Landesinstitut für
Gesundheit und Arbeit
des Landes Nordrhein-Westfalen

Scientific Expert Workshop.

Quantifying the health impacts of policies – Principles, methods, and models.

Düsseldorf, Germany, 16 - 17 March 2010.

Supplementary volume to LIGA.Fokus 11

WHO Collaborating Center for
Regional Health Policy
and Public Health

www.liga.nrw.de

Imprint

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LIGA.NRW

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Layout and publishing
LIGA.NRW

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Düsseldorf, Germany, December 2010

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ISBN 978-3-88139-173-3

This Supplementary volume contains the workshop presentations.

Table of Contents

What this supplementary is about

A workshop on quantification of health impacts (e.g. resulting from policies, plans and programs) was held in Düsseldorf Germany, 16 - 17 March 2010.

Workshop proceedings are published as LIGA.Fokus no. 11.

This is the supplementary volume, documenting in full detail the presentations given at the workshop.

Session 1 "Principles of quantification of health impacts"

Rainer Fehr:
Vision and promise of quantification of health impacts in health-related impact assessments

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Invitational Scientific Expert Workshop: Quantifying the health impacts of policies – Principles, methods and models. LIGA.NRW, Düsseldorf, 16-17 March 2010

Vision and promise of quantification of health impacts in health-related impact assessments

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Presentation structure

- Context: Policy <-> Science
- Impact Assessments, incl. LIGA.NRW involvement
- Quantification in HIA
- Conclusions

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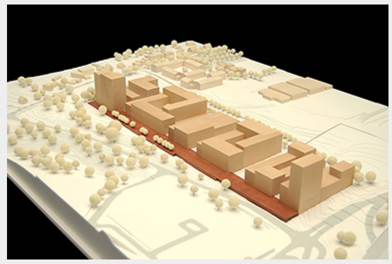
1. Context: Policy <-> Science

“Health Campus” NRW in Bochum (Ruhr area), funded by Ministries of: Health; Research; Economy, www.gc.nrw.de, incl. Cluster Management Health Economics NRW, MedEcon Ruhr, Epidemiologic Cancer Registry NRW, Health Strategy Center, U Applied Sciences for Health, LIGA.NRW, etc. **-> ample opportunities for interaction of (health) policy-making and (health) sciences**



NRW Institute of Health & Work (**LIGA.NRW**): “More health for all”, www.liga.nrw.de, LIGA.NRW & predecessors: work devoted to RHP for decades; multiple (EC) co-funded projects, often related to **HIA**

Quantifying the health impacts of policies – Principles, methods and models. LIGA.NRW, Düsseldorf, 16-17 March 2010 **2**

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WHO Collaborating Center for Regional Health Policy & Public Health

Leitmotifs include: **integration, prospective orientation,** theory and practice of policy-related health **assessments**

Activities include: Scientific discourse, workshops, advanced training, e.g. in March 2010: Health Systems Performance Assessment, with RAND Europe representative

Basic frameworks include:

	Theory	
Policy	⟷	Science
	Practice	

	Health	.
Regional Health	RHP	Health Policy
Region	Regional Policy	Policy

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Policy arena vs. Science arena

	Policy arena / rationality	Science arena / rationality
Drivers, values	Political programs, innovations, public approval, election success	Strive for knowledge, „objectivity", discovery, innovation, scientific recognition
Structure, actors	Division of power (legislative, executive, jurisdictive), political parties, civic society, NGOs, public media	Research groups, universities, professional asociations, funding agrencies, donors
Processes, work forms	Governance; policies, plans, programs, projects, innovative technologies (PPPPT)	Research projects and programs: basic / applied / Research & Development
Quality Assurance / Control	Elections, Review committees, „history"	Peer review, publications, acquisition of funding

Quantifying the health impacts of policies – Principles, methods and models. LIGA.NRW, Düsseldorf, 16-17 March 2010 4

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Policy – Science interface

Stimulates and challenges...
Creates demands for...
Provides support / funding for...

Policy ⇄ **Science**

Stimulates and challenges...
Provides supporting evidence for...
Evaluates...

Interfacing / Policy advice (*Politikberatung*):

- Traditional: Status analyses & reports, expert councils, committees ...
- Novel: *Impact assessments*, Policy dialogues, policy briefs ...

Quantifying the health impacts of policies – Principles, methods and models. LIGA.NRW, Düsseldorf, 16-17 March 2010 5

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2. Major tools to use at "science – policy" interface: Assessments

Assessments of...

- Status / trends of: Health, health determinants, health conseqences, i.e. health reporting, health forecasting
- Needs / Assets: Health Needs Assessment (HNA), Health Assets Assessment
- **"What-if" / Impacts**: Various forms of Impact Assessment (IA)
- Performance: Health Systems Performance Assessment (HSPA), ex-post asessment (evaluation)

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Health-related Impact Assessments / Involvement of LIGA.NRW, 1990s-2002

Early 1990s BMFT-funded Project "HIA"

1993 DGSMP; MEDICA; EUPHA; ASPHER; Healthy Cities Conf SF (USA)

1994 Environmental Med; IAIA Québec; GMDS; U Dortmund

1995 Forum U'med NRW; Public Health Congress Dresden

1996 ISEE Edmonton (CAN); IEA Nagoya (J); U'med Bad Nauheim

1997 AfÖG D'dorf; HIA Conf WHO & ILO Geneva; HIA book

1998 U'med Bad Nauheim; TEH Vienna; Review TEH for WHO Rome

1999 HIA Seminar Helsinki, HIA Transport Bielefeld (with RIVM), WHO Gothenburg Conference

2000 U Hamburg: Stadt & Staat; Round table NSPH Amsterdam; SEA Szentendre (Hungary)

2001 Eco-Informa Argonne IL (USA), ISEE Garmisch, California Health Department (Oakland), German National HIA workshop (BgVV Berlin)

2002 ISEE Vancouver, IAIA The Hague (NL), EUPHA Dresden

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Health-related Impact Assessments / Involvement of LIGA.NRW, 2003ff

2003 Workshop Birmingham (UK), EUPHA Rome

2004 AfÖG (Münster); AK U'Med (HH), EUPHA Oslo

2005 HIA Graz (A), RIVM (NL), IUPHE Stockholm, Xprob (UBA, Berlin)

2006 7th HIA congress Cardiff, 8th German EIA congress, Paderborn

2007 8th HIA congress Dublin, IAIA Seoul; Prevention congress by a German Parliamentary faction, Symposium Med. Geography, HIA/HSIA Lisbon

2008 International Policy Dialogue HIA Sevilla (E), 9th German EIA Congress Bad Kissingen, 9th HIA Liverpool, 2nd GHUP Graz (A); Regions for Health Network Varna (Bulg); EC consultation on IA guidelines; start of working group "Human health" with German EIA Assoc.

2009 16th Public Health Colloq U Bielefeld, ISEE Dublin, Exchange visit Kurume (Japan), EUPHA Lodz (PL), 10th HIA Rotterdam, SEA meeting WHO Rome, WHO CC workshop Bielefeld; "Family of IAs" initiative

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Initiative "Family of health-related Impact Assessments"

- Focus: Health Impact Assessment (HIA), Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), Social IA, Sustainability IA, Health Technology Assessment (HTA), EC-type (or: integrated) IA
- **Objectives:**
  - to learn from each other, and harnass synergies of different kinds of IAs
  - to mitigate conflicts of multiple IAs being conducted on same policy, plan, program, project, technology (PPPPT)
  - to discuss pro's and con's of integrated IAs

Quantifying the health impacts of policies – Principles, methods and models. LIGA.NRW, Düsseldorf, 16-17 March 2010 **9**

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Policy-related IAs, examples from LIGA.NRW

- EC EPHIA project: European Employment Strategy
- EC ENHIS project: Traffic noise and children's health
- More: Drinking water privatization; extension of waste disposal site; siting airport; etc.
- Current: Rapid HIA of novel spatial planning in Ruhr metropolitan area: LIGA.NRW acted as "Institution responsible for public concerns" and supported the coverage of health aspects -> variety of substantive & procedural themes
- Current: EC RAPID project: NRW housing policy, etc.
- **Conclusion: Health opportunities in policy-making across non-health sectors = chronically under-used**
- Options to strengthen "Health in all policies" (WHO):
  - Departmental health plans (*Fachplan Gesundheit*) - ?
  - **Quantification of health impacts - ?**

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3. Quantification in HIA

- Quantification = a core issue from the early days, e.g. extension of waste disposal site
- 1995-2001 Project „Quantitative risk assessment" (QRA) with cross-relations to HIA
- 1997 HIA book: Ch. 3 = „QRA – the pro's and con's"
- 1997ff: German working group „Probabilistic exposure & risk assessment" (*Arbeitskreis PQRA*), incl. public / environmental / occupational health, consumer protection)
- 2001-03 EC co-funded Project „European Policy HIA" (EPHIA)
- 2002-07 UBA co-funded Project „Reference values and distributions for exposure factors for the German population" (Xprob)

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Quantitative approaches in HIA: Advantages

Quantitative approaches...

- fit appropriately with prevalent health, environmental, and policy science paradigms
- may help to integrate preventive and curative efforts, by providing common metric for "preventive" & "treatment" results
- can help increase transparency
- may help to tailor a structured discussion among stakeholders
- can facilitate comparisons of potential impacts across PPPPT alternatives and scenarios

modified after Nusselder & Lhachimi, 2008

Quantitative approaches in HIA: Disadvantages

Quantitative approaches...

- incorporate numerous value- and model-based assumptions that are not always made explicit
- are less familiar than traditional measures of health/disease
- may be infeasible because of limited data on the effect estimates and baseline characteristics of the population
- may be too time- and cost-intensive
- based on "garbage in – garbage out" principle (e.g. non-causal associations), may give an unwarranted *patina* of robust science
- may de-emphasize, or even omit, stakeholder participation

modified after Nusselder & Lhachimi, 2008

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Quantitative approaches in HIA: Open questions

- Once models are available more easily, will the practice of Public Health and health policy-making be improved?
- Given the large amounts of data needed for quantification: will it be worth all the efforts?
- Given similar input to different models, will these models then tend to produce similar output?
- Given the current focus on "disease", are existing models appropriate for the field of health promotion at all? Can, and should, "well-being" be integrated into the quantification?
- Could research on rare diseases, contributing small amounts to the population BoD, get into a difficult position for being funded?

modified after Nusselder & Lhachimi, 2008

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4. Conclusions

HIA = a Public Health promise which is hitherto – at least partially, and in some countries widely – unfulfilled.

There are different "schools", or traditions, of HIA, incl. at least the following:

- qualitative / procedural / focus on stakeholder participation
- quantitative / methodological

Currently, more than ever, these 2 traditions show a distinct tendency towards convergence.

With respect to HIA, each country (or even region) seems to feature a specific situation, incl. opportunities for, and obstacles to, implementation of HIA (language not being smallest obstacle)

We hope this workshop contributes to further the development of HIA as a key tool for securing health, in NRW and way beyond

Quantifying the health impacts of policies – Principles, methods and models. LIGA.NRW, Düsseldorf, 16-17 March 2010 **15**

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Annette Prüss-Ustün:
Summary measures of population health (SMPH) in health-related impact assessments

Summary measures of population health (SMPH) in health-related impact assessments

Dr Annette Prüss-Ustün
Public Health and Environment

World Health Organization

From Wikipedia, the free encyclopedia

Disability-adjusted life year

*The **disability-adjusted life year (DALY)** is a measure of **overall disease burden**. Originally developed by the World Health Organization, it is becoming increasingly common in the field of **public health** and **health impact assessment (HIA)**.*

2 | SPMH in health-related impact assessments | 16 March 2010 World Health Organization

Summary measures of population health

Health expectancies

- QALY Quality adjusted life years
- HEALY Healthy Life Years
- DFLE Disability-free life expectancy
- ALE Active Life Expectancy

Health gaps

- DALY Disability-adjusted Life Years
- etc.

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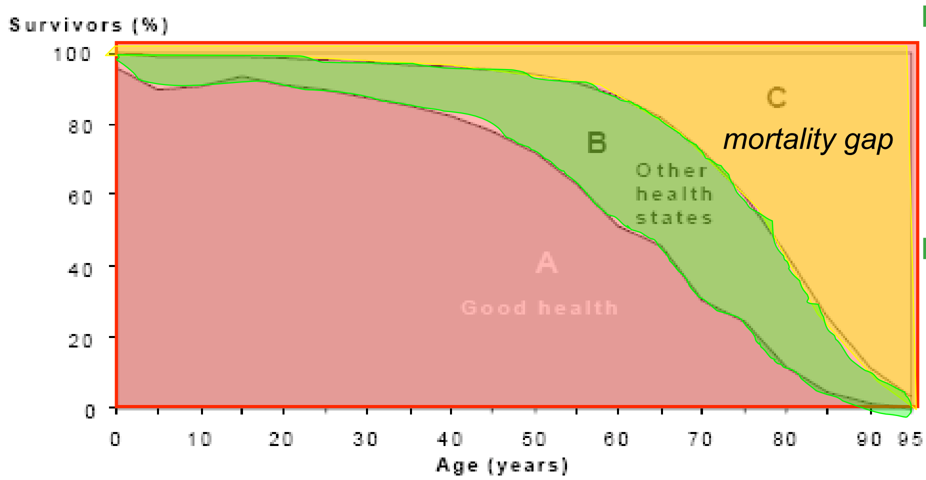
Two families of SMPH



Health expectancies

= A + *f* (B)

Where full health = 1

e.g. HALE

Health gaps

= C + *g* (B)

Where 1 is equivalent to death

e.g. DALY

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Burden of disease: how to measure?

Need of summary measure of population health that combines:

Mortality + Disability

And which allows to address the following questions:

- How does a death at age 20 compare with a death at age 70?
- How do 200 respiratory infections compare to 300 cases of infectious diarrhoea?

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Summary measure of population health: DALY

Disability-Adjusted Life Years

DALY = YLL + YLD

years of life lost because of premature death (YLLs)

years of life lived with disability (YLDs)

Burden = Mortality + Disability

one DALY = one lost year of healthy life

- Death at age 50 = 30 DALYs
- Mild mental retardation due to lead at birth = 30 DALYs

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Years of Life with disability

YLD = I x DW x d

YLD = Years of life lived with disability

I = Number of incident cases in the population

DW = Disability weight

d = Duration of disability [years]

3 cases of mild mental retardation due to lead at birth:

3 cases/year x 0.36 x 80 years = 84 YLD

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How to make a quantified health-related impact assessment?

- Guides for EBD assessment at local level are available
- Comprehensive data needed:
  - Exposure data for selected risk factors in a selected setting (PM10, solid fuel use, % access to safe drinking water, etc)
  - Health data (deaths, incidence or DALYs) for given diseases in a selected settings
- Calculations easy to perform

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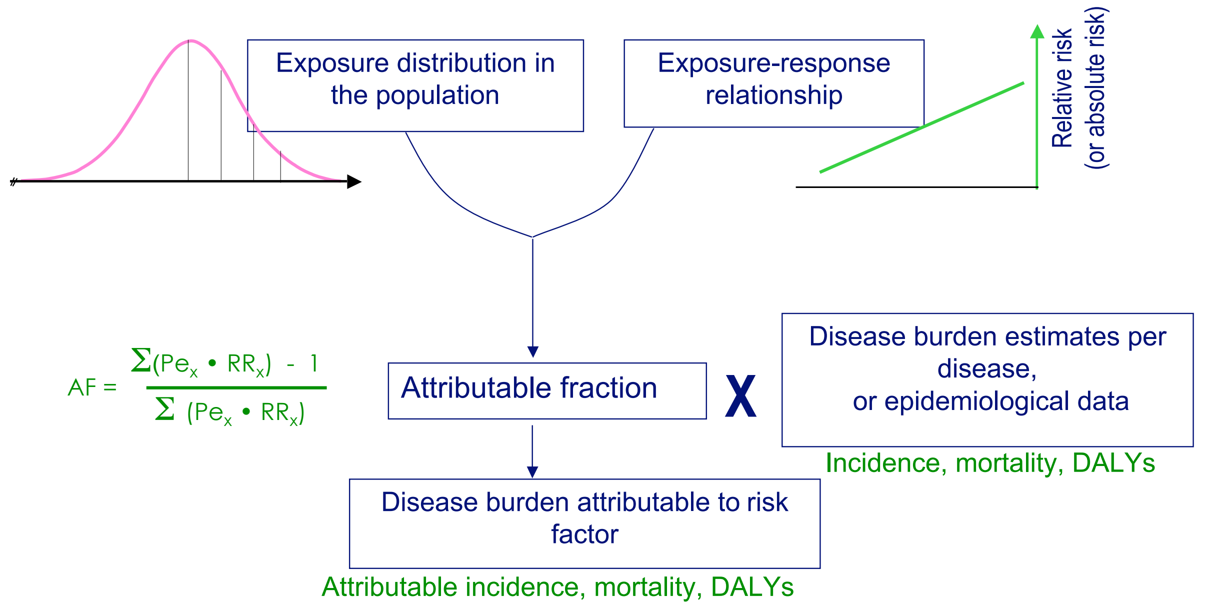
Assessments for estimating attributable disease



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Why use SPMH for assessing health impacts?

Veerman JL et al (2005) Quantitative HIA: current practice and future directions

- Reviewed assessments included numerous indicators for health outcomes:
  - E.g.: Deaths; hospitalizations for asthma, accident injuries
- SMPH recommended in addition to conventional health outcome measures

Kjellström et al (2003) Comparative assessment of transport risks—how it can contribute to health impact assessment of transport policies

- A common basis for comparison removes ambiguity when trying to make decisions on the basis of the health equivalent of apples and pears that can occur in HIA
- Problem: limited scientific research on changing health risks from transport policies.

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Advantages of using SMPH in HIA

- Comparable across health outcomes
- Comparable across policy options
- Common language across health issues (risk factors, diseases)
- Standardized measure
- Coherent framework – HIA, EBD, guidelines, status report can all be linked
- Additional decision-making support for selecting interventions/policies
- SMPH constitutes a basis of CEA

11 | SPMH in health-related impact assessments | 16 March 2010 World Health Organization

Works if…

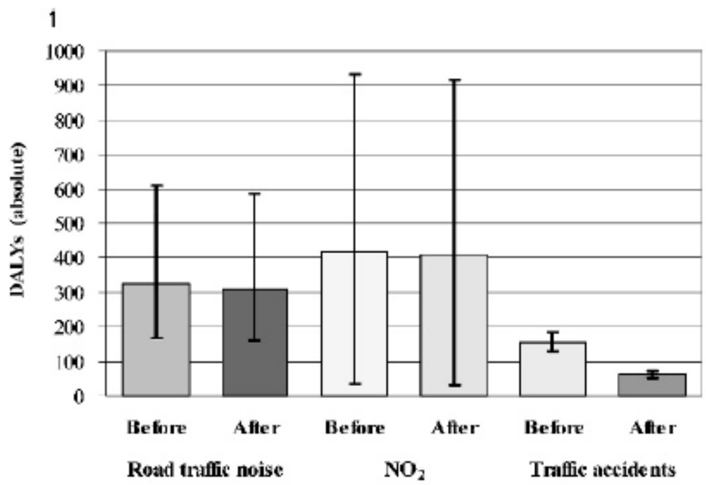
- Burden of disease estimates are known for study population (including future burden?)
- Quantitative evidence for relevant exposure-risks is known
- In addition to conventional health measures, and as relative measure
- Supported by meaningful communication of results

12 | SPMH in health-related impact assessments | 16 March 2010 World Health Organization

Example of assessment using a comparative measure

Quantitative HIA of transport policies: two simulations related to speed limit reduction and traffic re-allocation in the Netherlands

D Schram-Bijkerk, E van Kempen, A B Knol, et al. (2009)



13 | SPMH in health-related impact assessments | 16 March 2010

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Example of assessment using a comparative measure

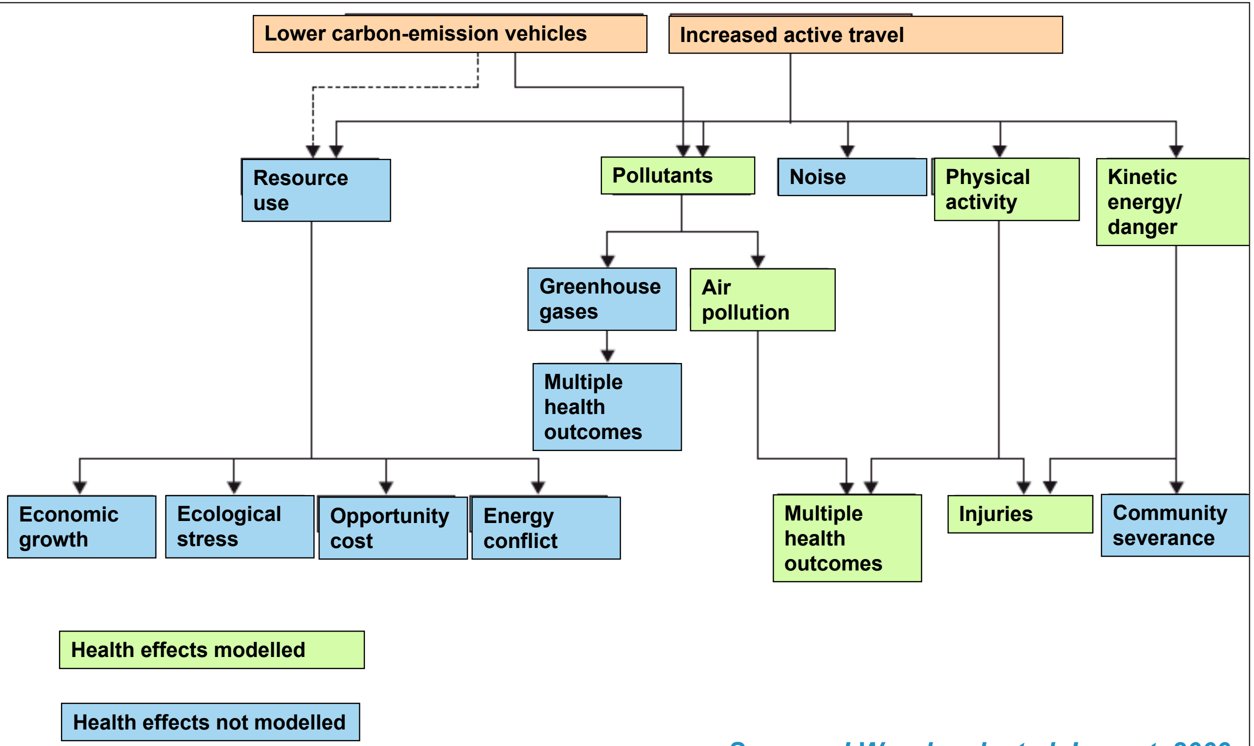
Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport

J Woodcock et al. Lancet, 2009

Measure: per million population

	Delhi	
	Lower-carbon-emission motor vehicles	Increased active travel
Physical activity		
Premature deaths	0	−352
YLL	0	−6040
YLD	0	−816
DALYs	0	−6857
Air pollution		
Premature deaths	−74	−99
YLL	−1696	−2240
YLD	0	0
DALYs	−1696	−2240
Road traffic crashes*		
Premature deaths	0	−67
YLL	0	−2809
YLD	0	−730
DALYs	0	−3540
Total†		
Premature deaths	−74	−511
YLL	−1696	−10 969
YLD	0	−1547
DALYs	−1696	−12 516

14 | SPMH in health-related impact assessments | 16 March 2010



Source: J Woodcock et al. Lancet, 2009

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Larger scale assessments: Energy policies in Africa

BAU: Business as usual

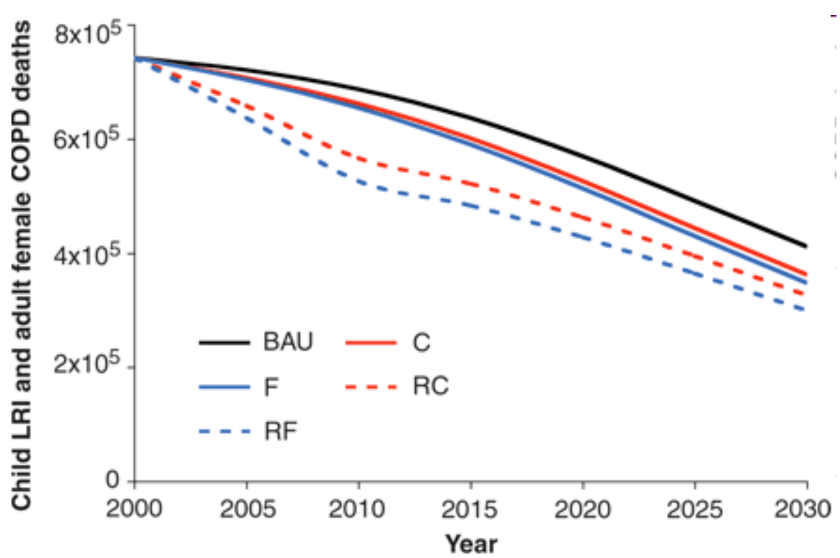
F, RF: fossil fuel–intensive scenarios

C, F: gradual transitions to charcoal (C) and fossil fuels (F)

****

From: Mortality and Greenhouse Gas Impacts of Biomass and Petroleum Energy Futures in Africa

Bailis et al. (2005)



16 | SPMH in health-related impact assessments | 16 March 2010

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Tools for estimating impacts

- Spreadsheets to assist estimation of health impacts from change in:
  - Exposure to second-hand smoke
  - Exposure to outdoor air pollution ($PM_{10,2.5}$)
  - Solid fuel use for cooking
  - Blood lead levels
  - Mercury concentration in hair

Etc.

18 | SPMH in health-related impact assessments | 16 March 2010

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Series of guides on EBD for national or local assessment

- Lead
- Malnutrition
- Water, sanitation & hygiene
- Indoor air from solid fuels
- Ambient air
- Climate change
- UV radiation
- Community noise

+ calculation spreadsheets

- Occupation
  - carcinogens
  - dusts
  - back pain
  - needlestick injuries
- Poverty (only association)
- Housing
- Radon
- Mercury
- Second-hand smoke

19 | SPMH in health-related impact assessments | 16 March 2010

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Conclusions

- SMPH is one of the only comparable measures across multiple health impacts (compares HIA apples with oranges)
- Standardized measure, therefore transparent (under certain conditions)
- Increased application of SPMH for policies is relatively recent, as are calculation tools and common understanding
- SMPH can only translate impacts in areas with sufficient scientific knowledge
- Need to be communicated in a user-friendly way
- Can be a basis for costing health impacts
- Allows to speak in a common language

20 | SPMH in health-related impact assessments | 16 March 2010

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More information and references

WHO's web sites on:

Global burden of disease

http://www.who.int/healthinfo/global_burden_disease/en/index.html

Quantifying health impacts from environmental risks

http://www.who.int/quantifying_ehimpacts/en/

Health impact assessment

http://www.who.int/hia/en/

21 | SPMH in health-related impact assessments | 16 March 2010

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Michael Schümann:
Critical comments on the use of summary measures of population health (SMPH) in health related Impact Assessment

Quantifying the health impacts of policies
Principles, methods, and models
Düsseldorf / March 2010

Critical comments on the use of summary measures of population health (SMPH) in health related Impact Assessment

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Behörde für Soziales, Familie, Gesundheit und Verbraucherschutz

Dr. Michael Schümann 1

My Summary points

- **As an epidemiologist:**
  - uncertainties in estimating the „life expectancy“
  - application for individuals and for group prediction
  - discounting/tariff of life years in dependence to the Age-QoL-relationship is not a scientific task, it is an economic or political valuation of humans
- **As a psychometric scientist:**
  - restrictions to formulate a test instruments (questionnaire/ visual scales) resulting in a one-dimensional scale for the „Quality of life“, „Quality of the State of Health“ or „Subjective Wellbeing“ of individuals and populations.
  - weighted aggregation to one dimension is not a scientific based task, it is a valuation.
  - The LE*QoL→QALY scale as a multiplication of two different scales is neither linear, additive, consistent, reliable, neutral nor valid.

Summary points

Ethical issues:

- „values/discounts/tariffs“ to „the life of individuals and groups“ like adjusted DALYs are unfair against newborns, elderly and any person with disabilities (UN Convention on the Rights of Persons with Disabilities 2007)..
- applying these weights is polically and legally not justifiable.
- survey or panel data (even if they are representative) should not be applied as a basis for adjusting/ weighting/ assessing of „life years“ against „quality of life“ for population, groups and individuals (equal rights).

Summary points

As a scientific health policy adviser:

Cost-utility-comparison and Cost-QALY–Evaluation can‘t be done for individuals without taking into account medical and ethical councils, patient-physician interaction and/or individual decisions

.. and in practice:

Using „generic instruments“ for economical Cost-Utility-Evaluation might result in „generic decisions“ for the allocation of resources (money, medical treatment, access to infrastructure, ..)

abcNEWS

Death Drugs Cause Uproar in Oregon

Terminally Ill Denied Drugs for Life,
But Can Opt for Suicide
By SUSAN DONALDSON JAMES
Aug. 6, 2008

The 64-year-old Oregon woman, whose lung cancer had been in remission, learned the disease had returned and would likely kill her. Her last hope was a $4,000-a-month drug that her doctor prescribed for her, but the insurance company refused to pay.

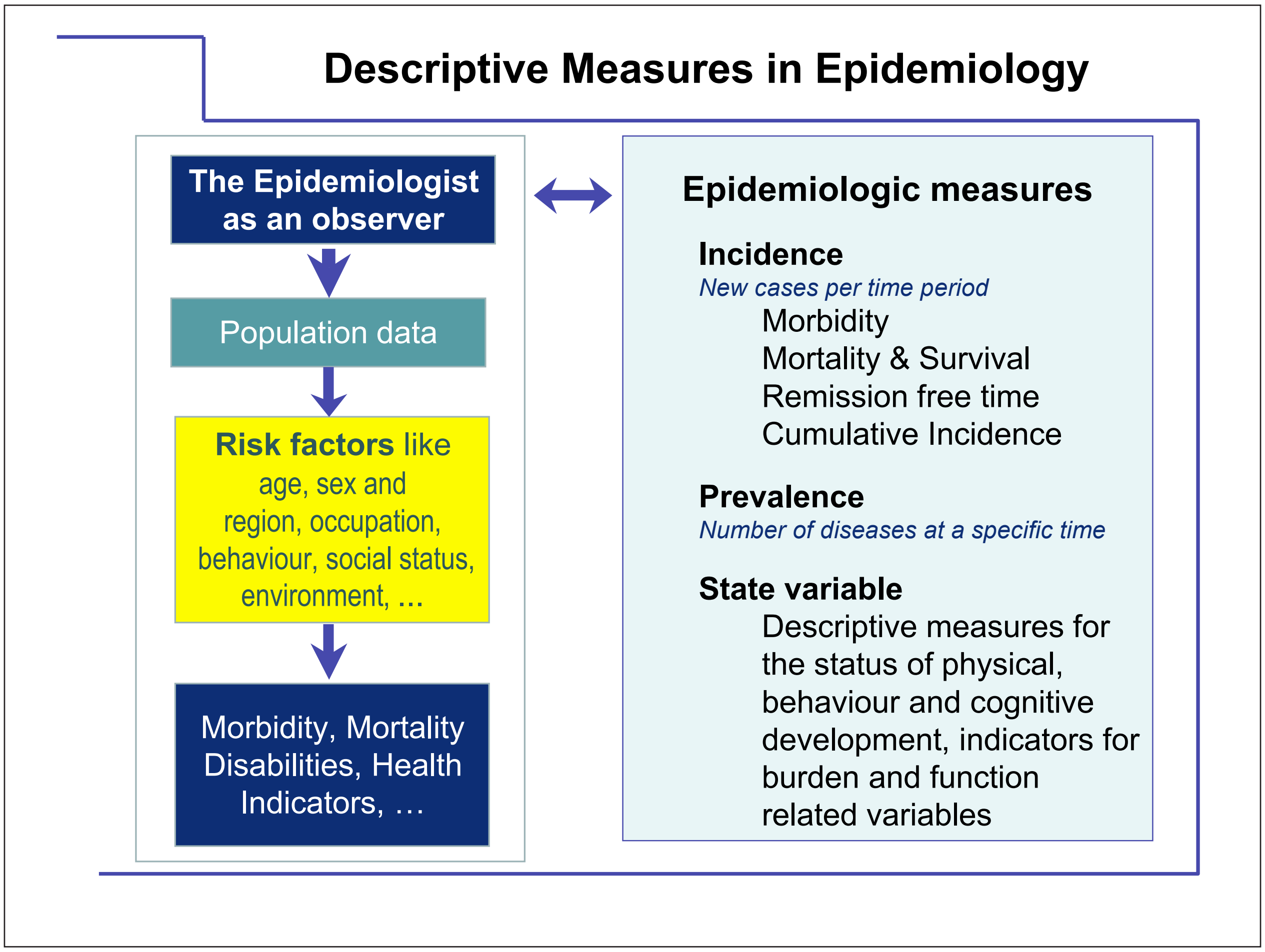
What the Oregon Health Plan did agree to cover, written to her in that letter, however, were drugs for a physician-assisted death. Those drugs would cost about $50.

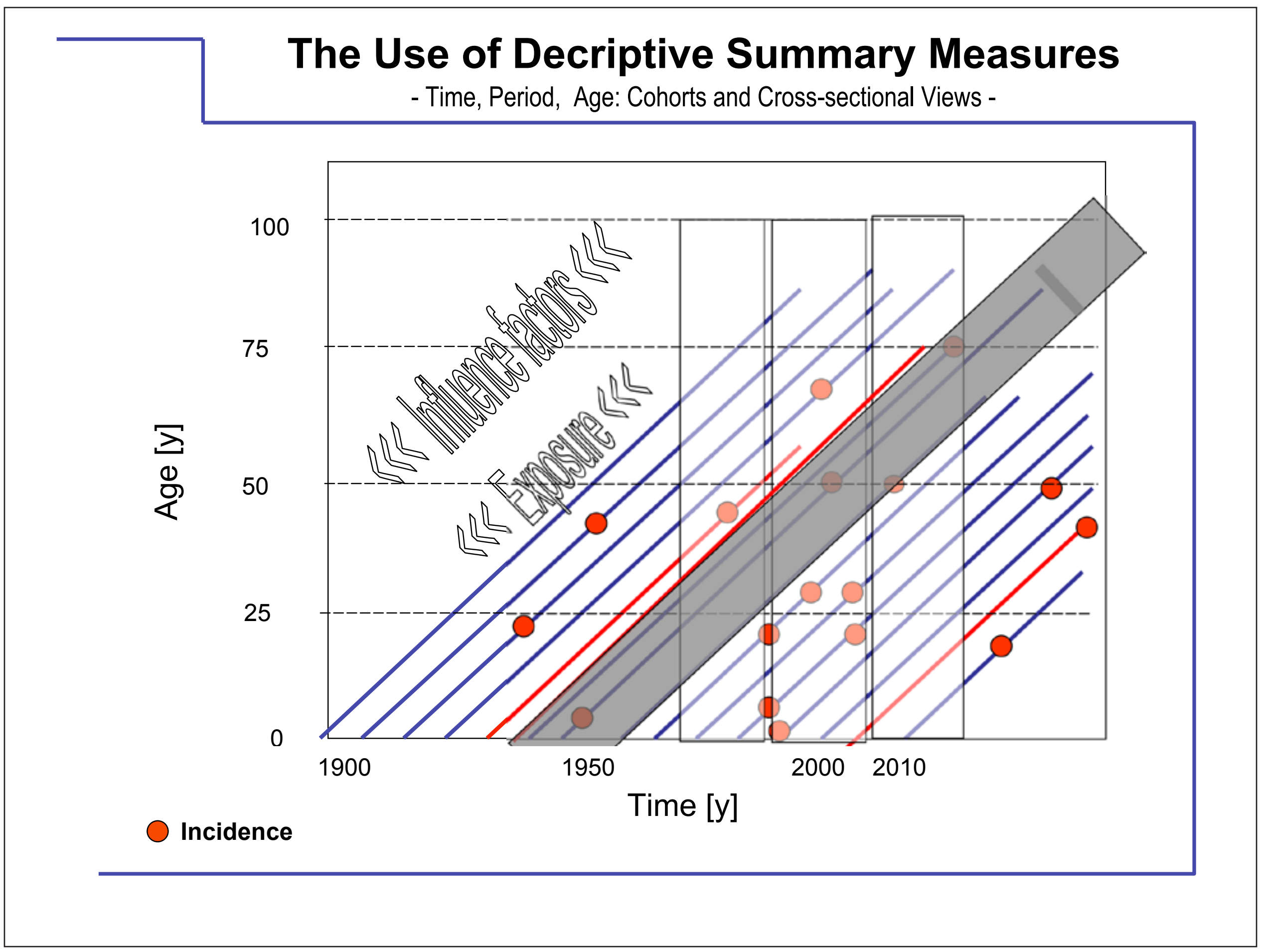
http://abcnews.go.com/print?id=5517492

Consensus: Our mission

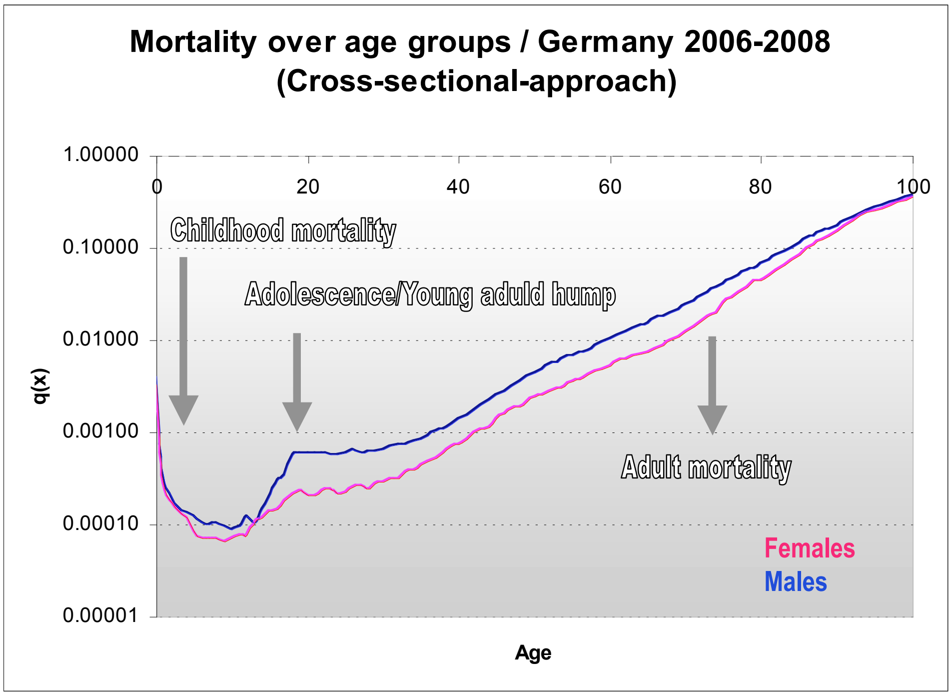
Policies and programmes to combat diseases and injuries should properly be based on current, timely information about the nature and extent of health problems, their determinants, and how the impact of such diseases and injuries is changing, both with respect to magnitude and distribution in populations.

MATHERS, Colin D. et al. Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bull World Health Organ* [online]. 2005, vol.83, n.3, pp. 171-177c .
Available from: [cited 2010-03-02]:
http://www.scielosp.org/scielo.php?script=sci_arttext&pid=S0042-96862005000300009&lng=en&nrm=iso
doi: 10.1590/S0042-96862005000300009.


Descriptive Measures in Epidemiology
The Epidemiologist as an observer
Population data
Risk factors like age, sex and region, occupation, behaviour, social status, environment, …
Morbidity, Mortality Disabilities, Health Indicators, …
Epidemiologic measures
Incidence
New cases per time period
Morbidity
Mortality & Survival
Remission free time
Cumulative Incidence
Prevalence
Number of diseases at a specific time
State variable
Descriptive measures for the status of physical, behaviour and cognitive development, indicators for burden and function related variables


The Use of Decriptive Summary Measures
- Time, Period, Age: Cohorts and Cross-sectional Views -
100
75
50
25
0
Age [y]
<< Influence factors <<
<< Exposure <<
1900
1950
2000
2010
Time [y]
Incidence

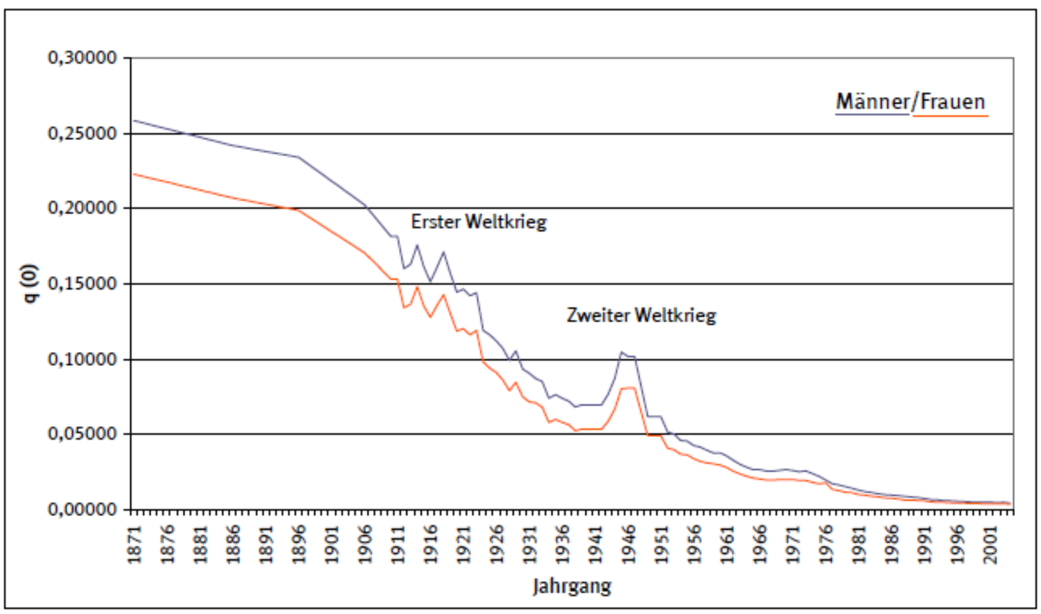
Age structure of mortality rates: Males ~ Females



Data Source for the calculations shown here: © Statistisches Bundesamt, Wiesbaden, 2009

The change of mortality in the first year of life 1871-2004

LE at birth	Females	Males	Diff.
Deutschland	82.7	77.6	5.1



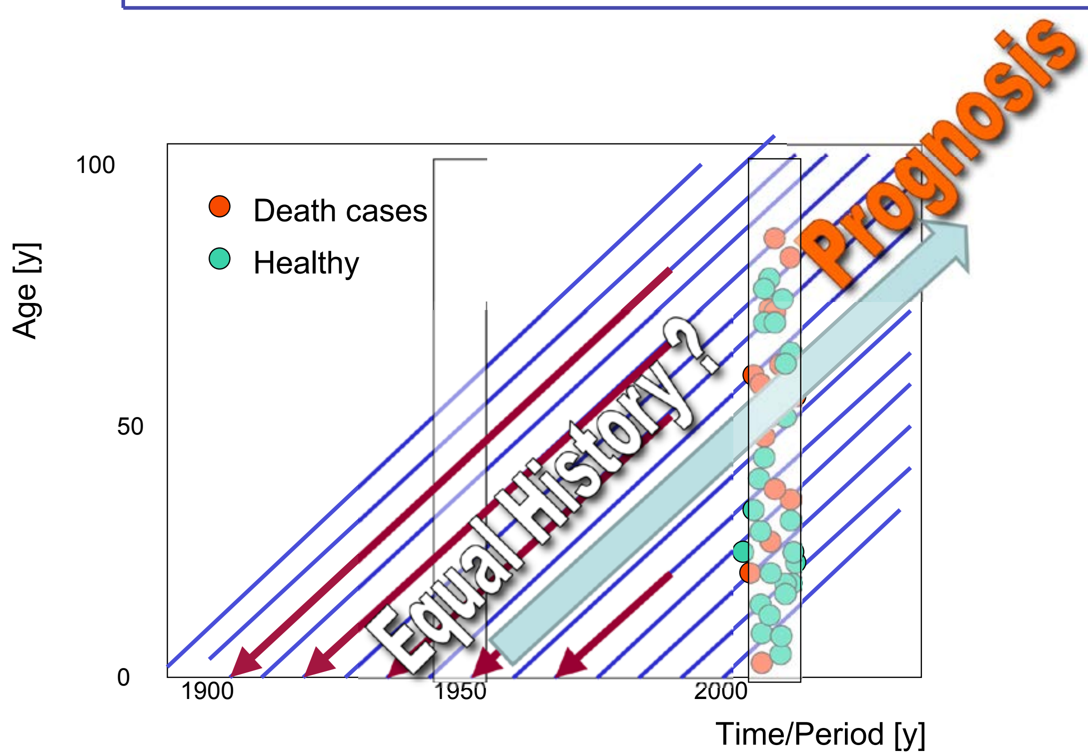
© Statistisches Bundesamt, Wiesbaden 2006

Life expectancy

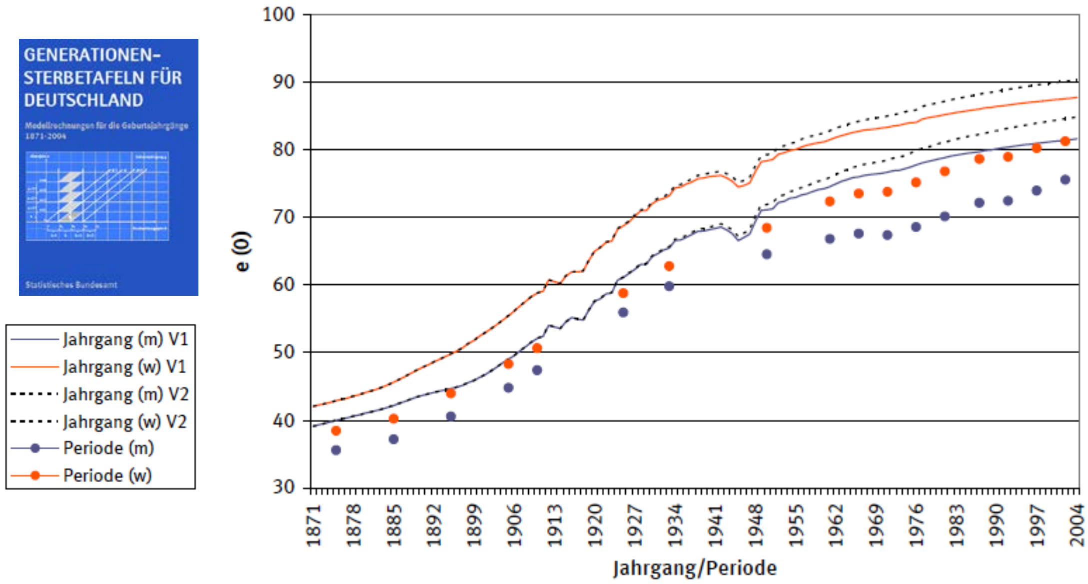
A conventional algorithm
to aggregate age-specific mortality data
into a single indicator

Life expectancy as a projection into the future

A Cross sectional data based prognosis



LE at birth seen from cohorts and periods view

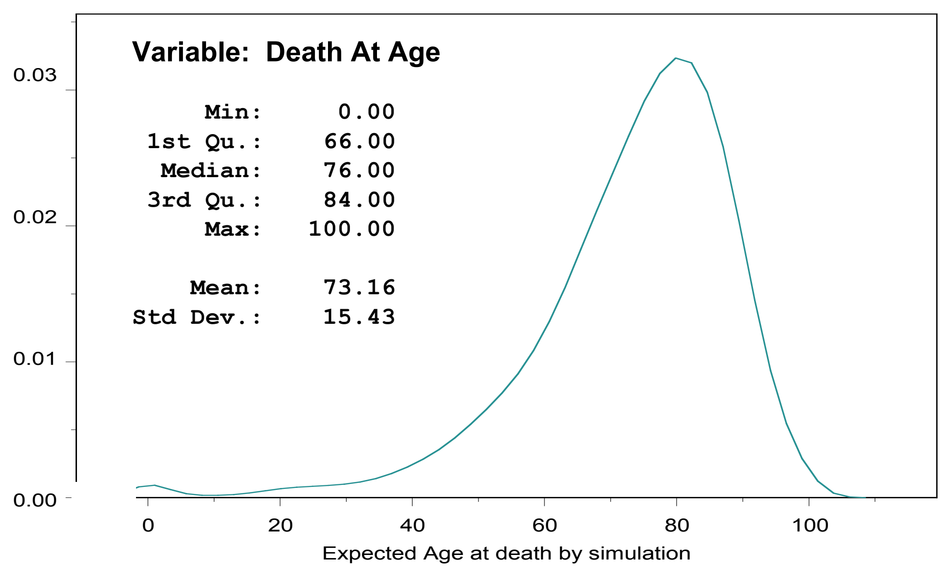


Generationen-Sterbetafeln für Deutschland. Modellrechnungen für die Geburtsjahrgänge 1871-2004. Statistisches Bundesamt, Wiesbaden 2006

A Cohort's „Age at Death"-Density-Distribution

given an age-sex-specific mortality and a resulting survival table

High variance = High uncertainty in prediction



Simulation with 100.000 repetitions / Males: North Germany 1994

M-F- differences in Life Expectancy LE

The result is influenced by economic and social factors

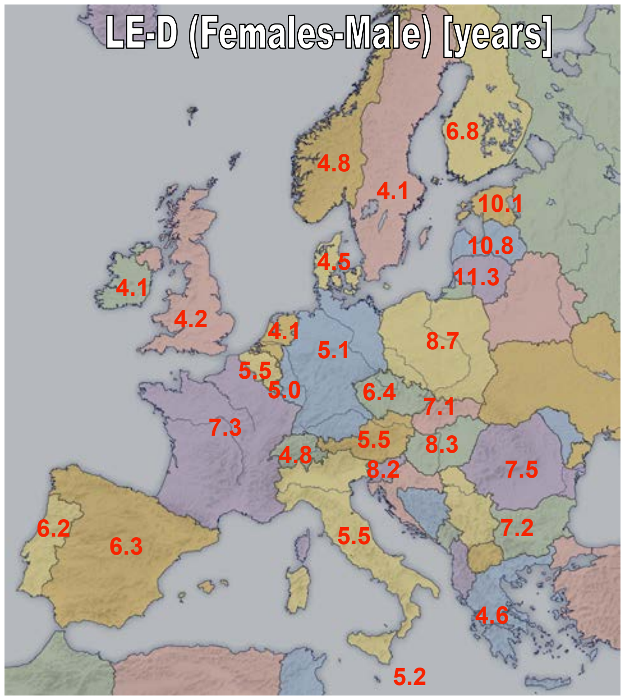
Differences between Male and Female Life Expectancy in 27-EU member states

27-EU members
Period: 2006-2008

EuroStat Data
March 2010

Ranges in LE:

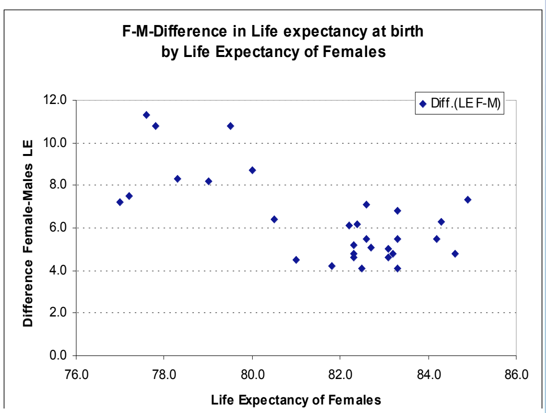
77.0-84.9 Females
66.3-79.8 Males



Contrafactious to 82.5 (M) and 85 (F)

LE in Europe

Male and Female Life Expectancy in the 27-EU member states
- Sorted by F-M-difference -
27-EU members
Period: 2006-2008
EuroStat Data / March 2010



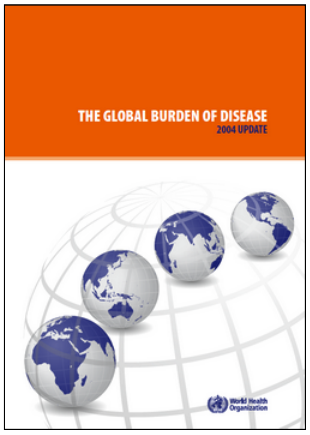
LE at birth	*Females*	*Males*	*Diff.*
Niederlande	82.5	78.4	4.1
Schweden	83.3	79.2	4.1
Ver. Königreich	81.8	77.6	4.2
Dänemark	81.0	76.5	4.5
Griechenland	82.3	77.7	4.6
Zypern	83.1	78.5	4.6
Irland	82.3	77.5	4.8
Norwegen	83.2	78.4	4.8
Schweiz	84.6	79.8	4.8
Luxemburg	83.1	78.1	5.0
Deutschland	82.7	77.6	5.1
Malta	82.3	77.1	5.2
Belgien	82.6	77.1	5.5
Italien	84.2	78.7	5.5
Österreich	83.3	77.8	5.5
Portugal	82.4	76.2	6.2
Spanien	84.3	78.0	6.3
Tschech. Rep.	80.5	74.1	6.4
Finnland	83.3	76.5	6.8
Slowenien	82.6	75.5	7.1
Bulgarien	77.0	69.8	7.2
Frankreich	84.9	77.6	7.3
Rumänien	77.2	69.7	7.5
Slowakei	79.0	70.8	8.2
Ungarn	78.3	70.0	8.3
Polen	80.0	71.3	8.7
Estland	79.5	68.7	10.8
Lettland	77.8	67.0	10.8
Litauen	77.6	66.3	11.3
EU27	82.2	76.1	6.1

Survival, Life expectancy and QoL adjustment

The Use of Summary Measures of Population Health

- Comparison and evaluation of national/regional economics, economic growth and the impact of political decisions on the public health
- Allocation of restricted resources using decision-analytic approaches for priorisation and cost-utility-approaches

DALY: disability-adjusted life year (1)



The global burden of disease: 2004 update.
I.World Health Organization (WHO) Geneva, Switzerland 2008

“A consistent and comparative description of the burden of diseases and injuries, and risk factors that cause them, is an important input to health decision-making and planning processes.“ (The first sentence of the report, p. 2)

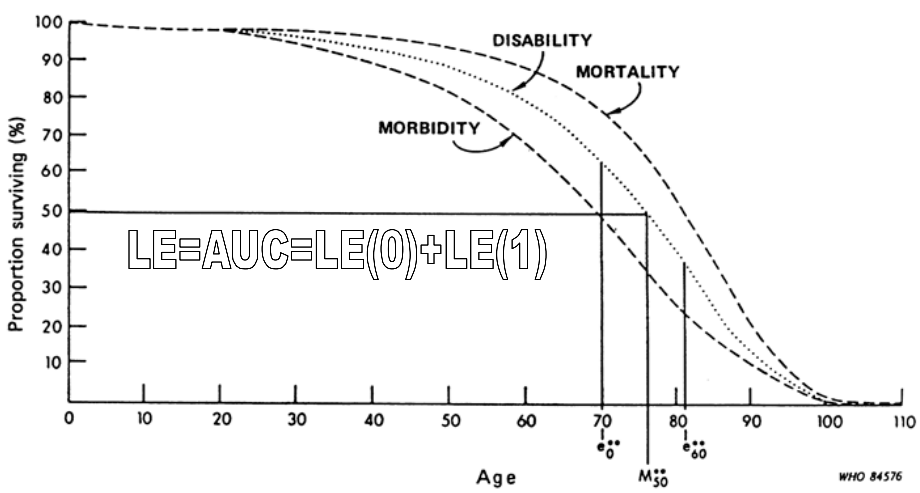
The disability-adjusted life year (DALY) extends the concept of potential years of life lost due to premature death to include equivalent years of “healthy” life lost by virtue of being in states of poor health or disability.

The DALY is based on years of life lost from premature death and years of life lived in less than full health.

There remain substantial data gaps and deficiencies, particularly for regions with limited death registration data. (p. 117)

WHO (1984): The general model of health transition

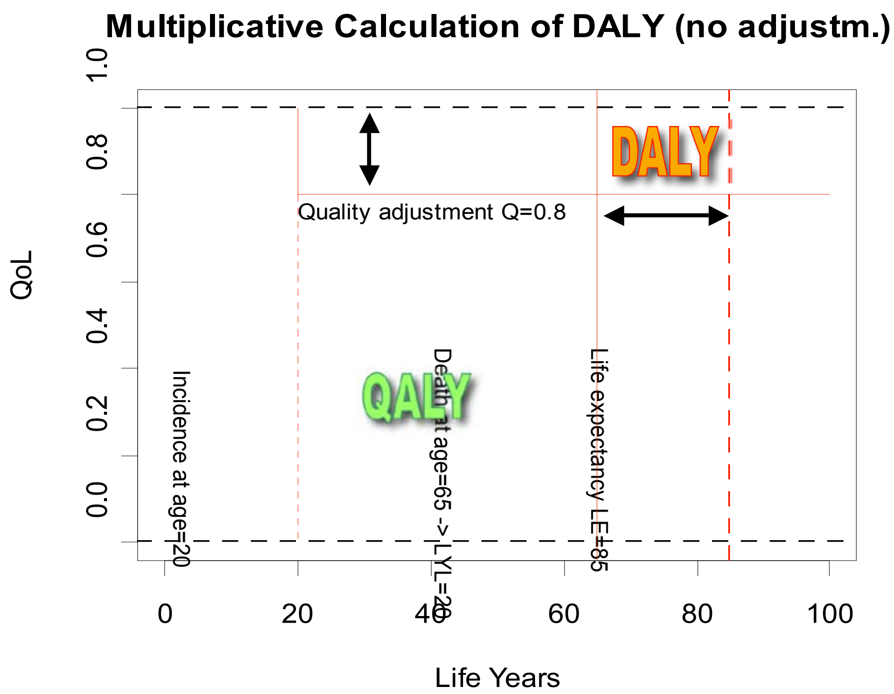
The observed mortality and hypothetical morbidity and disability survival curves for females
United States of America, 1980



e_0** and e_{60}** are the number of years of autonomous life expected at birth and at age 60, respectively.
M_{50}** is the age to which 50% of females could expect to survive without loss of autonomy.

World Health Organization (1984) *The uses of epidemiology in the study of the elderly: Report of a WHO Scientific Group on the Epidemiology of Aging.* Geneva: WHO (Technical Report Series 706).

Illustration of the HALY, DALY and QALY concept



Health adjusted life years

DALYs = healthy years lost
QALYs = healthy years gained

- **DALY (Disease Adjusted Life Years) is a modification of QALY (Quality Adjusted Life Years).**
- **Both concepts combine information about Length of life and Quality of life.**
- **A DALY is a negative QALY.**

DALY: disability-adjusted life year

One quality-adjusted life year (DALY) can be thought of as one lost year of "healthy" life, and the burden of disease can be thought of as a measurement of the gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability.

DALY = YLL + YLD

where:

YLL = number of deaths
× standard life expectancy at the age of death

YLD = incidence (period)
× average duration of the illness
× disability weight

The weight factor reflects the Quality of the disease on a scale from 0 (perfect health) to 1 (death).

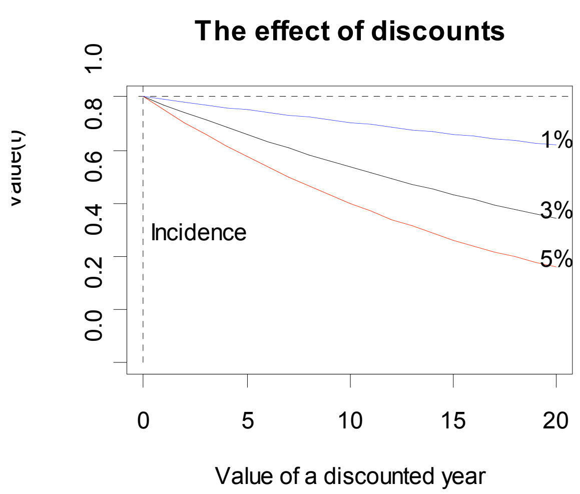
The global burden of disease: 2004 update.
World Health Organization (WHO)
Geneva, Switzerland 2008

Formula for and Effects of Discounting

$$QALE_{discounted} = \sum_{t=a}^{a+L} \frac{Q_t}{(1+r)^{t-a}}$$

a = year of incidence
L = LE at incidence
= discounting perspective [years]

Q = current value at incidence
t = years/time interval pas incidence
r = discount rate



Dr. Michael Schümann 24

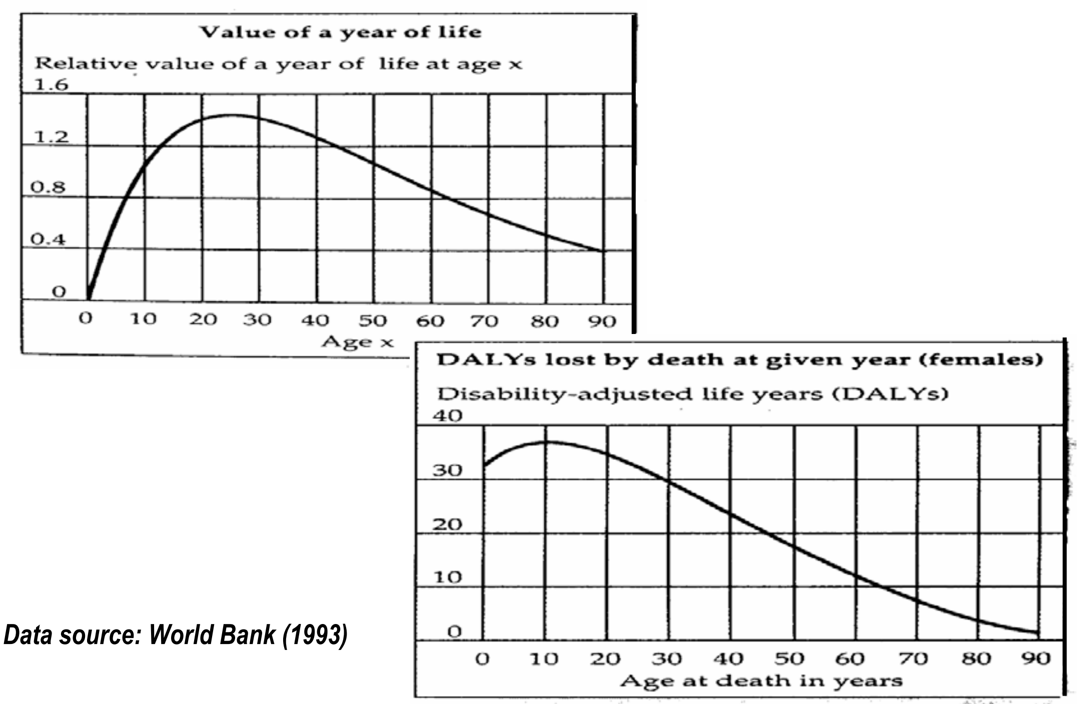
Choices behind the DALY concept

In the standard DALYs calculations of YLL and YLD uses an additional 3% time discounting and non-uniform age weights that give less weight to years lived at young and older ages.

Using discounting and age weights, a death in infancy corresponds to 33 DALYs, and deaths at ages 5–20 years to around 36 DALYs.

- **Discounting**
  - the value of a life year now is set higher than the value of future life years
- **Age weighting**
  - life years of children and old people are counted less

The World Bank evaluates the "Relative Value of a Year of Life"



Data source: World Bank (1993)

Justice
Equity

The DALY approach has been criticised for discriminating

- the young (age weight)
- the elderly (age weight)
- future generations (discounting)
- future health benefits (discounting)
- Women (age weight & LE)
- the disabled (discrimination)

Convention on the Rights of Persons with Disabilities (2007)

UNITED NATIONS enable
Rights and Dignity of Persons with Disabilities

Article 2 Definitions

…

discrimination on the basis of disability means any distinction, exclusion or restriction on the basis of disability which has the purpose or effect of impairing or nullifying the recognition, enjoyment or exercise, on an equal basis with others, of all human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field. It includes all forms of discrimination, including denial of reasonable accommodation;

…

http://www.un.org/disabilities/default.asp?id=182

Some remarks with respect to the the theory and the practice of QoL scaling

„.. the challenge in measuring quality of life lies in its uniqueness to individuals.“

Carr AJ & Higginson IJ: *Measuring quality of life: Are quality of life measures patient centred? BMJ* 2001;322:1357-1360

General problems of QoL validity

- **What is “Quality of Life” or “Disability Weighting of Life Years”?**
- **Can Quality of Life be measured in a single and precise number?**
- **Can Quality of Life be measured in a linear additive scale?**
- **Does the same health problem have equal impact on different persons or groups?**
- **Is there a general agreement to underlying value choices: discounting, age weighting and choice of life expectancy**

General problems of QoL validity

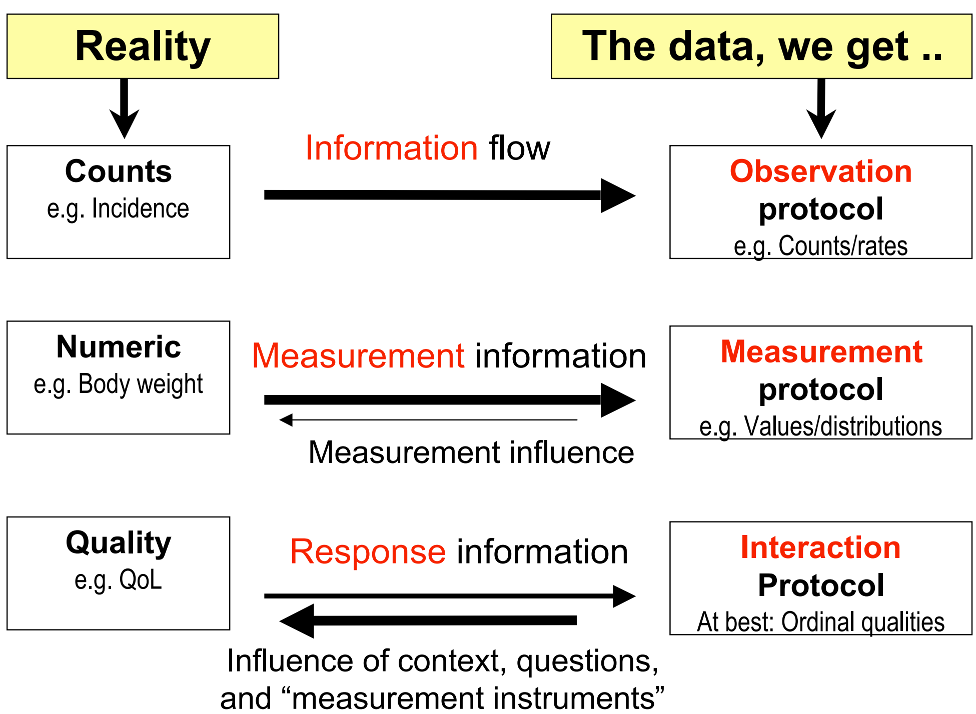
A fundamental part of the definition of a high QoL is a large degree of freedom in thinking and behaviour that includes personal subjective feelings.

As a result, the cornerstones of science—which include objectivity, universality, reproducibility, and logical consistency— can no longer be totally applied.

Unless a logical and scientific way of assessing personal feelings is established, QoL simply cannot be evaluated using scientific analysis and numeric expression.

*Sagar SM (2008):*How do we evaluate outcome in an integrative oncology program? *Current Oncology, Vol. 15., Suppl. 2, S78-S82*

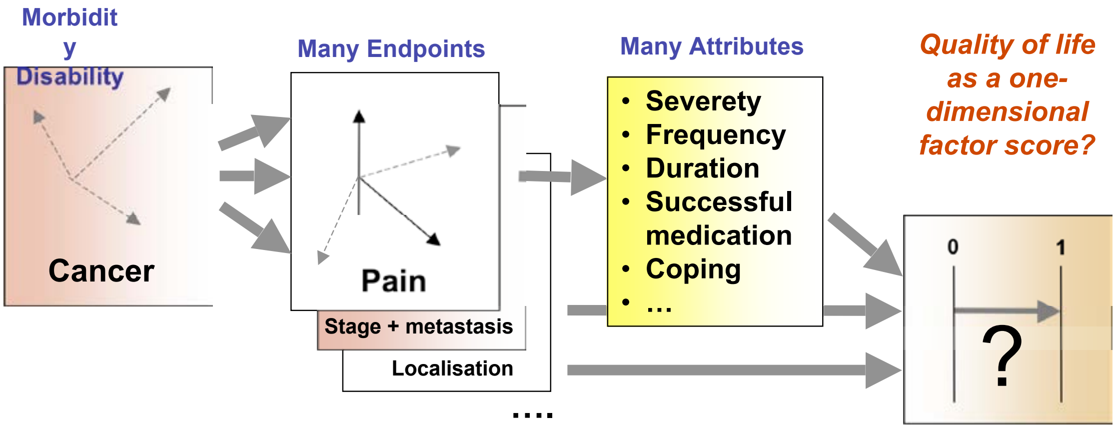
Observation, Measurement or Interaction Protocol



QoL

What we are talking about?

The content of a one-dimensional QoL scale



The Ratings for many endpoints and many attributes of a state of health are converted to a health utility score using a scoring algorithm based on the preferences of the general adult public or subgroups of it. But what is the content of that scale? Has it a unit? Is it additiv? Is it useful/justified to use it multiplication?

Understanding the Choices That Patients Make:

How Preferences Are Measured

“One of the other fundamental problems with eliciting patient preferences is the assumption that one-dimensional preferences already exist in the patient's mind, ..

.. the problems of translation the preference into a question / interview is very difficult to sustain in the real-world interaction in a physician's office.”

→ **Validity problems**

Thomas R. Taylor: J Am Board Fam Med. 2000;13(2) © 2000 American Board of Family Medicine

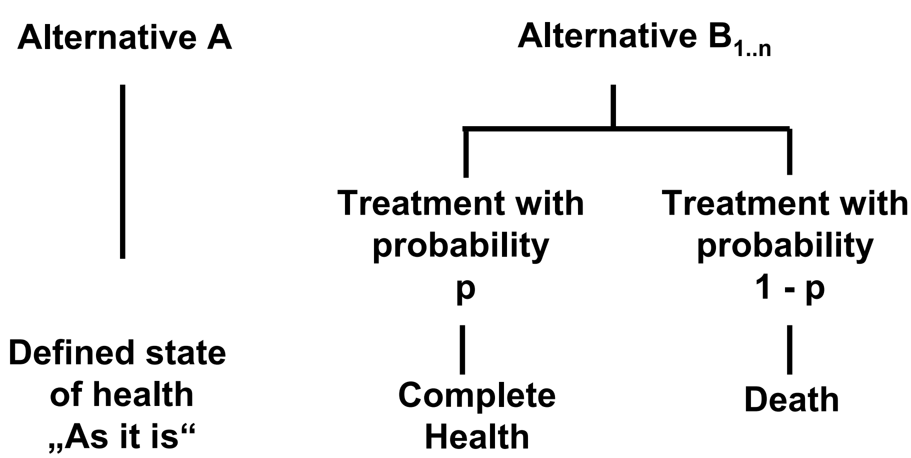
The process of eliciting preferences and utilities

- Standard Gamble
- Time-Trade-Off
- Rating-Scale-Approaches
- Multi-Attribute-Utility-Scales
  - HRQL/HUI Inc.
  - EuroQual
- Magnitude-Estimation-Approach
- Equivalence-Approach
- Willingness-To-Pay
- … and some more

- General Quality Remarks

The Standard Gamble Approach ~ Indifference of utility

The participant of the study is asked to decide between two alternatives or to signal indifference. The investigator is changing the assigned probabilities of alternative B until indifference is found.



Model assumptions: $(U_{Death} = 0, U_{Complete\ Health} = 1) \rightarrow$

For $Util_A = Util_B \rightarrow p * Util_{Complete\ Health} + (1 - p) * U_{Death} = p$

The TTO protocol

The Time-Trade-Off (TTO) scheme (1)

Test item / Instruction

Imagine that you are told that you are ill (with a specific disease) and you have 10 years left to live. In connection with this you are also told that you can choose to live these 10 years in your current health state or that you can choose to give up some life years to live for a shorter period in full health.

Indicate with a cross on the line the number of years in full health that you think is of equal value to 10 years in your current health state.

Model assumption

*10 [y] * Current State of health [ ] = x [y] * State of „Full Health“ [ ]*

The TTO protocol

The Time-Trade-Off (TTO) scheme (2)

Response

Assignment of a number position (e.g. 4) on a line of length (e.g. 10 units)

Quality of Life Weight “Measure QoL”

Indicated value (e.g. in range 0 to 10) / Length of TTO line’s range (e.g. 10)

Calculation of a QALY from QoL index

*QALYs lived in one year = 1 * QoL = e.g. 4/10 = 0.4 with QoL ≤ 1*

Quality adjusted Residual Life Span

$$QALE = \Sigma_{t=a}^{a+Residual(LE)} Q_t$$

The TTO protocol

Face and Content Validity problems

- Forced impossibility to answer that all individuals and all years of life are equally valuable (acceptance of experimental context)
- Not easy to answer since the investigator gives a promise that he or she might never keep.
- Forced consistency with respect to comparibility between the two situations that are essentially different
- Lack of simplicity, lack of uniform diagnostic criteria, difficult to understand : give an answer for disease's values without personal experience (→ prejudice)
- Assumption of an artificial "all-or-nothing" process
- The "expert panel" will not represent the values of other people
- The investigators never ask for "Do you agree to the consequences of your adjustment that ..?"

Health Related Quality of Life: Health Utilility Inc. /CA

- The multi-attribute utility functions provide all the information required to calculate single-summary scores of health-related quality of life (HRQL) for each health state defined by the classification systems.

- **Utility Measurement Theory**
- There are two main approaches to measuring utilities, direct measurement and the use of multi-attribute systems. In the multi-attribute approach used for HUI, a respondent completes a questionnaire providing information about an individual's health status that is then scored using a multi-attribute scoring function derived from community preference measures for health states.

Horsman *et al. Health and Quality of Life Outcomes* 2003 **1**:54 doi:10.1186/1477-7525-1-54

Health Related Quality of Life: Health Utilility Inc. /CA

Multi-Attribute Health Status Classification System:
Health Utilities Index Mark 2 (HUI2)

Attribute	Levels	Min / Max descripttion of the Attribute
Sensation	4	Able to see, hear, and speak normally for age. Blind, deaf, or mute
Mobility	5	Able to walk, bend, lift, jump, and run normally for age. Unable to control or use arms and legs.
Emotion	5	Generally happy and free from worry. Extremely fretful, angry, irritable, anxious, or depressed usually requiring hospitalization or psychiatric institutional care.
Cognitive	4	Learns and remembers school work normally for age. Unable to learn and remember
Self-Care	4	Eats, bathes, dresses, and uses the toilet normally for age Requires the help of another person to eat, bathe, dress, or use the toilet.
Pain	5	Free of pain and discomfort. Severe pain. Pain not relieved by drugs and constantly disrupts normal activities
Fertility	3	Able to have children with a fertile spouse. Unable to have children with a fertile spouse

http://www.hqlo.com/content/1/1/54/figure/F1?highres=y

Health Related Quality of Life: Health Utilility Inc. /CA

- The major criterion for selecting attributes for the HUI systems was the importance that members of the general public placed on each attribute. Attribute levels were defined to cover the full range of possible abilities/disabilities and to be clearly distinguishable from one another. HUI utility scores represent mean community preferences.
- The HRQL score for each health state is calculated using a mathematical formula (utility function) developed from preference scores measured in accordance with von Neumann-Morgenstern utility theory. Subjects were asked to rate states on a 100-point visual analogue scale (VAS), then to assess a series of health states using a standard gamble chance board (SG). This combination of preference measures ensures appropriate ranking of scores among health states and provides a direct link to the fundamental axioms of utility theory

Horsman *et al.* : The Health Utilities Index (HUI®): concepts, measurement properties and applications. *Health and Quality of Life Outcomes* 2003 **1**:54 doi:10.1186/1477-7525-1-54

EQ-5D: A standardised instrument for use as a measure of health outcome

- „Dimensions" of the EQ-5D scale
  - **mobility,**
  - **self-care,**
  - **usual activities,**
  - **pain/discomfort,**
  - **anxiety/depression**

http://www.euroqol.org/eq-5d/what-is-eq-5d/eq-5d-nomenclature.html
http://www.euroqol.org/eq-5d/what-is-eq-5d/how-to-report.html

W. Greiner & C. Claes (2007): Der EQ-5D der EuroQol-Gruppe. In **Oliver Schöffski & J. - Matthias Graf v. d. Schulenburg:** Gesundheitsökonomische Evaluationen. Springer Berlin Heidelberg

EuroQol

By placing a check-mark in one box in each group below, please indicate which statement best describes your own state of health today.

EuroQol EQ-5D Questionnaire

Mobility
I have no problems in walking about ❑
I have some problems in walking about ❑
I am confined to bed ❑

Self-Care
I have no problems with self-care
I have some problems washing or dressin
I am unable to wash or dress myself

Usual Activities *(e.g. work, study, house*
leisure activities)
I have no problems with performing my us
I have some problems with performing my
I am unable to perform my usual activities

Pain/Discomfort
I have no pain or discomfort ❑
I have moderate pain or discomfort ❑
I have extreme pain or discomfort ❑

Anxiety/Depression
I am not anxious or depressed ❑
I am moderately anxious or depressed ❑
I am extremely anxious or depressed ❑

QoL

What is the QoL ? Questions

- What they meant by Quality of Life?
- Domains wanted to measure as components of Quality of Life?
- Reasons for choosing the instruments used?
- Aggregating the results from multiple items, domains, or instruments into a single Composite Score for Quality of Life?
- Were patients asked to give their own Global Rating for Quality of Life?
- Was Overall Quality of Life distinguished from Health-Related Quality of Life?
- Were patients invited to supplement the items listed in the instruments offered by the investigators?
  - If so, were these supplemental items incorporated into the final rating?
- Were patients asked to indicate which items (either specified by the investigator or added by the patients) were personally important to them?
  - If so, were these importance ratings incorporated into the final rating?

Because quality of life is a uniquely personal perception, denoting the way that individual patients feel about their health status and/or nonmedical aspects of their lives, most measurements of quality of life in the medical literature seem to aim at the wrong target.

Gill TM & Feinstein AR (1994): A Critical Appraisal of the Quality of Quality-of-Life Measurements. JAMA. 1994;272:619-626

0 1

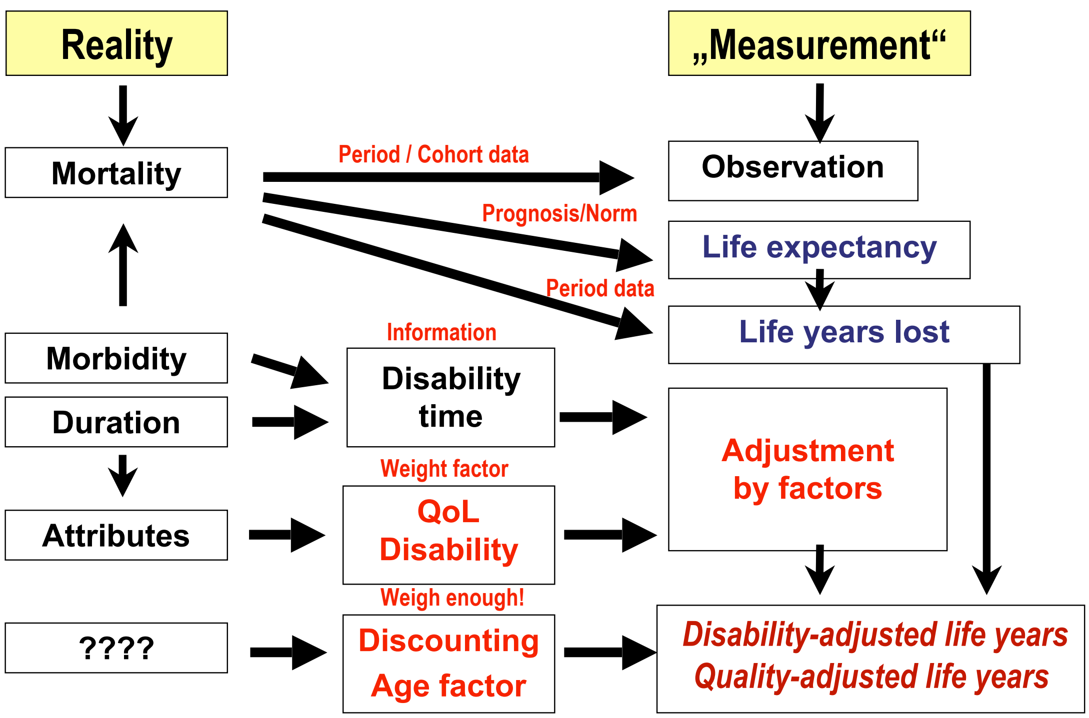
Self-assessment for the Quality of Life generates no measurement data !

- The **Quality of Scale** containing subjective estimates is unknown, it is at best ordinal.
- The **Reference System** will be at best pseudo-numeric for each individual, but might be better assumed to vary from person to person.
- The **Response** will show high instability over time, resulting in low reliability.
- The **Unit of the Scale** is not defined. **Equality of Scale Intervals** is violated. In consequence, the validity of numerical operations like addition and multiplication is invalid.
- The **Dimensionality of the QoL Scale** is at least health state dependent. There might be other influences on the attributes structure like age, sex, experience, coping, cultural back-ground among others.

Critical points with respect to „Data and Methods“

Some remarks on measurement

DALY/QALY estimates have no measurement qualities, they are at best values calculated by convention !



Summary:
Application of SMPH in Health Economy

Some remarks on application

„The ability to compare directly the dollar cost of different health outcomes is attractive to the decision-maker.“

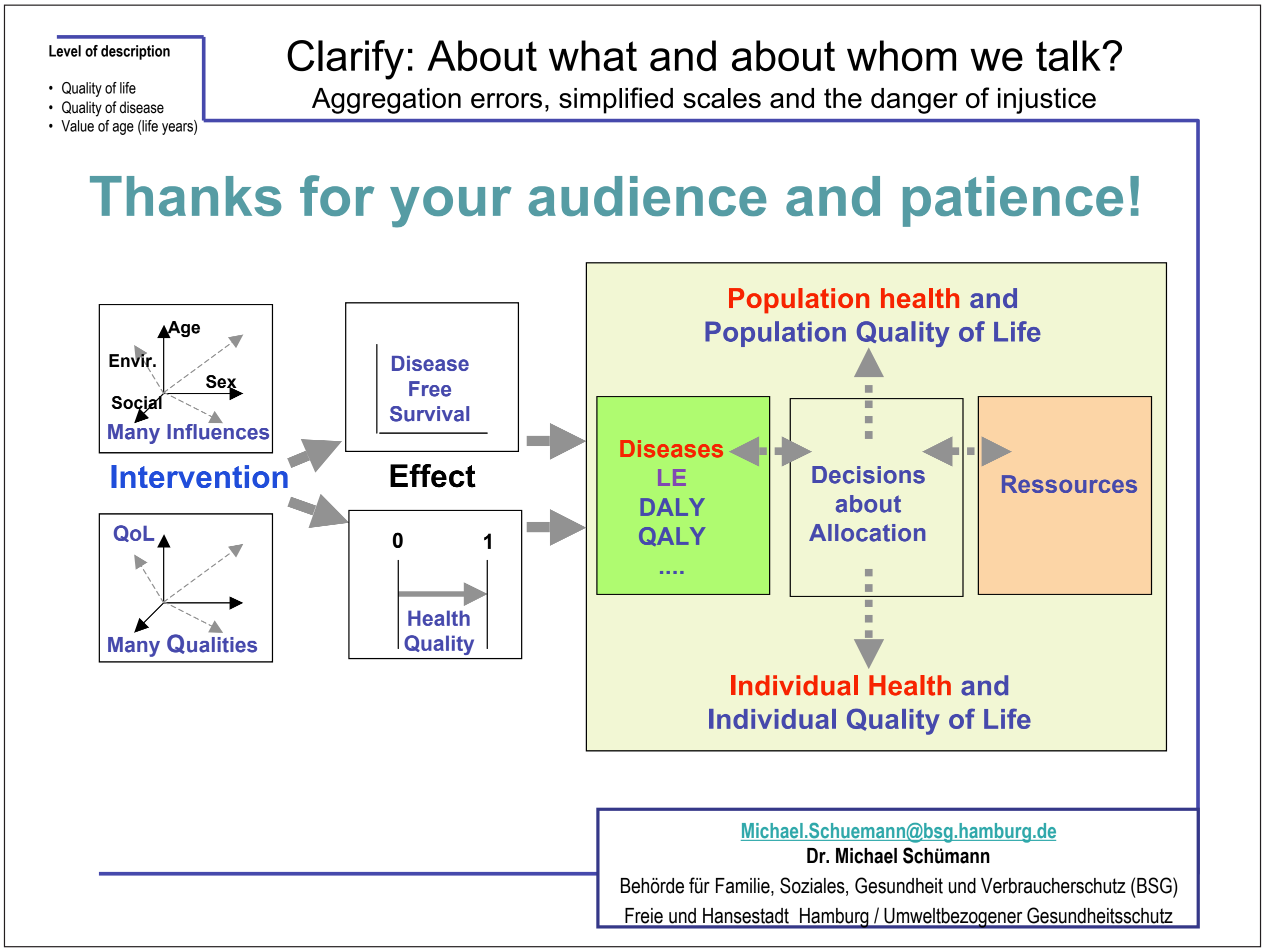
McGregor M: Cost-utility analysis: Use QALY only with great caution. *CMAJ.* 2003 February 18; 168(4): 433–434.

Evaluating Costs and Utilities / Values of benefit

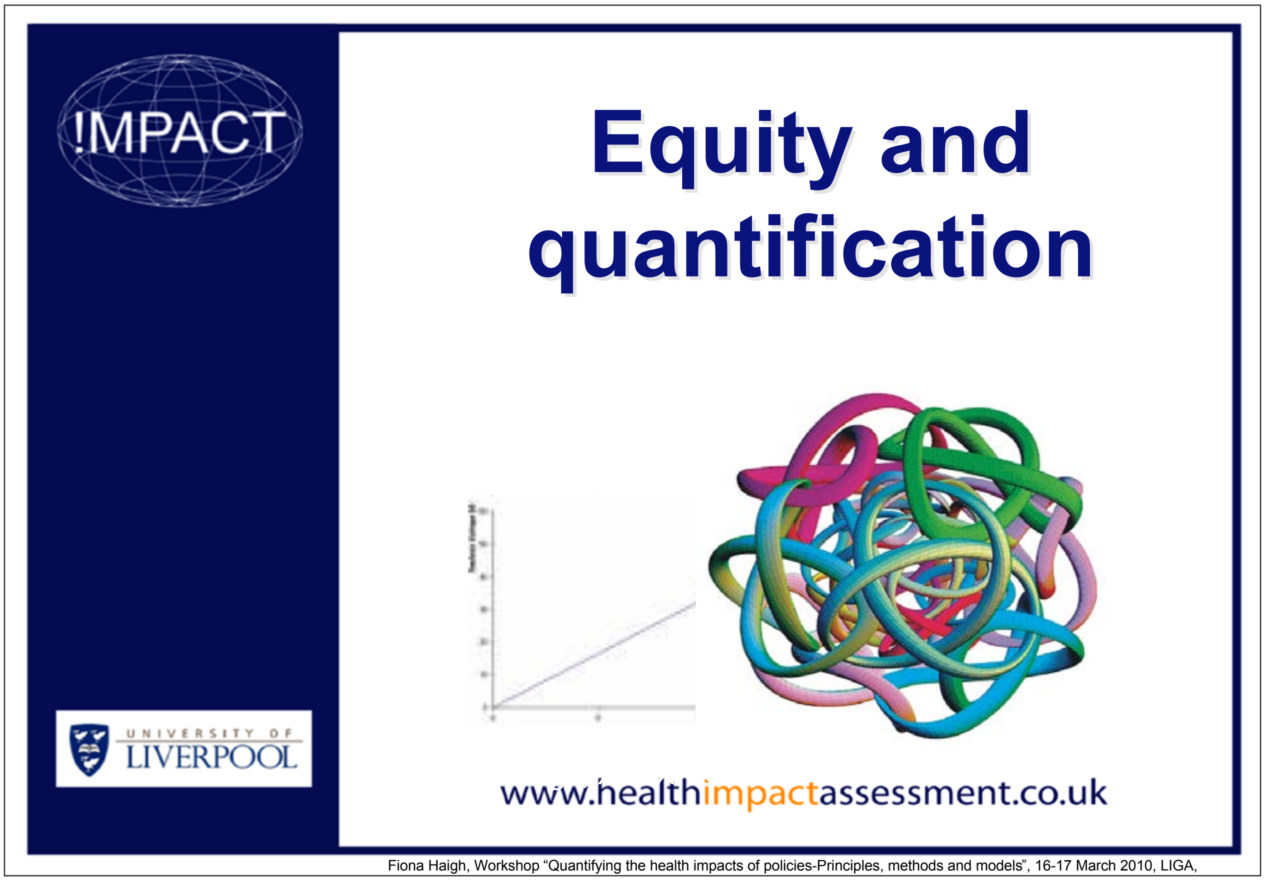
Type of health related evaluation	Costs	Result
Cost-of-illness-study (COI)	€	-
Cost-minimization-study (CM)	€	-
Cost-effectiveness-analysis (CEA)	€	Outcome
Willningness-to-pay (WTP)	€	Outcome
Cost-benefit-analysis (CBA)	€	€
Cost-utility-analysis (CUA)	€	utility ~ €
Utility-Utility-Comparison	Outcome	Outcome
Risk-Risk-Comparison	Outcome	Outcome
Health-Health-Comparison	Outcome	Outcome

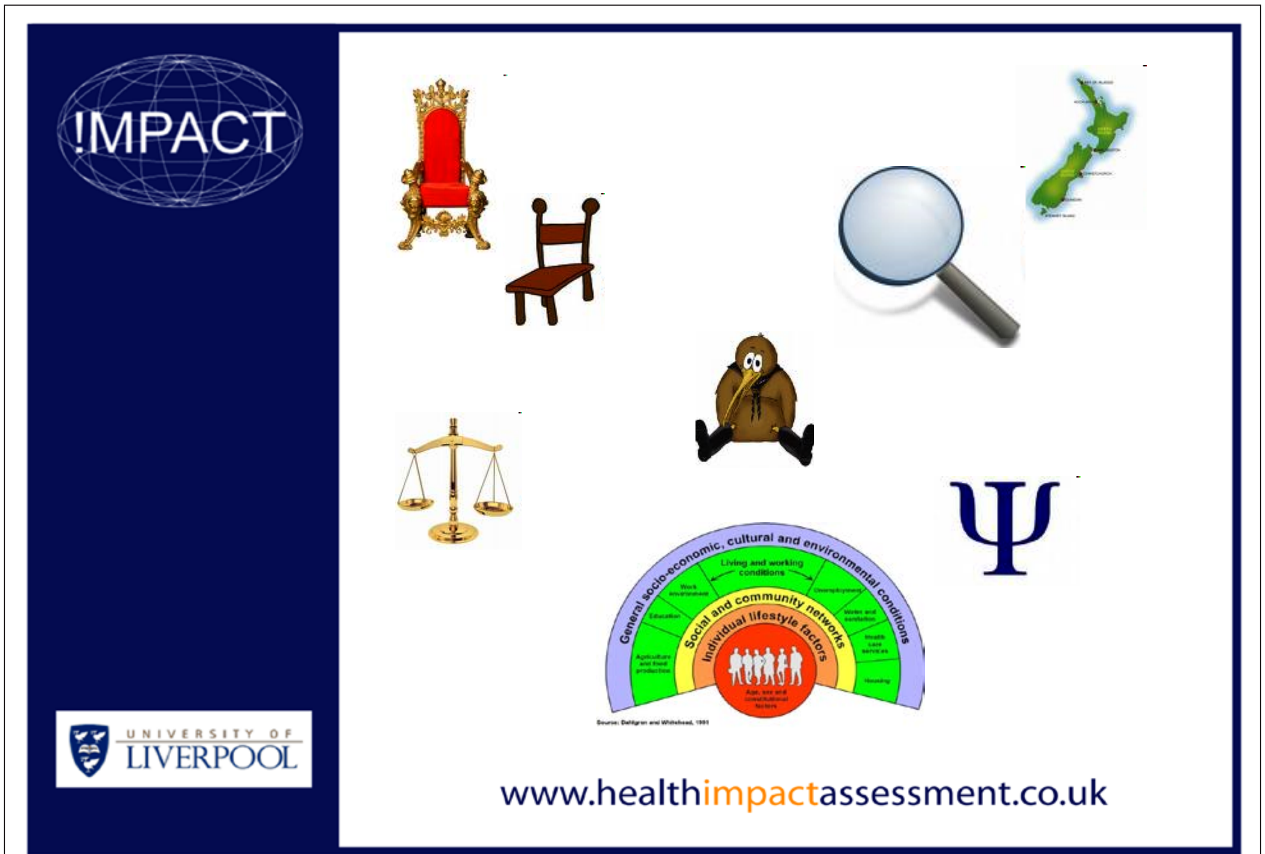
For a discussion see: http://www.ers.usda.gov/publications/aer784/

Dr. Michael Schümann **50**


Level of description
• Quality of life
• Quality of disease
• Value of age (life years)
Clarify: About what and about whom we talk?
Aggregation errors, simplified scales and the danger of injustice
Thanks for your audience and patience!
Age
Envir.
Sex
Social
Many Influences
Intervention
QoL
Many Qualities
Disease
Free
Survival
Effect
0
1
Health
Quality
Population health and
Population Quality of Life
Diseases
LE
DALY
QALY
....
Decisions
about
Allocation
Ressources
Individual Health and
Individual Quality of Life
Michael.Schuemann@bsg.hamburg.de
Dr. Michael Schümann
Behörde für Familie, Soziales, Gesundheit und Verbraucherschutz (BSG)
Freie und Hansestadt Hamburg / Umweltbezogener Gesundheitsschutz

Fiona Haigh: Equity and quantification





Fiona Haigh, Workshop “Quantifying the health impacts of policies-Principles, methods and models”, 16-17 March 2010, LIGA,

!MPACT

UNIVERSITY OF LIVERPOOL

Equity

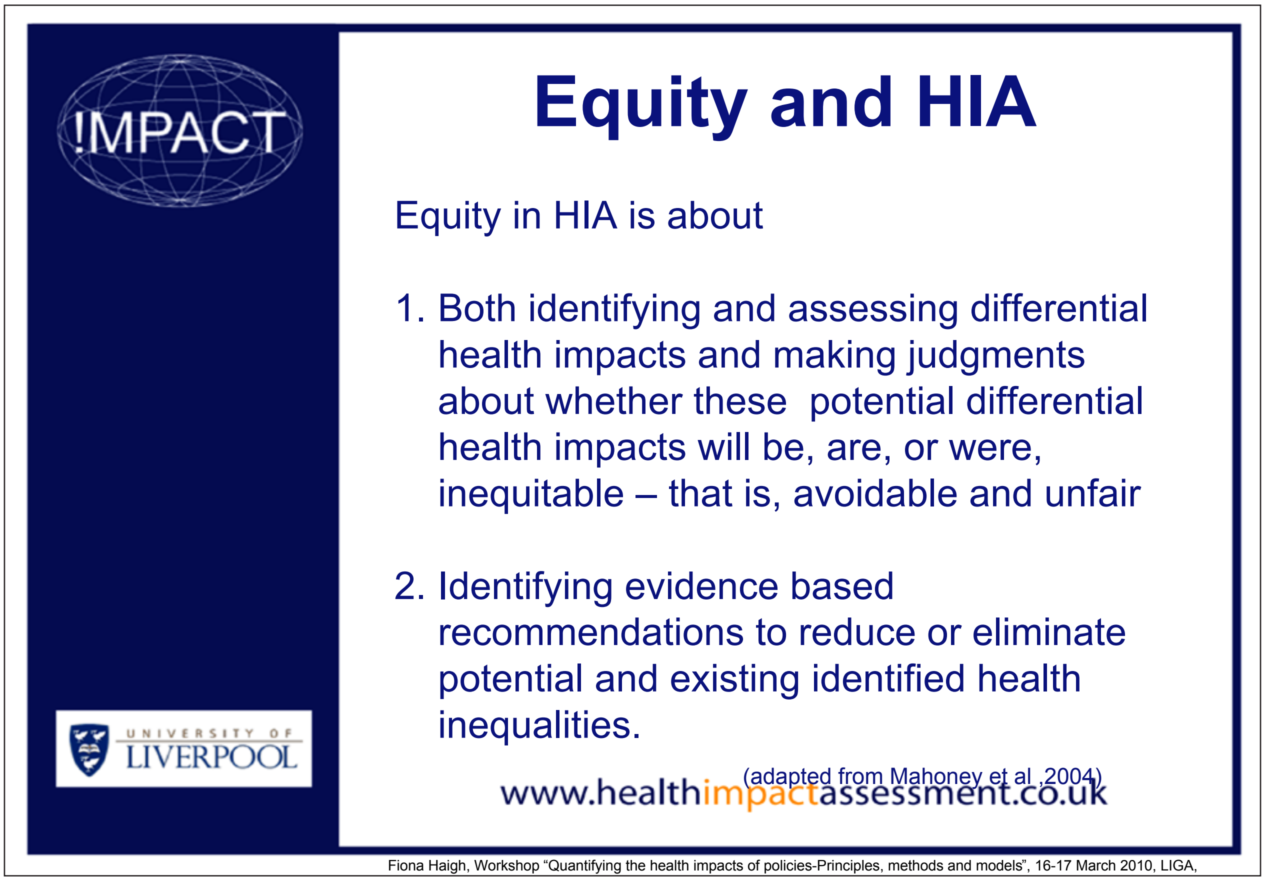
differences in health that are not only unnecessary and **avoidable**, but in addition **unfair** and **unjust**.
(Whitehead and Dahlgren 1991)

Difference between variations and social inequities in health: They are ***systematic, socially produced*** (and therefore modifiable) and ***unfair*.**
(Whitehead and Dahlgren 2007)

health equity is the absence of systematic differences in health, both between and within countries that are judged to be avoidable by **reasonable** action (CSDH 2008)

www.healthimpactassessment.co.uk

Fiona Haigh, Workshop “Quantifying the health impacts of policies-Principles, methods and models”, 16-17 March 2010, LIGA,


!MPACT
Equity and HIA
Equity in HIA is about
1. Both identifying and assessing differential health impacts and making judgments about whether these potential differential health impacts will be, are, or were, inequitable – that is, avoidable and unfair
2. Identifying evidence based recommendations to reduce or eliminate potential and existing identified health inequalities.
(adapted from Mahoney et al ,2004)
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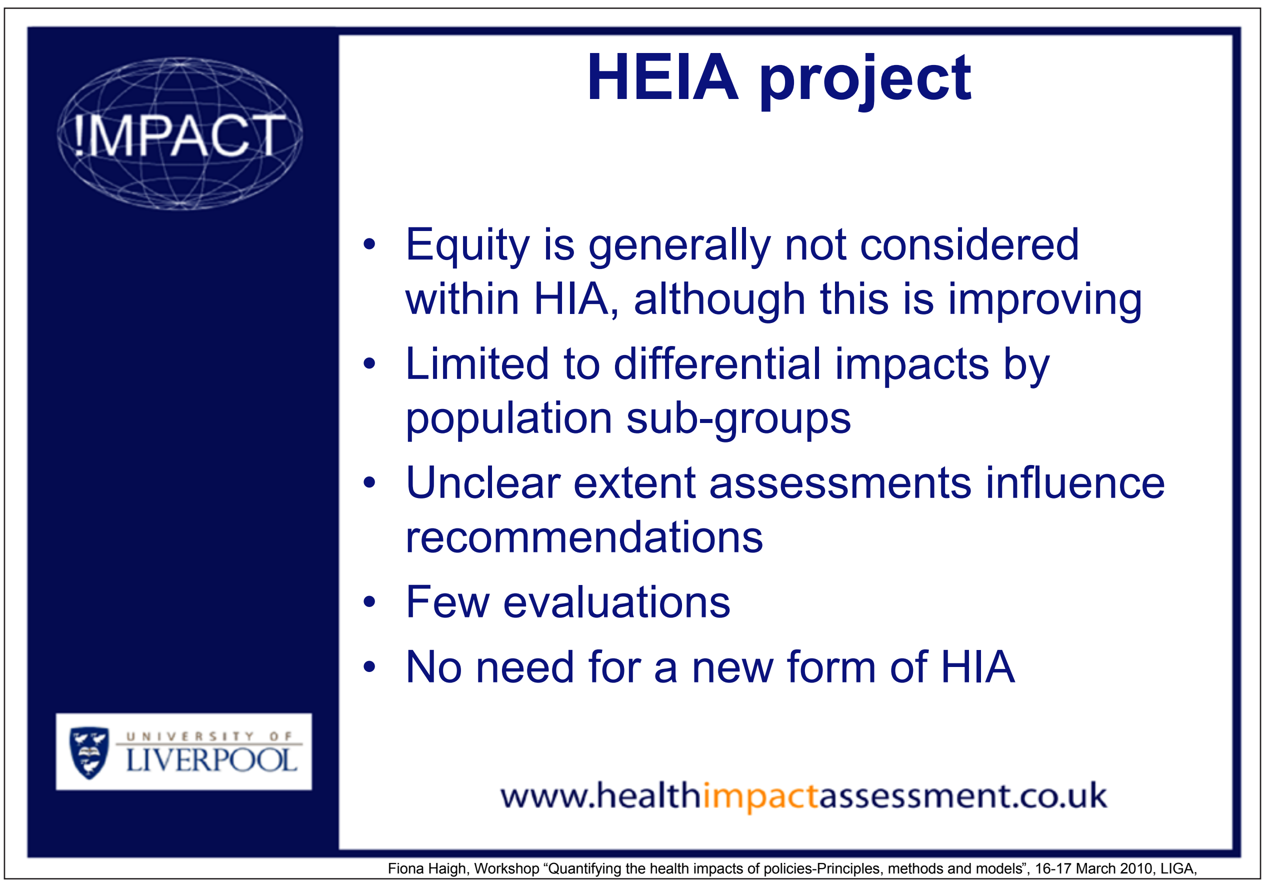
!MPACT
HEIA project
• Equity is generally not considered within HIA, although this is improving
• Limited to differential impacts by population sub-groups
• Unclear extent assessments influence recommendations
• Few evaluations
• No need for a new form of HIA
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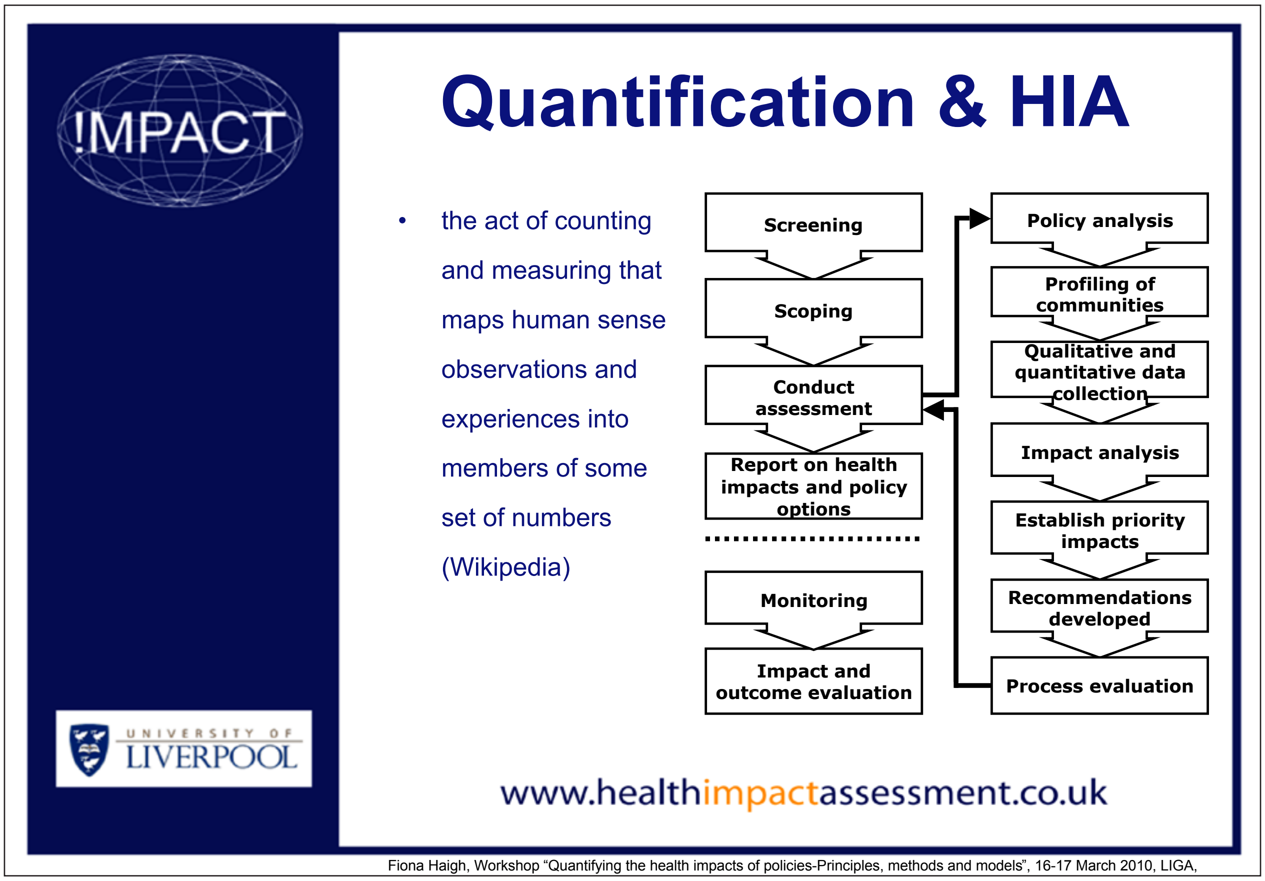
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Quantification & HIA
• the act of counting and measuring that maps human sense observations and experiences into members of some set of numbers (Wikipedia)
Screening
Scoping
Conduct assessment
Report on health impacts and policy options
Monitoring
Impact and outcome evaluation
Policy analysis
Profiling of communities
Qualitative and quantitative data collection
Impact analysis
Establish priority impacts
Recommendations developed
Process evaluation
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Disaggregate
BOX 16.3: TOWARDS A COMPREHENSIVE NATIONAL HEALTH EQUITY SURVEILLANCE FRAMEWORK
HEALTH INEQUITIES
Include information on:
health outcomes stratified by:
– sex
– at least two socioeconomic stratifiers (education, income/wealth, occupational class);
– ethnic group/race/indigeneity;
– other contextually relevant social stratifiers;
– place of residence (rural/urban and province or other relevant geographical unit);
the distribution of the population across the sub-groups;
a summary measure of relative health inequity: measures include the rate ratio, the relative index of inequality, the relative version of the population attributable risk, and the concentration index;
a summary measure of absolute health inequity: measures include the rate difference, the slope index of inequality, and the population attributable risk.
HEALTH OUTCOMES
mortality (all cause, cause specific, age specific);
ECD;
mental health;
morbidity and disability;
self-assessed physical and mental health;
cause-specific outcomes.
DETERMINANTS, WHERE APPLICABLE INCLUDING STRATIFIED DATA
Daily living conditions
health behaviours:
– smoking;
– alcohol;
– physical activity;
– diet and nutrition;
physical and social environment:
– water and sanitation;
– housing conditions;
– infrastructure, transport, and urban design;
– air quality;
– social capital;
working conditions:
– material working hazards;
– stress;
health care:
– coverage;
– health-care system infrastructure;
social protection:
– coverage;
– generosity.
Structural drivers of health inequity:
gender:
– norms and values;
– economic participation;
– sexual and reproductive health;
social inequities:
– social exclusion;
– income and wealth distribution;
– education;
sociopolitical context:
– civil rights;
– employment conditions;
– governance and public spending priorities;
– macroeconomic conditions.
CONSEQUENCES OF ILL-HEALTH
economic consequences;
social consequences.
(CSDH, 2008)
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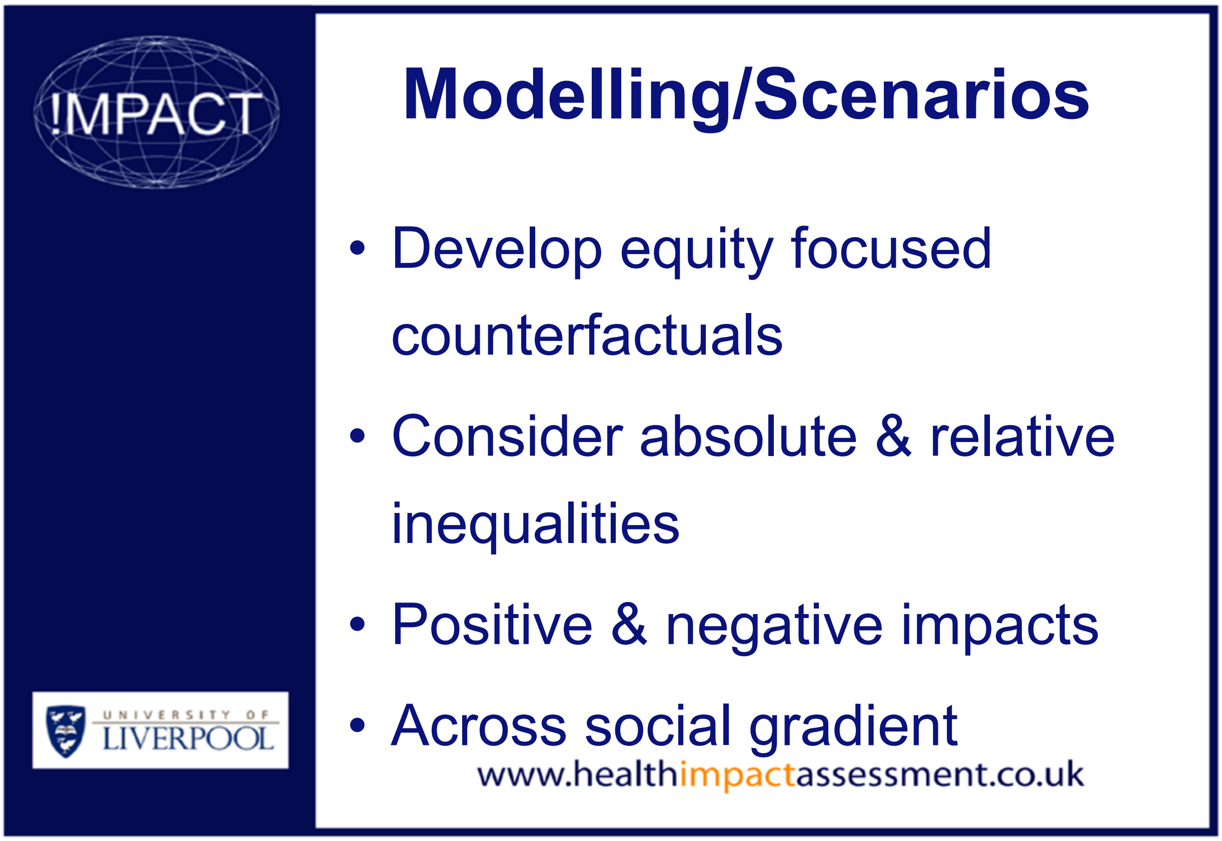

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For example...

Standard Tool for Quantification in Health Impact Assessment A Review (Lhachimi et al. 2010)

- 6 evaluation criteria- no mention of equity or inequalities
- Focus - proximal, narrow, biomedical, simplified

"The ***standard HIA causal pathway*** assumes that a policy intervention leads to a change in risk-factor prevalence that, in turn, leads to changes in ***disease*** incidence and disease-related mortality and therefore in ***overall*** population health"

(emphasis added)

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Way forward…

- Models should help us address inequalities
- Equity as criteria
  - Selection of models
- Disaggregation at all stages
- Use an 'equity lens' in modelling
- Don't hide from reality (complexity, chaos, open systems) - How much reality are you prepared to compromise for useability
- Talk about where you sit
- Progressive realisation rather than 'reasonable'

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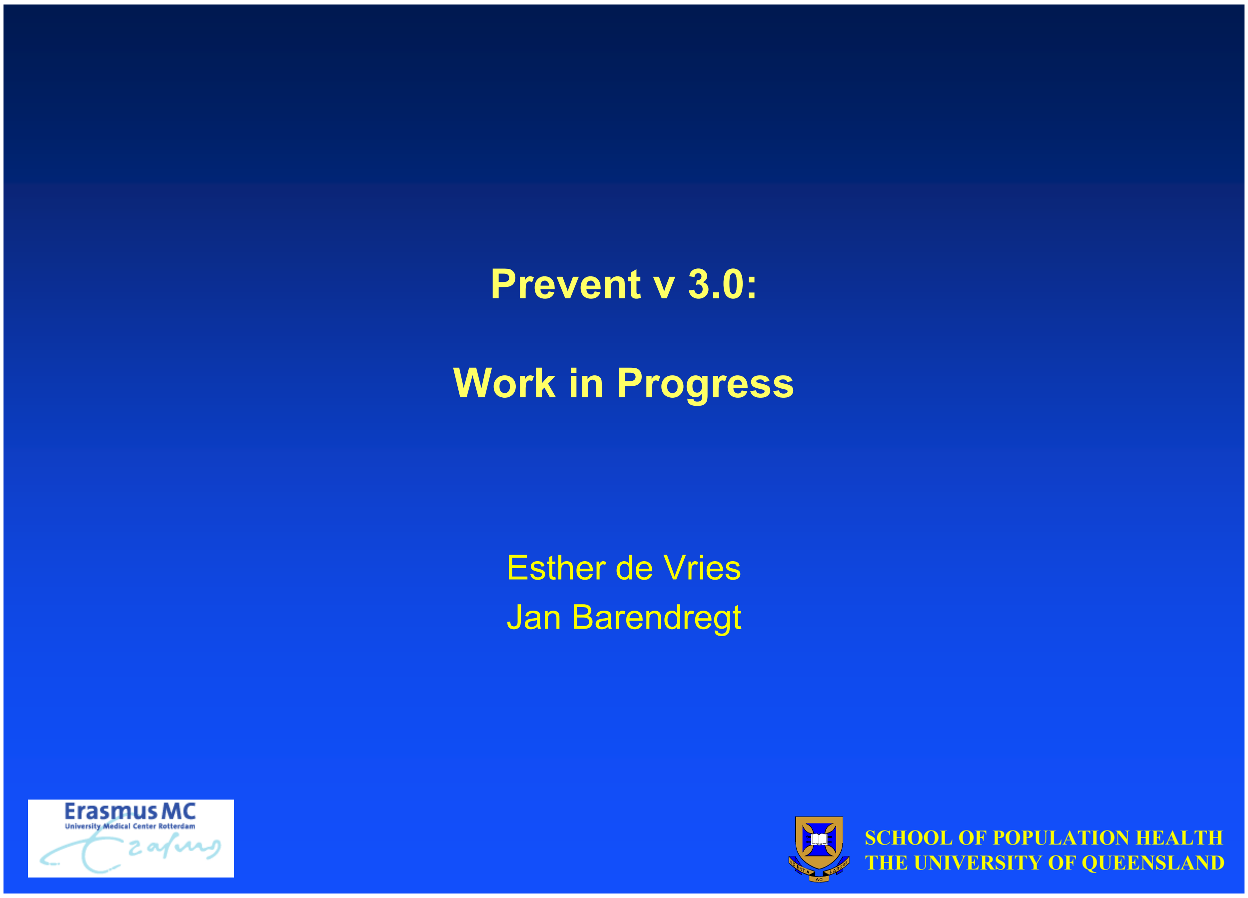
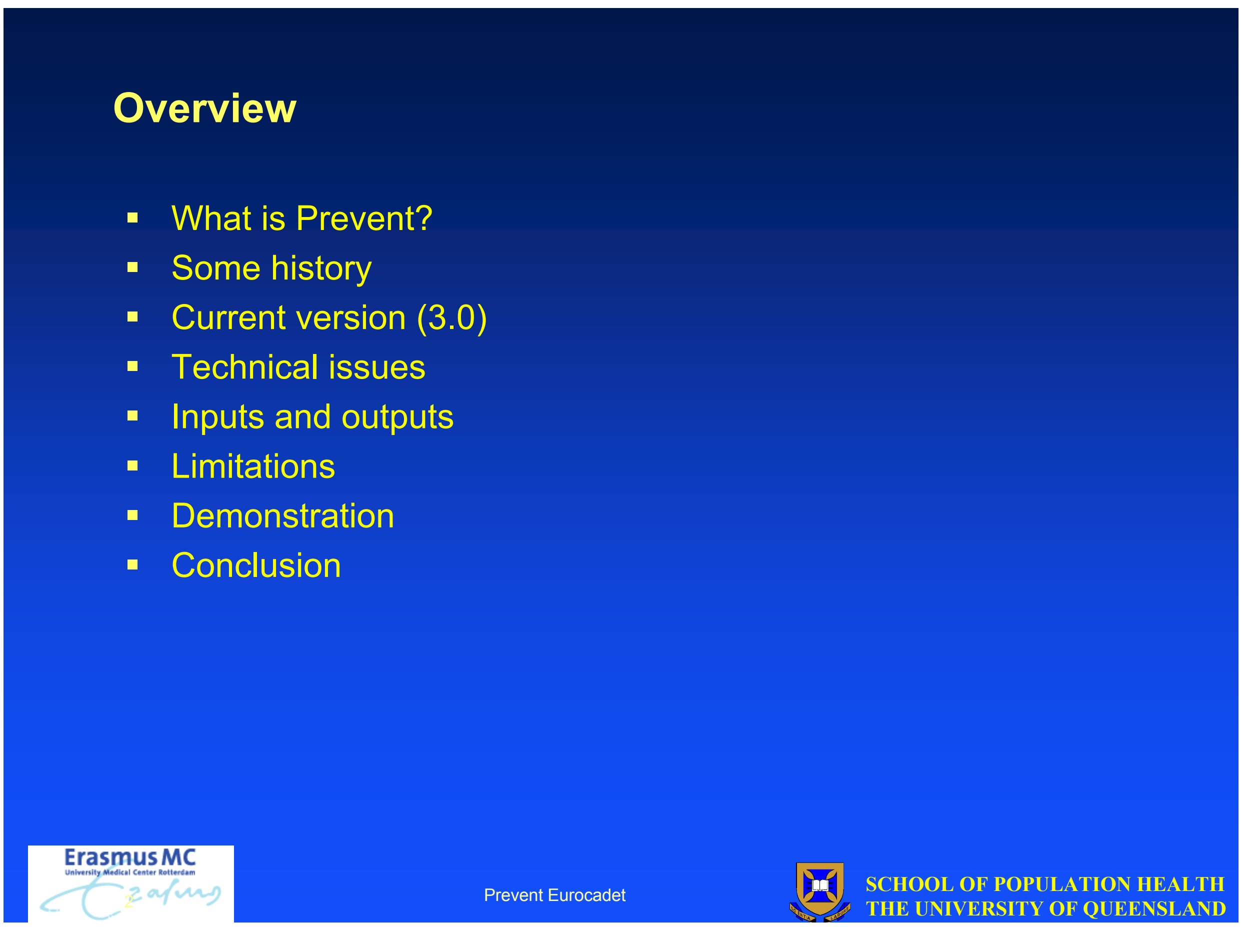
Session 2 „Models / projects“

PREVENT

Esther de Vries: Prevent v 3.0: Work in Progress





What is Prevent? (1)

- Prevent is a Public Health model that links changes in risk factor exposure to changes in risk factor related disease specific outcomes and to changes in generic health outcomes
- Prevent handles multiple risk factors and diseases simultaneously
- A risk factor can be related to many diseases, and a disease can have many risk factors
- Lag times can exist between a change in a risk factor and changes in the risk of related diseases

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What is Prevent? (2)

- Diseases and risk factors are embedded in a dynamic population model
  - Intervention effects are calculated over ‘real’ time
  - Population projections, ageing, migration
- It calculates two scenarios (called ‘reference’ and ‘intervention’), that are the same in all respects, except for the intervention(s) to be evaluated
  - Therefore the difference between the two is due to the intervention(s)

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Some history (1)

- Work on the first version started in 1986
  - At first in-house use only (PhD Louise Gunning-Schepers 1988), first semi-publicly available version (2.0) in 1989
- Features:
  - Model is an empty shell: input files determine risk factors, diseases, and relationships
  - Health outcomes only disease specific and total mortality, and mortality based outcomes such as YLL
- Usage:
  - Intended to be used by policy makers, but that never happened
  - Interest more from public health researchers

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Some history (2)

- Version 2.9 (~1997) features:
  - Windows version
  - Simple disease model added: incidence, prevalence, mortality
  - Morbidity based outcomes added, including disability and costs
  - Various limits lifted (numbers of risk factors and diseases, length of time lags)
- Usage:
  - Mostly for teaching
  - Some own research

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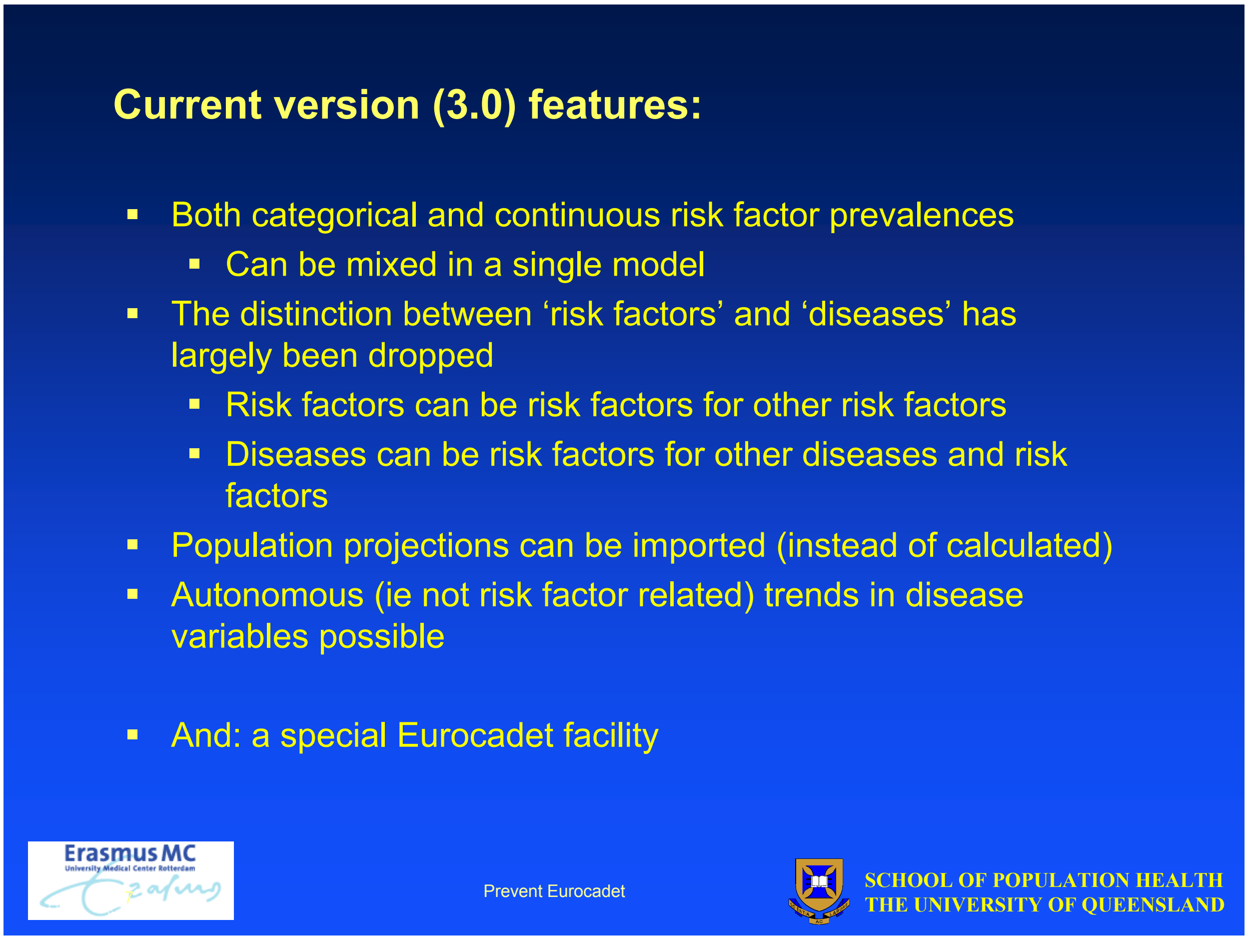
Current version (3.0) features:
Both categorical and continuous risk factor prevalences
Can be mixed in a single model
The distinction between 'risk factors' and 'diseases' has largely been dropped
Risk factors can be risk factors for other risk factors
Diseases can be risk factors for other diseases and risk factors
Population projections can be imported (instead of calculated)
Autonomous (ie not risk factor related) trends in disease variables possible
And: a special Eurocadet facility
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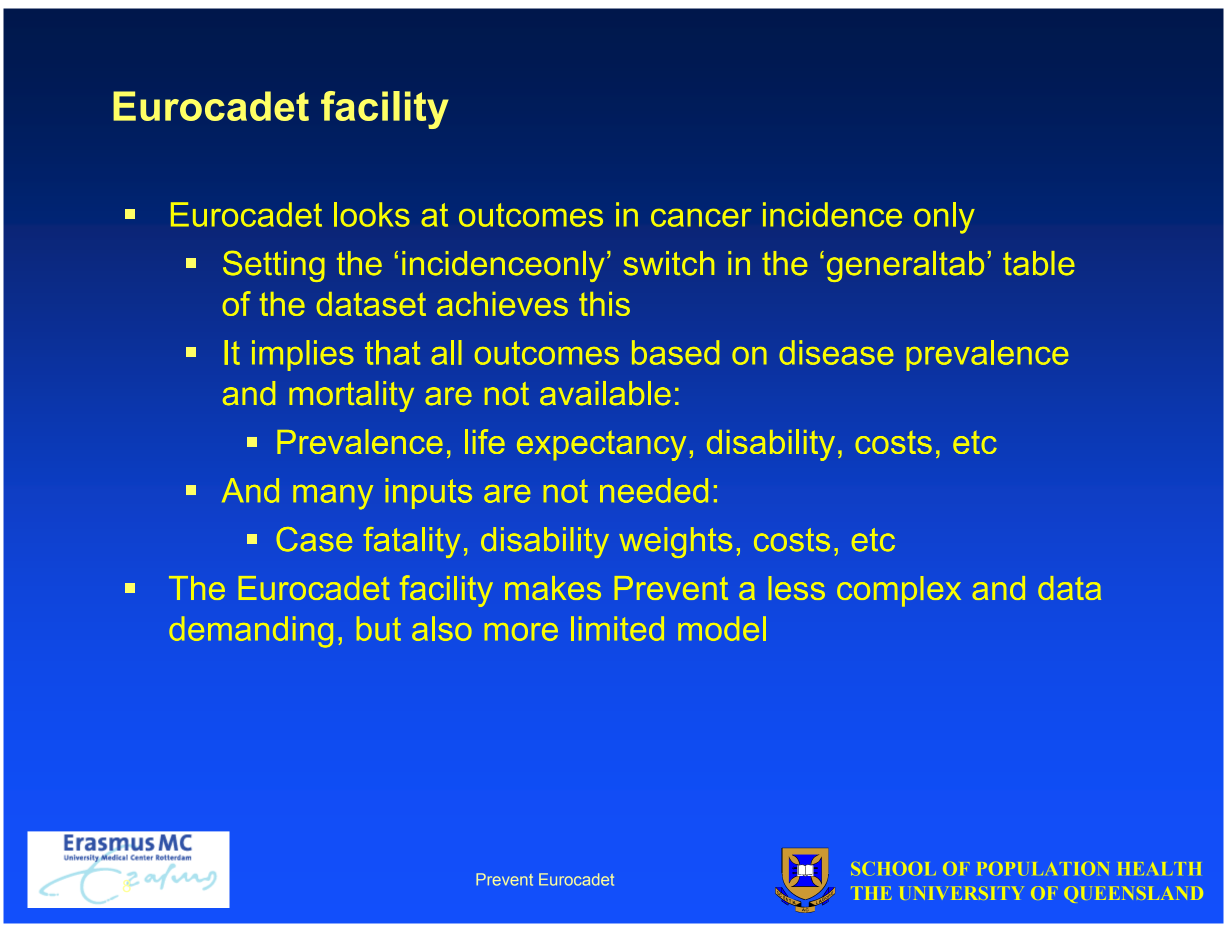
Eurocadet facility
Eurocadet looks at outcomes in cancer incidence only
Setting the 'incidenceonly' switch in the 'generaltab' table of the dataset achieves this
It implies that all outcomes based on disease prevalence and mortality are not available:
Prevalence, life expectancy, disability, costs, etc
And many inputs are not needed:
Case fatality, disability weights, costs, etc
The Eurocadet facility makes Prevent a less complex and data demanding, but also more limited model
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Technical issues (1)

- Prevent expects an intervention to affect risk factor prevalence
  - The change in risk factor prevalence is expressed as a change in disease risk using a relative risk (RR) to calculate a potential impact fraction (PIF)
- For a dichotomous risk factor the PIF equation is:

$$PIF = \frac{(p - p^*)(RR - 1)}{p(RR - 1) + 1}$$

- With *p** the risk factor prevalence after intervention
- When *p** =0 the PIF reduces to the population attributable fraction (PAF):

$$PAF = \frac{p(RR - 1)}{p(RR - 1) + 1}$$

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Technical issues (2)

- For multiple exposure categories *c* this equation applies:

$$PIF = \frac{\sum_c p_c RR_c - \sum_c p_c^* RR_c}{\sum_c p_c RR_c}$$

- For continuous risk factor distributions the following equation applies:

$$PIF = \frac{\int_a^b RR(x)P(x)dx - \int_a^b RR(x)P^*(x)dx}{\int_a^b RR(x)P(x)dx}$$

- Note that in the continuous case the RR is replaced by a risk function *RR(x)*

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Technical issues (3)

- Prevent has two sets of PIFs
  - TIFs: trend impact fraction
  - PIFs: potential impact fraction
- The TIF calculates the effects of autonomous trends in risk factor exposure on related diseases
- The PIF calculates the effects of risk factor interventions on related diseases
- We want the difference between the reference and intervention scenarios to be attributable to the interventions only
  - In the reference scenario therefore only the TIF applies
  - In the intervention scenario both TIF and PIF apply

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Technical issues (4)

- Because of the diluted distinction between risk factors and diseases Prevent can model a “causal web” of risk factors
- For example:
  - Cardiovascular disease (CHD & stroke) has many risk factors
    - Some of these risk factors are diseases themselves
    - Some of these risk factors have risk factors themselves
  - The result is a tangle of risk factors, diseases, and relationships

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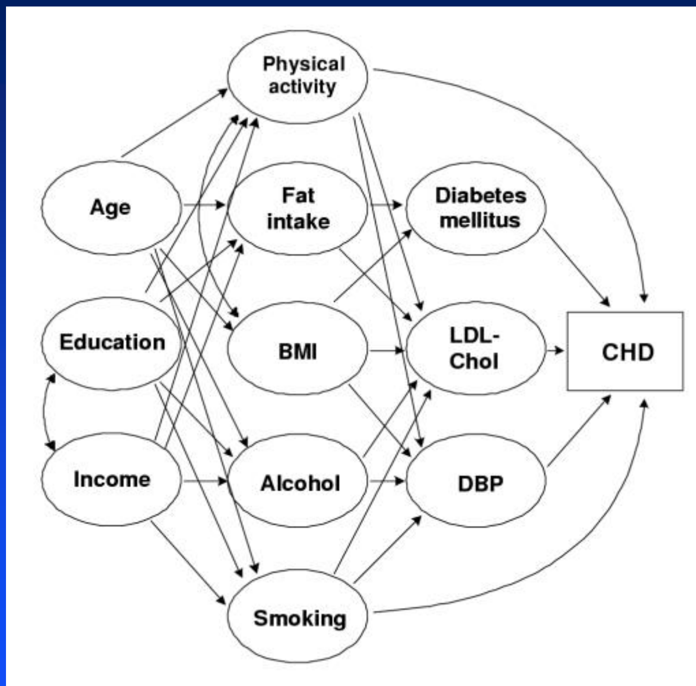
A possible causal web



Source: Murray et al, 2003

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Inputs (1)

- Definition tables
  - Base year, highest age group, and such
  - List of diseases and risk factors and their characteristics
  - List of risk factor and disease relations
- Population tables
  - Population numbers in base year
  - Total mortality
  - Population projections

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Inputs (2)

- Categorical risk factors
  - List of categories
  - Prevalence by category and year
  - Relative risk by category
  - Interventions
- Continuous risk factors
  - Distribution type (choice of Normal, lognormal, Weibull)
  - Parameters by year
  - Parameters of the distribution with theoretical minimum risk
  - Risk functions (choice of linear, two-piece-linear, per unit, loglinear, and logit) and parameters
  - Interventions

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Inputs (3)

- Disease inputs
  - Incidence in the base year
  - Disease trends and interventions, expressed as proportional changes by year

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Outputs

- All outputs are by year and sex, many by age and available in rates and numbers
- Population outputs
  - Numbers by age
  - % age 60 and over
- Disease specific outputs
  - Incidence (all ages) in numbers, and by age in numbers and rates
- Risk factor outputs
  - Prevalences
  - TIFs and PIFs

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Limitations (1)

- Prevent is about relations between risk factors and diseases
  - The valid domain is changes in risk factor exposure, that give rise to change in related disease incidence, but do not substantially change disease natural history
  - This generally excludes early detection, interventions that improve survival
  - Prevent uses an average population perspective
  - Despite the risk factors there is no heterogeneity
  - No selective mortality for exposed
  - No strongly competing risks (but there is substitution)
- Many of these limitations do not apply in the case of Eurocadet

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Limitations (2)

- Prevent makes independence assumptions
  - Risk factors are independently distributed
  - Disease incidence rates are independent
  - All diseases specific cause of death rates are independent
  - Each disease incidence is independent of all disease specific causes of death except its own
- Note that the independence assumptions are not violated:
  - When diseases have a risk factor in common
  - When a disease is a risk factor for another disease
- Disease incidence independence assumption:

$$\Pr\left\{\bigcap_{i\in Z}\{A_{Ii} \le a\}\right\} = \prod_{i\in Z}\Pr\{A_{Ii} \le a\}$$

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Limitations (3)

- Currently Prevent uses an age-perspective
  - Effects of interventions in a specific age-group are applied to that same age-group in the projection
  - For some interventions, however, effects are long-lasting and should be applied to older age-groups too as the population ages (cohort-perspective)
  - This is a problem only when
    - The intervention is applied to a specific age-group
    - The effect is long-lasting
  - Some childhood interventions may fit the bill
- This limitation is to be removed

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Conclusions

- Prevent is (and probably always will be) a work in progress, and it shows
  - Things are planned, but not yet implemented, leading to unused fields in the database
  - Some times things could be more consistent
  - The output lags the implementation of new features
- It could be better, but it is usable
- Prevent clearly has methodological limitations
  - No heterogeneity
  - Independence assumptions
- But if these limitations are understood, it will do the job for Eurocadet

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Relevant literature

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2. Gunning-Schepers LJ, Barendregt JJ, Van Der Maas PJ. Population interventions reassessed. Lancet 1989;1(8636):479-81.
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6. Mooy JM, Gunning-Schepers LJ. Computer-assisted health impact assessment for intersectoral health policy. Health Policy 2001;57(3):169-77.
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11. Barendregt JJ, Bonneux L, van der Maas PJ. The health care costs of smoking. N Engl J Med 1997;337(15):1052-7.
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14. Barendregt JJ, Ott A. Consistency of epidemiologic estimates. European Journal of Epidemiology 2005;20(10):827-832.

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Demonstration of an application, predefined case

- New program on housing: increase proportion of barrier-free residences, should reduce number of falls.

Choices in Prevent, data needed:

- Risk factor: categorical (proportion living in barrier-free residence)
- OR/RR for health related outcomes in both exposed and unexposed (if needed by age and sex)
- Data on occurrence of health related outcomes in population, by age and sex
- Data on population structure as a whole
- Duration of building houses etc
- If wanted: other co-occurring risk factors
- Specified intervention: change in proportion of barrier free residences

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Expected results

- Number of cases under both reference and intervention scenario by calendar year
- Rates under reference and intervention scenario
- If information on case-fatality and costs:
  - Prevalence
  - Mortality
  - Costs
  - etc

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DYNAMO-HIA
Wilma Nusselder; Hendriek Boshuizen; Stefan Lhachimi

DYNAMO-HIA

Wilma Nusselder
Hendriek Boshuizen
Stefan Lhachimi

On behalf of DYNAMO-HIA team

“Workshop on quantifying health impacts of policies - principles, methods, and models“, Düsseldorf, March 16-17, 2010

1

Outline of presentation

Part A:

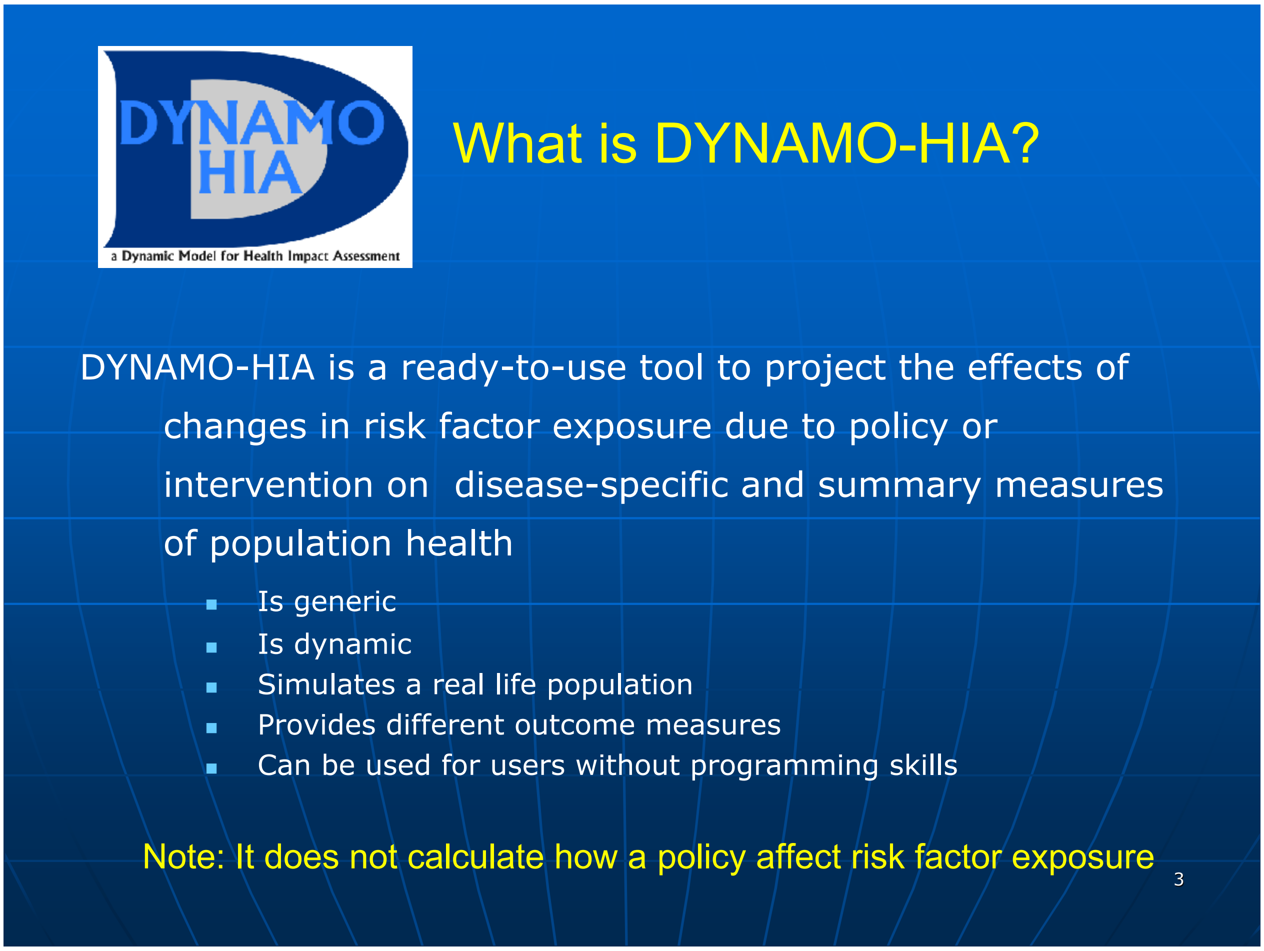
1. Background of the model:
   - Persons and institutions involved; Associated projects; Date of completion; Availability
2. Objective:
   - Target audience; Application spectrum
3. Model structure and principles:
   - Intrinsic (default) data; Data input requirements; Model results; Model validation/evaluation; Model sensitivity
4. Demonstration

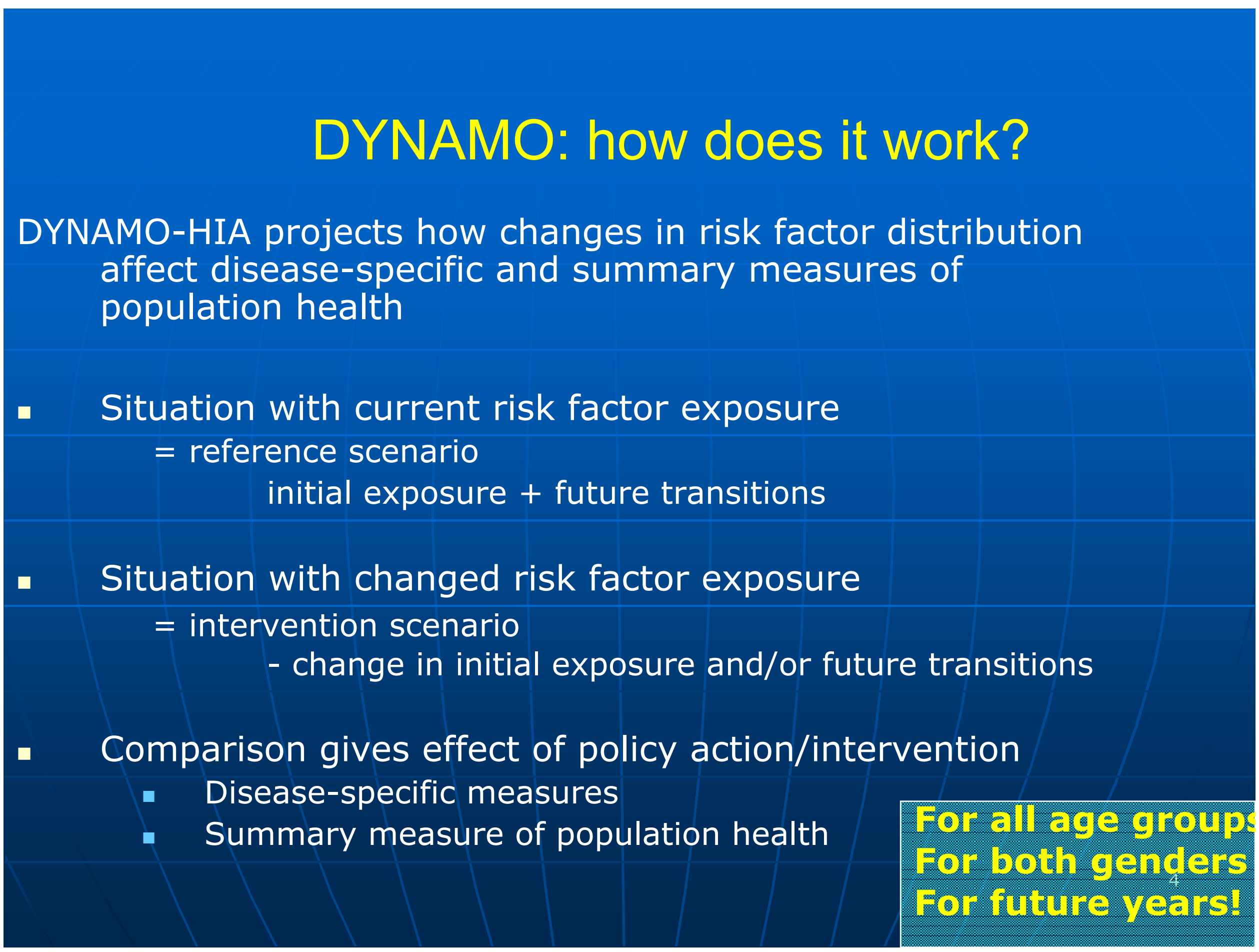
Part B:

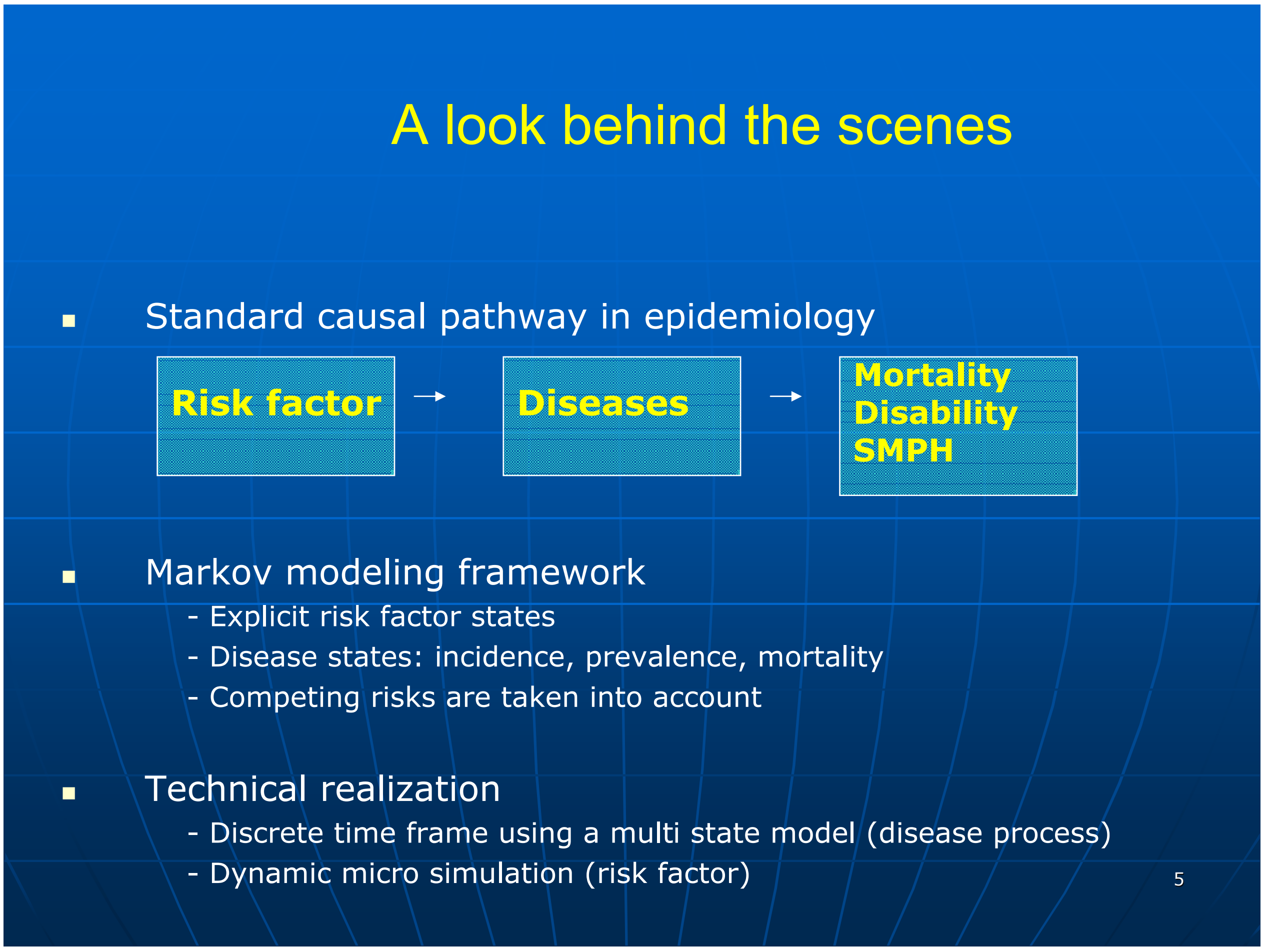
1. Predefined case

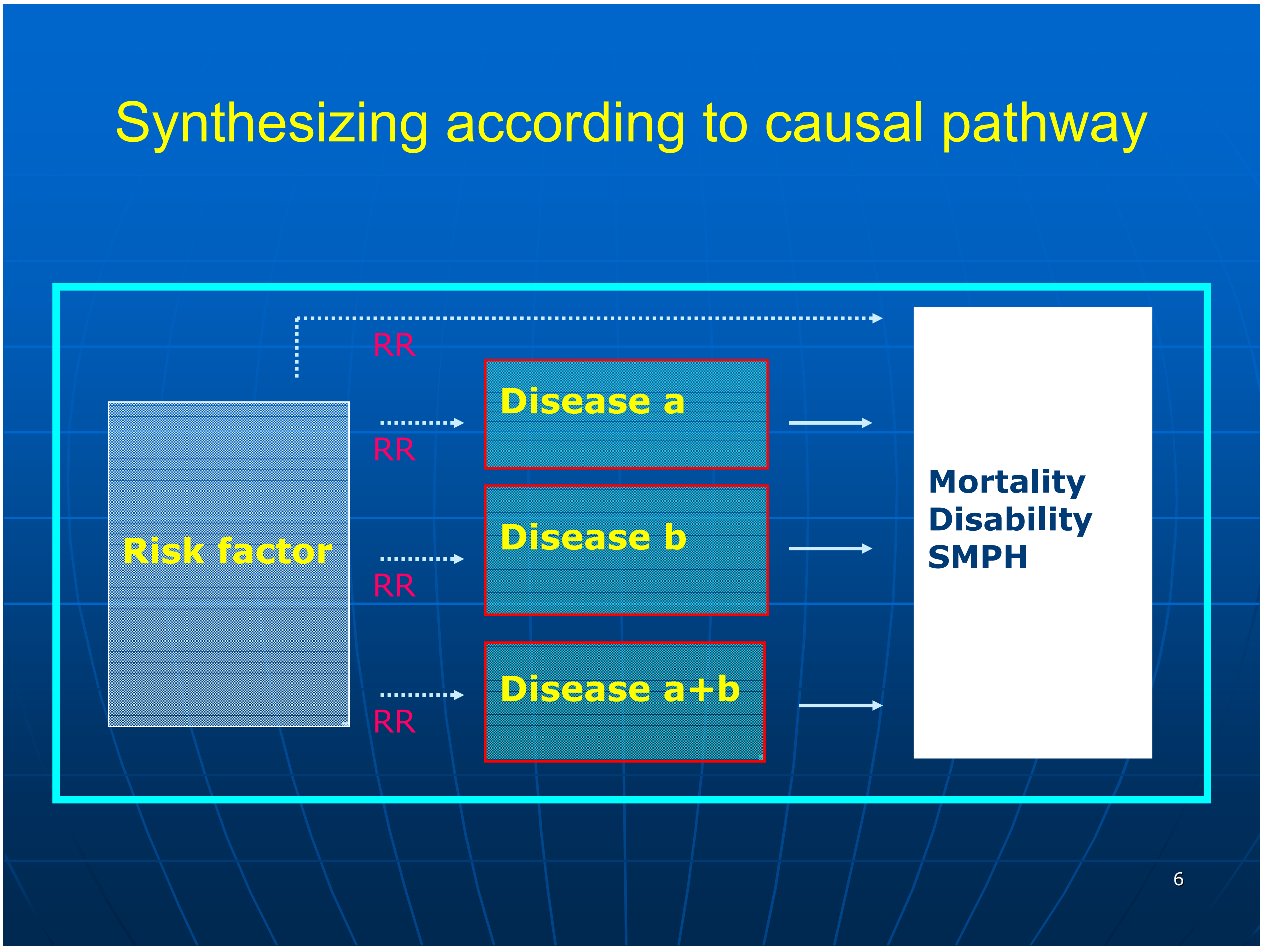
FIRST: What is DYNAMO, what does it do, and how does it work

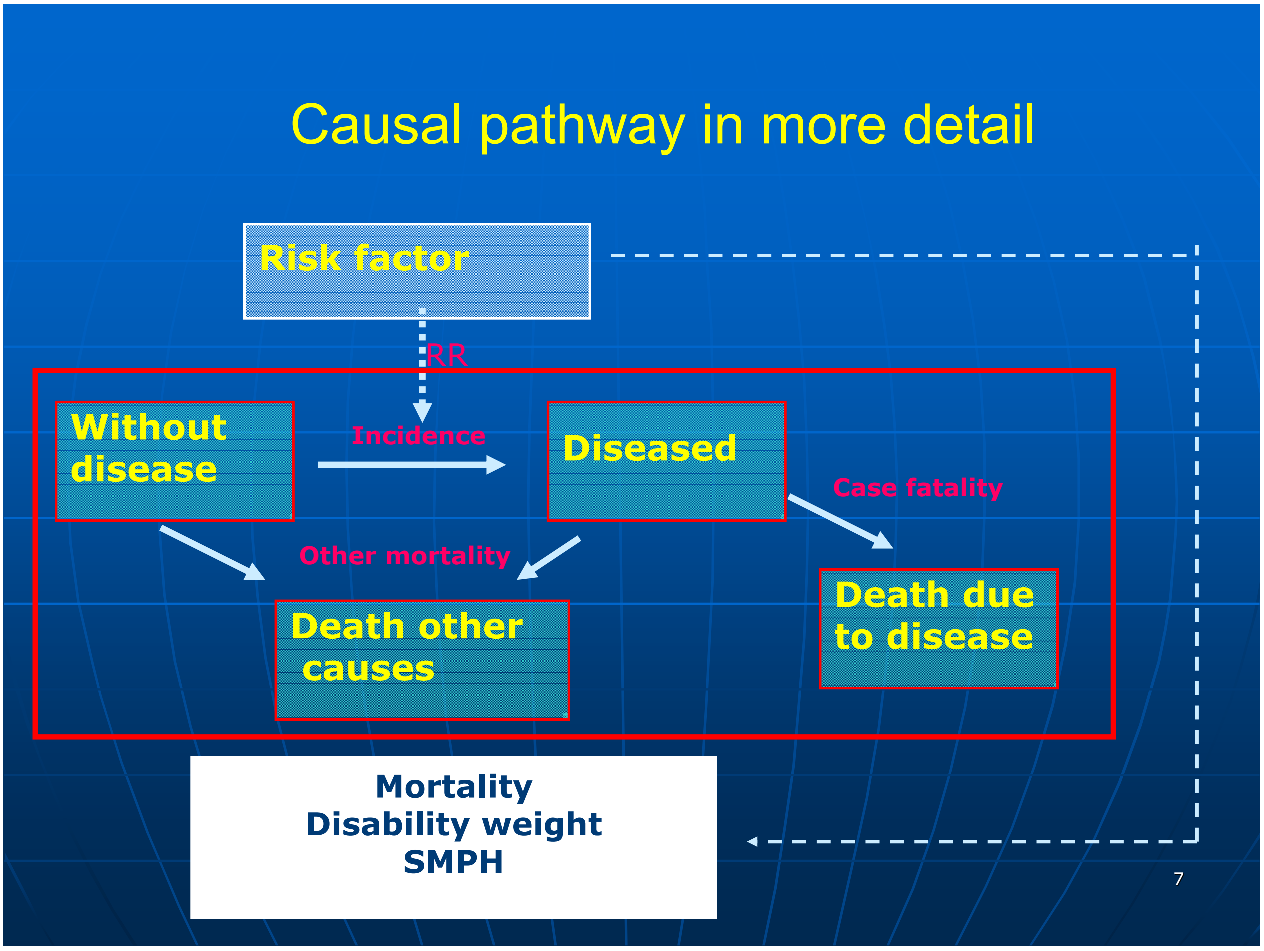
2

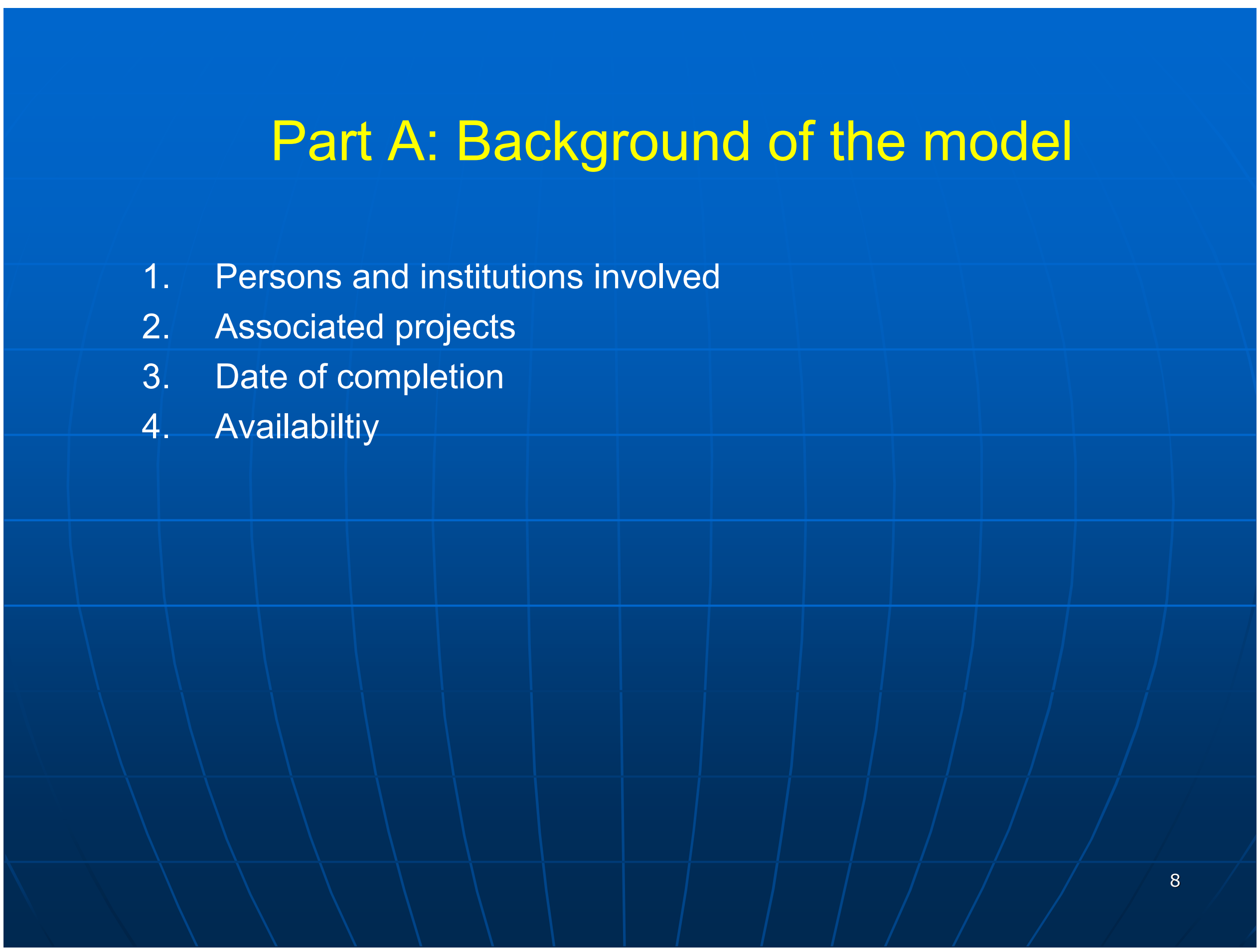

DYNAMO HIA
a Dynamic Model for Health Impact Assessment
What is DYNAMO-HIA?
DYNAMO-HIA is a ready-to-use tool to project the effects of changes in risk factor exposure due to policy or intervention on disease-specific and summary measures of population health
Is generic
Is dynamic
Simulates a real life population
Provides different outcome measures
Can be used for users without programming skills
Note: It does not calculate how a policy affect risk factor exposure
3


DYNAMO: how does it work?
DYNAMO-HIA projects how changes in risk factor distribution affect disease-specific and summary measures of population health
Situation with current risk factor exposure
= reference scenario
initial exposure + future transitions
Situation with changed risk factor exposure
= intervention scenario
- change in initial exposure and/or future transitions
Comparison gives effect of policy action/intervention
Disease-specific measures
Summary measure of population health
For all age groups
For both genders
For future years!
4


A look behind the scenes
Standard causal pathway in epidemiology
Risk factor
Diseases
Mortality
Disability
SMPH
Markov modeling framework
- Explicit risk factor states
- Disease states: incidence, prevalence, mortality
- Competing risks are taken into account
Technical realization
- Discrete time frame using a multi state model (disease process)
- Dynamic micro simulation (risk factor)
5


Synthesizing according to causal pathway
RR
Risk factor
RR
Disease a
RR
Disease b
RR
Disease a+b
Mortality
Disability
SMPH
6


Causal pathway in more detail
Risk factor
RR
Without disease
Incidence
Diseased
Case fatality
Other mortality
Death other causes
Death due to disease
Mortality
Disability weight
SMPH
7


Part A: Background of the model
1. Persons and institutions involved
2. Associated projects
3. Date of completion
4. Availabiltiy
8

1. Persons and institutions involved

1. Coordinator: Erasmus MC Rotterdam, the Netherlands

2. Coordinating Center:
   - ErasmusMC, Rotterdam, The Netherlands
     J.P. Mackenbach, W.J. Nusselder, S. Lhachimi, M. Kulik
   - National Institute of Public Health, Bilthoven (RIVM), The Netherlands
     H. Boshuizen, P. van Baal, H. Smit

3. Other Associate Partners:
   - Catalan Institute of Oncology, Barcelona, Spain
     Esteve Fernandez
   - International Obesity task force, London,UK
     T. Lobstein, R. Jackson Leach
   - London School for Hygiene and Tropical Medicine, London, UK
     M. McKee, J. Pomerleau K. Charlesworth
   - Haughton Institute, Ireland, Dublin
     K. Bennett
   - Instituto Tumori, Italy, Milan.
     - P. Baili, A. Micheli

9

2-4: Associated projects, date of completion, availability

2. Associated projects:
   - RIVM: Chronic Disease Model
   - EMC/RIVM: JA EHLEIS: Dynamo-HIA with HLY as outcome (proposal submitted)

3. Date of completion:
   - November 30, 2010 (original April 28, 2010, amendment pending)

4. Availabiltiy
   - Free available from internet (end 2010)
   - Launched: at final conference: EUPHA November 10-13, 2010, Amsterdam, The Netherlands

10

Target groups and application spectrum

1. Target groups:
   - Directly using the tool: experienced public health official/researcher
   - Using the outcomes of the tool: policy makers, EU officials

2. Application spectrum:
   - Health Impact Assessment
   - Health evaluations of policies and interventions (priority setting)

   -> DYNAMO-HIA starts from change in risk factor exposure, defined by the user

11

Model structure and principles

1. Intrinsic (default) data
2. Data input requirements
3. Model results
4. Model validation/evaluation
5. Model sensitivity

12

1. Intrinsic data

For large number of EU countries:

- Population numbers (all MS)
- Projected Newborns (all MS)
- Incidence, prevalence and mortality for 5 cancers, IHD, stroke, COPD, diabetes (10 MS)
- All-cause mortality (all MS)
- All-cause disability (all MS)
- Exposure distribution of smoking (3 categories + time since quitting), BMI (mean, 3 categories, alcohol (5 categories) (at least 18 MS)
- RRs linking exposure to health outcomes (one set)

13

2. Data input requirements

Type of data

- Population numbers
- Newborns (optional)
- Incidence, prevalence and mortality for relevant diseases
- All-cause mortality
- All-cause disability (optional)
- Exposure distribution of risk factors
- RRs linking exposure to health outcomes

General:

- All data by single-year of age (0-95 years) and sex
- Flexibility in choice risk factor exposure, disease type and transitions between risk factor states

14


DYNAMO HIA
a Dynamic Model for Health Impact Assessment
…but flexibillity
Risk factor exposure:
- Categories: never, current, former smokers
- Continuous: mean BMI
- Compound: former smokers by time since quitting
Diseases: 3 types of disease processes
- Chronic disease
- Partly acute fatal disease
- Disease with cured fraction
Transitions between risk factor states:
- Approximation assuming net transitions
- Approximation assuming zero transitions
- User-defined transitions
15


DYNAMO HIA
a Dynamic Model for Health Impact Assessment
and population-based data
Tool back-calculates from population-based data
Data need is not:
Incidence of diabetes in 40 year old women with overweight
Often not available
But data need is:
Incidence of diabetes in 40 year old women
% overweight for 40 year old women
RR association between overweight and diabetes
Available &
Used in DYNAMO-HIA
16

3. Model results

- Future risk factor prevalence
  - By age or calendar year
- Future disease prevalence
  - By age or calendar year
- Future mortality/survival
  - By age or calendar year
- Summary measures of population health
  - Life expectancy
  - Life expectancy with(out) diseases
  - Disability-adjusted Life expectancy
- Structure of population:
  - Age, sex, diseased vs. non-diseased

17

4. Model validation/evaluation

- Test plan for code verification
- Comparison with excel calculations
- No formal model evaluation conducted but:
  - model structure is well founded in epidemiological evidence and demographic modeling practice
  - Software and source code will be publicly available for cross validation

18

5. Model sensitivity

Sensitivity:

- Imbalance between incidence, prevalence and mortality will cause implausible projections
  - DISMOD testing of input is needed

Sensitivity analyses:

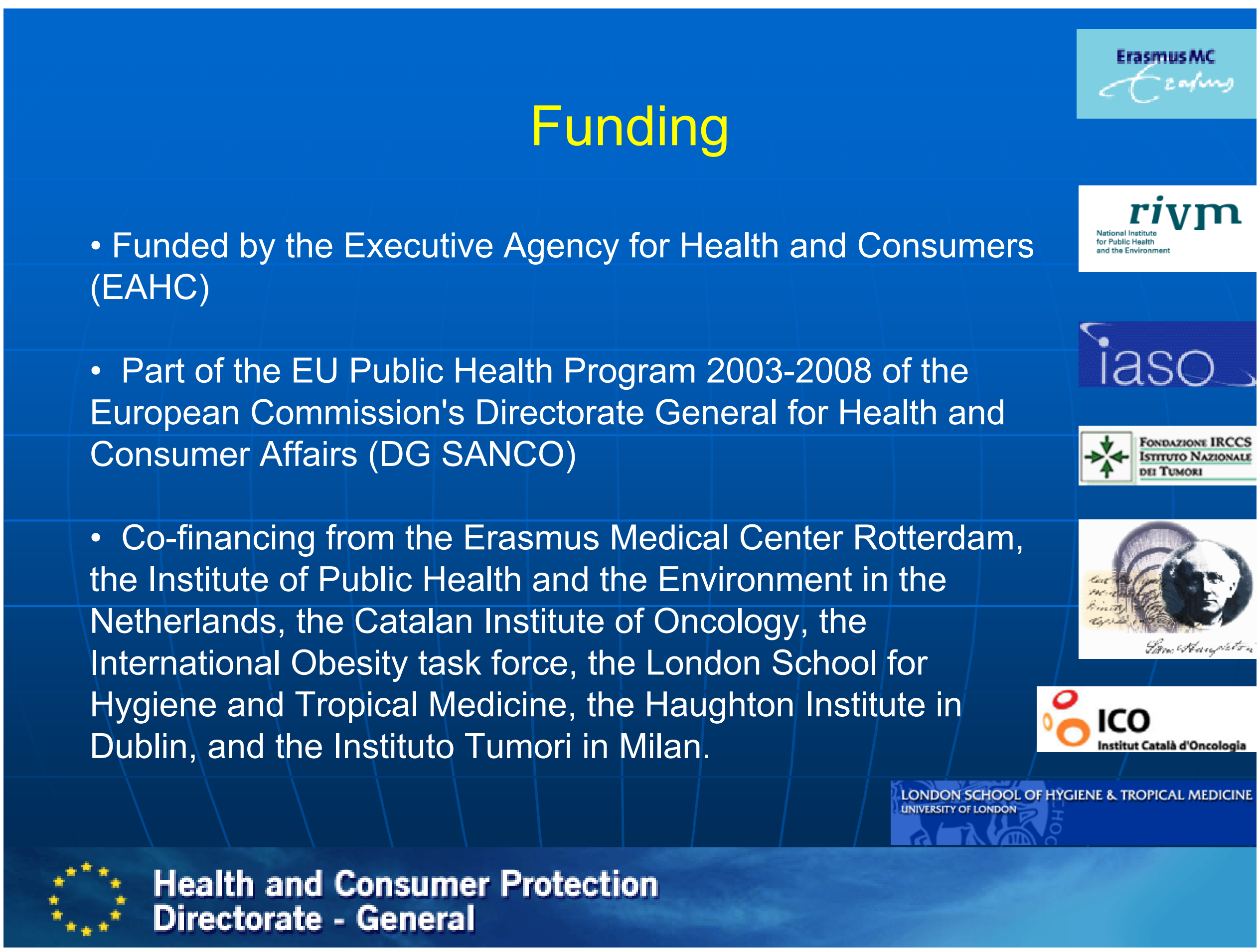
- No Probabilistic Sensitivity analyses (PSA)
  - One way sensitivity analyses to assess sensitivity of outcomes for input parameters is possible
  - PSA can be built around DYNAMO

19

But first, let's see how it works

20


DYNAMO HIA
a Dynamic Model for Health Impact Assessment
Contact:
Website: www.dynamo-hia.eu
Email: w.nusselder@erasmusmc.nl
21


Funding
• Funded by the Executive Agency for Health and Consumers (EAHC)
• Part of the EU Public Health Program 2003-2008 of the European Commission's Directorate General for Health and Consumer Affairs (DG SANCO)
• Co-financing from the Erasmus Medical Center Rotterdam, the Institute of Public Health and the Environment in the Netherlands, the Catalan Institute of Oncology, the International Obesity task force, the London School for Hygiene and Tropical Medicine, the Haughton Institute in Dublin, and the Instituto Tumori in Milan.
Erasmus MC
rivm
National Institute for Public Health and the Environment
iaso
Fondazione IRCCS Istituto Nazionale dei Tumori
ICO
Institut Català d'Oncologia
LONDON SCHOOL OF HYGIENE & TROPICAL MEDICINE
UNIVERSITY OF LONDON
Health and Consumer Protection
Directorate - General

BoD in NRW
Claudia Terschüren et al.:
Burden of Disease in North Rhine-Westphalia (BoD in NRW), part 1

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Universität Bielefeld

Landesinstitut für Gesundheit und Arbeit des Landes Nordrhein-Westfalen

Burden of Disease in North Rhine-Westphalia (BoD in NRW), part 1

Quantifying the health impacts of policies - principles, methods, and models
Düsseldorf, March, 16 – 17, 2010

C. Terschüren, O. Mekel, R. Fehr, part 1
NRW Institute of Health and Work (LIGA.NRW)
WHO CC Regional Health Policy and Public Health

C. Hornberg, T. Claßen, R. Samson, part 2
Universität Bielefeld
Fakultät für Gesundheitswissenschaften

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Key questions:

Effects of demografic change in NRW

- which effect has the demographic change in North Rhine – Westphalia on the burden of disease?
- 2025: which diseases are contributing which proportion to burden of disease, resulting in needs in terms of health care?

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Demografic change in NRW cont.

Characteristics:

- decrease in population : approx. -2.5% until 2025

- life expectancy in 2025: increased by 2 years

male newborns:	75.8 years (2004)	↗	78.3 (2025)
female newborns:	81.3 years (2004)		83.5 (2025)

Source: population forecast. LDS NRW

Age group	2004 male	2004 female	2025 male	2025 female	2025 vs 2004 male	2025 vs 2004 female
0	80952	76868	77110	73068	95%	95%
1-4	343768	326502	314552	298985	92%	92%
5-9	478086	454815	394200	375131	82%	82%
10-14	523088	496979	388647	369965	74%	74%
15-19	527095	503422	402602	385325	76%	77%
20-24	516247	508415	461316	459973	89%	90%
25-29	507824	505354	540502	541166	106%	107%
30-34	582337	573735	584655	587843	100%	102%
35-39	781410	752688	568939	580810	73%	77%
40-44	782147	754707	527277	546083	67%	72%
45-49	679704	667361	487080	512604	72%	77%
50-54	587953	600430	545798	566557	93%	94%
55-59	488125	496806	721319	726561	148%	146%
60-64	534125	[illegible]	691495	707323	129%	127%
65-69	536944	[illegible]	[illegible]	[illegible]	[illegible]	102%
70-74	368254	[illegible]	[illegible]	[illegible]	[illegible]	116%
75-79	272370	408309	[illegible]	391142	114%	96%
80-84	[illegible]	[illegible]	264836	370468	188%	114%
85+	71799	229780	[illegible]	[illegible]	365%	199%
total	8 803 255	9 272 097	8 540 989	9 067 031	97%	98%

18.075.352

-2.5%

17.608.020

- 467 332

Source: based on LDS data. LIGA.NRw / Uni Bielefeld)

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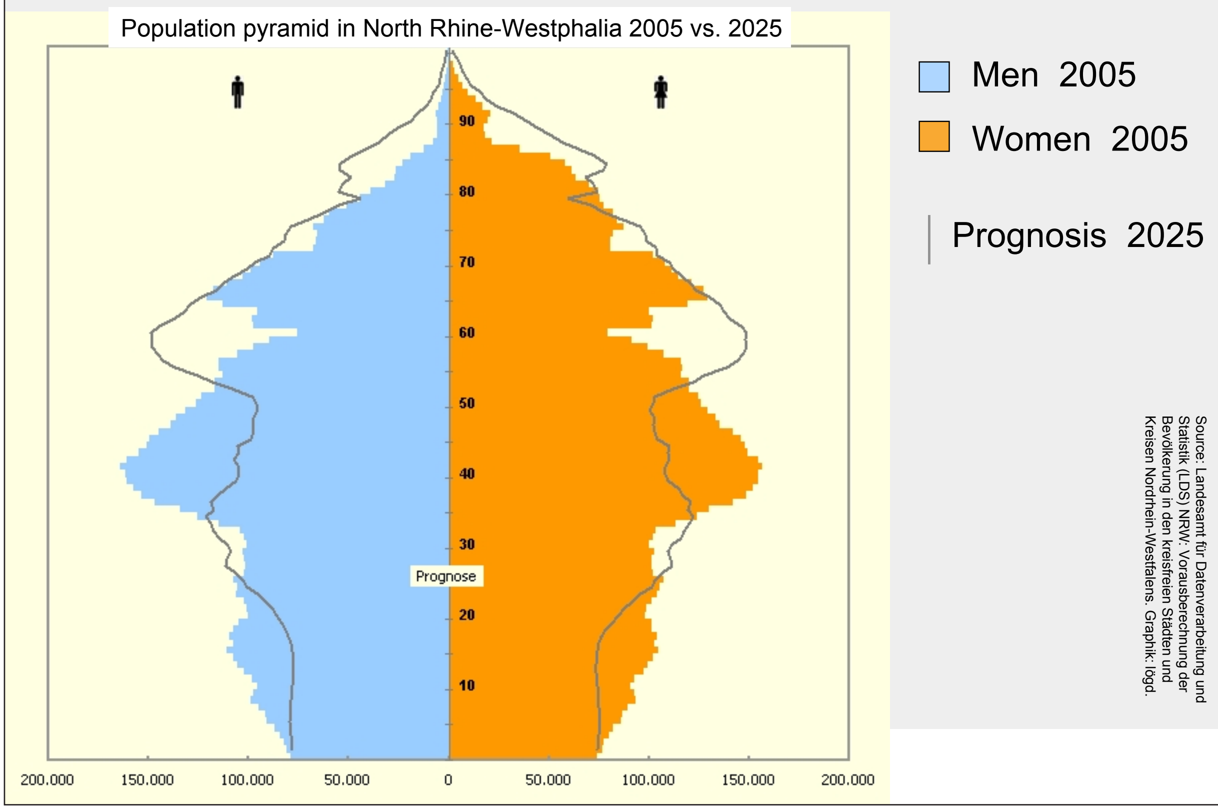

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Identifying relevant cancer sites:

- lung:	26% of the male cancer patients die of lung cancer, 12% of the female
- colon/rectum:	either in men and women, 12% of the cancer patients in total die of colon/rectum cancer
- stomach:	men: 5.6%; women 5.1%
- pancreas:	men: 5.5%; women 6.2%
- breast:	men: not ranked ; women 20.0%
- prostate:	men: 9.4%
- ovary:	women. 6.3%

Source: Krebsatlas, German Cancer Research Center (DKFZ). 2003

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Selected health outcomes for BoD prognosis

Health outcomes	ICD-10
Selected tumo ur sites	
Lung	C34
Colon	C18
Rectum	C20
Pancreas	C25
Stomach	C16
Prostate	C61
Breast	C50
Ovary	C56
Myocardial infarction	I21-I23
Dementia	F00, F03, G30-G31

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WHO approach adapted

Burden of disease = mortality +
disability due to mobidity

expressed as DALYs (Disability-Adjusted Life Years):

1 DALY = loss of 1 year lived in complete health

calculated as:

DALY = YLL + YLD

YLL = *years of life lost because of premature death*

YLD = *years of life lived with disability due to illness*

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WHO approach adapted cont.

YLL = N x (L - l)

YLL = years of life lost (due to premature death)
N = number of deaths in the population
L = life expectancy (by age group)
l = age at death

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WHO approach adapted cont.

YLL = N x (L - l)

N = number of deaths in the population
↳ data source: death statistics of NRW,
by administrative unit: county / major city
l = *age at death (by age group)*
L = *life expectancy (by age group)*

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WHO approach adapted cont.

YLD = I x DW x d

YLD = years lived with disabilities due to the disease

I = number of incident cases in the population

DW = *disability- weight*. disease specific

d = time period lived with disabilities [years]

→ **DALY = YLL + YLD**

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Data sources

mortality, incidence

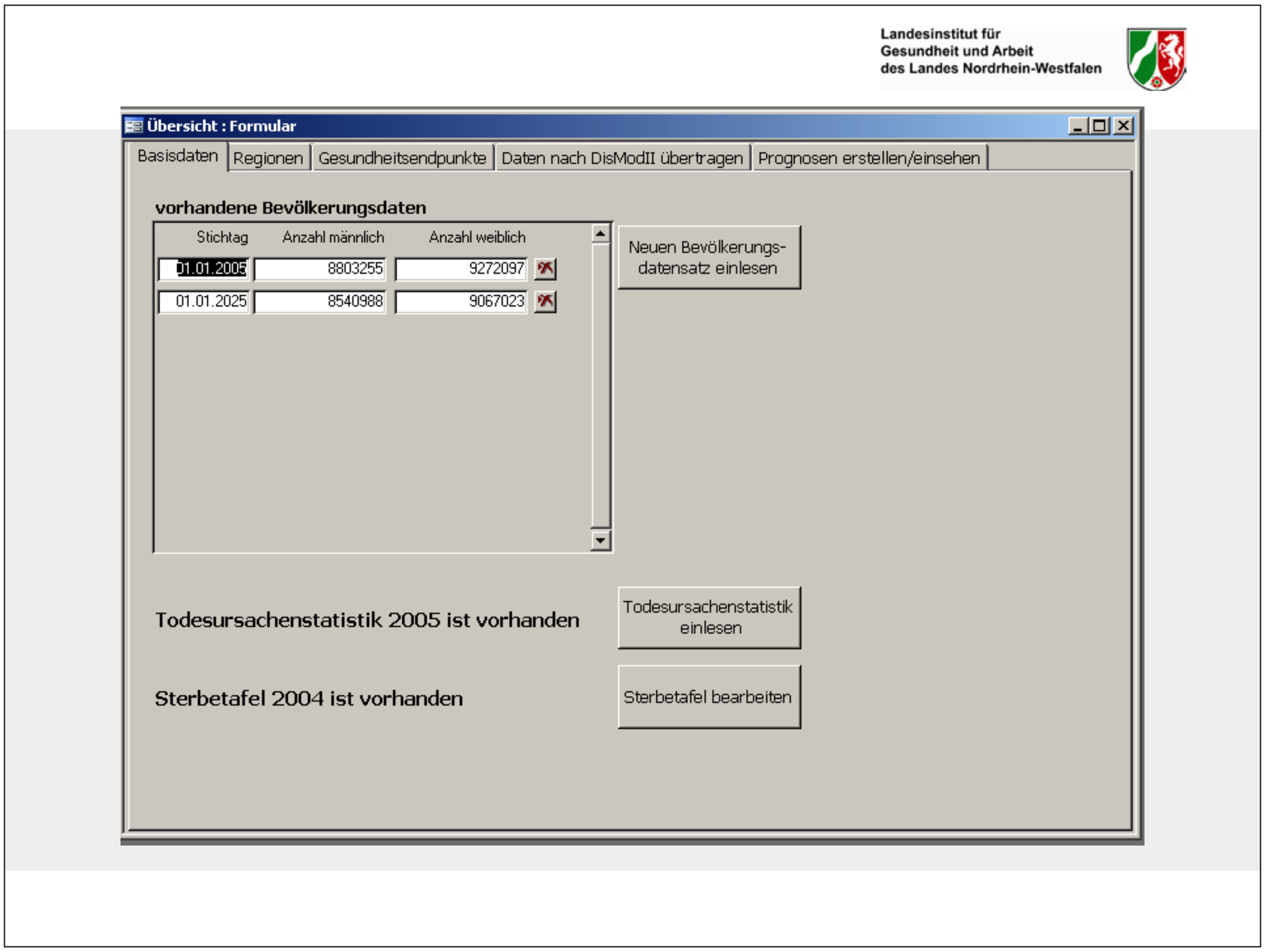
- Cancer registry NRW (tumour sites)
- German infarction registry within the KORA Study, Augsburg (MI)
- Meta-analysis (dementia)

population forecast

- NRW statitistics bureau

calculation tools

- WHO Excel template
- DisMod function
- Ms Access based tool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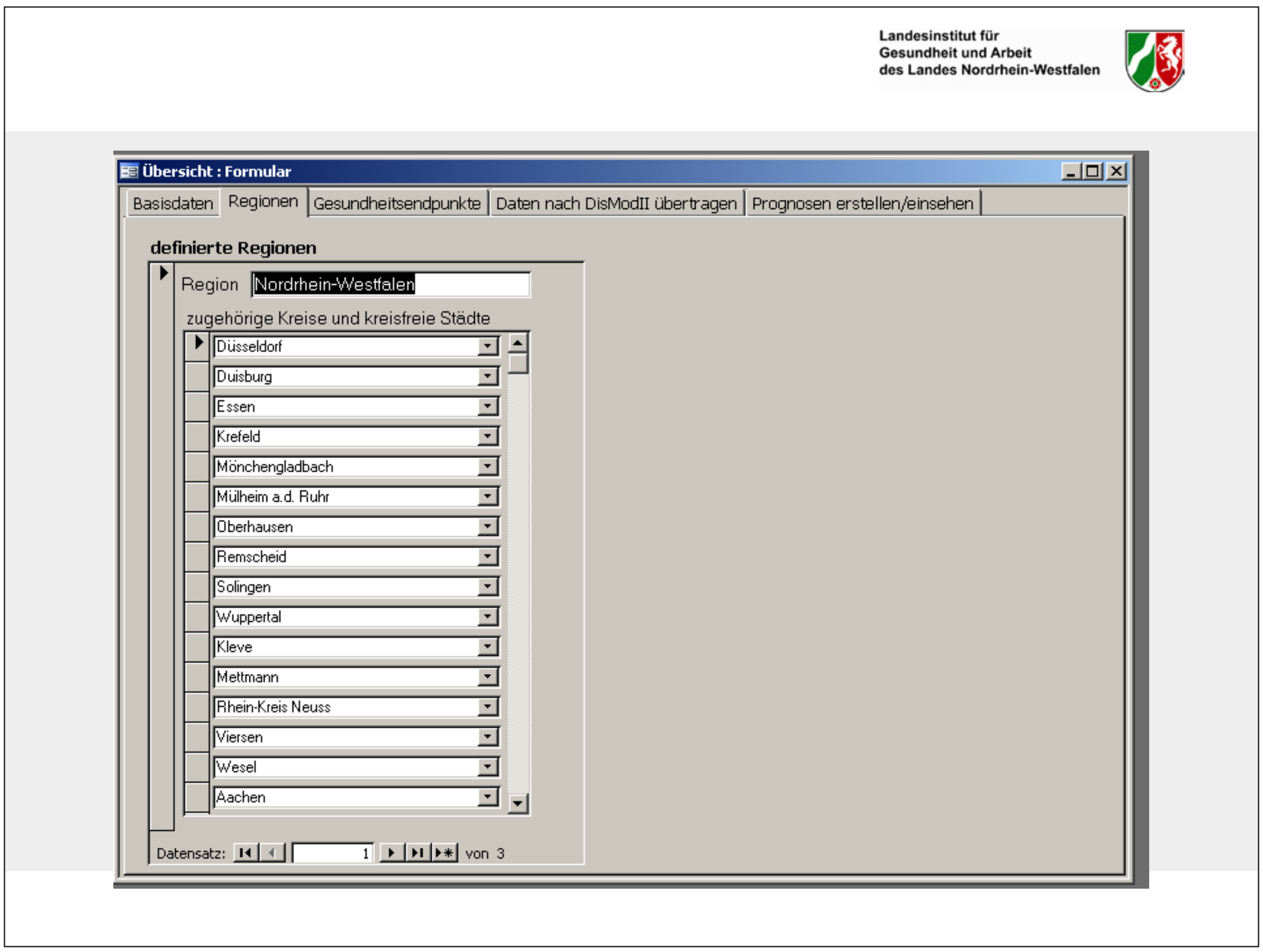
Basisdaten
Regionen
Gesundheitsendpunkte
Daten nach DisModII übertragen
Prognosen erstellen/einsehen
vorhandene Bevölkerungsdaten
Stichtag
Anzahl männlich
Anzahl weiblich
01.01.2005
8803255
9272097
01.01.2025
8540988
9067023
Neuen Bevölkerungs-datensatz einlesen
Todesursachenstatistik 2005 ist vorhanden
Todesursachenstatistik einlesen
Sterbetafel 2004 ist vorhanden
Sterbetafel bearbeiten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Gesundheitsendpunkte
Daten nach DisModII übertragen
Prognosen erstellen/einsehen
definierte Regionen
Region
Nordrhein-Westfalen
zugehörige Kreise und kreisfreie Städte
Düsseldorf
Duisburg
Essen
Krefeld
Mönchengladbach
Mülheim a.d. Ruhr
Oberhausen
Remscheid
Solingen
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Kleve
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Rhein-Kreis Neuss
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Wesel
Aachen
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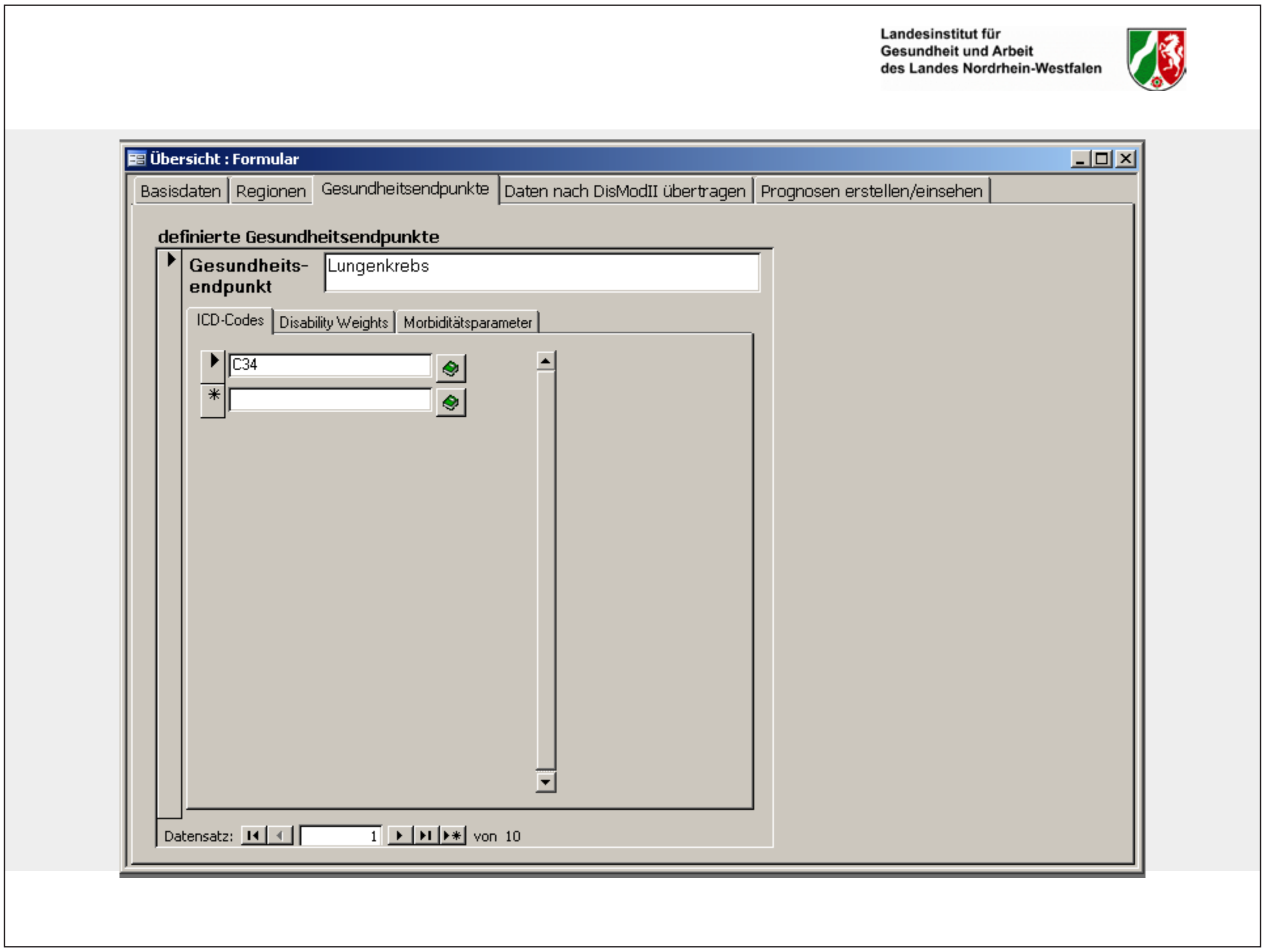
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ICD-Codes
Disability Weights
Morbiditätsparameter
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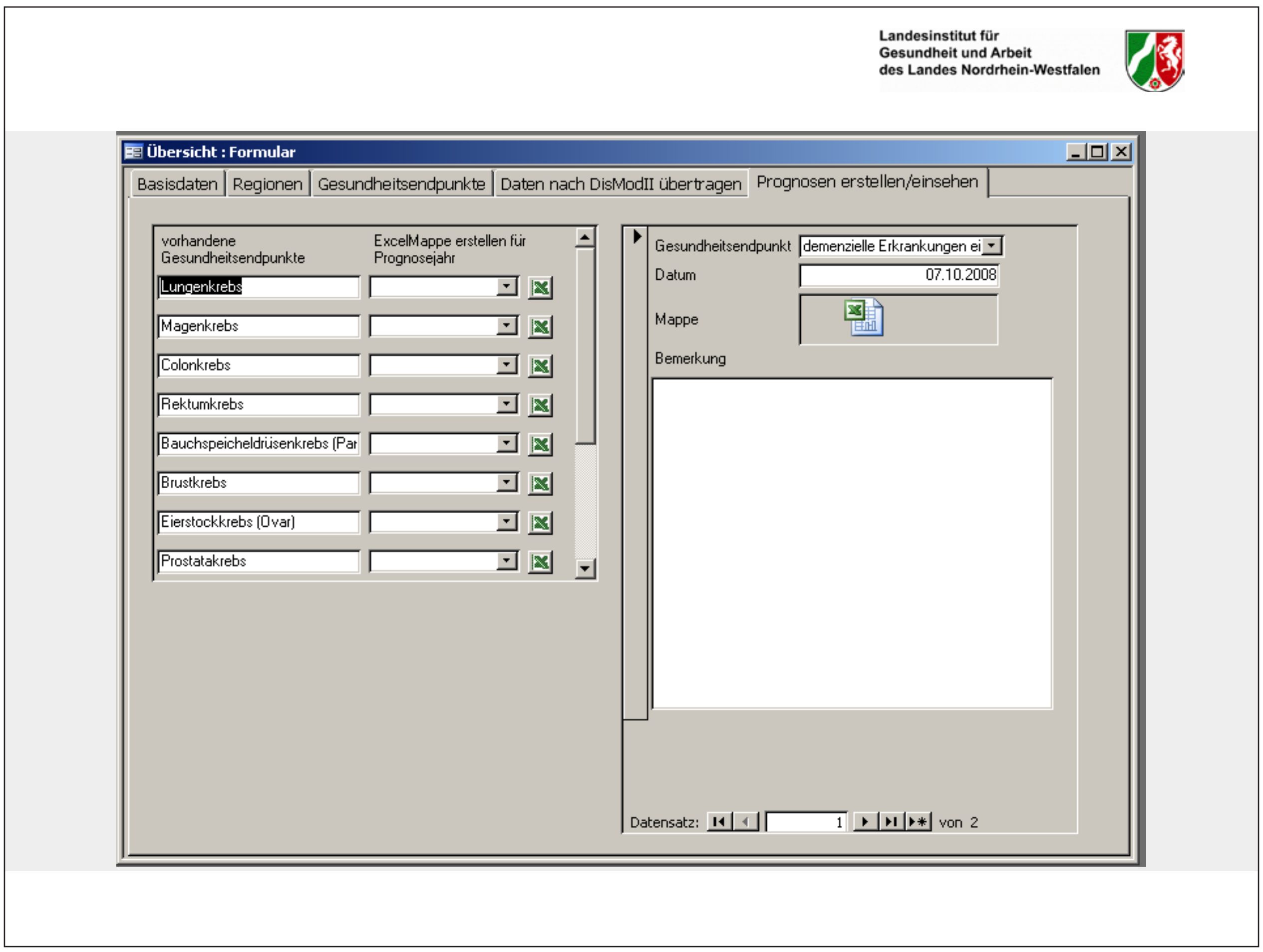
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Prognosen erstellen/einsehen
vorhandene
Gesundheitsendpunkte
ExcelMappe erstellen für
Prognosejahr
Lungenkrebs
Magenkrebs
Colonkrebs
Rektumkrebs
Bauchspeicheldrüsenkrebs (Par
Brustkrebs
Eierstockkrebs (Ovar)
Prostatakrebs
Gesundheitsendpunkt
demenzielle Erkrankungen ei
Datum
07.10.2008
Mappe
Bemerkung
Datensatz:
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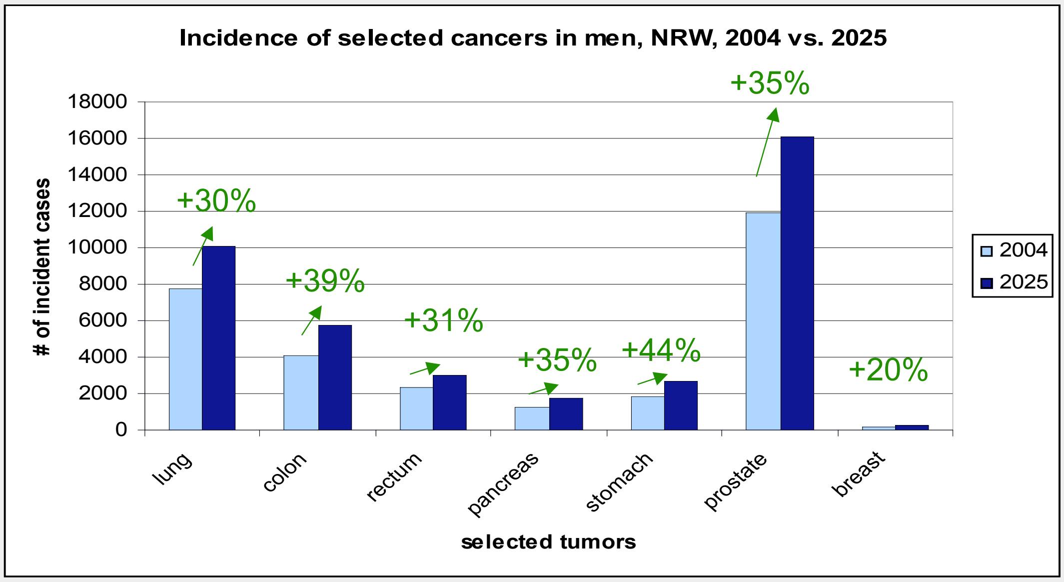

2004 vs.2025: approx. 10,000
additional cases = Ø 34% increase

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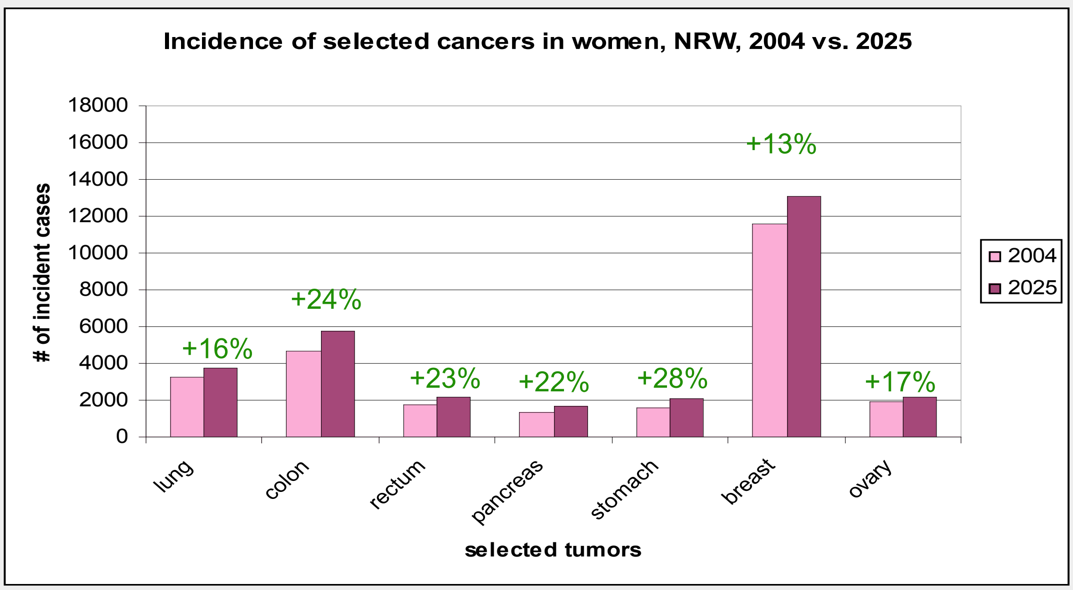

2004 vs.2025: approx. 4,500 additional
cases = Ø 20% increase

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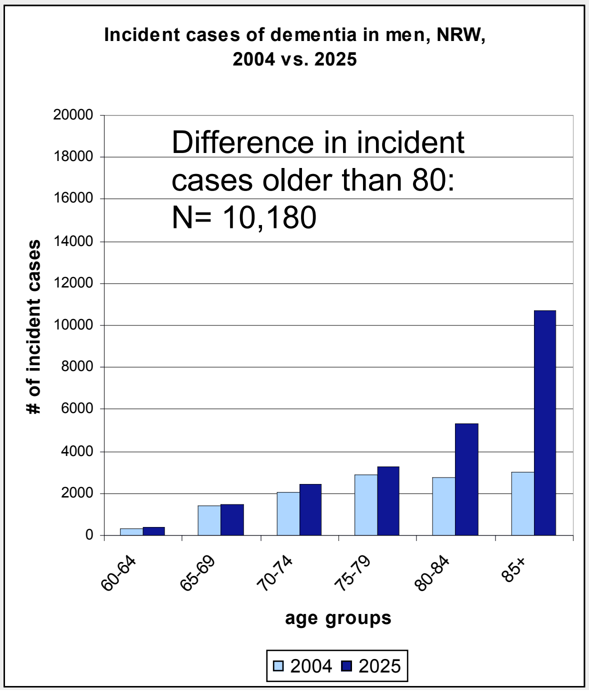

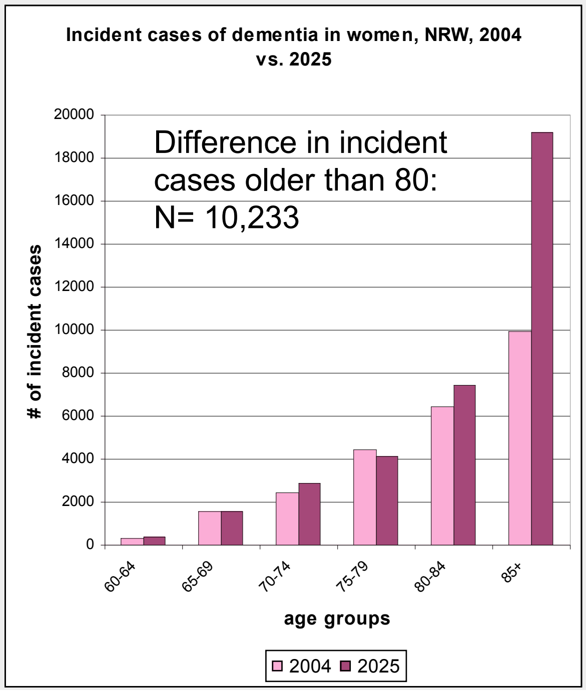

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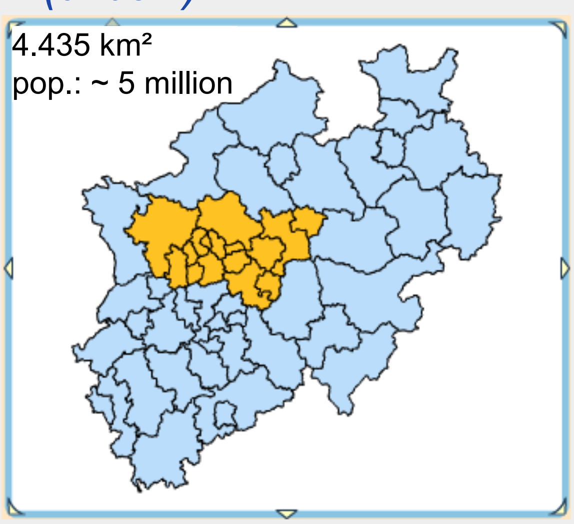
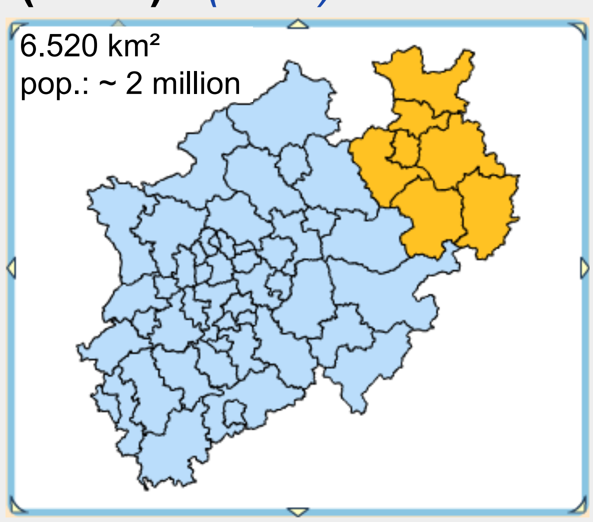
BoD prognosis of demografic change in NRW

Ruhr area *(urban)*



East Westphalia Lippe (OWL) *(rural)*



	2004		2025		2025 vs. 2004	
Age group	male	female	male	female	male	female
0	22253	20991	19888	18887	89%	90%
1-4	93713	88636	81514	77416	87%	87%
5-9	131202	124253	103203	97969	79%	79%
10-14	147184	139589	102317	97188	70%	70%
15-19	149553	143274	105720	101259	71%	71%
20-24	148175	145519	121833	121596	82%	84%
25-29	146714	143808	144256	143701	98%	100%
30-34	167133	162550	157608	157249	94%	97%
35-39	220142	210552	152977	155446	69%	74%
40-44	222565	214464	142200	146317	64%	68%
45-49	202491	199865	132584	137690	65%	69%
50-54	180239	184621	150037	153947	83%	83%
55-59	150877	152208	[illegible]	196718	130%	129%
60-64	160424	[illegible]	[illegible]	195033	[illegible]	[illegible]
65-69	160712	[illegible]	160667	175023	100%	97%
70-74	116007	142395	128540	[illegible]	111%	108%
75-79	[illegible]	[illegible]	91188	115508	103%	86%
80-84	[illegible]	[illegible]	[illegible]	[illegible]	165%	101%
85+	20620	70386	[illegible]	[illegible]	349%	187%
total	2573085	2729094	2327638	2481324	90%	91%

- 9.5%

- 493 217

5 302 179

4 808 962

Ruhr area

Source: based on LDS NRW Database

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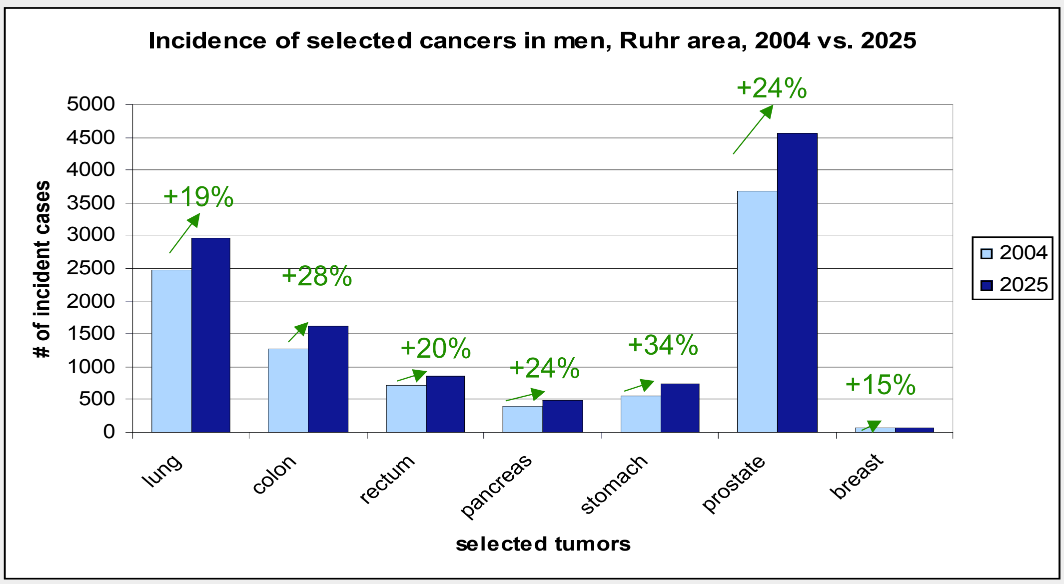

2004 vs.2025: approx. 2,200 additional cases = Ø 23% increase

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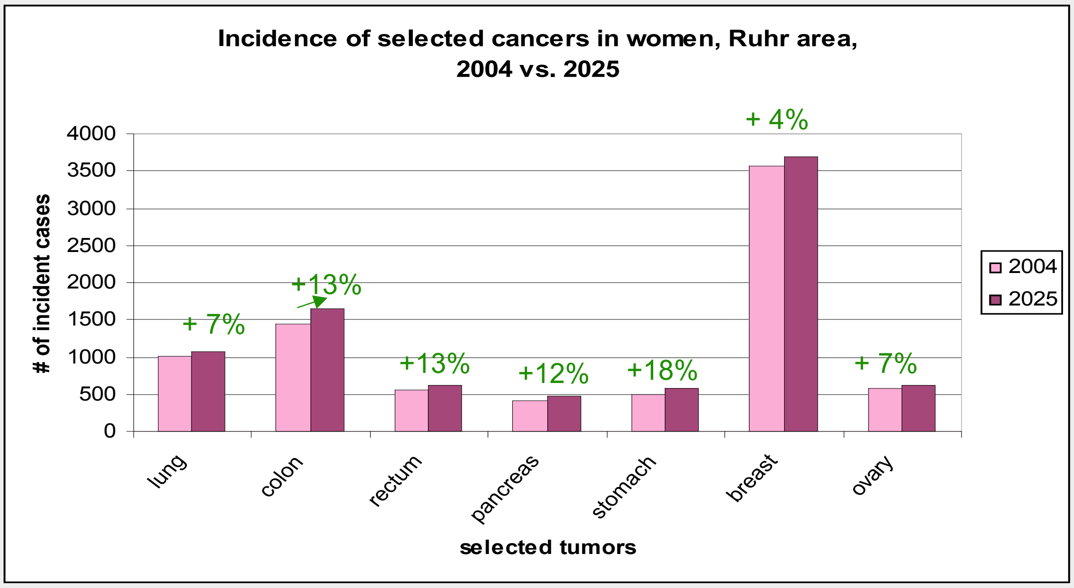

2004 vs.2025: approx. 650 additional cases = Ø 8% increase

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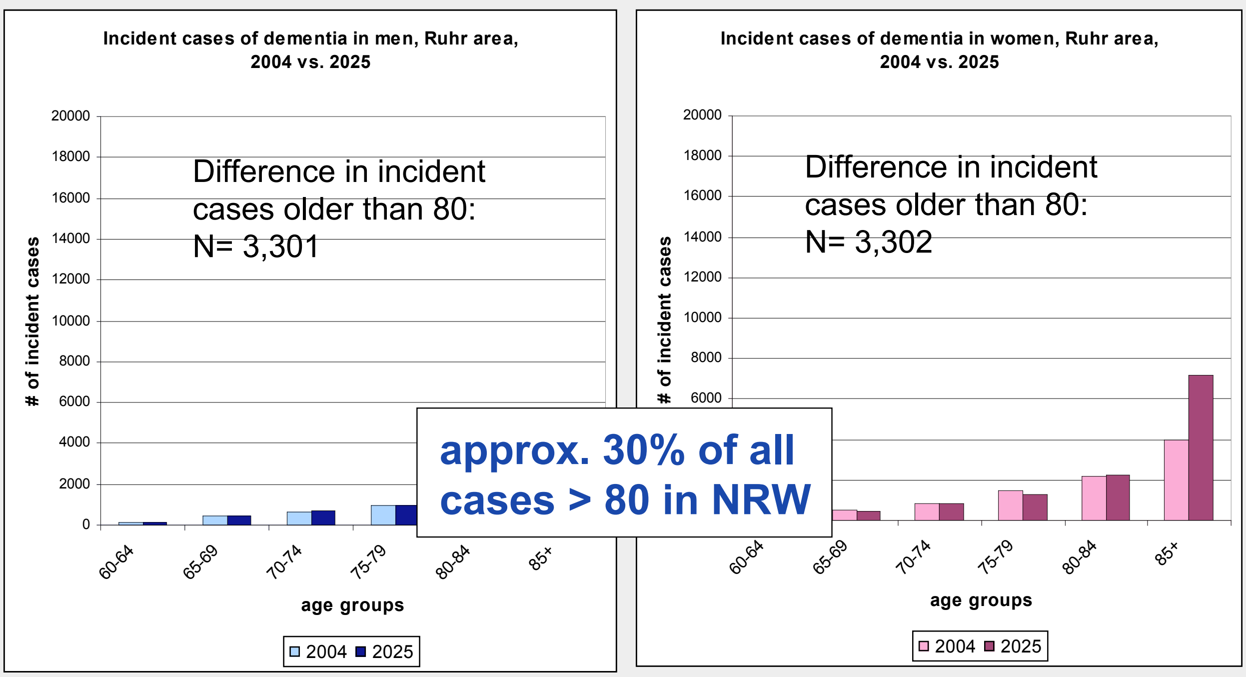

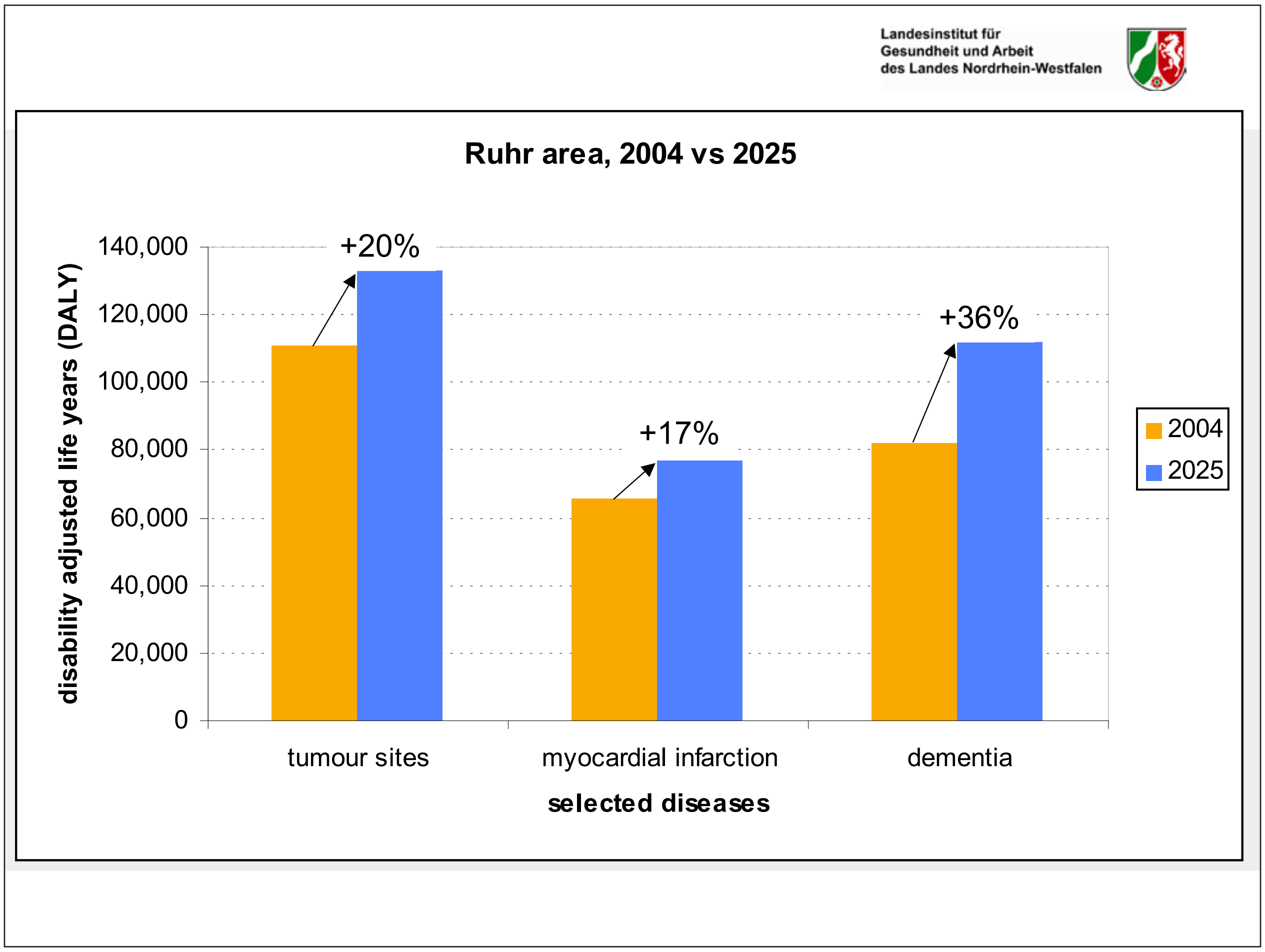
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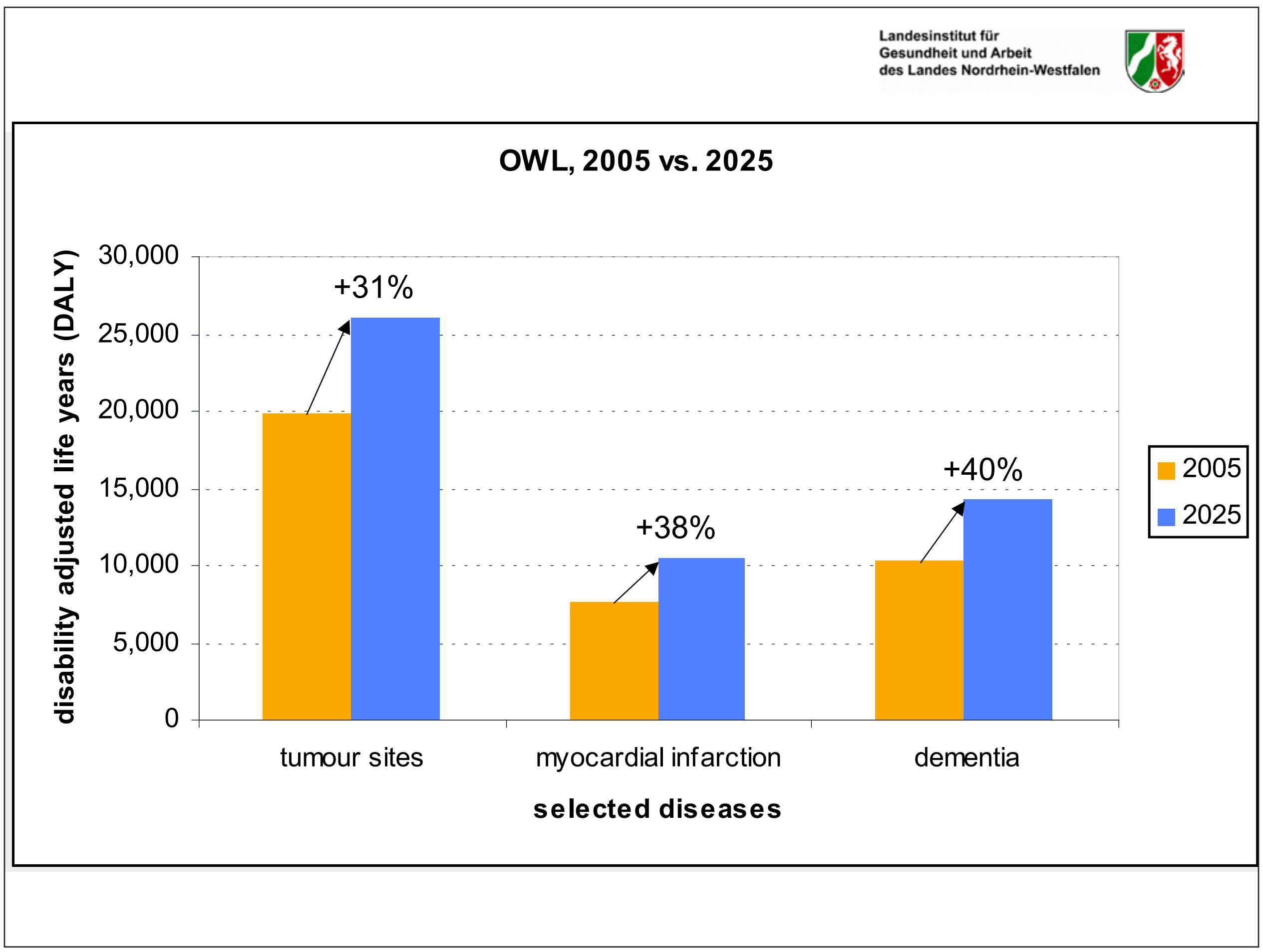
Ruhr area, 2004 vs 2025
disability adjusted life years (DALY)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
+20%
+17%
+36%
tumour sites
myocardial infarction
dementia
selected diseases
2004
2025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OWL, 2005 vs. 2025
disability adjusted life years (DALY)
30,000
25,000
20,000
15,000
10,000
5,000
0
+31%
+38%
+40%
tumour sites
myocardial infarction
dementia
selected diseases
2005
2025

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BoD prognosis of demografic change in NRW - Outlook

- prognoses of the development of burden of disease demonstrate large changes
- potentially associated with opportunities for considerable health gains via a range of preventive measures across different sectors
- initiate preparedness in health care for a higher number of patients of very old age
- (medical) therapies need to become more adjusted for patient of old age
- the prognoses will be used as baseline estimates in upcoming HIAs, with the effects of different interventions on health to be quantified accordingly

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Thank you very much!

… and now I pass on to: EBD in NRW

Claudia Hornberg

University of Bielefeld

Claudia Hornberg et al.:
Burden of Disease in North Rhine-Westphalia (BoD in NRW), part 2: Environmental Tobacco Smoke (ETS)

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Burden of Disease in North Rhine-Westphalia (BoD in NRW), part 2: Environmental Tobacco Smoke (ETS)

before implementation of non-s moker-protection legislation

Claudia Hornberg, School of Public Health, University of Bielefeld
Reinhard Samson, School of Public Health, University of Bielefeld
Thomas Claßen, School of Public Health, University of Bielefeld
Odile C.L. Mekel, NRW Institute of Health and Work (LIGA.NRW)
Claudia Terschüren, NRW Institute of Health and Work (LIGA.NRW)
Rainer Fehr, NRW Institute of Heal th and Work (LIGA.NRW)

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Background and objectives

Background:

- Non-smokers exposed to environmental tobacco smoke (ETS) indoors are at risk of the same acute and chronic illnesses (e.g., respiratory & cardiovascular diseases) as are smokers.
- Children are particularly sensitive to ETS.
- Prenatal exposure of a foetus if the mother smokes during pregnancy can have severe adverse healths effects.
- In 2008 legislation came into effect in NRW to protect non-smokers from ETS at the workplace, at recreational sites and inside public buildings.

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Background and objectives

Objectives:

- Estimate the ETS-caused EBD in NRW under the conditions before 2008.
- Estimate the health gains expected from this legislation.
- Test the method developed by the WHO for assessing the environmental burden of disease (EBD) from ETS.

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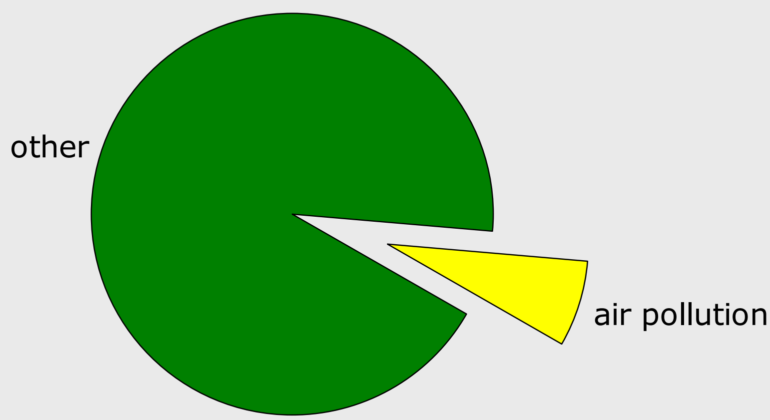
From BoD to comparative risk assessment (CRA) and environmental burden of disease (EBD)

Attributable cases - Health outcome X



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How to do EBD

- Specify **exposure**
- Define appropriate health outcomes
- Specify the **dose-response** relationships
- Derive **population baseline frequency** measures for the health outcomes (from morbidity and mortality statistics)
- Calculate the number of **attributable cases** in the target population
- Calculate DALYs attributable to a specific risk factor
- Calculate/assess potential **health gains** (scenarios)

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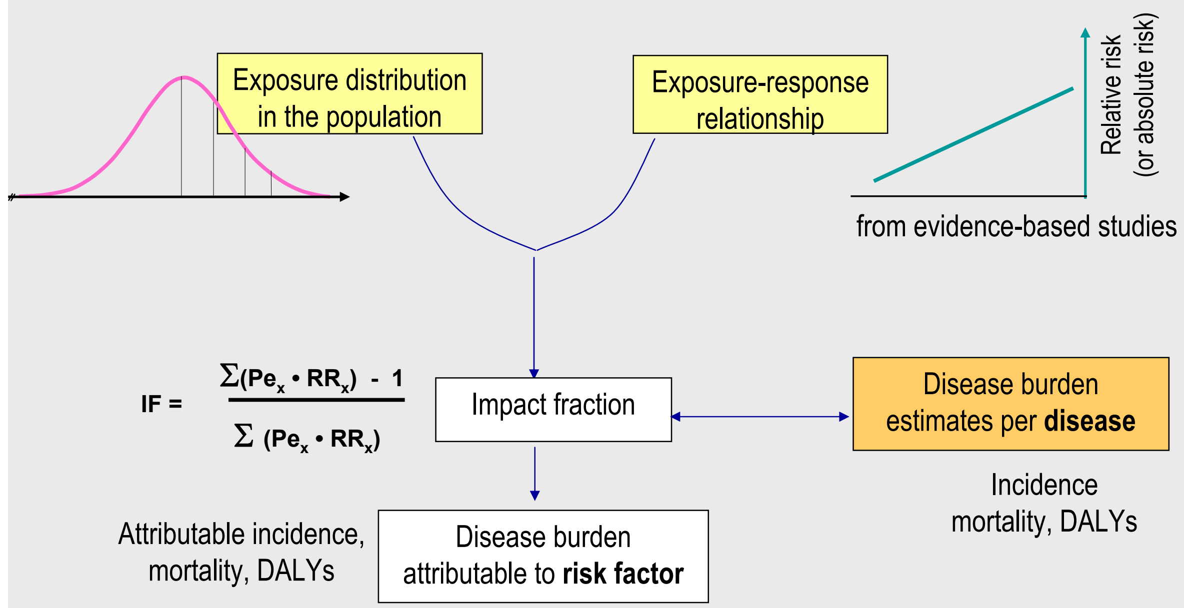
Exposure-based approach in EBD



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Assumptions for ETS exposure assessment I

- The smoking prevalence and ETS exposure in non-smokers was estimated from data of the

  - German Health Survey 2003

  - German Epidemiological Survey on addictions 2003 (self-assessments given through telephone interviews).

Limitations:

- Data about ETS exposure is differentiated by site of exposure (home, workplace, recreational facilities, other places), but the magnitude of exposure cannot be estimated due to survey design.
- Exposure can only be assumed at home and at work because exposure at recreational facilities and other places is irregular.

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Assumptions for ETS exposure assessment II

- Smokers are also exposed to ETS, but the additional impact of ETS can be neglected because of the exceedingly high impact of smoking itself.
- Even being a former smoker by far exceeds the impact of ETS regarding lung cancer and COPD (chronic obstructive pulmonary disease).
- Foetal exposure is estimated from the smoking habits of the woman.

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Prevalence of smoking

	Current smokers (%)		Current non-smokers (%)		Never smoked (%)		Former smokers (%)	
Age	M	F	M	F	M	F	M	F
20-29	54	43	46	57	31	42	69	58
30-39	45	37	55	63	33	39	67	61
40-49	43	36	57	64	26	38	74	62
50-59	32	28	68	72	31	44	69	56
60-69	20	15	80	85	35	65	65	35
70-79	15	6	85	94	28	71	72	29
80+	8	4	92	96	28	71	72	29

Source: Telephone health survey 2003; Lampert, Burger 2005

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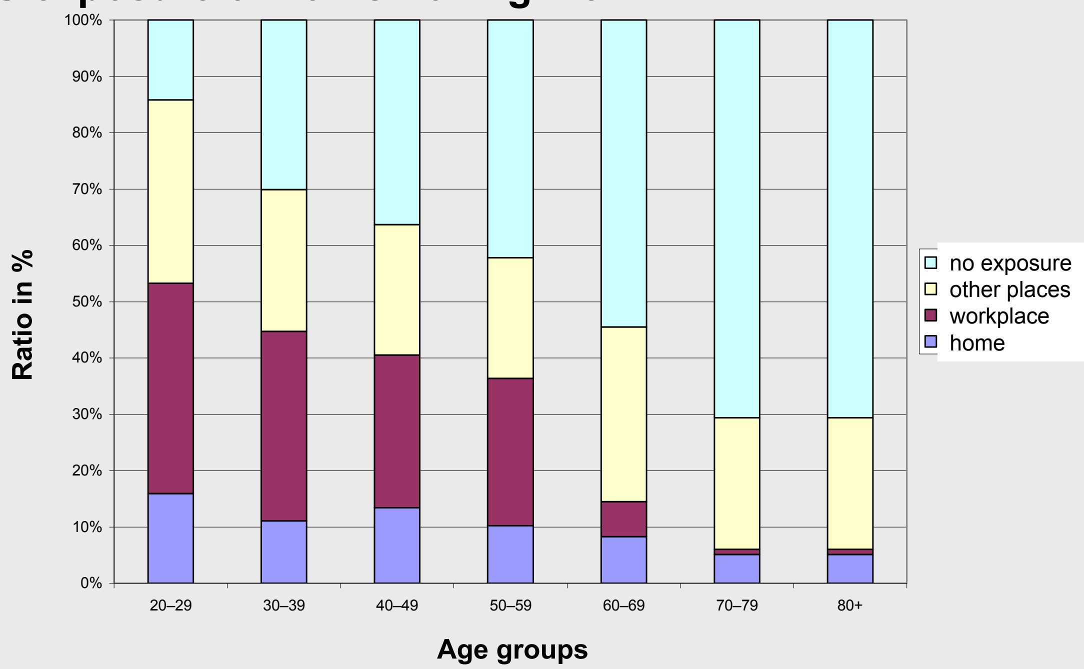
ETS exposure of non-smoking men



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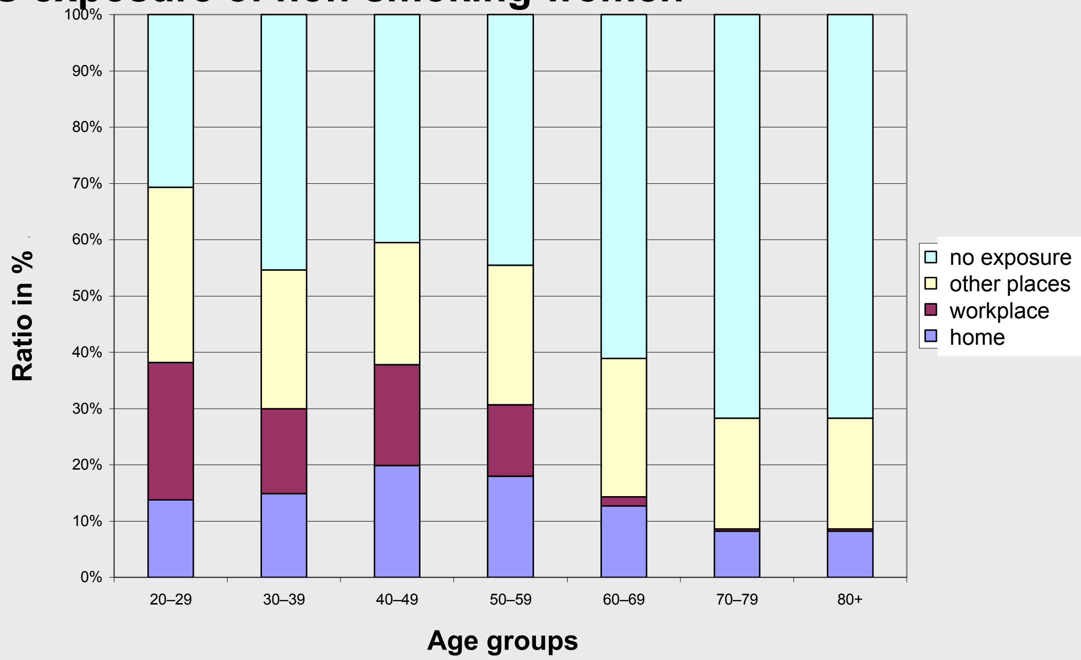
ETS exposure of non-smoking women



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Health outcomes

	ICD-10	Age groups	Population of non-smokers
Lung cancer	C33, C34	>20 years	Never smoked
Coronary heart disease (CHD)	I20-I24	>20 years	Never smoked & former smokers
COPD	J41-J44	>20 years	Never smoked and former smokers
Stroke	I60-I69	>20 years	Never smoked
Low birth weight	P07.0, P07.1	0 years	
Sudden infant death (SIDS)	C33, C34	<1 year	

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Burden of disease (BoD) attributable to tobacco smoke: Assumptions

- For children:
  Active smoking has a minor impact.
  → ETS is responsible for the total burden of disease due to tobacco smoke.

- For adults:
  The BoD fraction attributable to ETS must be estimated by excluding the BoD due to active smoking.

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BoD attributable to ETS (cases in 2004)

	Premature deaths	Incidence	Premature deaths	Incidence	Premature deaths	Incidence
			Adults			
	Males		**Females**		**Total**	
Lung cancer	31	34	42	45	74	79
CHD	257	781	333	606	590	1387
COPD	4	60	12	75	16	135
Stroke	44	122	118	225	162	347
			Children			
Low birth weight					3	822
SIDS					24	
Sum	**336**	**997**	**505**	**951**	**869**	**2770**
Total Burden	**31828**	**55116**	**31000**	**51986**	**62828**	**107102**

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BoD attributable to ETS in DALYs in 2004

	YLL	YLD	YLL	YLD	YLL	YLD	DALY	DALY/ Mio. inh.
				Adults				
	Males		Women		Total			
Lung cancer	266	5	356	45	623	50	673	37,23
CHD	2032	847	1322	395	3353	1242	4596	254,24
COPD	31	89	58	113	89	202	291	16,10
Stroke	251	208	454	366	705	574	1279	70,76
				Children				
Low birth weight					787		787	43,54
SIDS					98		98	5,42
Sum	**2580**	**949**	**2190**	**909**	**5655**	**2068**	**7724**	**378,33**

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Health gains due to intervention

Assumption: eliminating ETS exposure at work
→ Reduction of DALYs by 26%

- Limitations:
- BoD attributable to ETS might be underestimated due to limitations of the study design.

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Conclusions

- Legislation protecting non-smokers cannot directly influence the ETS exposure at home.
- Further efforts are needed to reduce active smoking, especially amongst children and adolescents.

→ Examples would include smoke-free schools and recreational facilities as well as other measures aimed at fighting the ubiquitousness of smoking.

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Thank you for your attention!

HEIMTSA / INTARESE toolbox

Hilary Cowie et al., HEIMTSA and INTARESE

INTARESE HEIMTSA

HEIMTSA and INTARESE

Fintan Hurley, IOM Edinburgh

Hilary Cowie, IOM Edinburgh hilary.cowie@iom-world.org

David Briggs, Imperial College, London

INTARESE and HEIMTSA are Integrated Projects funded under the EU 6th Framework Programme - priority 6.3 Global Change and Ecosystems

INTARESE HEIMTSA

Large European research consortia...

Two Integrated Projects under EU FP6:Environment and Health, Global Change and Ecosystems

- INTARESE – 5 years; 33 partners; will finish 31 October 2010
- HEIMTSA – 4 years; 21 partners; will finish 31 January 2011

Both developing methods and tools in environmental health impact assessment (HIA)

Working closely together and with other projects

- European: Including EU FP6 and FP7 projects such as 2-FUN, NoMiracle, HENVINET, APHEKOM etc.
- Local and regional HIA projects, including EDPHiS in Scotland

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INTARESE

Fundamental idea of these projects

HEIMTSA

INTARESE and HEIMTSA are trying to take us

- Beyond risk assessment of pollutants….
- To environmental health impact assessment (HIA) of policies and measures
  - May be designed to reduce pollution or otherwise improve health
  - May be for other purposes, i.e. not primarily health; but may have health consequences

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INTARESE

Environmental Health Impact Assessment

HEIMTSA

General approach to environmental HIA

- Develop a baseline scenario, i.e. projecting forward but without the proposed policies
- Alternative scenarios, i.e. with policies and measures in place
- Look at differences in (environmental) health impacts between alternative and baseline
  - Those health effects that are caused by the interaction of people (populations) with the physical environment, i.e. by 'environmental exposures'
  - Includes aggregated effects of changes in environmental exposures (good as well as bad), including mixtures

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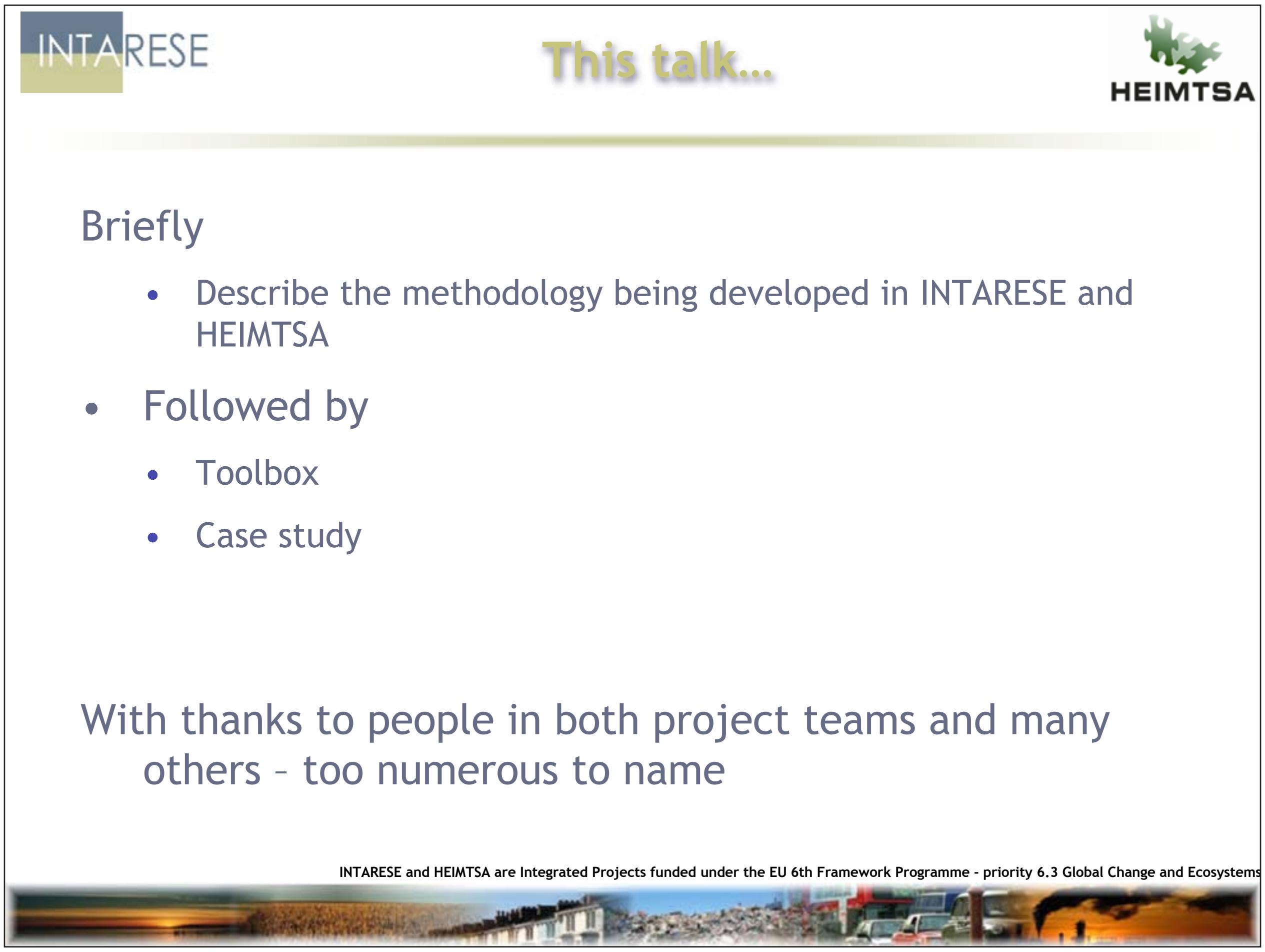
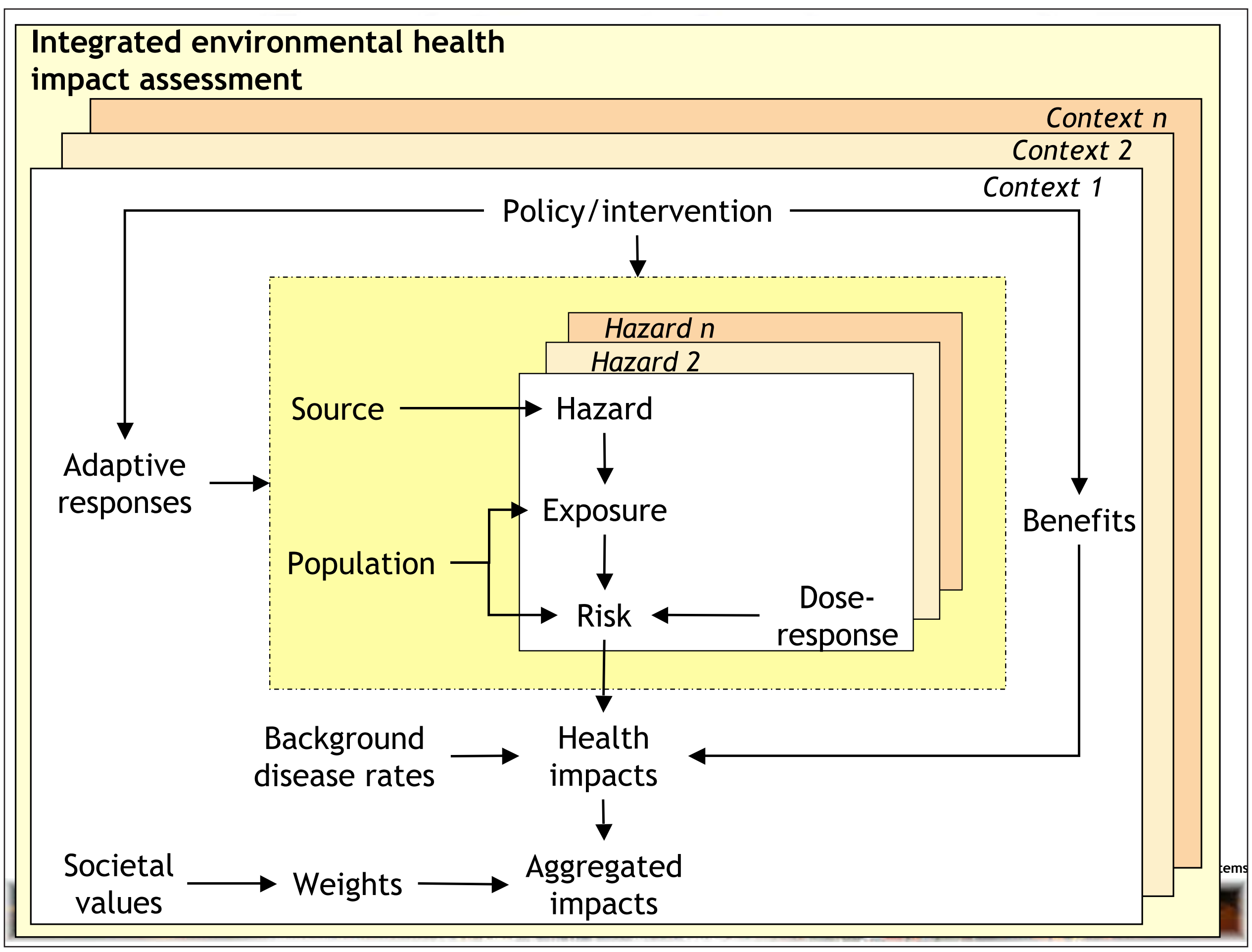

INTARESE
This talk...
HEIMTSA
Briefly
• Describe the methodology being developed in INTARESE and HEIMTSA
• Followed by
• Toolbox
• Case study
With thanks to people in both project teams and many others – too numerous to name
INTARESE and HEIMTSA are Integrated Projects funded under the EU 6th Framework Programme - priority 6.3 Global Change and Ecosystems


Integrated environmental health impact assessment
Context n
Context 2
Context 1
Policy/intervention
Hazard n
Hazard 2
Source
Hazard
Adaptive responses
Exposure
Benefits
Population
Risk
Dose-response
Background disease rates
Health impacts
Societal values
Weights
Aggregated impacts

INTARESE HEIMTSA

Conceptual Frameworks
for Integrated Environmental HIA
- For understanding and to guide actions

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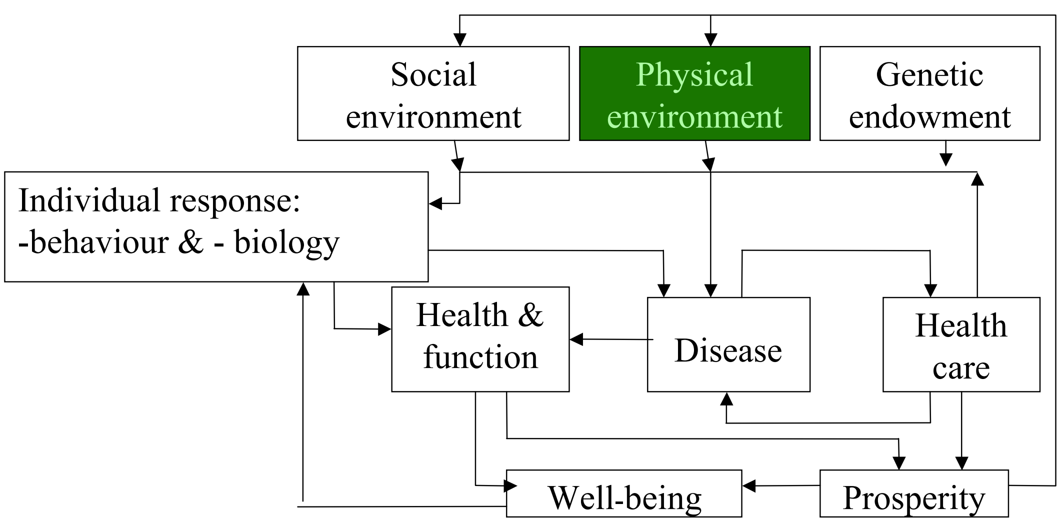
INTARESE HEIMTSA

The Socio-ecological model of health - too simple re. environment



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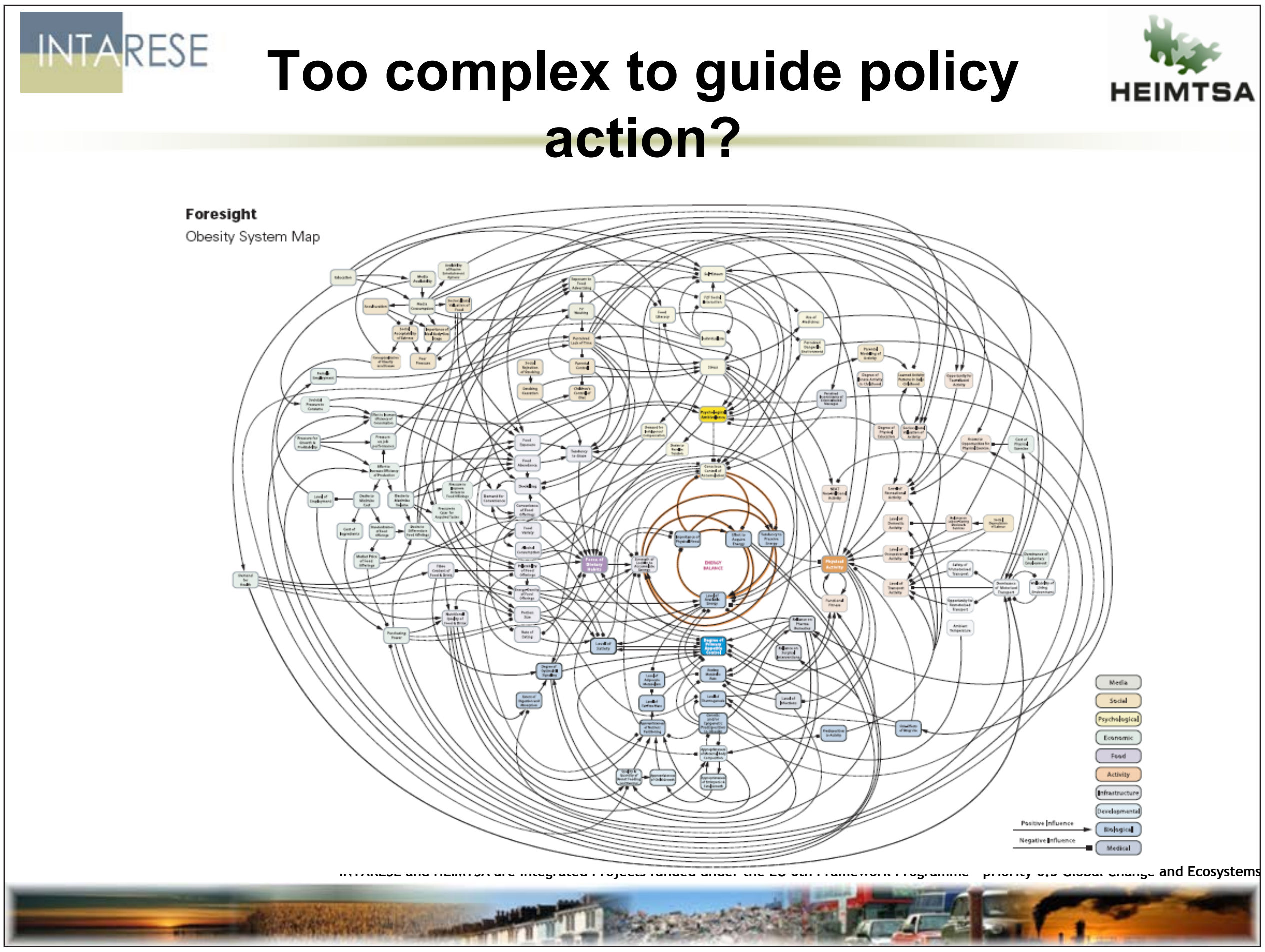
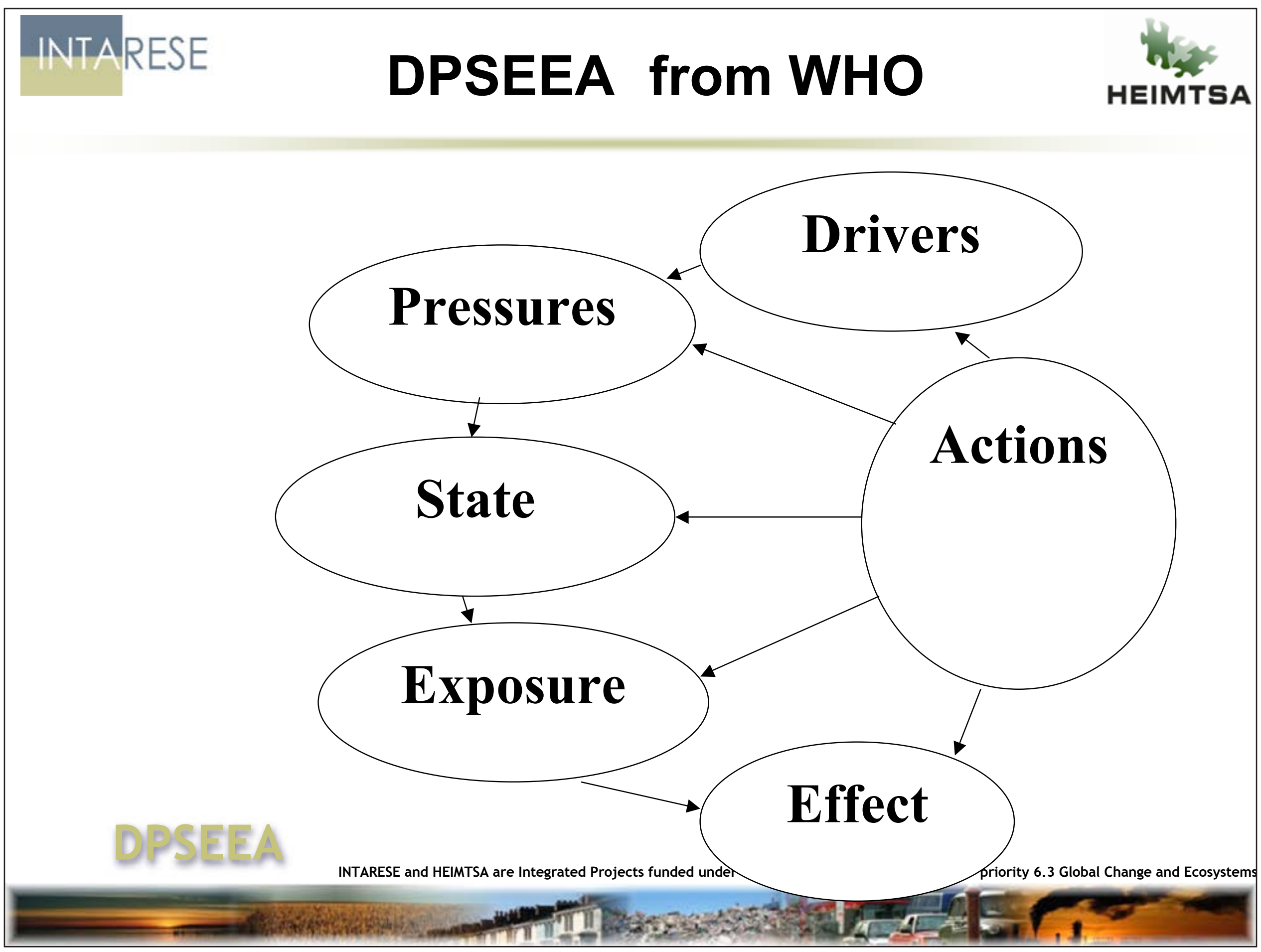

INTARESE
Too complex to guide policy action?
HEIMTSA
Foresight
Obesity System Map
Media
Social
Psychological
Economic
Food
Activity
Infrastructure
Developmental
Biological
Medical
Positive Influence
Negative Influence
and Ecosystems


INTARESE
DPSEEA from WHO
HEIMTSA
Drivers
Pressures
Actions
State
Exposure
Effect
DPSEEA
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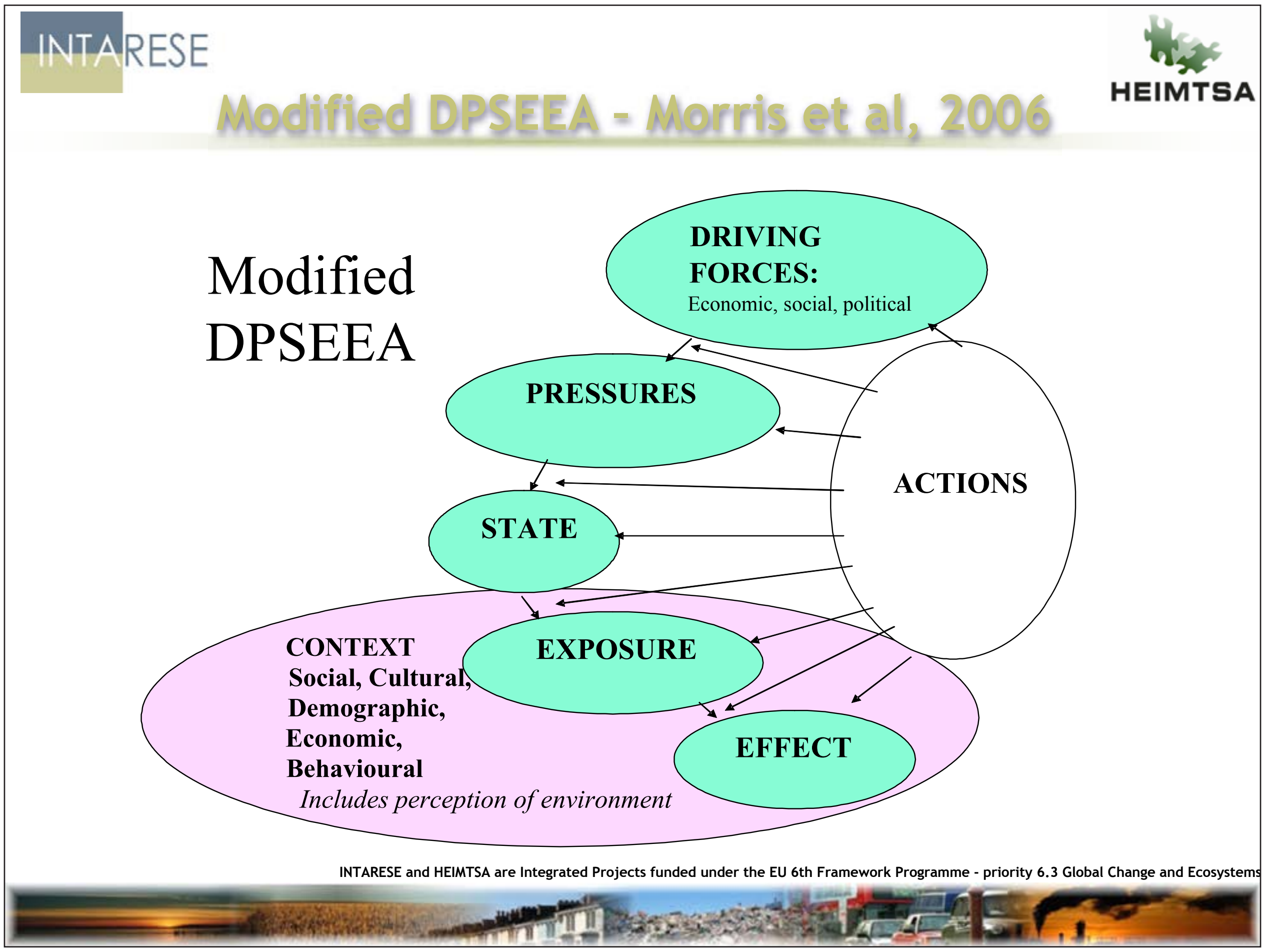
INTARESE
HEIMTSA
Modified DPSEEA - Morris et al, 2006
Modified DPSEEA
DRIVING FORCES:
Economic, social, political
PRESSURES
STATE
EXPOSURE
EFFECT
ACTIONS
CONTEXT
Social, Cultural, Demographic, Economic, Behavioural
Includes perception of environment
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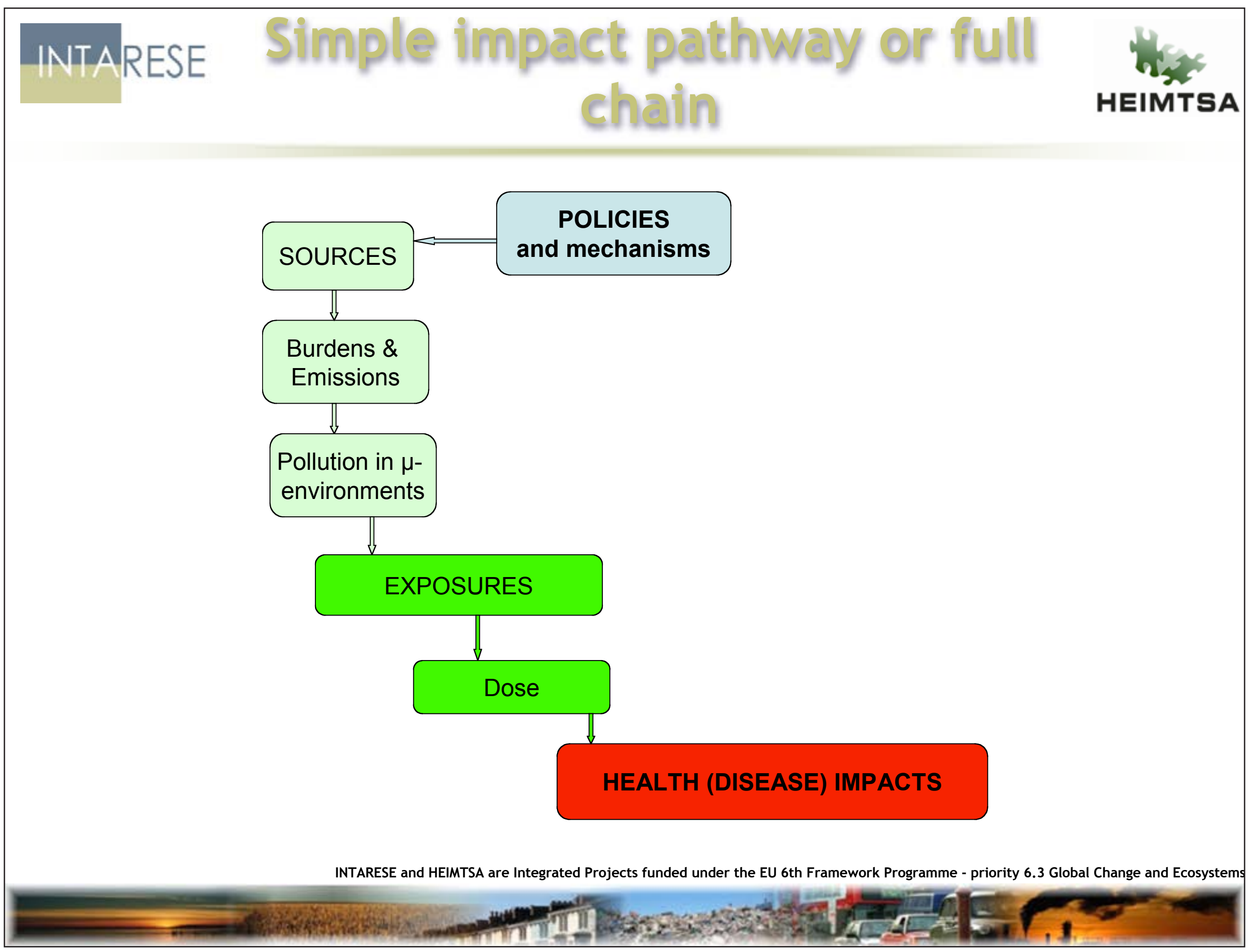
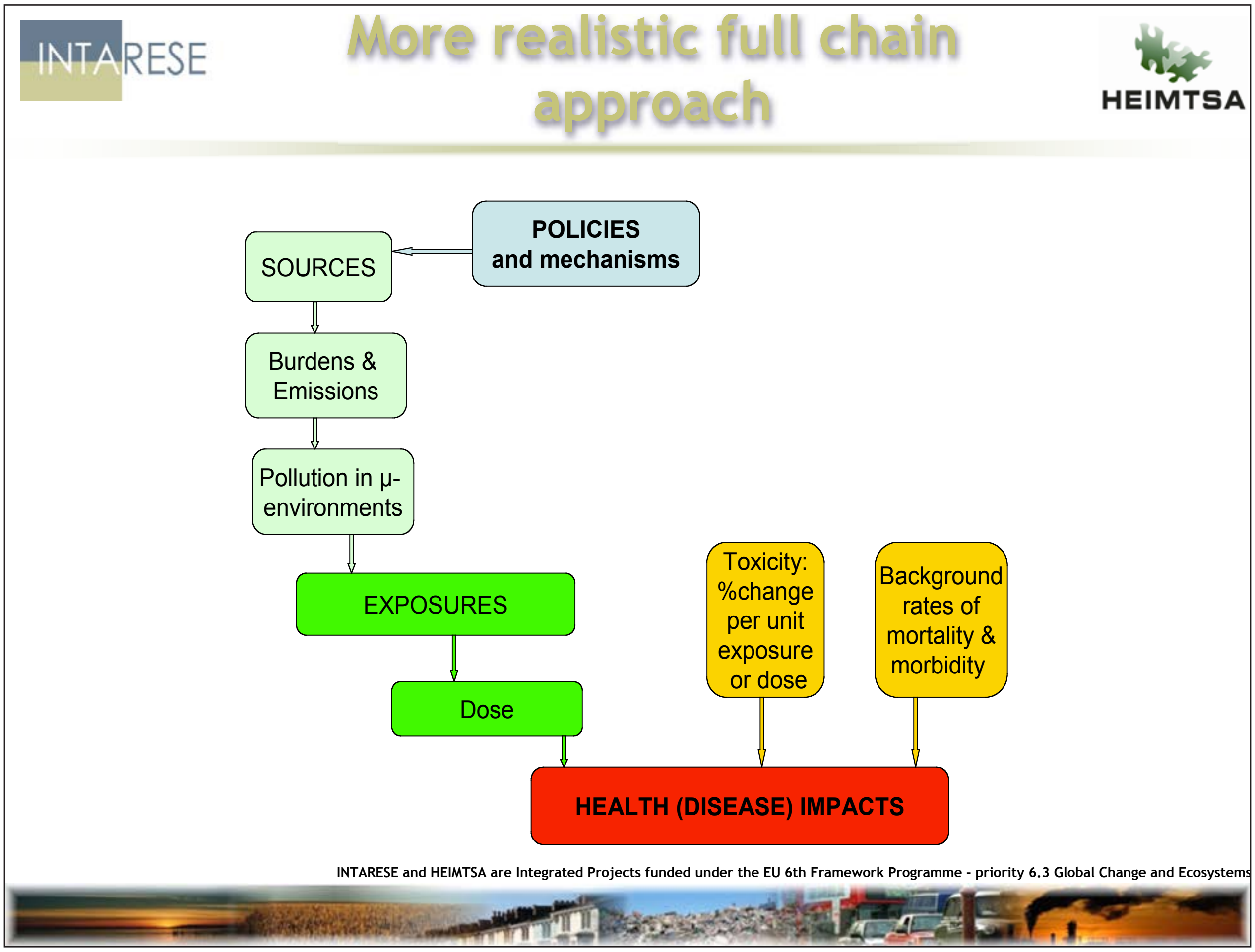
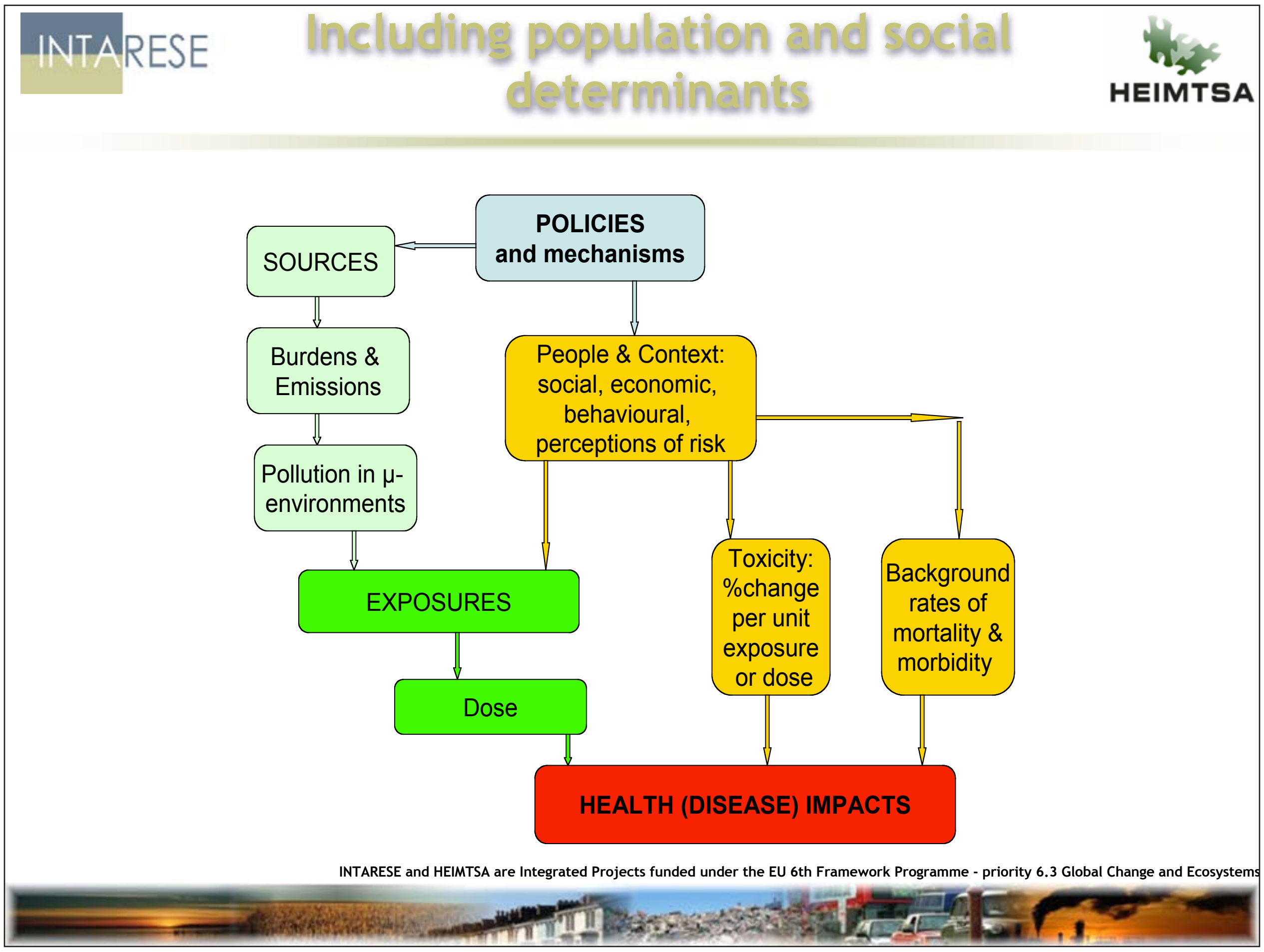

INTARESE
HEIMTSA
Simple impact pathway or full chain
POLICIES and mechanisms
SOURCES
Burdens & Emissions
Pollution in μ-environments
EXPOSURES
Dose
HEALTH (DISEASE) IMPACTS
INTARESE and HEIMTSA are Integrated Projects funded under the EU 6th Framework Programme - priority 6.3 Global Change and Ecosystems


INTARESE
More realistic full chain approach
HEIMTSA
POLICIES and mechanisms
SOURCES
Burdens & Emissions
Pollution in µ-environments
EXPOSURES
Dose
Toxicity: %change per unit exposure or dose
Background rates of mortality & morbidity
HEALTH (DISEASE) IMPACTS
INTARESE and HEIMTSA are Integrated Projects funded under the EU 6th Framework Programme - priority 6.3 Global Change and Ecosystems


INTARESE
Including population and social determinants
HEIMTSA
POLICIES and mechanisms
SOURCES
Burdens & Emissions
Pollution in µ-environments
People & Context: social, economic, behavioural, perceptions of risk
EXPOSURES
Dose
Toxicity: %change per unit exposure or dose
Background rates of mortality & morbidity
HEALTH (DISEASE) IMPACTS
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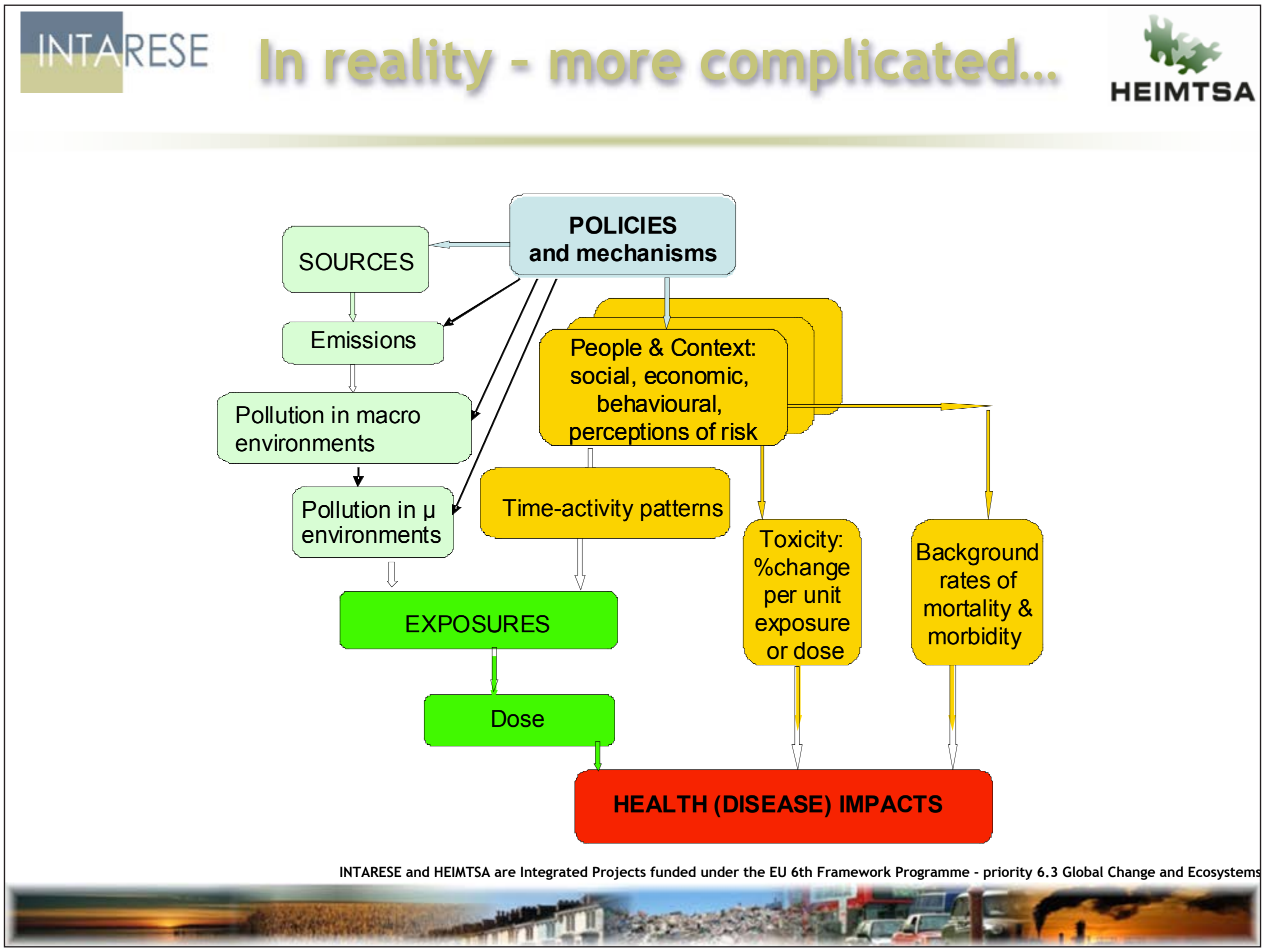
INTARESE
In reality - more complicated...
HEIMTSA
POLICIES
and mechanisms
SOURCES
Emissions
Pollution in macro environments
Pollution in μ environments
People & Context: social, economic, behavioural, perceptions of risk
Time-activity patterns
Toxicity: %change per unit exposure or dose
Background rates of mortality & morbidity
EXPOSURES
Dose
HEALTH (DISEASE) IMPACTS
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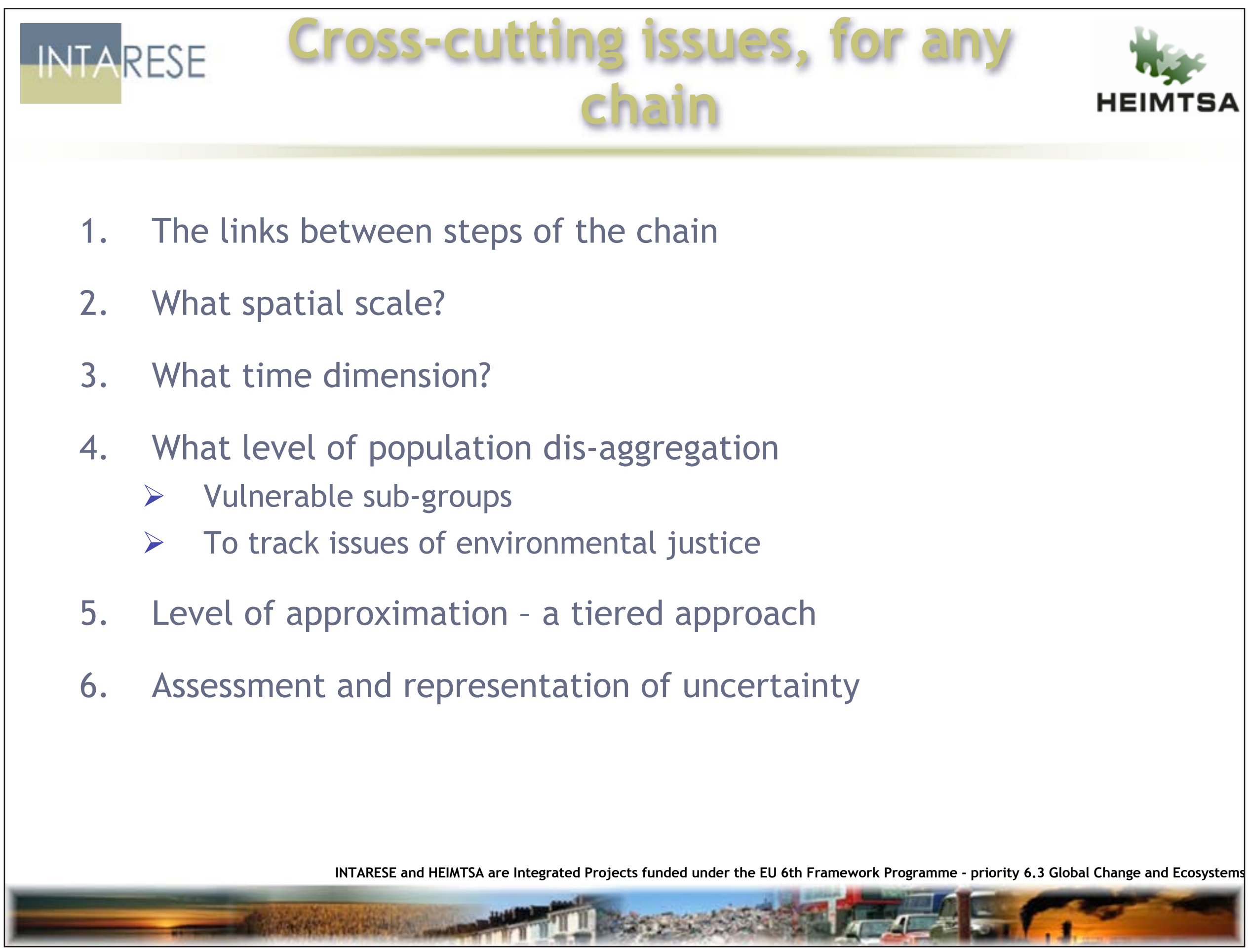
INTARESE
Cross-cutting issues, for any chain
HEIMTSA
1. The links between steps of the chain
2. What spatial scale?
3. What time dimension?
4. What level of population dis-aggregation
Vulnerable sub-groups
To track issues of environmental justice
5. Level of approximation – a tiered approach
6. Assessment and representation of uncertainty
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INTARESE HEIMTSA

Methodological Process

A tiered approach

- Identify and map out the pathways, from policies and measures through to (aggregated) health impacts
- Preliminary scoping analysis; identify
  - Links along the pathway
  - Issues in space and time and population disaggregation
  - Main evidence and data gaps
  - Other uncertainties
- Identify pathways and aspects of pathways that matter most; focus on improving analysis of these

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INTARESE HEIMTSA

Some specific 'chains' from HEIMTSA

Pollutant-based 'case studies'

1. The classical air pollutants
   - Improve and extend what was done in CAFE for PM and ozone
2. Selected pollutants in indoor air
   - Naphthalene, radon, formaldehyde and ETS
   - Other combustion sources – heating and cooking
3. Noise from road traffic
4. Pollutants with complex pathways
   - Metals: Lead, Arsenic; some work on PCBs

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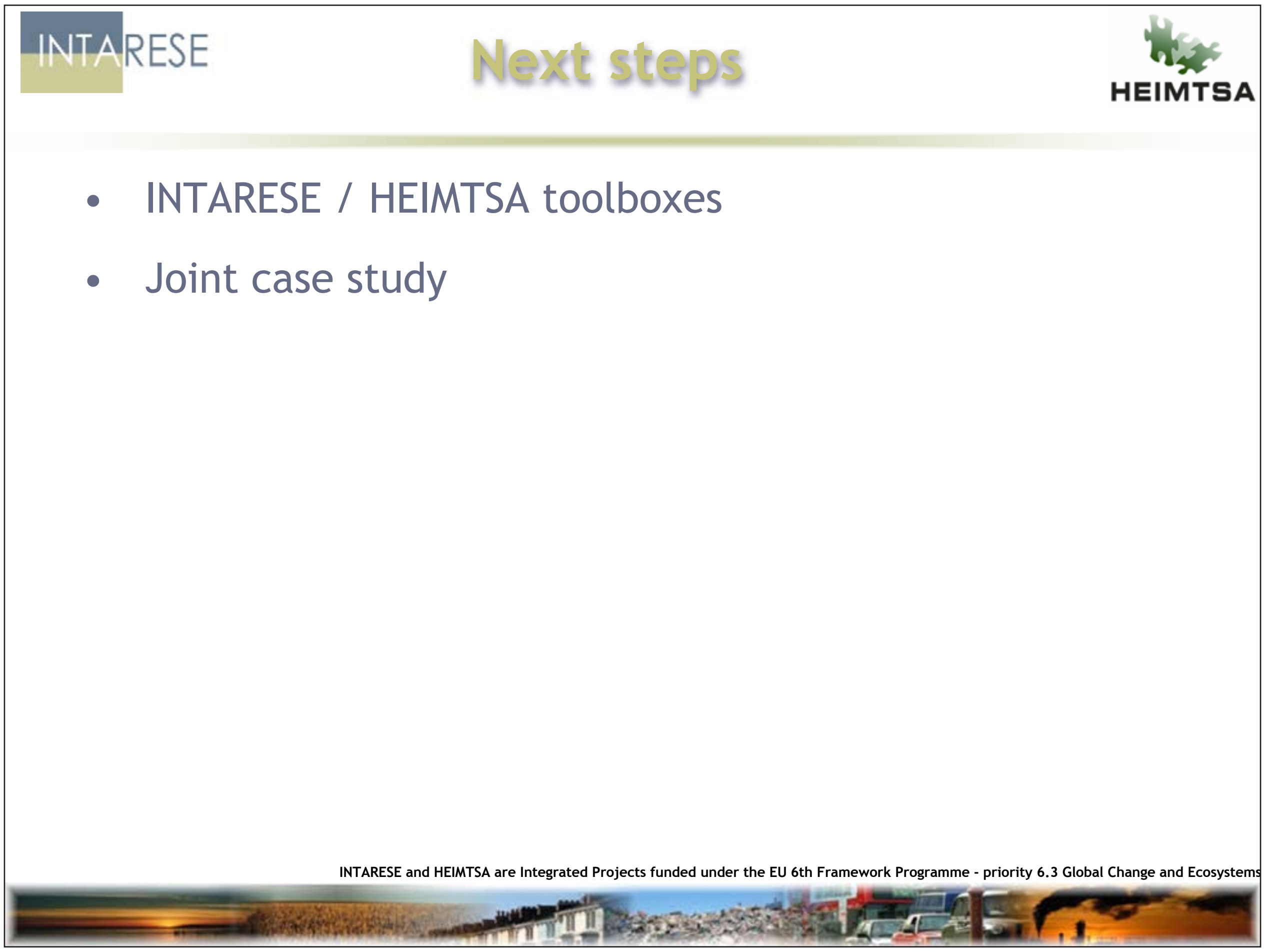
INTARESE
Next steps
HEIMTSA
• INTARESE / HEIMTSA toolboxes
• Joint case study
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Volker Klotz et al.:
INTARESE-based Guidebook and Resource Centre

Universität Stuttgart
Institut für Energiewirtschaft und Rationelle Energieanwendung IER

INTARESE-based Guidebook and Resource Centre

Volker Klotz,

Alexandra Kuhn, Joachim Roos, et al.

USTUTT, IC, LSHTM, RIVM, UU, AFSSET, THL, NILU, UM-ICIS, VITO, INERIS, CERTH, PBL, *JRC*

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The toolbox

It's a place where all relevant information around **integrated environmental health impact assessment** (IEHIA) is available

- Articles to inform the user and to provide an overview over the complex topics constituting the basis of IEHIA
- Background information and links to additional information
- A consistent conceptual framework of IEHIA
- Examples how an IEHIA could be done
- And support to actually do an IEHIA
  - Source of data and models, e.g. population data, CRFs, impact calculation tool
  - Source of tools assisting the user, e.g. visualization, uncertainty, stakeholder integration.
  - References to data and models

Guidebook

Resource Centre

Volker Klotz et al., USTUTT — INTARESE-based Guidebook and Resource Centre, Düsseldorf, 16-17 March 2010

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For whom is the toolbox meant?

- Assessors in the different fields, who are not experts in all fields
  - How to start / steps along an IEHIA?
  - What are the state-of-the-art methods/approaches around IEHIA?
  - Where-to-find data / which data is required?
  - Resources: where to get appropriate models / good examples of IEHIA?
- Policy makers
  - What are the state-of-the-art methods/approaches around IEHIA?
  - Where could I get good examples of IEHIA?
- Students, all interested
  - What is IEHIA?
  - What are the state-of-the-art methods/approaches around IEHIA?
  - Where could I get good examples of IEHIA

Volker Klotz et al., USTUTT INTARESE-based Guidebook and Resource Centre, Düsseldorf, 16-17 March 2010

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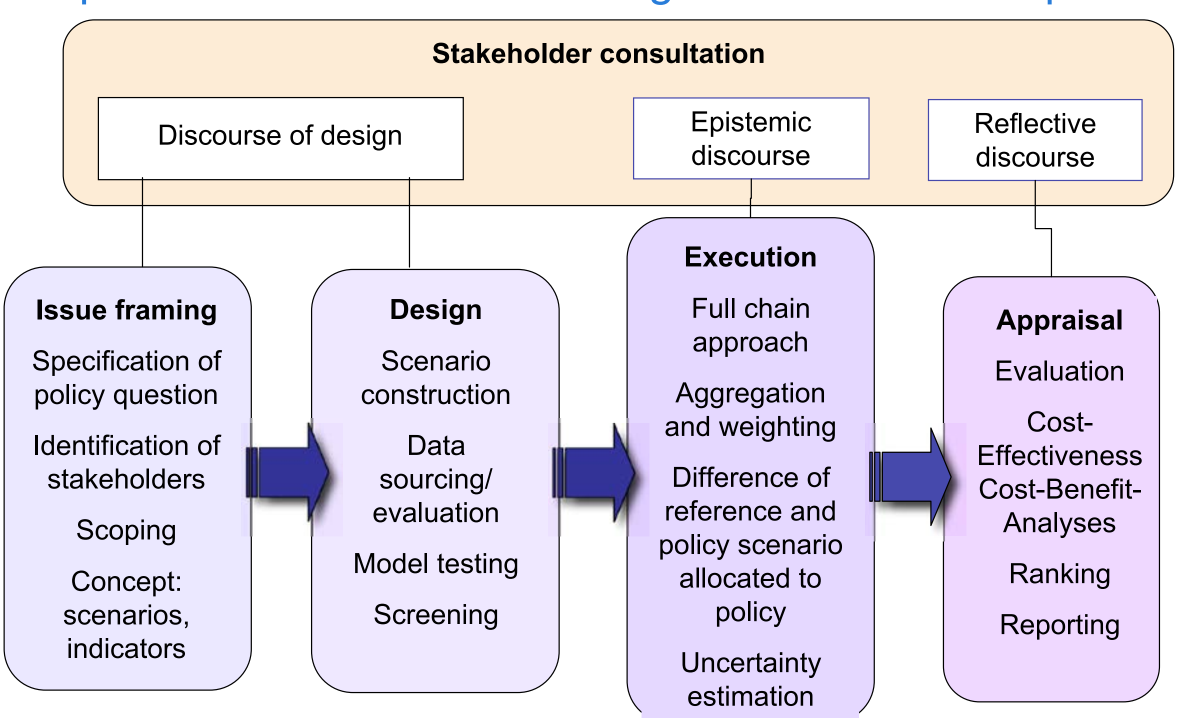
Topics of the toolbox - The integrated assessment process



Volker Klotz et al., USTUTT INTARESE-based Guidebook and Resource Centre, Düsseldorf, 16-17 March 2010

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Toolbox Solutions

- “The toolbox provides essential information, data, models to carry out an integrated assessment”
  - Q1: How to get this “essential information”?
  - Q2: How to get complete and high quality information into the toolbox?

Volker Klotz et al., USTUTT INTARESE-based Guidebook and Resource Centre, Düsseldorf, 16-17 March 2010

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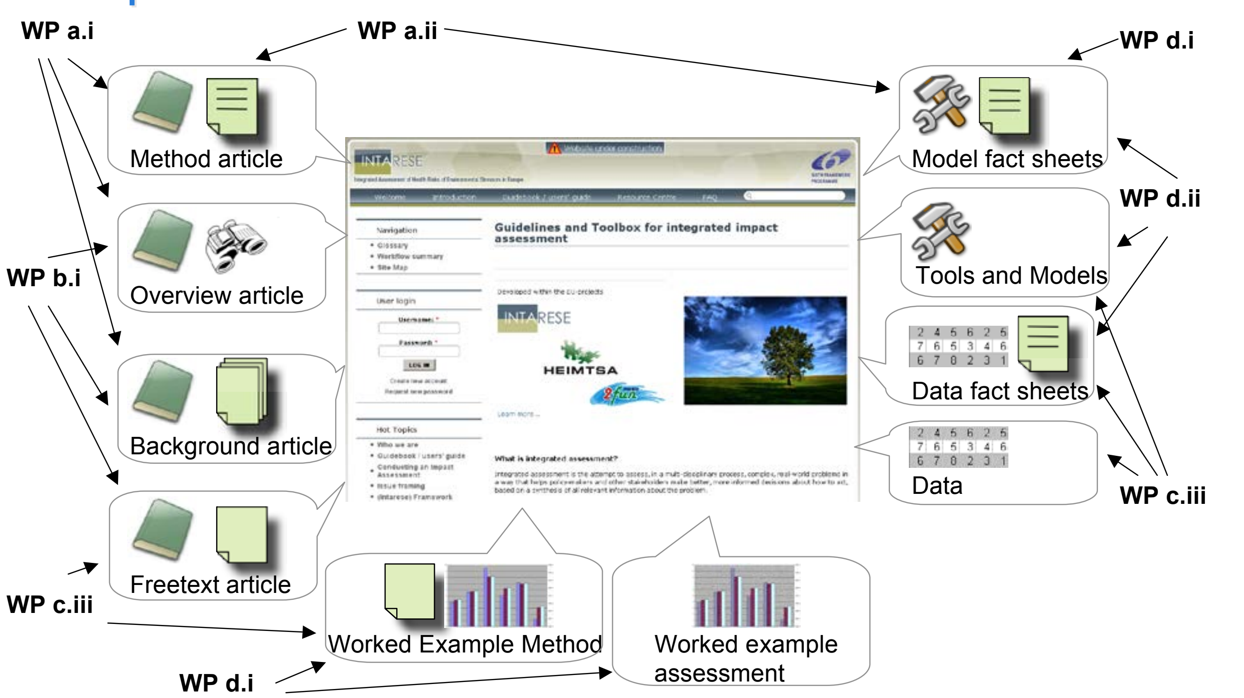
Input from INTARESE and HEIMTSA-Experts



Volker Klotz et al., USTUTT INTARESE-based Guidebook and Resource Centre, Düsseldorf, 16-17 March 2010

Toolbox Solutions (3)

- "The toolbox provides essential information, data, models to carry out an integrated assessment"
  - Q1: How to get this "essential information"?
  - Q:2 How to get complete and high quality information into the toolbox?
  - Q3: How to guarantee consistency and quality of the content?
  - A1: Well structured content by the use of content types, e.g. Methods or Model fact sheets.
  - A2: Use of a well defined workflow and review process.

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www.integrated-assessment.eu

… a place where all relevant information around **integrated environmental health impact assessment** (IEHIA) is available

It helps the users to carry out an integrated assessment and

it provides essential information, data, models to carry out an integrated assessment

Contact:

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Alexandra.kuhn@ier.uni-stuttgart.de

Volker Klotz et al., USTUTT INTARESE-based Guidebook and Resource Centre, Düsseldorf, 16-17 March 2010

Alberto Gotti:
The HEIMTSA computational toolbox

JRC
EUROPEAN COMMISSION

Dusseldorf 16-17 March 2010 – Workshop: "Quantifying the health impacts of policies - Principles, methods and models " 1

Joint Research Centre (JRC)

The Institute for Health and Consumer Protection (IHCP)
Science for a healthier life

The HEIMTSA computational toolbox

A. Gotti (on behalf of HEIMTSA toolbox team)

HEIMTSA toolbox

JRC
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HEIMTSA Project: broad aims

Dusseldorf 16-17 March 2010 – Workshop: "Quantifying the health impacts of policies - Principles, methods and models " 2

1. Quantify as fully as practicable the environmental health effects of policies in various sectors
   – Policies designed to improve health
   – Health effects of policies developed for other reasons
2. Give a fair = unbiased assessment of
   – Uncertainties in what is included
3. Identify priority information/knowledge gaps
   – Priority = having a major influence on answers
4. Enable assessment of environmental health effects of future policies

HEIMTSA toolbox

JRC EUROPEAN COMMISSION

Strategy: 'Full chain' approach

ihcp Institute for Health and Consumer Protection

Dusseldorf 16-17 March 2010 – Workshop: "Quantifying the health impacts of policies - Principles, methods and models" 3

'Full chain' = 'Impact pathway'; from:

i. (changes in) policy; to
ii. (changes in) emissions, to air, soil and water; to
iii. (changes in) pollutant concentrations in different environments; to
iv. (changes in) exposures of individuals and populations (by inhalation, dermal and/or ingestion routes); to
v. (changes in) internal dose at target organs in the body; to
vi. (changes in) health impacts (overall and in sub-populations); to
vii. (changes in) monetary value of health effects

HEIMTSA toolbox

JRC EUROPEAN COMMISSION

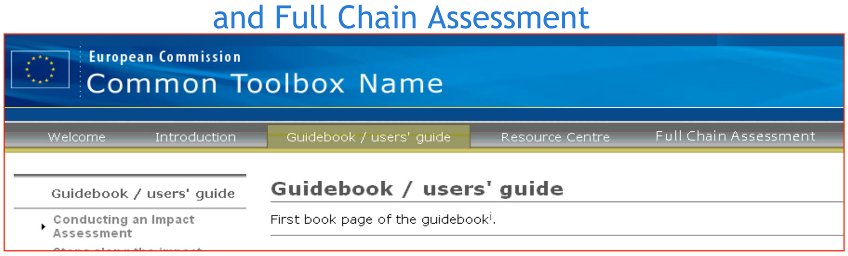
Integrated Toolbox

ihcp Institute for Health and Consumer Protection

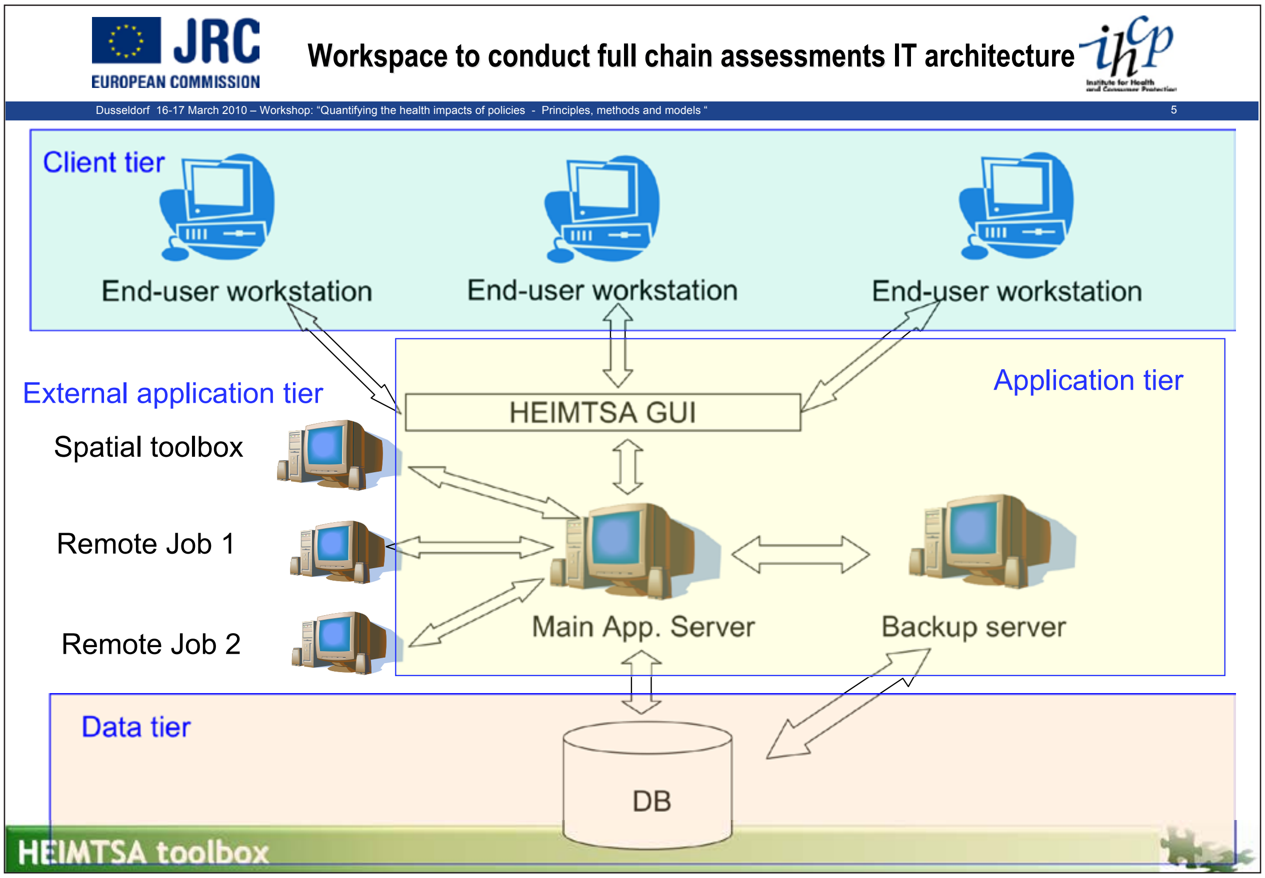
Dusseldorf 16-17 March 2010 – Workshop: "Quantifying the health impacts of policies - Principles, methods and models" 4

- All these parts find their place in a coherent framework of a common INTARESE-HEIMTSA toolbox
- The aim is that the integrated toolbox contains:
  - a Guidebook
  - a Resource Centre
  - a Workspace to conduct full chain assessments by applying and linking ready to use models

View of an integrated toolbox with Guidebook, Resource Centre and Full Chain Assessment



HEIMTSA toolbox



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The HEIMTSA toolbox structure

Dusseldorf 16-17 March 2010 – Workshop: "Quantifying the health impacts of policies - Principles, methods and models " 6

Beside the HEIMTSA Db the toolbox includes five vertical computational modules:

1. Emission module (to calculate emissions)
2. Concentration module (from emission to concentration)
3. Exposure module (from concentration to exposure)
4. Health impact module (from exposure to health impacts)
5. Monetary valuation module (form health impacts to costs)

And two horizontal modules

1. Visualization module
2. Uncertainty module

HEIMTSA toolbox

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HEIMTSA Toolbox: main characteristics

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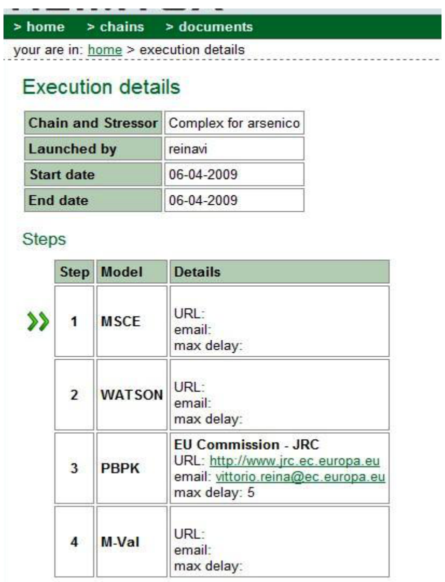

- The core is represented by a geodatabase handling input and output data (incl. intermediate results) of model runs
- The models „talk“ to each other through the geodatabase
- Well-defined interfaces between the models
- Simple models are as far as possible implemented into the platform. More complex models will be run on the local servers where they reside

HEIMTSA toolbox

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The Data Tier (DBMS)

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The HEIMTSA centralized DBMS stores:

Dynamic data

- Input/output files of each model execution

Supporting data

- Population data
- Land use / land cover
- Time activity pattern
- Background rate of diseases
- Exposure-response function for the health end-points of interest
- Monetary valuation functions for the health end-points of interest
- …

HEIMTSA toolbox

The HEIMTSA Toolbox: current status

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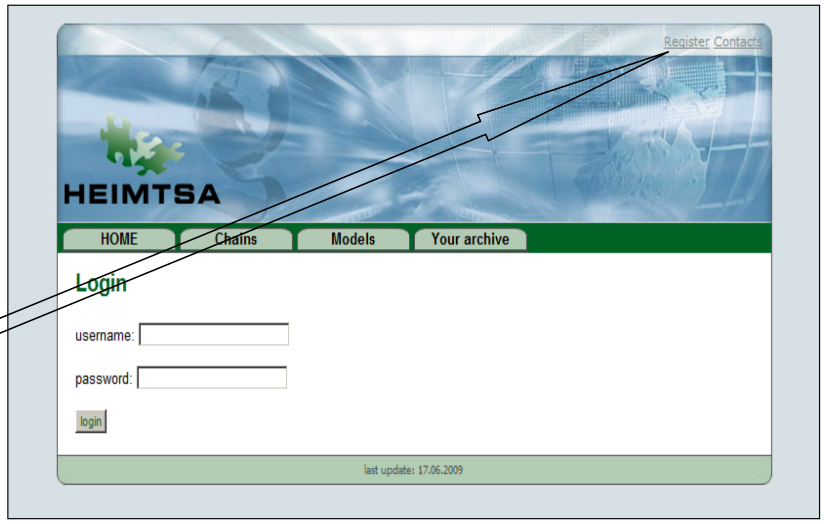
Alpha version

The login page of the toolbox requires user registration.

Users can click *Register* in the top-right in the login page



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The HEIMTSA Toolbox: the home page

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The home page of the toolbox is composed of four main sections:

- Home
- Chains
- Models
- Your archive

HEIMTSA toolbox


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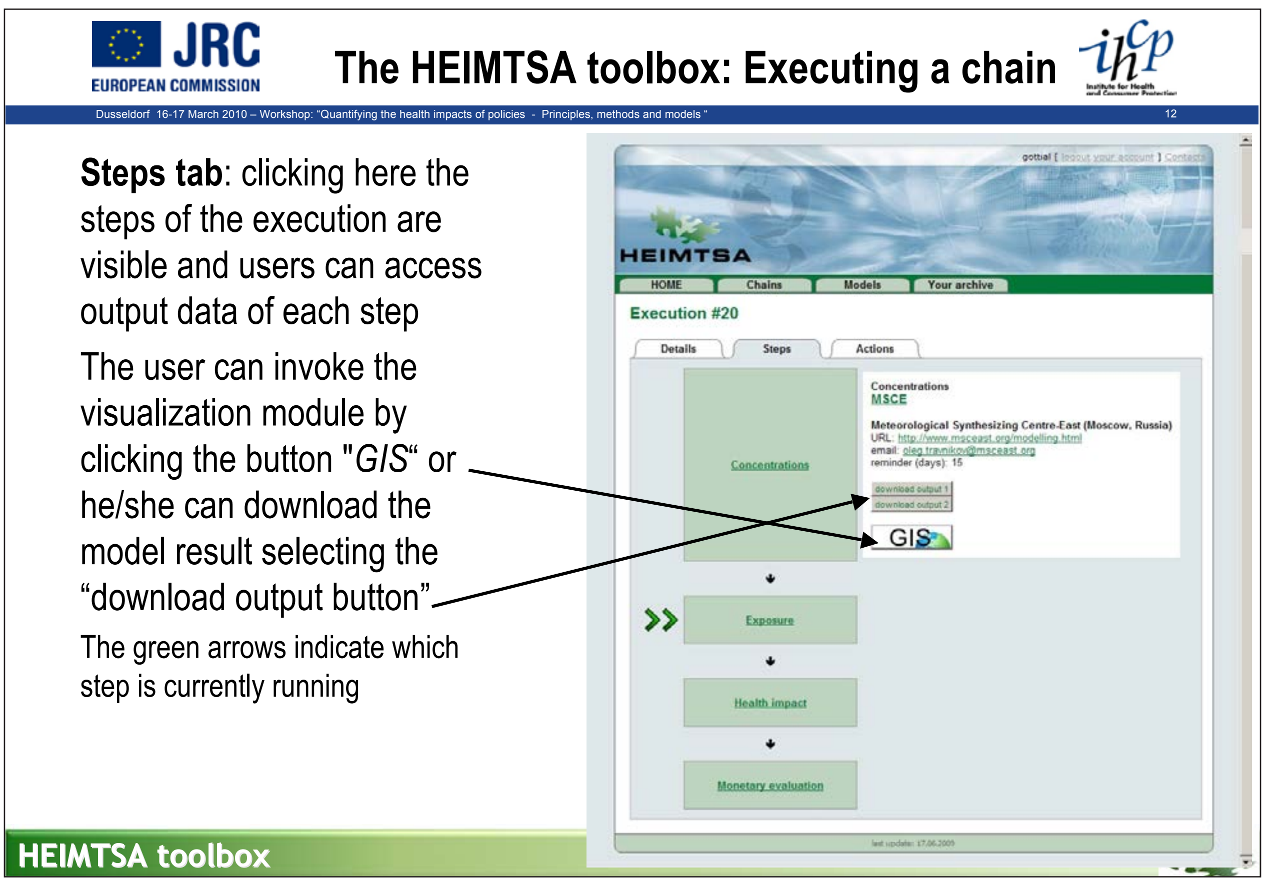
The HEIMTSA toolbox: Executing a chain
Dusseldorf 16-17 March 2010 – Workshop: "Quantifying the health impacts of policies - Principles, methods and models "
11
The details tab displays more detailed information of the execution of the chain
gottial [logout your account] Contacts
HEIMTSA
HOME
Chains
Models
Your archive
Execution #20
Details
Steps
Actions
Chain and Stressor
Complex for Arsenic (BAU2010 base)
Launched by
gottial
Start date
02-09-2009
Approved
02-09-2009 by reinavi
Current step
2 (WATSON)
Current step start date
04-09-2009
last update: 17.06.2009
HEIMTSA toolbox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12
Steps tab: clicking here the steps of the execution are visible and users can access output data of each step
The user can invoke the visualization module by clicking the button "GIS" or he/she can download the model result selecting the "download output button".
The green arrows indicate which step is currently running
HEIMTSA
HOME
Chains
Models
Your archive
Execution #20
Details
Steps
Actions
Concentrations
MSCE
Meteorological Synthesizing Centre-East (Moscow, Russia)
Concentrations
GIS
Exposure
Health impact
Monetary evaluation
HEIMTSA toolbox

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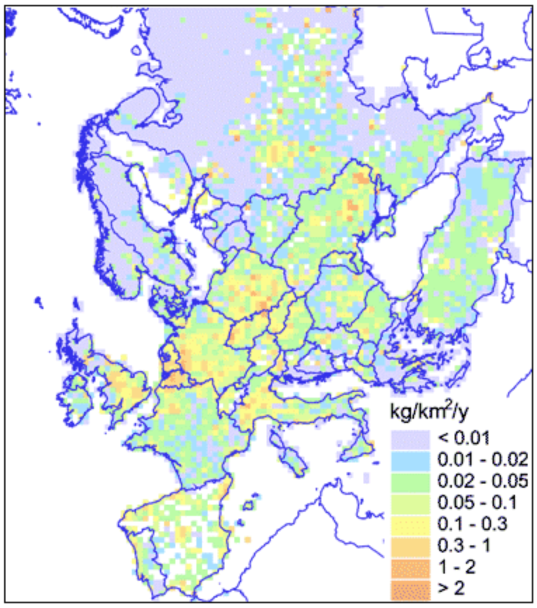

Spatial distribution of anthropogenic air emissions of arsenic in Europe for the year 2000 [kg/km^2/y].

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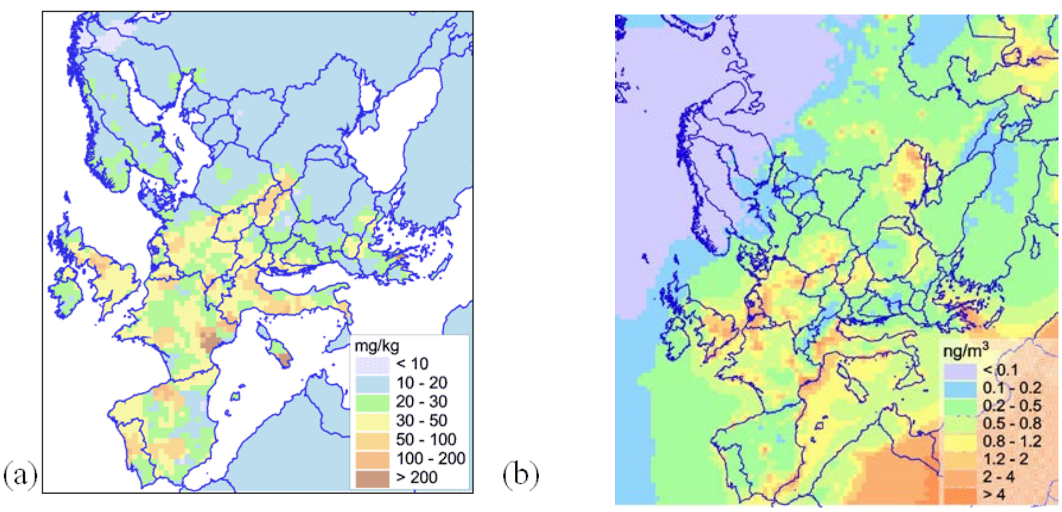
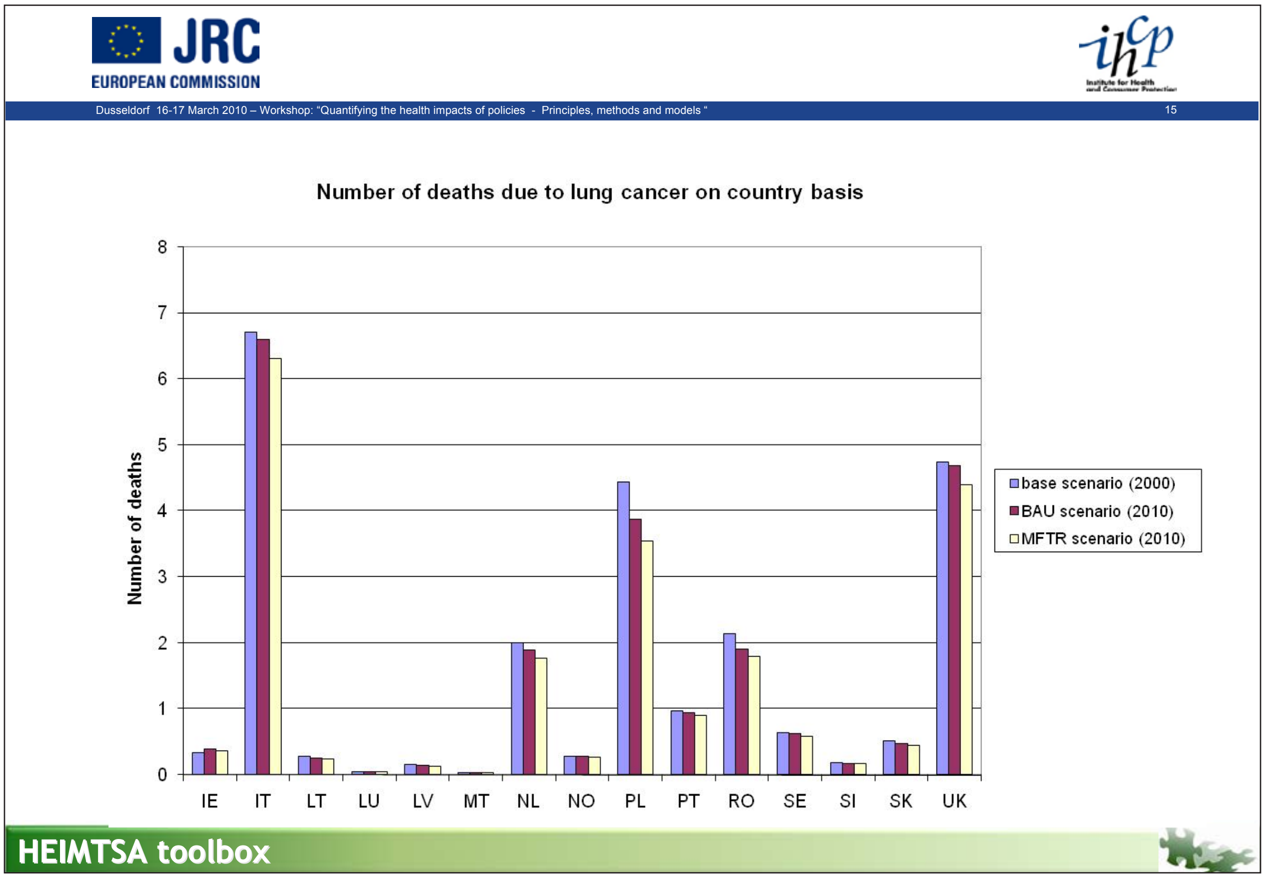


Spatial distribution of concentrations in European top-soils including adjacent territories [mg/kg] (a) and mean annual concentration in ambient air (b) for arsenic for the year 2000.

HEIMTSA toolbox



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Conclusions

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- The HEIMTSA toolbox is unique in providing a comprehensive solution to integrated health impact assessment
- Its software architecture is novel, focused on a decentralised computing paradigm, which allows the parallel use of simple and more sophisticated models in different parts of the chain
- The decentralised architecture requires continuous commitment of the HEIMTSA team to maintain the operability of the toolbox
- There is a need to ensure the continuous updating of the underlying databases and the integration of new model versions

HEIMTSA toolbox

Impact Calculation Tool

Anne Knol et al.:
Impact Calculation Tool

Background of the Impact Calculation Tool

- Modelling tool for quantification of health impacts from environmental exposures
- Affiliated projects:
  - International INTARESE project
  - International EBoDE project (Environmental Burden of Disease in Europe)
  - Finnish national projects Seturi and CLAIH
  - Dutch national projects IQARUS, VAMPHIRE and KIP
- Developed by THL in collaboration with RIVM and PBL
- (Intended) date of completion: nov 2010
- Availability:
  - Part of INTARESE toolbox
  - downloadable freely from the internet (in the future)

rivm
National Institute for Public Health and the Environment

INTARESE project

- Integrated Risk Assessment of Health Risks from Environmental Stressors in Europe
- International project with scientists in the areas of epidemiology, environmental science, toxicology, ethics, biosciences, etc
- Integrated environmental health impact assessment:
  "a means of assessing health-related problems deriving from the environment, and health-related impacts of policies that affect the environment, in ways that take account of the complexities, interdependencies and uncertainties of the real world"
- Development of methodology (e.g. problem framing, uncertainty analysis, exposure assessment, stakeholder consultation, etc), case studies and toolbox
- Now: Final year of the project

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EBoDE project

- Environmental burden of disease in Europe
- Six countries: Belgium, Finland, France, Germany, Italy, and the Netherlands
- Nine environmental stressors:
  - Particulate matter air pollution
  - Environmental noise
  - Radon
  - Passive smoking
  - Lead
  - Dioxins
  - Ozone
  - Formaldehyde
  - Benzene
- WHO environmental burden of disease methodology
- Pilot study finished – presented at Parma conference

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Objectives

Primary target group:

- Environmental health scientists carrying out an environmental health impact assessment

Aims and features:

- Harmonized burden of disease calculations
- Developed in Analytica: a licensed software, but models can be run with a free Analytica player (those with Analytica software can also edit the model)
- Openly available on the internet in the future (only web browser needed)
- Simple user interface (no need for advanced knowledge of Analytica)
- Extensive user guidance (to be developed)
- Flexible inputs and outputs
- Options for advanced uncertainty and sensitivity analyses
- Dynamic life tables
- ***Not*** a database (but links to data sources to be provided)

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Thanks!

(any questions…?)

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National Institute for Public Health and the Environment

Virpi Kollanus:
The Impact Calculation Tool (ICT) – Model specifics

NATIONAL INSTITUTE FOR HEALTH AND WELFARE

The Impact Calculation Tool (ICT) – Model specifics

Virpi Kollanus
National Institute for Health and Welfare (THL)
Workshop: Quantifying the Health Impacts of Policies – Principles, methods, and models
Düsseldorf 17.3.2010

Contents

- Model boundaries and outputs
- Quantification methods
- Input requirements
- Uncertainty and sensitivity analyses
- Demonstration 1
  Health impacts of PM2.5 in Finland
- Demonstration 2
  Predefined case study

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Impact Calculation Tool (ICT)

- For quantifying:

  What is the BoD caused by a given environmental exposure?

  How much does BoD change if the exposure changes?

- Suitable for different types of exposures / risk factors
  – Continuous, categorical
  – Chronic, acute

- Developed with Analytica-software
  → Allows probabilistic modeling
  → Can be added to other Analytica-models
  → Compatible with Excel (transfer of inputs and outputs)

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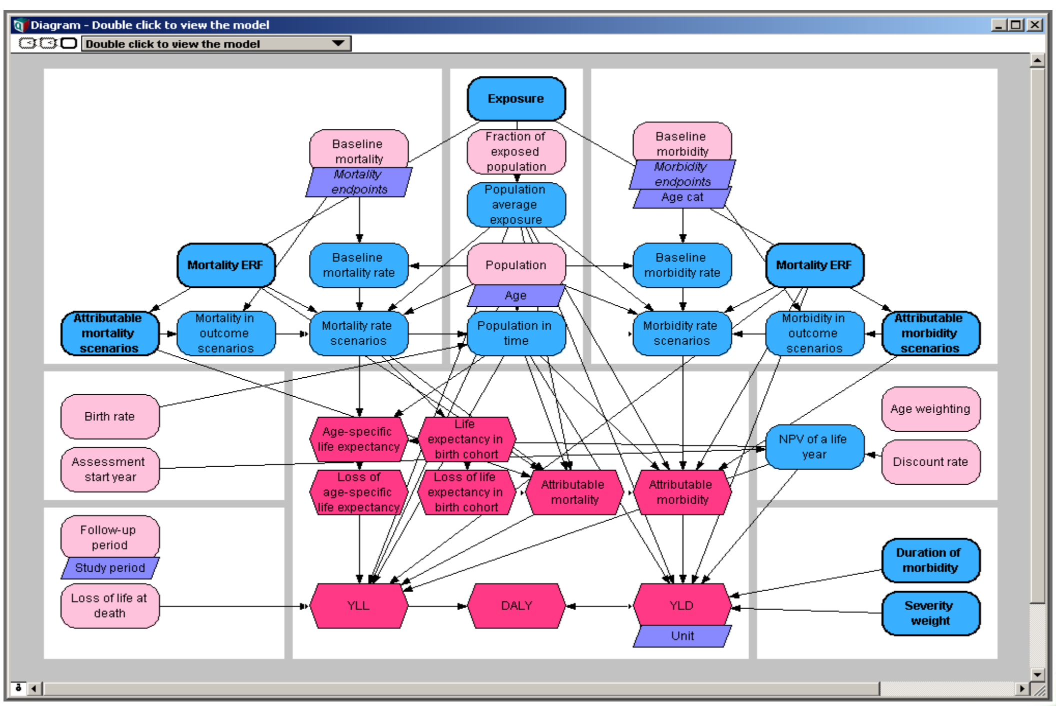
Model



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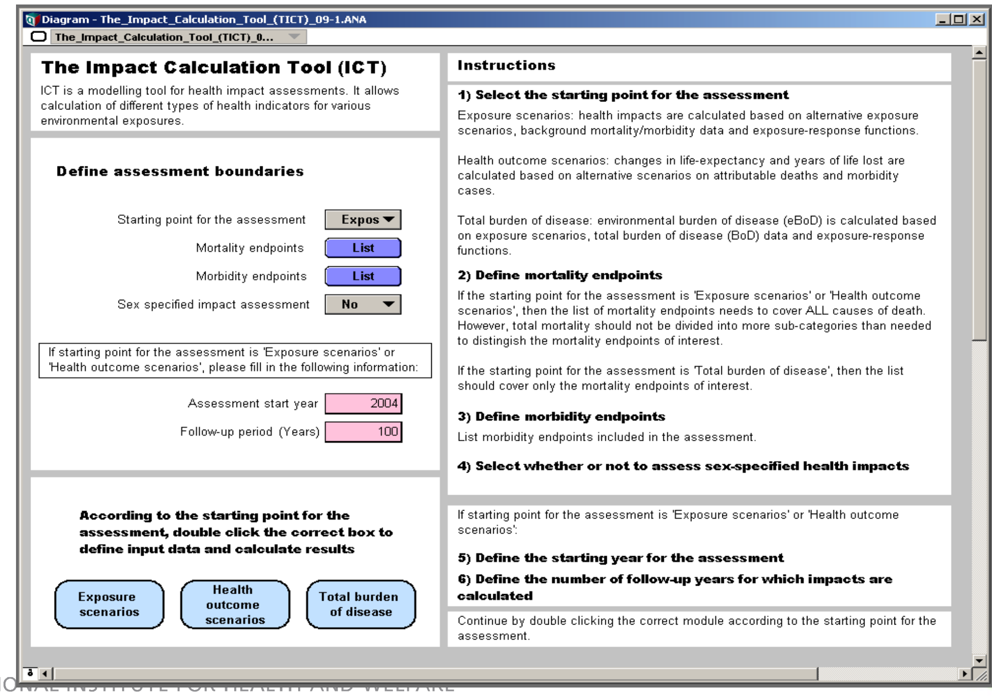
User interface – first level



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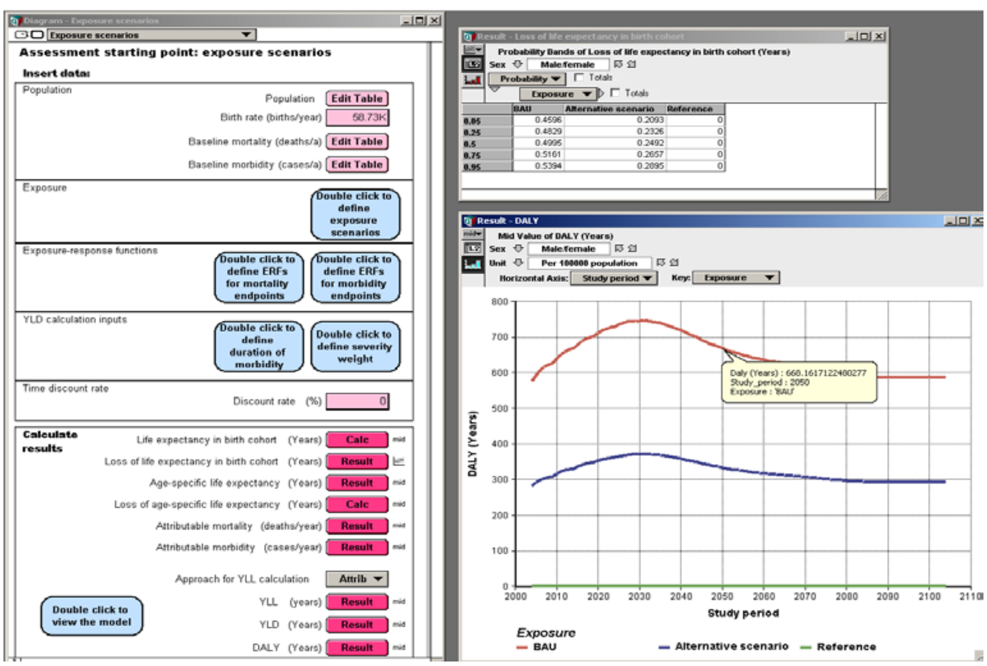
User interface – second level



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Model boundaries

- One exposure / risk factor per assessment
- Time frame
  - 1…100 years
  - Exposure / risk level can be varied through follow-up
- Target population
  - Sex specified?
  - Current population or everyone alive during follow-up?
- Health endpoints of interest
  - Free selection of mortality and morbidity endpoints
- All input data provided by the end user

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Model outputs

- Loss of disability-adjusted life years (DALY)
  - Years lost due to mortality
  - Years lost due to morbidity

  → annually
- Loss of life-expectancy
  - Age-specific for target population
  - Birth cohort
- No. of attributable deaths and morbidity cases

  → Age-specific

  → Annually

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Quantification of health impacts in ICT (1)

- Health impacts can be quantified using different approaches

  → Depending on the type of exposure and input data available

1) Exposure or health outcome scenarios
   → Change in mortality / morbidity risk
   → Population projections with dynamic lifetables
   → Years of life lost due to mortality / morbidity

2) Calculation of attributable BoD from total BoD
   → Fraction caused by the risk factor of interest

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Input data: Exposure / health outcome scenarios

- Exposure scenarios
  - Exposure level (reference, BAU, alternative)
  - Exposure-response functions for health endpoints of interest (RRs, ARs)
- Health outcome scenarios
  - Change in health outcome (% or no. of cases)

  → Exposure / risk can vary through time
- Population data (age-specific)
- Birth rate
- Baseline mortality / morbidity (age-specific)
- Severity weight and duration for morbidity endpoints
- Optional: time discount factor

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Input data: Attributable BoD from total BoD

- Exposure level (BAU, reference)
- Exposure-response functions for health endponts of interest
- Burden of disease data for health endpoints of interest

→ Calculated for the time period represented by the total BoD data

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Model validation /evaluation

- Comparison to other models, e.g. IOMLIFET

Uncertainty and sensitivity

- ICT enables probabilistic assessment with Monte Carlo simulation
  - Probability distributions defined for key inputs
- Provides uncertainty views for outputs
  - Basic statistics
  - Probability bands
  - Probability density function
  - Cumulative probability density function
- Analytica has several built-in functions for sensitivity analyses
  - For both deterministic and probabilistic analyses
  - Not yet incorporated into the user interface

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Demonstration: Health impacts of PM2.5 exposure in Finland

- Exposure level
  - BAU: 9 µg/m3
  - Alternative: 7 µg/m3
  - Reference: 0 µg/m3
- Time frame:
  - Start year 2007
  - Follow-up 20 years
- Target population
  - Everyone alive during follow-up
- Mortality endpoint
  - Total mortality (non-accidental)
- Morbidity endpoints
  - New cases of chronic bronchitis
  - Restricted activity days (RAD)

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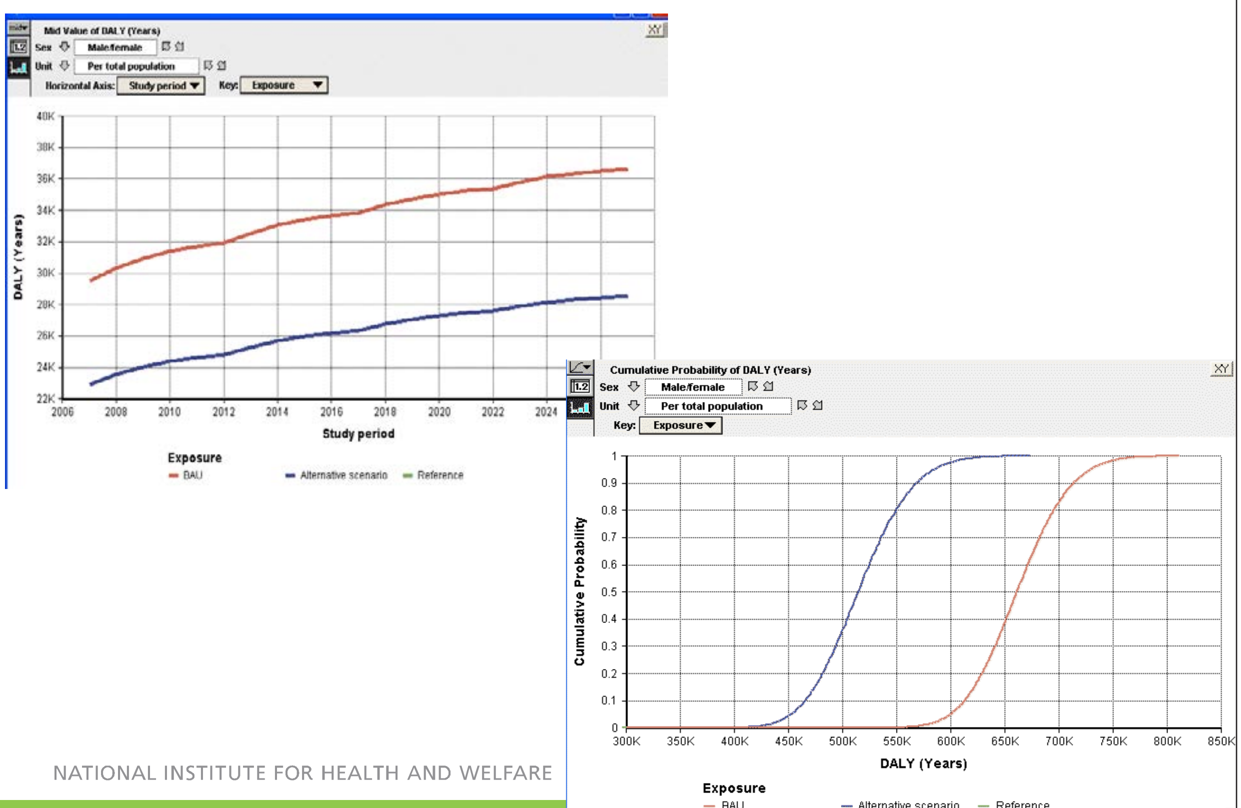
DALY due to PM2.5 exposure



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Predefined HIA case study

- Prevention of domestic falls in older people by increasing the proportion of barrier free residences
  → Assessment can be conducted with ICT
- Simplest way is to use health outcome scenarios –approach
- Define model boundaries
  - Health endpoints of interest, e.g.
    - Femoral fractures
    - Accidental deaths
  - Follow-up time
  - Target population

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Predefined HIA case study: input data

- Health outcome scenarios
  - BAU: fraction of outcomes caused by housing with barriers currently
  - Alternative: change in the risk due to increase in barrier free residences
- Population data (Age classification: 1 year intervals)
- (birth rate)
- Baseline data mortality (Age classification: 5 year intervals)
  - Total mortality
  - Accidental deaths
- Baseline morbidity data (Age classification: 5 year intervals)
  - Femoral fractures
- Severity weight and duration for a femoral fracture

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Predefined HIA case study: outputs

- Femoral fractures attributable to residences with barriers
- Accidental deaths attributable to residences with barriers
  - → Annually, total per follow-up period
  - → Age-specific
- Change in life-expectancy due to prevented deaths
- Loss of disability adjusted life years (DALY)
  - → Fractures, deaths, total
  - → Annually, total for follow-up period

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UCLA Health Forecasting

Jeroen van Meijgaard: Assessing and Forecasting Population Health

Assessing and Forecasting Population Health

Jeroen van Meijgaard – UCLA School of Public Health

March 17, 2010

UCLA

HEALTHFORECASTING
Tools for Improving Population Health

HEALTH FORECASTING AT UCLA

Health Forecasting is

- a sister project of Health Impact Assessment, both based at the UCLA School of Public Health
- a collaborative effort between UCLA, Los Angeles County Department of Public Health, California Department of Public Health
- conceived and principally led by Dr Fielding
- fully supported by foundation grants, supporting a small staff of 1-3 researchers

Funding from

- The California Endowment
- The Robert Johnson Foundation
- UniHealth Foundation (local Los Angeles foundation supporting hospitals)
- Placer County (small county in California)

Target audience

- Local Health Departments
- Foundations
- Legislators and legislative analysts
- Advocacy groups

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HEALTHFORECASTING
Tools for Improving Population Health

DEVELOPING A CALIFORNIA HEALTH FORECAST

Need for health forecasting…

- Policy makers want to know the likely effects of possible laws, regulations, programs and other actions on health of the population over time
- Large disparities in health outcomes—limited knowledge on how policy decisions affect these
- Health providers and health agencies need info on health trends and changes in disease burdens
- No other authoritative source of information on key health trends
- California rapidly changing unique socio-demographic population mix

…and improved modeling capability…

- Advances in data collection, such as the California Health Interview Survey and Los Angeles County Health Survey
- Increased computing capability --allows for cost effective micro-simulation models
- More epidemiological studies to support modeling
- Future population health is more easily predicted than outcomes in many other sectors (economics, agriculture, weather etc.)

…provide the right environment for a California Health Forecast

A framework that helps users to anticipate the future impact of current decisions and actions on health outcomes

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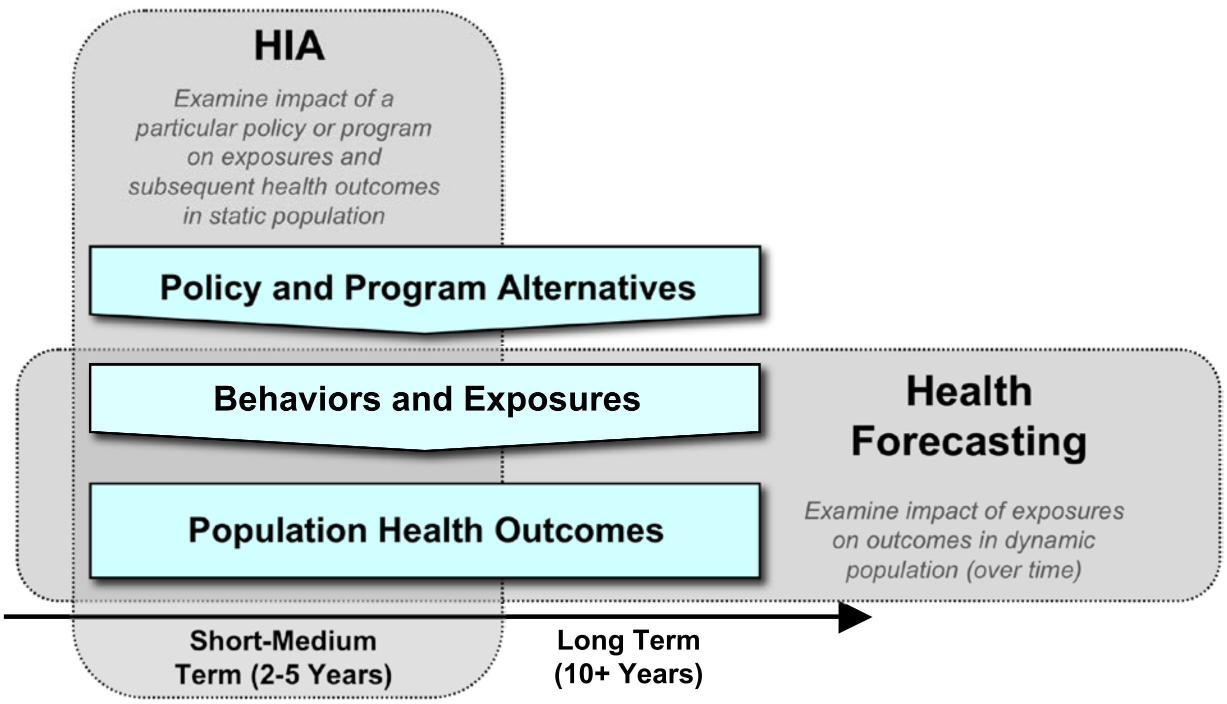
THE RELATION BETWEEN HEALTH IMPACT ASSESSMENT AND HEALTH FORECASTING AT UCLA



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COMBINING SCOPE OF HIA AND HEALTH FORECASTING REMAINS A CHALLENGE

Ad hoc/ Tailored HIA ⟷ **Uniformly Applicable Model**

Small/Local Populations

- Narrowly targeted programs
- Relevant geographic challenges, e.g. Built Environment
- Interactions between individuals and environment
- Need for specifically defined exposures/risks

Large/Regional Populations

- Broadly applicable policies
- Assume uniformity across regions
- Exposures may be averaged

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ENABLING DECISION MAKERS TO MAKE MORE INFORMED DECISIONS USING HEALTH FORECASTING

The model aims to allow **decision makers** in health related fields to answers questions at **various levels of detail** – primarily addressing **chronic disease conditions**

- How will mortality rates in the state of California (or any county) change over time?
  - What is the incidence or prevalence of disease X in different counties in California, and how is this expected to change in the next 10 years?
    - How much of the differences in disease incidence rates and other key health outcomes across ethnic and geographic segments can be attributed to known factors?
      - 10 years from now, what will be the effect of a public health intervention Y on the health outcomes for different ethnic and racial groups in Ventura County and Los Angeles County?

UCLA — HEALTH FORECASTING

DEVELOPING THE MODEL AND DISSEMINATING THE RESULTS

First we determined feasibility and built a prototype model; disseminating the results has required the development of additional tools

Disseminate information (e.g. briefs) and educate and train stakeholders through workshops, presentations and mailings

Web-based interface to provide public health practitioners and advocates intuitive access to results from the Health Forecasting model

Synthesis of evidence-based research into a comprehensive **Health Forecasting Model**

UCLA HEALTHFORECASTING Tools for Improving Population Health

INTUITIVE INTERFACE – ENABLING STAKEHOLDERS TO USE MODEL RESULTS FOR LOCAL POPULATIONS

The full model will be maintained at UCLA by project team – users can request scenarios to be simulated.

A **user friendly interface** that uses static model output to enable users to perform analysis on a local communities or counties. Users may input **community specific demographic information**, and the interface provides tables and graphics based on modeling results.

The **website** is a primary means of wide distribution of tools, results, and analyses

- Baseline forecasts
- Technical documentation
- Simplified version of the model that can be used by local health officers, their staffs and other stakeholders.

UCLA HEALTHFORECASTING Tools for Improving Population Health

APPLICATIONS OF THE FORECASTING MODEL

- **Evaluate research questions about the association between sets of variables that can not be observed directly through surveys, e.g. estimates of life time expenditures associated with levels of physical activity and weight,**
- **Inform debate on important policy issues in public health through issue briefs,**
- **Support community advocacy to strengthen local communities and efforts to improve population health – intuitive access via web-based interface (www.health-forecasting.org), and**
- **Provide analysis on the long term impact of proposed policies and programs.**

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BUILDING THE PROTOTYPE MODEL

Descriptive Population Framework

Population model including socio-economic and demographic information of the population of interest – includes variables such as gender, age, race/ethnicity, education, income, etc

+

Risk Factor/Disease Modules

Smaller models that describe linkages between individual risk factors, environment effect, socio-economic and demographic characteristics and health outcomes

+

Forecasting Module

Future trends of assumptions and underlying data of risk factor/disease modules and the population framework

The model is built around a continuous time microsimulation setting, allowing for inclusion of joint distributions as well as analysis of complex interactions, and distributional information on outcomes

The model focuses on the relation between exposures/risk factors and outcomes; no summary statistics. Outcome are disease incidence, prevalence, mortality, etc.

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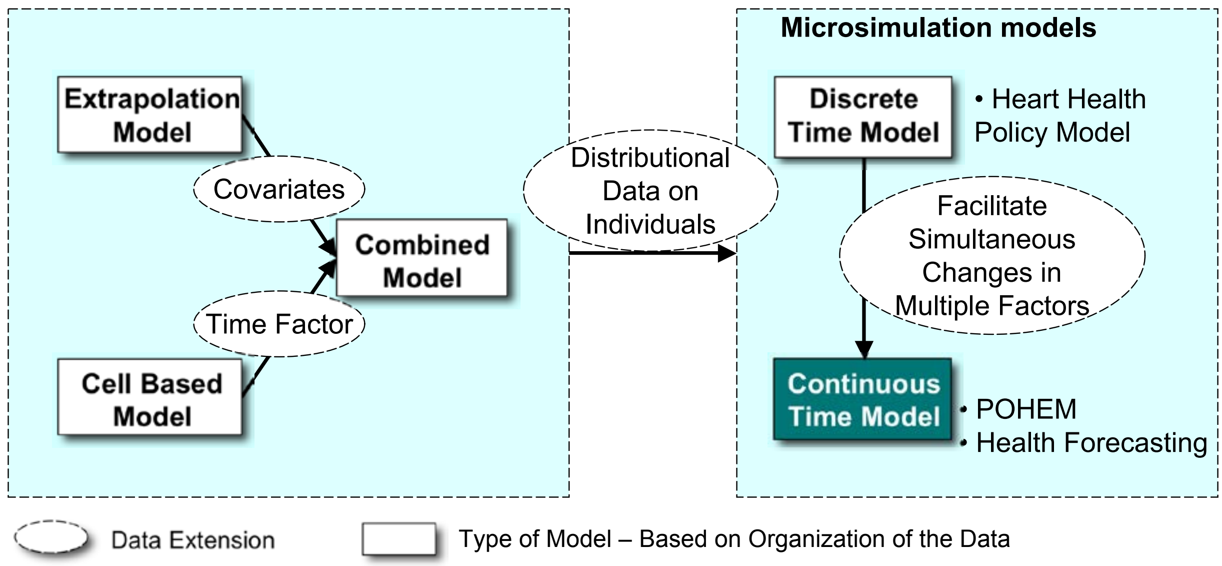
ENABLING SYNTHESIS OF ALL THE DATA AT THE INDIVIDUAL LEVEL WITH MICROSIMULATION

Aggregate Level Models: Information on joint distributions is generally not incorporated into the model, potentially creating bias in the estimates

Individual Level Models: Information on joint distributions can easily be incorporated into the model



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PROTOTYPE MODEL: INITIAL COMPONENTS

The Descriptive Population Framework

What will happen to patterns of mortality (and likely disease burden) over time based on substantial changes in demography due to:

- Changes in age distribution of different ethnic/racial groups based on current populations
- Immigration
- Marriage rates
- Birth rates

Risk Factor – Physical Activity and Obesity

Physical Activity and Obesity are risk factors for many chronic diseases. They are associated with each other and each impact morbidity, mortality and related medical outcomes in different ways

Ameliorable through:

- Individual interventions (medical care system, spas, gyms, home)
- Environmental interventions (worksite, school, community)
- Nutrition interventions

Health Outcomes – Coronary Heart Disease

What is the disease burden of a specific disease on different population groups, and how does this develop over time.

Coronary Heart Disease is the leading cause of death in the United States, while mortality has been reduced significantly during the last 30 years. Still both incidence and mortality can be reduced further through changing people's behavior.

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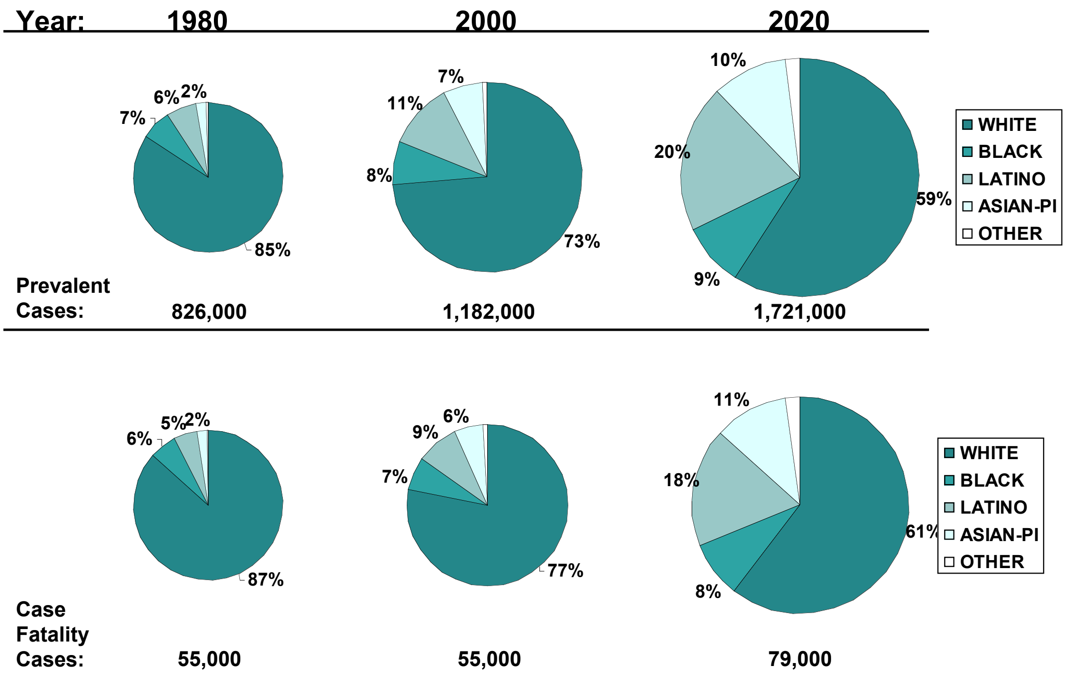
CORONARY HEART DISEASE IS INCREASINGLY IMPACTING AGING MINORITY POPULATIONS



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APPLICATIONS OF MODEL

Primary prevention versus treatment – Physical activity and CHD

- Use the model to simulate the impact of different physical activity patterns and levels in the population and compare those to alternative scenarios that target a reduction in case fatality
- Objective is to show the impact of different approaches on CHD incidence, prevalence and case mortality as well as mortality from other causes
- Using the model show that small improvements in physical activity improves mortality (life expectancy), reduces disease (CHD), and increases years lived without CHD; reduction in case fatality rates improves mortality, but increases prevalence, and does no change years lived without CHD

Address impact of Ozone and PM2.5 on local population health

- Placer County DHS(~300,000 people, east of Sacramento, CA) requested the assessment of the impact of changes in Ozone and PM2.5 on population health to support advocacy
- Simulated air quality data and changes in O3 and PM2.5 under different scenario, and impact on asthma, other health outcomes, but also missed days of school and missed days of work

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VALIDATION AND SENSITIVITY

Validation

- Limited experience validating the forecasting component of the model, however model can be updated as new data becomes available. E.g. estimates for CHD incidence and prevalence were based on data through 2001, and incorporated into model in 2003/2004; however new data released in 2005 showed a marked reduction in CHD incidence as well as CHD case fatality requiring revision to underlying to rates
- The risk factor component of the model have been cross validate with other models where relevant

Sensitivity

- Users of the model have rarely requested sensitivity analyses of the results; generally this is done in the form of simulating different what-if scenarios
- Uncertainty on the parameters can be incorporated by multivariate sampling on the parameters domain

UCLA HEALTH FORECASTING Tools for Improving Population Health

BARRIER FREE HOMES

Case analysis of increase of number of people living in a barrier free home

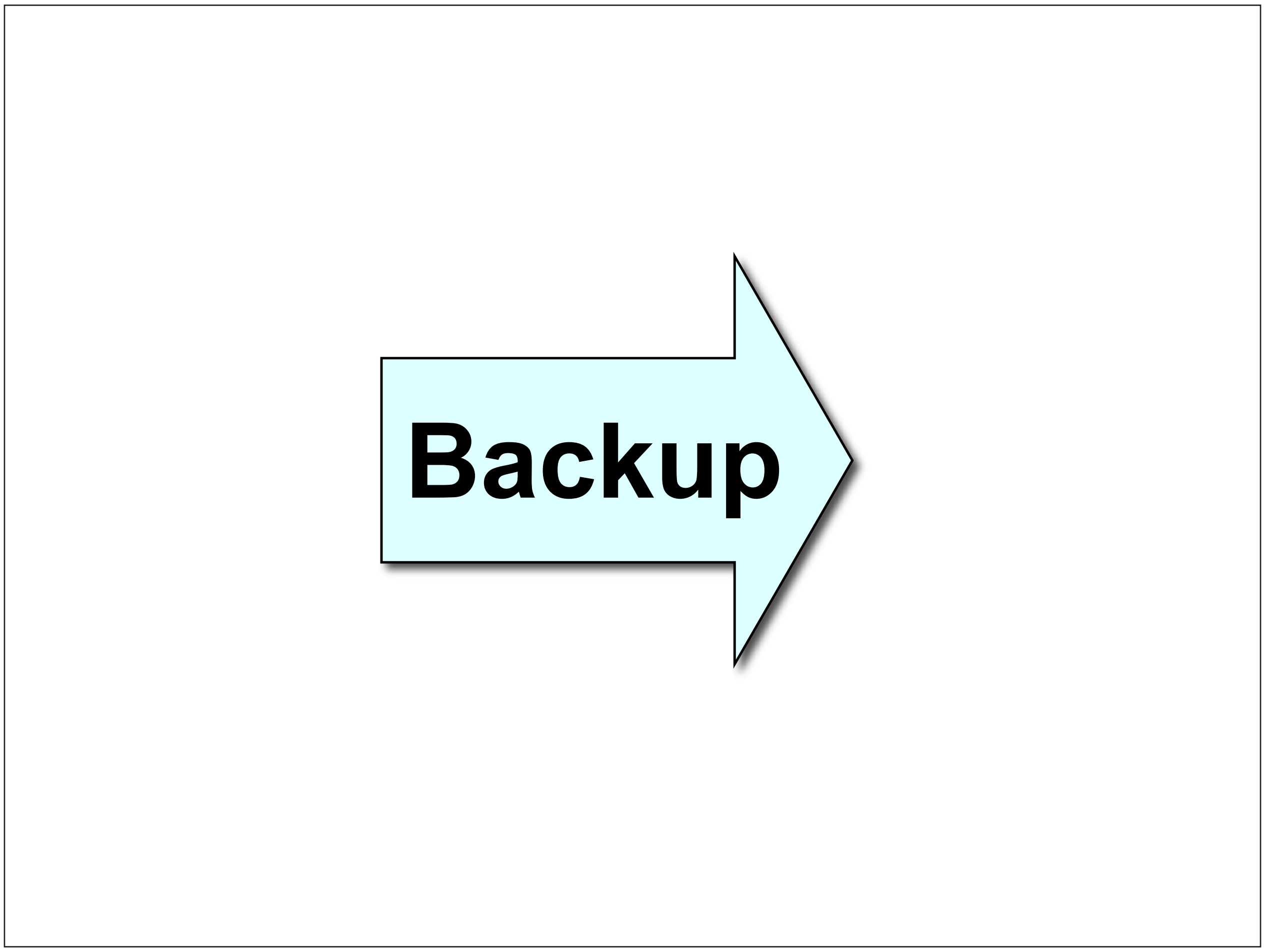
For simple case would need:

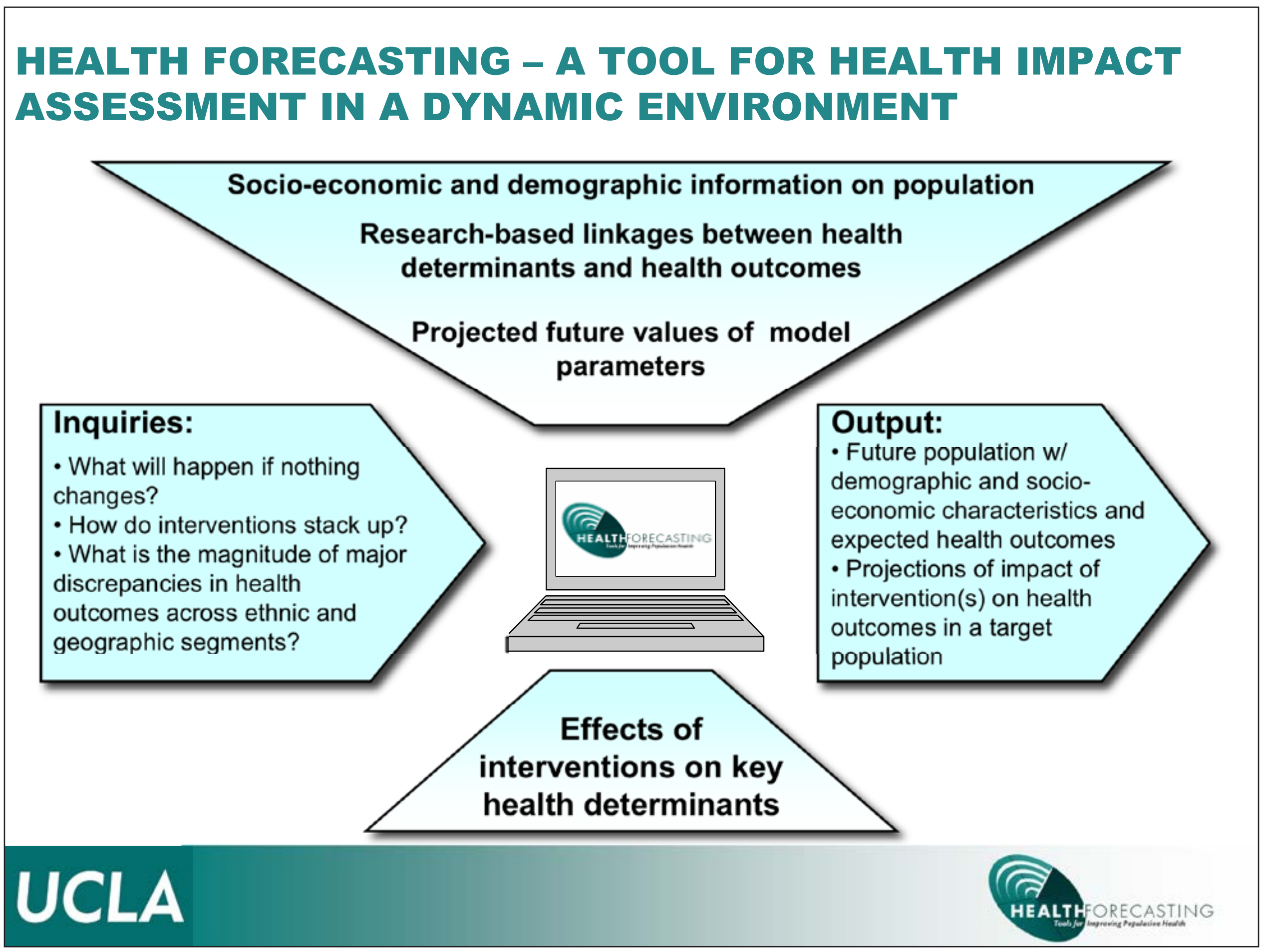
- 'Exposure' -> probability of living in a barrier free home, versus a regular home
- Risk of a fall conditional on type of home (or total falls and relative risk)
- Scenario -> probability of living a barrier free home in the case scenario
- Mortality conditional on fall (optional)

Simulation would generate

- Number of falls in each year for reference as well as the scenario
- Number of deaths for reference as well as the scenario
- Related outcomes

UCLA HEALTH FORECASTING Tools for Improving Population Health


Backup


HEALTH FORECASTING – A TOOL FOR HEALTH IMPACT ASSESSMENT IN A DYNAMIC ENVIRONMENT
Socio-economic and demographic information on population
Research-based linkages between health determinants and health outcomes
Projected future values of model parameters
Inquiries:
• What will happen if nothing changes?
• How do interventions stack up?
• What is the magnitude of major discrepancies in health outcomes across ethnic and geographic segments?
Output:
• Future population w/ demographic and socio-economic characteristics and expected health outcomes
• Projections of impact of intervention(s) on health outcomes in a target population
Effects of interventions on key health determinants
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EXAMPLE – MODELLING THE IMPACT OF OBESITY ON MEDICAL EXPENDITURES

Overweight and Obesity in California

Observations

- BMI levels have increased steadily since the early 1980s
- Increases are seen among all groups but are most pronounced among younger people and Latinos
- Individual BMI levels are highly correlated over time
- BMI and Physical Activity are negatively correlated

Model Implementation

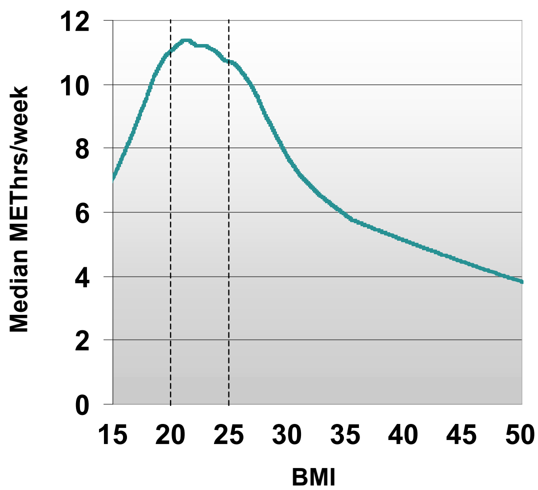
- Individual BMI levels are determined by gender, ethnicity, age, previous BMI and Physical Activity
- BMI impacts mortality though a relative risk function derived from the literature. RR of BMI on mortality decreases as age increases and are gender specific
- BMI trends in the model with three scenarios
  1. Decline to 1984 levels by 2025
  2. Stable at 2005 levels
  3. Continued increase through 2025

UCLA HEALTHFORECASTING

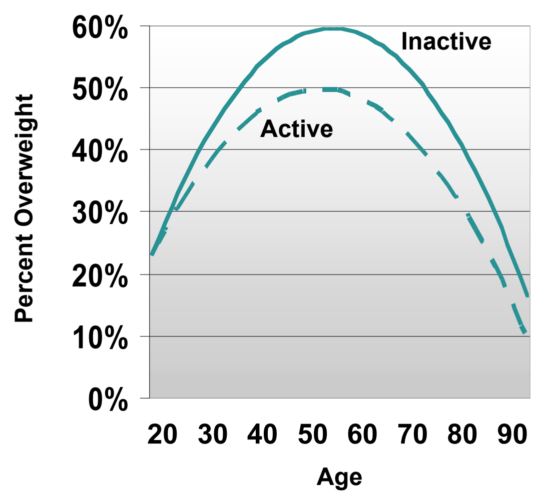
EXAMPLE – PHYSICAL ACTIVITY AND OBESITY ARE NOT INDEPENDENT

Any intervention targeting physical activity or obesity should take into account the association between these two behaviors. The population health forecasting model explicitly enables users to explore the joint distribution and the joint impact on health outcomes

People with healthy BMI have higher levels of Physical Activity:



People with low levels of Physical Activity (<8 METhrs/wk) are more likely to be overweight:



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EXAMPLE – MODELLING THE IMPACT OF OBESITY ON MEDICAL EXPENDITURES (CONTINUED)

Medical Expenditures associated with Obesity and Physical Activity

- Direct Personal Medical Expenditures associated with Obesity and Physical Activity are estimated using NHIS data linked with data from the Medical Expenditure Panel Survey 1998-2005
- Medical expenditures are significantly higher for Obese people (BMI>30) among the under 65 population, and significantly higher for Overweight and Obese people (BMI>25) among the over 65 population.
- Medical expenditures are significantly lower for people over 65 with recommended levels of Physical Activity (>16 METhrs/wk)
- The simulation model allows researchers to analyze expenditures as BMI and PA levels change for each individual from year to year, thus enabling analysis of lifetime medical expenditures

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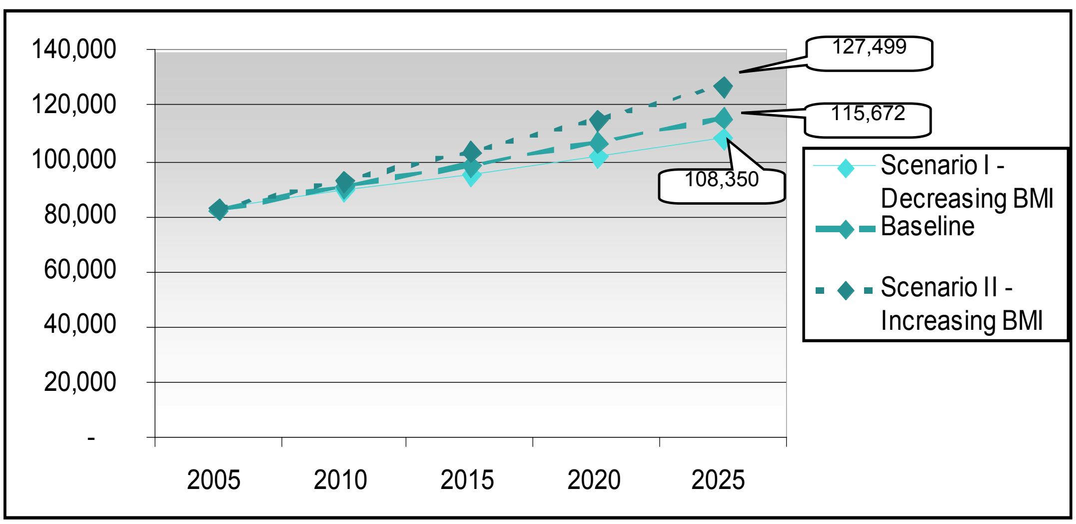
EXAMPLE – FURTHER INCREASES IN BMI COULD COST CALIFORNIANS AN ADDITIONAL $12 BILLION IN DIRECT PERSONAL MEDICAL EXPENDITURES ANNUALLY BY 2025

Total direct personal medical expenditures*, age 18+ (2003 $000,000)

Direct personal medical expenditures for the non-institutionalized population make up about 50-55% of total medical expenditures as defined by the National Health Accounts



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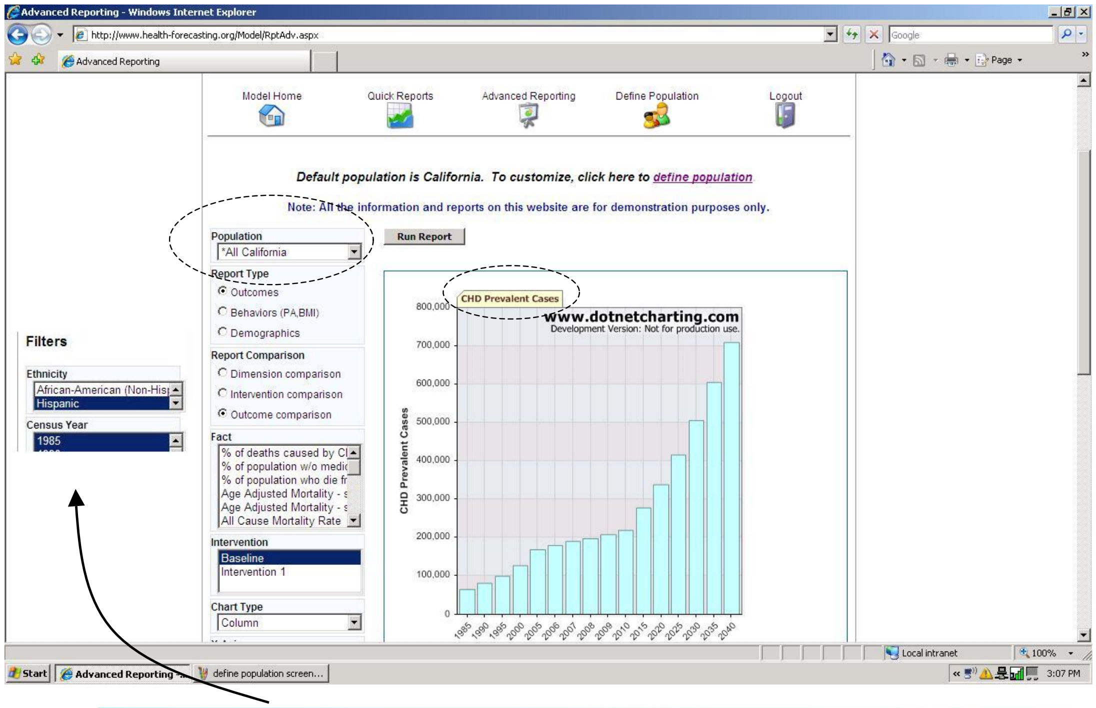
USER FRIENDLY INTERFACE – FORECAST OUTCOMES FOR SPECIFIC POPULATIONS



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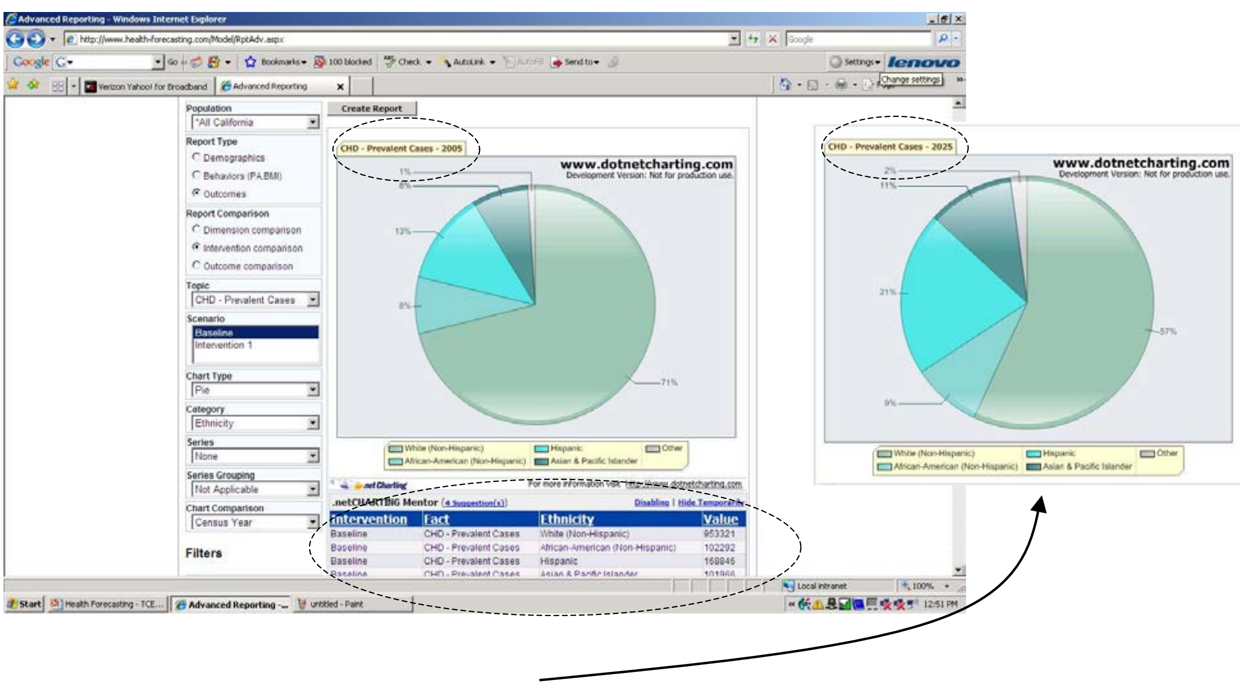
USER FRIENDLY INTERFACE – COMPARE OUTCOMES ACROSS DIMENSIONS



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