



Scientific Expert Workshop.

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

Düsseldorf, Germany, 16 - 17 March 2010.

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In addition, the workshop presentations were consolidated into a Supplementary volume, available on the LIGA.NRW website.

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Summary

Quantification of health impacts (e.g. resulting from policies, plans and programs) based on modeling is a scientific field which rapidly moves forward. In the opinion of many, such (prospective) quantification and the associated health impact metrics are approaching a key role for health protection, health promotion, and possibly health policy at large.

Different approaches, models and tools have been, or are being, developed internationally for this purpose. Envisioning potentially widespread use, well-accepted quantification models and tools are crucial. Therefore, beyond the individual models and projects we need „overarching“ discussion.

Originating from both a health policy context (LIGA.NRW as WHO Collaborating Center for Regional Health Policy) and from a methodological context (LIGA.NRW Group „Innovation in Health“), the workshop was directed towards model developers and interested presumptive users. It pursued the following objectives:

- ◆ to provide an overview of the „state of the art“ of health impact quantification
- ◆ especially to demonstrate different quantification approaches and models
- ◆ to discuss the commonalities and differences of the models, and the opportunities for each each of them, and
- ◆ to identify ways how to take this case forward.

The workshop identified advantages, disadvantages, and open questions concerning quantitative approaches. In summary, HIA can be regarded as a Public Health promise which is hitherto – at least partially – unfulfilled. Each country (or even region) seems to feature a specific situation, incl. opportunities for, and obstacles to, implementation of HIA. The workshop was meant to contribute to further the development of HIA and health impact metrics as key tools for securing health, in North Rhine-Westphalia and way beyond.

Participants agreed that the cross-model discussion was indeed needed. In particular it was welcomed that approaches from the Environmental Health arena were presented and discussed side-by-side with approaches from the general field of Public Health. There was a broad consensus that the discussion along these lines should be continued.

Zusammenfassung

Die modellgestützte Quantifizierung gesundheitlicher Folgewirkungen (z.B. von Strategien, Plänen und Programmen) ist ein wissenschaftliches Arbeitsfeld, welches sich rasch fortentwickelt. Nach verbreiteter Ansicht erlangen solche (prospektiven) Quantifizierungen samt zugehöriger Gesundheitsmetriken zunehmend eine Schlüsselrolle für Gesundheitsschutz, Gesundheitsförderung und möglicherweise für Gesundheitspolitik insgesamt.

Unterschiedliche Ansätze, Modelle und Werkzeuge wurden und werden international für diesen Zweck entwickelt. Mit Blick auf potenziell weit verbreiteten Einsatz kommt breit anerkannten Quantifizierungsmodellen und -werkzeugen eine Schlüsselrolle zu. Daher ist eine über die einzelnen Modelle und Projekte hinausgehende "übergeordnete" Diskussion unentbehrlich.

Dieser Workshop hatte seine Wurzeln sowohl im "Policy"-Bereich (LIGA.NRW als WHO-Kooperationszentrum für regionale Gesundheitspolitik und Öffentliche Gesundheit") als auch im Methodischen (LIGA-Fachgruppe Innovation in der Gesundheit) und richtete sich an Modellentwickler sowie interessierte Nutzergruppen. Er verfolgte folgende Ziele:

- ◆ einen Überblick über den Entwicklungsstand zur Quantifizierung gesundheitlicher Folgewirkungen zu liefern
- ◆ insbesondere auch die unterschiedlichen Quantifizierungsansätze und -modelle aufzuzeigen
- ◆ die Gemeinsamkeiten, Unterschiede und Potenziale der Modelle zu diskutieren und
- ◆ Wege zur Weiterentwicklung aufzuzeigen.

Der Workshop identifizierte Stärken, Schwächen und offene Fragen für Quantifizierungsansätze. Zusammenfassend lassen sich die mit Health Impact Assessment (HIA) verbundenen Entwicklungschancen als bisher nur teilweise eingelöst ansehen. Wie es scheint, ist bezüglich HIA die Situation in jedem Lande (vielleicht sogar in jeder Region) unterschiedlich, samt spezifischer Chancen und Hindernisse für eine Umsetzung. Der Workshop sollte einen Beitrag liefern zur Weiterentwicklung von HIA und entspre-

chenden Metriken als Schlüsselwerkzeuge der Gesundheitssicherung, in Nordrhein-Westfalen und auch weit darüber hinaus.

Unter den TeilnehmerInnen bestand Einigkeit über die Notwendigkeit modellübergreifender Diskussion. Insbesondere wurde auch begrüßt, dass Ansätze des umweltbezogenen Gesundheitsschutzes und allgemeine “Public Health”-Ansätze parallel vorgestellt und diskutiert wurden. Es bestand breiter Konsens darüber, die begonnenen Diskussionen fortzuführen.



1. Workshop overview

Quantification of health impacts, especially of those resulting from policies, plans and programs, is a scientific field which rapidly moves forward. In the opinion of many, such (prospective) quantification and the associated health impact metrics are approaching a key role for health protection, health promotion, and possibly health policy at large, either for better or – possibly – for worse. So there is both, enthusiasm and skepticism about the promises and feasibility of such quantification.

At any rate, over the last few years the field gained markedly in recognition. Several scientific groups in different contexts are currently working on this issue. Different approaches, models and tools have been, or are being, developed internationally for this purpose. Envisioning potentially widespread use, well-accepted quantification models and tools are crucial. Therefore, beyond the individual models and projects we need „over-arching“ discussion.

In 2008, the NRW Institute of Health and Work (LIGA.NRW) was endowed with the status of WHO Collaborating Center (WHO CC) for Regional Health Policy and Public Health. In this function, our leitmotifs include: integration across topics and approaches to regional health policy-making; fostering a prospective orientation in health policy-making; and bridging the theory and practice of policy-related health assessments.

LIGA.NRW, especially in its function as WHO CC, decided to take the issue of quantification forward – e.g. for application in health-related assessments in North Rhine-Westphalia and for application in projects like the cooperative RAPID project¹. We identified a need of broader discussion involving both advocates and skeptics of quantified impact assessment. Therefore, we tried to initiate a sound discussion process on the status quo, involving both model providers and presumptive users, including international players such as the European Commission (EC) and the World Health Organization (WHO).

¹ www.sdu.dk/Om_SDU/Institutter_centre/Ist_sundhedstjenesteforsk/Forskning/Forskningsenheder/Sundhedsfremme/Forskningsprojekter/RAPID.aspx?sc_lang=en

1.1 Workshop objectives

Originating from both a health policy context (LIGA.NRW as WHO CC for Regional Health Policy) and from a methodological context (LIGA.NRW Group “Innovation in Health”), the workshop was directed towards model developers and interested presumptive users. It was meant to provide an opportunity to share expertise and to help propagate good practice.

More specifically, the workshop pursued the following objectives:

- ◆ to provide an overview of the “state of the art” of health impact quantification, and their respective ranges of application, e.g., differentiation of impact on various population subgroups
- ◆ especially to demonstrate different quantification approaches and models, providing participants with the chance to get more acquainted with different models
- ◆ on this basis, to allow the group to discuss the commonalities, differences and opportunities of application for each model, in the context of considered health policies and resulting health outcomes
- ◆ and to discuss how to take this case forward, including issues of model evaluation, general acceptance, and promotion.

The workshop dealt with those models which are „generic“ in the sense of neither being limited to specific exposures (e.g. physical activity) nor to specific outcomes (e.g. coronary heart disease). In contrast, there are „specific“ health impact models, e.g. the Health Economic Assessment Tool (HEAT) for cycling, developed by WHO Europe. For the start, such specific tools were not included.

1.2 Arrangement

This was a self-sustained (externally unfunded), invitational 1.5 day workshop for interested professional audiences, held in March 2010 in the Düsseldorf Gurlittstraße campus of LIGA.NRW.

International speakers were invited, based on existing collaborations and shared professional fields of work. As for the agenda, cf. the appendix.

1.3 Participating institutions and persons

The workshop was attended by academics and professionals from the following institutions:

- ◆ BSG – Behörde für Familie, Soziales, Gesundheit und Verbraucherschutz / Umweltbezogener Gesundheitsschutz. Freie und Hansestadt Hamburg, D
- ◆ Erasmus MC – Erasmus Medical Centre, Rotterdam, NL
- ◆ IMPACT – International Health Impact Assessment Consortium, University of Liverpool, UK
- ◆ IOM – Institute of Occupational Medicine, Edinburgh / London, UK
- ◆ JRC – EC Joint Research Centre, Institute for Health and Consumer Protection (IHCP), Ispra, I
- ◆ LIGA.NRW – Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work) inkl. WHO CC for Regional Health Policy and Public Health. Düssel-dorf – Münster – Bielefeld – Bochum, D
- ◆ NWCIS – North West Cancer Intelligence Service, Liverpool, UK
- ◆ RIVM – Dutch National Institute for Public Health and the Environment (RIVM), Bilthoven, NL
- ◆ SDU – University of Southern Denmark, Unit for Health Promotion Research, Esbjerg, DK
- ◆ SZ – Strategiezentrum Gesundheit NRW, Bochum, D
- ◆ THL – National Institute for Health and Welfare, Kuopio, FI
- ◆ U BI – Fakultät für Gesundheitswissenschaften (School of Public Health), Universität Bielefeld, D
- ◆ UBA – Umweltbundesamt, Berlin, D
- ◆ UCLA – University of California at Los Angeles. Health Forecasting Unit, Los Angeles, USA
- ◆ USTUTT-IER – Universität Stuttgart, Institut für Energiewirtschaft und Rationelle Energieanwendung, D
- ◆ WHO European Centre Environment and Health, Rome, I
- ◆ WHO Headquarters, Division of Public Health and Environment, Geneva, CH
- ◆ WMPHO – West Midlands Public Health Observatory, Birmingham, England, UK.

2. Workshop presentations and discussion statements

Welcome speech by Dr. Eleftheria Lehmann, Director General of LIGA.NRW

Ladies and Gentlemen,

Welcome to Düsseldorf, welcome to the NRW Institute of Health and Work, LIGA.NRW. I am very glad that so many international researchers found time to join this workshop and share expertise and experience about “Quantifying the health impacts of policies – Principles, methods, and models”. A short introduction to our institute may help you to understand why we have put this topic on our agenda.

LIGA.NRW was founded in 2008 as a merger of the State Institute for Occupational Safety and Health (Landesanstalt für Arbeitsschutz) and the Institute of Public Health (Landesinstitut für den Öffentlichen Gesundheitsdienst Nordrhein-Westfalen, Iögd) with local offices in Düsseldorf, Bielefeld and Münster.

The institute is part of the new “Gesundheitscampus = Health Campus” North Rhine-Westphalia, which is currently developed at the city of Bochum in the Ruhr area. The Campus aims to concentrate expertise in health, endorse innovations in the health economy and to offer a venue for meetings and networking of research, health economy and education.

We are engaged in advising and supportive tasks for the state government, the authorities and bodies as well as the municipalities of the state of North Rhine-Westphalia on issues of health, health policy, and health and safety at work.

The institute’s main areas of activity range from health policy to prevention and health promotion, innovation in health, health management and the healthy design of working conditions as well as drug safety & surveillance and protection against infectious diseases and hygiene.

The mission of the institute is to promote health for all by reducing burden of disease, focussing especially on 3 settings: community (physical and social environment), workplace and health care system.

This workshop is organised by the group „Innovation in Health“ of the Department „Prevention and Innovation“. The group and the issues the group members are working on are quite new on the institute’s agenda. North Rhine-Westphalia – like most regions in Europe with a long industrial tradition – faces the challenges of the economic breakdown, an ageing population and increasing incidence of chronic diseases. Against this background LIGA.NRW established the group ‘Innovation in Health’.

Regarding health relevant innovations in NRW, the prediction of future development of disease burden and changing health needs play an important role in the activities of the group. Key question we address are:

- ◆ What are the future trends with regard to the disease burden?
- ◆ What kind of problems will NRW face in the future?
- ◆ What innovative approaches may be effective to improve population health in NRW?

In this context we also focus on policies and interventions that may deliver positive health outcomes. However, we are aware, that many proposed new policies inside and outside the health domain may have unintended – and undesired – health consequences. Impact assessments of these policies will guide policy makers to develop better, evidence-based policies by careful consideration of the impact on the health of the population. Therefore, the policy-related quantification of health impacts is an essential component in the work of the group ‘Innovation in Health’.

We want to participate in the international research and dialog of measuring impact on health. Therefore, we have enlisted our WHO Collaborating Centre for Regional Health Policy and Public Health to join this workshop and use it as a platform for further exchange with other regions in Europe and worldwide.

The Institute was designated in 2008 as a WHO Collaborating Centre for Regional Health Policy and Public Health. The mission of the Centre is to contribute to the national and international exchange of concepts, data and professional expertise, and also to improve regional and local health policy throughout the policy cycle. The objectives are to promote exchange on regional and local health policy including assessments, evaluations and reviews. Local and regional health policy is planned to be connected to

European and global developments. Main topics are research, policy and development, health promotion and education, health systems research and development.

We believe that the quantification of health impact is essential for fulfilling these tasks. Both for policy advice and the public we have to answer the questions of why, when and how. I am sure there will be two days of intensive exchange, discussions and networking, very informative and fruitful for all of you.

Have a successful workshop and thanks for your attention.

2.1 Session 1 „Principles of quantification of health impacts“

2.1.1 Vision and promise of quantification in health-related Impact Assessments

Rainer Fehr, LIGA.NRW

The larger context for health impact quantification is the interface between the large realms of „policy“ on one side and „science“ on the other. Obviously, the policy arena and the science arena are working differently, with respect to drivers and values; to structure and actors; to processes and work forms; and to quality assurance / quality control.

The two arenas are, however, also heavily interacting. The policy arena stimulates and challenges scientific activities, it creates demands for scientific results, and provides support including funding for the scientific sector. The science arena, on the other side, stimulates and challenges policy-making; it provides supporting evidence for, and also evaluates, policies.

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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**

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Some of the activities located at the interface refer to policy advice (Politikberatung). This includes, e.g., status analyses & reports, policy briefs, expert councils, committee work, policy dialogues as well as other traditional and innovative approaches. One specific type is the use of explicit assessments.


Such assessments are of major importance for the “science – policy” interface. They include the following:

- ◆ assessments of status and trends of population health, of health determinants, and health consequences; this is the focus of health reporting, and increasingly also of health forecasting
- ◆ assessment of health (care) needs and health (care) assets, sometimes explicitly dubbed Health Needs Assessment (HNA), or Health Assets Assessment
- ◆ “what-if” assessments or prospective impact assessments; this includes a range of different types (more or less formalized) of Impact Assessment (IA)
- ◆ assessment of the performance of health (care) systems: Health System Performance Assessment (HSPA)
- ◆ ex-post assessment (evaluation) of any interventive or preventive actions.

Triggered by the potential which is affiliated especially with Impact Assessments, WHO CC at LIGA.NRW started an initiative “Family of health-related Impact Assessments”, focussing on Health Impact Assessment (HIA), Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), Social IA, Sustainability IA, Health Technology Assessment (HTA), and EC-type (or: integrated) IA. Objectives of this initiative include the following: to learn from each other, and harness synergies of different kinds of IAs; to mitigate conflicts of multiple IAs being conducted on same policy, plan, program, project, technology; to discuss pro’s and con’s of integrated IAs.

We realize that health opportunities in policy-making across non-health sectors (WHO strategy “Health in all policies”) are chronically under-used. Based on own experience with project- as well as policy-related IAs, we see several options to strengthen this approach. One mostly qualitative

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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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approach refers to systematic promotion of Departmental health plans (Fachpläne Gesundheit). Another approach refers to increasing the weight of analyses by quantification of health impacts.

Such quantification in HIA has been a core issue from the early days of our HIA work, e.g. extension of waste disposal site. During 1995-2001, we conducted the project „Quantitative risk assessment“ (QRA) with cross-relations to HIA. Our 1997 book on Health Impact Assessment² contains a chapter „Quantitative risk assessment – the pro’s and con’s“. In 1997, we started the German working group „Probabilistic exposure & risk assessment“ (Arbeitskreis Probabilistische Quantitative Risikoanalyse, PQRA) which has evolved into an ongoing forum for public / environmental / occupational health as well as consumer protection professionals, and is still operational. In 2001-2003, we participated in the EC co-funded Project „European Policy HIA“ (EPHIA), coordinated by IMPACT Liverpool, and in 2002-2007 we coordinated the Project „Reference values and distributions for exposure factors for the German population“ (Xprob) which was co-

² Kobusch, AB, Fehr, R, Serwe, HJ (1997): Gesundheitsverträglichkeitsprüfung: Grundlagen – Konzepte – Praxiserfahrungen. Nomos Verlag, Baden-Baden

funded by the German Federal Environment Agency (Umweltbundesamt, UBA).

As for health impact quantification, we see a whole range of advantages, including the following: it may help to integrate preventive and curative efforts, by providing a common metric for “preventive” & “treatment” results; and it can facilitate comparisons of potential impacts across alternatives and scenarios concerning policies, plans, programs, projects or technologies („PPPPT“).

Among the disadvantages of quantitative approaches are the following: they incorporate numerous value- and model-based assumptions that are not always made explicit; based on the “garbage in – garbage out” principle (e.g. non-causal associations), they may give an unwarranted patina of robust science; and they may de-emphasize, or even omit, stakeholder participation.

Open questions include the following: Given similar input to different models, will these models then tend to produce similar output? Given the large amounts of data needed for quantification: will it be worth all the efforts? Once models are available more easily, will the practice of Public Health and health policy-making be improved?

In summary, HIA can be regarded as a Public Health promise which is hitherto – at least partially, and in some countries widely – unfulfilled. It should be acknowledged that with respect to quantification, different traditions of HIA exist. Some HIA groups focus strongly on stakeholder participation and qualitative methods, possibly with no particular role for quantification. For other groups, quantification constitutes an essential HIA element. Currently, as it seems, these two traditions distinctly tend towards dialogue and possibly 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 and health impact metrics as key tools for securing health, in North Rhine-Westphalia and way beyond.

2.1.2 Quantification in health-related Impact Assessments: why, when, and how? Discussion with invited experts:

Gabriel Gulis, John Kemm, Marco Martuzzi, Gerlienke Schuur

Gabriel Gulis (SDU)

There are clear advantages of quantification, e.g. in relation to health profiling; for health target setting, etc. – For project HIA: quantification is definitely desirable. For policy HIA, there tend to be huge numbers of potential chains to be considered. In many cases, these chains are probably too many to be considered quantitatively.

John Kemm (WMPHO)

The advantage of models is that they require to specify, in detail, the assumptions made. Qualitative and quantitative HIA models currently still seem to dwell on “separate planets”. On the English HIA gateway, most HIAs use (implicit) ordinal scales. Where good examples of quantification exist (transport; air pollution), it often shows that major outcomes (e.g. deaths) are actually quite rare.

Modellers should try to include the key issues of current HIA and Public Health debate into the models. Today, this would, e.g., be: income, access to green space. – An open question is how to include well-being into modeling? – To restrict oneself in the use of metrics and to use a “single metric” such as DALYs exclusively is probably a step in the wrong direction.

Marco Martuzzi (WHO-ECEH Rome)

WHO’s mandate is to provide evidence-based advice to its Member States. In the environmental health domain, and in intersectoral work, the quality of the evidence base is not homogeneous, as it tends to be scant in some areas (like waste management), and more solid in others (e.g. transport). It is thus useful to tailor the methodology to the nature of the question, considering, among many factors, the quality of available evidence.

When questions are specific and when evidence is robust, products like quantitative assessments can be more easily carried out. For broad questions, with limited underlying evidence, the response may be more like a process, rather than a product, for example the implementation of a reflective policy dialogue among stakeholders. These exercises are

difficult to evaluate, as their effectiveness is ultimately measured by their policy impact.

HIA is often used as a tool or an approach to guide this kind of assessments, both quantitative and qualitative. In many applications HIA is not so close to Environmental Impact Assessment (EIA) (on which it is supposedly based), but much closer to health promotion. This may reflect the need to deal with qualitative assessments, as well as quantitative, as necessary when considering questions at the policy level.

As the daily experience in policy advice shows, and as underlined by the Parma Declaration, policy drivers are manifold and complex; some are linked to measurable health impacts, other less so – for example equity. Quantitative assessments may fail to embrace such complexity. There is a danger of unwarranted impression of accuracy of quantification, in particular when ignoring (a long list of) co-benefits.

Gerlienke Schuur (RIVM)

The contribution was based on HIA of policy measures for chemicals in non-food consumer products. Concerning “When to do health impact quantification?” the answer refers to cost & effectiveness, to the comparison of policy measures; and to comparisons of substances to be banned with alternative(s).

Concerning “How to do health impact quantification”, this often happens in a “learning by doing” mode. Different health measures are being used, implying a range of extrapolations, especially from animal to actual human situation, and from toxicological effect to disease. Exposure assessment should be realistic and population based which is different from a preventive RA (Risk Assessment) when it usually is worst-case and person-based. Beware of “quantification bias”, i.e. focusing on parameters only where data are available.

In a structured comparison of Quantitative Risk Assessment (QRA) and HIA, it was pointed out that QRA provides “worst case” estimates while HIA is geared towards best estimates; reflecting the different basic orientations (protective vs. predictive).

The question of “Why to do quantification?” is easily answered: On request of policy! For example, the Dutch Ministry of Health, Welfare and Sports

requests it; and needs arise also within the context of the REACH (Registration, Evaluation und Authorisation of Chemicals) procedures.

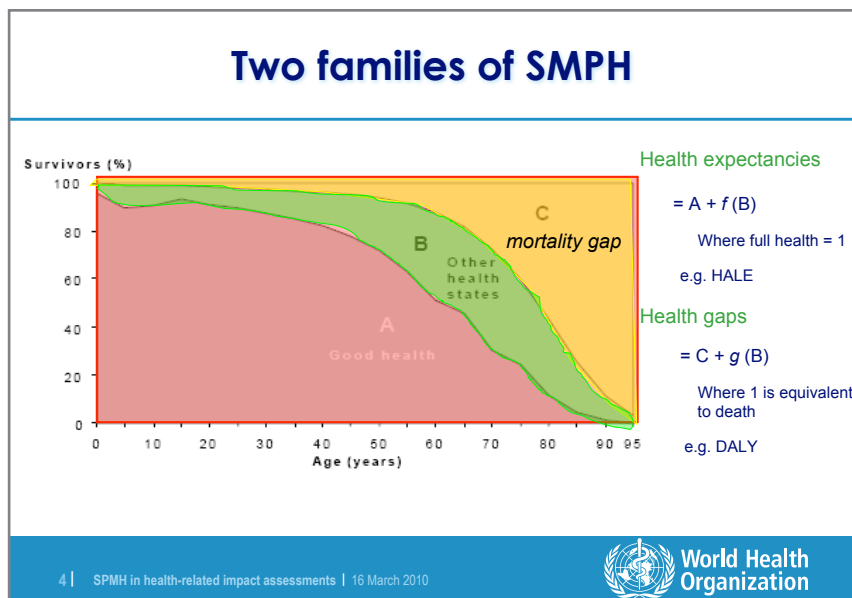
2.1.3 Summary of Measures of Population Health (SMPH) in health-related Impact Assessments

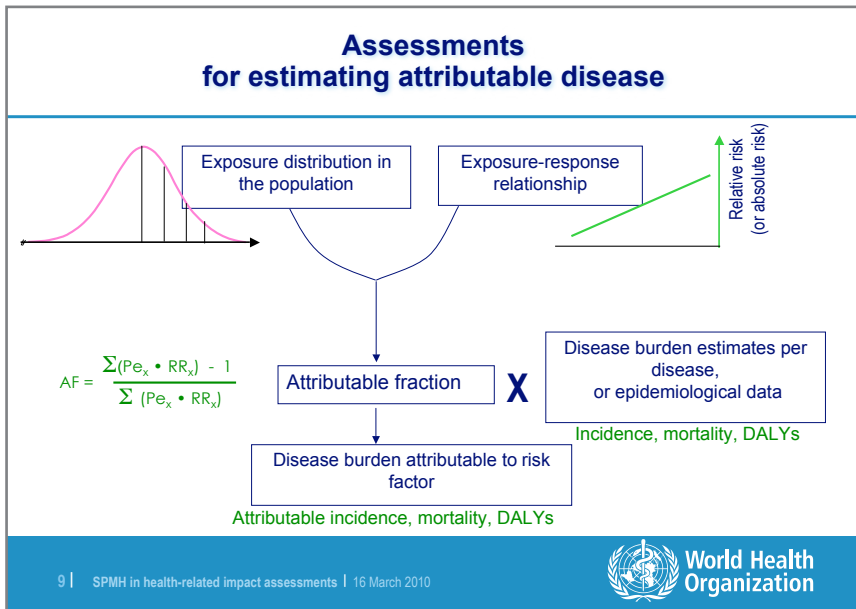
Annette Prüss-Üstün, WHO Geneva

Two families of SMPH can be distinguished: health expectancies and health gaps. The former includes Quality Adjusted Life Years (QALYs), Healthy Life Years (HEALYs), Disability-free life expectancy (DFLE), and Active Life Expectancy (ALE), the latter especially Disability-adjusted Life Years (DALYs).

WHO acknowledges the need of a summary measure of population health that combines mortality and disability, and which allows to address, e.g., 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?

The disability-adjusted life year (DALY) is such a measure of overall disease burden. Originally developed by the World Bank and the World Health





Organization, it is becoming increasingly common in the field of public health and health impact assessment (HIA). Disability-Adjusted Life Years (DALYs) is calculated as the sum of two components. The first component is „years of life lost because of premature death“ (YLLs), the second component is „years of life lived with disability“ (YLDs). One DALY means one lost year of healthy life. Assuming a life expectancy of 80 years, a death at age 50 years means 30 DALYs.

To calculate the component „years of life lived with disability“, we need condition-specific disability weights (DW). The amount of „years of life lived with disability“ then results from multiplying the number of incident cases in the population by both the disability weight and the duration of disability in years. If for mild mental retardation, the disability weight is 0.36, then three cases of mild mental retardation due to lead at birth amount to „3 cases/year x 0.36 x 80 years“, i.e. 84 YLD.

How to make a quantified health-related impact assessment? Guides for EBD assessment at national level are available. Comprehensive data are needed, including exposure data for selected risk factors in a selected setting (PM₁₀, solid fuel use, % access to safe drinking water, etc), and health

data (deaths, incidence or DALYs) for given diseases in a selected settings. The calculations are easy to perform.

Why use SPMH for assessing health impacts? The speaker refers to two pertinent publications. The first one is „Quantitative HIA: current practice and future directions“ by J. L. Veerman et al. (2005). The assessments reviewed there included numerous indicators for health outcomes, e.g. deaths; hospitalizations for asthma, and accident injuries. The usage of SMPHs was recommended in addition to conventional health outcome measures. The second publication is „Comparative assessment of transport risks – how it can contribute to health impact assessment of transport policies“ by T. Kjellström et al. (2003). Here, the message is that 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.

Advantages of using SMPH in HIA include the following: Comparability across health outcomes, comparability across policy options; common language across health issues (risk factors, diseases); coherent framework: HIA, EBD, guidelines, status report can all be linked. This works if certain pre-conditions are fulfilled: (i) Burden of disease estimates are known for study population; quantitative evidence for relevant exposure-risks is known; supported by meaningful communication of results.

Examples of assessments using a comparative measure include the following: quantitative HIA of transport policies, i.e. two simulations related to speed limit reduction and traffic re-allocation in the Netherlands; Public health benefits of strategies to reduce greenhouse-gas emissions concerning urban land transport; and a large-scale assessment of energy policies in Africa.

There are spreadsheets available to assist estimation of health impacts from change in exposure to second-hand smoke; exposure to outdoor air pollution (PM_{10} , $PM_{2.5}$); solid fuel use for cooking; blood lead levels; mercury concentration in hair; etc. – There is a whole series of guides on EBD for national assessments. – WHO currently applies age-specific weighting and discounting, but is moving towards presenting both: with, and without, age weighting, and discounting over time.

The following conclusions were drawn:

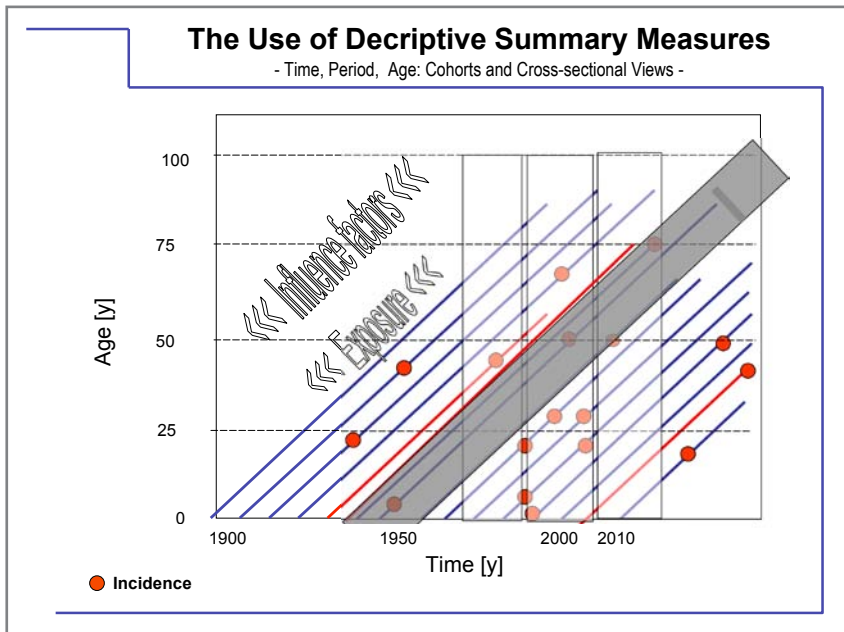
- ◆ SMPH as comparable, standardized measures across multiple health impacts can increase transparency (under certain conditions)
- ◆ Increased application of SMPH for policies is relatively recent, as are calculation tools and common understanding
- ◆ SMPH can only translate impacts in areas with sufficient scientific knowledge
- ◆ SMPH need to be communicated in a user-friendly way
- ◆ SMPH can be a basis for costing health impacts
- ◆ SMPH allow to speak in a common language.

2.1.4 Critical comments on the use of Summary of Measures of Population Health (SMPH) in health-related Impact Assessments

Michael Schümann, BSG

This contribution is directly related to the preceding presentation which gave an overview of summary of measures of Population Health (SMPH) in health-related Impact Assessments. Beside the positive aspects of an application of summary measures for the comparison and evaluation of the impact on the public health like those mentioned before, there exist several limitations and uncertainties that should be taken into account before applying the DALY-methodology of the WHO. Both authors agree with respect to the necessity to find a consistent and comparative description of the burden of diseases and injuries, and an appropriate evaluation of risk factors that cause them. Appropriate health metrics might support health decision-making and planning processes as an important input.

The disability-adjusted life year (DALY), as one of these metrics, extends the concept of morbidity, mortality and 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 summary measure, used and propagated by the WHO, is based on years of life lost from premature death and years of life lived in less than full health. One disability-adjusted life year (DALY) is proposed be thought of as one lost year of “healthy” life, and the burden of disease should 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.

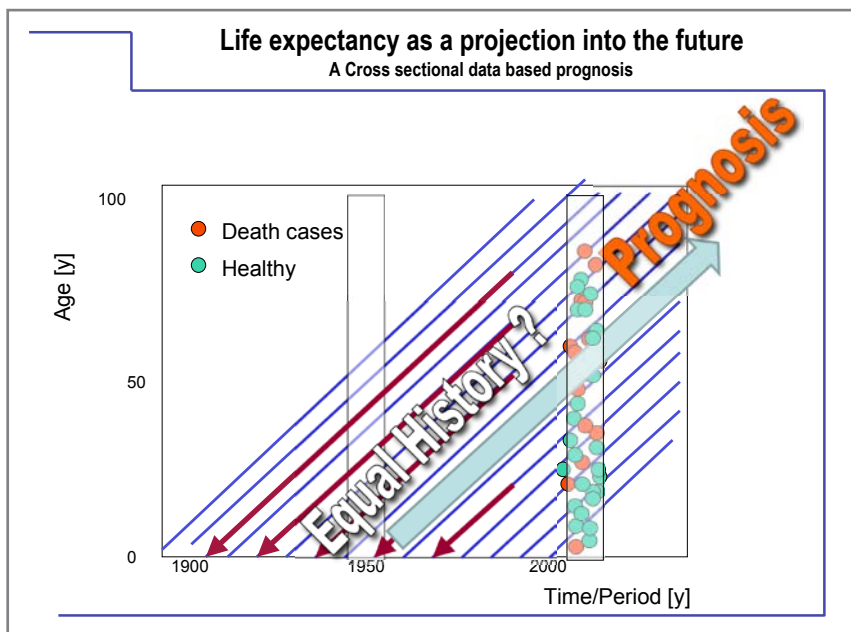
It is an additive composite of deviance from life expectancy (ideal or empirical) and weighed life years with disabilities. Each disability weight factor should reflect the quality of a disease on a scale from 0 (perfect health) to 1 (death). Although the DALY concept seems to be simple and useful for risk communication, at the first glance, it is necessary to see several critical points from different perspectives.

From the perspective of an epidemiologist the calculated DALY values are not a sound science based indicator: There are considerable uncertainties in estimating „life expectancy“. Life expectancy might be calculated for cohorts and periods using different methods, data and different age structures. The results differ remarkably. Predictions of the life expectancy (LE) have a different meaning applied to individuals or groups. For every individual it characterizes high uncertainty due to high variance. The average life expectancy of a population has nearly no predictive value for the near future of a real person. Although life expectancy is communicated as a useful indicator, it is indeed not useful or applicable for individuals. From a demo-

graphic or life insurance company's view it characterizes a mean expected life span for a specific period – but an insurer would never rely on it fixing a premium. They will use cohort (longitudinal) based data for a calculation of the expected life expectancy of the customers.

The period life-table based life expectancy, resulting from cross sectional views, is an artificial value with no empirical or individual meaning. In the public debate “life expectancy” is a misnomer. It is an aggregation of the mortality distribution at a specific time for a specific population using a mathematical convention for aggregation. This index is more sensitive to changes in infant mortality than to mortality changes in higher age groups. The life expectancy shows high variation over different regions in Europe as well as within the European countries, regions and social groups. Gender, economic and social influence factors have a high impact. The application of gender-specific life expectancy constants as used in WHO's DALY approach, thought to be achievable to all countries in the world, might lead to differential errors in application for one country.

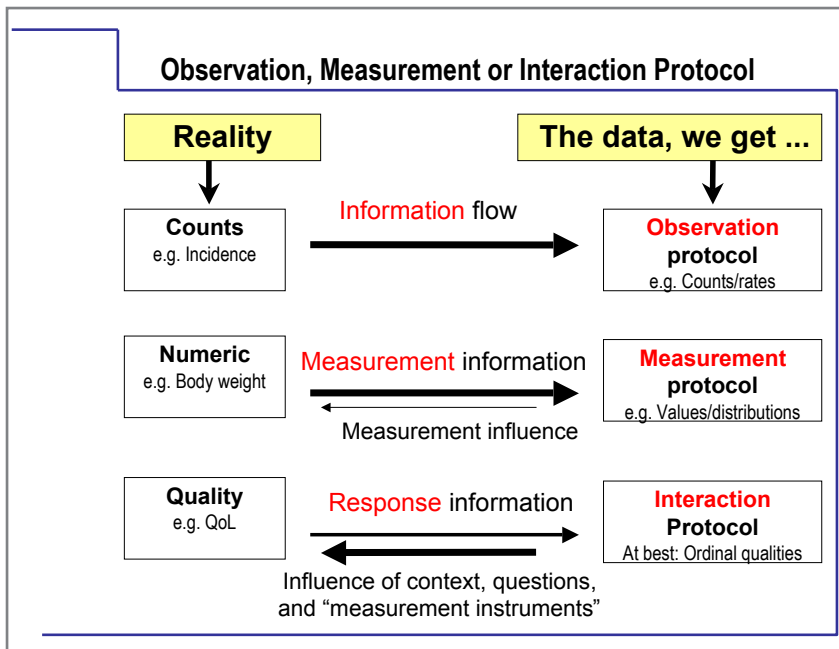
Furthermore, due to the composite characteristic of the DALY metric, including mortality and morbidity, uncertainties with respect to mortality,



to incidence and to morbidity prevalence structures influence the uncertainty of the resulting target values. The time and age distribution of incidence of any critical illness, the severity or the functional impairment must be known as well as the duration of the illness. Since many diseases are age and sex dependent, the data needs sufficient stratification. Incidence, severity and duration of disease are dependent on access to, and usage of, medical treatment and prevention.

Ignoring unequally distributed influence factors might hide relevant deviances in the results. Any additive combination of averages without weighting or stratification will result in distorted results. Any additive combination of averages for several diseases into one DALY indicator variable will at best result in a thumbnail sketch of reality. Even if all the information would be available as average values, the resulting estimates would be rough. The resulting figures would at best describe a lump-sum view at the general population’s burden of disease.

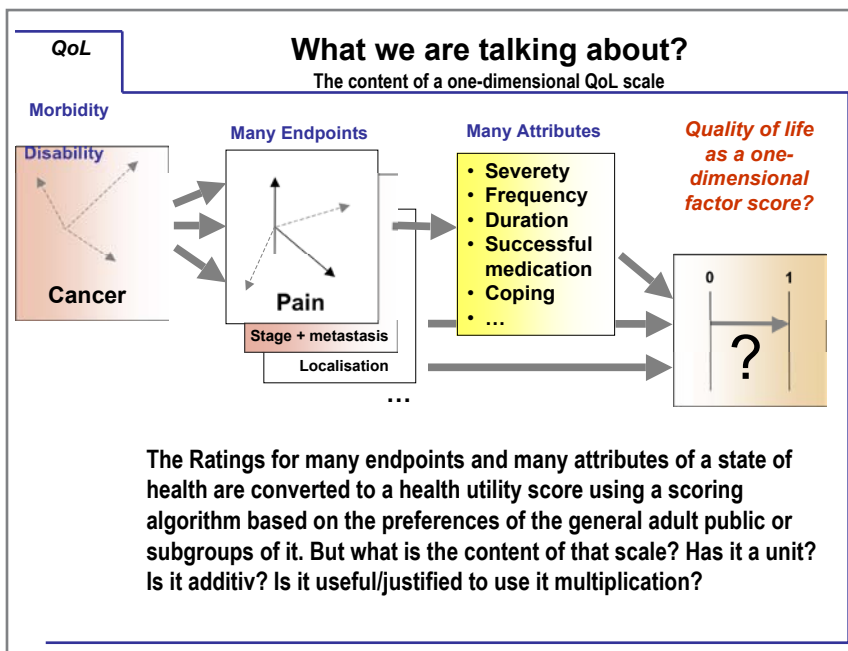
The WHO DALY methodology includes (meanwhile the option of dropping) a differential age weighting, giving higher weights to persons in the pro-



ductive and reproductive age. Future incidence expectancy is discounted. Neither the age related weighting factors nor the discounting factors for future incidence, used in the WHO-DALY-methods, have an epidemiological background. The arguments for using these weights are related to economical reasoning. They are not science based but value based. For these reasons the DALY approach has been criticised for discriminating the young, the elderly, future generations, future health benefits, women and disabled individuals.

The valuation of life time with disease or disability (the application of disability factors) is per se no scientific and thus no epidemiological task. The only epidemiological valid unit is time, not time multiplied by adjustment values. The DALY method contains an economic, a political and/or a common sense valuation of the time with disease/disability. It results in a valuation of the human's life span. Epidemiological science cannot and will not contribute information to this part of the DALY indicator.

From the perspective of a psychometric scientist the disease adjustment factors do not represent a scientific sound and justifiable construct: The



basic assumption behind the construct of the disease adjustment of the time with disease, impaired function or disability is that it is possible to build a scale that reflects a valid and unique evaluation of a psychologically defined state of illness or impairment. The WHO DALY concept demands for a scale from value zero (0=perfect health) to one (1=death). This requires a range-limited one-dimensional scale. But each instrument assessing the quality or importance of a disease will have problems with eliciting patients' or persons' preferences into such a simple scale. The implicit assumption that a one-dimensional preference structure already exists in each person's mind is definitely wrong.

A neglected danger seems to be the application of a "measurement situation" resulting in a value on a 0-1 range scale even though the concepts of the personal disease qualities show a higher degree of complexity. The one-dimensional scale construction reflects the investigators ignorance to acknowledge that it would be necessary to draw a realistic picture that reflects the complexity of the health and disease related qualities of life, as well as of suffering resulting from disease and disability. It might and should be assumed that the reference system for the valuation of health states will vary from person to person and will change over time with experience (and age). The responses to any instrument will show variation over persons and high intra-individual instability over time, resulting in low reliability. Which period of time under disease is described, seems often unclear. The dimensionality of the scale might be health state dependent. And there might be other influence factors such as age, sex, experience, coping, cultural and religious background that are relevant for the valuation of diseases.

The multiplicative weighting scheme claims for one-dimensional scale. But what is the content of the scale: disability-adjustment, quality of life, quality of health, subjective wellbeing, degree of functional or subjective impairment by the disease, economic cost or social evaluation of disease? The approaches and definitions differ. No single scientific approach has the ability to conceptualize and measure this mixture of concepts or any of the singular concepts in one single dimension. The WHO concept of disability weighting started in the 90th with a classification in six classes from "limited ability to perform at least one activity in one of the following areas: recreation, education, procreation or occupation (Class 1)" to "needs assistance with instrumental activities of daily living such as meal preparation,

shopping or housework (Class 5)” and “needs assistance with activities of daily living such as eating, personal hygiene or toilet use (Class 6)”. This function related classification was revised later and claims today to describe a community based, health professional assessment supported multi-method based valuation of diseases.

The instruments and tools to derive a value for disability weighting included (a) Standard Gambles (decision or indifference between two probability-outcome alternatives), (b) Time-Trade-Off (comparison of diseased years against healthy years), (c) Rating-Scale-Approaches (scaling of disease quality on a visual or numerical scale), (d) Multi-Attribute-Utility-Scales (questionnaire evaluations of diseases, see below), (e) Willingness-To-Pay-approaches (evaluation by monetary values), and some more. Most of these instruments are based on the assumption that ordinal preferences structures between diseases exist and that underlying utilities trigger the individual evaluation and the answer/response in an examination/questionnaire situation as well as in real-live in a similar manner.

Most questionnaire instrument come up with multiple dimensions (called factors): e.g. the HRQL (Health Related Quality of Life, Health Utilities Index Mark 2 (HUI2); Health Utility Inc. /CA) comes up with seven subscales called attributes (sensation, mobility, emotion, cognition, self-care, pain, fertility), the EQ-5D EuroQuol questionnaire comes up with five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression). In the end, an aggregation into one scale is achieved by using “standard” weights (“importance” valuations). This weighted sum operation does not generate a scale. In consequence, the numerical operations of addition and multiplication in DALY calculation are disputable.

A general problem with these scaling and weighting approaches arise from the fact that there is a large degree of freedom in thinking about, and behaviour with, disease that includes personal subjective feelings. In consequence the scientific requirements like objectivity, universality, reproducibility/reliability, and logical consistency can no longer be applied. Furthermore, assuming a one-dimensional representation of disease valuations, we should neither expect a general agreement in values nor any democratic legitimization of the underlying value and weighting choices.

Which perspective should be taken, e.g. asking diseased persons, the medical personnel, public health experts, the care givers, medical organisations,

insurance companies, political parties, the affected family members or the general population? The concept of using data even from a representative census basis for disease adjustment might be misleading for individual or patient's decisions. Asking persons without experience with the diseases might reproduce prejudice or use incompetent common sense ideas about the consequences of a specific disease – at best the adjustment factors would be some average social valuations of diseases, impairments and disabilities. Generating health metrics for priority settings by using public opinion might not be the best choice.

Again, it should be mentioned that weighted aggregation of different attributes of disease consequences into one dimension is not a scientific task of psychometrics, it is a valuation. From a methodological psychometric view the multiplication algorithm of the “life time with disease” times “disability weight” resulting in DALY values is expected to be neither on a linear, additive, consistent, reliable, neutral nor valid scale.

In a third perspective, there are ethical issues at stake: Any „values/discounts/tariffs“ to „the life of individuals and groups“ such as age- or disability-adjusted DALYs might result in unfair decisions (e.g. resource allocations, priority settings) against newborns, elderly and any person with disabilities (cf. UN Convention on the Rights of Persons with Disabilities 2007). Applying these weights is politically and legally barely justifiable. Survey or panel data (even if they are representative) should not be applied as a basis for adjusting, weighting or assessing of „life years“ against „quality of life“ for populations, groups or individuals. All persons have equal rights; any prioritisation might violate it. Any valuation of the “quality of life” and “adjustment of life time” might be seen as an instrument of social discrimination. The author demands for caution.

From the perspective as a scientific health policy adviser, it should be noted that cost-utility-comparison and cost-QALY/DALY-evaluation cannot be done for individuals without taking into account medical and ethical councils, patient-physician interaction and individual decisions. Using generic instruments and applying generic values for economical cost-utility-evaluation, using disease adjustment factors, might result in generic decisions for the allocation of resources (investment, medical treatment, access to infrastructure, etc.) which might be misleading.

The speaker underlines the Public Health 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 populations³.

From an epidemiological preventive view it is sufficient and necessary to look at age-specific morbidity and mortality data with adequate differentiation taking into account relevant risk factors. For communication with the public the usage of higher aggregated index variables might be useful (e.g. life years lost). The health metric indicator life expectancy is ambiguous. The usage of the indicator DALY (Disease [or Disability] Adjusted Life Years) as well as QALY (Quality Adjusted Life Years) both combine information about the expected length of life, the expected life years lost, expected incidence of morbidity and disease duration and severity and the expected resulting loss of quality of life. By this they contain undisclosed valuations – the standard of a science based risk communication is lost.

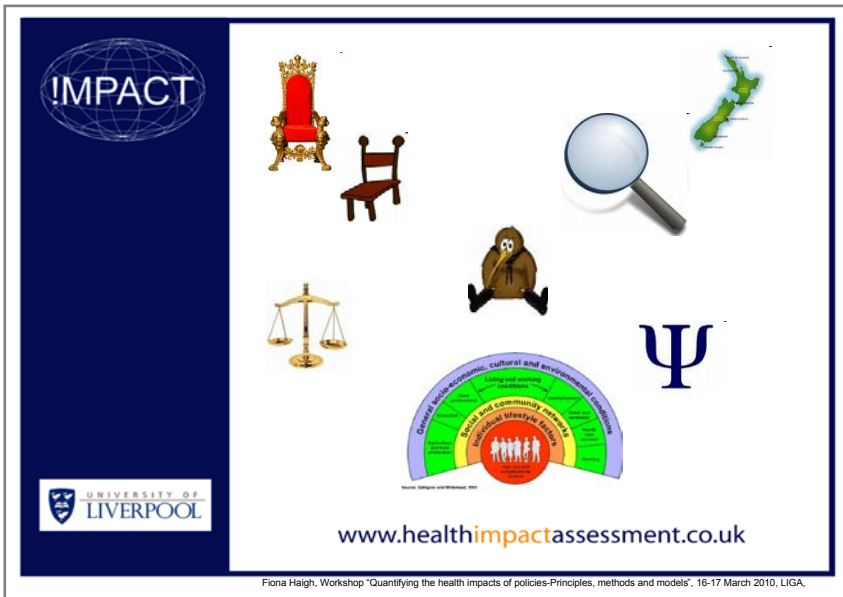
2.1.5 Equity and quantification in health-related Impact Assessments

Fiona Haigh, IMPACT+

In the Public Health debate, (in)equity refers to the situation that differences in health are not only unnecessary and avoidable, but in addition unfair and unjust (Whitehead and Dahlgren 1991). In contrast with ubiquitous variations in health, social inequities in health 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).

Equity in HIA is about 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. And it is about identifying evidence based recommendations to reduce or eliminate potential and existing identified health inequalities.

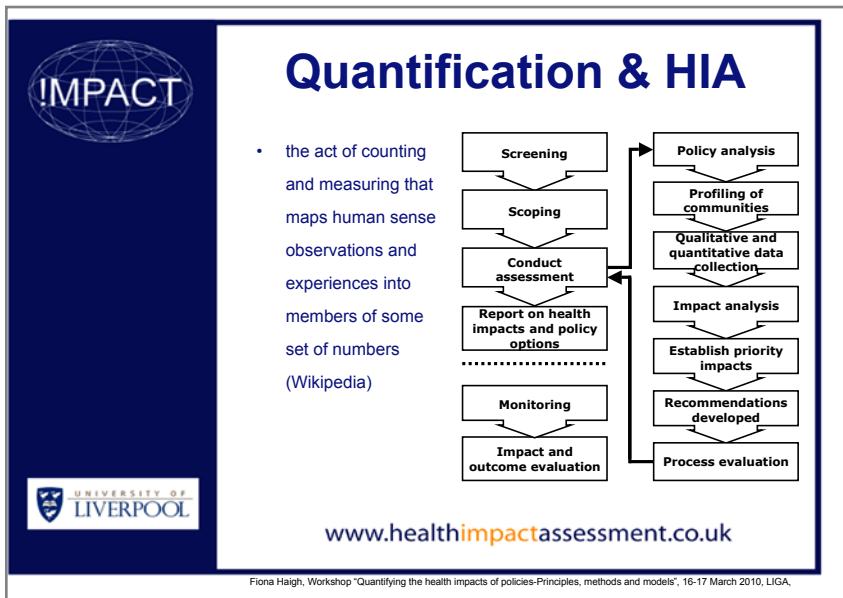
³ Mathers, CD et al.: Counting the dead and what they died from: an assessment of the global status of cause of death data. Bull World Health Organ, 2005, vol.83, n.3, pp.171-177c



As the HEIA project (www.wellesleyinstitute.com/policy-fields/healthcare-reform/roadmap-for-health-equity/heath-equity-impact-assessment) concluded, equity is generally not considered within HIA, although this is improving; the consideration is often limited to differential impacts by population sub-groups; it is unclear to what extent assessments influence recommendations; there are few evaluations; and there is no need for a new form of HIA, i.e. no need for „Health Equity Impact Assessment“.

Quantification (according to Wikipedia) is the act of counting and measuring that maps human sense observations and experiences into members of some set of numbers. Subtypes of quantitative modeling include the following: equity focused counterfactual; absolute & relative estimates; positive & negative influences on health; social gradient. Reasons for reservations include the following: Over-simplification (context, complexity); focus on proximal determinants; what about (structural) causation? Summary measures may prioritise those already winning; tendency to aggregation; prioritisation of things we can count; excluding the hard bits.

A recent paper „Standard Tool for Quantification in Health Impact Assessment – A Review“ (Lhachimi et al. 2010) utilizes six evaluation criteria, but does not mention equity or inequalities.



To proceed towards better coverage of equity issues in HIA, the following recommendations were given: Models should help us address inequalities. Equity as criterion in selecting models. Disaggregate 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.

2.2 Session 2 „Models / projects“

For this part of the workshop, developers of existing and emerging models were invited to present their respective tool, incl. current status and exemplary applications. The presenters were asked beforehand to include, where possible, the prevention of falls in elderly persons as a “standard application”.

2.2.1 PREVENT

Esther de Vries, Erasmus MC

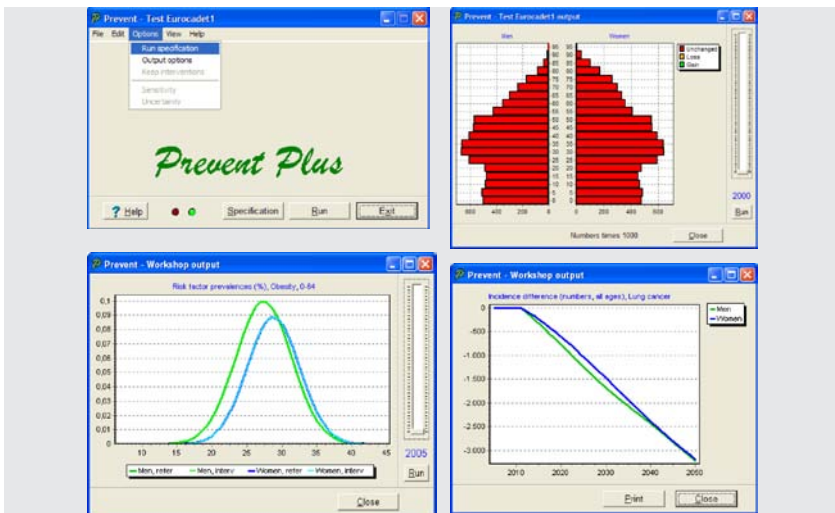
The dynamic population model “PREVENT” was developed by Jan Barendregt, now at the University of Queensland. Work on PREVENT started in

1986. The program handles multiple risk factors and diseases simultaneously. If the independency assumption is not fulfilled, additional data are needed. Lag time between exposure and outcome is allowed to exist and can take several shapes (suddenly appearing, slowly appearing, etc). Intervention effects are calculated over “real time”.

The typical application works with two scenarios: “reference” and “intervention”. Instead of “predictions”, the preferred interpretation is “comparisons of scenarios”. The first use by policy-makers/assistants was in the context of smoking ban in Denmark. Apparently, it caused intense reactions. Currently, some policy-related organisations in regions in Spain started to work with it.

In the academic setting, it has recently been used for the Eurocadet program, an 6th Framework Project funded by the European Commission to study the potential effects of population interventions on future cancer incidence in Europe (www.eurocadet.org). Some of the work of Eurocadet is available through the special issue of the European Journal of Cancer.

The model is an empty shell; the program is semi-publicly available. Since 1997, there is a Windows version, incorporating several extensions. This is often used for teaching now. The current (3.0) version accommodates both categorical and continuous variable. There is no formal distinction between risk factors and diseases; so the program allows for “causal web”



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):

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



Prevent Eurocadet

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modelling, where diseases can be risk factors for other diseases. So-called “autonomous trends” in diseases (not related to risk factors included in the databases) can be included. A variant of PREVENT is used in the Eurocadet project; this looks at outcomes in cancer incidence only and includes “intrinsic” data.

Changes in risk factor prevalence are used to deduce changes in disease risk. Relative risks are used to calculate a potential impact fraction (PIF), and a trend impact fraction (TIF). Input needs include the following: definition tables, population tables; categorical risk factors, continuous risk factors, disease inputs. The outputs are all by year and sex, and often by age (rates and numbers); there are population outputs, disease outputs, etc.

As for limitations, it was discussed that to look at screening is difficult because it changes the “natural history” of a disease; strongly competing risks cannot be handled adequately. – The program currently is, and probably will remain, “work in progress”. – It was made clear that it is not policy-makers themselves using this program.

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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Concerning the “standard” example of barrier-free housing environment, it was pointed out that this should be possible to model in PREVENT, assuming the data are available.

References

www.eurocadet.org, accessed 10 Oct 2010

www.epigear.com/index_files/prevent.html

2.2.2 DYNAMO-HIA

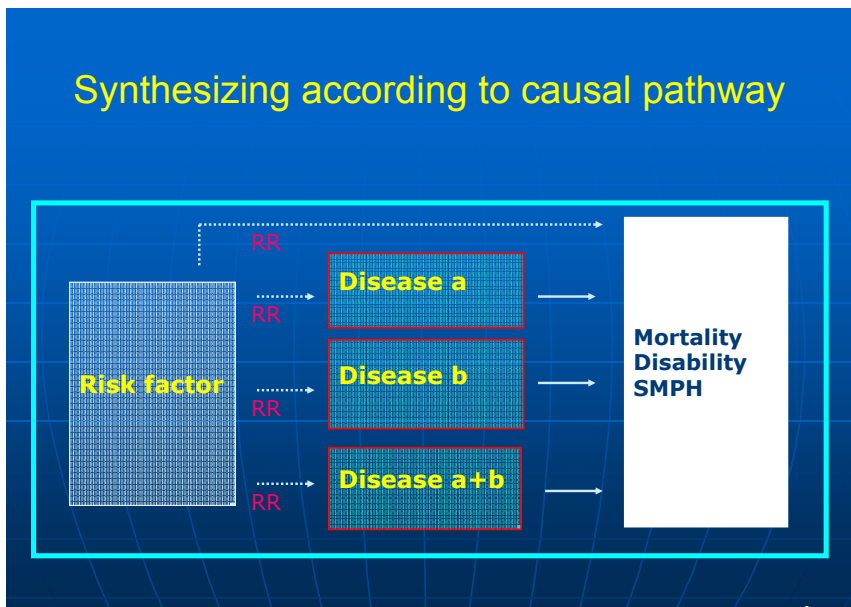
Wilma Nusselder, Erasmus MC; Hendriek Boshuizen, RIVM; Stefan Lhachimi, Erasmus MC

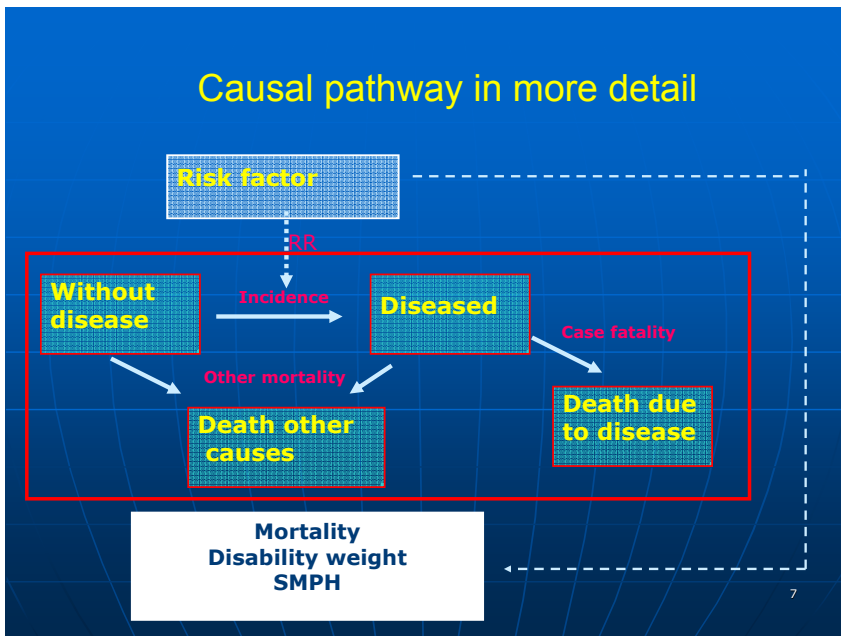
DYNAMO-HIA is a ready-to-use tool to project the effects of changes in risk factor exposure due to policy or intervention on measures of population health. It is a generic, dynamic model, which simulates a real-life population and can be used by users without programming skills.

The program projects how changes in risk factor distribution affect disease-specific or summary measures of population health. The starting point is the situation with current risk factor exposure. This so-called reference scenario is defined by initial exposure and future transitions. The next element is the situation with changed risk factor exposure; this intervention scenario is defined by changes in initial exposure and/or changes in futures transitions. The effect of policy action or intervention is given by comparing these two scenarios. The approach considers all age groups and both genders for future years.

The approach is based on a Markov modeling framework using explicit risk factor states and incidence, prevalence and mortality as disease states. Competing risks are not taken into account. Technically, for the disease process a discrete time frame with a multi-state model is being used, and for the risk factors, dynamic micro simulation. The tool does not calculate how a policy affects risk factor exposure.

The DYNAMO-HIA project is coordinated by Erasmus MC, Rotterdam (NL). The Coordinating Center is composed of Erasmus MC and RIVM. Other associate partners include: Catalan Institute of Oncology (Barcelona),





International Obesity Task Force (London), London School for Hygiene and Tropical Medicine (LSH&TM), Haughton Institute Dublin, and Instituto Tumori, Milan.

DYNAMO HIA is going to be launched at the EUPHA conference in Rotterdam, November 2010; and will be available on the Internet for free. The target group for directly using the tool are experienced Public Health researchers and officials, while the target group for the output are policy-makers incl. EU officials.

The spectrum of application covers both Health impact Assessment and health evaluations of policies and interventions, from a perspective of priority-setting. For a large number of EU countries, the system already contains data incl. population numbers; projected newborns; incidence, prevalence and mortality for 5 cancers, IHD, stroke, COPD, and diabetes, all-cause mortality, all-cause disability, exposure distribution of smoking, BMI, alcohol consumption; and relative risks linking exposure to health outcomes.

Data input requirements are flexible, they include risk factor exposures, several types of disease processes (e.g. “partly acute fatal disease”), and

several transitions between risk factors (e.g. approximation assuming zero transitions). Input data need to be tested using the DISMOD software. (Imbalance between incidence, prevalence and mortality would cause implausible projections.) The tool back-calculates from population-based data. If data are too coarsely classified, they would be smoothed before the model is run.

Running the model produces a range of output data, including the following: future risk factor prevalence (by age or calendar year), future disease prevalence, future mortality/survival, summary measures of population health, and structure of population (incl. diseased vs. non-diseased). One way sensitivity analyses to assess sensitivity of outcomes for input parameters is possible.

No formal model evaluation has been done, but the model structure is seen as well-founded in epidemiological evidence and demographic modeling practice. Furthermore, the source code will be publicly available for cross-validation.

Sample applications of the program include the Swedish deregulation of alcohol. As for the “standard” example of barrier-free housing environment, it was pointed out that DYNAMO works with chronic states, and “falls” is not such chronic state. A solution could be to work with “fractures” instead.

The project is co-funded by the Executive Agency for Health and Consumers (EAHC), within the EU Public Health program 2003-2008 of the EC’s Directorate general for Health and Consumer Affairs (DG Sanco).

References

Website: www.dynamo-hia.eu, accessed 10 Oct 2010

2.2.3 BoD in NRW

Claudia Terschüren, LIGA.NRW; Claudia Hornberg,
University of Bielefeld

Part A: Claudia Terschüren, LIGA.NRW

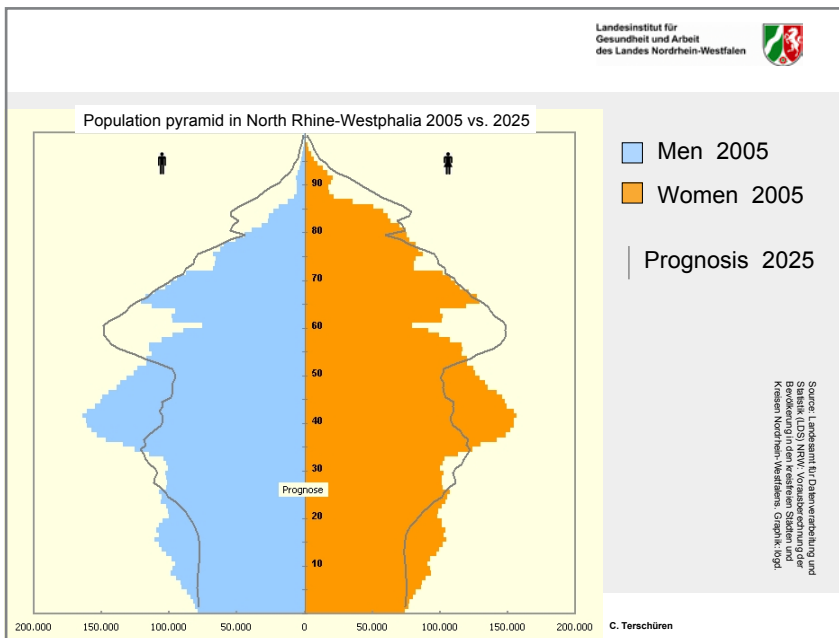
This presentation started from demographic change, and its impacts on health care. The key questions are:

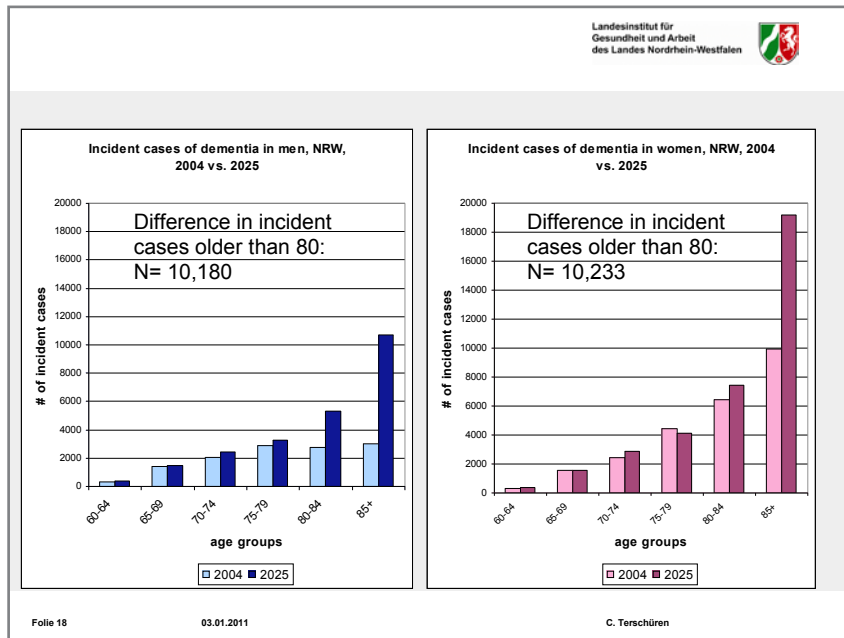
Which effect does the demographic change in North Rhine-Westphalia have on the burden of disease?

For the year 2025, which diseases are contributing which proportion to the overall burden of disease, resulting in what needs in terms of health care?

It was demonstrated that the burden of disease will significantly change. Based on the BoD prognosis of demographic change in NRW, the following conclusions were drawn:

- ◆ Prognoses of the development of burden of disease demonstrate large changes
- ◆ These changes are potentially associated with opportunities for considerable health gains via a range of preventive measures across different sectors
- ◆ There is a need to 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.





In the discussion, it was asked what causes the larger population decrease in the Ruhr area. The answer was that this is mainly outward migration. – It was commented that it should be very useful to look at the whole picture of BoD in population. It was questioned, however, what chances there are for intervention. – The question was brought up if it is appropriate to apply current age-specific rates to future populations. In case the answer was no, it was indicated that some cancer registries provide estimates of future rates. Another comment suggested flexibility also around survival rates.

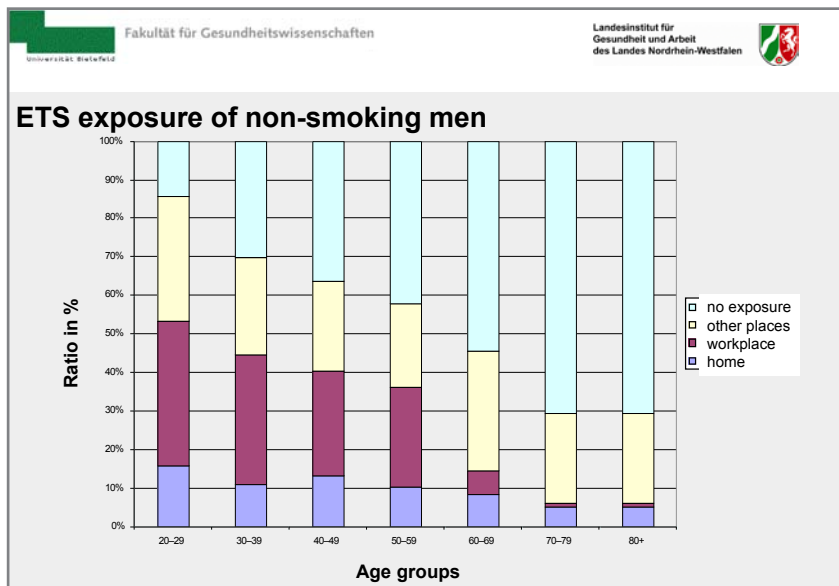
Part B: Claudia Hornberg, University of Bielefeld

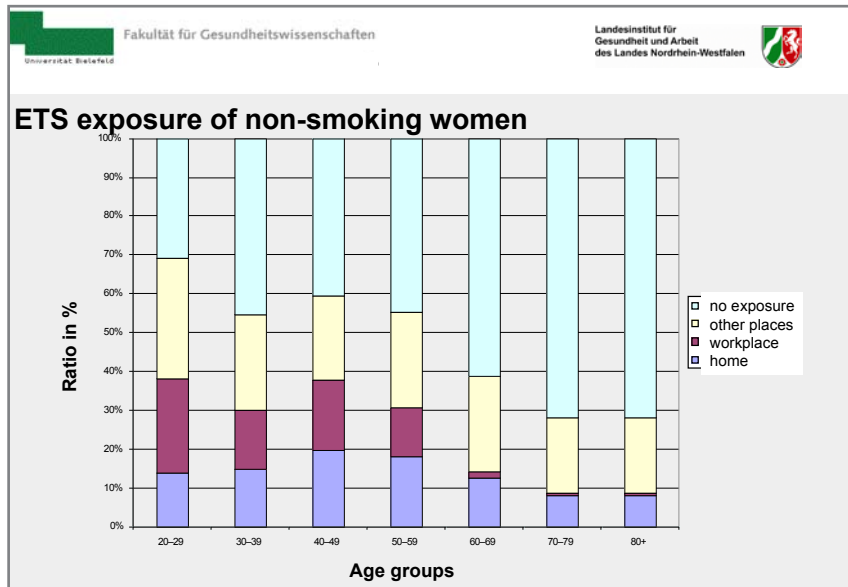
The analysis presented here was based on the following background information: Non-smokers exposed to environmental tobacco smoke (ETS) indoors are at risk of the same acute and chronic illnesses (e.g., respiratory & cardiovascular diseases) as are smokers. Children are particularly sensitive to ETS. Prenatal exposure of a foetus if the mother smokes during pregnancy can have severe adverse health 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.

The study objectives are: to estimate the ETS-caused EBD in NRW under the conditions before 2008; to estimate the health gains expected from this legislation; and to test the method developed by the WHO for assessing the environmental burden of disease (EBD) from ETS.

The smoking prevalence and ETS exposure in non-smokers was estimated from data of the German Health Survey 2003, and from the German Epidemiological Survey on addictions 2003 (self-assessments given via telephone interviews). Limitations include the following: 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. 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.

Estimation of the burden of disease (BoD) attributable to tobacco smoke is based on the following assumptions: For children, active smoking has a





minor impact; therefore, 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.

Health gains due to intervention, assuming the elimination of ETS exposure at work, were estimated to be a reduction of DALYs by 26%. However, the BoD attributable to ETS might be underestimated due to limitations of the study design.

It should be noted that 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.

References

Terschüren, C., Meikel, O.C.L., Samson, R., Claßen, T.K.D., Hornberg, C., Fehr, R. (2009): Health status of "Ruhr-City" in 2025 – predicted disease burden for the metropolitan Ruhr area in North Rhine-Westphalia. *EJPH* vol. 19, no. 5, 534-540, <http://eurpub.oxfordjournals.org/content/19/5/534.full>, accessed 10 Oct 2010

2.2.4 HEIMTSA / INTARESE Toolbox

Hilary Cowie, IOM; Volker Klotz, U Stuttgart;
 Alberto Gotti, JRC

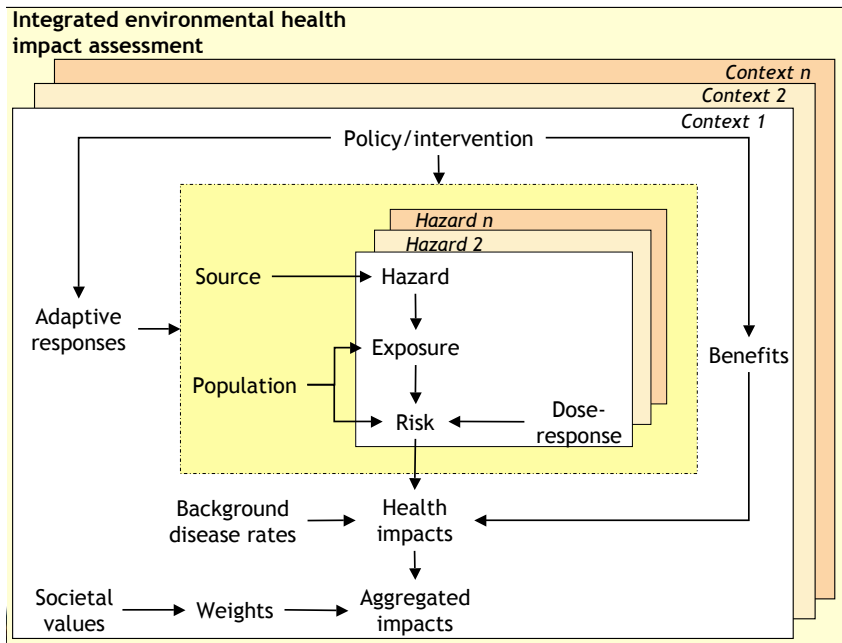
a) Introduction about the projects / integrated environmental HIA (Hilary Cowie, IOM)

This set of presentations refers to two integrated projects, co-funded under the 6th EU Framework program, section „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 projects develop methods and tools in environmental health impact assessment (HIA). They work closely together, and with other projects, both on European level (including EU FP6 and FP7 co-funded projects such as 2-FUN, NoMiracle, HENVINET, APHEKOM etc.), and local and regional HIA projects, including EDPHiS in Scotland.

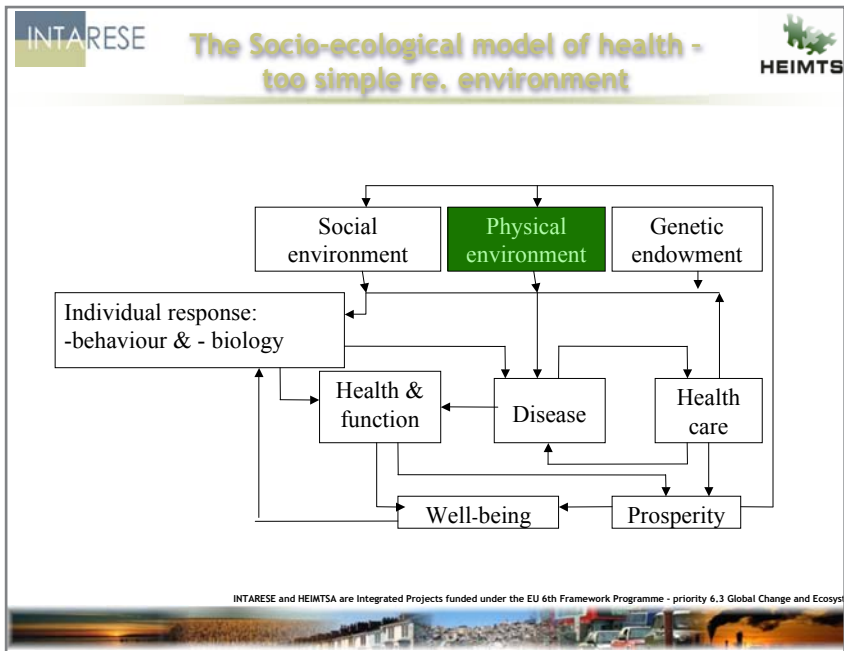


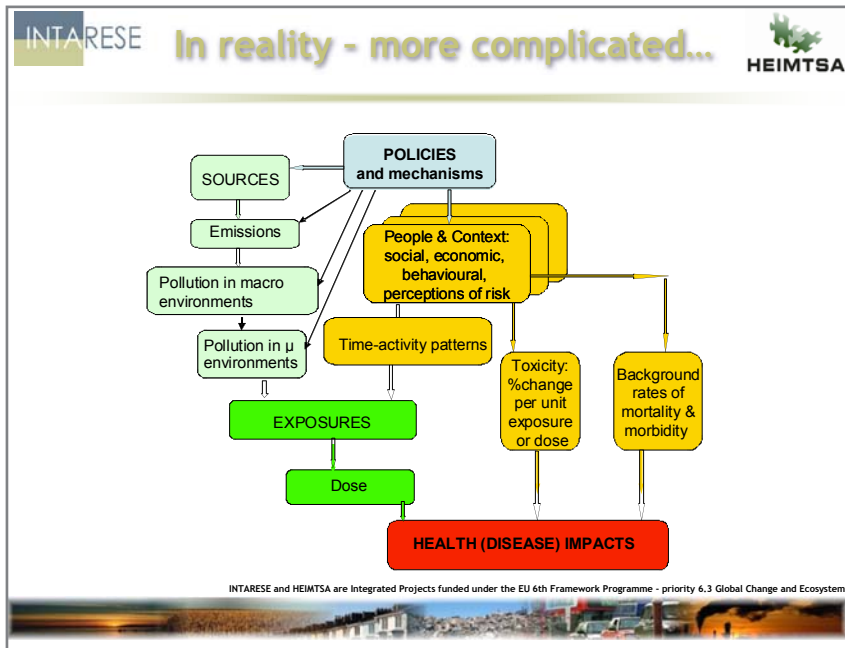
INTARESE and HEIMTSA are trying to take us beyond risk assessment of pollutants, and to environmental health impact assessment (HIA) of policies and measures. The approaches may be designed to reduce pollution or otherwise improve health; and potentially also for other purposes, i.e. not primarily health; but may have health consequences.

The usual approach distinguishes between baseline scenarios and alternative scenarios. The INTARESE and HEIMTSA projects involve a methodology, the development of a toolbox, and the execution of a case study. HEIMTSA (but not INTARESE) includes monetarisation.

The Foresight model was given as an example of a highly complex diagram of interrelationships. It seems preferable to stay with less complex structure models. A good approach is provided by the DPSEEA (Driving forces – Pressure – State of environment – Exposure – Effect – Activities) model, especially in the modified version provided by George Morris. Time-activity patterns are being accommodated here.

Cross-cutting issues, for any causal chain, include the following: links between steps; what spatial scale, and what time dimension to use, what level of population disaggregation (vulnerable sub-groups; to track issues of environmental justice); assessment and representation of uncertainty. In a tiered approach, one starts with mapping out pathways, from policies and measures through to (aggregated) health impacts; then proceeds to preliminary scoping, etc.; then identifies links along the pathway, etc.

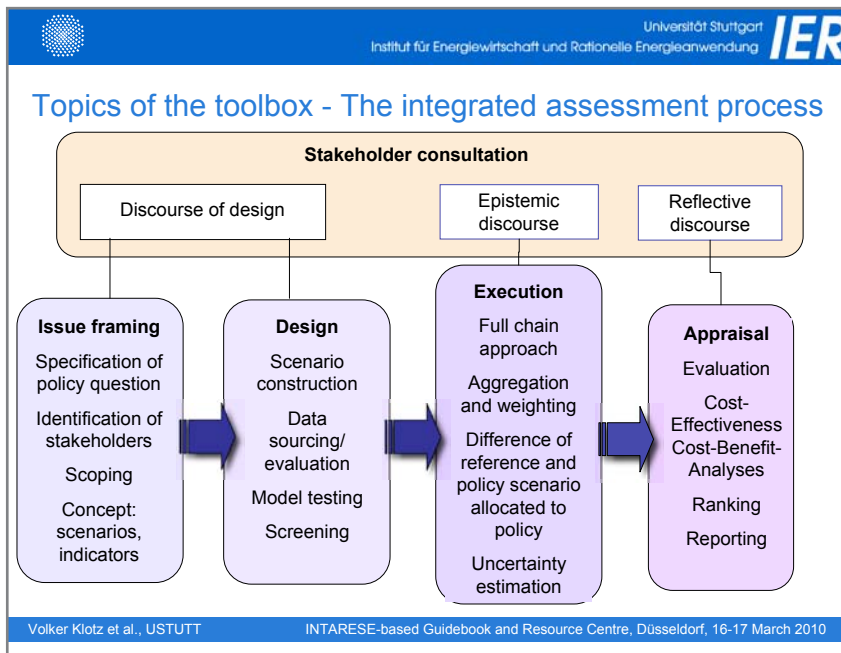




b) INTARESE-based Guidebook and Resource Center (Volker Klotz, University of Stuttgart)

In the INTARESE context, „toolbox“ is interpreted as „guidebook“ and „resource center“. It is a place where all relevant information around integrated environmental health impact assessment (IEHIA) is available, including the following: 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; 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.

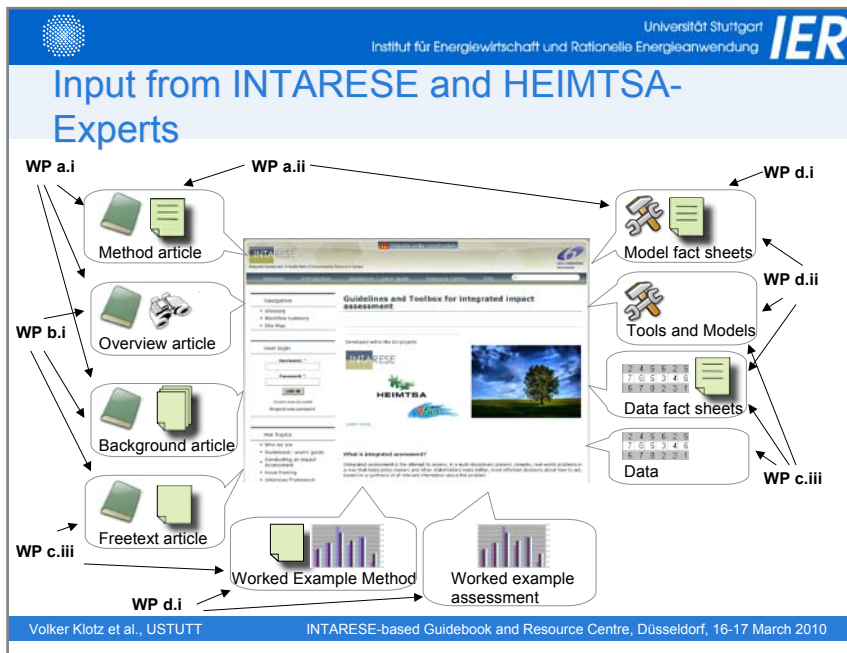
For whom is the toolbox meant? Mostly for assessors in the different fields, who are not experts in all fields, telling them how to start, and which steps to take along an IEHIA; what are the state-of-the-art methods / approaches around IEHIA? Where-to-find data / which data is required? and resources: where to get appropriate models / good examples of IEHIA. It is also meant



for Policy makers, telling them: What are the state-of-the-art methods / approaches around IEHIA? Where could I get good examples of IEHIA? Finally, the target group includes students, and all interested persons, explaining the following: What is IEHIA? What are the state-of-the-art methods / approaches around IEHIA? Where could I get good examples of IEHIA?

The toolbox helps the users to carry out an integrated assessment. The „guidance“ component provides essential state-of-the-art information on methods and approaches (stored in the Guidebook); together with search facilities, TOC, interlinkages, different content templates to provide uniformly structured information to the user. The „resources“ component includes basic data and useful data sources, models and tools, with structured and uniform descriptions of data and models (fact sheets), together with neatly and practically arranged data and search facilities.

The „integrated assessment process“ includes stakeholder consultation, discourse of design, epistemic discourse, and reflective discourse. The step of „issue framing“ involves the following components: specification



of policy question; identification of stakeholders; scoping; concept (scenarios, indicators). The „design“ step involves scenario construction; data sourcing / evaluation; model testing; and screening. The next step is „execution“ of the full chain approach, including aggregation and weighting, with the difference of reference and policy scenario being allocated to policy. Uncertainty estimation can be included. Finally, the „appraisal“ step includes evaluation, Cost-Effectiveness Cost-Benefit-Analyses, ranking of policy options, and reporting.


The website www.integrated-assessment.eu is being developed as 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.

c) HEIMTSA-based computational Toolbox (Alberto Gotti, JRC)


In broad terms, the aims of HEIMTSA project are: quantify as fully as practicable the environmental health effects of policies in various sectors (both of policies designed to improve health; and health effects of policies developed for other reasons); give a fair (i.e. unbiased) assessment of uncertainties in what is included; identify priority information/knowledge gaps (with „priority“ meaning: having a major influence on answers); enable assessment of environmental health effects of future policies.

HEIMTSA's main strategy is the „full chain approach“, i.e. the impact pathway from (changes in) policy over (changes in) emissions to air, soil and water and (changes in) pollutant concentrations in different environments; then further on to (changes in) exposures of individuals and populations (by inhalation, dermal and/or ingestion routes) and (changes in) internal dose at target organs in the body all the way to (changes in) health impacts (overall and in sub-populations) and to (changes in) monetary value of health effects.

All these parts are bound to find their place in a coherent framework of a common INTARESE-HEIMTSA toolbox which is going to contain: a guide-



The HEIMTSA toolbox: Executing a chain




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


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 toolbox



HEIMTSA Toolbox: main characteristics



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

your are in: [home](#) > [chains](#) > [documents](#)



Execution details

Chain and Stressor	Complex for arsenico
Launched by	reimati
Start date	06-04-2009
End date	06-04-2009

Steps

Step	Model	Details
1	MSCE	LURL: email: max delay:
2	WATSON	LURL: email: max delay:
3	PBPK	EU Commission - JRC LURL: http://www.jrc.ec.europa.eu email: yfiorio_reina@ec.europa.eu max delay: 5
4	M.Val	LURL: email: max delay:

- 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

book, a resource centre, and a workspace to conduct full chain assessments by applying and linking ready-to-use models. To support conducting full chain assessments, there will workspace involving a four-tier web-based architecture structured at the levels of client tier, application tier, data tier and external application tier.

The toolbox will also include five vertical computational modules: emission module (to calculate emissions), concentration module (from emission to concentration), exposure module (from concentration to exposure), health impact module (from exposure to health impacts), and monetary valuation module (form health impacts to costs). In addition, there will be two „horizontal“ modules: the visualization module and the uncertainty module.

Main characteristics of the HEIMTSA Toolbox are the following:

- ◆ 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 but will be centrally accessible.

Concerning the data tier (a Database Management System, DBMS), the HEIMTSA centralized DBMS stores and manages a wide range of data, including the following: 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, and monetary valuation functions for the health end-points of interest.

In conclusion, 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.

References

<http://heimtsa.jrc.ec.europa.eu/heimtsatb/>



JRC
EUROPEAN COMMISSION

The HEIMTSA Toolbox: the home page



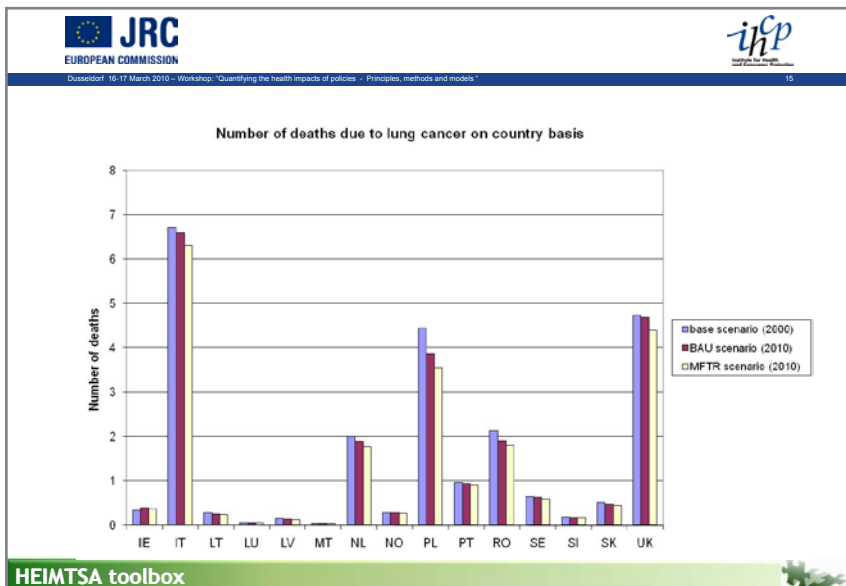
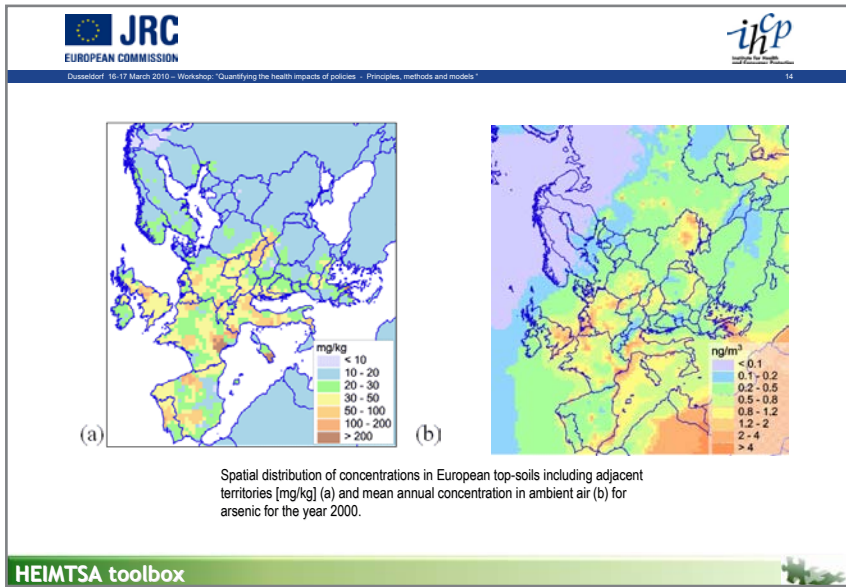
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The home page of the toolbox is composed of four main sections:

- Home
- Chains
- Models
- Your archive



HEIMTSA toolbox



**d) Current area of application: major case study
(Volker Klotz, University of Stuttgart)**

The aim of this case study is to assess environmental health impacts of high-level, cross-cutting policy issues at EU level, and to provide a full example of an integrated environmental health impact assessment according to INTARESE recommendations.

The case study deals with the following problem: Policies and measures for mitigation of and adaptation to climate change are nearly always chosen with only a few criteria: reduction of CO₂eq. emissions (mitigation), reduction of climate change impacts (adaptation), as well as costs and distribution of costs (who pays how much). However side benefits or side detriments might be relevant for the decision process, especially secondary environmental health impacts. Examples are the production and burning of biomass instead of coal and gas for electricity production; lower air exchange rate indoors; wood stoves indoors, etc. The INTARESE/HEIMTSA case study investigates the following question: What is the (negative or positive) impact of EU mitigation options (policies and resulting measures) to reduce greenhouse gas emissions, and of EU adaptation options (policies and resulting measures) to reduce impacts of climate change, on human health?

In the case study, a scenario with no further attempt to mitigate GHG emissions is being compared with a scenario with an average worldwide temperature increase of 2° for the years 2010, 2020, 2030, and 2050. The case study follows a tiered approach. Tier 1 implies scoping and screening; it involves identifying and mapping out the pathways, from policies and measures through to (aggregated) health impacts. Tier 2 identifies pathways and aspects of pathways that matter most; it focusses on improving analysis of these. The case study makes use of the toolbox, and there is stakeholder involvement.

Screening results indicate that health impacts of quite a number of climate change mitigation policies and adaptation measures (e.g. energy efficiency in the transport and housing sectors) are as important as the climate change effects. Some policies, e.g. biomass burning, might cause quite high additional health impacts.

In the discussion, it was pointed out that the same reduction measures of air pollution, in different parts of the world, would have the same physiological effects (e.g. by reduced air pollution), but possibly widely different effects in socio-economic terms (jobs, economy, etc.).

References

- ◆ www.heimtsa.eu, accessed 10 Oct 2010
- ◆ www.intarese.org, accessed 10 Oct 2010

2.2.5 Impact Calculation Tool

Virpi Kollanus, THL, Anne Knol, RIVM

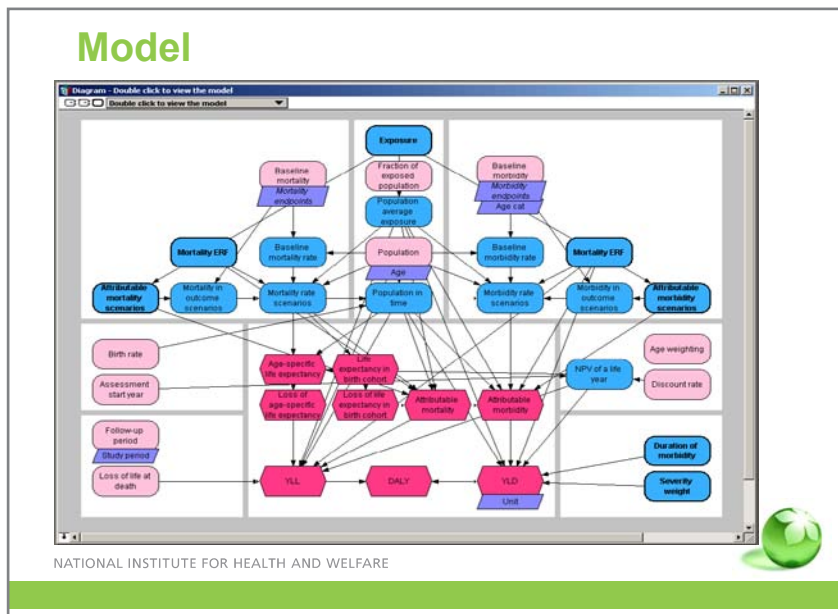
Impact Calculation Tool (ICT) is a modelling tool for quantification of health impacts from environmental exposures. It applies dynamic life table modelling for calculating target population specific health impacts. The development of the model is being carried in relation to international projects working on environmental health impact assessment (INTARESE, HEIMTSA), as well as national Finnish and Dutch projects. ICT is developed



Impact Calculation Tool
 Anne Knol (RIVM), Virpi Kollanus (THL)
 and Intarese partners

Workshop “Quantifying the health impacts of policies - principles, methods, and models”

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to give answers to questions such as: What is the Burden of Disease (BoD, expressed in, for example, disability adjusted life years (DALYs) or years of life lost (YLL)) attributable to a given environmental exposure? How much do these estimates change if the exposure changes?

The ICT program is being developed in trademarked Analytica®, for which a free software player is available. The model can be used as a stand-alone tool or as an add-on in other Analytica®, and it is compatible with Excel (transfer of input and output data). Concerning model boundaries, ICT can handle different types of exposures / risk factors (continuous, or categorical, chronic or acute), but only one exposure / risk factor can be evaluated in one model run. Assessment time frame can range from 1 to 100 years. Exposure / risk level can be adjusted to be age-specific and vary through the assessment time frame. Mortality and morbidity endpoints are freely defined to suit the needs of the particular assessment.

Health impacts can be quantified using different approaches, depending on the type of exposure and input data available. Mode 1: The user defines exposure or health outcome scenarios and provides exposure-response relationships, background mortality and, if needed, morbidity data for the

population and health outcomes of interest. The model then calculates the mortality or morbidity risks attributable to the exposure in different scenarios, makes population projections for the future using dynamic life tables, and based on these derives the different output indicators (YLL, BoD, etc.). Mode 2: The user defines exposure scenarios and provides exposure-response relationships and total BoD data (e.g. from WHO) for the health outcomes of interest. The model then calculates the fraction of BoD caused by the risk factor. In this approach, the assessment time frame is limited to the time frame of the total BoD data provided.

The model does not contain a database or default values for the input data required, but functions more like a calculation shell. Input data have to be provided by the user. Inputs required for mode 1 using the exposure scenarios approach: exposure level (business-as-usual (BAU), alternative, reference) and exposure-response functions for health endpoints of interest (Relative risks, Attributable risks). When using the health outcome scenarios approach: the fraction of baseline mortality/morbidity caused by the risk factor in BAU scenario, and the relative or absolute change in health outcome in the alternative scenario. Also required is data for population

User interface – first level

The Impact Calculation Tool (ICT)
ICT is a modelling tool for health impact assessments. It allows calculation of different types of health indicators for various environmental exposures.

Define assessment boundaries

Starting point for the assessment: Exposure scenarios Health outcome scenarios Total burden of disease

Mortality endpoints:

Morbidity endpoints:

Sex specified impact assessment:

If starting point for the assessment is 'Exposure scenarios' or 'Health outcome scenarios', please fill in the following information:

Assessment start year:

Follow-up period (Years):

Instructions

1) Select the starting point for the assessment
Exposure scenarios: health impacts are calculated based on alternative exposure scenarios, background mortality/morbidity data and exposure-response functions.
Health outcome scenarios: changes in life-expectancy and years of life lost are calculated based on alternative scenarios on attributable deaths and morbidity cases.
Total burden of disease: environmental burden of disease (EBoD) is calculated based on exposure scenarios, total burden of disease (BoD) data and exposure-response functions.

2) Define mortality endpoints
If the starting point for the assessment is 'Exposure scenarios' or 'Health outcome scenarios', then the list of mortality endpoints needs to cover ALL causes of death. However, total mortality should not be divided into more sub-categories than needed to distinguish the mortality endpoints of interest.
If the starting point for the assessment is 'Total burden of disease', then the list should cover only the mortality endpoints of interest.

3) Define morbidity endpoints
List morbidity endpoints included in the assessment.

4) Select whether or not to assess sex-specified health impacts
If starting point for the assessment is 'Exposure scenarios' or 'Health outcome scenarios':

5) Define the starting year for the assessment

6) Define the number of follow-up years for which impacts are calculated
Continue by double clicking the correct module according to the starting point for the assessment.

User interface – second level

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(age-specific), birth rate, baseline mortality/morbidity (age-specific), and severity weights and durations for morbidity endpoints. The user can also define a time discount factor for future impacts. Inputs required for mode 2: Exposure level (BAU, alternative, reference) and exposure-response functions (RR) and total burden of disease data for health endpoints of interest.

Model outputs include disability adjusted life years (DALY, age-specific), loss of life-expectancy (age-specific for target population and average for a birth cohort) and number of attributable deaths and morbidity cases (age-specific).

So far, the results of ICT have been validated to some extent by comparisons with results of other health impact modelling projects, for example the EBoDE-project (<http://en.opasnet.org/w/EBoDE>). The life table modelling has been validated against the IOMLIFET spreadsheet system for life table calculations (<http://www.iom-world.org/research/iomlifet.php>).

Analytica® software enables probabilistic modelling using Monte Carlo simulation and, therefore, advanced uncertainty analysis. This requires key inputs to be defined as probability distributions. The model provides the following outputs for viewing uncertainty in the results: basic statistics, probability bands, probability density function, and cumulative probability density function. Analytica® also has several built-in functions for conducting sensitivity analyses for both deterministic and probabilistic analyses. However, these functions are not incorporated into the user interface and their use requires advanced model editing.

The function of ICT was demonstrated using an example of PM_{2.5} exposure in Finland. Concerning the predefined HIA case study (prevention of domestic falls in older people by increasing the proportion of barrier free residences), it was asserted that such assessment can be conducted with ICT. The simplest way is to use the health outcome scenarios approach. Health endpoints of interest would include femoral fractures and accidental deaths. Input requirements would include: fraction of outcomes caused by housing with barriers (in current business-as-usual situation), change in the risk due to increase in barrier free residences, population data, baseline data on mortality (divided into non-accidental and accidental deaths), baseline morbidity data on femoral fractures, and severity weight and duration for a femoral fracture. ICT output would include: femoral fractures attributable to residences with barriers, accidental deaths attributable to residences with barriers, loss of life-expectancy due to the deaths, and loss of disability adjusted life years (DALY) due to the deaths and femoral fractures.

2.2.6 MicMac

Presented by Claudia Terschüren, LIGA.NRW, on behalf of Anton Kunst, Amsterdam MC⁴

The MicMac approach originated from the study „Bridging the micro-macro gap in population forecasting“, co-funded by the European Commission under the 6th Framework Programme. The provision of high quality and sustainable health care services and pension systems requires an instrument to monitor and forecast demographic change. The aim of this study was to develop such an instrument. The intended instrument consisted of

⁴ Anton Kunst was prevented from participating in the workshop in person.

a macro-model (MAC) that models demographic changes at the population level, and a micro-model (MIC) that models demographic events at the individual level.

In the project, special attention has been given to the development of a micro-simulation (MIC) model that could be applied in the field of public health. In this simulation model, any number of individual people can be followed from birth towards death with regards to transitions relevant to health. Basically, it simulates how individual people experience episodes of disability over their life time, from birth until death. Age-specific probabilities of getting or recovering from disability are modelled as a function of people's exposure to determinants of health during their lives. The covariates included in the simulated life histories included people's gender, educational level, marital status, smoking status, and overweight/obesity status. Empirical estimates on disability incidence and recovery rates, also in relationship to these covariates, were derived from analysis of longitudinal data of the European Community Household Panel.

In one specific application of this microsimulation model, we estimated the impact of future scenarios of tobacco control on future trends in life expectancy, and life expectancy without disability. These models were applied to Italian data. In a series of policy-based scenarios, we estimated the extent to which effective tobacco control would result in an increase in (disability free) life expectancy in Italy.

The microsimulation model made it possible to apply several types of scenarios. For example scenarios on reductions in smoking initiation could be compared with those for smoking cessation. The outcomes of these scenarios could be presented both according to future calendar period, and according to birth cohort. In general, it was found that a reduction in smoking initiation had much larger effects than reductions in smoking cessation. However, it would take more than 50 calendar years before the effects of reduced initiation rates would substantially increase the (disability-free) life expectancy in Italian population at large.

By including educational level as one co-varying characteristic in the simulation of individual life histories, it was possible to estimate the effects of tobacco control among higher educational groups as compared to lower groups. In the Italian case, future reductions in smoking cessation or initia-

tion were expected to have equally large effects on the (disability free) life expectancy of lower and higher educational groups.

A particular strength of the micro-simulation model was its ability to measure the number of episodes of disability experienced by individual people during their life, and the duration of each individual episode of disability. Preliminary results indicate that a reduction in smoking initiation and cessation rates would slightly increase the average number of episodes of disability that people experience over their life time, as well as the average length of these episodes.

To conclude, the MICMAC micro-simulation model is able to show how demographic careers and changing risk factor exposures determine the occurrence of episodes of disability over the life course of individual people, and the length of their lives. The aggregation of these individual life histories provides new possibilities for understanding the health situation of populations at large. Further, it provides a new basis for the preparation of scenarios aimed to assess the population health effects of preventive policies.

References

MicMac Website, www.nidi.knaw.nl/en/micmac/, accessed 10 Oct 2010

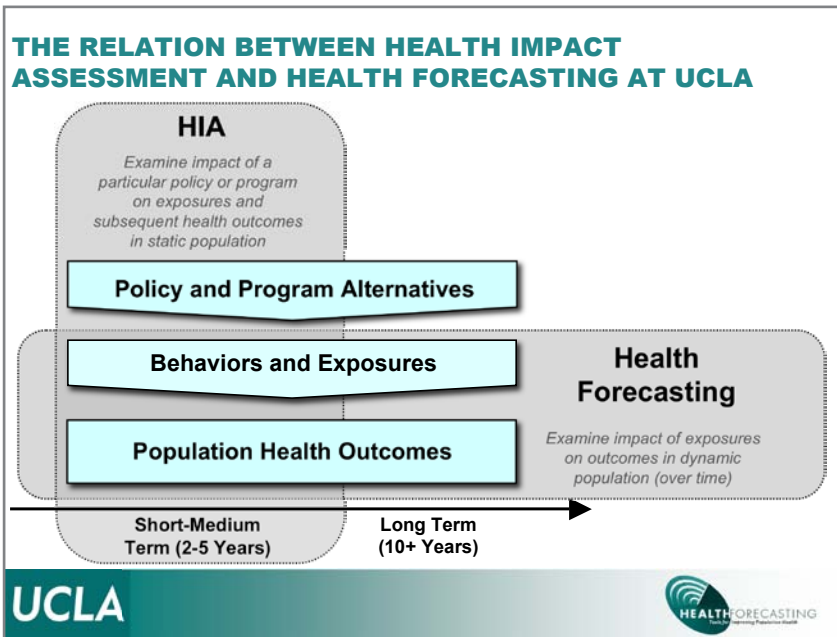
Newsletters 2006-2008, www.nidi.knaw.nl/en/micmac/newsletter/, accessed 10 Oct 2010

2.2.7 UCLA Health Forecasting

Jeroen van Meijgaard, UCLA

At UCLA, Health Forecasting is a collaborative effort between UCLA, Los Angeles County Department of Public Health, and the California Department of Public Health. Funding is being received from the California Endowment, the Robert Johnson Foundation, the UniHealth Foundation, and from Placer County (a small county in California).

The target audience includes local health departments; foundations; legislators and legislative analysts; and advocacy groups. There are large disparities in health outcomes, but there is limited knowledge on how policy decisions affect these.



At UCLA, there is the sister HIA project which examines impact of a particular policy or program on exposures and subsequent health outcomes in small local (and static) populations. These „ad hoc“ or tailored HIAs tend to refer to more narrowly targeted programs, considering relevant geographic challenges (e.g. built environment), interactions between individuals and environment and corresponding need for specifically defined exposures/risks. In contrast, the Health Forecasting approach examines the impact of exposures on outcomes in large regional (dynamic) populations, over time, considering broader policies, assuming uniformity across regions; here, exposures may be averaged. To combine the scope of the HIA and Health Forecasting approaches remains a challenge.

The model aims to enable decision-makers to make more informed decisions. Sample questions are: How will mortality rates in a state or county change over time? What is the incidence of disease X in different counties, and how is this expected to change in the next 10 years? How much of the differences in disease incidence rates 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 a given county?

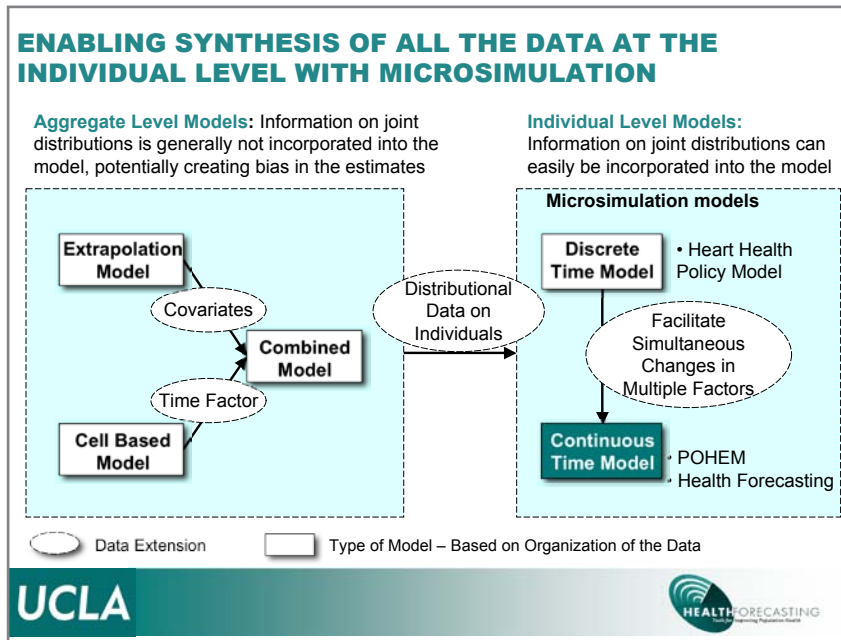
Developing the model first meant to determine feasibility and to build a prototype model. Disseminating the results required the development of additional tools: Synthesis of evidence-based research into a comprehensive Health Forecasting Model; web-based interface to provide public health practitioners and advocates intuitive access to results; disseminate information (e.g. briefs) and educate and train stakeholders.

The full model is being maintained at UCLA by the project team. Users can request scenarios to be simulated. An intuitive interface uses static model output to enable users to perform analysis on a local communities. 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, incl. baseline forecasts and a simplified version of the model that can be used, e.g., by local health officers.

Major applications of the model include the following: 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; inform debate in public health through issue briefs; support community advocacy to strengthen communities and efforts to improve population health, with access via web-based interface (www.health-forecasting.org); and provide analysis on the long term impact of proposed policies.

Building the prototype model involved the following components: (i) Descriptive Population Framework: Population model including socio-economic and demographic information of the population of interest; (ii) Risk Factor / Disease Modules: Smaller models that describe linkages between individual risk factors, environmental, socio-economic and demographic characteristics and health outcomes; and (iii) Forecasting Module: Future trends of assumptions and underlying data of 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. E.g., since phy-



sical activity and obesity are not independent, any intervention targeting these factors should take into account the association. – Such microsimulation or individual level models (whether discrete time or continuous time models) enable synthesis of all the data at the individual level, with information on joint distributions easily incorporated. This is not the case for aggregate level models, potentially creating bias in the estimates.

Several sample applications of the model were presented:

- ◆ Primary prevention versus treatment – Physical activity and coronary heart disease (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. It shows that small improvements in physical activity improves mortality, reduces disease, 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(O_3) and $PM_{2.5}$ on local population health: In Placer County, the Department of Health Services requested the as-

assessment of the impact of changes in O_3 and $PM_{2.5}$ on population health to support advocacy. The following data were used: simulated air quality data and changes in O_3 and $PM_{2.5}$ under different scenarios, and impact on asthma, other health outcomes, but also missed days of school and work.

The model can be updated as new data becomes available. For example, estimates for CHD incidence and prevalence were based on data through 2001. New data released in 2005 showed a marked reduction in CHD incidence as well as CHD case fatality requiring revision to underlying rates.

- The risk factor component of the model has been cross validated with other models where relevant.

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.

Concerning the predefined HIA case study of barrier-free homes, the analysis would need the following information: „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 in a barrier free home in the case scenario; mortality conditional on fall (optional). Simulation would generate: number of falls and of deaths in each year for reference as well as the scenario; related outcomes.

In the discussion, it was pointed out that there are two ways to do micro-simulation: using an actual sample, or a “synthetic” population. The UCLA Health Forecasting approach uses “characteristic” (synthetic) individuals. As for longitudinal data, the Alameda County human population laboratory was mentioned as a source. – Users have been more interested in morbidity and mortality rather than in DALYs. – Concerning validation, there are several approaches: (i) comparing models; (ii) backcasting; (iii) re-doing analyses with more recent data. It was reported that some analyses of the UCLA Health Forecasting conducted many years ago where recently re-run with fresh data: Observed improvements tended to be much larger than predicted.

References

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- ◆ Meijgaard, J. van, Fielding, J.E., Shimkhada, R., Teutsch, S. (2009): How do improvements in physical activity compare to better clinical coronary heart disease management? Issue brief, August 2009, <http://www.health-forecasting.org/images/pdf/issuebrief4.pdf>

2.3 Session 3 „Quantification perspectives“

This part of the workshop was intended to discuss the following issues: Critical evaluation of presented models, including strengths and weaknesses, with a focus on application spectrum, and mapping out how they (don't) connect; monetarization in health-related Impact Assessments – pro's and con's, approaches, problems; acceptance status of Health Impact quantification among professionals and the general public. Not all of these issues were discussed with equal intensity. Discussion highlights included the following.

(1) Workshop participants agreed that Health Impact modeling is a valuable approach. It can be very useful for understanding the complexity of health issues; it can facilitate comparisons of potential impacts across policy alternatives; and it can inform different debates in Public Health. In particular, it constitutes a great opportunity to provide “additional” information for decision-makers and thus can support policy-making, e.g. by providing answers to “what-if” questions. Health Impact modelling and Health forecasting represent tools for improving population health. Reportedly, the initiator of the UCLA approach specifically wanted to start a counterbalance to short-term orientation of policy-making.

(2) There are, however, also numerous reservations and caveats. Modelling the health impact of policies requires both information on (i) how the policy affects risk factors, and (ii) how risk factors affect health. A limitation arises from the fact that the effects of most interventions on exposures are not evaluated. Often the effects on exposures are only assumed, not validated. It was pointed out that “What-if” statements can still be useful, e.g. by showing that effects would be small anyway; and by assisting more objective prioritizing of Public Health activities.

One major caveat refers to the fact that reality is not always “pretty”, or easily understood. Interventive measures, e.g., often reach best those groups who have the smallest needs. Time characteristics of health benefits can be surprising; often on short term; effects of smoking bans were seen earlier than expected. Extrapolation from animal studies to human health continues posing a big challenge. The whole field of infectious disease modelling with specific challenges was left outside the scope of this workshop. In many respects, between Environmental Health and Public

Health there remains a divide which is in need of being bridged. Otherwise policy-makers as well as the public are at risk of being confused by uncoordinated and (at least seemingly) contradictory statements, e.g. concerning the contribution of different risk factors to the overall burden of disease.

The importance was stressed to never forget the „bigger picture“. For example, when modeling policies as interventions, this should include the concept of “invasiveness”. A case study of reindeer hunting in the Lapp population was mentioned. The intention to forbid the reindeer hunting due to high contaminant levels is an invasive intervention, with resulting dramatic impact on lifestyle of the population. The question was asked if regulators have the right to do experiments on populations with unknown outcome. – In the discussion it was pointed out that this example may show limitations of the modeling approach, but it seems to underline the need of broad impact assessment. Obviously, there are cases where qualitative analysis is more important than the quantitative or modeling part.

Summary measures of population health are less familiar than traditional measures of health and disease; the debate on strengths and weaknesses need to be continued. It was also stressed that the complexity of models should be acknowledged. The approaches discussed at this workshop incorporate value- and model-based assumptions that are not always made explicit. Data requirements are crucial; they should always be made clear in detail. In practice, analyses may be infeasible because of limited data on the effect estimates and baseline characteristics of the population. On the other hand, it was also pointed out that models could go further than they currently; they could try and integrate, e.g., employment, income, quality of social relationships. Care needs to be taken, of course, not to build models on non-causal associations.

(3) A detailed synopsis of the models currently available was beyond the scope of this workshop. Sample observations, however, include the following: The PREVENT model incorporates “20 years of experience”, at the same time the design and source code may not always meet current standards. The DYNAMO-HIA model is said to make the most out of given data set; but uncertainty analysis seems to be somewhat rudimentary. The ICT model is simple and straightforward, but may provide only a limited reflection of the complexity of the world. The UCLA Health forecasting model offers a great deal of flexibility but requires comprehensive expertise, and

large amounts of data. The HEIMTSA / INTARESE approach tries to integrate a considerable range of models. It still needs to be demonstrated how much improvement and practical advantage this will imply.

As one participant put it, „all models are wrong, but some are useful“. Models involving microsimulation, e.g., are more easily explained to the general public; and they enable synthesis of all data at the individual level. Time will tell which of the models and approaches prove most robust in practice, and most useful for real-life applications. At any rate, the models now seem ready to use for exploration, in scientific contexts, but apparently not yet for everyday practice in HIA. One concern refers to the question if the choice of model will predetermine the type of output, e.g. the specific metric of health and disease. The parallel use of different models can be important for validation: If, for a given set of input data, several models agree, then this will be more convincing than “individual” model results.

The question was raised if there are, maybe, too many complex models now. Both simple and complex models seem to be needed. It was explicitly suggested that different models should be run over a sufficiently long period, e.g. a decade, and then should be evaluated together.

Should health impact models be useable “off the shelf”? On one side, it is an obvious goal to create a resource website, providing access to several models and assisting the less experienced users. On the other hand, there are reservations that health impact modeling should not be made looking more simple than it is in reality, i.e. websites should not „try to develop a big airplane that an idiot can fly“.

(4) Principles to be kept in mind when trying to quantify policy impacts include the following:

- ◆ The models should state which concepts they imply, and why
- ◆ Transferability of models across populations can be a challenge, e.g., reliance on absolute vs. relative risk
- ◆ For best results, recombine data and knowledge to produce “what-if” statements
- ◆ Always look at the subpopulations at highest risk first
- ◆ Output results of modeling should be scaled to appropriate population(s), in a sensible way; it is not always trivial to decide on that

- ◆ Caution is necessary in “who uses the model”; a realistic approach involves teams of experts working together for doing the modeling
- ◆ Leave decision-making to the politicians.

3. Summary of workshop results, and perspectives

This section summarizes the workshop results under three headlines: key observations concerning health impact quantification; selected opinions and theses on this issue; main open questions, and how to proceed.

Key observations concerning health impact quantification

- ◆ WHO has been (and continues to be) a protagonist for summary measures of population health, in both the generic version and the environmental health version.
- ◆ The European Commission has sponsored (and continues to do so) a whole range of projects on health impact assessment, many of them focussing strongly on health impact quantification, e.g. DYNAMO HIA, INTARESE, and HEIMTSA. These projects involve large consortia of scientific institutions and considerable financial investments.
- ◆ With respect to health impact modeling, expectations – e.g. from EC side – are high; the goals set by the researchers involved in these projects are likewise very ambitious.
- ◆ Although critical discussion at the workshop was mainly focussed on the usage of summary measures as metrics of population health, workshop participants were aware that significant reservations exist concerning the overall usefulness and the appropriate execution of health impact modeling; in particular that models may give an unwarranted patina of robust science.
- ◆ Health impact modeling exists in both the Environmental Health arena and the general Public Health arena. Up to now, the debate (where taking place as cross-project debate at all) mostly was separated along this divide. Currently, these strands start to take more notice of each other and to discuss common perspectives. The workshop contributed to this development.
- ◆ The basic idea of health impact quantification can be interpreted, and implemented, in different ways and along different traditions. In Environmental Health, current flagship projects (especially INTARESE and HEIMTSA) aim at full-chain modeling where the full chain is meant to start with policy options and (at least for the HEIMTSA project) to extend

all the way to monetarization. In general Public Health (e.g. DYNAMO HIA project), modeling tends to be limited to the route from risk (or protective) factor to health outcome.

- ◆ Several recent models and approaches are in intermediate stages of development; but models of longer existence also seem not to have been applied on a very broad scale. Hitherto, at any rate, full-blown examples are rarely available.
- ◆ So far, very little evidence exists concerning the demand of health impact modeling expressed by decision-makers and politicians; on the satisfaction of these groups with modeling results provided to them; and on the eventual usefulness of the approach.

Selected opinions and theses on health impact quantification

- ◆ Judging by the views expressed at the workshop (admittedly, a selection biased in favor of modeling), many initial problems of health impact modeling are now being eliminated; and a variety of promising specific models and programs does exist.
- ◆ Workshop participants saw chances that the models under discussion would help to reach a new and improved quality of science-policy interaction.
- ◆ The quantification approach seems to fit appropriately with prevalent health, environmental, and policy science paradigms.
- ◆ The long-term relevance of the current developments of health impact modeling for Public Health up to now is difficult to assess.
- ◆ Summary measures of population health can be applied in this context. However, they are add-ons and no essential ingredients of health impact modeling; their relative merits can be evaluated separately.
- ◆ The arena of Environmental Health on one side and that of general Public Health on the other can both profit from the emerging joint debate on their respective health impact modeling approaches.
- ◆ Producing a set of examples of good practice of health impact quantification seems overdue and should be useful indeed.

Main open questions on health impact quantification, and on how to proceed

- ◆ Is it possible to reach broad consensus concerning summary measures of population health (SMPH), especially on when and when not to use them?
- ◆ Should more specific models of health impact quantification, e.g. the Health Economic Assessment Tool (HEAT) for cycling (as developed by WHO Europe), or specific models for estimating impact on morbidity and mortality from coronary heart disease, be included in future discussions?
- ◆ Given similar input to different models of health impact quantification, will these models tend to produce similar output?
- ◆ Once models for health impact quantification are available more easily, will the practice of Public Health and health policy-making be improved? What needs to be done to improve the chances that this will happen?
- ◆ How to establish a permanent and reliable basis for the practice of health impact quantification, incl. updating data within systems?
- ◆ Would a competition of tools involving sample applications of health impact quantification (if possible: a policy question of current common interest) help to promote the development of this field?

Perspectives

At this workshop on health impact quantification, participants agreed that the cross-model and cross-project discussion was indeed needed. The workshop was seen as a rather unique opportunity to unite important strands of development in health impact quantification, and therefore providing a useful learning experience. In particular it was welcomed that approaches from the Environmental Health arena were presented and discussed side-by-side with approaches from the general field of Public Health. From this background, there was a broad consensus that the discussion along these lines should be continued.

Appendix

A.1 Workshop Agenda

Workshop "Quantifying the health impacts of policies - Principles, methods, and models" 16 - 17 March 2010, LIGA.NRW Düsseldorf		
Workshop "Quantifying the health impacts of policies - Principles, methods, and models" 16 - 17 March 2010, LIGA.NRW Düsseldorf		
Programme		
March 16		
12:00	<i>Arrival</i>	
12:30	Opening, welcome and introduction	Eleftheria Lehmann, Odile Mekel (LIGA.NRW)
Principles of quantification of health impacts		
12:50	Vision and promise of quantification in health-related Impact Assessments	Rainer Fehr (LIGA.NRW)
13:10	Quantification: why, when and how? - Discussion with invited experts -	Gabriel Gulis (SDU), John Kemm (WM PHO), Marco Martuzzi (WHO Rome), Gerlienke Schuur (RIVM)
13:40	<i>Break</i>	
14:00	Summary Measures of Population Health (SMPH) in health-related Impact Assessments	Annette Prüss-Üstün (WHO Geneva)
14:20	Critical comment on the use of Summary Measures of Population Health (SMPH) in health-related Impact Assessments	Michael Schumann (BSG)
14:40	Equity and quantification in health-related Impact Assessments	Fiona Haigh (IMPACT+)
15:00	<i>Break</i>	
Models / projects		
15:30	PREVENT	Esther de Vries (Erasmus MC)
16:15	DYNAMO HIA	Wilma Nusselder (Erasmus MC), Hendriek Boshuizen (RIVM)
17:00	BoD in NRW	Claudia Terschüren (LIGA.NRW), Claudia Hornberg (University of Bielefeld)
17:30	Closure day 1	
19:30	<i>Informal Dinner</i>	
		

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

Workshop
"Quantifying the health impacts of policies - Principles, methods, and models"
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Programme

March 17

Models / projects (cont.)

09:00	HEIMTSA / INTARESE Toolbox	
	Introduction about the projects / integrated environmental HIA	Hilary Cowie (IOM)
	INTARESE-based Guidebook / Resource Centre	Volker Klotz (University Stuttgart)
	HEIMTSA-based computational Toolbox	Alberto Gotti (JRC)
	Current area of application: major case study	Volker Klotz (University Stuttgart)
09:45	Impact Calculation Tool	Virpi Kollanus (THL), Anne Knol (RIVM)
10:25	<i>Break</i>	
10:40	MicMac	Anton Kunst (Amsterdam MC) (apology)
10:40	Health Forecasting	Jeroen van Meijgaard (UCLA)
11:35	<i>Lunch</i>	
12:15	Quantification perspectives	
	<ul style="list-style-type: none"> • Discussion on presented models / critical evaluation incl. SW(OT), with a focus on application spectrum, and mapping out how they (don't) connect • Monetization in health-related Impact Assessments – pro's and con's, approaches, problems • Acceptance status among professionals and the general public • Next steps 	All
16:00	<i>Closure workshop</i>	

A.2 Workshop participants

Name		Institution
Boshuizen	Hendriek	RIVM – Dutch National Institute for Public Health and the Environment (RIVM), Bilthoven, NL
Conrad	André	UBA – Umweltbundesamt, Berlin, D
Cowie	Hilary	IOM – Institute of Occupational Medicine, Edinburgh, UK
Delges	Anne	SZ – Strategiezentrum Gesundheit NRW, Bochum, D
Diehl	Anke	SZ – Strategiezentrum Gesundheit NRW, Bochum, D
Fehr	Rainer	LIGA.NRW – Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work) inkl. WHO CC RHPPH. Düsseldorf – Münster – Bielefeld – Bochum, D
Gotti	Alberto	JRC – EC Joint Research Centre, Institute for Health and Consumer Protection (IHCP), Ispra, I
Gulis	Gabriel	SDU – University of Southern Denmark, Unit for Health Promotion Research, Esbjerg, DK
Lhachimi	Stefan	Erasmus MC – Erasmus Medical Centre, Rotterdam, NL
Hänninen	Otto	THL – National Institute for Health and Welfare, Kuopio, FI
Haigh	Fiona	IMPACT – International Health Impact Assessment Consortium, University of Liverpool, UK
Hornberg	Claudia	U BI – Fakultät für Gesundheitswissenschaften (School of Public Health), Universität Bielefeld, D
Jantunen	Matti	THL – National Institute for Health and Welfare, Kuopio, FI
Kemm	John	WMPHO – West Midlands Public Health Observatory, Birmingham, England, UK
Klotz	Volker	USTUTT-IER – Universität Stuttgart, Institut für Energiewirtschaft und Rationelle Energieanwendung, D
Knol	Anne	RIVM – Dutch National Institute for Public Health and the Environment (RIVM), Centre for Substances and Integrated Risk assessment (SIR), Bilthoven, NL
Kollanus	Virpi	THL – National Institute for Health and Welfare, Kuopio, FI
Lehmann	Eleftheria	LIGA.NRW – Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work) inkl. WHO CC RHPPH. Düsseldorf – Münster – Bielefeld – Bochum, D
Martuzzi	Marco	WHO European Centre Environment and Health, Rome, I
Meijgaard	Jeroen	UCLA – University of California at Los Angeles. Health Forecasting Unit, Los Angeles, USA
Mekel	Odile	LIGA.NRW – Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work) inkl. WHO CC RHPPH. Düsseldorf – Münster – Bielefeld – Bochum, D
Möller	Holger	NWCIS – North West Cancer Intelligence Service, Liverpool, UK
Nusselder	Wilma	Erasmus MC – Erasmus Medical Centre, Rotterdam, NL
Prüss-Üstün	Annette	WHO Headquarters, Division of Public Health and Environment, Geneva, CH
Schümann	Michael	BSG – Behörde für Familie, Soziales, Gesundheit und Verbraucherschutz / Umweltbezogener Gesundheitsschutz. Freie und Hansestadt Hamburg, D
Schuur	Gerlienke	RIVM – Dutch National Institute for Public Health and the Environment (RIVM), Centre for Substances and Integrated Risk assessment (SIR), Bilthoven, NL
Sierig	Sarah	LIGA.NRW – Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work) inkl. WHO CC RHPPH. Düsseldorf – Münster – Bielefeld – Bochum, D
Terschüren	Claudia	LIGA.NRW – Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work) inkl. WHO CC RHPPH. Düsseldorf – Münster – Bielefeld – Bochum, D
Vohra	Salim	IOM – Institute of Occupational Medicine, London, UK
de Vries	Esther	Erasmus MC – Erasmus Medical Centre, Rotterdam, NL

A.3 Handout: Short description of the models

This section presents selected web-based information, in alphabetical order of models.

DYNAMO-HIA, www.dynamo-hia.eu

DYNAMO-HIA aims to contribute to informed policy making, both on the EU-level and the national level, by providing an instrument that enables health experts to predict the magnitude of health consequences that result from changing health determinants, using generally available data. DYNAMO-HIA will build upon existing modelling experiences in individual countries to develop a generally applicable instrument for health impact assessment. Data required by the instrument will be data that are usually available for most countries. DYNAMO-HIA will be implemented in the form of a user-friendly software tool.

HEIMTSA, www.heimtsa.eu

Health and Environment Integrated Methodology and Toolbox for Scenario Assessment brings together an international team of scientists in the areas of epidemiology, environmental science, and biosciences, to collaborate on developing and applying new, integrated approaches to the assessment of environmental health risks and consequences, in support of European policy in transport, energy, agriculture, industry, household, and waste treatment and disposal.

ICT

Impact Calculation Tool is an Analytica®-based model for quantifying health impacts from environmental exposures. The model is developed to provide probability distribution of:

- ◆ total population years of life lost (YLL)
- ◆ attributable numbers (if possible)
- ◆ disability adjusted life years (DALYs)
- ◆ potentially (later): monetary values

ICT includes scenario analysis, dynamic life tables, uncertainty and sensitivity analysis. The program is under development at THL in cooperation with RIVM, PBL.

INTARESE, www.intarese.org

Integrated Assessment of Health Risks of Environmental Stressors in Europe is designed to support implementation of the European Environment and Health Action Plan, by providing the methods and tools that are essential to enable integrated assessment of environment and health risks. Drawing upon the large range of studies carried out in Europe over recent years and the advances made in specific areas of toxicology and epidemiology (especially air pollution), and in close collaboration with users, it will develop a methodological framework and a set of tools and indicators for integrated assessment that can be applied across different environmental stressors (including pollutants and physical hazards), exposure pathways (air, water, soil, food) and policy areas.

MicMac, www.nidi.knaw.nl/en/micmac

MicMac will create a system for monitoring and forecasting population changes, to support policy planning for health care and pension services.

The project will:

- ◆ develop a methodology consisting of a macro model of demographic changes at population level, and a micro model of demographic events at the level of the individual.
- ◆ use simulation technology to make projections based on census and survey data and other population statistics
- ◆ develop user-friendly software to run the models and provide training to forecasters from across Europe
- ◆ build a self-sustaining European network on ageing.

PREVENT, www.eurocadet.org, www.epigear.com/index_files/Prevent.htm

The simulation model PREVENT estimates the effect of changes in risk factor prevalence, 81 autonomous trends in incidence, and interventions on disease occurrence and/or mortality. It was developed as a tool to translate the results of epidemiological studies into estimates of potential health benefits of preventive interventions in a specific population.

The model takes into account:

- ◆ associations between risk factors and diseases
- ◆ associations between risk factors
- ◆ time dimensions (including lag times e.g. for smoking)
- ◆ projected changes in demography
- ◆ trends in incidence of disease independent of the risk factors under study in the model (autonomous trends).

UCLA Health Forecasting, www.health-forecasting.org

The UCLA Health Forecasting Model uses a continuous-time microsimulation framework to simulate individuals' lifetime histories by using birth, risk exposures, disease incidence, and death rates to mark changes in the state of the individual. The model generates a reference forecast of future health in California, including details on physical activity, obesity, coronary heart disease, all-cause mortality, and medical expenditures. We use the model to answer specific research questions, inform debate on important policy issues in public health, support community advocacy, and provide analysis on the long-term impact of proposed changes in policies and programs, thus informing stakeholders at all levels and supporting decisions that can improve the health of populations. The comprehensive population model has the potential to interject new and valuable information about the future health status of the population.

WHO approach adapted for BoD in NRW, www.liga.nrw.de, www.uni-bielefeld.de/gesundhw/ag7/arbeitsgebiete/01_environmental.html

The Burden of Disease (BoD) approach of the World Health Organisation (WHO) summarizes the health status of populations. This approach was adapted to assess the current and future BoD for the NRW population. It was used to predict the future regional disease burden in 2025 by calculating disability adjusted life years (DALY) as the sum of life years lost due to premature death and years lived with disability due to selected diseases. The projection for North Rhine-Westphalia (NRW) and selected regions in NRW included selected tumours, myocardial infarction, and dementia. The projection of disease burden showed that health status will decrease due to the demographic change. The regional DALY estimates showed the potential health benefits, which can be gained by implementing measures to reduce premature deaths and to prevent new cases. Environmental Burden of Disease in NRW was estimated for ETS and particulate matter reduction scenarios.

A.4 Background material

John Kemm, WMPHO Birmingham: Assessing the magnitude of health impacts

While the ultimate goal of HIA must be to quantify impacts and describe them on ratio scales in many cases it is not possible to do more than use ordinal scales. Most HIAs list the range of impacts, classing them in terms such as major, moderate and minor or strongly significant, weakly significant, negligible. Too often those using these terms do not realise that they are using ordinal scales. The use of such terms implies that some criteria have been used to place the impacts on these scales. However these criteria are hardly ever made explicit.

It is possible to rank impacts on at least five dimensions

- ◆ Nastiness/niceness
- ◆ Number and proportion of people affected
- ◆ Timing
- ◆ Equity
- ◆ Certainty

The “nastiness/niceness” dimension might for example rank impaired hearing as a less bad impact than death and worse than being “highly annoyed”. The ranking will also be affected by degree of “dread” so that death from an unfamiliar cause is probably classed as worse than death from a familiar cause.

The “number affected” dimension seems simple – the more affected the greater the impact. However one also has to consider the proportion affected – one death in a hundred is worse than one death in a million.

The “timing” dimension also seems simple – immediate impacts are given greater weight than delayed ones. Economists have used discounting to allow comparison of impacts occurring at different times.

The “equity” dimension considers on whom the impact falls. Negative impacts on deprived or vulnerable individuals might be seen as worse than negative impacts on privileged individuals. It is clear that this conflicts with the principle that all humans are of equal worth but the principle of equity clearly implies that negative impacts on some people are less acceptable than negative impacts on others.

The “certainty” dimension covers two ideas; the probability of an impact with likely impacts being given greater weight than unlikely ones and also strength of evidence with impacts where the causal link is sure being given greater weight than those where the causal link is unsure.

It should be noted that, although weighting techniques of varying degrees of sophistication may be used, ranking in all these dimensions (except for number affected) involves value rather than scientific judgements.

Having ranked the impact on these five dimensions, the dimensions have to be combined in order to produce an overall priority ranking. Because all dimensions except “number affected” have ordinal scales they cannot be combined by simple mathematical manipulation but require explicit rules. Prioritisation of impacts can only be a useful process if the criteria and rules are explicit.

“Not everything that counts can be counted and not everything that can be counted can be counts.” Quantification carries the risk that by concentrating on that which can be measured and counted it neglects impacts and paths which cannot be measured, although these may be far more important than the measurable impacts and paths. Comparative risk assessment can be criticised on these grounds.

Models and quantification have a major contribution to make to comparison of impacts but it must be remembered that they cannot be a complete answer and will need to be combined with other methods of ranking impacts.

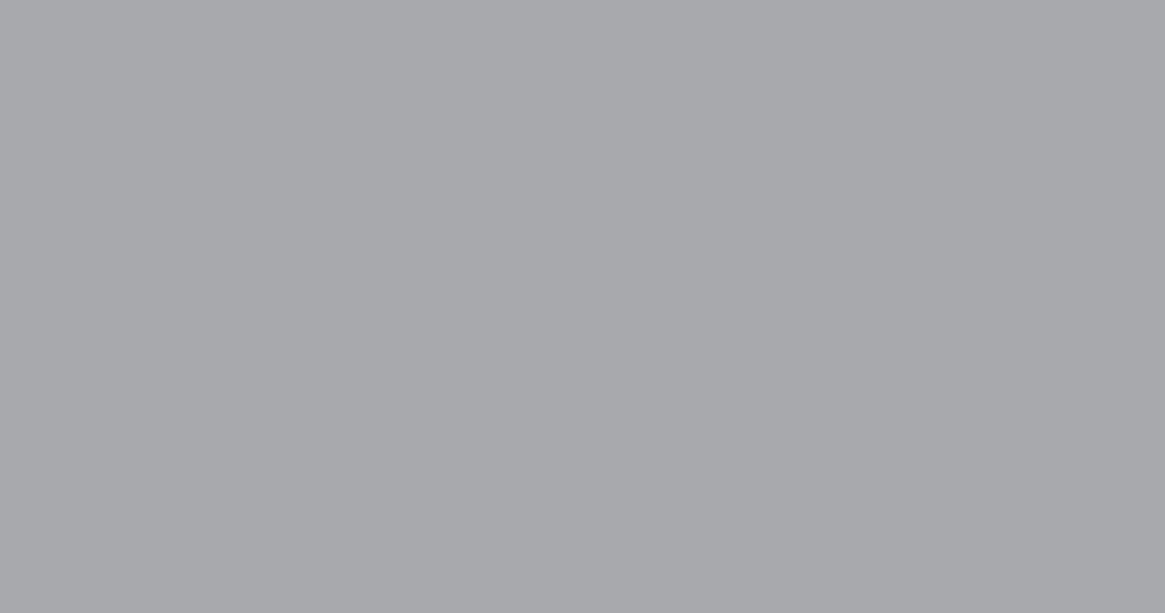
A.5 Abbreviations used

ALE	Active Life Expectancy
AR	Attributable risk
BAU	Business-as-usual
BMI	Body Mass Index
BoD	Burden of disease
BSG	Behörde für Familie, Soziales, Gesundheit und Verbraucherschutz
CHD	Coronary heart disease
COPD	Chronic obstructive pulmonary disease
CSDH	Commission on Social Determinants of Health
CRF	Concentration response function
DALY	Disability-adjusted Life Years
DBMS	Database Management System
DFLE	Disability-free life expectancy
DPSEEA	Driving forces – Pressure – State of environment – Exposure – Effect – Activities
DW	Disability weight

DYNAMO-HIA	Dynamic Modelling for Health Impact Assessment
EAHC	Executive Agency for Health and Consumers
EBD	Environmental burden of disease
EBoDE	Environmental Burden of Disease in Europe
EC	European Commission
EIA	Environmental Impact Assessment
EPHIA	European Policy HIA
EUPHA	European Public Health Association
EQ-5D™	“EuroQuol” questionnaire with five dimensions
Erasmus MC	Erasmus Medical Centre
ETS	Environmental tobacco smoke
HEALYs	Healthy Life Years
HEAT	Health Economic Assessment Tool
HEIA	Health Equity Impact Assessment
HEIMTSA	Health and Environment Integrated Methodology and Toolbox for Scenario Assessment
HIA	Health Impact Assessment
HNA	Health Needs Assessment
HRQL	Health Related Quality of Life
HSPA	Health System Performance Assessment
HTA	Health Technology Assessment
HUI2	Health Utilities Index Mark 2
IA	Impact Assessment
ICT	Impact Calculation Tool
IEHIA	Integrated environmental health impact assessment
IHD	Ischaemic heart disease

IMPACT	International Health Impact Assessment Consortium, University of Liverpool
INTARESE	Integrated Assessment of Health Risks of Environmental Stressors in Europe
IOM	Institute of Occupational Medicine
JRC	EC Joint Research Centre
LE	Life expectancy
LIGA.NRW	Landesinstitut für Gesundheit und Arbeit NRW (NRW Institute of Health and Work)
MicMac	Micro model / macro model
NWCIS	North West Cancer Intelligence Service
PIF	Potential impact fraction
PPPPT	Policies, plans, programs, projects or technologies
PQRA	Arbeitskreis Probabilistische Quantitative Risikoanalyse
QALY	Quality Adjusted Life Years
QRA	Quantitative risk assessment
RIVM	Dutch National Institute for Public Health and the Environment
RR	Relative risk
SDU	University of Southern Denmark
SEA	Strategic Environmental Assessment
SMPH	Summary Measures of Population Health
SZ	Strategiezentrum Gesundheit NRW
THL	National Institute for Health and Welfare, Finland
TIF	Trend impact fraction
TOC	Table of content
U BI	Universität Bielefeld

UBA	Umweltbundesamt
UCLA	University of California at Los Angeles
UN	United Nations
USTUTT-IER	Universität Stuttgart, Institut für Energiewirtschaft und Rationelle Energieanwendung
WHO	World Health Organization
WHO CC	WHO Collaborating Center
WMPHO	West Midlands Public Health Observatory
Xprob	Reference values and distributions for exposure factors for the German population
YLD	Years of life lived with disability
YLL	Years of life lost



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