Identifying and managing adverse environmental health effects: a new series

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ß See related article page 1049

Those of us who felt that the *E. coli* outbreak from the contaminated municipal water supply in Walkerton, Ont.,[1] was an abrupt wake-up call from the environment have been in a deep sleep. The alarm went off a long time ago. In 1962 Rachel Carson's book *Silent Spring* provided some of the first public evidence of how pesticides were poisoning our environment.[2] In 1963 we knew that herring gulls in the Great Lakes region were failing to reproduce and understood (later) that it was due to dichlorodiphenyltrichloroethane (DDT) exposure.[3] In 1972, upon the culmination of evidence from multiple studies, the Great Lakes Water Quality Agreement was signed; the agreement identified over 350 hazardous polluting substances and called for the virtual elimination of the discharge of any or all persistant toxic substances.[4] In 1978, 1030 households were evacuated from the Love Canal near Niagara Falls when a commercial soup of industrial solvents, pesticides and process sludge seeped into their backyards. *Our Stolen Future*, published in 1996,[5] takes up where Carson left off and reviews a large and growing body of scientific evidence linking synthetic chemicals to aberrant sexual development and behavioural and reproductive problems, raising the specter of endocrine disruption — a topic discussed in *CMAJ*'s recent series on health and the environment.[6]

These historical milestones in environmental health prompted Canadian regulatory responses, which resulted in the banning of certain persistent organic pollutants such as DDT and polychlorinated biphenyls (PCBs), the phasing out of lead in gasoline and paints, and the establishment of transboundary agreements to improve the quality of water in the Great Lakes. The results have not been inconsequential. The concentration of organochlorine pesticides and PCBs in breast milk from women in the Great Lakes region, monitored since 1967, has been decreasing,[7] and the mean blood lead level in children screened in Ontario decreased at a steady rate of 0.05 μmol/L per year between 1983 and 1992.[8]

Advances in epidemiological and laboratory evidence have direct and practical implications for clinical practice and patient management. In this issue we launch the first of a series of short, peer-reviewed articles designed to assist physicians in identifying and managing patients with health effects of exposure to specific environmental contaminants. The topics in the series include exposure to outdoor air pollution, lead, pesticides, persistent organic pollutants and carbon monoxide. The first article (page 1049 of this issue) outlines how to take an environmental exposure history and identifies common sources of certain contaminants.

As this series will illustrate, the evidence associating poor air quality with exacerbations of respiratory disease is convincing and impels physicians to identify patients at risk and to advise them on ways to reduce this risk. The link between lead exposure and neurodevelopmental delay is also clear. Sensitive screening questions have been designed to help physicians identify children at elevated risk of lead exposure. Identifying such a child can be very gratifying because, through the cooperation of public health officials, effective interventions are available to clean up the environment and thereby reduce the level of exposure. Other evidence that is indisputable is the toxicity of certain indoor air contaminants, such as carbon monoxide. In the few minutes it takes to take an environmental exposure history, an unsuspected exposure to carbon can be revealed and appropriate corrective action instigated.

Pitted against these small Davids, however, is the looming Goliath of an estimated 70 000 industrial chemicals distributed globally. Over 23 000 substances are currently in industrial use in Canada, with less than 15% having had a complete or comprehensive evaluation of their toxicological properties.[9] The list includes organochlorine chemicals, volatile organic compounds, lead, mercury, cadmium, particulates and substances formed secondarily such as acid aerosols and ozone. The substances come from sources such as industrial discharges, pulp and paper mill effluent, waste incineration, fossil fuel combustion, sewage treatment effluent, fertilizer run off and pesticides. Over 500 active ingredients in pesticides are registered for use in Canada, at least 300 of which were approved for use before 1981, when testing requirements were much more lax than they are today.[10] About 1.2% of the domestic food supply and 2% of imported fresh produce sampled between 1994 and 1998 in Canada had pesticide residues that exceeded the maximum levels set according to the Pest Control Products Act.[11] A report by the Canadian Environmental Law Association in 1997 listed 15 toxic chemicals found in milk, 13 found in beef and 10 found in apples from the Canadian food supply.[12] In 1992 the Organisation for Economic Co-operation and Development, of which Canada is a member, established a pesticide program that required the completion of new risk assessments for hundreds of pesticides that have been on the market for many years,[13] a task of such enormity

that international collaboration and exchange is essential.

The task of assessing exposure risk is hindered not only by the scale of the problem, but also by the limits of data and methodology. The problems of finding an unexposed control group, of assessing the effects of multiple exposures of varying doses and durations, of assessing special risks for children, pregnant women and other potentially susceptible populations, and of recognizing the subtle health effects of long, latent exposures all present methodological challenges.[14] For the majority of environmental chemicals much more is known about the human health effects from acute, high-dose occupational, accidental and intentional overexposure[15–18] than from chronic, low-level exposure.

Faced with scientific uncertainties, environmental scientists, such as those at Health Canada and members of the International Joint Commission, may invoke the "precautionary principle"[19] when weighing the accumulated evidence from wildlife studies, toxicological research on laboratory animals and gene–toxin interactions, epidemiological studies and case reports of occupational and accidental acute poisonings. From existing evidence, the International Joint Commission compiled a list of 11 critical pollutants: PCBs, dioxins, furans, toxaphene, DDT, mirex, dieldrin, hexachlorobenzene and benzopyrene, methyl mercury and alkyl lead.[20] In 1997 Health Canada issued a statement saying that "the weight of evidence indicates that certain heavy metals and persistent chlorinated contaminants, present as low level contaminants in the Great Lakes basin, can cause adverse health effects in animals and humans."[21]

All humans have body burdens of foreign chemicals. These "xenobiotics" can be found throughout the body, including serum,[22] breast milk,[7,23] semen,[24] adipose tissue,[25] endocrine glands,[26] bone[27] and follicular fluid.[28] For the most part, levels of these xenobiotics have been measured and assessed in adults. We are now recognizing that children are more vulnerable than adults to environmental contaminants because they have greater exposure and physiological susceptibility.[29,30] For example, Health Canada recently established that there is a definite unnecessary and unacceptable health risk from exposure to the most common phthalate, diisononyl phthalate, among children under 1 year of age who chew on toys made of polyvinyl chloride for extended periods.[31] More recently Health Canada advised Canadians about potential lead exposure from inexpensive jewelry and candles with lead core wicks.[32]

When warnings such as these are issued, parents seek advice and answers from their physicians. In a recent survey Ontario family physicians reported that many patients question them about the environment, yet most of the physicians rated their level of knowledge of environmental health issues to be very low.[33] What are the signs of insecticide exposure in children or elderly people? What does a urine lead level of 0.52 mean? When might a spontaneous abortion suggest pesticide exposure? What should people with asthma do during a smog advisory? Who is at risk of lead exposure?

To assist primary care physicians to answer such questions, some members of the Environmental Health Committee of the Ontario College of Family Physicians, with financial support from the International Joint Commission Health Professionals Task Force, the Canada Mortgage and Housing Corporation (www.cmhc-schl.gc.ca) and the Ontario College of Family Physicians (www.cfpc.ca/ocfp), has compiled a series of case-based modules that instruct family physicians, specialists such as pediatricians, obstetricians and respirologists, and midwives, nurse practitioners and other members of the health profession on the clinical management of lead exposure, outdoor and indoor air quality, and exposure to pesticides and persistent organic pollutants. The content areas presented in these modules were derived from a needs assessment of family physicians and from a consensus process that included family physicians and experts in environmental and public health. The fully elaborated modules are available on the International Joint Commission Web site (www.ijc.org/boards/hptf/modules/content.html). Some of the content from the modules has been transformed into short, peer-reviewed articles that constitute the new *CMAJ* series.

To proceed through the series, physicians need to know how to take an environmental exposure history. The University of Toronto affiliated Environmental Health Clinic of the Sunnybrook & Women's College Health Sciences Centre, in collaboration with the Ontario College of Family Physicians Environmental Health and Continuing Education Committee, has developed an approach that uses a simple mnemonic — CH^2OPD^2 (Community, Home, Hobbies, Occupation, Personal habits, Diet and Drugs) — to identify possible sources of a patient's environmental exposures. This tool is introduced in this issue and explained through an illustrative case of sick-building syndrome (page 1049).

In conjunction with this series, the Air Health Effects Division of Health Canada's Safe Environments Directorate, in partnership with the University of Toronto's Faculty of Medicine, has sponsored the development of an accredited online continuing professional development course, hosted through *CMAJ*, to educate physicians about the health effects of outdoor air pollution. The course will run over 4 weeks in May 2002 and will take the format of a case-based, moderated email discussion group. A maximum of 30 participants can register. Two cases, with associated questions, will be posted and discussed. Participants will be asked to locate and appraise online resources that might help with managing the cases. Participants will be required to commit 1.5 hours per week, at their convenience, to the course and to check their emails at least 3 times weekly. They will complete an online pre-assessment of learning needs and a post-test and course evaluation. Three months after finishing the course participants will be asked to complete a small exercise to reflect on the impact of the course on their practice. This program has been reviewed by the College of Family Physicians of Canada and has been approved for 6 Maintenance of Proficiency (MAINPRO-C) credits. It has also been approved for 6 credits as an accredited group learning activity under

section 1 of the framework of continuing professional development options for the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada. Please visit *CMAJ*'s Web site (www.cmaj.ca) or contact Suzanne Charron (suzanne.charron@cma.ca) for further updates on this initiative.

As we proceed through our new series on environmental health, family physicians, pediatricians, respirologists, obstetricians, nurse practitioners and other health care professionals who are sometimes stymied by the environmental health concerns raised by patients will learn practical strategies for identifying, investigating and managing the health effects of exposure to environmental contaminants. The aim of the series is not to hold the evidence up for critical appraisal but, rather, to advance precautionary practice in the presence of scientific uncertainty.

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