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# **IAQ HEALTH EFFECTS AND RISK IDENTIFICATION**

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# IAQ HEALTH EFFECTS AND RISK IDENTIFICATION

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Indoor air quality health effects are the central catalyst for a huge world wide effort to understand the complex inter-relationships between the dose of the chemical, biological, particulate and psychological cocktail (often shaken and stirred before serving) and the wide ranging sub-clinical health effects reported by occupants of buildings. That the effects are real is no longer in question. How they come about, at what level and under what circumstances is the challenge to environmental hygienists and environmental medical specialists worldwide.

Cetec has a special interest in the correlation between subclinical toxicology and human stress conditions. Stress, caused by physical or psychological interactive factors can induce physiological and mental illness, which is often misdiagnosed, even by traditionally qualified medical specialists.

The human factors must be recognised and quantified if successful solutions are to be found in the design and operation of commercial, industrial and residential buildings.

**Airborne contaminants and their adverse affects** constitute the major challenge both in terms of reliable measurement and extrapolation from higher doses known to cause identifiable health effects and promulgated in work place threshold limit values.

<b>Chemical Classes</b>	<b>Reported Health Effects</b>
CO	Tiredness, stuffiness, headaches
CO <sub>2</sub>	Tiredness, stuffiness
CHO	Eye nose and throat irritation (ENTI)
pH	Odour, headaches, cancer (?)
Aldehydes, ketones and alcohols	Odour, ENTI, cancer (?)
Volatile fatty acids	Odour, ENTI
Solvent chemicals	ENTI, headaches, cancer (?)
Process chemicals	ENTI, headaches, skin irritation, cancer (?)
<b>Biological Classes</b>	<b>Reported Health Effects</b>
Irritants	(Many moulds, fungi and bacteria) Emit irritating VOC chemicals such as alcohols, aldehydes, ketones, volatile fatty acids.
Allergens	(Many moulds and fungi and dead bacteria ) Emit or carry allergenic materials resulting in sinusitis, ENTI, lung irritations.
Toxicants	(Many moulds and fungi) Emit or carry toxic or carcinogenic chemicals
Infections	(Bacteria such as pseudomonas, gram-ve) Promote or aggravate lung irritation, ENTI or skin infection.

<b>Physical Classes</b>	<b>Reported Health Effects</b>
Lighting	Eye strain, irritation, headaches
Noise	Distraction
Electrostatics	Discomfort, anxiety, dust accumulation
Electromagnetic Radiation	Effects still under study and speculative
Space and Visual	Claustrophobia, isolation, moodiness, distraction

**Environmental or Occupation Standards** were earlier confused in setting IAQ goals. The general consensus is now clearly that environmental standards apply but the relative toxicity for single compounds (rare) generally follow those listed in occupational standards.

Occupational	Applies to 80% of selected persons fit for task. Incapacitating illness or long term effects expected. Does not protect elderly, young, unfit or unwell.
Environmental	Applies to more than 95% of population without pre-selection. Irritation and discomfort based. Prevents precursors to illness. Protects elderly, young, unfit and unwell.

Qualities required of building occupants.

<b>Activity</b>	<b>Pre-selection Criteria</b>
Security	Fit, strong, alert, focussed
Clerical	Intelligent, focussed, alert
Management	Intelligent, focussed, alert, strategic, fit
Maintenance, engineering and contractors	Intelligent, focussed, alert, fit, chemically tolerant
Visitors	No qualities

**Questionnaire, design and delivery** are highly variable in its approach but most overseas authorities consider that questionnaires are an integral part of an IAQ assessment. Occupants must be regularly screened to provide a target population for building performance and changing baseline establishment. The following are some of the questionnaire types used.

<b>Type</b>	<b>Purpose</b>
Anecdotal and informed	Unstructured reporting by concerned individuals or pressured management. Very difficult and deceptive to use.
Occupier symptom reporting	Structured reporting of health events, unprompted and for problem control.
Self administered questionnaire	Structured simple questionnaire on critical aspects of building occupation and health complaints.
Interview questionnaire	Structured complex questionnaire on all critical elements of building occupation, lifestyle, total health, stress, and psychological issues – suited for epidemiological studies.

There are several stages of concern during the development of indoor air pollution effects.

Stage	Action
Unconcerned and <u>not</u> discomforted	Ideal occupants.
Concerned but <u>not</u> discomforted	Seek HR help.
Discomforted but <u>not</u> actively concerned.	Mild intervention and must be actioned with HR and engineering level.
Discomforted and actively concerned.	Assist with high priority.
Unwell but <u>not</u> actively concerned.	Seek professional help.
Unwell and outraged but <u>not</u> active.	Seek multi-disciplinary professional help.
Unwell and outraged and active and marshalling support.	Seek multi-disciplinary professional help and management help, engage communications expert (and check your own retirement benefits and value of the building.)

**Medical intervention** is not always necessary and must be recommended judiciously. There are several stages and the following table suggests when medical intervention is appropriate of IAQ problems, which have scientific and engineering but no medical solutions.

Stage	Intervention
General health baseline (physical, chemical and psychological)	HR, IAQ specialist, medical
Minor irritations or general complaints	IAQ specialist and environmental hygiene specialists.
Frank irritation as illness	IAQ specialist and environmental health specialist.
Absenteeism	IAQ specialist, environmental health specialists and medical specialist.

**Building Surveys** require strong practical and investigative skills to allow correlation with the condition of the building and possible health effects.

<b>Hazards</b>	<b>Risks</b>
Air-conditioning systems and cooling towers.	Bacterial and fungal accumulation causing VOC and airborne contaminants. Proper operation, cleanliness and maintenance required.
Ducting systems	Original or deposited contamination. Construction defects allowing dust or moisture accumulation. Broken internal insulation, malfunctioning control equipment.
Flooring materials	Solvent and process chemical emissions, wear particles and fibres, microbial and insect contamination.
Paints and coverings.	Solvent and process chemical emissions, dust adhesion.
Ceiling tiles.	Mineral fibres and dust, dust accumulations.
Ceiling works.	Dust traps, ozone generation from fan motors.
Pest control sprays.	Residues, dead insects.
Furnishings	VOC emissions, paints, wood and chipboard dusts (drawers)
Windows	Radiative hot zones.
Computers, printer, photocopiers, VDUs	Ozone, VOC, thermal, dusts
Occupants offices	CO <sub>2</sub> , microbial, particulates, fibres, VOC, dust, paper dust and emissions.
External environment	Traffic VOC, particulates, industrial emissions, building emissions and microbials (legionella)

It is essential to use a structured database when inspecting buildings.

**Hazards and risk assessment** is currently one of the key issues for specialist IAQ researchers and managers. The key risks and their likely causative agents are listed below.

Dose response risk models	VOC, microbial, particulates.
Cancer risk models	VOC, microbial, particulates.
Exposure assessments	Temperature, % RM, VOC, microbials.
Susceptible populations	VOC, particulates at this stage
Behavioral and social effects	IAQ, stress, economics
Productivity losses	Management, psychology, IAQ, economics, engineering

Cetec has case studies for carpets, flooring materials, and materials of construction including

- ? Manufacturing
- ? Installation
- ? Early exposure
- ? Lifetime exposure
- ? Maintenance

