

EnVIE conference
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The WHO work on indoor environments

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<http://www.euro.who.int/air> - <http://www.euro.who.int/housing>



This presentation:

- Plan for development of WHO IAQ Guidelines
- Guidelines on IAQ – Dampness and Mould
- Developing IAQ guidelines on selected substances
- Other WHO work on indoor contaminants

Development of WHO Guidelines for Indoor Air Quality Working Group Meeting, Bonn, 23-24 October 2006

38 participants

(14 countries,
EC, WHO, IARC)



http://www.euro.who.int/Document/AIQ/IAQ_mtgrep_Bonn_Oct06.pdf

Development of
WHO Guidelines for
Indoor Air Quality

Report on a Working Group Meeting
Bonn, Germany
23-24 October 2006

Co-chairs: M. Jantunen, HR Anderson
Rapporteur: Kwok Wai Tham



Development of WHO Guidelines for Indoor Air Quality Working Group Meeting, Bonn, 23-24 October 2006

Three small groups

- Air pollutant specific guidelines
- Biological agents
- Combustion and other developing world issues

Tasks of the small groups

- Confirm the health relevance of the group of agents
- Recommend format of the guidelines
- Recommend actions to develop the guidelines (systematic review etc)

Group A – Air pollutant specific guidelines

Table 1. Specific compounds recommended for development of guidelines.

Group 1	Group 2
1.1 Formaldehyde	2.1 Toluene
1.2 Benzene	2.2 Styrene
1.3 Naphthalene	2.3 Xylenes
1.4 Nitrogen dioxide (NO ₂)	2.4 Acetaldehyde
1.5 Carbon monoxide (CO)	2.6 Hexane
1.6 Radon	2.7 Nitric oxide (NO)
1.7 Fine particles (PM _{2.5})	2.8 Ozone (O ₃)
1.8 Halogenated compounds (tetrachloroethylene, trichloroethylene)	2.9 Phthalates
1.9 PAH (BaP)	2.10 Biocides, Pesticides
	2.11 Flame retardants
	2.12 Glycol ethers
	2.13 Asbestos
	2.14 Carbon dioxide (CO ₂)
	2.15 Limonene and pinene

Criteria of classification to group 1:

- ✓ Indoor sources
- ✓ Toxi / epi data available
- ✓ Indoor levels of health concern

Group B – Biological Agents

Identification and prioritization of factors

- Dampness and mould
- Ventilation
- Allergens
 - From house dust mites (HDM)
 - From pets

Guidance

- Qualitative identification of sources / exposure
- Technological solutions

Group C – Combustion of solid fuels

- **Stove Venting**
 - Flues; Hoods
- **Household ventilation**
 - Natural / Forced
- **Combustion quality**
 - Stove types
 - Burning temperature
 - Air / fuel ratio
 - Fuel consumption
- **Cleaner fuels**
 - Solid
 - Processed biomass
 - Liquid fuels
 - Gas fuels
 - Electricity

Guidance /

Technology - based guidelines

Each option to include:

- Purpose
- Possible technical solutions
- Evidence on impacts on IAQ (PM, CO, ..)
- Evidence of total exposure reduction
- Practical limitations (costs, feasibility)

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Development of WHO Guidelines on IAQ : Dampness and mould

Background material:

1. Introduction
2. Building dampness and its impact on indoor exposures to biological and non-biological pollutants (J. Douwes - NZ)
3. Moisture control and ventilation
(O. Seppänen, J. Kurnitski - FIN)
4. Health effects associated with dampness and mould
(M. Mendell - USA, T. Sigsgaard, J. Bonlokke, H. Meyer - DEN,
M-R. Hirvonen, M. Roponen - FIN)
5. Evaluation of human health effects

Review (August – Oct. 2007): 3-4 invited experts / chapter + SG



Development of WHO Guidelines on IAQ : Dampness and mould: WG meeting, 17-18 Oct 07

Working Group members: 32 experts (16 countries)
- authors, reviewers, SG members, EC, WHO (+ CEFIC)

Co-chairs: A. Nevalainen, B. Seifert
Rapporteur: L. Morawska

RECOMMENDED GUIDELINES: formulated at the meeting

Meeting report – <http://www.euro.who.int/Document/E91146.pdf>

GUIDELINES – to be launched by the end of 2008



WHO Guidelines for Indoor Air Quality: Dampness and Mould WG Meeting, Bonn, 17-18 October 2007

Summary of the health risk evaluation (selected items)

- **Sufficient epidemiologic evidence ... showing that occupants of damp or mouldy buildings, ... are at increased risk of experiencing respiratory symptoms, respiratory infections, and exacerbations of asthma.**
- Some evidence suggests an increased risk of **developing allergic rhinitis and asthma.**
- **Remediation** of dampness problems leads to **reduction in adverse health outcomes.**
- **Clinical evidence:** exposures to moulds and other dampness-related microbial agents increase the risk of rare conditions, such as hypersensitivity pneumonitis/allergic alveolitis, chronic rhinosinusitis and the allergic fungal sinusitis.

WHO Guidelines for Indoor Air Quality: Dampness and Mould WG Meeting, Bonn, 17-18 October 2007

WG Recommendations (selected) (1 of 2)

- **Persistent dampness and microbial growth on interior surfaces and in building structures should be avoided (or minimized) as they may lead to adverse health effects.**
- **Indicators of dampness and microbial growth include:**
 - presence of condensation on surfaces or in structures,
 - visible mould,
 - perceived mould odour,
 - history of water damage, leakage or water penetration.
- **No quantitative health based guideline values or thresholds can be recommended for acceptable levels of specific micro-organism contamination** (no quantitative exposure-effect relationships available at present).

WHO Guidelines for Indoor Air Quality: Dampness and Mould WG Meeting, Bonn, 17-18 October 2007

WG Recommendations (selected) (2 of 2)

- **Dampness and mould-related problems should be prevented.** When they do occur, they should be remediated because of the increased risk of adverse microbial and chemical exposures.
- Well-designed, constructed, and maintained **building envelopes are critical to the prevention and control of excess moisture and microbial growth** by avoiding thermal bridges and preventing intrusion by liquid or vapour phase water.
- **Management of moisture requires proper control of temperatures and ventilation** to avoid high humidity, condensation on surfaces, and excess moisture in materials. Ventilation should be distributed effectively in spaces and stagnant air zones should be avoided.

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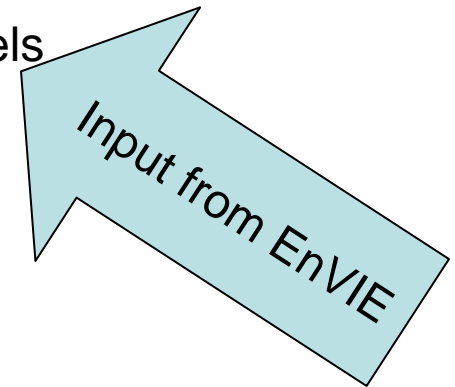
Air pollutants-specific guidelines – 2008/9

Pollutant	Authors of background material
Formaldehyde	C. Mandin (FRA), DA. Kaden (USA), P. Wolkoff, G.D. Nielsen (DEN)
Benzene	R. Harrison, J.D. Saborit (UK), F. Dor (FRA)
Naphtalene	D. Kotzias, S. Kephelopoulos (JRC), A. Buckpitt (USA)
NO ₂	V. Ezratty, G. Guillosoou (FRA), F. Kelly, D. Jarvis (UK)
CO	D. Penney (US), D. Kotzias, S. Kephelopoulos (JRC), A. Verrier (FRA)
Radon	M. Kreuzer (GER), J. McLaughlin (IRE)
Trichloroethylene	M. Loh (FIN), N. Bonvallot (FRA)
Tetrachloroethylene	M. Loh (FIN), N. Nijhuis (NET)
PAH (BaP)	R. Harrison, J.D. Saborit (UK), H. Komulainen (FIN), H. Choi (USA)

Air pollutants-specific guidelines – 2008/9

Structure of the assessment for each pollutant:

1. General description of the compound
2. Indoor sources and pathways of exposure
3. Current indoor levels and relationship with outdoor levels
4. Kinetics and metabolism
5. Health effects (non-cancer and carcinogenic effects)
6. Evaluation of human health risk
7. Guidelines and guidance (WG)
8. References



Air pollutants-specific guidelines – 2008/9

Time schedule:

1 Sept 2008	Selection of background material authors completed
1 Nov 08	Background material drafted
15 Nov 08	Background material distributed for external review (reviewers needed!)
1 Jan 2009	Comments returned
Feb/Mar 09	Working Group meeting – recommendation of guidelines
July 09	Background material finalized / edited
Nov 09	IAQG cleared and published



Funding available from France, Netherlands, UK

Development of WHO Guidelines on IAQ: Next steps

2008-9

Development of guidelines on:

- combustion products (Group C)**
- ventilation**
- allergens**

Funding needed

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WHO review of actions related to dampness and mould

Collection of case studies aiming at:

- Reduction of relative humidity in indoor air
- Reduction of damp / condensation in/on building structures
- Removal / prevention of mould growth
- Improvement of ventilation / air exchange rates

with the overall objective of exposure reduction and health benefits

Indoor spaces covered:

- Residential buildings / dwellings
- Schools
- Child and elderly centres with focus on non-care elements
- (typical medical care settings are excluded)

Case study review: Health assessment and associated problems

30 case studies collected from 11 countries

=> 17 case studies collected for discussion at WHO expert meeting

- 13 studies used questionnaires, six of them conducted medical examinations
- Effect sizes for improvement of health were greater if the authors used self reported data
- Possibility of a placebo effect, because blinding is not possible
- Possibility of publication bias

Results - scientific perspective

A: Prevention

- **Moisture control is the key**
- **Building standards**, building maintenance, ventilation systems and behavioral campaigns **can be effective**
- Solutions depend on climate and building use

B: Remediation

- **Proper remediation is effective** (good exposure evidence, some health evidence)
- **Needs to go with moisture control measures**
- May **include building, equipment and design adaptations**
- Has to be done promptly
- Depends on building use and occupants

Results - technical perspective

Key elements of successful actions identified from case studies

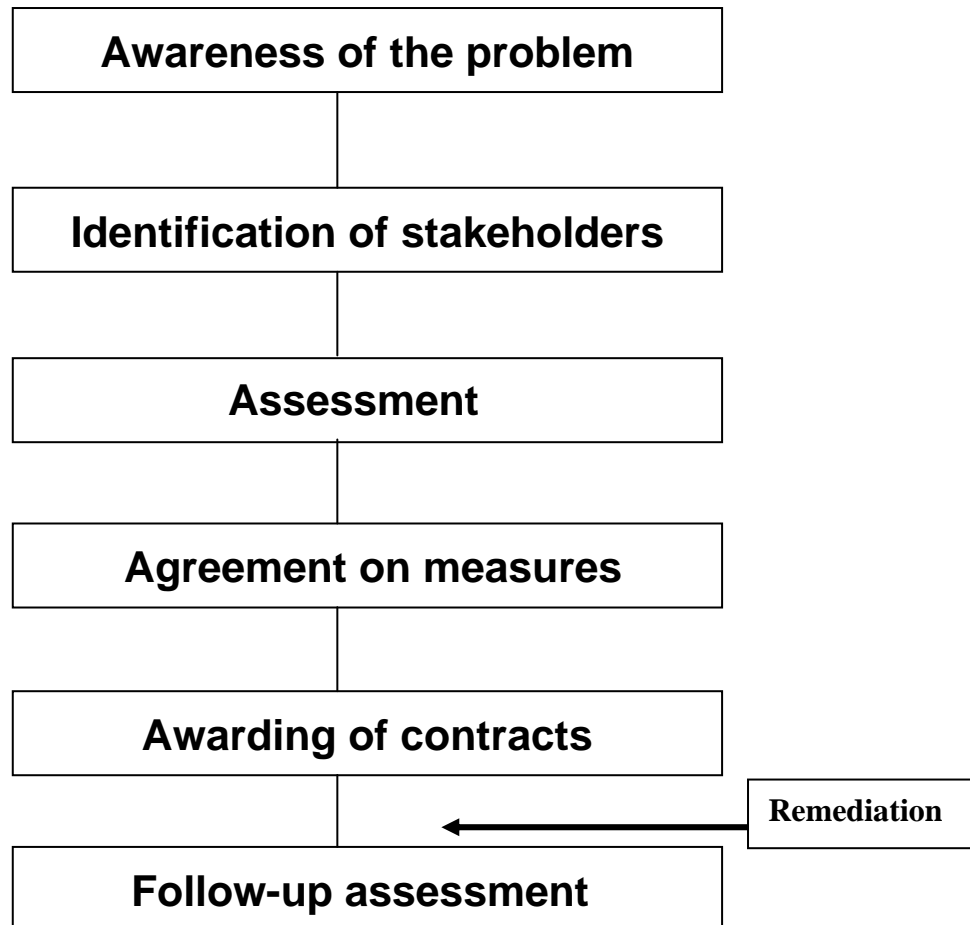
- examination of buildings by experts with proper tools
- **resolution of moisture problem causes**
- **removal of mould as well as damaged material** (mechanical or chemical cleaning)
- drying remaining structures
- **improvement of ventilation and thermal insulation**
- use of proper materials that do not promote mould growth
- protection of workers
- **prevention of cross-contamination** by separating clean-up areas from non-infected areas initiating remediation work as soon as possible
- minimizing the remediation period to prevent occupant discomfort
- relocation of occupants to reduce exposure and health complaints
- **follow-up of remediation and quality control.**

Results - technical perspective

Hygrothermal problems	Remedial action
1) Increased relative humidity indoors 2) Surface condensation without increased indoor humidity 3) Combined problem	1) Addressing indoor moisture sources, control of ventilation and HVAC systems, increasing temperature as necessary 2) Addressing thermal insulation, including local thermal bridges and defects 3) Measures starting with relative humidity indoors
Outdoor sources	Remedial action
1) Outdoor sources and rising damp	1) Diagnosis of moisture path, necessary actions addressing drainage, sealants, water-membranes, flashings, water stops, capillary layers etc. Consultation with an expert may be recommended.
Indoor sources	Remedial action
1) Plumbing 2) Occupants	1) Inspection, repairs and replacements 2) Addressing exact moisture source, educating occupants to change occupant behaviour
Catastrophic events	Remedial action
1) Flooding, storm water intrusion, fire fighting efforts, major waterline breaks, etc.)	1) Temporary relocation occupants, immediate remedial actions

Results - process perspective

Good practice process



Responsibilities

Description / Actors

Description / Actors

Description / Actors

Description / Actors

Description / Actors

Description / Actors

Results Working group C (Process perspective)

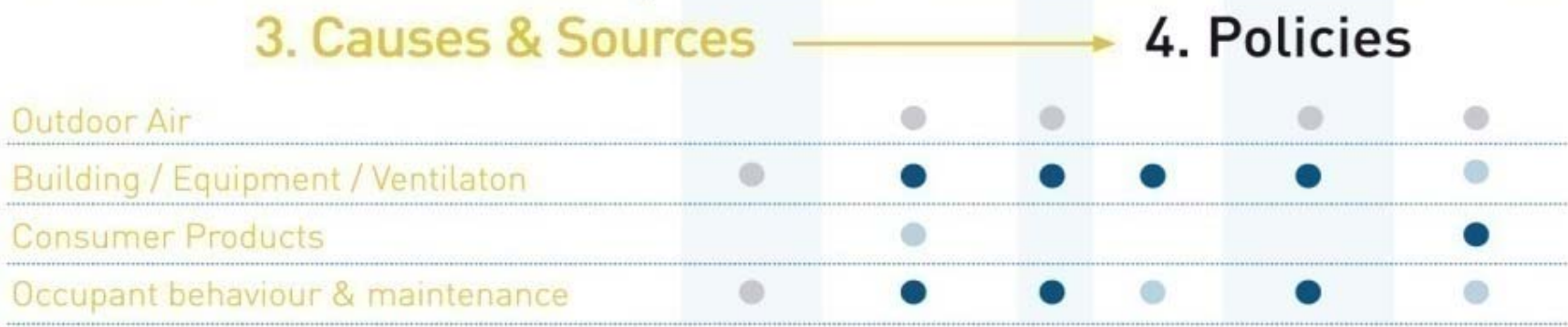
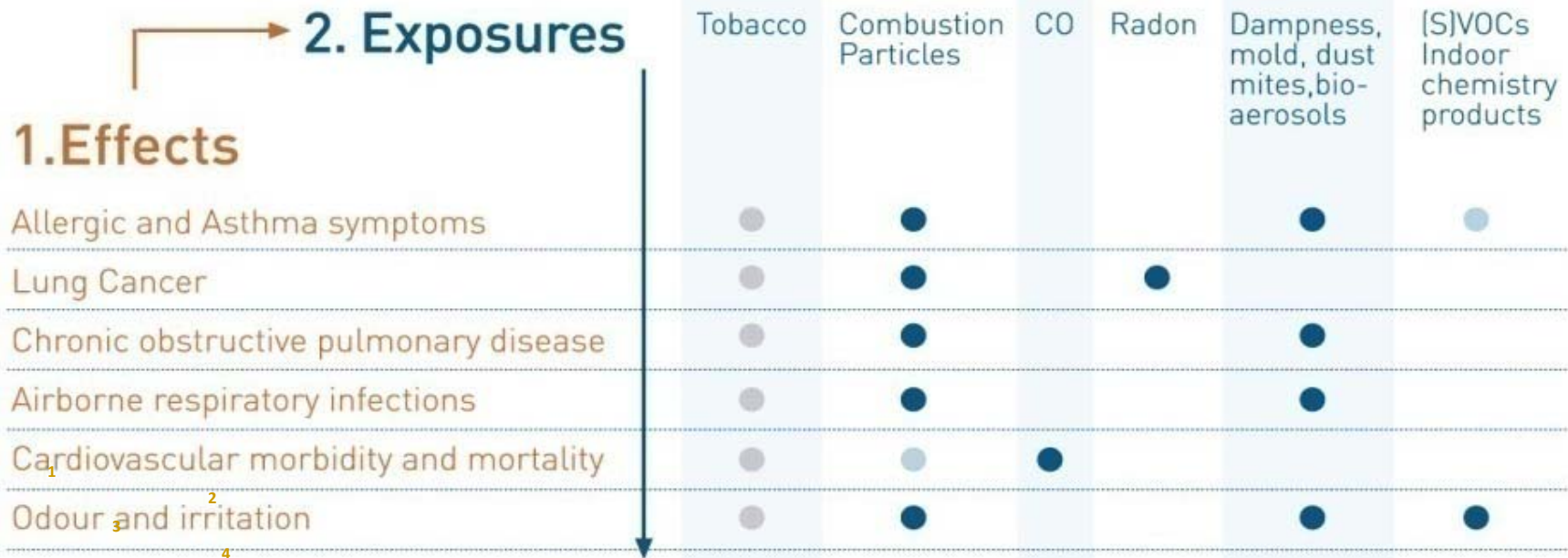
Example

Stage 3: Assessment	
Description	<p>Mould/dampness problems should be fully investigated to determine their causes. The assessment can be carried out on medical grounds, building physics investigation and tenant/occupant interview.</p> <p>Guidance can be given to the tenant/owner as to the level of intervention that may be required.</p>
Actors or stakeholder involved	<p>Occupants should be encouraged to clean small areas of mould as an initial step.</p> <p>Building owners should assess the extent of affected areas and determine the need to appoint a dedicated professional.</p> <p>Inspectors should be qualified and trained to a suitable level, as determined by a third-party organization where possible. Guidelines should be provided on how to carry out an investigation in a structured and effective manner. A directory of approved inspectors could be provided to ensure quality.</p> <p>Medical professionals should carry out examinations where a patient referral has been requested. Any diagnosis provided should be presented by specialized professionals.</p> <p>Tenant organizations or local authorities could carry out interviews.</p> <p>Funding agencies relevant to the situation should be involved in these discussions.</p>

Overall conclusion

Need for

- inter(national) guidance and tools
- targeted education (construction professionals, craftsmen / potential remediators, occupants)
- (national) guidance values on risk parameters (e.g. relative humidity)
- quality control mechanisms for remediation work
- adequate measures for risk identification (inspections, public information, etc.)
- mechanisms to address private residences
- **STRENGTHEN PREVENTIVE ACTION**



Different colours degrees ●● mean different levels of impact.
 Out of ENVIE scope. ●

EnVIE comments on policy options / proposal

Support to

- Housing / buildings as a health setting to be considered in a multidisciplinary way
 - „fail-safe“ buildings and equipment
 - Ventilation versus insulation / energy efficiency
 - Home safety; fire safety, product safety
 - Tolerance to user behaviour
- Building manual / operating book and responsible building manager
- Regular inspections of HVAC systems
- Smoking ban
- Ban unflued combustion devices

EnVIE comments on priorities

Priority action on

- Inter(national) guidance and tools
- Targeted education and official certification for craftsmen / service companies
- Evaluation and control mechanisms for indoor work and rehabilitation
- Filling the black box of responsibility for private homes (especially in rental sector)
- Policies suitable for the existing housing stock
- Minimum ventilation standards **being realized**
- Smoking ban in indoor settings
- Regulation on smoke and CO detectors
- Incentives and financial support on building renewal and removal of harmful substances
- Product labelling (voluntary and mandatory)
- Harmful materials and home products, toys etc.

EnVIE comments

General comments

- Need to address and find solutions for „other“ health-related effects of IAQ policies
 - => E.g water heating above 55°C to protect from Legionella versus risk for child accidents
- Introduction mentioned „conflicts“ which arise between various policies and objectives
 - => Give priority list to indicate which policy may rule over others
- Consider extending the HVAC inspections into a more solid health risk inspection approach
- Comment on dwelling layout in relation to natural ventilation (cross-ventilation!)
- Remove introductory note on accessibility as it is not discussed throughout the report
- Inform in more detail on the tolerance of policies and building conditions to various user behaviours
- Consider adding a note on relevance of outdoor exposure penetrating indoors (PM etc.)

EnVIE comments

Nota bene I

Sophisticated systems are energy-dependent.

„Fail-safe“ and energy dependency may be a contradiction.

Effectiveness of basic approaches and manually operated systems to be explored / weighed against benefits of powered systems.

EnVIE comments

Nota bene II

Many proposals are possibly increasing housing costs and rent levels.

This will mostly affect low-income households and potentially increase the expression of inequities.

Incentives and financial support campaigns needed.

Further information:

Indoor Air Quality Guidelines:

www.euro.who.int/air (=>Indoor Air Quality Guidelines)

Damp and mould case studies:

www.euro.who.int/housing (=>Policy support; Damp and mould)