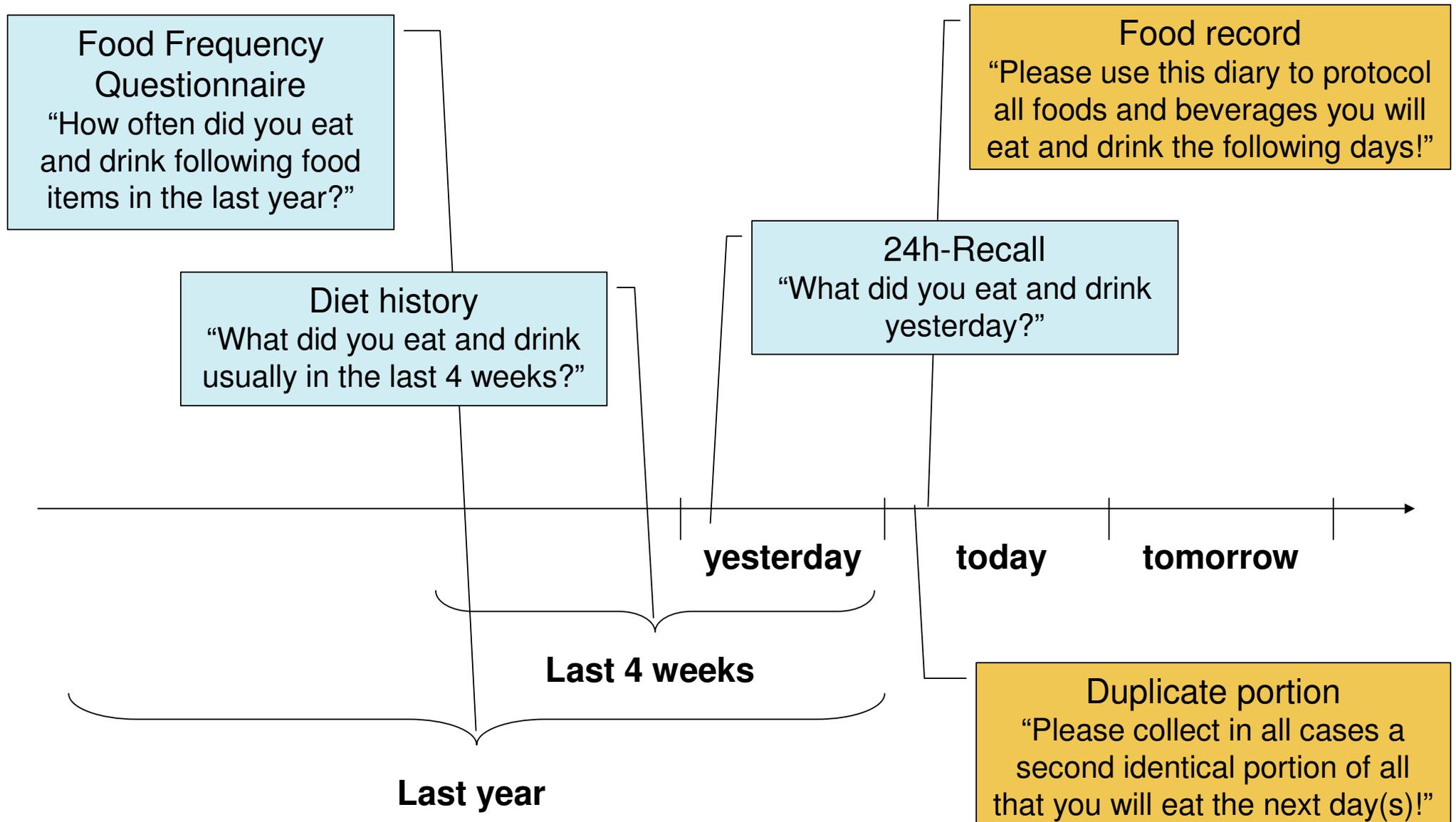**BfR**

Risiken erkennen – Gesundheit schützen

Comparison of methodologies for data collection with regard to exposure assessment

Oliver Lindtner

Short characterization of methods for data collections on food consumption data

Food Frequency Questionnaire
"How often did you eat and drink following food items in the last year?"

Food record
"Please use this diary to protocol all foods and beverages you will eat and drink the following days!"

Diet history
"What did you eat and drink usually in the last 4 weeks?"

24h-Recall
"What did you eat and drink yesterday?"

yesterday   today   tomorrow

Last 4 weeks

Last year

Duplicate portion
"Please collect in all cases a second identical portion of all that you will eat the next day(s)!"

24 h - Recall

"What did you eat and drink yesterday?"

- Normally the interviewee reports its own dietary behavior

- Normally done by phone

- Estimate amounts by using
  - Food frequency and
  - Standard portion sizes estimated by using e.g. photographs

- Can be repeated for several consecutive or non-consecutive days

- Retrospective methodology
  - Refers only to last 24h and following the bias from bad memory is as low as achievable
  - Possibility to aid memory of the consumer by chronologic (e.g. meals, activities) structured questionnaires (e.g. in combination with EPICSOFT)

- Possibility to come to more reliable and precise results by working with trained and skilled interviewers with nutritional background

- Details of food description is scalable

Food record

"Please use this diary to protocol all foods and beverages you will eat and drink the following days!"

- Normally the interviewee reports its own dietary behavior, but could also done by e.g. parents to collect information on the diet of their children

- Normally done on paper by the interviewee itself

- Estimate amounts by using
  - Food frequency and
  - Weighed amounts or standard portion sizes

- Can be repeated for several consecutive or non-consecutive days

- Prospective method - Protocol at the time food is eaten is minimizing reliance of the memory

- Possibilities to improve reliability of the results
  - Face-to-face training could be done to give precise instructions
  - Telephone hotline
  - Review of the protocol as soon as possible and callback if necessary

- Details of food description - all information available, but depend on cooperation and exactness of the interviewee

Diet history

"What did you eat and drink usually in the last 4 weeks?"

- Interviewee reports its own dietary behavior

- Normally done face-to-face

- Estimate amounts by using
  - Food frequency and
  - Portion sizes estimated by using e.g. samples of dishes used in households

- Retrospective methodology
  - Highly depend on the memory of respondents
  - Highly depend on the ability of respondents to estimate frequencies and amounts correctly
  - Possible to aid memory of consumers by structured questionnaires (e.g. DISHES)

- Possibility to come to more reliable results by working with trained interviewers with nutritional background
- Details of food description is scalable

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Food frequency questionnaire (FFQ)

"How often did you eat and drink following food items in the last year?"

- Interviewee reports its own dietary behavior

- Can be done by phone, on paper and face-to-face

- Estimate amounts by using
  - Food frequency and
  - Standard portion sizes

- Retrospective methodology
  - Highly depend on the memory of respondents
  - Highly depend on the ability of respondents to estimate frequencies and amounts correctly

- Details of food description
  - Limited number of foods in the questionnaire (max. 150)
  - Foods in the list are on high aggregation levels or covers only a small part of the diet

Duplicate portion

"Please collect in all cases a second identical portion of all that you will eat the next day(s)!"

- Interviewee reports its own dietary behavior

- Information on foods can be reported in parallel by combining with one of previous methods

- Estimate amounts by analyzing the samples that means that no nutrient tables are needed

- Often it is not feasible to analyze all samples separately so that they are normally pooled in a daily sample before analyzes

- Prospective methodology
  - Protocol at the time the food is eaten is minimizing the reliance of the memory
  - Availability of duplicates may influence the results

- Details of food description
  - In principal a lot of information is available, depends on food protocol method
  - Difficult to estimate the contribution of specific food items in pooled samples

- Best method to assess multiple exposures because no assumptions are needed on correlation between occurrence levels of similar substances in food

Effort and costs

- 24h Recall
    - Requires about 30 min
    - Costs of the software
    - Direct contact to the interviewer
- Food record
    - High effort for interviewed persons during the protocol phase
    - Low other costs
- Diet history
    - Time consuming interview, can last for 30 to 120 min
    - Time needed and need to overcome inhibitions to come to the centre
    - Personal & software costs
- FFQ
    - Low costs
- Duplicate portion
    - High effort for interviewed persons during the protocol phase
    - High effort in analyzing the samples and protocols
    - Highest costs will result in financial limitations in sample sizes

What best study design could be recommended?

EFCOSUM

- 2 x 24h Recalls

- Non-consecutive days

- CATI

- EPICSOFT

- (EFCOSUM- Food classification)

- Using EFCOSUM does mean to extrapolate from short number of days to long-term/ chronic exposures or intakes by using statistical approaches like the Nusser method

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Scope of the EFCOSUM recommendation

ORIGINAL COMMUNICATION

Estimating the distribution of usual dietary intake by short-term measurements

K Hoffmann[1]*, H Boeing[1], A Dufour[2], JL Volatier[2], J Telman[3], M Virtanen[4], W Becker[5] and S De Henauw[6] for the EFCOSUM Group

The problem investigated in the paper was that of estimating the habitual intake distribution in the whole population. To illustrate the approach, the distributions of total fat and of vegetable usual intake were estimated for diverse study populations with different sample sizes. The described procedure can be applied to other nutrients and food groups that are consumed daily or at least almost daily by all individuals. For special foods or food groups that are con-

EFCOSUM and food safety

- EFCOSUM is valid in nutritional epidemiology

- Is it adequate to accept the recommendation also for risk assessments?

- Compare requirements in risk assessments and recommendation regarding differences between nutritional epidemiology and risk assessment

  - Individual vs. population Groups

  - Number of protocol days

  - Number of foods containing the agent

  - Details of food description

  - Number of consumers

  - Input into statistical methods

  - Portion sizes

Scenario: Cadmium intake

- **Chronic** risks, that means we need a **long-term assessment** that averages the day-to-day variability

- Cadmium occurs in a wide number of foods and is following **consumed nearly by all persons and daily**

- Cadmium chronic intake assessment is comparable to nutrient intake assessment and the EFCOSUM recommendation is valid
- Keep in mind that extrapolation methods have to be applied

  - Legislation for Cd contains maximum permitted levels also for very specific food categories (e.g. oilseeds, funghi, celeriac, crustaceans, cephalopods)

  - Conclusions on intake of these specific food categories can not drawn based on EFCOSUM-recommendation

  - More sampling days may be needed

Estimation of mean daily (chronic) consumption

- Also other data collection methods are valid like food records or diet history

- In principal possible to calculate in all protocol methods at individual and group levels

- In diet history and FFQ methods estimation is not only based on calculations but also depended on ability of the respondents to estimate the frequencies of longer time intervals

- Duplicate portion based on pooled samples refers to nutrient/ substance intake and it may not be necessary that the consumption of specific food items can be assessed

- For methods like food records and 24h recalls the number of protocol days will influence the precision of the results. In case of too little days extrapolation methods to long-term consumption may be necessary.

Variety and specificity of food containing the agent influences the application to chronic assessment task:
- Ability of respondents to remember and describe details of consumed foods, as well as ability of protocol methods to collect the information
- Number of protocol days

Importance of number of protocol days for mean consumption

Level of food grouping
- Determines number of datasets mean estimates are based on.

**Average of day-to-day variability (intra-individual)**
- Refers to chronic/ acute/ microbial
- Higher variation for detailed food

Average of variability between individuals (inter-individual)
- What part of population should be analysed/ protected?
- Robustness of results for means and high percentiles depends on level of food-grouping and number of days

person-ID	Day1	Day2	Day3	Day4	Day5	Day6	Day7	weekly mean
0101121	29,6		11,6			15,0	3,2	**8,5**
0101122		27,3				7,5	22,7	**8,2**
0101123			5,3	10,3				**2,2**
0101124	24,0	20,0	30,2	5,0			18,2	**13,9**
010112A	18,8	15,0				6,9	2,9	**6,2**
0101161	102,0	40,0	81,0	90,0	100,0	90,0	91,4	**84,9**
0101162	34,1	13,4		31,8	20,5	2,9		**14,6**
0101211	30,0	45,0		40,0		18,7	20,0	**22,0**
0101362								**0,0**
...	...							...
population mean								**10,6**

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Food grouping and estimation of percentages of consumers
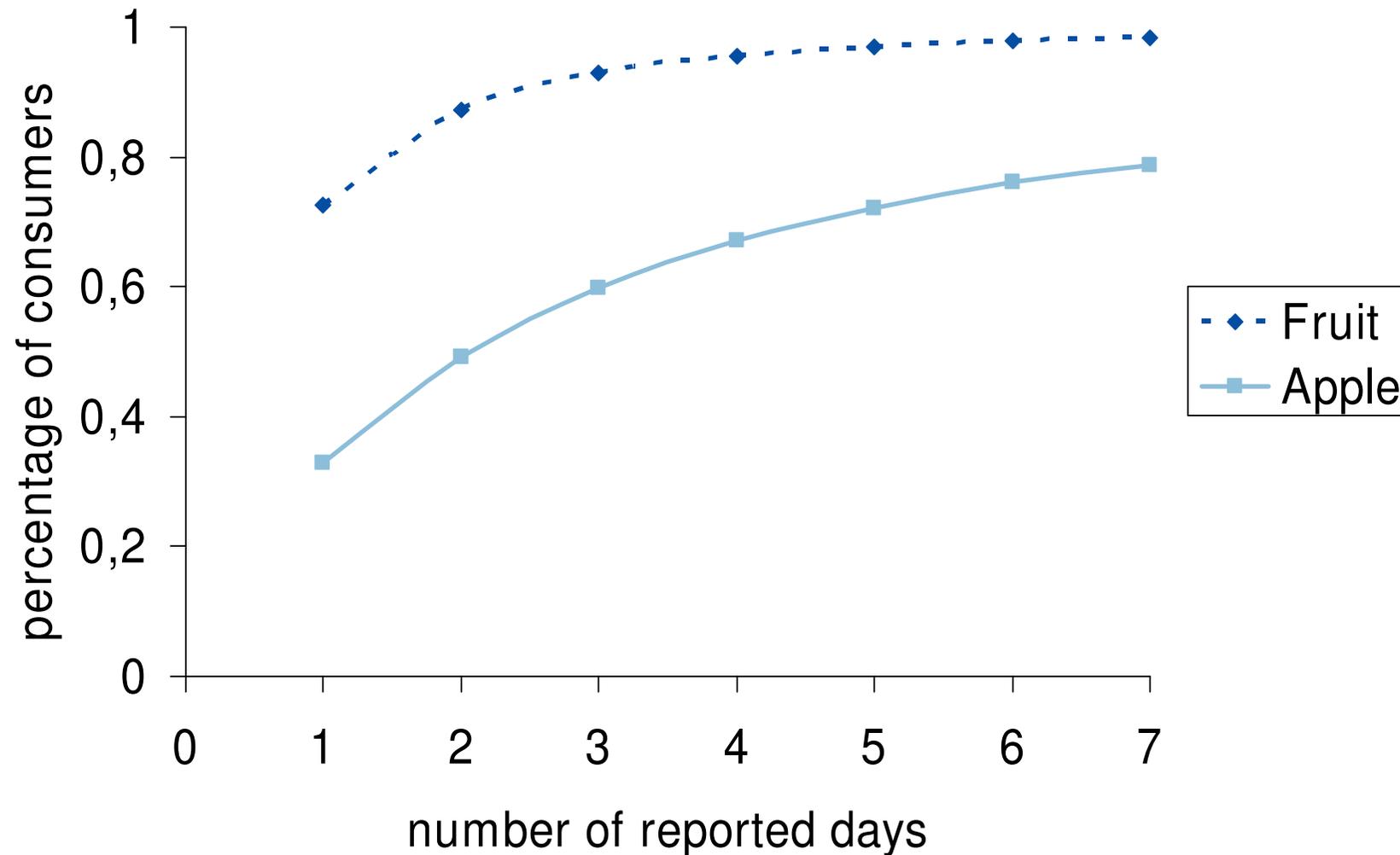
Based on German Nutrition Survey 1989, 7 days weighed food record, 23209 samples

Estimation of high short-term (acute, microbial) consumption

Other scenarios in risk assessments beside chronic and widely occurring contaminants

- Acute exposure (e.g. marine biotoxins, pesticides)

- Microbial exposure

High amounts for single days within defined time-intervals instead of mean usual intake
EFCOSUM recommendation is not valid

- Single days are necessary and therefore food records, 24h recalls and duplicate portion techniques can be used

- Too little days may not correctly describe full intra-individual variation and can result in high overestimations of upper percentiles

- For acute/ microbial exposures exact instead of estimated portion sizes (available from food records and eventually duplicate portion) are needed

Higher need for details in food description

- Often very specific food items in focus of risk assessments

- Often information is needed on e.g. brand names, packaging materials, from labeling, origin of food

Protocol methods have to be able to collect those information

EFCOSUM recommendation is not valid for all cases

Some information can be better collected in prospective methods

Food description in three protocol methods

24h Recall	Food record (circled)	Diet history
• Direct contact with trained interviewers	• Possible to collect all necessary details on consumed food including preparation and information available from packaging	• Direct contact with trained interviewers
• Possible to collect many details on consumed food	• In most cases enough days to cover also rare consumed food	• Ability of the respondents to split into all variations within 4 weeks
• Often not enough days to cover also rare consumed food	• Bad control of interviewed person regarding the completeness of provided food descriptions	• Interview will last to long by asking to many specifi-cations of consumed foods
• Not in all cases packaging information is available		• No packaging information available
• Limited possibility to ask the person that has prepared the food		• No possibility to ask person that has prepared the food

Different types of study designs used currently in Germany

Compromise to meet requirements of Nutritional epidemiology and food safety in the German National Nutrition Survey II

	Basic Module		**Sub-sample**
Methods	24h Recall	Dietary history	Weighing record
Time Period	2 days	Last 4 weeks	2 x 4 days
Tools	EPIC-SOFT	DISHES	Paper

Interpretation of results of EFSA Concise Database

EFSA CATEGORY	Percent Consumers	Mean	Median	95-th Percentile
01 Cereals & cereal products	93% - 100% (Slovakia - Sweden)	154g - 372g (Finland - Slovakia)	140g - 298g (Finland - France)	283g - 760g (Finland - Slovakia)
02 Sugar & sugar products including chocolate	48% - 100% (Slovakia - Germany)	21g - 143g (Italy - Slovakia)	16g - 43g (Italy - Slovakia)	55g - 240g (Italy - Slovakia)
03 Fats (vegetable and animal)	49% - 100% (Slovakia - Hungary)	21g - 59g (UK - Slovakia)	16g - 48g (United Kingdom - Hungary)	51g - 150g (UK - Slovakia)

- Does it mean that less Slovakians eat the presented foods but the highest amount?

- No, Slovakian data are based on a single 24h Recall and therefore the percentage of consumers is underestimated and the means and percentiles tend to overestimate the true values

- So it should carefully discussed what kind of survey can be compared and used for different tasks within the work of EFSA

Conclusions

- Best study design depends on scope of the intake assessment, no single design can cover all problems

- EFCOSUM is valid in nutritional epidemiology but not for all tasks in risk assessment

- Challenge to find solutions to keep in line with EFCOSUM standards for nutritional epidemiology and to overcome limitations regarding food safety problems

- Main challenges

  - more days needed for acute/ microbial assessments and rare consumed food

  - more detailed food descriptions or information on household preparation is needed (could not be asked by phone)

  - describe true variability in portion-sizes by weighing in a sub-sample

- Be careful in interpreting results of food consumption studies based on different study types (also in EFSA Concise Database)

- Discuss whether extrapolation methods should be applied to the data from countries using 2 x 24h-Recalls

- Work on a more comprehensive food coding that allows more detailed and flexible food classifications to refer to specific legislation
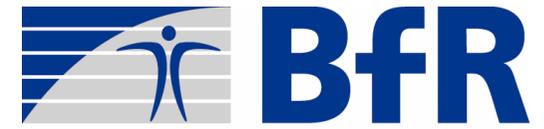
Thank you for your attention

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