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Environmental health impact assessment: the example of transportation

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This paper summarizes a view of Health Impact Assessment (HIA) which has evolved over several years [1 - 5]. The current paper intends to contribute the following:

- a selective chronology of HIA
- a sketch of WHO's Transport, Environment and Health (TEH) project and the related HIA workshop in Bielefeld, Germany, May 1999
- components of a systematic framework for HIA
- ideas for future developments of HIA.

In order to build bridges between the traditions of health promotion and environmental health, we developed the concept of "**ecologic health promotion**". This framework uses the public health triad of "assessment", "policy development", and "assurance". Health Impact Assessment (HIA) is a key component of ecologic health promotion. The term HIA is used here to denote the assessment of health impacts of projects, plans, and programmes.

The **impact** of a factor "A" may be seen as the (estimated) difference between the situation or course of events under the influence of factor "A" compared with the situation or course of events without the influence of factor "A". The comparison may refer to straightforward situations, involving only a single factor, or highly complex sets of factors ("scenarios"). Typically, a project, policy, or programme would affect human health by changes in the health determinants.

The enormous number of factors with potential health implications gives a need to structure the discourse. In environmental protection and management a commonly used model is "Pressure - State - Response"

(PSR). This is now often extended as in the "Driving forces - Pressure - State - Impact - Response" model (DPSIR). Neither the PSR model nor the DPSIR model explicitly consider "exposure", which is a crucial element from a health perspective. For the environmental health context, WHO developed the "Driving forces - Pressure - State - Exposure - Effects - Activities" (DPSEEA) model. In trying to accommodate issues of public health outside the usual environmental health field, we recently added more components including social environment and health care system. This "**extended DPSEEA model**" can be applied to many topics of ecologic health promotion, including HIA.

In a rudimentary typology, we can distinguish several dimensions of HIA including the following:

- the direction in which the assessment proceeds. It may work from exposures in a "forward" direction towards anticipated outcomes, or work from observed outcomes in a "backward" direction towards exposures which may explain the outcomes;
- the time reference: retrospective, concurrent, or prospective;
- the complexity, with HIA referring either to single factors (e.g. lead in gasoline; speed limit), combinations (e.g. impact of air pollution), or whole scenarios (e.g. modal shifts in transportation);
- the mode of dealing with variation and uncertainty: deterministic, or probabilistic; and
- the organizational framework: voluntary, or legally-based.

HIA chronology

A selective chronology is shown in Annex 1. The table combines HIA events of global significance with milestones of our local HIA efforts. Arguably, this study of the history of HIA invites the following conclusions:

- For a period of at least 2 decades, the idea of (prospective) impact assessment has been raised and supported by a variety of different institutions and high-ranking policy documents. This provides

encouragement that HIA is not a mere "fashion" but a relevant health policy issue.

- There are many different approaches but limited successes. This is a warning not to underestimate the obstacles. HIA is no trivial task. To conduct HIA successfully on a broad scale will require prudent action.

WHO "Transport, Environment and Health" (TEH) project

The **Third Ministerial Conference on Environment and Health** was held in London in June 1999. In preparation for this conference, an interdisciplinary group of scientists prepared science-based reviews of opportunities for walking and cycling, noise, air pollution, injuries, and also cross-cutting topics such as HIA and economic valuation. The results were used to prepare a European Charter on Transport, Environment and Health with specific targets and a plan of action. The European Environment and Health Committee had proposed the development of such a charter. The text of the charter was negotiated at a series of intergovernmental meetings attended by representatives of ministries of transport, the environment and health of Member States in WHO's European Region, international organizations, the European Commission and nongovernmental organizations [6].

HIA workshop, Bielefeld, Germany, May 1999

In preparing the London conference, the crucial role of the local and regional level for implementing Health Impact Assessments became obvious and it was decided to give special attention to this topic. A scientific meeting was held in Bielefeld in May 1999 which examined the Health Impact Assessment (HIA) of transportation with a focus on the regional and local perspective [4].

The meeting identified the following knowledge gaps and research priorities:

- For many agents and exposures, there is insufficient knowledge of exposure-effect relationships, and of the interaction of various factors with each other.

- We have inadequate information on how most health outcomes other than mortality might be affected, and there is a lack of precise knowledge on the vulnerability of groups such as the young, the elderly, and the sick.

- We lack good information with which to estimate the size of health risk associated with socio-economic factors and therefore find it difficult to include them formally in HIAs.

- We often do not know how to delineate the limits of a HIA and need a better basis for scoping decisions.

In addition, the meeting identified a range of policy priorities. Priorities concerning procedural and methodological aspects of HIAs included the following:

- The complete range of health outcomes should be covered in HIA and equity should be taken into account. Mechanisms are needed for timely public participation and stakeholder involvement as well as communication.

- The knowledge base for threshold concepts and quantitative dose-response relationships should be improved. Uncertainties in HIAs should be made explicit and put in perspective.

- The application of Geographic Information Systems (GIS) in HIA should be explored, and ways should be sought to combine GIS with standard statistical tools.
- Whenever possible, opportunities to follow up and validate HIA methodology should be used.

Priorities concerning the institutional framework and infrastructure of HIAs included the following:

- An overview of current HIA practice in Europe would be useful. Such a report would include policies, procedures, methods, institutions, and case studies.

- The exchange of HIA documents and literature should be facilitated, and the use of electronic resources such as offered by the PENELOPE network explored.

- A series of European HIA workshops should be held, for example several 2-day workshops over the next three years. Strategies for capacity-building should be explored.

- The production of HIA toolkits and need for consensus-building activities should be explored.

HIA components, methods, tools

This section tries to look at HIA systematically, including HIA components, applicable methods, and specific tools. In the past, procedures often received most of the attention. The focus of concern may now have to shift to methods and tools, or at least give them equal weight.

What are the key components of HIA? Prospective HIA seems impossible without a more or less explicit idea of what the future situation will be like. Prediction of a future situation or course of events is the first key component. The second component is the actual assessment and involves attaching value statements to the predicted future. It seems widely accepted that HIA, by its very nature, requires public participation, which is not possible without adequate communication. Finally, if we want to gradually improve HIA we must systematically and critically evaluate

current practices and results. Thus the HIA "gameboard" can be drawn as follows:

Prediction: predict one or more futures (if ... then)	**Communication**: communicate the prediction(s), use visualization	**Evaluation**: evaluate the prediction(s) and the communication of predictions
Assessment: assess the predicted future(s)	**Communication**: communicate the assessment(s)	**Evaluation**: evaluate the assessment(s) and the communication of the assessments

In the environmental health context, the key method for prediction is quantitative risk analysis (QRA), with different modes depending on whether the noxious agents of interest do or do not have thresholds. QRA may be seen as a special case of mathematical modelling. Examples of modelling in Environmental Health include the following:

- modelling of emission = f (traffic density, vehicle mix, fuel...)
- modelling of pollutant levels = f (Emissions, street geometry, meteorology, "environmental fate"...)
- modelling of exposure = f (pollutant levels, time budgets, activities, intake rates...); single or multiple exposure pathways
- modelling of effect = f (exposure, disposition, co-morbidity, etc.).

As a general rule, the modelling approach is more promising for simpler topics.

A prerequisite for the assessment of predicted future(s) is the existence of implicit or explicit values, e.g. health, equity, sustainability, personal freedom. The assessment can be based on the following methods:

- spontaneous, subjective (like / dislike)
- comparison of alternatives (e.g. in the form of ranking procedures)
- standards and criteria (for air, water, noise, etc.).

HIA **tools** include checklists, inquiry systems, modelling computer programs, etc. The same tool may be useful for several procedural steps.

Annex 2 tries to allocate selected tools to the steps of the Bielefeld EHIA procedure.

Levels of complexity, integration and quality criteria

HIA can be conducted on different levels of complexity, each of which has specific strengths and weaknesses (Table 1).

Table 1: HIA levels of complexity

HIA level	Basis	Strength	Weakness
zero	none	no cost	missed opportunity
ad hoc	improvised procedure, combining various approaches and opinions	low cost, fast	subjective, unreliable
qualitative	expert rating(s), based on explicit body of knowledge	widely applicable, moderately time-consuming	Limited transparency of how experts reach their conclusions
quantitative	prediction based on modelling; assessment based on explicit standards	ideally, best use of existing knowledge, high transparency	for a given topic, models and standards may be unavailable
integrated	as above plus use of a common metric, e.g. DALYs, Euros	allows to summarize and compare different impacts on human health, e.g. cancer, mental illness	algorithm of common metric introduces new element of subjective judgement

The following **quality criteria** might be considered for HIA:

- transparency of how the prognosis and the assessment are done
- objectivity (as far as achievable)

- choice of adequate modelling (e.g. agents with vs. without threshold limit)
- level of completeness of health outcomes considered
- explicit representation of both variation and investigator uncertainty
- integration of outcomes.empirical basis for the assumptions which enter into the HIA

Future developments

- **Feasibility**: HIA is not at all "impossible", it can be done. Examples of concurrent and prospective HIA exist. However, the current HIA situation in the field of Environmental Health is far from satisfactory. Standards of HIA practice should be improved, improving both scientific rigour and practical flexibility.

- **Public health expertise**: Where other sectors and departments, especially the environmental sector, have primary responsibility for health-related impact assessments, public health expertise should always be involved, in order to ensure a broad public health perspective.

- **Systematic analyses**: Given the wealth of existing approaches, it is useful to systematically analyse what has been done in the field of HIA. This should include how HIA was done (procedures, methods, tools), and what the actual effects of HIA on policy development and decision-making were. Quantitative Risk Assessment as applied in environmental health might be used for public health applications.

- **Priority areas of development** include:

- the development and evaluation of integrated measures of health outcome, including further exploration of the pros and cons of monetary measures
- the adequate coverage not only of health risks but also of health promoting factors

- a focus on alternative projects, plans, programs rather than on "acceptable burdens".

➢ **HIA training and information programs** may be directed towards at least 3 different target groups:

- persons needing to perform HIA themselves, at an expert level;
- persons responsible for the correct performance of HIA;
- Public Health generalists and decision-makers who want to know the basic principles of HIA.

In order to avoid illusions and to make best use of this policy tool, HIA needs to be seen in the overall context of health promotion and health policy.

References

1. Fehr, R., Prätor, K., van der Veen, A., Jukes, G. (1996): Environmental health information management (EHIM). Development of a European system. In: Frentzel-Beyme, R., Ackermann-Liebrich, U., Bertazzi, P.A. et al. (eds.): *Environmental epidemiology in Europe 1995. Proceedings of an international symposium.* Commission of the European Communities; BIPS Bremen, Germany.

2. Kobusch, A.-B., Fehr, R., Serwe, H.-J. (1997):Gesundheitsverträglichkeitsprüfung. Grundlagen – Konzepte – Praxiserfahrungen. Nomos Verlagsgesellschaft, Baden-Baden.

3. Fehr, R. (1999): Environmental Health Impact Assessment: evaluation of a ten-step model. *Epidemiology* vol.10, no.5, Sept. 1999, pp.618-25.

4. Fehr, R., Lebret, E. (1999): Report on the Scientific Meeting "Health Impact Assessment of transportation - the regional perspective", Institute of Public Health (loegd) North Rhine-Westphalia, Bielefeld, and Dutch Institute of

Public Health and the Environment (RIVM), Bilthoven, in Bielefeld, May 17-18, 1999.

5. Fehr, R., Lebret, E., Ackermann-Liebrich, U., Kofler W. (in print): *Integrated Environmental health impact assessment of transport policies and projects.* Paper prepared for WHO European Centre for Environmental Health (ECEH) Rome, Transport, Environment & Health (TEH) project.

6. For the TEH charter, the background document, and the Austria - France - Switzerland impact assessment, see: http://www.who.dk/London99/WelcomeE.htm

Annex 1: Chronology of Health Impact Assessment (HIA): Global and local events

"Early times"

1969	US National Environmental Policy Act (NEPA)
1970	California Environmental Quality Act (CEQA)
1978	WHO-Europe seminar on EIA, with Public Health representatives
1979-81	EHIA, with strategic aspects, of a superhighway project in a mountainous tourist region in Tyrole

1980s

1980	Aberdeen. EIA training program, sponsored by WHO
1982	Resolution of 35th World Health Assembly on HIA
1985	Council of the European Communities: Directive on the assessment of the effects of certain public and private projects on the environment; article 3 incl. direct and indirect effects on human beings
1986	WHO "Ottawa Charter for Health Promotion" calls for the systematic evaluation of health implications
1986	WHO, Copenhagen: HIA meeting, with report (1987): "Health and Safety Component of Environmental Impact Assessment (EIA)"
1986	Netherlands: Milieu-Effect-Reportage (MER) Act
1987	WHO Work programme 1990-95: "WHO will promote environmental health impact assessment"
1987	Canada: National HIA Workshop
1989	US-EPA: publications on Quantitative Risk Assessment
1989	VROM Netherlands: Gezondheidseffectrapportage
1989, Dec.	WHO-Europe: European Charter "Environment and health" calls for improved coverage of health in Environmental Impact Assessments
1989 / 1990	Canada: Four regional HIA workshops

Early 1990s

1990, Feb.	Germany: Environmental Impact Assessment Act (UVPG)
1991	UN-Economic Commission for Europe: Convention on Environmental Impact Assessments in a transboundary context; Espoo, Finland
1992, Feb.	European Communities: Treaty on European Union (Maastricht), Article 129: "Health protection requirements shall form a constituent part of the Community's other policies"
1992, June	UN Conference on Environment and Development, Rio de Janeiro: Agenda 21, incl. Ch. 8: Integrating environment and development in decision-making
1992	US-Agency for Toxic Substances and Disease Registry: Public Health Assessment
1992	California Air Pollution Control Officers Association: Health Risk Assessment
1992, Nov.	Conference of the German Ministers of Health: resolution on HIA in the context of Environmental Impact Assessment
1992, Nov.	OECD: Good practices for EIA on development projects
1992ff.	North Rhine-Westphalia Research Consortium: HIA project, funded by the Federal Ministry of Research and Technology
1993	WHO-Europe: Health For All, Target 19 on Environmental Health management, incl. HIA)
1993	Australia: Environmental Health Impact Assessment
1993, Dec.	University of Bielefeld and IDIS institute: First German HIA workshop
1994, June	WHO-Europe & European Commission: European Action Plan "Environment and Health" calls for improved HIA
1995	New Zealand Public Health Commission: A guide to Health Impact Assessment
1995, May	Commission of the European Union: First report on the integration of health protection requirements in Community policies
1995, Dec.	Council of the European Union: First resolution on the integration of health protection requirements in Community policies
1995ff.	University of Bielefeld: Project on Quantitative Risk Assessment

1996, Sept.	Commission of the European Union: Second report on the integration of health protection requirements in Community policies
1996, Nov.	Council of the European Union: Second resolution on the integration of health protection requirements in Community policies

1997

1997, April	UN, Commission on Sustainable Development: Overall progress achieved since UNCED. Addendum on protecting and promoting human health included: Unfulfilled expectations - Incorporating health in environmental impact assessments; Emerging priorities - Incorporating health in environmental impact assessments
1997, July	Geneva: WHO / ILO meeting on Environmental Health Impact Assessment
1997	University of Bielefeld, loegd & working group HIA: Survey on HIA training programs in Germany
1997, Oct.	European Communities: Treaty of Amsterdam
1997, Dec.	HIA monography (in German)

1998

1998, Jan.	North Rhine-Westphalia: Public Health Service Act, §8: HIA concerning regional planning
1998, Jan.	Commission of the European Union: Third report on the integration of health protection requirements in Community policies
1998, April	Council of the European Union: Third resolution on the integration of health protection requirements in Community policies
1998	IFUA on behalf of the State Institute of Public Health: Survey on the status quo of HIA in North Rhine-Westphalia
1998-99	WHO Rome: "Transport, Environment and Health" (TEH) project
1998, July	European Forum on Transport, Environment and Health, Vienna: International conference on environment related health impacts of transport and First preparatory meeting of the WHO member states for the TEH segment at the 3rd Ministerial Conference on Environment and Health in London 1999
1998, Nov.	Health department of the city of Hamm: HIA as a "product" of the group "Environmental health" services

1998, Nov.	First UK conference on HIA

1999

1999, Feb.	STAKES Institute, Helsinki: meeting "Healthy public policies in the European Community"
1999	WHO-European Centre for Health Policy (ECHP): e-mail-based HIA network
1999, April	HIA - A paper for the Welsh Public Health Network group
1999, May	lögd institute Bielefeld: workshop "HIA of transportation - the regional perspective"
1999, June	Third European Ministerial Conference Environment and Health, London; incl. Charter "Transport, Environment and Health"
1999, June	International Association of Impact Assessment conference: HIA workshop, Glasgow, UK
1999, July	HIA training course, organized by Merseyside HIA Training Consortium, Liverpool
1999, Aug.	Final report of the HIA group of the German Working Group of Chief Officers of the State Health Departments
1999, Sept.	International Society of Environmental Epidemiology (ISEE), Athens: Session "Accepting epidemiological evidence for Environmental Health Impact Assessment - report of the WHO working group"
1999, Sept.	Section: "Methods for health impact assessment in environmental and occupational health. A selection of the papers presented at a consultation sponsored by WHO and ILO, Geneva, 9-11 July, 1997" (10 papers, editorial), in Journal "Epidemiology"
1999, Oct.	WHO and Nordic Schools of Public Health, Gothenburg: HIA meeting

Annex 2: Selected computer tools and resources for EHIA

Step / components	Tools and resources
Step 1: Project analysis • Qualitative and quantitative project description • Hazard identification: compilation of emission inventory covering chemicals, odors, noise, radiation, and biological agents	• Industry-specific emission inventories, e.g. PROSA, GEMIS • Identification of chemicals via CAS no., e.g. ECDIN, NIS • Tools for chemical property estimation, e.g. RiskPro • Scientific / technical bibliographies, e.g. MEDLINE, SOMED • Full text / hypertext sources • Internet search engines and meta-databases
Step 2: Regional analysis • Definition of boundaries of the geographic area of interest • Compilation of time-space-related data on the area of interest, including geo-physical data (e.g. on terrain), meteorological data (e.g. on wind distribution), data on land-use and industrial activities	• Meta-information on time-space-related data / access to emerging "data warehouses" • Directory of institutions which provide such data • Geographic Information Systems (GIS) for handling of time-space-related data
Step 3: Population analysis • Identification of the population potentially affected by the development: residential population, occupational work-force, persons visiting the area, e.g. hikers • Compilation of data on the various populations: population size by age, gender • Analysis of health status: morbidity (e.g. based on school health examinations), mortality • Identification of vulnerable groups including old / very young persons, pregnant women • Description of consumption of local food products	• Statistical offices: population data, mortality data • Local health departments: morbidity data • Any appropriate surveys, e.g. on consumption of local food products • Statistical packages, e.g. EpiInfo and commercial software packages • Geographic Information Systems (GIS)

Step / components	Tools and resources
Step 4: Background situation Compilation of background pollution data concerning: • Air (outdoor / indoor) • Water (drinking water, groundwater, bodies of surface water) • Soil, incl. contaminated sites • Food	• Environmental monitoring • Environmental reports, e.g. UBA: "Daten zur Umwelt" • Systematic information on emissions from point sources / industrial plants. Toxics Release Inventory (TRI) in USA • Geographic Information Systems (GIS)
Step 5: Prediction of future pollution levels • Prediction of future emissions from the project • (Based on predicted emissions:) Pollutant dispersion modelling • (Based on dispersion modelling:) Prognosis of future pollutant concentrations in environmental media	• Technology-related specifications as a basis for prognosis of emissions from the project • (Multi-media) dispersion models (e.g. ISC-LT, MISKAM) and determination of dilution factors, using e.g. EML, EpiCode, Risk*Assistant, RiskPro • Tools to support selection of dispersion models, e.g. IMES
Steps 6 and 7: Prediction and assessment of health impacts • Qualitative assessment of impact on quality of life, e.g. by rating / expert judgement • Survey of citizen concerns about health impairments and quality of life • Total exposure assessment, using all pathways and various scenarios, e.g. concerning patterns of food consumption and leisure activities • Comparison with legal limit values and / or recommended reference values, e.g. Acceptable Daily Intake (ADI) • Quantitative Risk Assessment (QRA), especially for carcinogens	• Bibliographies, e.g. MEDLINE, SOMED • Population survey, using software for questionnaire design and statistical analysis • Round-table discussions with public participation • Tools for dose-response estimation, e.g. GEN.T, EPID.T • Tools for exposure modeling, e.g. EML, @risk, HRA92, Risk*Assistant, RiskPro • Sources of reference values , e.g. HEAST, IRIS, TOMES plus, NIS • Tools for determination of Hazard Index and Hazard Quotient, e.g. HRA92 • Tools for risk (cancer risk, cancer burden), e.g. HRA92, Risk*Assistant, RiskPro

Step / components	Tools and resources
Step 8: Recommendations • Formulation of recommendations concerning reduction or modification of emissions • Formulation of recommendations concerning mitigation • Formulation of recommendations concerning follow-up examinations	• Bibliographies, e.g. MEDLINE, SOMED • Full text / hypertext sources • For follow-up, as appropriate: setting up systems of environmental monitoring, biomonitoring (flora, fauna) and human biomonitoring of internal exposure and / or effect
Step 9: Communication of analyses, interpretations, and deliberations • Presentation of summary of analyses and results • Citizen participation: implemented throughout the IEHA procedure, but culminating in the discussion of analyses, interpretations, and deliberations	• Geographic Information Systems (GIS) for presentation of time-space-related information • Tools for report generation on results of risk assessment etc., e.g. Risk*Assistant • Tools for visualization using multi-media
Step 10: Evaluation • Validation of prognosis • Analysis of decision-making process	• As appropriate, statistical analysis of results from environmental monitoring, biomonitoring, human biomonitoring, epidemiological survey etc. and comparison with predicted effects • As appropriate, external review of decision-making process, e.g. based on interviews and / or analysis of technical and administrative documents

Source: adopted from (1, 5).

Health Impact Assessment: from theory to practice

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EUROPEAN HEALTH21 TARGET 14

MULTISECTORAL RESPONSIBILITY FOR HEALTH

By the year 2020, all sectors should have recognized and accepted their responsibility for health.

(Adopted by the WHO Regional Committee for Europe at its forty-eighth session, Copenhagen, September 1998)

ABSTRACT

Health impact assessment (HIA) is increasingly recognized as a potentially powerful tool in the achievement of multisectoral action for greater equity in health. The report on the meeting clarifies some of the basic concepts and definitions of HIA and proposes an approach towards a transparent process of HIA implementation. It brings together papers highlighting HIA experience in countries presented at the workshop (organized by WHO's European Centre for Health Policy and the Nordic School of Public Health) and the discussion that these papers generated. Finally, it records some of the recommendations made for future collaborative work to further develop HIA methods, processes and tools.

Keywords

HEALTH PLANNING — organization and administration
NATIONAL HEALTH PROGRAMS — organization and administration
HEALTH POLICY
INTERNATIONAL COOPERATION