Quantitative Risk – Benefit Analysis

Methodology development

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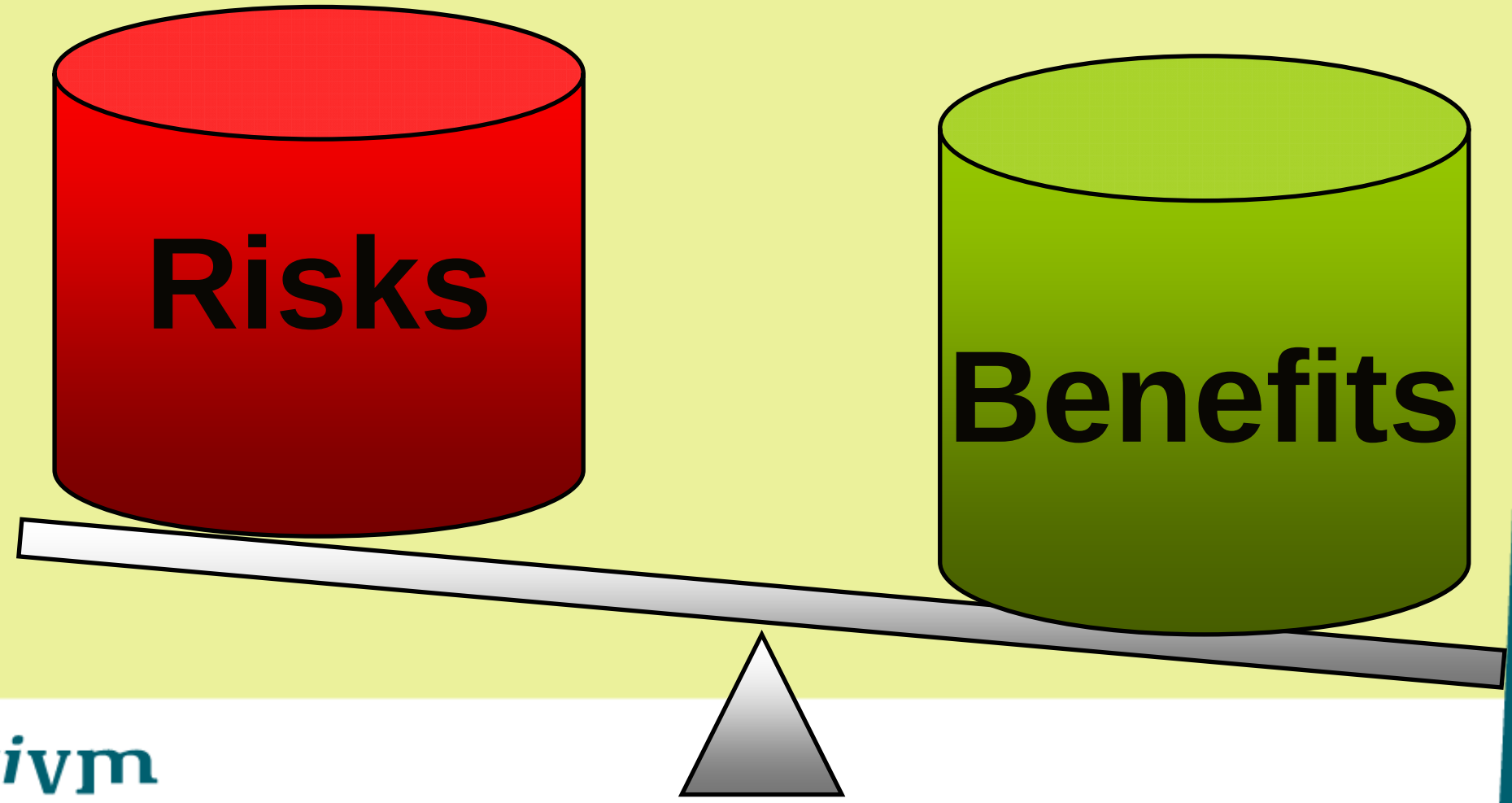
Diet, Foods, Ingredients, Supplements, Novel Foods, Fortified Foods, Functional Foods:



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Menu

- **Risk-Benefit: general methodology**
  - **case study**
- **Risk-Benefit Analysis for Fish**
  - **what has been done so far?**

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Diet / Food intake

Positive health effects

Negative health effects

dose-response

number of cases that will be lost (death, disease)

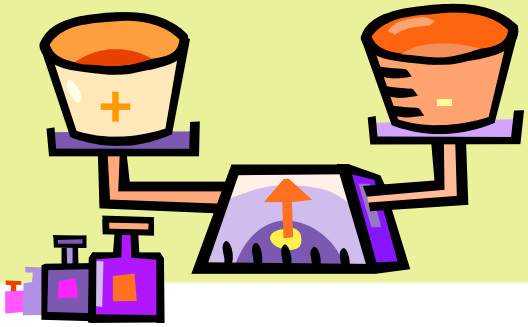
number of cases that will prevented (death, disease)

Integrated measure

DALY

Health gain

Health loss



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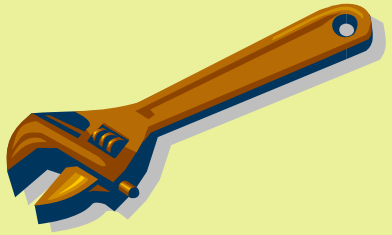
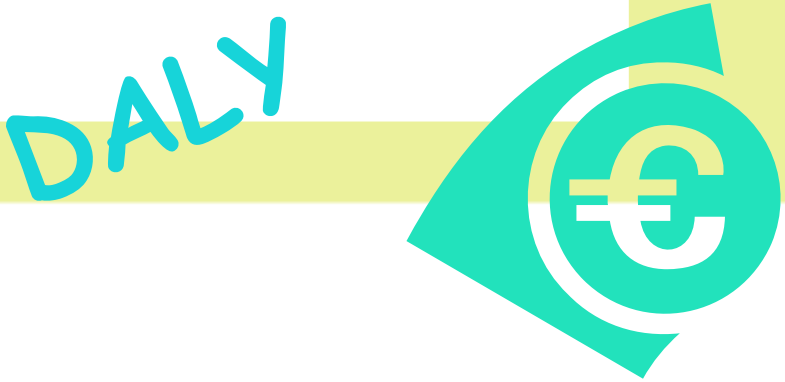
Risk-Benefit Requirements

1. A common method of intake scenario building

2. A common method of dose-response assessment



3. A common currency to describe the health impacts



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STEP 1

Select positive and negative health effects for ingredient of interest

Example folic acid:

- Positive effect: prevention of NTD
- Negative effect: masking of vitamin B12 deficiency

The case of folic acid…..

Osteoporosis

Depression

Masking vit. B_{12} deficiency

Folic acid deficiency

Long cancer

CVD

Epilepsy

Down syndrome

Colon cancer

Twins births

Pancreas cancer

Neurotoxicity

Spontaneous abortion

Prostate cancer

Alzheimer's

Neural tube defects

Zinc absorption

High blood pressure during pregnancy

Leukemia

Schisis

Oesophageal cancer

Parkinson

Breast cancer

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Folic acid: most suitable data for…

Most important positive effects:

- Prevention of folate deficiency
- **Prevention neural tube defects**
  - → mechanism unkown
  - → interventions with protective effect
- Prevention colon cancer
  - → possible mechanism known
  - → recent meta-analyses: 20-25% risk reduction
- Prevention CVD?
  - → Hcy-lowering effect
  - → lot of research on intermediary endpoints
  - → most recent insight: no association between intake and endpoint

Negative effects:

- **Masking vitamin B12 deficiency**
  - → safe upper level folic acid based on the fear for this phenomenon
- Stimulation of celproliferation in existing (colon) cancer?

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STEP 2

Define target population and population at risk

Example folic acid:

- Target population: women, 19-50
- Population at risk: the elderly, 65+

STEP 3:

Select fortification scenario and reference scenario

Example folic acid:

- Fortification scenario (choose product, fortification level): bread, 70 µg/100 g
- Reference scenario: no fortification

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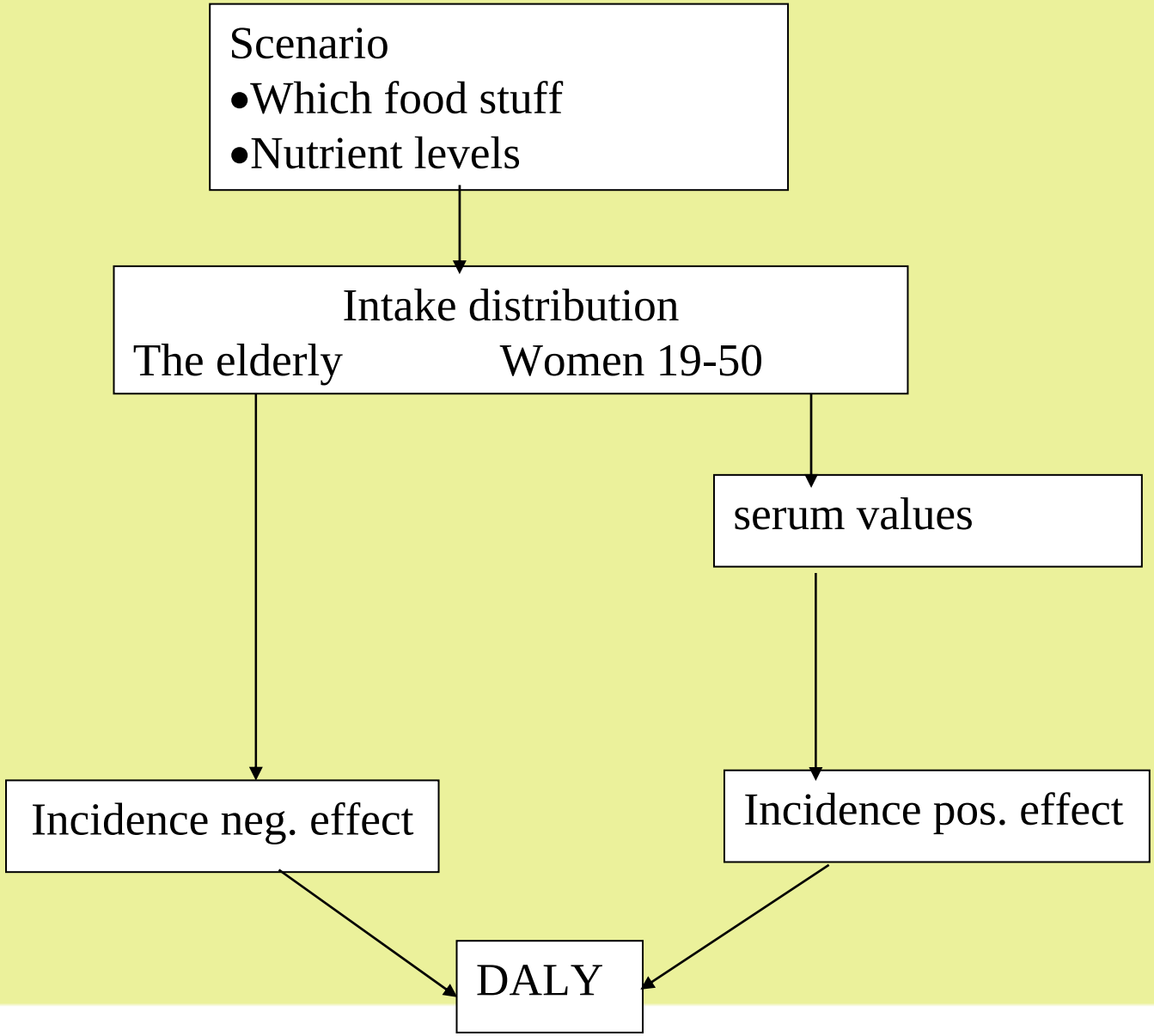
Intake scenario building

- **National Food Consumption Survey Data (2 d diet record)**
- **Assessment of habitual (long term) intake from reported intake**
  - Special software needed
  - Data adjustment for within person variation
  - Some intake scenarios difficult to transform to log-normality
- **Defining of intake scenarios (e.g. mandatory or voluntary fortification)**
  - Which products (milk products, cereals, …)?
  - Fortification levels?
  - Which population groups?

Scheme for calculation of risk/benefit



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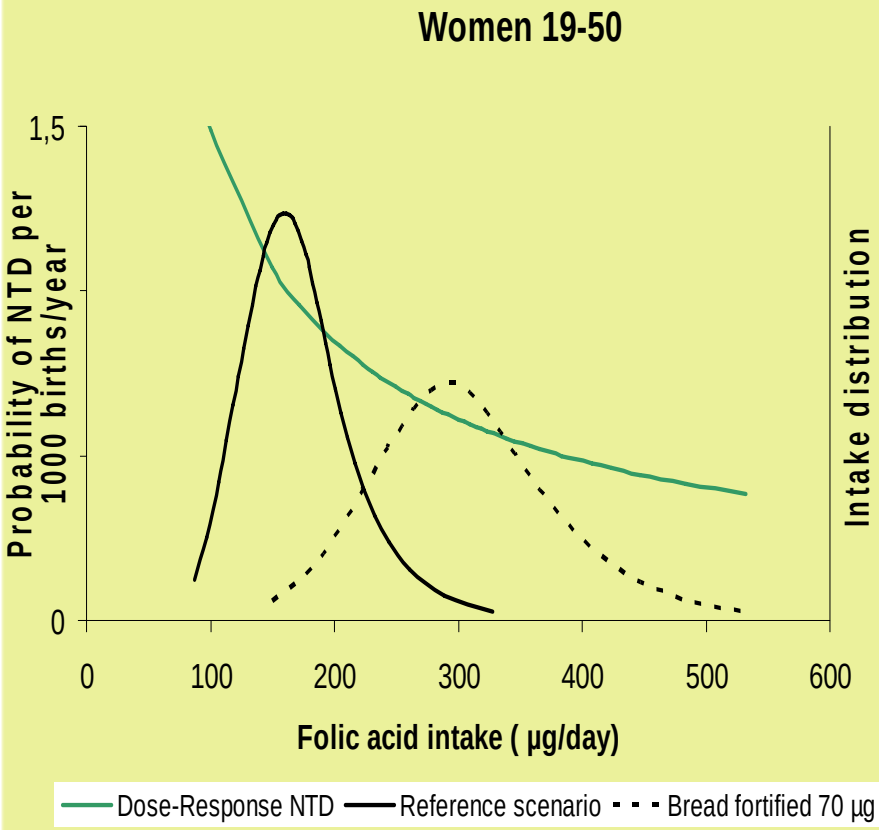
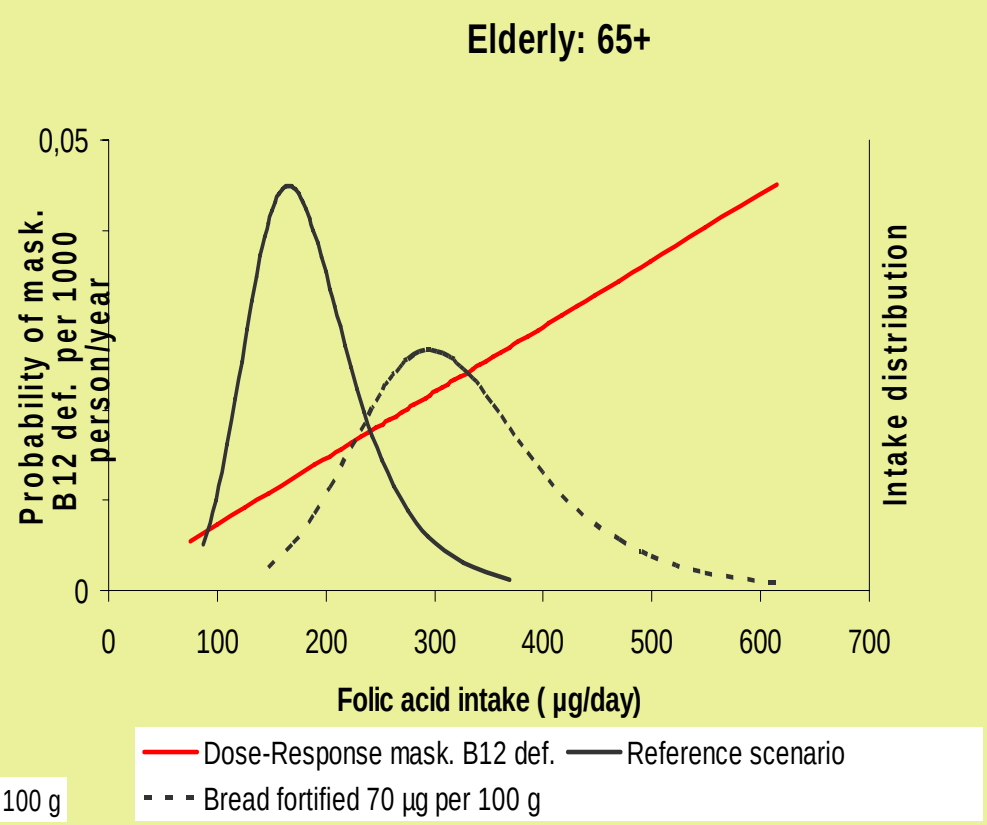
STEP 4

Compute intake distributions for both scenarios

Example folic acid:





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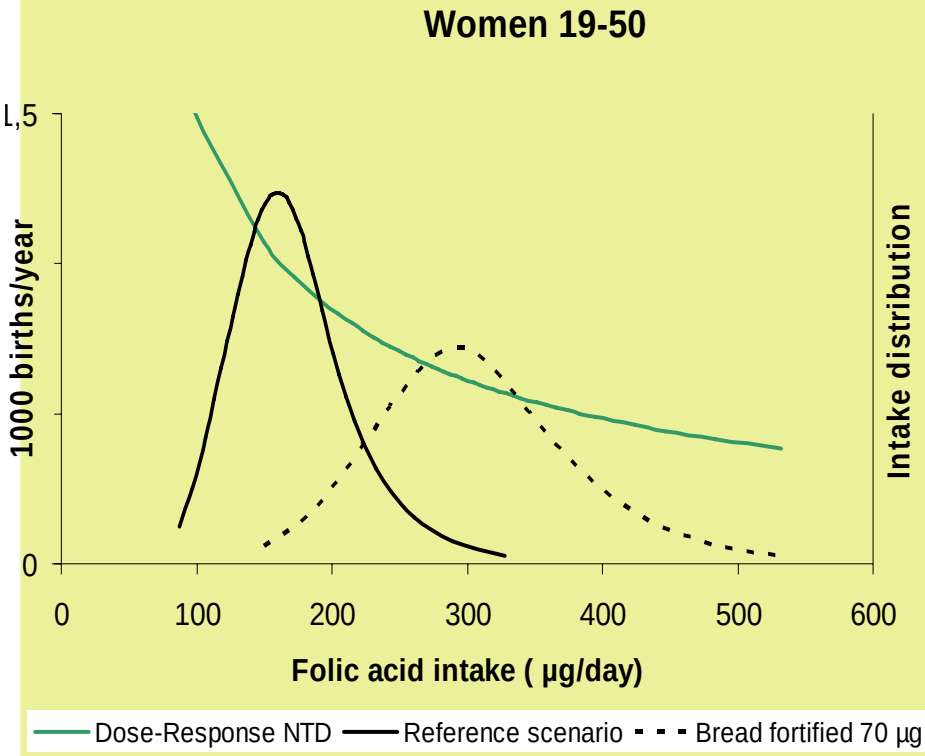
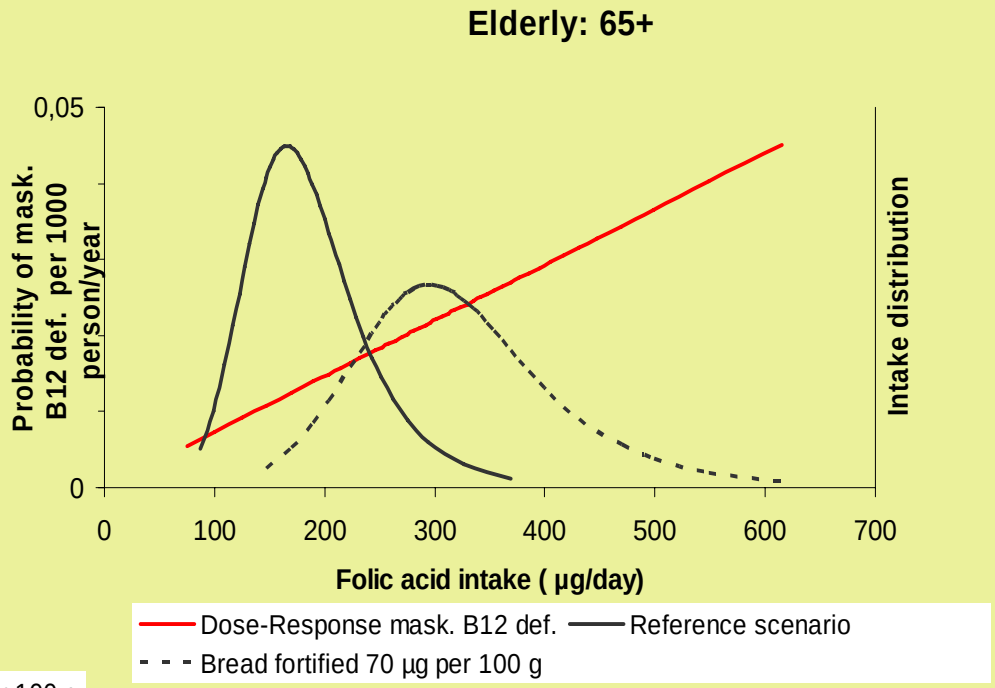
STEP 5

Per health effect: establish dose-response relation of daily intake and incidence of disease

- Example folic acid:





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STEP 6

Quantify number of new or prevented cases of disease at population level per year

Example folic acid:

- Prevented: 78 cases of NTD
- Caused: 54 cases of masking of vit B12 deficiency

STEP 7

Express number of cases of disease in a uniform measure of quality of life (DALY)

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Disability-Adjusted Life Years

- **Definition: the number of healthy years of life lost due to premature death and/or disability**

- **Developed by World Bank, WHO and Harvard in 1993**

- **DALY = YLL + (wt) YLD**

- **YLL = Years of Life Lost**
- **YLD = Years Lived with Disability**
  = incidence * duration (or prevalence)

- **wt = disability weight (severeness of the disability taken into account)**

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STEP 7

Express number of cases of disease in a uniform measure of quality of life (DALY)

Example folic acid:

- - 78 cases of NTD → health benefit: 5044 DALYs
- + 54 cases of masking vit B12 def. → health loss: 54 DALYs

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DALY (Disability Adjusted Life Years)

- Years Lived with the Disability
  - Life expectancy of a NTD patient (**32.5** CBS)
  - Disability weight (**0.59** Spina Bifida,**0.85** anencephaly WHO)

- Years of Life Lost

  Normal life expectancy (**78.915**, CBS) – Life expectancy of a NTD patient

- DALY: YLL + (weight) YLD - DALY: YLL + (weight) YLD

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STEP 8

Sum DALYs to obtain the overall health effect at population level

Example folic acid:

health benefit: 5044 DALYs

health loss: 54 DALYs

overall effect:

health benefit 4990 DALYs

→ different scenarios

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Integrated risk-benefit analysis

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Evidence for relations between food intake and chronic diseases: the Dutch situation

Food factor	Obesity	Diabetes	CVD	Cancer
Sat. Fatty acids		↑	↑↑	
Trans Fatty acids			↑↑	
Fish and fish oil (EPA and DHA)			↓↓	
Fruit/Vegetables	↓↓	↓	↓↓	↓
High intake of energy dense food	↑↑			

↑↑ = convincing risk inducing;
↓↓ = convincing risk reducing;

↑ = probably risk inducing;
↓ = probably risk reducing;

WHO Technical Report Series 916; 2003

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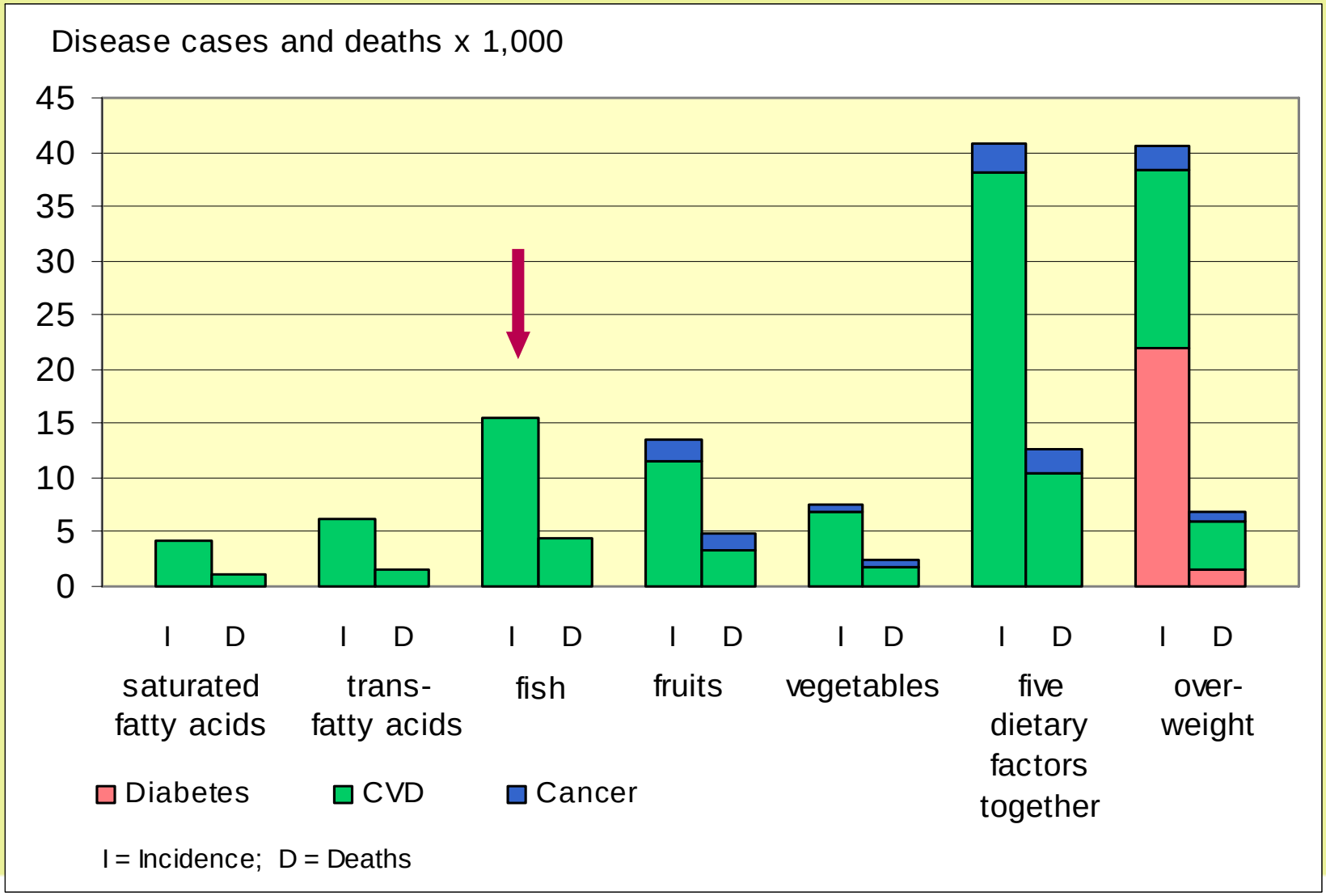
Health loss per year because the Dutch dietary pattern fails to meet the recommendations (per year)



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Food consumption pattern related to recommendations

Nutrient/Food	Recommen-dation	Mean consumption 1998	Trend
Saturated fatty acids (%E)	< 10	14,5	favourable
Trans fatty acids (%E)	< 1	1,8	favourable
Fish (times/month)	4 à 8	2 à 3	favourable
Fruit (grams/day)	200	102	unvafourable
Vegetables (grams/day)	150-200	120	unfavourable

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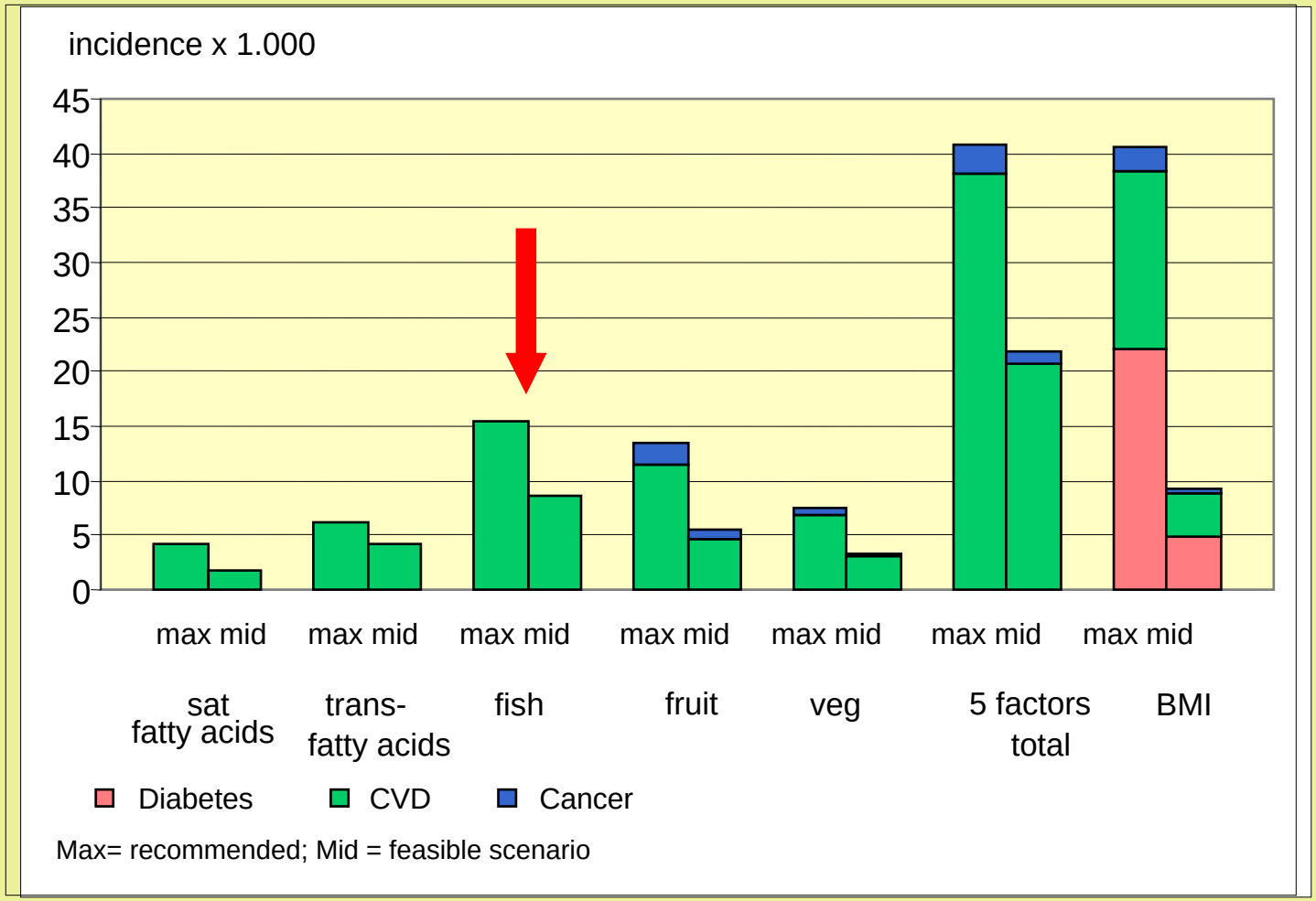
What are the effects for several intake scenarios in relation to chronic diseases?

Food factor	Current situation	Recommen-dation	Feasible
Sat. fat (%E)	14,5	<10	-2.5
Trans fat (%E)	1,8	<1	-0.5
Fish (times/month)	2 à 3	4 à 8	+ 1 à 2
Veg (g/day)	120	200	+50
Fruit (g/day)	100	200	+50

Health gain of feasible scenario vs recommendation per year



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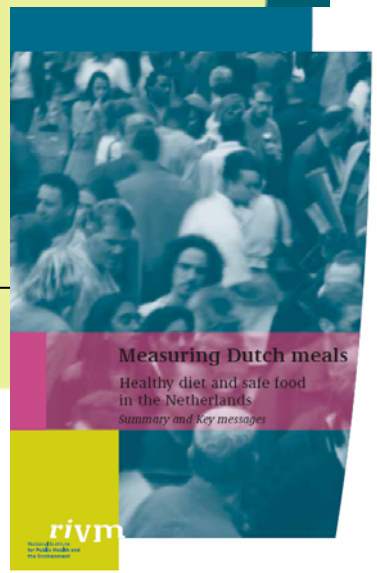
Risk-benefit analysis of health loss or gain for 3 recommended foodstuffs in the Netherlands

Foodstuff	Effect	Gain in DALY's	Risk factor/ Contaminant	Loss in DALY's
Fish	↓ CVD	82,000	Dioxins, PCBs	low
			Organic Hg	low
Vegetables	↓ CHD	47,000	Phytotoxins	low
	↓ Lung-cancer		Nitrate	ca 100-500
			Microorganisms	ca 50-200
Cereals / Fiber	↓ CVD	35,000	DON (mycotoxin)	low

CVD = Cardiovascular disease ; CHD = Coronary heart disease



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Discussion

- Availability and uncertainty of epidemiological data
  - Epidemiology non-fatal health outcomes
  - Epidemiology on fatal health outcomes
- High demand for data, many assumptions
- Comparability of data
  - International coding differences
  - Different outcomes of clinical trials in different populations
- DALY: relatively insensitive to disability weights
  - Disability weights: subjective weights: subjects vs. experts

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Further research

Quantitative Risk-Benefit analyses on Fish

QALIBRA

Objectives:

-To develop a generalised approach to risk-benefit analysis

-To develop web-enabled software for stakeholders

-To develop targeted risk-benefit communication strategies

-To carry out comprehensive risk-benefit analyses for selected food groups including oily fish

April 2006 – Dec 2009
EU 6th Framework Programme
Priority 5
Food Quality and Safety

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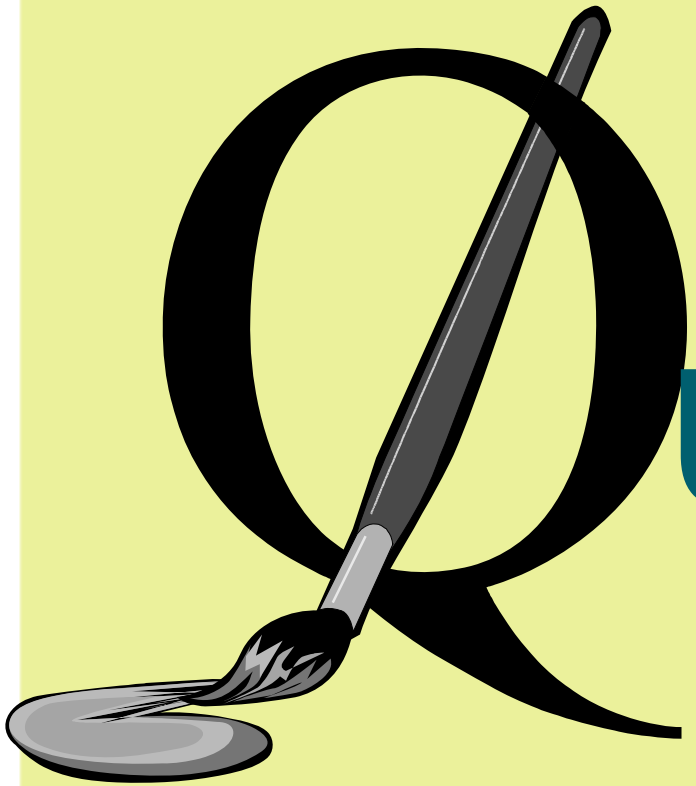

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