The Medical Perspective on Environmental Sensitivities

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Abstract

Approximately 3% of Canadians have been diagnosed with environmental sensitivities, and many more are somewhat sensitive to traces of chemicals and/or electromagnetic phenomena in the environment. People experience neurological and numerous other symptoms, and avoidance of triggers is an essential step to regaining health. The Canadian Human Rights Commission commissioned this report to summarize scientific information about environmental sensitivities. For those interested in the original scientific and technical literature, an annotated bibliography is available on request from environmentalhealthmed@gmail.com This report addresses issues such as the definition and prevalence of environmental sensitivities; recognition by medical authorities; education and training within the medical community; origins, triggers and symptoms of sensitivities; impact of environmental sensitivities in the workplace; government policies and standards for building codes, air quality and ventilation as they affect individuals with environmental sensitivities; and guidelines for accommodation within the workplace. For people with environmental sensitivities, their health and ability to work rests with the actions of others, including building managers, co-workers and clients. Accommodating people with environmental sensitivities presents an opportunity to improve workplace environmental quality and workers' performance, and may help prevent the onset of sensitivities in others.

Executive Summary

People's responses to factors in their environment vary enormously. For instance, we all know that blue-eyed red-heads are sensitive to sunshine, burning more readily than dark-skinned people. What may be less well known is that some people have debilitating reactions to other aspects of their environment, such as chemicals or electromagnetic phenomena.

This report was prepared to inform employers, service providers and individual Canadians about the medical aspects of environmental sensitivities. It reviews and summarizes the scientific literature on environmental sensitivities. For those interested in the original scientific and technical literature, an annotated bibliography is provided. The report reviews medical issues including recognition and awareness of environmental sensitivities; the range of symptoms and conditions associated with this condition; the development of scientifically sound diagnostic criteria; medical research and treatment; issues regarding building codes and practices that affect the accommodation of people with sensitivities; and the costs and benefits associated with accommodation in the workplace.

Approximately 3% of Canadians have been diagnosed with environmental sensitivities. They usually experience neurological impairments, and often experience other symptoms including runny eyes and nose, headaches, fatigue, pain and breathing and digestive problems. Environmental sensitivities may develop gradually after chronic exposure to relatively low levels of chemicals as seen in "sick buildings," or suddenly after a major exposure to an environmental disaster or a chemical spill. This condition may be initiated by one or a combination of environmental factors such as mould, pesticides, solvents, chemicals off-gassing from carpets or furnishings, or electromagnetic phenomena.

Once a person has developed environmental sensitivities, reactions may occur to a broader range of factors, at levels of exposure that were previously tolerated and that cause little difficulty to many others. The symptoms are reproducible with repeated exposures, and resolve with avoidance of the environmental factor(s). The impact of environmental sensitivities on workers' performance may range from mild (e.g. habituation to chronic exposures such that performance may be sub-optimal although not abnormal), to severe impairment such that work is impossible. Early recognition, environmental control, avoidance of symptom-triggering agents, removal of residual toxins from the body, and recovery of normal biological processes are key to regaining and maintaining health for people with sensitivities. However, susceptibility to sensitivities will be life long.

Internationally and in many Canadian government departments, recognition of environmental sensitivities is developing. Environmental sensitivities and related conditions are eligible for compensation by some Workers' Compensation Boards, although there is marked inconsistency across Canada. Public policy, law and regulation are advancing to protect people from triggers of sensitivities, such as tobacco smoke, pesticides, fragrances and other chemicals in public places.

No-smoking, scent-free, pesticide-free, no-idling and least-toxic cleaning policies in health care and other public institutions are increasingly common, and the medical community is also advocating for broader policies and laws. Consensus is gradually building in the medical community and among academics, as well as in the general population, that many chemicals are not as harmless as we might have believed. The medical community is also increasingly acknowledging environmental sensitivities in medical education.

Modern medicine recognizes that the mind and body are intimately interconnected in the "biopsychosocial model" for health care. However, controversy continues regarding the physical or psychological roots of environmental sensitivities, with ramifications for both health care and workplace accommodation. Research indicates that sensitivities generally have physical causes, with many neurological and psycho-social factors interwoven. Successfully addressing physical symptoms with safe housing, workplaces, food and water may also alleviate psychological symptoms. This is necessary before other psychosocial interventions may be helpful.

Canadian statutes do not prescribe building standards that are protective for people with environmental sensitivities. Building codes focus on topics such as strength of structures. Measures impacting indoor environmental quality, such as building materials or de-gassing of buildings before they are occupied, are not addressed. Insofar as building codes and guidelines are perceived to be sufficiently protective of health and safety, they constitute barriers to research, development, implementation and mandating of safer materials and methods. "Green" guidelines incorporate a wide range of important environmental measures, but do not ensure that indoor environmental quality will be sufficient for people with sensitivities. More stringent guidelines have been developed for schools.

Accommodation of people with environmental sensitivities is an opportunity to improve environmental quality and workers' performance, and to prevent the development of sensitivities in others. Sensitivities vary greatly from one individual to another, so the affected worker should be involved in determining accommodations to minimize potentially harmful exposures in the workplace.

Construction, renovation, repair and maintenance should be conducted to minimize the introduction of pollutants. Finishings, furnishings and equipment should contain low toxicity materials, have virtually no emissions, and be low-maintenance. Problems with structural dampness and moulds may be minimized with good design and construction. These considerations are increasingly important given the desire to conserve energy by reducing ventilation.

In addition to optimizing air quality and flow, ventilation systems must be maintained to avoid microbial contamination. Air filtration may play a role, but filters require frequent, routine maintenance. Least-toxic pest control that minimizes exposure to pesticides is effective and affordable.

Building and maintaining equipment and infrastructure to minimize exposure to electromagnetic radiation, fields and currents requires attention to detail and may entail limited one-time costs. Energy-efficient electrical equipment may (but not necessarily) increase radiofrequencies on electricity lines. Once recognized, however, these problems are amenable to engineering solutions. Health effects of unmeasured and uncontrolled parameters such as the quality of the electrical signal, radiofrequencies, locally elevated exposure levels and ground currents may have contributed to a lack of consensus in research regarding health effects of electromagnetic phenomena.

Workplace accommodation may include renovations, but some of the most important accommodations involve behaviour changes. These include the use of least-toxic cleaning and pest control practices, and avoidance of scented products. Unlike "built" accommodations such as ramps, accommodating people with sensitivities actively involves many people, such as employers, co-workers, others in the school or workplace, neighbours, etc.

There are high costs to society of not caring for people with sensitivities, and workplace environmental quality affects workers' productivity, health and attendance. Building or renovating with a view to accommodating people with sensitivities is not usually more costly over the long term, in part because hard, durable surfaces that do not off-gas are longer-lasting and require less maintenance. Education and leadership for behaviour change in the workplace is not expensive. Thus, improving the environmental quality of the workplace is an economically sound decision, as well as the best option for workers' health.

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I Introduction

People's responses to factors in their environment vary enormously. For instance, we all know that blue-eyed red-heads are sensitive to sunshine, burning more readily than dark-skinned people. What may be less well known is that some people have debilitating reactions to other aspects of their environment, such as chemicals or electromagnetic phenomena. Although there is a growing consensus in the medical community and society at large that chemicals in the environment are of concern, environmental sensitivities are neither universally recognized nor fully understood.

This report was prepared for the Canadian Human Rights Commission to examine, from a medical perspective, issues related to environmental sensitivities. The report begins by discussing the diagnosis of environmental sensitivities and conditions commonly occurring along with the range of medical conditions that may arise from environmental sensitivities. This is followed by an overview of the recognition of environmental sensitivities by international, federal, provincial and municipal bodies, and awareness of this condition among medical communities. The report then addresses the initiating factors, triggers, and symptoms of environmental sensitivities, with a focus on how environmental sensitivities affect the workplace performance of those who experience this condition. This is followed by a review of medical research into the initiation and manifestation of environmental sensitivities, and a discussion of how environmental sensitivities are diagnosed and treated. The final sections of the report examine how codes, regulations, policies and guidelines for construction address issues affecting environmental quality. Guidelines for the optimization of the indoor environment and accommodation of people with environmental sensitivities are presented, and the costs and benefits of protective measures are discussed. For those interested in the original scientific and technical literature, an annotated bibliography is available on request from environmentalhealthmed@gmail.com .

II What are "environmental sensitivities"?

The term "environmental sensitivities" describes a variety of reactions to chemicals, electromagnetic radiation and other environmental factors at exposure levels commonly tolerated by many people. These phenomena are not yet fully understood. In contrast, some toxic environmental agents such as such as metals (e.g. lead, mercury), rock dusts (e.g. asbestos, silica), chemicals (e.g. hydrogen sulphide, dioxin) and biological agents (e.g. snake or scorpion venom) are better understood as to their ill effects on people.[1]

"Environmental sensitivities" does not describe a single, simple condition with a universal cause. Environmentally sensitive individuals link their symptoms to aspects of their environment such as being in a particular place or being exposed to one or more factors such as chemicals, biological materials or electromagnetic phenomena. Table 1 lists some terms that have been used to describe aspects of environmental sensitivities.

Adding to the complexity of the clinical picture are overlapping conditions, also listed in Table 1. Environmental exposures may not contribute to all these conditions in all patients, but one should be alert to the possibility that a range of factors may contribute to an individual's ill health.

Table 1: Names used for aspects of environmental sensitivities and commonly overlapping conditions[2,3]*

Aspects of Environmental Sensitivities	**Commonly Overlapping Conditions**
State of heightened reactivity to the environment	Fibromyalgia
Total allergy syndrome	Myalgic encephalomyelitis (ME)
Toxicant-Induced Loss of Tolerance (TILT)	Chronic fatigue syndrome
Multiple chemical sensitivity(ies) (MCS)	Post-viral fatigue syndrome
Multiple chemical hypersensitivity(ies)	Post-infectious neuromyasthenia
Chemical intolerance(s)	Yuppie flu
Gulf War illness/syndrome	Chronic pain
Idiopathic environmental intolerance	Migraine
Environmental illness	Arthritis
Chemical injury/allergy	Allergies
Toxic injury	Rhinitis
Tight building syndrome	Asthma
Sick building syndrome	Food intolerance syndrome
Twentieth century disease	Celiac disease
Chemically induced illness	Irritable bowel syndrome
Chemophobia	Major depression
Electromagnetic (hyper)sensitivities/intolerance	Anxiety or panic disorder
Radiowave sickness	Hypothyroidism

*compiled from literature,[2,3] with input from collaborators

Given the complexities of the condition, the following section examines criteria for determining whether someone is experiencing environmental sensitivities.

A Diagnostic criteria

Diagnostic criteria are such that independent physicians would come to the same conclusion when examining a particular patient. This is important both for treatment purposes and for research.

With regard to multiple chemical sensitivity, thirty-four experienced North American physicians and researchers who had examined patterns of symptoms in thousands of people reached a consensus regarding criteria to establish a diagnosis:

- symptoms are reproducible with repeated exposure;
- the condition is chronic;
- low levels of exposure [lower than previously or commonly tolerated] result in manifestations of the syndrome;
- symptoms improve or resolve when the incitants[a] are removed;
- responses occur to multiple chemically unrelated substances; and
- symptoms involve multiple organ systems.[4]

A systematic literature review confirmed the diagnostic criteria, and suggested that neurological symptoms could be an additional criterion.[2] The consensus diagnostic criteria were also validated, as they identified those most and least likely to be affected among 2,546 patients in Toronto medical practices with high and low prevalence of patients with sensitivities. In the same study, a combination of four neurological symptoms also discerned people most likely affected by multiple chemical sensitivities: having a stronger sense of smell than others; feeling dull/groggy; feeling "spacey;" plus having difficulty concentrating.[5] A pattern consistent with these diagnostic criteria is also reported for sensitivities to electromagnetic phenomena.[6-8]

B Prevalence

Diagnostic criteria are used by physicians to identify a health condition in individuals, and by researchers to determine the proportion of the population experiencing the condition severely enough to seek medical care. Some people with environmental sensitivities are less severely affected and may not seek care. This proportion of individuals in the population is generally investigated with more general questions about reactions to perfumes or other everyday chemicals.

In January 2007, Statistics Canada reported that 5% of Canadians (1.2 million people) suffer "medically unexplained physical symptoms," including multiple chemical sensitivity, fibromyalgia and chronic pain.[9]

According to Statistics Canada's 2003 National Population Health Survey (N=135,573),[b] the prevalence of doctor-diagnosed multiple chemical sensitivities was 2.4% in people aged twelve or older,[9] and 2.9% in people thirty years of age or older.[10] The 2005 National Survey of the Work and Health of Nurses revealed that 3.6% of all Canadian nurses experienced chemical sensitivities (N=18,676).[11] Prevalence in the general American population has been reported to range from 3.1%

[a] incitant: a factor in the environment that provokes symptoms

[b] N designates the number of people included in a research study

doctor-diagnosed multiple chemical sensitivity in Atlanta, Georgia (N=1,582)[12] to 6.3% doctor-diagnosed chemical sensitivity in a large California survey (N=4,046).[13]

Many more people experience less severe sensitivities. Self-reports of heightened sensitivity (feeling ill) on exposure to "everyday" chemicals in American populations ranges from 11% of 1,057 participants in a US national survey [14] and 16% in California,[13] to 33% in rural North Carolina.[15] It is unclear to what extent people experiencing less severe intolerances are at an increased risk of developing full-blown, debilitating environmental sensitivities. However, recent studies have revealed genetic links to sensitivities,[16-22] and biochemical differences between people with sensitivities and "control" populations.[23] Clinical experience shows that increasing chemical exposures are associated with increasing symptoms and reports of sensitivity spreading to more incitants.[3,24]

More women than men are affected by environmental sensitivities. Almost twice as many women as men experienced "sick building syndrome" in a German study,[25] and approximately 60-80% of people diagnosed with environmental sensitivities in various surveys are female. [5,12,26-30]

Environmental sensitivities affect all socio-economic classes, according to population-based surveys.[12,29,30] The recent Canadian analysis indicates that people from a lower socio-economic class are more likely to report medically unexplained symptoms than are people from the highest socio-economic class.[9] On the other hand, clinic-based and citizens' groups surveys indicate that more highly educated or affluent people with sensitivities tend to seek medical care or self-help.[5,27,28]

Sensitivities may occur in anyone, even at an early age.[31,32] Children's respiratory, learning and behavioural difficulties may be associated with toxins passed on from the mother, as well as a variety of factors including pesticide exposure, indoor air quality and foods.[13,33-39] Studies have revealed that the prevalence of environmental sensitivities increases with age. For example, the prevalence of medically unexplained physical symptoms (chronic fatigue, fibromyalgia and multiple chemical sensitivity) in Canadians increases with age from 1.6% of people aged 12 to 24 years, to 6.9% in people 45 to 64 years old.[9] In a Statistics Canada survey of Canadian nurses, 1.4% of nurses younger than 35 years reported chemical sensitivities, which increased to 3.7% in nurses 35-44 years old, and 4.3% and 4.8% in successive decades.[11] Similarly, in studies in Arizona, 15% of college students and 37% of elderly participants reported heightened sensitivities to chemicals.[30,40] Increasing prevalence of sensitivities with age is relevant for the aging workforce, as well as for care of the elderly.

Unlike perfumes and moulds, electromagnetic fields are usually not perceived. Similarly, electromagnetic sensitivities, while plausible,[41] are poorly recognized. The prevalence of electromagnetic sensitivities is estimated to be 1-3% of the population in various countries.[42]

Summary

Environmental sensitivities may contribute to a variety of conditions that have been associated with circumstances (e.g. sick buildings), populations (e.g. veterans), chronic symptoms (e.g. pain or fatigue) or initiating/triggering factors (e.g. "chemical injury" or "radiowave sickness"). Criteria established for diagnosis of chemical sensitivities provide a framework for physicians and researchers to examine environmental sensitivities related to chemicals. Although it is not as extensively studied, this pattern may also apply to sensitivities related to electromagnetic phenomena.

Studies to determine the proportion of the population that experiences varying degrees of environmental sensitivities rely upon identification of the condition. Diagnostic criteria would be reflected in the recently-reported prevalence of doctor-diagnosed sensitivities (approximately 1 million Canadians). Evidence is that up to a third of the population may be experiencing discomfort. Environmental sensitivities affect approximately twice as many women as men, and increase with age. Sensitivities may be associated with higher-risk occupations and they disproportionately affect the poor, while the wealthy are more likely to be treated.

III Recognition and medical education

Along with consensus regarding the diagnosis being established, recognition of environmental sensitivities by decision-makers and in medical education is also necessary.

This section examines recognition of environmental sensitivities by international bodies, by levels of government and agencies, and by the health care community in Canada.

A Recognition

a) International recognition of environmental sensitivities

International recognition

Numerous countries have recognized environmental sensitivities in a variety of manners.

Table 2: International recognition of environmental sensitivities

Country/Region	Type of Recognition
International	• ASHRAE examined air quality standards for industrial settings in the USA and Germany, and concluded that standards are not set to protect environmentally sensitive individuals. Many are set to address irritation over the short term.[c] • Prominent scientists signed the Benevento Resolution (February 2006) affirming that there is considerable and strengthening scientific evidence that low-intensity, low-frequency and radio-frequency electromagnetic fields are responsible for biological effects and health effects. • Scientists called for more research, and a more precautionary approach to standards, recommended exposures and technologies in the market place.[43]
Europe	• Landmark legislation for Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) was passed in December 2006. • Requiring substitution of materials with less-toxic alternatives, which will affect building materials, finishing products, furnishings and equipment.[44]
United States	• Prevalence has been measured, based upon doctor diagnoses, and self-reporting
Germany	• Multiple chemical sensitivity is formally recognized by the national health care system. • The German General Medical Council supported extensive education of medical practitioners regarding environmental medicine, and evidence-based therapies are being developed.[45]
Denmark	• The Danish Environmental Protection Agency recently published a report on multiple chemical sensitivity. It concluded that there is ample evidence that

[c] ANSI/ASHRAE Addendum c to ANSI/ASHRAE Standard 62.1-2004, American Society of Heating, Refrigeration and Air-conditioning Engineers, Inc., Atlanta, Georgia.

	sensitivities are due to environmental contaminants, and that Danish initiatives to minimize off-gassing materials in the indoor environment may have contributed to a somewhat lower incidence in the Danish population. The Agency recommended that measures be taken to prevent the development of sensitivities.[46]
Sweden	• Electrical hypersensitivity is recognized as a disability • Health care facilities with very low electromagnetic fields and radiation are in place for sensitive individuals.[6]
Kazakhstan	• Issued a decree limiting radiofrequencies in wiring to 50 millivolts (microsurges) to decrease "negative influence of physical factors on human health" (November 6, 2003)

Classification of Diseases

The classification of diseases plays an important role in the recognition of and research into medical conditions.

The International Statistical Classification of Diseases and Related Health Problems (ICD) is a long-standing, ongoing international effort to categorize all causes and manifestations of disease. It is compiled and regularly updated by the World Health Organization,[47,48] and it is used as a basis for the provision of health care within Canada.

The ICD-9 includes some relevant categories such as Ill-defined conditions, Injury and poisonings, Late effects of poisoning due to drug and biological substances, Poisoning by drugs and biological substances, and Late toxic effects of non-medical substances. In the most recent version, ICD-10,[49] "environmental sensitivities" is not listed, but the related conditions of Chronic fatigue and Fibromyalgia have now been included. Many other possibly related conditions are also listed, such as Arthritis due to hypersensitivity. In an update of the ICD-10, wood preservatives have been recognized as causing disease.[48]

The ICD is an ongoing project. Recent recognition of environmental causes of ill health, and conditions related to environmental sensitivities are good steps toward a more comprehensive system for the classification of diseases.

b) Recognition of environmental sensitivities by the Canadian federal government and national bodies

Table 3 highlights some initiatives taken by the Canadian federal government and national bodies.

Table 3: Recognition of environmental sensitivities by the Canadian federal government and national bodies

Federal government / National bodies	Recognition
Canadian Institute for Health Information (CIHI)	• CIHI is a not-for-profit independent organization created by Canada's federal, provincial and territorial governments that collects, analyzes and disseminates information on health and health care in Canada. It reviews and publishes the ICD for the Canadian context, which includes diagnoses relevant to environmental sensitivities.
Health Canada	Health Canada's diverse roles include monitoring of health, regulation of drugs and pesticides, and public education. It cooperates with other departments such as Environment Canada and Statistics Canada regarding health and the environment, and regulation of toxic chemicals. • Health Canada, CIHI and Statistics Canada included questions on chemical sensitivities in the 2003 Canadian Community Health Survey,[10] and the 2005 National Survey of the Work and Health of Nurses.[11] • "Healthy Environments for Canadians" (HSPB 88-12), a 1988 report for Health and Welfare Canada, addressed many issues that remain unresolved to this day, such as the health effects of common pesticides and other toxic chemicals. It discusses environmental sensitivities, with special mention of children and the homeless, and it includes a 243-page annotated bibliography. • Health Canada promotes scent-free policies, in part because of environmental sensitivities.[50] • The Canadian Health Network, of the Public Health Agency of Canada, defines chemical sensitivity on its website.[51] • The Pest Management Regulatory Agency, within Health Canada, is the federal regulator for pesticides. The agency recognizes people with environmental sensitivities as a vulnerable population.[52,53]
Canadian Centre for Occupational Health and Safety	• This federal departmental corporation reports to the Parliament of Canada through the federal Minister of Labour. It recognizes multiple chemical sensitivities, sick building syndrome and indoor air quality as important occupational health and safety issues.[54]
Canada Mortgage and Housing Corporation (www.cmhc.ca)	• The CMHC has produced many publications on environmental sensitivities, including books on housing that incorporate innovative design features, materials and construction, indoor air quality, ventilation, heating and cooling, and dealing with moulds and bacterial contamination. • A demonstration house for environmentally hypersensitive people was built in Ottawa, and was the site of a 2006 announcement of federal initiatives addressing toxic chemicals.
National Research Council (www.nrc.ca)	• The NRC has researched indoor air quality extensively in the laboratory and in the field - in homes, commercial buildings, hospitals, and schools. • Research topics include characterization and health effects of contaminants; ventilation, heating and cooling; energy-efficiency; and building envelope air-tightness.

Royal Society of Canada	• The Royal Society of Canada published a series of reports on the health effects of radiofrequency fields from wireless telecommunications devices.[55,56] The Society concluded in the most recent report that more research is needed.

c) Recognition of environmental sensitivities by Canadian provincial bodies

Recognition of environmental sensitivities at the provincial level may translate into funding and access to optimum health care. Sensitivities may also be recognized with regulation of environmental agents such as pesticides, air pollution and scents, and through public education.

Provincial bodies

Ministries of Health

Physicians bill provincial ministries of health according to services rendered, and must note conditions treated. Some provinces still use the ICD-9, while others are gradually making the transition to the ICD-10. There is now a code for chronic fatigue syndrome in the Ontario diagnostic categories list, and a time-based service code. When the complexity of the condition necessitates time-consuming consultations, this allows the physician to bill accordingly.

Provincial bodies engage in anti-smoking, pesticide-reduction and scent-free initiatives, which benefit people with environmental sensitivities. Table 4 describes a few examples of these initiatives.

Table 4: Provincial Ministry of Health recognition of environmental sensitivities

Province/Territory	Recognition
Nunavut, NWT, New Brunswick, Manitoba, Saskatchewan, Newfoundland and Labrador, Ontario, Quebec, Nova Scotia	• As of July, 2006, smoking was banned in restaurants and bars in 9 out of 13 provinces and territories.[57]
Quebec	• Quebec has Canada's only provincial Pesticide Code, banning and restricting pesticides for landscaping.[58] The province has also taken the position that it would only consider spraying pesticides to kill adult mosquitoes in response to a true West Nile virus epidemic, noting that there is no evidence of effectiveness for disease reduction.[59]
Ontario	• The Government of Ontario was the primary funder for the development of the manual "Playing it Safe: Service Provider Strategies to Reduce Environmental Risks to Pre-conception, Pre-natal and Child Health," as part of a "child-proofing" campaign by BestStart: Ontario's Maternal, Newborn and Early Child Development Resource Centre (www.beststart.org) and the Canadian Partnership for Children's Health and the Environment (www.healthyenvironmentsforkids.ca).

Alberta	• Alberta Health is involved in air quality (both indoor and outdoor), tobacco, and children's health, as well as discussions on bottled water and the Kyoto Protocol.
Saskatchewan	• Saskatchewan Health recognizes that health is linked to the environment, with numerous public education activities. With a large farming population using pesticides, it also promotes screening for cholinesterase activity (www.labour.gov.sk.ca/safety/bulletins/organo.htm).

Clinics researching and treating environmental sensitivities

In the mid 1980s, the government of Ontario appointed an Ad Hoc Committee on Environmental Hypersensitivity Disorders, chaired by Judge George Thomson ("Thomson Committee").[60] The 1985 report produced by the Committee found that environmental (hyper)sensitivity was a significant problem requiring further research, and that patients were not having their needs met within the health care system. The Thomson Committee's recommendations and subsequent progress are summarized in Appendix D. Following the Committee's recommendations, the Ontario Ministry of Health funded the Environmental Hypersensitivity Research Unit at the University of Toronto in 1994, and opened the Environmental Health Clinic at Women's College Hospital in 1996 (www.womenshealthmatters.ca/Centres/environmental/index.html).

After a six-year pilot project,[61] the Nova Scotia Environmental Health Centre was established at a permanent site in 1997 (www.cdha.nshealth.ca/facilities/nsehc/index.html). This facility is associated with Dalhousie University and includes Canada's only environmental control unit for treatment and research.

Occupational health and safety – Workers' Compensation Boards

Some provincial workers' compensation boards recognize environmental sensitivities, but eligible conditions and nomenclature vary across jurisdictions. According to the Association of Workers' Compensation Boards of Canada, as well as a discussion paper prepared for WorkSafeBC,[62] a national framework common to all jurisdictions with respect to environmental sensitivities does not exist. Information about the recognition of environmental sensitivities by workers' compensation boards is presented in Table 5.

Table 5: Recognition of environmental sensitivities and possibly-related conditions on Workers' Compensation Boards websites

	BC	AB	SK	MB	ON	QB	NB	NS	NL	PE	YK	NT & NU
Environmental sensitivities/illness					X					X		
Multiple chemical sensitivity			X									
Sick building syndrome			X									
Chronic pain		X	X		X	X		X	X	X		X
Chronic fatigue		X										
Fibromyalgia		X	X		X			X				
Nervous System Disorder including solvent-induced neurotoxicity					X							
"Allergy" to formaldehyde or VOCs			X									
Toxic neuropathy			X									
Myofascial pain		X						X				
Temporomandibular joint disorders		X										
Brain injuries with persisting neurological deficit							X					
Organic brain syndrome				X	X							
Somatoform pain disorder					X							
Respiratory disorders related to acute or chronic workplace exposures					X							
Indoor air issues	X				X		X					X
Special treatment for pregnant and nursing women						X						
Limited or no information on website / search facility ineffective				X		X	X	X	X	X	X	X

Note: While various websites offer some information about environmental sensitivities, the information may not be always easily accessible.

Municipal Public Health

Many public health departments provide advice regarding smoking, scents, pesticides and idling of vehicles. This advice may lead to policies and bylaws within municipalities. The following are some examples.

In Ontario, local public health departments address smoking, scents, pesticides and vehicle idling. Special consideration may be given to people with environmental sensitivities in the event that pesticides are sprayed against mosquitoes carrying West Nile virus. Ottawa Public Health instituted a voluntary registry so that people with environmental sensitivities will receive increased notice should the city consider fogging with malathion in response to West Nile virus. Ottawa also has a safe public housing project for people with environmental sensitivities. The Region of Peel is studying fragrances from laundry facilities.

Many Canadian cities,[d] including most capitals, have anti-idling bylaws or policies (e.g. for vehicle fleets), idling-free zones (e.g. around schools) or educational initiatives. These are for both energy conservation and cleaner air.

Halifax was the first major Canadian city to enact a pesticide bylaw. As well, municipal employees who became sensitive to chlorine in public swimming facilities have been accommodated with changes in place of work.

Almost 130 cities in Canada now restrict the use of pesticides on private property, in part to protect people with environmental sensitivities.[63]

Calgary Public Health has no-scent, latex and pesticides policies. A ban on smoking in public places is coming in 2007. Unlike most Canadian provinces, Alberta does not have provincial no-smoking legislation.

Summary

Since diagnostic criteria for chemical sensitivity have been accepted internationally and in Canada, the recognition of environmental sensitivities at all levels of government has been steadily increasing. Environmental sensitivities and some related conditions are also eligible for compensation by some Workers' Compensation Boards, although there is marked inconsistency across the country. Public policy and regulations are advancing to protect people from tobacco smoke, pesticides, fragrances, vehicle exhaust and other chemicals in public places, and to minimize risks of exposures to pesticides for people with sensitivities.

[d] Including Ottawa, Toronto, Montreal, Vancouver, Calgary, Edmonton, Regina, Winnipeg, Mississauga, Markham, Oshawa, London, Halifax, St. John's and all of PEI and Quebec

B Awareness of environmental sensitivities by health care practitioners

a) Physicians' organizations

The mandate of the Canadian Medical Association is "To serve and unite the physicians of Canada and be the national advocate, in partnership with the people of Canada, for the highest standards of health and health care" (www.cma.ca). The medical associations at the national and provincial levels do not formally "recognize" diseases, although they do engage in limited advocacy such as a resolution calling for banning of "weed and feed" type products.[64] A 1995 letter on behalf of the Ontario Medical Association to the Ontario Ministry of Education Special Education Advisory Council urged that "multiple sensitivities syndrome" be recognized and dealt with as a disability and that environmental improvements be made to accommodate children with this special need. As well, articles have been published in the Canadian Medical Association Journal on environmental sensitivities.[65-68]

The Royal College of Physicians and Surgeons of Canada (RCPSC) is a national, private, non-profit organization that oversees the medical education of specialists in Canada. It notes on its website, "In recognition of employees who experience allergic reactions, asthma or migraine headaches due to chemical sensitivities, the Royal College supports a scent-free environment and requests that employees refrain from using scented products such as perfumes, aftershaves, air-fresheners, etc., during working hours."

The Environmental Health Committee of the Ontario College of Family Physicians (OCFP) is taking the lead within the College of Family Physicians of Canada on environmental health, as well as in the World Organization of Family Doctors (globalfamilydoctor.com). Not only are environmental sensitivities recognized, they are carrying out education on diagnosis and treatment, as well as many other environmental health initiatives.

The Canadian Society of Environmental Medicine is a national organization for education, advocacy and research, and supports health care workers treating environmental sensitivities.

An important voice for environmental health in Canada is the Canadian Association of Physicians for the Environment (www.cape.ca). This organization is composed mostly of physicians, who bring their health expertise to environmental issues.

b) Medical schools and continuing medical education

Environmental sensitivities have not historically been included explicitly in medical school curricula. Connections between environment and health are typically addressed under courses such as "Individual and Population Health," with a couple of hour-long lectures during the entire medical education. An "exposure history," a crucial step in diagnosing environmental sensitivities,[65,69] is covered only in the context of occupational health, rather than as a core concept.

Continuing Professional Development or Continuing Medical Education is required for fellows of the Royal College of Physicians and Surgeons, as well as for members of the College of Family Physicians of Canada. Credits are earned for courses, conferences and seminars. Diverse courses are available through numerous organizations, and individuals choose which to take. The OCFP offers Continuing Medical Education regarding environmental sensitivities and taking of a comprehensive patient history. Workshops have also been part of the Annual Scientific Assembly of the OCFP for the past four years,

and been included in the annual “Family Medicine Forum” sponsored by the College of Family Physicians of Canada. As well, the Ontario Ministry of Health and Long-term Care and Health Canada helped fund an Environmental Health Peer Presenter program for physicians, whereby physicians from various regions were trained to give seminars on environmental health to other health care professionals close to home.

In 2006, an Environmental Health Scholar was designated by the OCFP in each medical school in Ontario, in part to incorporate environmental health into the undergraduate medical curriculum.

Environmental sciences are increasingly popular in university education, with courses offered through many departments such as geography, engineering or sciences; some of these courses link to health sciences.

Summary

Awareness and recognition of chronic health conditions evolves over time, and on several levels. Initial reporting by a few patients and physicians leads to awareness, research and formal agreement regarding diagnosis. Further research explores causes, mechanisms, diagnostic tests and treatment strategies, which are then formally put into practice.

International, national, provincial and municipal governments have recognized conditions related to environmental sensitivities. This has led to funding for clinical health care programs and facilities. Public and political awareness are particularly important for conditions such as environmental sensitivities, because recognition of environmental causes has diverse implications for many interests in society.

The medical community is increasingly acknowledging environmental sensitivities in medical education. Scent-free and least-toxic cleaning policies, and advocacy for smoking, vehicle idling and pesticides policies and laws are increasing.

IV Initiating factors, triggers and symptoms of environmental sensitivities, and their impacts in the workplace

A Agents initiating the condition of environmental sensitivities and triggering reactions

People with sensitivities have individual susceptibilities to various environmental factors. As seen in Table 6, the more common agents that trigger reactions in susceptible people include pesticides, volatile organic compounds (VOCs) such as solvents, perfumes, formaldehyde and other petrochemicals, vehicle exhaust, moulds, pollens, foods, animal danders and electromagnetic phenomena. These may arise from the workplace structure, furnishings, equipment, exterior surroundings or cleaning products, or from co-workers and clients. Other aspects of the environment, including electromagnetic radiation, currents and fields, lighting, humidity, heat, cold and noise may also exacerbate environmental sensitivities.

Once people are initially sensitized to low levels of environmental factors, they may experience reactions triggered by a broader range of exposures if the condition is not recognized and addressed. In this two-stage process, environmental sensitivities may develop gradually with chronic exposure to relatively low levels of chemicals as seen in “sick buildings,” or suddenly after a major exposure to an environmental disaster or a chemical spill.

Table 6: Typical agents that trigger reactions in susceptible individuals (and may contribute to initiation of environmental sensitivities)[3,28,60,70,71]

Type of incitant	Examples of incitants	Examples of sources/products
Volatile organic compounds	Formaldehyde	Urea formaldehyde foam insulation* Wood glues (e.g. plywood and chipboard)**
	Solvents	Paints Varnishes Paint thinner and stripper Glues
	Scents	Air fresheners Perfumes, personal care products Household cleaning agents – e.g. detergents
	Off-gassing mixtures	Fabric softeners Equipment (e.g. computers) Furniture
	Petrochemicals	Carpets Inks in books, periodicals Fuel, oil
Combustion products	Tobacco smoke Vehicle exhaust Barbecue or wood smoke	Smokers Buses, trucks, cars Barbecues, wood stoves
Microbial products	Moulds Bacteria Mycotoxins Mould or bacterial metabolites	Mould or bacteria in structures Mould or bacteria in air conditioning/air handling systems Microbes in older documents Musty furnishings Soil (plants)
Pesticides	Insecticides Herbicides Fungicides Algaecides	Products used to kill insects Products used to kill weeds outside Products used to kill fungi Swimming pool chemicals, including chlorine
Natural inhalants	Pollens	Tree pollens (spring) Ragweed (August/September)
	Animal dander	Dogs, cats, horses etc.
Foods	Allergenic proteins Preservatives Flavouring Individual-specific (e.g. pungent foods)	Peanuts, milk, gluten in grains Sulphites in dried fruits and wine Monosodium glutamate (MSG) Curry, cinnamon
Electromagnetic radiation	Light	Lighting Video display screens
	Radiowaves and Microwaves	Fluorescent light bulbs, “dirty electricity,” wiring problems, energy-efficient devices, computers, televisions, telecommunications equipment
	Very low frequency electromagnetic fields	Power lines
	Ground currents	Power supply services that allow current to flow through the ground, pipes or structures
Other factors	Temperature Noise	Workplace infrastructure

* urea-formaldehyde insulation has been banned in Canada

** formaldehyde-containing glues are banned in new products in many countries including Europe, Japan and China

B Symptoms

Symptoms of environmental sensitivities are unique to the individual. Some possible symptoms are summarized in Table 7.

Sensitivity reactions to chemicals may vary for acute or chronic exposures. A single, isolated low-level exposure (e.g. perfume on someone several seats away in the theatre or bus, that is not obviously harming the wearer) may cause significant symptoms such as headache, confusion, breathing difficulties or loss of balance in a person with environmental sensitivities. These symptoms may take minutes, hours or days to resolve. However, regular exposure to something to which one is sensitive may lead to habituation or "masking," and chronic ill-health that may even be accepted as normal.[3] Habituation is also the reason why research into sensitivities would benefit from an environmental medical unit with high quality air, water, food and surroundings, so that affected people attain a "baseline" unmasked level of health.[72,73] A study found that people with environmental sensitivities do not adjust as quickly as healthy volunteers to research situations, so deficiencies in trial design may explain inconclusive studies in the scientific literature.[72,74]

Table 7: Environmental sensitivity symptoms/reactions[5,60,75,76]

Body system	Symptoms
Nervous system	Heightened sense of smell Difficulty concentrating Difficulty remembering Apparent variability in mental processes Feeling dull or groggy Feeling "spacey" Headaches Restlessness, hyperactivity, agitation, insomnia Depression Lack of coordination or balance Anxiety Seizures Tinnitus
Upper respiratory system	Stuffy nose, itchy nose (the "allergic salute") Blocked ears Sinus stuffiness, pain, infections
Lower respiratory system	Cough Wheezing, shortness of breath, heavy chest Asthma Frequent bronchitis or pneumonia
Eyes	Red, watery eyes Dark circles under eyes Pain in eyes Blurred, disturbed vision
Gastrointestinal system	Heartburn Nausea Bloating Constipation Diarrhea Abdominal pain
Endocrine system	Fatigue, lethargy Blood sugar fluctuations
Musculoskeletal system	Joint and muscle pain in the extremities and/or back Muscle twitching or spasms Muscle weakness
Cardiovascular system	Rapid or irregular heartbeat Cold extremities High or low blood pressure
Skin (dermatological system)	Flushing (whole body, or isolated, such as ears, nose or cheeks) Hives Eczema Other rashes Itching
Genitourinary system	Frequency and urgency to urinate Painful bladder spasms

C Impacts of environmental sensitivities in the workplace

Almost everyone with environmental sensitivities has neurological symptoms. Two concerns are that neurological symptoms may not be recognized (may be "masked") when exposures are chronic,[3] and that cognitive impairment may not be reported in the workplace where consistent mental acuity, strength and/or coordination are important for both executing one's job and advancement. Other symptoms of ill health may make continued employment difficult.

Many people with environmental sensitivities end up changing their work, becoming under-employed or unemployed. This may be driven by lack of accommodation, and health may deteriorate as people face ongoing triggers in the workplace.[28,77,78]

Improving indoor environmental quality will potentially benefit many more people than the individual identified with sensitivities. Workers are more productive and general symptoms of "sick building syndrome" may improve when ventilation is improved [79-82] or a pollution source is removed from offices.[83,84] Children are healthier and learn better when indoor environmental quality is improved in schools.[8,85-87]

Summary

Sensitivities may be initiated by a range of environmental factors and once the condition is initiated, reactions may be triggered by a broadening array of incitants. Environmental sensitivities may affect every system in the body, so multiple symptoms are possible, with variation among individuals. Neurological symptoms are almost universal. Common incitants are summarized in Table 6 and symptoms are summarized in Table 7. The impact of environmental sensitivities on workers' performance may range from mild (e.g. habituation to chronic exposures such that performance may be sub-optimal, although not "abnormal") to severe impairment such that work is impossible. The health and ability to work for those with environmental sensitivities rests with the choices and actions of others, such as building managers, co-workers and clients.

V Origins of environmental sensitivities

The subject of environmental sensitivities is replete with controversies over the causes and mechanisms. This section examines debates over physical versus psychological causes, and whether sensitivities are allergies. Various proposed mechanisms and toxicological roots of sensitivities are also explored.

A The controversies

One debate is focused on whether the origins of environmental sensitivities are psychological or physical. This was addressed extensively by Thomson in the report of the Ad Hoc Committee on Environmental Hypersensitivities,[60] noting that patients see "an attempt by physicians to take refuge in a psychiatric label whenever it is impossible to identify a biological cause for their illness." Regarding the polarized debate he noted, "Those who see the illness as simply a psychological manifestation can be said to be as inflexible as those who see it as strictly a biological disorder." Indeed, treating a patient from the neck-up or the neck-down is not consistent with the comprehensive biopsychosocial model used in medicine. This model recognizes that the body, mind and environment (social and physical) are all connected and important in determining wellness.[88]

a) Physical or psychological origins

Although nasal biopsies of people with multiple chemical sensitivities have revealed tissue abnormalities and greater numbers of nerve fibres,[89,90] and symptoms induced by chemicals have been shown to be accompanied by elevated nerve growth factor,[91] there are no consistently informative and non-invasive diagnostic tests (e.g. blood or urine tests) for environmental sensitivities. Consequently doctors base their diagnosis on patient-reported symptoms and triggers of sensitivities. Self-reporting is standard for psychological symptoms, bringing some to the conclusion that sensitivities may be psychologically based.[92] This has broad implications for treatment, workplace accommodations, compensation and liability.[93,94]

In 2003, authors who have written extensively on the psychological basis of sensitivities analysed and discussed the body of research regarding environmental sensitivities. They examined the physical and psychological theories according to the Hill Criteria (strength of evidence, consistency/replication, specificity, temporality, biological gradient, plausibility, coherence, experiment and analogy). According to their analysis, the physical basis hypothesis failed every criterion while the psychological hypothesis passed every criterion.[95,96] To reach this conclusion, they made assumptions about unreported results of other researchers, and re-analysed research data such as responses of people with sensitivities to inhalation challenges, neurological testing and brain imaging. The conclusions were also based upon classical understandings of toxicology (the limitations of this paradigm led to the formation of the National Center for Toxicogenetics within the US National Institute of Environmental Health Sciences - www.niehs.nih.gov/nct/concept.htm).

Although some researchers believe that environmental sensitivities may have strictly psychological origins, a 1994 review of psychological studies found methodological and logical problems in the then-current psychological research.[97] Environmental sensitivity reactions to inhalation challenges may mimic panic disorder, which is classified as a psychiatric condition.[98,99] However, it is difficult to separate physiological from psychological anxiety responses.[72] Neuropsychological tests that yield abnormal results among patients with environmental sensitivities also yield abnormal results among

people with chronic fatigue syndrome[100] and exposure to neurotoxicants.[101] Moreover, the only test that identified people with environmental sensitivities relative to healthy individuals, was one complex test of verbal memory.[101,102] Another recent study concluded that symptoms of heavy metal and solvent exposure were psychosomatic.[103] This conclusion was based upon a lack of correlation between claims of sensitivities and contaminant concentrations in workers' urine. However, this relationship may not be evident because heavy metals and organic pollutants accumulate in fat, organs and bones, and individuals have variable metabolism and excretion.[104,105] This means that urine concentrations are not necessarily representative of body burdens.

Recent research with better defined patient populations concluded that psychiatric symptoms are more likely to stem from, rather than to cause, symptoms of environmental sensitivities.[106,107] Development of sensitivities usually pre-dates symptoms of depression and anxiety in people with sensitivities, with 1.4% of patients identifying problems before the onset of sensitivities and 38% reporting the development of depression, anxiety and other symptoms after sensitivities became apparent.[12] Although emotional and behavioural problems, including depression, are more frequently found in people with sensitivities and fibromyalgia than in the general population,[100] psychological symptoms cannot be accounted for by psychiatric illness alone.[108-111] People dealing with a poorly recognized chronic illness that affects their brain, impairs their quality of life and earning potential, and has impacts on family and friends, would be under psychological distress. They could be expected to report anxiety and depression.[29,60,112]

Adding to the complexity are recent findings that environmental factors such as pesticides and moulds have been shown to be associated with symptoms such as depression and anxiety.[113-116]

Other research shows that psychological interventions are not entirely effective. For example, cognitive -behavioural therapy, used to desensitize one to the fear of sensitivity to substances, only partially reduced symptoms in a single case.[117] Medication and psychological interventions may be used to treat phobia or panic disorder,[118] but for individuals with environmental sensitivities, lasting benefits have been achieved only by avoiding incitants.[28] In a survey of 917 people with multiple chemical sensitivities, tranquilizers and antidepressants were the least effective therapy and caused harm[28] (possibly because of a genetically-determined inability to metabolize them[16]). In another study, psychological treatment of medically unexplained physical symptoms provided no additional benefit compared to care by a general practitioner.[119]

Physicians seeking the most efficient and effective treatments have found that when people with environmental sensitivities were placed in an uncontaminated environment in which their physical symptoms resolved, their psychological symptoms also resolved.[120] Successfully alleviating symptoms of sensitivities (with safe housing, workplaces, food, water, etc.) is necessary before other psychosocial interventions may be helpful.[121] In a large patient survey regarding treatments, avoidance of incitants was reported to be the most effective strategy, followed by meditation and prayer to address the psychological aspects of the condition.[28]

People may be genetically pre-disposed to sensitivities. As a result of genetic polymorphisms, some bodies have less effective enzymes for detoxifying chemicals and metabolizing drugs. This is more prevalent in patients with multiple chemical sensitivity[16-19,22,55,122] and in Gulf War veterans who became ill.[20,21] Interestingly, these genes are also more common in children who developed leukemia[123] (the very young are particularly susceptible because the immature liver has low enzyme levels[19]). In

multiple chemical sensitivity patients, a higher prevalence of a gene that has been associated with a biochemical basis for panic disorder has been found.[124]

This review indicates that physical factors contribute to environmental sensitivities. There remain many unanswered questions regarding sensitivities and the interplay between biochemical, neurological and psychological processes.[125] It is important for society to come to a common understanding, in order to offer the most efficient, effective care to people with environmental sensitivities.

b) Allergy/role of the immune system

Labelling of environmental sensitivities as "being allergic to everything" has also engendered controversy, and the role of the immune system is an area of ongoing research. People with environmental sensitivities often experience runny noses and reactive airways, with asthma-like symptoms, but this is not necessarily classic allergy.

The lay person may consider "allergy" to be equivalent to "adverse reaction," but medically speaking, "allergy" refers to a specific type of reaction in the body that induces inflammation. Allergies involve an immune reaction wherein exposure to an allergen (e.g. pollen, animal dander, bee venom, peanut protein) stimulates the immune system to produce immunoglobulin E antibodies. Re-exposure may induce a range of inflammatory symptoms from rash, hives, red eyes or runny nose, to asthma or life-threatening anaphylaxis. However, immunoglobulin E antibodies are not present in reactions to very low levels of formaldehyde.[126,127] Nevertheless, people with environmental sensitivities may also have conventional allergies and indeed exhibit more allergies than the general population, with considerable overlap between asthma and multiple chemical sensitivities.[14,15]

Although sensitivities are not classic allergic responses, the immune system may nevertheless be affected. Anti-neural autoantibodies (antibodies that attack one's own nerves) may develop in response to mouldy environments.[128] Hyper-reactivity induced by scents and chemicals is accompanied by elevated nerve growth factor,[90] and exposure to electromagnetic fields may affect immune response.[6]

B Possible explanations

a) Chemical exposures

In recent history, Canadians have been exposed to a rapidly expanding number of new synthetic chemicals, with over 23,000 not assessed for health effects.[e] In the workplace or elsewhere, chemicals may enter the body by ingestion, inhalation or absorption through the skin. People with environmental sensitivities frequently identify chemical exposures, either acute or chronic, as initiating their condition or "tipping them over the brink."[3,30,74] This is quite plausible because many people with sensitivities may be genetically less able to metabolize chemicals.[16-19,22,55,122]

Healthy bodily functions depend upon chemical (e.g. hormonal) as well as electrical signals to keep all systems (e.g. circulatory, digestive, endocrine, respiratory and nervous systems) working harmoniously. Foreign chemicals can mimic signalling chemicals such as hormones (e.g. estrogen, thyroid hormones, testosterone), thereby sending the wrong messages or blocking their transmission. Chemicals may also inhibit or stimulate production of enzymes, disabling or skewing important

[e] http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/brochure/index_e.html

biochemical pathways. Developmental neurotoxicity is becoming increasingly important in understanding the roles of chemicals in human development.[39,129]

Natural or synthetic chemicals may also affect biochemical pathways and development via "epigenetics," whereby genes are marked to be "read" or "silenced." These changes may be passed to successive generations.[130,131]

After the 2001 World Trade Center collapse in New York, firefighters and workers were exposed to a multitude of substances of varying toxicities. Many developed severe breathing difficulties, as well as environmental sensitivities and other symptoms identified in Table 7.[132] In the 9/11 example, there is a concern that conditions may be ineffectively treated as post-traumatic stress, whereas symptoms were reported to diminish or resolve when a sauna detoxification regimen with anti-oxidant and essential fatty acid supplementation[133] was used to enhance elimination of contaminants.

Common synthetic chemicals have been measured in many tissues, at all stages of life.[53,65,134-139] Biomonitoring (measuring contaminants in the body, as is done by the US Centers for Disease Control[104]) is an emerging area of research into relationships between contaminant levels, exposure levels and health risks.[140]

Canadian workers have varying body burdens of heavy metal and organic pollutants, and different natural abilities to metabolize and excrete chemicals, putting them at a wide range of risks of developing sensitivities or other health effects. Chemical sensitivities may predispose people to increased sensitivity to other factors such as electromagnetic radiation, and vice-versa.[6,141]

b) Neural sensitization

The high prevalence of neurological symptoms in people with environmental sensitivities led to interest in "kindling" within the nervous system. Kindling is a phenomenon whereby repeated low level exposures to chemicals, or electromagnetic currents or fields eventually cause symptoms at levels previously tolerated.[142-144] In this process, neurochemical, behavioural, endocrine and/or immunological responses are amplified.

The limbic system is identified as a target for kindling. This is a basic part of the brain, governing autonomic functions that maintain biological homeostasis. It is involved with the sense of smell, sleep, emotions and behaviour, as well as learning and short-term memory. The limbic system can become sensitized to stressors, and once sensitized will react even to very weak stimuli,[143,145] eliciting symptoms as seen in environmental sensitivities. The limbic system of the brain is affected directly from the nose via the olfactory nerve, and by inhaled chemicals that bypass the blood-brain barrier.

c) Receptor sensitization

The chemical and electrical signals that govern body systems involve "receptors." When a normal body chemical such as a neurotransmitter binds with them, the receptor sites initiate cascades of reactions. These sites may become over-sensitized and initiate unwanted conditions when "activated" by contaminants such as volatile organic solvents, formaldehyde or mycotoxin.[146,147] For instance, vanilloid receptors (which respond to capsaicin in hot peppers) have increased activity in people with chemical sensitivities.[146]

Heightened sensitivity of gamma-aminobutyric acid (GABAa) receptors, as well as an abnormal cholinergic system,[f] are implicated in chemical sensitivities.[148,149] GABA is involved in neural transmission, affecting motor function, vision and anxiety (suggesting again a physiological link to psychological symptoms).

N-methyl-D-aspartate (NMDA) receptors are in the limbic system, as well as in many other tissues. Activation of NMDA receptors results in elevated nitric oxide and peroxynitrite (an oxidizing agent), which are prominent in inflammation.

d) Inflammatory cycle

It has been proposed that increased levels of peroxynitrite contribute to neurological sensitization, as well as to a cycle of chronic inflammation as seen in a range of diseases including fibromyalgia, chronic fatigue syndrome, post-traumatic stress disorder and multiple chemical sensitivity.[147,150] Mitochondria (the part of the cell where cellular energy is regulated), cellular membranes, and an important enzyme system for detoxification (cytochrome-P450) are all harmed by the elevated levels, with widespread biological consequences such as neurological disruption, pain, fatigue and organ dysfunction. This model also explains the clinically observed efficacy of the nitric oxide scavenger, vitamin B12, and various combinations of antioxidants in treating these chronic illnesses.

The inflammatory cycle theory offers a basis for hypothesis-driven research and development of treatments. It complements the theory that kindling may explain sensitization, and addresses not only the preponderance of neurological symptoms in environmental sensitivities, but also the broad range of other symptoms.[150]

e) Overload

The "General Adaptation Syndrome" model underpins modern medicine, describing how the body responds to "stressors" (e.g. chemical agents, vigorous exercise, emotional loss). If the stress does not kill, initially there is a "flight/fight" response, then a period of adaptation and then resistance to the stressor. Eventually, if the stress continues for long enough, or there is a sudden surge of stress, adaptive mechanisms are exhausted. This brings generalized breakdown of body systems and non-specific illness.[151] Recognition of these universal bodily reactions to stressors of all types, which are mediated via the pituitary/hypothalamus/adrenal axis, spawned the science of psychoneuroendocrine immunology.[152-154]

Ashford and Miller described this scenario as "Toxicant-Induced Loss of Tolerance" (TILT), a disease paradigm affecting a broad cross-section of society, including veterans of war, workers in many professions and trades, and children in poorly ventilated or maintained schools.[3,73] This toxic overload is treated by reducing the number of stressors, including chemicals and allergens in the body, the surroundings, food and water, as well as electromagnetic fields, currents and radiation. Reduction of emotional stressors may also help.[155]

[f] The cholinergic system is the part of the brain in which acetylcholine is a neurotransmitter. This part of the brain is important for leaning and memory. It is damaged in Alzheimer's Disease.

Summary

The balance of scientific evidence and experience indicates that environmental sensitivities generally arise from physiological causes, although there are many neurological and psychological consequences. Physiological responses to environmental factors vary greatly among individuals, and individuals' experiences must play an important role in determining treatments. Once environmental factors initiating and triggering environmental sensitivities are addressed with safe housing, workplaces, food and water, then psychosocial interventions may assist people. The comprehensive biopsychosocial model of medicine, treating the body, mind and environment, is therefore the most appropriate and effective framework for treating environmental sensitivities.[125] The most practical approach, which is consistent with the practice of modern medicine, is to minimize potentially harmful exposures in the workplace for the health of all workers. Once a person has exhibited sensitivities they will always be susceptible to recurrence. Even though they may well regain their health and productivity, this predisposition to environmental sensitivities is life-long.

VI Diagnosis and treatment of sensitivities

People with environmental sensitivities often consult several medical practitioners before their condition is recognized. When first seen, patients may be experiencing many symptoms, which are due to constant or frequently repeated exposure to environmental conditions that cannot be tolerated.

Physicians take a systematic approach to establishing connections between patients' symptoms and their environment, because there is no single or definitive diagnostic test for environmental sensitivities. Investigation requires a complete assessment of the patient's chronological health and exposure histories,[65,69] a thorough physical examination and routine tests. Other possible conditions are ruled out, or are treated so that their contributions to ill health are minimized. Then, the consensus diagnostic criteria for environmental sensitivities,[4] strengthened by discriminating symptoms,[5] may be used to "rule in" the condition of environmental sensitivities, using a diagnostic checklist for physicians.[65,156]

The theory that an illness was caused by toxins might be strengthened if elevated levels are found upon chemical analysis of the blood, urine, hair or tissue. However, toxins are ubiquitous in our bodies, so information must be considered in the context of exposure history and symptoms. Conversely, not detecting a toxic chemical in the blood or urine is not evidence that it did not precipitate illness. The chemical may have been metabolized and excreted, or it may have been sequestered in fat, organs or bone and therefore be at lower levels in the blood or urine by the time they are sampled. Nevertheless, monitoring levels of toxic chemicals and biomarkers such as enzymes may play an important role in following patient progress. Establishing standard monitoring is necessary for other research regarding environmental sensitivities and for studies of methods to reduce body burdens (e.g. heat, exercise and medications such as chelating agents that will accelerate excretion[g]).[132,133,157] Lack of availability and access to analytical expertise and services, as well as lack of funds to pay for tests, may limit the ability to identify and monitor biomarkers and toxin levels.

Once a diagnosis of environmental sensitivities has been established, there are a variety of strategies for treating and living with the condition.[158,159] Avoidance of symptom triggers and removal of toxic chemicals stored in the body are key to treating environmental sensitivities. Safe housing, school or workplace, and food and water are top priorities. Drinking purified or spring water may lower exposure to water-based contaminants.[160] Home and workplace cleanups/renovations, and possibly air filtration both at home and at work, may be necessary.

Food sensitivities are common in people with environmental sensitivities and may be managed with an elimination or rotation diet. One example of food intolerance that is commonly missed is celiac disease, an autoimmune response to gluten in many grains. It is assessed annually up to the age of 6 in Italy, but in Canada testing is not routine and may be preceded by months or years of symptoms. The delay between onset of symptoms (some of which are vague and may be missed by physicians) and diagnosis with a simple test leads to deterioration of health and well-being, and serious possible consequences including neurological problems and diabetes.[161-164] As with the broader range of environmental sensitivities, celiac disease is chronic; the related malabsorption and "leaky gut" may lead to diverse toxicities; it is under-diagnosed; and the most effective and important treatment is gluten avoidance.

[g] A chelating agent binds with a toxic metal such as lead or mercury, and causes it to dissolve in the blood so that it can be excreted by the kidney and liver.

Once exposure to incitants is eliminated, helpful interventions include:

- treating gastrointestinal infections which, if untreated, can lead to absorption of internal toxins and large-molecule food antigens, or conversely, may lead to poor absorption of nutrients;
- regimens to enhance detoxification and elimination such as sauna and exercise therapy;
- reduction of heavy metal contamination using oral and intravenous chelation for toxic metals (shown to be safe to treat lead in children;[165] it is currently in clinical trials for children with autism[157,166]);
- oral and intravenous vitamins;
- securing hormonal homeostasis, given that many of the toxins observed are endocrine disruptors;
- correcting biochemical irregularities;
- desensitization for foods and/or inhalants;
- psychological, social and spiritual support;
- occupational accommodation; and
- financial support for safe workplaces, housing, food and water.

Summary

Diagnosis of people with environmental sensitivities involves systematically identifying and treating conditions contributing to ill health, then determining if remaining symptom patterns meet the diagnostic criteria. Early recognition, avoidance of symptom-triggering agents, environmental control, treatments that may reduce residual toxins and recovery of normal biological processes are key to regaining health for people with sensitivities. Without safe food, water, shelter and workplaces, people with environmental sensitivities may become severely debilitated and unemployed.[12,60,78]

VII Building codes, regulations and guidelines

Canadians spend much of their time indoors, and environmental sensitivities generally stem from aspects of the indoor environment. Construction, furnishing and maintenance of the indoor environment is therefore critical to addressing environmental sensitivities.

Described in this section are governmental initiatives addressing construction as it affects people with environmental sensitivities. Guidelines and the scientific background regarding indoor environmental quality are also described, and the implications of construction and renovation for people with environmental sensitivities are explored. Scents, moulds and pest control are discussed. Pollution prevention is preferable, but will not be sufficient indoors, so ventilation is important to ensure indoor air quality. Finally, electromagnetic phenomena and sensitivities are discussed.

A Building codes

Building codes, the rule-books for construction of indoor environments, are the first place to look for standards that may address environmental sensitivities.

a) International initiatives

The need for improved laws, codes and initiatives affecting people with environmental sensitivities is being recognized and acted upon at the international level.

Table 8: International initiatives addressing environmental sensitivities in building

Country	Initiatives
International	• ASHRAE examined air quality standards for industrial settings in the USA and Germany, and concluded that standards are not set to protect environmentally sensitive individuals. Many are set to address irritation over the short term.[h] • Prominent scientists signed the Benevento Resolution (February 2006) affirming that there is considerable and strengthening scientific evidence that low-intensity, low-frequency and radio-frequency electromagnetic fields are responsible for biological effects and health effects. Scientists called for more research, and a more precautionary approach to standards, recommended exposures, and technologies in the market place.[43]
Europe	• Passed landmark legislation for Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) in December 2006. The legislation requires substitution of materials with less-toxic alternatives, which will affect building materials, finishing products, furnishings and equipment.[44]
Denmark Environmental Protection Agency	• Following a review of scientific information on multiple chemical sensitivities, it was concluded that present Danish regulations to minimize off-gassing materials in the indoor environment may have led to a lower incidence of sensitivities in the Danish population. As a result, it was recommended that stronger measures be taken to prevent the development of sensitivities.[46]
Australia Human Rights and Equal Opportunity Commission	• Recommendations were made that the needs of people with environmental sensitivities should be considered in revisions to the building code.[167]
England	• Recommendations were made to improve building codes to ensure accessibility for people with environmental sensitivities.[i]
United States California	• Building code contains provisions for voluntary "cleaner air rooms."[168,169] These rooms in public buildings are designed and maintained to minimize volatile organic compounds (VOCs), are accessible via corridors with similarly good air quality, and people using the rooms must not use scented products or bring in food.
United States Access Board	• Ongoing cooperative effort with the National Institute of Building Sciences and other partners to compile comprehensive guidelines to ensure accessibility of buildings to people with environmental sensitivities.[169]
American Society of Heating, Refrigeration and Air-	• Building ventilation guidelines are referenced in Canadian building regulation documents, and as such Canadians are required to meet these standards for ventilation in new buildings. • Have noted that meeting ASHRAE ventilation standards may be insufficient for people with higher sensitivities.[i]

[h] ANSI/ASHRAE Addendum c to ANSI/ASHRAE Standard 62.1-2004, American Society of Heating, Refrigeration and Air-conditioning Engineers, Inc., Atlanta, Georgia.

[i] Personal communication, Dr. Kartar Badsha, Environmental Law Centre, UK. (August 14, 2006)

conditioning Engineers (ASHRAE)	people with higher sensitivities.[j] • Recommended a high air filtration, stating "This is the level required if there is concern for a hypersensitive or allergic family member."[k]
Sweden	• Recognizes electrical hypersensitivity as a disability • Created health care facilities with very low electromagnetic fields and radiation for sensitive individuals.[6]
Kazakhstan	• Issued a decree limiting radiofrequencies in wiring to 50 millivolts (microsurges) to decrease "negative influence of physical factors on human health" (November 6, 2003)

b) Canadian federal initiatives

Like the international community, various Canadian codes, regulations and guidelines recognize some form of environmental sensitivity. At the national level, these codes are not enforceable. They are, however, part of an overall framework that increasingly addresses the impact of environmental sensitivities on daily lives.

The Canadian Commission on Building and Fire Codes, with expertise from industry, the regulatory community and general interest groups, develops and updates six model national codes for buildings: the Model National Building Code of Canada, the Model National Energy Codes for houses and buildings, as well as model codes for fire, farm buildings and plumbing. Codes for electrical, gas and oil installations are developed by the Canadian Standards Association.[170] Model national codes provide guidance (much as the medical information published at the national level by the CIHI is advisory). They provide a minimum standard for structures and ventilation, and address fire and occupant safety, in the design and construction of buildings.[170]

[j] "Considering the diversity of indoor air contaminants and the range of susceptibility in the population, compliance may not be acceptable for everyone." ASHRAE Standard 62, Ventilation for Acceptable Indoor Air quality. American Society of Heating, Refrigeration and Air-conditioning Engineers, Inc., Atlanta, Georgia.

[k] ASHRAE® STANDARD, BSR/ASHRAE Standard 62.2P: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, American Society of Heating, Refrigeration and Air-conditioning Engineers, Inc., Atlanta, Georgia.

Table 9: Canadian national initiatives addressing environmental sensitivities in building

Codes, regulations or guidelines	Initiatives
Model National Codes[170]	• These codes provide guidance regarding measures that affect indoor environmental quality such as barriers preventing moisture or radon infiltration from the soil; thermal insulation; covering and moisture barriers for walls, heating, ventilation and air conditioning (HVAC) systems, and plumbing; ventilation of working spaces, cooking facilities, storage spaces, roof spaces, crawl spaces, garages etc.; minimization of growth of micro-organisms; priority for removal of air contaminants at source; and requirements to avoid depressurization that may lead to back-draughts from sources of contamination such as garages or units for combustion.
National Research Council (www.nrc.ca)	• Conducts research focusing on the health effects of contaminants; ventilation, heating and cooling; energy efficiency; and building envelope air-tightness in the laboratory and in the field (i.e., in homes, commercial buildings, hospitals and schools).[170]
Canada Mortgage and Housing Corporation (www.cmhc.ca)	• Produced publications regarding environmental sensitivities, including books on housing that incorporates innovative design features, materials and construction, indoor air quality, ventilation, heating and cooling, and dealing with moulds and bacterial contamination. A popular publication is "Building Materials for the Environmentally Hypersensitive." • Built a demonstration house for environmentally hypersensitive people in Ottawa, which was the site of a 2006 announcement of federal initiatives addressing toxic chemicals.
Environment Canada and Health Canada	• Participate in joint initiatives addressing toxic chemicals in the environment, including revision of the Canadian Environmental Protection Act, classification of industrial chemicals and various regulations.[l] • Health Canada's Environmental and Workplace Health website offers information on air, noise, soil and water pollution, climate change, environmental contaminants, occupational health and safety, pest control and radiation.[m] • The Minister of Health proposed a residential indoor air quality guideline for moulds in December 2006.[171]
Canadian Construction Association	• Guidelines for construction and mould remediation refer to environmental sensitivities.[172]

[l] www.ec.gc.ca/substances and www.chemicalsubstanceschimiques.gc.ca

[m] http://www.hc-sc.gc.ca/ewh-semt/index_e.html

c) Provincial initiatives

Provincial building codes must adopt the model National Building Code of Canada under provincial legislation, and may include other standards to reflect location conditions and practices. The provincial codes are enforced by building codes officers, as provinces may delegate authority to lower tiers of government.[170]

The Ontario Association of Architects has published guidelines addressing mould in construction and water penetration. They acknowledge that additional measures may be necessary to protect people with sensitivities.[173]

d) Municipal measures and roles

Municipalities can go beyond provincial codes in regulating or implementing more stringent building or use requirements (e.g. restrictions on building materials and methods of construction, or the discharge of perfumes and fabric softeners in air from clothes dryers). Institutions such as governments, schools or universities may follow guidelines for environmental design or institute specific provisions for their own buildings (e.g. University of Calgary's no-carpet guideline[n] or Lakehead University's wireless-free policy[o]).

Summary

Canadian statutes do not prescribe standards that are protective for people with environmental sensitivities. Building codes focus on topics such as strength of structures, but they are silent on many issues impacting indoor environmental quality such as building materials or commissioning of the structure (de-gassing before being occupied). Insofar as building codes and guidelines are perceived to be sufficiently protective of health and safety, they may constitute barriers to stricter guidelines, and to research and development of safer materials and methods.

B Indoor environmental quality

Indoor environmental quality covers many concerns, including heat, light, air quality, noise and electromagnetic phenomena. A large scientific effort has been directed towards air quality. Internationally, there are disparate air quality guidelines for a variety of chemicals that may be found in indoor air. The World Health Organization recently published guidelines that apply to Europe,[174] but Canada does not have its own benchmarks for many of these same chemicals.[175] Canadian employers have a duty under provincial occupational health and safety acts to take reasonable precautions to protect workers from substandard environmental quality, including air contaminants exceeding workplace guidelines. Guidelines also exist for residential buildings, but these are not enforceable by law. Workplace standards and guidelines are typically not stringent, to avoid being considered too costly or impractical in industrial occupancies.

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[n] http://www.ucalgary.ca/ci/stewardship/flooring.html
[o] http://www.canada.com/ottawacitizen/news/story.html?id=f1c244c9-5634-484a-af13-c0c13b1dacc8
http://www.itbusiness.ca/it/client/en/home/News.asp?id=38093&PageMem=1

The following is an overview of some concerns regarding indoor air quality. The origin of possible contaminants, and strategies to avoid or remediate them are discussed, with particular focus on moulds, scents, pest control and electromagnetic phenomena.

a) Air quality

Indoor air quality is affected by many potential contaminants:

- gases such as carbon dioxide (CO_2), carbon monoxide and volatile organic compounds (VOCs) (e.g. myriad chemicals from carpets, furniture, building materials and paints, or gases given off by microbes);
- particles that may include smoke, heavy metals and other chemicals, pollen, skin flakes, bacteria, and mould particles and spores.

Excessive CO_2 impairs well-being and is generally controlled with the addition of fresh air. Measuring CO_2 is useful to gauge the adequacy of ventilation in a fully occupied building, but it does not reflect the many other air contaminants arising from the building and contents. Generally, facilities are not fully utilized around the clock, so 24-hour average CO_2 levels will underestimate actual exposures and are not helpful.[176] Health and well-being are related to the actual concentration of CO_2, so real-time continuous monitoring over several days is necessary to determine peak concentrations. In office buildings without other sources of carbon dioxide (e.g. combustion appliances or air intakes close to sources of exhaust), CO_2 measurement may also be a surrogate for occupant-generated pollutants. However, CO_2 measurements cannot be usefully compared amongst buildings with different activities (e.g. cooking or combustion), concentrations of people, or practices with respect to scents or smoking.[177]

VOCs originate from a multitude of sources, including the built environment (materials used in construction, furnishings and equipment), scents from cleaning and personal care products, odours from food preparation and incoming air. Ninety chemicals have been identified as priority substances amongst approximately 2,300 chemicals found in indoor air.[175,176,178] Canada does not have guidelines for many of them, but the issue is slated to be addressed under the Canadian Environmental Protection Act.[179]

Dust can contain asbestos, pesticides, organisms such as fungi and bacteria, heavy metals (e.g. lead), fragments of material from plastic products (including plasticizers, flame retardants and stain repellents), or animal products (e.g. cat dander, dust mites, etc.). These may cause infections, provoke allergies or sensitivities, or have toxic effects.

Air quality guidelines are based upon toxicity testing in laboratory animals, and some workplace sampling to determine human exposures. This system has several weaknesses, which explains why guidelines may not be sufficiently protective to ensure no adverse health effects for people with environmental sensitivities:

- Rats have detoxification enzymes that do not exist in people, so toxicity conclusions may not apply to humans;[180]
- Neurotoxicity (noted with the development of environmental sensitivities), particularly developmental neurotoxicity that might anticipate problems such as autism and attention deficit hyperactivity disorder in children, may not be studied;[129]
- Research on workers is skewed by the "healthy worker effect." In other words, workers who cannot tolerate chemicals will find other work. Thus, the self-selected group of employees would not

include people with a predisposition to chemical sensitivities. Furthermore, avoiding obvious toxicities in healthy adults will not translate into protection for the unborn; and

- Guidelines address toxicity of a single chemical at a time, whereas the workplace may contain many chemicals and biological agents from work processes, carpets and furniture, people wearing perfumes, moulds, contaminants from equipment such as copiers, etc. Combined and synergistic toxicities are not addressed under this system.

Building materials and finishing

The first priority in optimizing indoor air quality is to minimize the pollutants added to indoor air from the building and its contents. Several authorities, including the Canada Mortgage and Housing Corporation (www.cmhc.ca), the National Research Council of Canada (www.irc.nrc-cnrc.gc.ca) and the American Society for Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)[181] formally recognize this imperative.

A large number of chemicals in plastics, glues, paints, carpets, etc. may impair health, and formaldehyde is a particularly prevalent contaminant.[182,183] Tolerated products include materials such as natural fabrics, wallboard without pesticide additives, woods (this has to be assessed individually), metal, ceramic tiles and cement products (concrete, grout, etc.) without toxic additives.

Inexpensive materials and furnishings may be associated with increased toxicities (e.g. formaldehyde-containing composite wood products). More durable materials tend to be better tolerated, so over the longer term, both costs and maintenance may be reduced and indoor air quality improved.

There is no Canadian assessment of building materials specifically focused on low toxicity for people with environmental sensitivities. However, CMHC has many publications including “Building Materials for the Environmentally Hypersensitive” and “Research House for the Environmentally Hypersensitive.” The Ecologo (www.environmentalchoice.com) designates environmentally preferable choices for over 300 types of products. Health is not the primary focus of this initiative (for instance, products might include scents), and the program does not recognize that sometimes the environmentally preferable action would be not to produce or purchase certain types of products (e.g. air “fresheners”).

Innovative interiors can be both aesthetically pleasing and good choices for the environmentally sensitive. However, every detail must be considered. For instance, in the case of cast concrete flooring in a housing project for people with sensitivities, the oil used to release the concrete from the forms was replaced with an alternative unscented lotion tolerated by individuals with sensitivities.

“Commissioning” involves a period of increased heating and ventilation to exhaust fumes from paints, wallboard filler, flooring and equipment. It is used to eliminate volatile materials to the greatest extent possible and should take place before spaces are occupied.[184]

Furnishings and Equipment

Furnishings and equipment contribute significantly to VOCs in indoor air, and may off-gas for extended periods of time.[185,186] Equipment such as photocopiers, fax machines, laser printers and laminators also compromise the air quality in buildings as they emit dozens of air contaminants including VOCs, ozone and carbon black. Minimizing the toxic contaminants such as flame-retardants,

plasticizers, heavy metals and solvents in electronics makes them both safer and easier to recycle.[187] Specifications for electronics should indicate that higher frequencies not be introduced into the electrical wiring.[8]

Scents

After tobacco smoke, perfumes are one of the most noticeable air contaminants in public places and the workplace, and they are reported to cause difficulties for most people with environmental sensitivities.[29,60,188] Fragrances are in personal care products, laundry and cleaning products, and can be in many other products such as tissues, wipes and other paper products. The ingredients may include any of approximately 4,000 plant or animal extracts or synthetic chemicals, with maybe 100 ingredients in a given fragrance.[189] Fragrances now contain more synthetic chemicals, and are stronger and more persistent. Some ingredients are respiratory irritants, asthma triggers and neurological toxins. Some are listed as potentially causing cancer and birth defects.[188-191] The ingredients are proprietary, and are not assessed for toxicity. Neither are they listed on labels, in the Workplace Health Information Management System (WHIMS), on Material Safety Data Sheets (MSDS) or under labelling requirements for personal care products.

"Scent-free" means that additional fragrance was not added to the product, but some cleaning products contain ingredients smelling of citrus or pine that can trigger sensitivity reactions and/or asthma. "Scent-free" products such as fabric softeners may contain neurologically active "masking agents," added to cover the unpleasant odour of the active ingredient or contaminants. People with environmental sensitivities may also react to the "softener" ingredients themselves, which coat clothes, evaporate slowly and contaminate dust.

A wide range of organizations promote no-scent workplace policies,[p] including hospitals,[q] universities[r] and medical organizations, Health Canada and the Department of Justice, unions such as PSAC[192] and CUPE, school boards, large facilities (e.g. the National Arts Centre) and the Lung Association.[s]

Scent-free policies may help stem the influx of people into the group of those who are extremely sensitive to chemicals. Adherence to such a policy is necessary for people with sensitivities because scents can linger for several washings of clothes and hair.

b) Microbes - moulds and bacteria

Moulds are increasingly recognized as serious contaminants in buildings, contributing to "sick buildings" and to environmental sensitivities.[193-195] Moulds may also cause neurological and

[p] See for instance http://www.mcscanadian.org/pdf/scentfree2005.pdf

[q] Ontario hospitals with scent-free policies include: Toronto General Hospital; Women's College Hospital, Toronto; Wellesley Hospital, Toronto; Lyndhurst Spinal Hospital, Toronto; Middlesex Hospital Alliance, Middlesex; Leamington District Hospital, Leamington; Grand River Hospital, Freeport Health Centre, Kitchener; Ottawa Hospital Civic Campus; Ottawa Hospital General Campus; Children's Hospital of Eastern Ontario, Ottawa; Queensway-Carleton Hospital, Ottawa; University of Ottawa Heart Institute, Ottawa Health Research Institute; Kingston General Hospital; Hotel Dieu, Kingston; Soldiers' Memorial Hospital, Orillia; Niagara-on-the-Lake Hospital; North Bay General Hospital.

[r] Including Dalhousie, McMaster, Acadia, Memorial, St. Mary's, Thompson Rivers, Mt. Allison and Malaspina Universities, and the Universities of Calgary, Toronto, Windsor, British Colombia, Prince Edward Island, Ottawa, Victoria, Saskatchewan, Waterloo and Guelph.

[s] http://www.lung.ca/protect-protegez/pollution-pollution/indoor-interieur/scents-parfums_e.php

psychological disorders including depression.[114,116] Moulds have other diverse effects on health, and more research is needed into their toxic effects.[196] Spores and mycotoxins (toxic chemicals produced by moulds) cause inflammatory responses [197] and may lead to asthma, allergies and environmental sensitivities.[194] Moulds may result in damage to the nervous system as they stimulate neural auto-antibodies, peripheral neuropathy, and neurophysiologic abnormalities.[128] Remediation of mould problems will improve workers health, attendance and well-being.[34,86,198-203] Those with environmental sensitivities should be relocated during mould remediation work.[172]

Greater awareness of bacteria in ventilation systems arose after Legionnaire's Disease sickened 180 and killed 29 at a Philadelphia conference in 1976.[204] Apart from their pathogenic potential, bacteria are a significant source of multiple adverse health effects and may be monitored along with moulds in indoor air.[205]

Moisture control is key to controlling microbes.[172,173] Design considerations for modern mould-free interior spaces include architectural details, materials selection, and moisture control with ventilation.[172,206] Information is available from the CMHC Healthy Home resource page,[t] from the Canadian Construction Association [172] and the Ontario Association of Architects.[173] Following the hurricanes of 2005, the US Centers for Disease Control published a review concerning moulds and a summary of clean-up procedures regarding mould in buildings.[207]

Chlorine bleach is sometimes recommended to clean up residual mould.[207] However, vapours may cause difficulties for people with allergies or environmental sensitivities,[208-212] and this is not recommended as a routine practice by the US Environmental Protection Agency.[213] A wire brush and trisodium phosphate or peroxide bleach (hydrogen peroxide) are effective. Another alternative approach that is less studied is to use beneficial organisms to eradicate moulds before final cleaning and renovations, and possibly to head off re-infestation.[214] Although ultra-violet (UV) light technology is proven to disinfect water, it is not effective for moulds in air.[u]

c) Ventilation

Indoor air quality cannot be maintained without ventilation. Workplace materials and equipment produce various emissions; inhabitants emit carbon dioxide; and individuals and food give off odours. Ventilation is necessary to address these emissions, but it cannot supplant the overriding priority to minimize indoor air pollution arising from structures, fixtures, furnishings and equipment.

It is generally preferable to have natural ventilation with windows that open, but this is neither practical in inclement weather nor available in modern commercial buildings. Thus when air contaminants are generated from cooking, bathroom activities or photocopiers, a mechanical exhaust fan is the only effective method for removing the fumes. Furthermore, outside air will only enter a building if there is an air pressure difference between inside and outside, such as wind or "stack effect" (otherwise known as "chimney effect"). Therefore the design, operation and maintenance of heating, ventilation and air-conditioning (HVAC) systems are critically important.[215] Standards set in North America by ASHRAE[216] do not guarantee optimum health. Improvements in well-being have been observed when the ASHRAE standard for ventilation was exceeded,[76,79,83,217,218] as recognized in an ASHRAE position paper.[181]

[t] http://www.cmhc-schl.gc.ca/en/co/co_001.cfm

[u] Unpublished tests conducted by Prof. Tang G. Lee, University of Calgary, April 1, 2001.

Ventilation, heating and air-conditioning systems are required to minimize condensation and collection of water (except in properly designed condensers for dehumidification). Maintenance of these systems is extremely important to prevent accumulation of dust and water, or growth of microbes.[172]

Renovations can lead to compromised HVAC performance, if proper attention is not paid to vent connections and airflow through the new layout (newly created walls and doors, and arrangement of furnishings). Vents may also be blocked with equipment, or by employees who perceive a draught. As well, ventilation systems designed and installed at times when there were lower ventilation requirements may require attention in order to improve indoor air quality.

Indoor levels of pollution generally exceed outdoor levels, so outdoor air is usually relied upon for ventilation to control indoor pollutants. During cool weather moisture is also controlled with drier outdoor air. External sources of air contaminants include vehicle emissions (including from parking garages), pesticides, wood smoke and exhaust from adjacent buildings.

Air filtration

High efficiency particulate air (HEPA) filters are effective at removing dust and aerosols from ambient air, and may improve the health of people with allergies, asthma and environmental sensitivities.[219] Unfortunately there are no regulations to standardize what can be labelled as a HEPA filter. Activated carbon and other media such as potassium permanganate filters effectively remove many but not all volatile organic compounds.

Filtration of intake air and within air handling may improve air quality. However, filters that are not maintained become a contaminant source, particularly during humid weather when microbes grow more readily.[219-221]

When supplied to many workers, multiple air filters can result in improved air quality and health parameters.[82] During consultations, personal air filters within closed offices were identified as a common accommodation for office workers with environmental sensitivities in the UK.[v] This is not as desirable as ensuring higher quality air for all workers and does not improve access to the rest of the premises and facilities such as washrooms; however, personal air filters are certainly worthy of consideration as an accommodation, along with other actions.

d) Pest control

Pesticides are frequently implicated in initiation and triggering of sensitivities.[3,30] Low activity of the enzyme acetylcholinesterase (AChE), which is inhibited by common insecticides, is linked to neurological dysfunction and immune suppression.[222] The Ontario College of Family Physicians has recommended that people take all possible steps to minimize exposure to pesticides,[223] and Canada's pesticide assessment system was criticized in light of the re-evaluation of the herbicide 2,4-D.[53]

Fortunately, modern pest control does not require the use of most toxic chemicals. For instance, the experience in Ottawa hospitals is that aggressive, preventive maintenance and sanitation, non-toxic electronic insect monitoring and control, as well as traps with pheromones or baits have supplanted the

[v] Personal communication, Dr. Kartar Badsha, Environmental Law Centre, UK. (August 14, 2006)

spraying of toxic chemicals in food handling areas. Eliminating the conditions necessary for a pest to live and propagate (e.g. moisture and rotting wood), low-tech solutions (e.g. traps), and judicious and very limited use of least-toxic products that are approved for organic agriculture (e.g. borax or diatomaceous earth) have been sufficient. The most toxic chemicals such as organophosphate and carbamate insecticides are simply never used.[w]

The Pesticides Code in Quebec prohibits the use of common toxic pesticides on Quebec greenspaces, and pesticide bylaws are currently in various stages of implementation in over 130 cities, towns and villages across Canada.[63] Many institutions, including hospitals and school boards, have also resolved not to use pesticides for landscaping. Scientific application of sound agronomic/horticultural principles results in healthy plants that resist diseases and insects, eliminating the need for pesticides.[x]

C Electromagnetic radiation and fields

"Electromagnetic radiation" covers a broad range of frequencies (over 20 orders of magnitude), from low frequencies in electricity supplies, radiowaves and microwaves, infrared and visible light, to x-rays and cosmic rays.[224] Our limited understanding of the biological effects of the vast majority of frequencies gives reason for concern.[225-230] Although there is still debate in this regard,[231-233] tinnitus, brain tumours and acoustic neuroma are associated with cell phones and mobile phones.[234-237]

Communications and radar antennae expose those who live or work near these installations to their emissions. The radiation travels through buildings, and can also be conducted along electrical wires or metal plumbing. Wireless communications create levels within buildings that are orders of magnitude higher than natural background levels.[238]

The World Health Organization (WHO) acknowledges the condition of electromagnetic sensitivity, and published a 2006 research agenda for radio-frequency fields.[239] The WHO recommends that people reporting sensitivities receive a comprehensive health evaluation. It states: "Some studies suggest that certain physiological responses of EHS individuals tend to be outside the normal range. In particular, hyperactivity in the central nervous system and imbalance in the autonomic nervous system need to be followed up in clinical investigations and the results for the individuals taken as input for possible treatment." Studies of individuals with sensitivities ought to consider sufficient acclimatization of subjects as recommended by Joffres for chemical sensitivities,[72] as well as recognition of individuals' wavelength-specific sensitivities. Reduction of electromagnetic radiation may ameliorate symptoms in people with chronic fatigue.[240]

It is worth noting that off-gassing of electrical equipment may also contribute to sensitivities.[84] Different sorts of technology (e.g. various medical equipment, analogue or digital telephones; flat screen monitors and laptop computers or larger older monitors) may vary significantly in strength, frequency and pattern of electromagnetic fields.[238]

a) Lighting

[w] Doug Perkins, DPEnvironmental, pest management services for Ottawa hospitals, personal communication, July 30, 2006

[x] Frank Reddick, agronomist, Turflogic, personal communication, August 4, 2006

Visible light is a narrow range of electromagnetic radiation. Light affects hormone levels, including cortisol and melatonin,[241-244] which affects the ability to sleep, among other things. Seasonal affective disorder (SAD), wherein some people are increasingly depressed and fatigued during the winter months, may be alleviated with increased exposure to certain wavelengths of light in the blue end of the spectrum.[245] People with environmental sensitivities may be unusually sensitive to light, reacting positively or negatively. Natural or full spectrum, non-flickering light is often best, but individuals ought to be consulted since they may be adversely affected by bright light.

Fluorescent lighting, which is increasingly common and is promoted to save electrical energy, may cause increased radiofrequencies in the electrical supply and harm people with electromagnetic sensitivities. The flickering may also exacerbate sensitivities.[246]

b) Electromagnetic radiation arising from the use of electricity

There are four phenomena that emerge from the use of electricity: ground currents; "electromagnetic smog" from communications equipment; magnetic fields from power lines and specialized equipment; and radiofrequencies on power lines or so-called "dirty electricity."

Ground currents

Ground current or "stray current" is electricity that is not contained in wiring; passing through the ground, building structures, plumbing, etc. Electrical current flows along the path of least resistance (e.g. through metal pipes or rods rather than through wood or concrete), with diverse health effects including behavioural, cardiovascular and reproductive problems (sterility and birth defects).[247-249]

On October 19, 2006, the Ground Current Pollution Act unanimously passed second reading in the Ontario Legislature. The Bill defines "objectionable current,"[y] establishes a time frame for utility companies to respond to and remedy complaints, and provides for the development and implementation of a plan to eliminate current that goes through the ground instead of through the neutral wire.

Low frequency electromagnetic fields

Extremely low frequency fields from high-voltage electrical supply lines have been associated with genetic damage[250] and leukemia in children and may be considered an occupational carcinogen.[251]

One clear example of health effects from magnetic fields involved workers on magnetic resonance imaging (MRI) machines. When electrical current flows, a magnetic field is created (measured in Gauss), and when conductors (including biological tissues) are moved within a magnetic field, electrical currents are induced. Workers experienced headaches and cognitive impairment at a greater rate and severity with increasing exposure time and magnetic field strength.[252] Workers with quicker movements, which would have caused greater induced currents, suffered greater health effects.

[y] "objectionable current flow" means any steady state of electrical ground current for five seconds or more on a grounding conductor or any other conductor that normally does not carry electric current, except for any temporary flow of electrical fault current that is caused by a phase-to-ground fault condition and that results from the performance of a grounding conductor's protective functions regarding faults or lightning

Telecommunications

The Royal Society of Canada reviewed the issue of health effects of radio-frequency transmissions for Health Canada in 1999, with updates in 2001 and 2004.[56] The latest report summarizes and is consistent with positions taken by many other authorities in Britain, Europe and the USA (e.g. California). Regulations for telecommunications are based upon avoiding heating of tissue as a result of exposure to electromagnetic radiation. However, other biological phenomena are both plausible and observed at much lower exposure levels.[7] The Royal Society concluded that even if the evidence is not clear that adverse health effects from lower exposures to radiofrequencies exist, there is a need for further research.[55,56] There is growing evidence of cancers (particularly acoustic neuroma) associated with the use of mobile telephones.[235,237,253,254] Given the seriousness of the adverse effects and the availability of alternative technologies, a precautionary approach is warranted.[255]

In 2006, based upon a comprehensive review of the scientific literature, the International Firefighters took the position that transmission facilities should not be located at fire stations.[256] The growing plethora of wireless communication devices such as Internet, WiFi, cell phones, satellite radio, microwave transmissions, TV broadcasts, etc. are exposing the populace to more and stronger electromagnetic frequencies. Shielding may block electromagnetic radiation (but not magnetic fields). Buildings, geography, weather and immediate surroundings affect exposure from telecommunications by reflecting or focusing radiation, thereby creating elevated local levels. Measurements in Canadian cities are many times higher than the regulated levels.[z] Canadian regulations do not require labelling of emissions from communications devices. Use of alternative technologies (wire or fibre data transmission) is the most straightforward, feasible and effective measure to accommodate workers with electromagnetic sensitivities.

Radiofrequencies on power lines

Some emerging research regarding electromagnetic sensitivities focuses on the radio-frequency "noise" on power lines. This arises from problems in the wiring and from "chopping" of the 60-cycle signal in modern power-efficient and sophisticated electronics. Remediation of wiring and addition of low-cost tuned circuits to electrical equipment are two steps to address this problem. As a "band-aid," Graham-Stetzer filters can be plugged into outlets to remove these high frequencies from the power lines. Using these filters to create an electromagnetically "cleaner" environment, improvements are reported for several health outcomes, including multiple sclerosis, behavioural problems and asthma in children in schools, and diabetes.[8]

Canadian standards for electrical equipment do not require testing for or limits on "dirty power." The CSA requires most products to be assessed only for shock and fire hazard. Electromagnetic compatibility testing is required for ballasts on fluorescent lights and medical equipment and can be carried out at the request of manufacturers.

There is a lack of consensus in research regarding the health effects of electromagnetic phenomena. This may be due to methodological limitations including unmeasured and uncontrolled parameters such as the quality of the electrical signal, radiofrequencies, locally elevated exposure levels and ground currents.

[z] Dr. Andrew Michrowski, Ottawa, December 5, 2006 personal communication based upon his unpublished research completed for the CMHC.

Summary

One of the most effective and economical strategies for achieving healthy indoor spaces and good air quality is to minimize potential pollutants during construction and renovation. This includes the use of low-maintenance surfaces that do not off-gas, design and construction that minimizes dampness and moulds, and an air intake system that avoids ground-level air. Energy conservation concerns create pressure to decrease ventilation in sealed buildings, reinforcing the need to use materials, finishings and furnishings with low toxic and volatile inputs and emissions. Least-toxic construction, maintenance and pest control, and infrastructure that minimizes exposure to electromagnetic phenomena all require attention to detail and might entail minimal additional costs. Minimizing on-going sources of environmental factors that initiate and trigger environmental sensitivities such as perfumes, dusts and vehicle exhaust require education and policies, and appropriate maintenance practices.

VIII Accommodating and preventing environmental sensitivities

There is a growing recognition of the need for action to prevent and accommodate environmental sensitivities. Poor indoor environmental quality can affect other workers and reduce productivity; it also puts them at risk of developing environmental sensitivities. This section discusses additional details for consideration within the workplace, and some accommodation guidelines that are presently available. Costs and benefits of healthier workspaces are also addressed.

A Environmental sensitivities and the workplace

a) Organization of the work space

Employees must be able to access their workspace, the "tools for the job" such as office equipment, and amenities such as washrooms. Accommodation of people with environmental sensitivities should include good air quality, building, furnishings and materials standards, and maintenance practices in entranceways, hallways, elevators and stairways, washrooms and in the workspace. Areas with equipment that give off emissions (e.g. photocopiers, printers and faxes) should be separately ventilated. Outdoor clothing can be kept in closed closets with an exhaust. A meeting room can be designated along the lines of California's "cleaner air room." Wireless-free zones may improve both worker health and security of communications.

A 2006 report outlined that Canada allows the use of 60 pesticides that are banned elsewhere in agriculture, and has higher allowable residues and poorer monitoring of pesticides in food than many other nations.[257] In the workplace attention could be paid to listing ingredients in cafeteria food. Filtered water is also important for people with environmental sensitivities.

b) Energy costs vs. ventilation

As the price of energy for heating and cooling rises, building owners and managers will feel increasingly pressured to reduce ventilation when buildings are not in use. Heat-recovery equipment may allow ventilation to be continued while constraining costs.[258]

Shutting down air exchange overnight and during weekends or holidays will lead to VOC build-up. This possibility reinforces the need to minimize off-gassing materials in the indoor environment. Filtration is a partial substitute for fresh-air makeup during those periods when buildings are not occupied, as long as there is no source of pollution such as combustion, which could lead to carbon dioxide or carbon monoxide accumulation.

Intermittent VOC build-up is undesirable, because the VOCs are absorbed by surfaces such as furniture and fabrics. Although air can be rapidly flushed, the absorbed VOCs give off more slowly, contributing to poorer air quality over an extended period of time.

c) Buildings' surroundings

The workplace is no more isolated from its surroundings than are the workers from their environment. Landscaping, scents from neighbours' laundry facilities and other outdoor air pollutants may all affect access to premises, as well as the quality of indoor air through ventilation.

Typically air intakes for buildings are located close to the ground because the furnace is in the basement. Debris, dust, soil moulds, and snow are drawn inside from these low lying air intake grills. Air intakes should not be close to sources of pollution such as loading docks and should be up high to avoid ground level contaminants.

Vehicle exhaust is particularly problematic. In October 2005, the Minister of Education for New Brunswick announced a province-wide idling ban for all school buses, the first provincial initiative of its kind in Canada, to protect health and save fuel.[aa] "Idling gets you nowhere" signs are gaining prominence in some jurisdictions, and no-idling policies are being instituted outside of entrances and in the vicinity of air intakes.

Proximity to high-voltage power lines and electrical transformers should be avoided, and electrical fuse or breaker panels should be located at a distance from workspaces. Power supplies / electrical wiring should be designed and maintained so that circuits are self-contained and balanced, and electricity is maintained in the wires. Minimizing exposure to radio-frequency radiation should be considered.

d) Air quality inside vehicles

Drivers of trucks and buses are regularly exposed to fuel and exhaust fumes, potentially putting them at risk of developing sensitivities. There is no requirement for school buses and delivery trucks to keep their engines idling, but some ambulances may be required to do so. The exhaust fumes can be extremely harmful to people with environmental sensitivities, putting them at greater risks during a health emergency. Avoiding exposure to exhaust could improve the prognosis for many people, particularly those with sensitivities.

Poor air quality in public transit also limits the mobility of people with environmental sensitivities, who are over-represented in the lower socio-economic groups.[10] Masks with activated carbon may be used by some who have enough strength and sufficiently competent airways, to allow access to places with poor air quality such as public transit. However, these charcoal filters are costly, have limited effectiveness and life-span, and must be changed regularly (perhaps weekly). Anti-idling policies are very helpful, and alternative and highly fuel-efficient technologies such as hybrid vehicles should be considered.

[aa] www.elements.nb.ca/theme/Pollution05/NB%20Lung/Jane.htm

B Accommodation resources

a) Publications related to the workplace

Four publications specifically addressing accommodation of people with environmental sensitivities in the workplace are:

- "Accommodating Employees with Environmental Sensitivities: A Guide to the Workplace" and "Accommodating Employees with Environmental Sensitivities: A Guide for Building Managers" by Leslirae Rotor, Elizabeth Hare and Debra Sine, posted at http://www.harepublishing.com
- "Understanding & Accommodating People with Multiple Chemical Sensitivity in Independent Living" by Pamela Reed Gibson, Ph.D. James Madison University, available from http://www.ilru.org/html/publications/bookshelf/MCS.html.[141]
- "Multiple Chemical Sensitivity at Work" (1997) is a guide by the Public Service Alliance of Canada for PSAC Members. It addresses recognition and tolerance issues, as well as details regarding accommodations. A scent-free guide, published in 1998, builds upon this guide.[192]
- "Environmental Hypersensitivity in the Workplace" (1994) by Bruce Small and Associates discusses the phenomenon of hypersensitivity and includes detailed lists of considerations and accommodations for people with chemical, biological and electromagnetic sensitivities.

The federal Department of Justice published "Policy on Accommodating Differences in the Workplace" (June 2001). This is a more general document that discusses the positive impacts of accommodation of people with environmental sensitivities.

The Canadian Society of Environmental Medicine published the two-volume guide "Environmental Health in Hospital (2001)" for hospital staff. It addresses pollution prevention and caring for the environmentally sensitive patient. The first volume contains detailed information regarding maintenance and practices, while the second volume focuses on patient care.

Workplace hygiene initiatives should include education and early action to minimize toxic exposures, as well as monitoring employees for environmental sensitivities, as described by the New Zealand Association of Hairdressers Inc.[259] (In the US, 20% of hairdressers leave the profession for health reasons.[260])

Assessment of electromagnetic phenomena in the workplace involves a variety of measurements and potential remediation,[261] from correction of wiring in the building to use of alternative technologies.

Many guides and self-help websites discuss coping with environmental sensitivities. Some sources are listed in Appendix C.

b) Publications related to "green" buildings

Guidelines for the construction industry to improve both environmental impact and indoor environmental quality have been published by the Canada Green Building Council (Leadership in Energy and Environmental Design – LEED).[184] The Building Owners and Managers Association (BOMA) also promotes a variety of environmental standards to address environmental concerns including energy efficiency and indoor air quality (www.boma.ca). Although these guidelines are not completely protective for people with environmental sensitivities, they do recommend some helpful steps to address several important environmental issues.

c) Best practices - Accommodations for children in daycares and schools

Some of the more detailed and stringent guidelines to improve indoor air quality and to minimize microbes and VOCs in indoor air have been the result of providing healthy environments for children. Citizens for a Safe Learning Environment (CASLE)[bb] exhaustively examined considerations for optimum indoor environments in institutions. Recently, the Canadian Partnership for Children's Health and Environment released "Playing it Safe: Service Provider Strategies to Reduce Environmental Risks to Preconception, Prenatal and Child Health." The Partnership also provides a checklist that covers many factors impacting environmental sensitivities, which follows from its "Child Health and the Environment - A Primer." [cc] Health Canada has developed "Tools for Schools" information to optimize environmental quality,[dd] although they are not as stringent as the citizens' initiative. As of September 2006, New York State required "Green Cleaning" in schools, hoping to improve asthma and behavioural problems.[ee]

In order to accommodate or prevent sensitivities in children, similar issues are identified as for workplace accommodation. These include fragrance-free non-toxic cleaning materials; non-toxic learning materials (papers, books and writing materials); high quality ventilation and air purification systems; construction and maintenance to prevent mould; conducting all renovations with non-toxic materials and no carpets, renovating only when the children are not present, and conducting adequate off-gassing; maintaining a scent-free environment; organic and wholesome foods with no colourings, preservatives or artificial flavours; avoiding known sources of contamination such as paint containing lead; and strict least-toxic pest control methods both inside and outside, with a large buffer zone from more toxic pesticide applications (e.g. as required by the Pesticide Code of Québec).

[bb] www.chebucto.ns.ca/Education/CASLE

[cc] All available at: http://www.beststart.org/resources/env_action/index.html

[dd] www.hc-sc.gc.ca/ewh-semt/pubs/air/tools_school-outils_ecoles/index_e.html

[ee] http://www.emsc.nysed.gov/facplan/greenclean.htm and http://www.ogs.state.ny.us/bldgadmin/environmental/GreenGuidelines.pdf

C Costs and benefits of accommodations

An effective strategy for achieving healthy indoor spaces and good air quality is to minimize potential pollutants during construction and renovation. Energy conservation concerns will create pressure to decrease ventilation in sealed buildings, further reinforcing the need to use low-maintenance materials, finishings, furnishings and equipment that contain materials with low toxicity, and have few emissions. Healthy indoor environments for children in schools are cost-effective in terms of building construction and maintenance,[262] and they lead to health and learning improvements.[8,86,262,263] Workers' health and productivity also improves with better indoor environmental quality.[8,79,83,218,264-266]

Costs of accommodation may include some renovation (e.g. to replace carpeting or furniture with tolerated materials), but some of the most important aspects of accommodation involve behaviour changes at the individual level. Accommodation may involve, for example, using less toxic cleaning products such as vinegar and hot water. The benefits that result in terms of improved worker productivity and student behaviour and learning[8,79,83,218,264-266] make the choices regarding indoor environmental quality straightforward from an economic point of view.[262]

Summary

Accommodation of people with environmental sensitivities should involve the person affected. It requires evaluation of many aspects of the workplace environment. Documents discussing accommodations are available, as are resources regarding construction and renovation for people with environmental sensitivities. Health and productivity benefits far outweigh possible minimal extra costs of designing, planning, and acting to minimize factors in the workplace that would be harmful to people with environmental sensitivities. For people with environmental sensitivities, their health and ability to work rests with the actions of others, including building managers, co-workers and clients.

IX Conclusions

This report was prepared to inform employers, service providers and individual Canadians about the medical aspects of environmental sensitivities. It covers the range of symptoms and conditions associated with environmental sensitivities; recognition and awareness by international, national, provincial and municipal bodies; medical research, diagnosis and treatment; issues regarding building codes and practices that affect accommodation of people with sensitivities; accommodation guidelines; and their impact in the workplace.

People's responses to factors in their environment vary enormously. Some people have debilitating responses to chemicals or electromagnetic radiation. They usually experience neurological difficulties and often have symptoms such as fatigue, burning eyes, headaches, trouble thinking and concentrating, nasal congestion, pain in various parts of the body, respiratory distress and gastrointestinal ailments. These may be accompanied by psychological symptoms. Symptoms are reproducible with repeated exposures, and resolve with avoidance of environmental factors that trigger symptoms. Environmental sensitivities may develop gradually after chronic exposure to relatively low levels of substances found in buildings with poor air quality ("sick buildings") or suddenly after an exposure to an environmental disaster or chemical spill. This condition may be initiated by one or a combination of environmental factors such as mould, pesticides, solvents, chemicals (e.g. off-gassing from carpets or furnishings) or electromagnetic phenomena.

Once a person has developed environmental sensitivities, reactions may occur to a broader range of factors, at levels of exposure that were previously tolerated and that cause little difficulty to many others. The impact of environmental sensitivities on workers' performance may range from mild (e.g. habituation to chronic exposures such that performance may be sub-optimal if not overtly abnormal), to severe impairment such that work is impossible. Sensitivities vary greatly from one individual to another, so the affected worker must be involved in determining accommodations.

Approximately 3% of Canadians have been diagnosed with environmental sensitivities and up to one-third of the population may experience discomfort due to factors in their environment. Early recognition, environmental control, avoidance of symptom-triggering agents, removal of residual toxins from the body, and recovery of normal biological processes are key to regaining and maintaining health for people with sensitivities. However, susceptibility to sensitivities will be lifelong.

Recognition of environmental sensitivities is developing internationally and in many Canadian government departments. Environmental sensitivities and related conditions are eligible for compensation by some Workers' Compensation Boards, although there is marked inconsistency across Canada. Public policy, law and regulation are advancing to protect people from triggers of sensitivities, such as tobacco smoke, pesticides, scents and other chemicals in public places.

Consensus is gradually building in the medical community and among academics, as well as in the general population, that many chemicals are not as harmless as we might have believed and that their combined effects are unpredictable. No-smoking, scent-free, pesticide-free, no-idling and least-toxic cleaning policies in health care and other public institutions are increasingly common. Furthermore, the medical community is advocating for broader policies and laws and increasingly acknowledging environmental sensitivities in medical education.

Modern medicine recognizes that the mind and body are intimately interconnected in the "biopsychosocial model" for health care. However, controversy continues regarding the physical or psychological roots of environmental sensitivities, with ramifications for health care and workplace accommodation. The research indicates that sensitivities have physical causes, with many neurological and psycho-social factors interwoven. Successfully addressing symptoms of sensitivities, with safe housing, workplaces, food and water, may also alleviate psychological symptoms. This is necessary before other interventions may be helpful.

Canadian statutes do not prescribe building standards that protect people with environmental sensitivities. Building codes focus on topics such as strength of structures. Measures impacting indoor environmental quality, such as building materials or de-gassing of buildings before they are occupied, are not addressed. Insofar as building codes and guidelines are perceived to be sufficiently protective of health and safety, they constitute barriers to research, development, implementation and mandating of safer materials and methods. "Green" guidelines incorporate a wide range of important environmental measures, but do not ensure that indoor environmental quality will be sufficient for people with sensitivities. More stringent guidelines have been developed for schools.

Construction, renovation, repair and maintenance should be conducted to minimize the introduction of pollutants, and design and construction should minimize later problems with dampness and moulds. Finishings, furnishings and equipment should contain low toxicity materials, have virtually no emissions, and be low-maintenance. These considerations are increasingly important given the desire to conserve energy by reducing ventilation. In addition to optimizing air quality and flow, ventilation systems must be maintained to avoid microbial contamination. Air filtration may play a role, but filters require frequent and routine maintenance. Least-toxic pest control, minimizing exposure to pesticides, is effective and affordable.

Building and maintaining equipment and infrastructure to minimize exposure to electromagnetic radiation, fields and currents requires attention to detail and may entail additional initial costs. Energy-efficient electrical equipment might increase radiofrequencies on electricity lines. Once recognized, however, these problems are amenable to inexpensive engineering solutions. There is a lack of consensus in research regarding the health effects of electromagnetic phenomena. This may be due to methodological limitations including unmeasured and uncontrolled parameters such as the quality of the electrical signal, radiofrequencies, locally elevated exposure levels and ground currents.

Workplace accommodation may include renovations, but some of the most important accommodations involve behaviour changes. These include the use of least-toxic cleaning and pest control practices, and avoidance of scented products. Unlike "built" accommodations such as ramps, accommodating people with sensitivities actively involves many people, such as employers, co-workers, others in the school or workplace, neighbours, etc. With education and leadership, people successfully adjust to policies addressing smoking, personal care, building maintenance and foods.

Improving the environmental quality of the workplace promotes workers' health and productivity and can prevent the development of sensitivities in others. Building or renovating with a view to accommodating people with sensitivities is not costly over the longer term; nor are education and leadership for behaviour change in the workplace.

Appendix A: Acronyms and abbreviations

AChE	Acetylcholinesterase (an enzyme in the nervous system and elsewhere in the body)
AEHA	Allergy and Environmental Health Association
ASHRAE	American Society of Heating, Refrigeration and Air-conditioning Engineers
BOMA	Building Owners and Managers Association
CASLE	Citizens for A Safe Learning Environment
CHRC	Canadian Human Rights Commission
CIHI	Canadian Institute for Health Information
CMHC	Canadian Mortgage and Housing Corporation
CO_2	carbon dioxide
GABAa	gamma-aminobutyric acid
HEPA	high efficiency particulate air [filter]
HVAC	Heating, ventilation and air-conditioning
ICD	International Statistical Classification of Diseases and Related Health Problems
IEQ	Indoor environmental quality
IgE	Immunoglobulin E
ME	Myalgic encephalomyelitis
MSDS	Material Safety Data Sheet
N	Number of people included in a research study
NMDA	N-methyl-D-aspartate
NRC	National Research Council
OCFP	Ontario College of Family Physicians
ppmv	Parts per million by volume (as opposed to weight)
RCPSC	Royal College of Physicians and Surgeons of Canada
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (European legislation)
SAD	Seasonal affective disorder
TILT	Toxicant induced loss of tolerance
US	United States of America
VOC	Volatile organic compounds
WHIMS	Workplace Health Information Management System
WHO	World Health Organization

Appendix B: Collaborators, people and organizations consulted

This project would not have been possible without the knowledge, input and support of the following collaborators:

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George Thomson	Chair, Ad Hoc Committee on Environmental Hypersensitivity Disorder (1985)

Appendix C: Resources

Allergy and Environmental Health Association – Ottawa	www.aeha.ca
Allergy and Environmental Health Association – Quebec (bilingual)	www.aeha-quebec.ca
American Academy of Environmental Medicine	www.aaem.com
American Industrial Hygiene Association	www.aiha.org
Asthma and Allergy Foundation of America	www.aehf.com
Best Start	www.beststart.org
Beyond Pesticides	www.beyondpesticides.org
Canada Green Building Council	www.cagbc.org
Canada Employment Immigration Union	www.ceiu-seic.ca/page_1766.cfm
Canadian Association of Physicians for the Environment	www.cape.ca
Canadian Coalition for Health and Environment	www.cche-info.com
Canadian Coalition for Green Healthcare	
Canadian Electricity Association	www.canelect.ca/en/home.html
Canadian Environmental Law Association	www.cela.ca
Canadian Mortgage and Housing Corporation	www.cmhc.ca
CMHC “About your house” resource page	www.cmhc-schl.gc.ca/en/co/co_001.cfm
Canadian Partnership for Children’s Health and Environment (bilingual)	www.healthyenvironmentforkids.ca
Canadian Society for Environmental Medicine	www.eimed.ca
Centre for the Environment, University of Toronto	www.environment.utoronto.ca
Chemical Injury Information Network	www.ciin.org
Chemical Injury.NET	www.chemicalinjury.net
Children’s Health Environmental Coalition	www.checnet.org
Coalition for a Healthy Ottawa	www.healthyottawa.ca
Collaborative on Health and Environment (including Toxicant and Disease Database)	database.healthandenvironment.org
International Academy of Detoxification Specialists	www.detoxacademy.org
DPEnvironmental Consulting	www.magma.ca/~nandd
Electrical Pollution Solutions	www.electricalpollution.com
Electromagnetic Hazard & Therapy (UK independent newsletter)	www.em-hazard-therapy.com
ElectroSensitivity-UK	www.electrosensitivity.org.uk
ElektroSMOG NEWS (German)	www.elektrosmognews.de
EMFacts Consultancy	www.emfacts.com
EM Radiation Research Trust	www.radiationresearch.org
EMR Association of Australia	www.ssec.org.au/emraa

Environmental Defence – Toxic Nation (bilingual)	www.environmentaldefence.ca/toxicnation
Environmental Health Clearinghouse	www.infoventures.com/e-hlth
Environmental Health Clinic at Women's College Hospital	www.womenshealthmatters.ca/Centres/environmental/index.html
Environmental Health Perspectives	www.ehponline.org
Environmental Law Centre (UK)	www.elc.org.uk
Environmental Protection Agency (US) Indoor Air Quality	www.epa.gov/iaq
Environment Canada	www.ec.gc.ca
FEB – The Swedish Association for the ElectroSensitive	www.feb.se
Fragranced Products Information Network	www.fpinva.org
Green Health Care	www.greenhealthcare.ca
Health Canada	www.hc-sc.gc.ca
Healthy Indoor Partnerships	healthyindoors.com
Human Ecology Action League	www.members.aol.com/HEALNATN/index.html
Institute for Environmental Health Sciences	www.niehs.nih.gov
Institute for Environmental Health Sciences (US)	www.niehs.nih.gov
International Commission for Electromagnetic Safety	www.icems.eu
International Commission on Non-Ionizing Radiation Protection	www.icnirp.de/pubEMF.htm
Invisible Disabilities Association of Canada	www.nsnet.org/idacan/index.html
Job Accommodation Network	www.jan.wvu.edu
Logic Alliance	www.logicalliance.ca
Mast Sanity (UK)	www.mastsanity.org
MCS Canadian Sources	www.mcscanadian.org
MCS Referral & Resources	www.mcsrr.org
MCSurvivors	www.mcsurvivors.com
ME/FM action network	www.mefmaction.net
ME Association of Ontario	www.meao-cfs.on.ca
Microwave News – a report on non-ionizing radiation	www.microwavenews.com
National Foundation for the Chemically Hypersensitive	www.mcsrelief.com
Next-up Organisation (regarding health effects of phone masts, based in France, multilingual)	www.next-up.org
Nova Scotia Environmental Health Centre	www.cdha.nshealth.ca/facilities/nsehc/index.html
Ontario College of Family Physicians	www.ocfp.on.ca
Overgevoeligheid voor elektrische en elektromagnetische velden (Danish, with summaries in other languages)	www.electroallergie.org

Pesticide Action Network of North America	www.panna.org
Planetary Association for Clean Energy Inc.	www.pacenet.homestead.com
Powerwatch (UK)	www.powerwatch.org.uk
Research Information on the EMFRAPID Program 1994-1998	www.niehs.nih.gov/emfrapid/html/resinfo.htm
Stop Transmission Lines Over People	www.stop-emfs.ca
Sustainable Building Information System	www.sbis.info
The Chemical Sensitivity Foundation	www.chemicalsensitivityfoundation.org
The Guide to Less Toxic Products	www.lesstoxicguide.ca
The Irish Doctors' Environmental Association	www.ideaireland.org
The Swedish Association for the ElectroSensitive	www.feb.se/index_int.htm
US Centers for Disease Control page of publications re: Electromagnetic fields	www.cdc.gov/niosh/topics/emf/
World Health Organization EMF research databases	www.who.int/peh-emf/research/database/en/index1.html
World Health Organization EMF topics	www.who.int/health_topics/electromagnetic_fields/en

Appendix D: Thomson recommendations (1985) and progress to 2006

[Report of the ad hoc Committee on Environmental Hypersensitivity Disorders [60]]
This Committee was established in November 1984 at the request of then-Minister of Health for the Province of Ontario, Keith Norton to report on the prevalence, level of knowledge, and methods of diagnosis and treatment of "environmental hypersensitivity." The Committee was also asked to outline possible approaches to investigating, treating or undertaking further research into such disorders.

Committee Recommendation (1985)	Status in 2006
Develop initiatives to minimize exposure to smoke, including bylaws restricting smoking in public places, and public education programs.	• Anti-smoking bylaws and provincial laws are in place.
Undertake action to ensure that patients and others have accurate information about food content, chemicals and other products in everyday use	• Content labelling of personal care products has been required by law since November 2006. • The *Controlled Products Regulations* of the *Hazardous Products Act* does not require that the full content of fragrance mixtures be reported. • The *Food and Drugs Act* does not require that all colours or flavours added to food be labelled specifically • Neither the *Hazardous Products Act*, the Canadian *Environmental Protection Act* nor the *Pest Control Products Act* requires comprehensive labelling of everyday use products (e.g. cleaners). The Domestic Substances List has identified priority substances and these will undergo hazard assessment in 2007. • In the absence of government action, monitoring and verification of organic agriculture is being carried out by non-governmental groups. • There are no requirements to label genetically modified food. • There are no requirements to label ultra-small particles (nano-particles) in products.
Estimate the prevalence of environmental hypersensitivity	• The 2003 national population health survey covered multiple chemical sensitivities.[10] • The 2005 National Survey of the Work and Health of Nurses covered multiple chemical sensitivities.[11]
Research the diagnostic tests and treatments used by clinical ecologists to determine which are demonstrably useful	• Researchers at the Nova Scotia Environmental Health Centre are conducting research in this area. This facility includes Canada's only Environmental Control Unit. • Some tests and treatments are commonly used with good success. Funds are necessary to conduct formal trials to confirm the utility of tests and treatments.
Establish a multi-disciplinary investigative and therapeutic environmental unit for research and for out-patient and in-patient	• In 1994 the Environmental Hypersensitivity Research Unit at the University of Toronto (U of T) was established with total funding of $1.5 million over 10

treatment of people with environmental sensitivities.	years. This unit brought together epidemiologists and health care professionals. • The Unit has published research on diagnosing environmental sensitivities and on the characteristics and genetics markers of patients. • In 1996 the Environmental Health Clinic, funded by the Ontario Ministry of Health, opened at Women's College Hospital in Toronto. It is affiliated with the U of T. It does not include an Environmental Control Unit or in-patient facilities. OHIP covers one initial and one follow-up consultation per patient.
Amend the fee schedule to cover the time required to obtain good histories, to counsel a patient on avoidance procedures and to monitor the patient's performance.	• The Ontario fee schedule has a time-based billing code for patients with chronic fatigue syndrome, which compensates doctors for the time required to obtain a full history.
Various recommendations were made for people with limited income	• Routine laboratory tests are funded; testing for toxins is neither readily available nor funded. • OHIP does not cover several types of treatments. • Private insurance covers few treatments. • Medications that patients can tolerate (e.g. with less colouring and other excipients) are not covered for people receiving disability support.
Support the following treatments with public funds: 1) avoidance 2) the prescription of nutritionally safe diets.	• Tax relief is offered for equipment to assist avoidance (e.g. air and water filters). • In 2006 the Ontario government discontinued a diet supplement allowance that included organic food.
The environmental unit should undertake public education by: • producing easily understood pamphlets on the more controversial issues related to environmental hypersensitivity; • issuing a summary of the Committee's report for a general audience; • ensuring adequate involvement in conferences, meetings, etc.; • offering assistance to school boards, public health units, etc. in preparing accurate and balanced documents about environmental sensitivities.	• Information is available about environmental sensitivities, chronic fatigue syndrome and fibromyalgia in pamphlet form and on the Environmental Health Clinic website. • Educational seminars are provided by the Environmental Health Clinic and partners about numerous environmental health issues such as smoking, pesticides, perfumes, mercury and lead. • Staff physicians of the Environmental Health Clinic serve on the Environmental Health Committee of the Ontario College of Family Physicians (EHC-OCFP) and many other organizations.
Educate medical health officers and public health nurses so that they are prepared to provide current information on environmental illness and environmental hypersensitivity.	• Some public health units are particularly well-informed about environmental sensitivities and are able to provide current information • To gain expertise in environmental health, the Environmental Health Clinic trains medical students, residents, fellows and nursing students. • Environmental Health Clinic engages in public education in cooperation with Public Health Units.

Develop programs of continuing education to provide practitioners with scientific information about theories and beliefs in the field of environmental hypersensitivity (e.g. there is a general lack of understanding of the possibility that indoor air can contribute to illness).	• The EHC-OCFP provides environmental health information (see www.ocfp.on.ca), workshops and Continuing Medical Education. • Some family medicine post-graduate programs cover theories and concepts in the field of environmental sensitivities.
Review basic social assistance programs to ensure that they recognize how disabling environmental sensitivities can be. Regardless of disagreement within the medical profession regarding the causes of environmental sensitivities, people are disabled and are entitled to minimal support.	• As a result of disagreement, people who are disabled due to environmental sensitivities are often left with little or no support. This can lead to more stress, increasing poverty and worsening of their condition.
In cases of genuine financial need (i.e., people receiving social assistance), rent supplements or discretionary payments should be available for those seeking to make modest environmental changes.	• Funding is available for environmental changes only if the changes result in improved energy efficiency.
The environmental unit should provide expert assistance to appeal bodies and be involved in the selection of physicians who are knowledgeable about environmental hypersensitivity and who are willing to assess the patients' condition irrespective of diagnosis.	• Environmental medicine physicians, and doctors in the Environmental Health Unit provide expert assistance on behalf of patients.
Encourage private insurers to assess the patient's condition irrespective of the causes of the condition.	• Some private insurers provide limited but unpredictable coverage.
Involve the environmental unit in the development and promotion of special housing such as: • apartments modified for patients who are participating in the environmental unit's research program; • special hospital rooms for patients diagnosed as environmentally hypersensitive.	• CMHC and NRC have researched building materials, maintenance and ventilation. CMHC and the Environmental Health Unit have collaborated for many years. • The Unit and the EHC-OCFP supports housing projects currently being undertaken by Allergy and Environmental Health Association groups in Ontario, Quebec and Manitoba. • Healthy Indoors Partnership is bringing together many parties, including the Environmental Health Clinic, to compile sources of environmentally preferable materials. • The Environmental Health Clinic made arrangements with a nearby hotel to provide cleaner-air rooms for patients, at a substantially reduced rate. • The Canadian Society for Environmental Medicine published hospital staff guidelines to assist with the care of people with environmental sensitivities who are hospitalized.

The environmental unit should develop recommendations regarding possible curriculum changes in medical schools to ensure that issues relating to environmental illness are part of medical education.	• The Continuing Medical Education unit was developed by the OCFP. It is available through the Women's College Hospital in Toronto. • In 2006 the EHC-OCFP launched an Environmental Health Scholars Program to introduce environmental health concepts into many aspects of the curriculum in Ontario medical schools.
Hold an interdisciplinary conference to discuss this report and its recommendations. Conferences of this type should be held regularly as part of the environmental unit's vital educational role.	• Health Canada held conferences in Ottawa in 1990 and 1992. • The Environmental Health Clinic held a conference in 1998. • The Environmental Health Clinic and OCFP co-sponsored a Peer Presentation Program on Environmental Health in 2000. • Since 2000, the Environmental Health Clinic and the OCFP have co-sponsored an annual Environmental Health Day at the OCFP Annual Scientific Assembly.
The Ontario Medical Association should consider establishing an environmental health subsection to bring together practitioners interested in this field.	• OCFP-EHC members collaborate with the Ontario Medical Association on environmental health matters.

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