-platform: key points

in general: awareness and hygiene

- general information on Zoonosis monitoring for farmers
- harmonising controls at primary production
- slaughterhouses: do not want "specific, internal process related" discussions, but a product-related criterium
- kitchen hygiene and awareness are important