



The Environment and Health

An Introduction for Nurses



CANADIAN NURSES ASSOCIATION
ASSOCIATION DES INFIRMIÈRES ET INFIRMIERS DU CANADA

This document has been prepared by CNA to provide information on a particular topic or topics. The views and opinions expressed in this document do not necessarily reflect the views of the CNA Board of Directors.

All rights reserved. Permission to photocopy or download for individual use is granted. Further reproduction in any manner, including posting to a website, is prohibited without prior written permission of the publisher. Permission may be obtained by contacting CNA at permissions@cna-aiic.ca.

© Canadian Nurses Association
50 Driveway
Ottawa, ON K2P 1E2

Tel: 613-237-2133 or 1-800-361-8404
Fax: 613-237-3520
Website: www.cna-aiic.ca

December 2007

ISBN 978-1-55119-214-7

photo: Comstock

Contents

Acknowledgments / i

Introduction / 1

PART 1 LINKING HEALTH, ENVIRONMENTAL ISSUES AND NURSING

Introduction / 2

Definition of environmental health / 3

Burden of disease / 3

Key concepts: Pathways of contaminants, the definitions of risk and the precautionary principle / 3

Nursing and environmental health: Background / 5

Nursing's role in environmental health / 5

Principles of environmental health for nurses / 7

PART 2 ENVIRONMENTAL ISSUES

Outdoor air quality and CVD / 9

The issue / 9

Smog / 9

Evidence of the impact of smog on CVD / 9

Summary of the impact of smog on health / 10

Implications for nursing / 11

Exposure to lead among children / 13

The issue / 13

Background / 13

Evidence of neurotoxicity in children from lead exposures / 13

Summary of the impact of lead on children's health / 14

Implications for nursing / 15

Dioxin and incineration of health-sector wastes / 17

The issue / 17

Background / 18

Evidence of the impact of dioxin on health / 18

Implications for nursing / 19

Cosmetic Use of Pesticides / 21

The issue / 21

Background / 21

Evidence of the impact of pesticides on health / 21

Implications for nursing / 22

Conclusions and further resources / 24

References / 27

Acknowledgments

The English version of the article “Les infirmières et l’environnement : L’urgence d’agir” by Fiona Hanley, published in French in la Revue officielle de l’Ordre des infirmières et infirmiers du Québec, Perspective infirmière, 3(2); nov.-déc. 2005, 39-49, was helpful in developing this guide.

The Canadian Nurses Association (CNA) would like to acknowledge the significant contribution of the members of the Environmental Health Reference Group to the preparation of this paper. The members of the reference group are:

Chelsee Albo

Western Regional Director
Canadian Nursing Students Association

Heather Anderson, BN, M.Ed.

Instructor
Portage College

Penelope A. Barrett, PhD, B.Ed.(Nurs.), RN, RM(Aust.), FRCNA

Associate Professor
University of Northern British Columbia

Carol Bassingthwaighe, MSN, RN

Lecturer
University of British Columbia

Paul Boudreau, RN, BScN

Policy Analyst
Association of Registered Nurses of Prince Edward Island

Nancy Brookes, RN, M.Sc.(A), PhD, CPMHN(C)

Nurse Scholar
Royal Ottawa Health Care Group

Andrea Chircop, RN, MN, PhD(c)

Assistant Professor
Dalhousie University

Kim English, RN, BScN, MN

Trent/Fleming School of Nursing Faculty
University of Trent

Candace Franke, RN

Staff Nurse
Saskatoon Surgicentre Inc.

Gloria Fraser, RN, MHST

Nurse Education Coordinator
Women’s College Hospital

Donna Goodridge, PhD, RN, CHPCN(C)

Assistant Professor
University of Saskatchewan

Fiona Hanley, RN, M.Sc.

Lecturer
McGill University

Patricia A. Hansen-Ketchum, RN, MN

Assistant Professor
St. Francis Xavier University

Jean Harrowing, RN, PhD(c)

Lecturer
University of Lethbridge

Roberta Heale, RN(EC), MN, DNP(c)

Assistant Professor
Laurentian University

Laurie Higgins, RN, BN

Learning Facilitator
Atlantic Health Sciences Corporation



Billie Hilborn, RN, BScN, M.H.Sc.
PhD Student – Nursing and Bioethics
University of Toronto

Cindy Hunt, DrPH, RN
Associate Dean, Nursing, School of Health Sciences
Humber Institute of Technology and Advanced Learning

Kristine Hutchison, RN, BN
Representing the Community Health Nurses Association
of Canada
Manager Public Health – Iqaluit
Department of Health and Social Services, Nunavut

Sarah Liberman, RN, BScN
Policy Analyst
Saskatchewan Registered Nurses' Association

Priscilla Lockwood, RN, MSN, ENC(C)
Representing the Canadian Association for Rural and
Remote Nursing
Staff Nurse
Tofino General Hospital, Vancouver Island Health Authority

Jackie Mace, RN, ONC(C)
Clinical Manager, Orthopaedics
The Ottawa Hospital, General Campus

Jessica Madrid, RN, BScN
Public Health Nurse
Northern Interior Health Unit, British Columbia

Marjorie McDonald, RN, PhD
Associate Professor
University of Victoria

Bonnie McLeod, RN, BScN, CPN(C)
Representing the Operating Room Nurses Association
of Canada
Clinical Nurse Educator – Perioperative
Fraser Health Authority

Jayne Ménard, RN, BTSN
Program Manager
St. Mary's General Hospital

Sharolyn Mossey, RN, MScN
Assistant Professor, Nursing Vice-Dean, Professional Schools
Laurentian University

Tricia Newport, RN, BScN
Home Care Nurse
Health and Social Services, Yukon Government

Eileen Owen-Williams, DNP, FNP, CNM, SANE-A
Associate Professor Coordinator, Family Nurse
Practitioner Program
University of Northern British Columbia

Pammla Petrucka, RN, BScN, MN, PhD
Associate Professor
University of Saskatchewan

Janet Purvis, RN, B.Sc., MN
National Practice Consultant
VON Canada

Charlene Schiffer, RN, BScN, R.R.Pr., TTP
Treasurer
Canadian Holistic Nurses Association

Kari Simonson, RN, MN
Clinical Coordinator: Research & Aboriginal Health
Canmore General Hospital

Lori Strudwick, RN, BN
Community Health Nurse
Watson Lake Hospital/Health Centre, Yukon Government

Kendra Swinn
National Community and Public Health Officer
Canadian Nursing Student Association

Hilda Swirsky, RN, BScN, M.Ed.
Representing the Registered Nurses' Association of Ontario
Clinical Nurse
Mount Sinai Hospital

Joyce Woods Surrendi, RN, BN, BA, M.Ed., PhD
Nursing Educator
Mount Royal College



Introduction

Supporting nurses' engagement in environmental health is one of three themes chosen by the Canadian Nurses Association (CNA) to celebrate its centennial in 2008. The association has therefore launched an environmental health initiative to support work in environmental health in the domains of nursing practice, education, research and policy. This introductory document is the first in a series of papers on nursing and environmental health that are part of the initiative, and it was developed with guidance from the Environmental Health Reference Group.¹

This introductory guide provides an overview of the basic concepts of environmental health so that nurses can understand more about the environmental factors that influence the health of individuals, families and communities. Part 1 provides background on environmental health principles, and part 2 presents four issues, each of which illustrates a particular aspect of environmental health. The overall purpose of the document is to:

- identify links between health and the environment;
- explore the roles of nursing in environmental health;
- identify examples of environmental health issues; and
- propose ways to incorporate environmental health principles into nursing practice, education, research and policy.

For many nurses this document will not be enough to support them in their work in environmental health, and therefore guidance on where to access more information is provided in relevant sections and in the conclusion. Fortunately, excellent material on environmental health and nursing is available.

The purpose of nursing education in environmental health is to ensure that every nurse can consider environmental factors that may be contributing to poor health, understand environmental hazards and their impact on health, understand the role of individuals and communities in providing good stewardship of the environment, and make recommendations about how to reduce or prevent exposures to environmental hazards.

“A healthy environment is fundamental to life, and attention to the effect of the environment on human health is imperative if we are to attain the goal of health for all.”

– Canadian Nurses Association & Canadian Medical Association, 2005



¹ The members of the Environmental Health Reference Group are listed in the Acknowledgments.

PART 1

LINKING HEALTH, ENVIRONMENTAL ISSUES AND NURSING

INTRODUCTION

Our physical environment is a basic determinant of health: it has a profound impact on why some people are healthy and others are not. The connections between health and clean air and water as well as safe and nutritious food have long been known. More recently, our understanding has broadened to include other environmental influences on health such as housing quality, waste disposal, road safety and noise (Myres & Betke, 2002) (Figure 1).

There is also concern about hazards from the environment that threaten well-being more globally. These include ozone depletion, climate change, the energy crisis, air pollution, soil erosion and desertification, deforestation, water shortages, chemicals, toxic waste, arms spending, international debt and population growth (Poffitt, 1993).

In Canada we have already seen the effects of some of these global threats to health. The effects of ozone depletion have been felt for many years, and in the mid-1990s CNA published an educational booklet with Friends of the Earth on this issue (CNA & Friends of the Earth, 1995). Global warming has affected the health of Canadians through increases in exposure to vector-borne disease (such as West Nile virus infection), higher incidence of water- and food-borne illnesses, more frequent extreme weather events and severe heat waves (Health Canada, 2005a). The health impacts of global warming are likely to worsen since further climate changes are thought to be inevitable, given the time it will take to significantly reduce worldwide emissions of greenhouse gases (Intergovernmental Panel on Climate Change, 2007).

Canadians' health has also been affected by poor outdoor air quality (resulting in increases in mortality and morbidity from both cardiovascular and respiratory diseases), chemicals (implicated as a cause of cancer, endocrine disruption, reproductive toxicity and neurotoxicity, among other health effects [Wigle, 2003]), and toxic waste. More detail on the health impacts of selected environmental hazards is provided in part 2 of this guide.

Workplaces can also be a source of significant environmental exposure. Unhealthy work environments are related to unhealthy buildings and biological, chemical, radiological or physical hazards that affect indoor air and the health of workers (Guenther & Hall, 2007). For example, exposure to organic solvents during pregnancy most commonly occurs in an occupational setting and has been found to be associated with congenital malformations and developmental delay (Khattak et al., 1999). With strong support from the labour movement, work is underway to replace substances known to be toxic – for example, ingredients in cleansers, paints and solvents – with less toxic alternatives to reduce exposure to hazardous materials in the workplace (Canadian Strategy for Cancer Control, 2006).

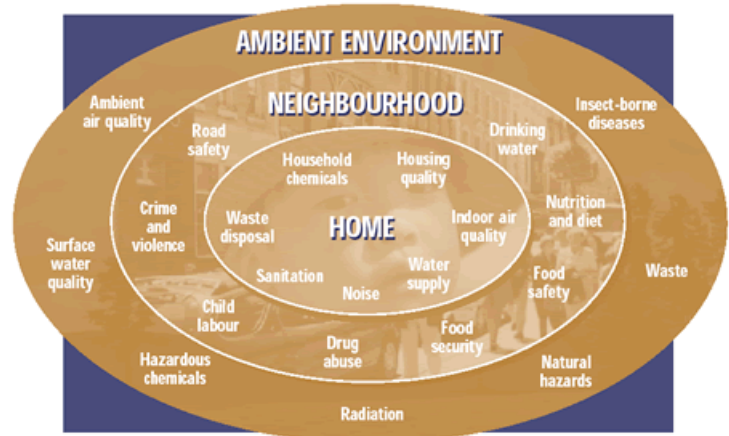


Figure 1: Environmental influences on health

Source: Myres, A., & Betke, K. (2002). Healthy Environments = Healthy People. *Health Policy Research Bulletin*, Issue 4. Reprinted with permission.

DEFINITION OF ENVIRONMENTAL HEALTH

The World Health Organization (WHO) has defined environmental health as comprising “those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations” (2007).

This definition is useful in guiding nursing practice, education, research and policy because it includes determinants of health nurses already routinely address (biological, social and psychosocial factors, including income inequity) and adds others they may not (physical and chemical factors). Use of this definition supports the view that addressing environmental health enhances work in which nurses are already engaged, rather than introducing a new specialty area. The definition also provides specific guidance for areas of nursing intervention (assessing, correcting, controlling and preventing) that are part of theories and conceptual frameworks used by nurses.

BURDEN OF DISEASE

WHO has calculated that the impact of environmental hazards on health is heaviest among poor and vulnerable populations in developing countries (Figure 2). Within developed countries, vulnerable populations, including families living in poverty, migrant workers and visible minority groups, are more likely to be exposed to environmental hazards at home, in their community and at work (Chaudhuri, 1998). In addition, children, wherever they live, are especially vulnerable “because they have no control over their prenatal and postnatal environments, including the quality of the air they breathe, the water they drink, the food they eat, and their place of residence” (Wigle, 2003, p. 1). The rapid cellular development of children’s tissues and organs also makes them more vulnerable to exposures to environmental hazards. In Canada, residents of First Nations communities are particularly at risk of health problems related to unsafe drinking water, lack of adequate sanitation and substandard housing (Health Canada, 2000).

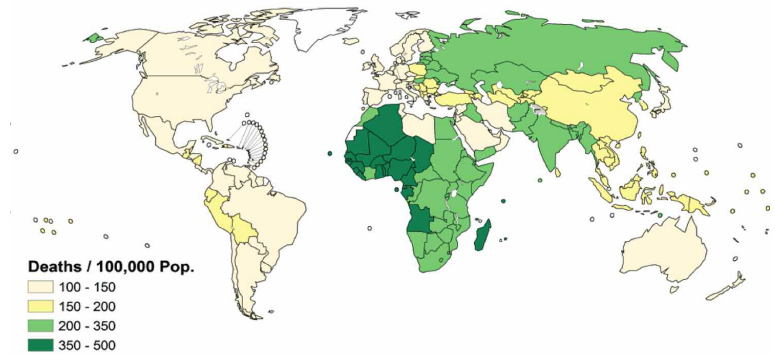


Figure 2: Mortality due to environmental causes

Source: World Health Organization. (2006). *Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease*. Geneva: Author.

KEY CONCEPTS: PATHWAYS OF CONTAMINANTS, THE DEFINITION OF RISK, AND THE PRECAUTIONARY PRINCIPLE

Three concepts are particularly helpful in understanding environmental health issues. They illustrate how individuals, families and communities are exposed to environmental contaminants, how the risk of these exposures is conceptualized and how this risk can be reduced.

PATHWAYS OF CONTAMINANTS

Contaminants, or hazards, follow defined pathways from the time they enter the environment until they come in contact with individuals, families or communities. These exposure pathways have five components:

- the source of contamination (e.g., emissions, waste water and disposal sites, volcanoes, fires, household products);
- the medium through which the contaminant travels (e.g., water, soil, air, food);

- the point at which people come in contact with the contaminant;
- the person, plant or animal that is the receptor of the contaminant; and
- the route of exposure (e.g., inhalation of gases, vapours or particulate matter, dermal contact with contaminated soil or water, or ingestion of food or water) (Health Canada, 1998).

DEFINITION OF RISK

Risk is the measure of both the adverse health effects of the hazard and the probability of the occurrence – in other words, the probability of exposure of a susceptible individual to the hazard (Figure 3). In Figure 3, *hazard* is a property of the chemical, substance, object or event that leads to an adverse health effect; *susceptibility* is a property of the individual, family or community being affected by the hazard; and *exposure* is a property of the intervening environment from the point where the substance is released and along its pathway to humans (Myres & Betke, 2002).

The precautionary principle

The precautionary approach or principle proposes that “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation” (United Nations, 1992).

Although the precautionary principle was developed to protect the environment, it can also be used to guide health protection activities. This approach is illustrated by the earlier example of workplaces replacing substances known to be toxic with less toxic alternatives to reduce exposure to hazardous materials. From a nursing perspective, it means that risk reduction activities with individuals, families and communities should focus on minimizing exposures to environmental hazards through advocacy and risk communication, as well as recognized occupational and public safety controls, even where there is not full scientific certainty of the negative health impact of exposure.

Advocacy activities include promoting cosmetic pesticide bylaws and clean air regulations and legislation. Risk communication includes advice and written materials that recommend – for example – wearing a hat and using sunscreen (to avoid ultraviolet radiation), cleaning up mould in houses (to improve indoor air quality), staying away from high-traffic areas (to avoid breathing air pollution), painting over old paint (to decrease lead in dust), using less toxic cleansers (to avoid chemical exposures) or being aware of heat advisory days (to avoid heat stroke).

+

4



Figure 3: Definition of risk

Source: Myres, A., & Betke, K. (2002). Healthy Environments = Healthy People. *Health Policy Research Bulletin*, Issue 4. Reprinted with permission.

“[Nursing] ought to signify the proper use of fresh air, light, warmth, cleanliness, quiet, and the proper selection and administration of diet – all at the least expense of vital power to the patient.”

– Florence Nightingale, 1860, p. 8

NURSING AND ENVIRONMENTAL HEALTH: BACKGROUND

It is generally agreed that nursing’s focus on environmental health was first acknowledged by Florence Nightingale, who recognized the importance of the environment in promoting the health and recovery of soldiers wounded in the Crimean War. Nightingale saw the environment as a tool that could be manipulated in support of health (Butterfield, 2002). Another early proponent of nursing’s role in environmental issues was Lillian Ward, a district nurse working in the tenements of the lower east side of New York at the end of the 19th century. As well as teaching mothers about home sanitation, she also proposed that nurses should study larger conditions of city sanitation that were beyond the individual’s control yet could have an even greater impact on health (Butterfield, 2002). Another pioneer in environmental health practice is Mary Breckenridge, who worked as a nurse in communities in rural Kentucky in the early part of the 20th century. She addressed issues of sanitation and access to clean water in an effort to lower infant mortality rates (Thomlinson, 2003).

Many Canadian nurses, especially in their roles in community health, public health and occupational health, are actively involved in addressing exposures to a range of environmental hazards in the home, school, community and workplace. For example, Sandra Pike-MacDonald and her co-authors (2007) conducted a community health needs and resources assessment study in Newfoundland and Labrador that identified the quality of drinking water as a serious concern of residents. Nurses from the Environmental Health Clinic at Sunnybrook and Women’s College Health Sciences Centre worked with others from the South Riverdale Community Health Centre and the Family Health Division of Public Health in Toronto to design and pilot two workshops about hidden environmental risks during pregnancy (Fraser, 2004). Nurses from the British Columbia Nursing Union have worked with members of the Labour Environment Alliance Society to decrease the use of intravenous tubing with di-ethylhexyl phthalate in hospitals (British Columbia Nursing Union, 2005). In a final example, Fiona Hanley, a lecturer at Dawson College in Montreal, has developed modules for teaching nursing students about environmental health, which have sensitized many students to environmental health issues.

Despite the work going on in this area, there is some evidence that nurses could benefit from a greater understanding of the health impacts of environmental factors. A study by the Institute of Medicine (IOM) found that nurses considered themselves unprepared to address environmental health issues, were unaware of environmental legislation and regulations and believed they were not competent to recognize the health effects of environmental contaminants (Pope, Snyder & Mood, 1995). Although some nurses have been involved in aspects of environmental health for many years, it is widely acknowledged in the nursing literature that nurses could be more broadly engaged in these issues (Sattler & Lipscomb, 2003; Stevens & Hall, 1993; Thomlinson, 2003; Tiedje & Wood, 1997).

Nurses will likely increasingly recognize that part of reducing exposure to environmental hazards involves reducing the waste and emissions that we ourselves are responsible for, both as individuals and as workers within the health-care industry. Information on greening health-care institutions and how nurses can reduce their own environmental footprint is provided in the section “Dioxin and incineration of health-sector wastes” as well as in the second paper in this series, *The Role of Nurses in Greening the Health System*.

NURSING’S ROLE IN ENVIRONMENTAL HEALTH

So the question becomes, how can nurses make the environment central to their vision of health? Two approaches are often cited in descriptions of how nurses can engage in environmental health activities. The first, from the International Council of Nurses (ICN) in 1990, proposes seven key strategies for nursing’s role in environmental health. The second,

from the IOM, defines four general environmental health competencies that all nurses should have (Pope, Snyder & Mood, 1995). Both approaches provide useful guidance for nurses on how to incorporate environmental health principles in their work.

“Despite the fact that a significant proportion of disease is attributable to environmental factors, environmental health is often viewed as an appendage of occupational health nursing rather than central to nursing’s vision of health.”

– Butterfield, 2002, p. 43

KEY STRATEGIES FROM THE ICN FOR NURSING’S ROLE IN ENVIRONMENTAL HEALTH

- 1 Assess the environment and detect hazards when they exist.
- 2 Provide information to individuals and groups on the health effects of environmental toxins and more global hazards.
- 3 Report serious environmental threats to appropriate agencies.
- 4 Develop and implement school-based and workplace wellness programs.
- 5 Aid in the formulation of public policy and legislation involving the environment.
- 6 Help prevent excessive exposure to immediate toxins and larger, global hazards.
- 7 Help facilitate behaviour change in people (e.g., using public transportation, recycling, planting CO₂-absorbing trees).

In 1993 Stevens and Hall proposed that a process component be added to these strategies: the community must be involved in defining environmental issues. The process of determining what is considered problematic will raise awareness of these issues. Of the ICN strategies, the first three and last one can be used by nurses working in any setting: home, school, health-care institution or workplace. The fourth strategy is most likely to be used by nurses working in public health, community health or occupational health, while the fifth and sixth strategies are more likely to be used by nurses working in occupational health or policy settings, such as professional, regulatory or labour organizations.

These strategies can also be used by nurses in their personal lives to make a positive impact on environmental issues. For example, in Ontario nurses have been active in promoting bylaws to ban the cosmetic use of pesticides. These nurses have been supported by their professional association, the Registered Nursing Association of Ontario, which has been active in this policy area.

General environmental health competencies for nurses from the IOM

- 1 Basic knowledge and concepts: All nurses should understand the scientific principles and underpinnings of the relationship between individuals or populations, and the environment (including the work environment). This understanding includes the basic mechanisms and pathways of exposure to environmental health hazards, basic prevention and control strategies, the interdisciplinary nature of effective interventions, and the role of research.
- 2 Assessment and referral: All nurses should be able to successfully complete an environmental health history, recognize potential environmental hazards and sentinel illnesses, and make appropriate referrals for conditions with probable environmental aetiologies. An essential component of this process is the ability to access and provide information to patients and communities, and to locate referral sources.
- 3 Advocacy, ethics and risk communication: All nurses should be able to demonstrate knowledge of the role of advocacy (case and class), ethics, and risk communication in patient care and community intervention with respect to the potential adverse effects of the environment on health.
- 4 Legislation and regulation: All nurses should understand the policy framework and major pieces of legislation and regulations related to environmental health. (Pope, Snyder & Mood, 1995, p. 5)



Influencing public policy is seen as important by both the ICN and the IOM. “Policy encompasses the choices that a society, segment of a society, or organization makes regarding its goals and priorities and the ways it allocates its resources to attain those goals” (Mason, Leavitt & Chaffee, 2006, p. 3). Nurses have a long history of involvement in issues such as women’s suffrage, public health, birth control and women’s rights (Lewenson, 2006). One potential area of engagement in an environmental health policy issue is the promotion of clean air: nurses could focus on ensuring that government efforts to reduce air pollution give appropriate weight to the effect of emissions on health.

Code of ethics

Nurses’ engagement with environmental health is also supported by their code of ethics in relation to promoting social justice. The 2008 *Code of Ethics for Registered Nurses* states that:

There are broad aspects of social justice that are associated with health and well-being and that ethical nursing practice addresses. These aspects relate to the need for change in systems and societal structures in order to create greater equity for all. Nurses should endeavour as much as possible, individually and collectively, to advocate for and work toward eliminating social inequities by:

- vi. Supporting environmental preservation and restoration and advocating for initiatives that reduce environmentally harmful practices in order to promote health and well-being.
- xi. Maintaining awareness of broader global health concerns such as violations of human rights, war, world hunger, gender inequities and environmental pollution. Nurses work individually and with others to bring about social change. (CNA, in press)

To support this work the CNA has issued two position statements, *The Environment is a Determinant of Health* and *Joint CNA/CMA Position Statement on Environmentally Responsible Activity in the Health Sector*, as well as the backgrounder *The Ecosystem, the Natural Environment, and Health and Nursing*. These documents are available on the CNA website.²

PRINCIPLES OF ENVIRONMENTAL HEALTH FOR NURSES

Associations in Canada and the United States have developed environmental health principles for nurses. The American Public Health Association (APHA) recently released a set of principles for public health nurses, and the Canadian Occupational Health Nurses Association has standards for the occupational health nurse on their website that address environmental health.³ The American Nurses Association is currently working on environmental health principles for nurses that should be approved over the next year. Another component of the CNA’s centennial environmental health initiative is developing consensus on environmental health principles for Canadian nurses.

2 <http://www.cna-aiic.ca/cna/>

3 <http://www.cohna-aciist.ca/english/>

The environmental health principles for public health nursing defined by the APHA (2005) are:

- 1 Safe and sustainable environments are essential conditions for the public's health.
- 2 Environmental health is integral to the role and responsibilities of all public health nurses.
- 3 All public health nurses should possess environmental health knowledge and skills.
- 4 Environmental health decisions should be grounded in sound science.
- 5 The Precautionary Principle is a fundamental tenet for all environmental health endeavors.
- 6 Environmental justice is a right of all populations.
- 7 Public awareness and community involvement are essential in environmental health decision-making.
- 8 Communities have a right to relevant and timely information for decisions on environmental health.
- 9 Environmental health approaches should respect diverse values, beliefs, cultures, and circumstances.
- 10 Collaboration is essential to effectively protecting the health of all people from environmental harm.
- 11 Environmental health advocacy must be rooted in scientific integrity, honesty, respect for all persons, and social justice.
- 12 Environmental health research addressing the effectiveness and public health impact of nursing interventions should be conducted and disseminated.



PART 2

ENVIRONMENTAL ISSUES

In this section of the guide, four environmental health issues are explored in more depth: smog and its effect on individuals with cardiovascular disease (CVD), exposure to lead among children, dioxins and the incineration of health-sector waste, and cosmetic use of pesticides. In addition to introducing important health issues, these overviews demonstrate how risks to exposures are identified and propose nursing responses.

OUTDOOR AIR QUALITY AND CVD

THE ISSUE

There is strong evidence that poor outdoor air quality, particularly from particulate matter (PM), can lead to increased morbidity and mortality due to CVD (Pope & Dockery, 2006; Routledge & Ayres, 2005). In 2004, the American Heart Association published a scientific statement that concluded that “numerous epidemiological studies conducted worldwide have demonstrated consistent associations between short-term elevations in PM and increases in daily CVD morbidity and mortality” (Brook et al., 2004, p. 2667). Although pregnant women, elderly people, children, and patients with emphysema, bronchitis or diabetes are all particularly sensitive to the health effects of outdoor air pollution (American Lung Association, 2005), this discussion focuses on the links between exposure to pollution and CVD.

SMOG

Smog is one of the most recognizable air quality problems in Canada. The major components of smog are particulate matter (PM) and ozone. PM, which includes both inhalable particles (or PM_{10}) and fine particles (known as $PM_{2.5}$), is emitted directly into the atmosphere from such sources as cars, trucks, factories, and wood burning, and can also be formed in the air from precursor gases such as nitrogen oxides (NO_x), volatile organic compounds (VOC), sulphur dioxide (SO₂), and ammonia. Ground-level ozone is a secondary pollutant formed in sunlight from precursor gases such as NO_x and VOC, which come from fossil fuel combustion in motor vehicles, power plants and industrial processes as well as some natural sources. (Environment Canada, 2007)

Ambient levels of smog in Canada

Measurements of ambient $PM_{2.5}$ and ozone levels showed that for the period 2003-05,

- at least 30% of Canadians lived in communities with $PM_{2.5}$ levels above the ambient levels identified in the Canada-Wide Standards (CWS); and
- at least 40% of Canadians lived in communities with ozone levels above the ambient ozone identified in the CWS (Environment Canada, 2007).

EVIDENCE OF THE IMPACT OF SMOG ON CVD

CVD is a significant health concern for Canadians. In 2002, CVD accounted for 74,626 deaths in Canada (Heart and Stroke Foundation, 2002), while in 2000, 460,000 people were admitted to hospital because of some form of CVD (Heart and Stroke Foundation, 2003).

Although early work on the health impact of smog focused on respiratory disease, higher rates of cardiac mortality and morbidity have been associated with poor outdoor air quality, particularly PM exposure, in a number of large-scale epidemiologic studies from around the world. The direction of the association between PM exposure and CVD mortality and morbidity is consistent, with higher levels and longer-term exposures being associated with poorer health outcomes (Pope & Dockery, 2006).

Epidemiologic studies

Epidemiology focuses on the “distribution and determinants of health and disease in groups” (Sackett, Haynes, Guyatt & Tugwell, 1991, p. 5). Most studies on the relationship between smog and CVD morbidity and mortality have focused on exposures to various sizes of PM. Analysis of a number of large-scale studies in this area shows that the average increase in daily CVD mortality from exposures to elevated PM_{2.5} levels ranges from 1.1% to 1.4% per 10 μm/m³ increment in PM_{2.5} levels (Pope & Dockery, 2006).⁴ Results from studies on CVD-related hospital admissions suggest 0.8%-2.8% increases in hospital admissions with every 20 μm/m³ increase in ambient PM₁₀ levels (Pope & Dockery, 2006).

This means that increased levels of PM over even a short period are associated with an increase in CVD-related death of 1% (or more, depending on the increase in PM levels), and CVD-related hospital admissions are higher when the ambient air has increased PM levels. Although these differences do not make exposure to smog as great a risk factor for CVD as smoking, a sedentary lifestyle or obesity, it is a significant risk for people with CVD.

Studies on mechanisms of action

Evidence from human and animal exposure studies provides insight into how exposure to smog affects human health (Barclay, Hillis & Ayres, 2005). In a review article, Bai, Khazaei, van Eeden and Laher (2007, p. 18) concluded that two hypotheses on the mechanisms of PM₁₀ exposure on health have been supported in the literature. The first is that the “deposition of particles in the lung provokes a low-grade alveolar inflammation with a secondary systemic inflammatory response resulting in downstream cardiovascular exacerbations in susceptible individuals.” The second is that fine or ultra-fine particles “enter the blood and adversely affect the heart by initiating arrhythmias and sudden death in susceptible subjects.” The authors of another review article suggest that there are likely multiple mechanisms with complex interactions that could plausibly explain the link between PM exposure and CVD morbidity and mortality (Pope & Dockery, 2006). Studies in this area are ongoing.

SUMMARY OF THE IMPACT OF SMOG ON HEALTH

We have known about the impact of episodes of smog on health for many years; for example, “a severe air pollution episode in a river valley in Belgium in 1930 caused several thousand [cases of] acute respiratory illness and about 60 deaths” (Wigle, 2003, p. 300). However, the links between environmental exposure and health outcomes are complex. Before nursing interventions in this area are discussed, it must be stressed that several precursors and components of smog – CO, NO₂, SO₂, VOC, PM and ozone – are known to have a negative impact on health. Each of these substances has a different mechanism of impact with a susceptible population. Ozone, for example, has a strong effect on lung function among asthmatic children (Kinney, Thurston & Raizenne, 1996).

In real life, the components of smog appear together: when a person is exposed to high PM levels, he or she is exposed to other contaminants as well. Impact studies, however, tend to be conducted by substance. This is one of the cardinal difficulties in assessing the risk posed by environmental exposures: although impact studies are conducted by substance, exposures are always to multiple substances by individuals with varying susceptibilities.

⁴ μm is the scientific symbol for microgram.

IMPLICATIONS FOR NURSING

Nurses can respond to the issue of smog exposure within the realms of practice, research and policy.

Nursing practice

Nurses can help protect people with CVD (as well as other vulnerable populations) from the effects of smog in three ways:

- 1 being aware of and teaching clients about the air quality index (AQI) in their community;
- 2 making recommendations on reducing exposure to emissions; and
- 3 promoting steps that reduce emissions.

1 Air Quality Index: Health Canada (2006a) has a useful description of the AQI:

The AQI is a communications tool. It is used to report upon current and near term air quality conditions. It provides a general idea of the level of air pollution at a particular place and time. A numerical value on a scale and a rating such as “good,” “fair” or “poor” is used to inform the public of air quality conditions without reporting concentrations of individual pollutants. Some of the pollutants captured in currently reported Canadian AQIs are: sulphur dioxide, ozone, nitrogen dioxide, total reduced sulphur compounds, carbon monoxide and fine and coarse particulate matter [PM_{2.5} and PM₁₀].

AQIs are issued by provinces, territories and some regional districts or municipalities. The federal government provides scientific, technical and monitoring services to support these indices. Of particular importance are air quality forecasts, as issued by Environment Canada, which assist those in responsible jurisdictions with predicting air quality conditions.

AQI readings are based on whichever pollutant is highest at the time of measurement or predicted to be within a forecast period. The higher the number, the poorer the air quality. Sub-indices are calculated for each of the available pollutants which equate to AQI values. The highest AQI value and the pollutant are reported as the AQI.

Teaching clients about the AQI means that they can make choices to decrease their exposure to poor outdoor air.

2 Reducing exposure to emissions: Nurses can advise families and vulnerable individuals on ways to reduce exposure to smog. Health Canada gives these recommendations in its “Smog and Your Health” fact sheet (2004a):

- Check the AQI in your community, especially during “smog season” from April to September, and tailor activities accordingly.
- Avoid or reduce strenuous outdoor activities when smog levels are high, especially during the afternoon when ground-level ozone reaches its peak. Indoor activities can be chosen instead.
- Avoid or reduce exercise near areas of heavy traffic, especially during rush hour.

3 Promoting steps that reduce emissions: Nurses can encourage everyone to reduce emissions of harmful pollutants. Suggestions from Health Canada’s fact sheet include:

- When possible, use public transportation instead of your car. You could also walk or ride your bicycle, as long as smog levels are not too high.
- Look for alternatives to gas-powered machines and vehicles. Try a rowboat or sailboat instead of a motorboat or a push-type lawnmower instead of one that runs on gasoline.
- Consider fuel efficiency when you buy a vehicle. Keep all vehicles well maintained.
- Reduce energy use in your home. Learn more about alternative energy resources.
- Do not burn leaves, branches or other yard wastes.



- Consider joining a citizens' committee to advocate for cleaner air in your community.
- Spend time talking with your children about the importance of a sustainable lifestyle.

Nursing research

Potential areas of focus for nursing research include:

- how patients with CVD perceive the impact of smog on their health
- actions and strategies vulnerable populations use to cope when air quality is poor
- actions by individuals, families and communities to reduce their own, and others', production of emissions

Nursing policy

This is a good time for nurses to focus on policy about air pollution, given the ongoing debates and negotiations in all jurisdictions in Canada on climate and clean air commitments. In October 2006 the Government of Canada announced new regulations that will lead to improved air quality. These regulations are embedded within existing acts such as the *Canadian Environmental Protection Act 1999* (CEPA).⁵ The rationale for the new regulations stated:

The Government recognizes that reducing air emissions is a matter of national concern as Canada's performance on air emissions has lagged behind most Organisation for Economic Co-operation and Development (OECD) countries for well over a decade. Canada commits to take measures that reduce these emissions to achieve tangible benefits to the health of Canadians and to Canada's environment. Canada has historically relied on a variety of non-compulsory measures to reduce air emissions. However, these have not proved sufficient to reduce the health and environmental risks across the country. We will not only deliver significant emissions reductions but commit to ensuring, through emissions monitoring and fully transparent, public and accountable reporting, that these emission reductions occur on schedule. Improving air quality by reducing air emissions is essential for the protection of human health and our environment. ("Government notices," 2006)

Nurses can be involved in advocacy work around reducing air pollution in a number of ways, including:

- Supporting resolutions by their professional associations to ensure that clean air provisions address health concerns
- Asking their professional associations to become involved with coalitions that are already engaging with the government in support of strategies that reduce air pollution such as the phase-out of coal-fired power generation, urban redesign and enhanced public transit (RNAO, 2007)
- Working on an individual level with non-governmental organizations to identify where support would be most useful
- Reviewing the progress of the clean air regulations on the Environment Canada website Clean Air Online (<http://www.ec.gc.ca/cleanair-airpur/>)

For more information

- The Canadian Association of Public Health has been active in promoting clean air for many years. Brochures, pamphlets and other resources for raising public awareness about the health effects of air pollution can be downloaded for public use from their website: <http://www.cpha.ca/cleanair/>
- The Lung Association has also worked to reduce outdoor air pollution. Information on their website clearly explains the impact of air pollution on health: http://www.lung.ca/protect-protegez/pollution-pollution/outdoor-exterior/index_e.php
- Health Canada is jointly responsible with Environment Canada for managing CEPA. Health Canada has information and publications on outdoor air quality on its website at http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/index_e.html, as well as a fact sheet on smog that is part of the It's Your Health series: http://www.hc-sc.gc.ca/iyh-vsv/environ/smog_e.html

⁵ More information on CEPA can be found on the Health Canada website http://www.hc-sc.gc.ca/iyh-vsv/environ/cepa-lcpe_e.html



- Regulations related to health and air quality can be accessed at http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/reg_e.html
- Pollution Probe and the Canadian Automobile Association have published “Driving Towards a Cleaner Environment – A Healthier Future,” which is available at http://www.pollutionprobe.org/Reports/CAA_Driving_Towards%20Nov-01-06.pdf
- Toronto Public Health offers information on reducing air pollution in “20/20 The Way to Clean Air” at <http://www.toronto.ca/health/2020/>

EXPOSURE TO LEAD AMONG CHILDREN

THE ISSUE

As our understanding of the harmful effects of lead exposure on children has grown, it has become clear that these effects can be seen at far lower levels of exposure than previously thought (Lanphear, 2005). The goal of interventions in this area now is to prevent any exposure among pregnant women, infants and young children.

This overview focuses on the neurotoxic effects of lead exposure. Other effects, such as growth deficits, hearing loss and reduced sensorimotor abilities, are no less important. Suggestions for further reading are found at the end of this section.

BACKGROUND

Lead is a heavy, soft bluish-grey metal that occurs naturally in the earth’s crust in small amounts (average concentrations of 5-50 micrograms per kilogram). Much higher concentrations are found in lead ores. Lead tastes sweet but does not have a special smell. It can be found everywhere in our environment, not only because it occurs naturally, but also because it’s used extensively in modern industry (mining, manufacturing and burning of fossil fuels). (Health Canada, 2004b)

In Canada, children’s lead exposure had decreased significantly by the 1970s because of the phase-out of lead in paint and gasoline. However, it is still a concern. For example, children in the South Riverdale community in Toronto were found to have elevated blood lead levels from contaminated soil in the early 1980s. Children are also exposed to lead through contact with imported jewellery and other consumer products as well as during renovations of older homes. As recently as 1997 polyvinyl chloride (PVC) blinds were recalled in Canada because of high levels of lead, and in 2007 homeowners in Montreal, Toronto and other Canadian cities were notified that their water might contain lead leached from older pipes.

EVIDENCE OF NEUROTOXICITY IN CHILDREN FROM LEAD EXPOSURE

Effects on cognitive function

Although acute lead poisoning is rare in developed countries, widespread low-level exposure continues to be a concern for children’s health, particularly in relation to neurotoxicity (Lanphear, 2005). Relatively subtle neurobehavioural deficits are believed to occur at blood levels below 5µg/dL, even though clinically obvious symptoms are not seen until a level of 50 µg/dL is exceeded (Wigle, 2003). Results from several longitudinal and cross-sectional studies have confirmed that low and moderate lead exposure during childhood is associated with adverse outcomes. Two conclusions were drawn regarding the association between exposure to lead and children’s intelligence quotient (IQ):

- 1 A doubling of blood lead from 10 to 20 µg/dL, or of tooth lead from 5 to 10 µg/g, appears to cause an average full-scale IQ deficit of 1-3 points; and



- 2 Full-scale IQ deficits among school-age children were more consistently associated with blood lead levels at about age 2 years in cohort studies and tooth lead levels in cross-sectional studies, compared with current blood levels in cross-sectional studies (Wigle, 2003, p. 77).

The second conclusion means that the most important predictors of IQ deficits were blood lead levels among children two years of age and tooth lead levels among older children. Although blood lead levels in children will decrease over time if exposure is reduced (often as mouthing behaviour declines), lead levels in teeth are more constant and over time represent a cumulative exposure to lead. Thus in older children the impact of early exposures on IQ is more strongly associated with the lead stored in their teeth than with the lead in their blood.

Mechanism of action

“Rapid development of the human brain [of the fetus] during pregnancy and before three years involves a complex cascade of processes including cell division and migration, differentiation of neuroblasts to neurons with axons, dendrites, synapse and neurotransmitter system, and programmed cell death” (Wigle, 2003, p. 73). Lead interferes with brain development in a number of key ways, including:

- Competition with iron, zinc and calcium at binding sites of proteins in a way that disrupts their function. This means that lead reduces the production of heme and impairs oxygen transport and storage, among other effects.
- Reduction of the likelihood of synapse formation occurs because of disruption of key molecules and pathways. This means that neurons do not function well, do not form synapses properly and undergo early apoptosis (cell death) (Wigle, 2003).

Lead absorption varies with its chemical form, the amount of the exposure and the diet of the individual. In general, adults absorb about 10%-15% of lead ingested with food, whereas pregnant women and children absorb up to 50% of ingested lead. Poorly nourished children will absorb a higher proportion of lead than those with a higher consumption of calcium and iron (Wigle, 2003).

SUMMARY OF THE IMPACT OF LEAD ON CHILDREN’S HEALTH

Although chelation therapy can reduce blood lead levels and the symptoms of acute lead toxicity, it will not eliminate the neurotoxic effects on young children. This is a situation where prevention of exposure is far, far better than a “cure.” Given the strong evidence of harm resulting from exposure to lead, the goal must be to minimize exposures.

Families with young children need to be aware of health problems related to lead and how their children’s exposure can be reduced. Parents who are concerned about potential lead exposures can ask their health-care provider to test their child’s blood lead level. Current guidelines on blood lead levels among children propose that 2 µg/dL is a more appropriate cut-off level of concern than 10 µg/dL because neurotoxic effects are seen following such low levels of exposure (Gilbert & Weiss, 2006). At either level the goal is to find and remove the source of lead.

IMPLICATIONS FOR NURSING

From a practice perspective, nurses who work in hospital, clinic and community settings with pregnant women and families of infants or young children have an important role to play in communicating the risks of lead exposure. Protecting children from lead poisoning by reducing lead levels in paint and other consumer products is a nursing policy issue.

Nursing practice

Teaching for parents should focus on minimizing exposure to lead during home renovations, in water and in consumer products. Handouts on these recommendations are available from Health Canada at http://www.hc-sc.gc.ca/iyh-vsv/environ/lead-plomb_e.html.

Home renovations

- If a home was built before 1960, it can be assumed that significant amounts of lead were used in the original exterior and interior paint.⁶ Leaded paint that is chipping or peeling is a serious health hazard, especially to children, who might eat it or dust in the home, which will also have high lead levels. Chipped or peeling paint should be contained or removed following the guidelines in the booklet *Lead in Your Home*. Call the Canada Mortgage and Housing Corporation (CMHC) at 1-800-668-2642 to obtain a printed copy or visit http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/inaiqu/inaiqu_007.cfm for a link to a free download.
- Parents should review this booklet before starting any renovation project in an older home since renovations that are improperly carried out greatly increase the risk of exposure to lead from old paint.

Water

- Plumbing systems may have solder or other parts that contain lead. Because lead will leach into water sitting in pipes, water should run until it is cold before being used for drinking or cooking and especially before being used for making baby formula.
- Water from the hot water tap should never be used for cooking or drinking.
- If there is concern about elevated lead levels in a home's drinking water, the local public health department will be able to provide information on where to have the water tested. The appendix of the booklet *Lead in Your Home* from CMHC has further information on collecting samples for lead testing:
http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/inaiqu/inaiqu_007.cfm#water.

Soil

- Because of the historic use of leaded gasoline, soil in urban areas, especially near major highways, may have higher lead levels than soil in rural areas. Soil near some industrial areas can also be high in lead, and the soil surrounding the perimeter of houses and apartments with painted siding can become contaminated over time owing to paint deterioration or refinishing activities.
- Parents should wash children's hands before meals, at regular intervals, and especially after playing outside to help protect them from lead exposure. All family members should remove their shoes before coming inside to reduce the amount of lead from soil coming into the house.
- Parents can learn how to test their soil for lead at http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/inaiqu/inaiqu_007.cfm#soil.

6 In a house built between 1950 and 1959 an average of seven pounds of white lead is present in the paint; if the house was built between 1920 and 1929, there will be approximately 87 pounds of lead in the paint (Wigle, 2003).

Occupational exposure

- Workers in smelters, refineries and other industrial workplaces may be exposed to high levels of lead.
- Lead dust may be breathed in, and it can also cling to skin, hair, clothing and vehicles and thus be carried home, exposing workers' families. Careful handling of clothes worn at work and showering at the workplace will help reduce children's exposure.
- Workers are tested for lead to ensure their exposure levels are within safe limits.

Consumer products

- Costume jewelry containing lead is a health hazard for children who chew or suck on it. Parents and others should ask when purchasing children's jewelry to make sure it does not contain lead. If the jewelry feels heavy or makes a grey mark on a piece of paper, or if the staff don't know what it is made of, then it is not appropriate for young children.
- Avoid inexpensive imported metal toys for children since they may contain lead.
- In general, children should be discouraged from putting non-food items in their mouths, particularly when the lead content is not known.
- When drinks are stored in leaded crystal containers some lead may dissolve into the liquid. Pregnant women and children should not drink liquids stored in leaded crystal, nor should they drink from leaded crystal glasses.
- Lead fumes or particles can be released when waste oil, coloured newsprint, battery casings or wood covered in paint containing lead is burned. Candles that contain lead in their wicks may also release lead when burned.

Arts and crafts

- Using lead solder or lead fishing weights, or a hobby such as making stained glass, may expose pregnant women and children to harmful vapours.

Nursing education

There is strong evidence of lead's harmful effects on children and of effective strategies that can reduce exposure. Every nursing student should be taught about the risks of lead for children and how to prevent exposures, ideally when they learn about maternal and child health nursing.

Nursing research

Risk communication is an important area for nursing research. Suggested questions include:

- Are parents who are planning a home renovation aware of the hazards of lead for their children and, if so, what steps are taken to mitigate these hazards?
- How aware are public and community health nurses of the impact of lead exposure on the health of infants and young children, and do they understand the steps to mitigate this impact?
- How can nurses best communicate the hazards of lead exposures to parents in hospital, clinic and community settings?

Nursing policy

Nurses can work with existing coalitions, industry, and Health Canada and other government agencies to continue to reduce the amount of lead in consumer products. Strategies such as joining existing coalitions and monitoring the progress of regulations are similar to those focused on decreasing air pollution described earlier. More information about policies aimed at reducing lead exposure is found on Health Canada's website at http://www.hc-sc.gc.ca/cps-spc/legislation/consultation/leadrisk_e.html.

In the U.S., children's blood lead levels are regularly screened through the National Health and Nutrition Examination Survey. Canada has not systematically screened for blood lead levels in children since 1978 (Feldman & Randel, 1994). In 2007, however, Statistics Canada will begin collecting biomonitoring data and health information from a random sample of 5,000 Canadians over six years of age for the two-year Canadian Health Measures Survey. Although the survey won't provide information on young children, who are most at risk of harm from lead exposure, it will identify areas in the country where blood lead levels tend to be higher (Health Canada, 2006b). Nurses should be aware of the results of this survey for their risk communication activities. More information on the survey can be found at http://www.hc-sc.gc.ca/ewh-semt/contaminants/health-measures-sante_e.html.

For more information

- The "Effects of Lead on Human Health" fact sheet in Health Canada's It's Your Health series is a good teaching tool on lead exposure: http://www.hc-sc.gc.ca/iyh-vsv/envIRON/lead-plomb_e.html. Health Canada's *Lead Information Package* also has good information on common questions around lead: http://www.hc-sc.gc.ca/ewh-semt/contaminants/lead-plomb/asked_questions-questions_posees_e.html
- Information on home renovations and reducing lead exposures from the CMHC, including a link to a free download of the booklet *Lead in Your Home*, is found at http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/inaiqu/inaiqu_007.cfm
- *Healthy Environments for Children – What You Can Do!*, a booklet for parents from Health Canada, covers a number of topics around healthy environments for children and includes a section on lead exposure. It is available at http://www.hc-sc.gc.ca/hl-vs/pubs/child-enfant/child_safe-enfant_sain_e.html
- The Healthy Spaces website by Child & Family Canada has a parent-friendly overview on reducing exposures to lead: http://www.cfc-efc.ca/healthy-spaces/resources/lead_en.php



DIOXIN AND INCINERATION OF HEALTH-SECTOR WASTES

THE ISSUE

While the health system provides services to improve and maintain Canadians' health, it also consumes resources and produces wastes in a way that can harm the environment and human health. According to Hancock (2001), "it has been estimated that the health sector...is a source of 1 percent of solid waste and – as a result of medical waste incineration – is the second largest sectoral source of dioxin contamination in Canada, accounting for 16% of total emissions" (p. 6). More recently, the Canadian Council of Ministers of the Environment (CCME) concluded that aging medical incinerators in hospitals contribute the highest emissions of dioxins to air (CCME, 2007). There is also concern about radioactive wastes from hospitals and safe disposal of pharmaceutical products (Jameton & Pierce, 2001).

Over the past couple of decades hospital administrators have focused on "greening" their institutions, in part because of a sense of corporate responsibility and in part because environmentally positive options often save money that can be put toward patient care activities (Hancock, 2001). A number of groups and organizations are working on sustainable approaches to providing health care. They include Health Care Without Harm, an international group that has worked in Canada with the Toronto Environmental Alliance to reduce harmful wastes such as mercury and dioxin in hospitals, the Canadian Centre for Pollution Prevention and the Canadian Coalition for Green Health Care, which published *Doing Less Harm: Assessing and Reducing the Environmental and Health Impact of Canada's Health Care System* (Hancock, 2001). Hospitals such as the Cambridge Memorial Hospital, the Hospital for Sick Children and the Winnipeg Health Sciences Centre, among others, have put in place comprehensive energy and waste reduction initiatives (Canadian Centre for Pollution Prevention, n.d.). Other hospitals are also moving toward, or are interested in, becoming more environmentally responsible.

This section focuses specifically on hazards from dioxin rather than on all hospital wastes and emissions because of the health-care sector's contribution to the emission of this chemical. Suggested nursing interventions focus on reducing the hospital waste that is sent for incineration. Medical waste incinerators are important sources of mercury⁷ as well as emissions of CO, NO₂, SO₂, PM and VOC. Although the closure of many older incinerators has reduced emissions from medical waste incineration, incinerators as a group still represent a significant source of dioxins.

BACKGROUND

Health Canada (2004b) is an excellent source of information on dioxins:

All dioxins have the same basic chemical "skeleton," and they all have chlorine atoms as part of their make-up. Furans are similar, but have a different "skeleton." These substances vary widely in toxicity. The one considered most toxic is referred to as 2,3,7,8-tetrachlorodibenzo-p-dioxin, or simply TCDD...

These substances work their way up the food chain by moving into and remaining stored in body fat. Because of this, people actually take more dioxins and furans into their bodies through food than through air, water or soil. Ninety per cent of people's overall exposure to dioxins is estimated to be from the diet. Meat, milk products and fish have higher levels of dioxins and furans than fruit, vegetables and grains...

The biggest source of dioxins and furans in Canada is the large-scale burning of municipal and medical waste. Other major sources include:

- the production of iron and steel
- backyard burning of household waste, especially plastics
- fuel burning, including diesel fuel and fuel for agricultural purposes and home heating
- wood burning, especially if the wood has been chemically treated
- electrical power generation
- tobacco smoke

EVIDENCE OF THE IMPACT OF DIOXIN ON HEALTH

The weight of evidence on the toxicity of dioxins is incontrovertible. Dioxins are one of the "dirty dozen" persistent organic pollutants identified by the United Nations' Environment Programme and are subject to international emission-reduction agreements. Human exposure occurs almost exclusively through food, since dioxins are fat soluble and accumulate as they move up the food chain.

Health Canada (2005b) reports that to determine the impact of dioxins on human health,

Scientists have studied the effects of dioxins on laboratory animals. They have also researched the health effects on people exposed to dioxins through industrial accidents, contaminated food and occupational exposure to certain herbicides prior to improved manufacturing processes that have reduced these contaminants.

These studies show that dioxins have the potential to produce a range of effects on animals and humans. Health effects associated with human exposure to dioxins include:

- skin disorders, such as chloracne;
- liver problems;
- impairment of the immune system, the endocrine system and reproductive functions;
- effects on the developing nervous system and other developmental events; and
- certain types of cancers.



⁷ Mercury is a neurotoxin.

IMPLICATIONS FOR NURSING

The CCME (2001) has proposed strategies to reduce the dioxins emitted by waste incineration, some which have implications for nursing practice. These strategies include:

- waste diversion initiatives to minimize the generation of wastes destined for disposal (waste reduction, material reuse options)
- waste segregation initiatives aimed at materials with greater potential to generate emissions of dioxins and furans or other air pollutants of concern (e.g., mercury, other heavy metals) and aimed at diverting those wastes to recycling or other non-incineration disposal options
- combustion control strategies to optimize performance of existing combustors at destroying pollutants of concern
- use of alternative disposal or treatment technologies (e.g., anaerobic digestion of wastes with material recovery and combustion of biogas).

Nursing practice

Nurses may not have influence over combustion control strategies or the use of alternative disposal technologies, but they can be very influential in:

- introducing recycling programs for hospital waste, 45% of which is usually paper (Hancock, 2001);
- purchasing medical supplies that are less likely to release toxins;
- supporting the purchase of reusable linens in hospital and clinic settings and reducing the use of other disposable products; and
- making sure that only material that needs to be incinerated goes to the medical incinerator.

It appears that much of the solid waste currently being incinerated at hospitals could go to a landfill site. For example, in 1993 the Ontario Ministry of the Environment found that 39% of the solid waste incinerated as biomedical waste in fact consisted of ordinary waste and required no special handling (Hancock, 2001). Nurses do not often think of themselves as engaged in waste reduction initiatives, yet it is nurses at the bedside who often decide what waste goes into which bag. Participation on hospital health and safety committees is also an opportunity to reduce the use of disposable products.

Nurses can also reduce the amount of dioxins to which people are exposed by teaching them about the following Health Canada (2005b) recommendations:

- Prepare meat and fish in a way that minimizes exposure by trimming visible fat from food. Bake, broil, roast, barbecue or microwave instead of frying, and drain off extra fat after cooking.
- Follow the advice in *Canada's Food Guide to Healthy Eating*, and enjoy a variety of foods. Vegetables, fruit and grains contain fewer dioxins and furans than meat, milk products and fish.
- Follow provincial/territorial government advisories about eating certain types of fish.
- Do not burn garbage, especially construction materials that might contain wood preservatives or plastic.
- Limit the amount of wood you burn in your fireplace or stove, and learn about wood-burning techniques that release fewer dioxins.⁸
- Do not smoke, and keep your family away from second-hand smoke as much as possible.

These steps will reduce exposure to dioxins and help limit the overall release of these substances into the environment (Health Canada, 2005b).

8 For tips on safer ways to burn wood, visit Environment Canada's Residential Wood Heating website at <http://www.ec.gc.ca/cleanair-airpur/default.asp?lang=En&n=50E7D551-1>.

Nursing policy

CNA and the Canadian Medical Association (CMA) have issued a position statement on environmentally responsible activity in the health sector, which addresses the issue of medical waste. This position statement proposes the following roles for professional associations:

- Information sharing:
 - 1 supporting and encouraging educational initiatives for individual practitioners on environmentally responsible practices in a variety of health care settings,
 - 2 sharing information on successful practices nationally and among professional groups,
 - 3 encouraging research by health professionals and others on:
 - a) the environmental determinants of health, e.g. health effects of contaminants, and
 - b) ways the health sector can move towards environmentally responsible practices, e.g. minimizing waste production and practicing safe waste disposal, and,
 - 4 supporting the efforts of all Canadians to find environmentally responsible ways to perform their daily activities;

- Lobbying individual legislators and governments regarding the need to:
 - 1 initiate stricter legislation, e.g. reduce carbon dioxide emissions, and ban all use of CFCs before the end of this century,
 - 2 initiate pricing policies that reflect the full environmental costs of goods and services, and,
 - 3 provide incentives to promote the use of more energy efficient technologies and non-polluting energy sources; and,

- Encouraging international professional bodies and their members to lobby their governments to promote sustainable environments, e.g. address the problem of toxic waste disposal in the Third World. (CNA & CMA, 2005)

For more information

- The Health Canada information sheet on dioxins and furans from the It's Your Health Series is available at http://www.hc-sc.gc.ca/iyh-vsv/alt_formats/cmcd-dcmc/pdf/dioxins_e.pdf
- The Sustainable Hospitals Program is a U.S. organization with information on green procurement and managing harmful substances: http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi
- Health Care Without Harm is a global coalition of 443 organizations in 52 countries working to protect health by reducing pollution in the health-care industry: <http://www.noharm.org/>
- The Canadian Centre for Pollution Prevention promotes pollution prevention and sustainability in the health-care sector: http://www.c2p2online.com/main.php3?section=83&doc_id=169&session
- The report by Trevor Hancock for the Canadian Coalition for Green Health Care, *Doing Less Harm: Assessing and Reducing the Environmental and Health Impact of Canada's Health Care System*, is a good introduction to improving environmental practices: http://www.c2p2online.com/documents/CCGHC_DoingLessHarm.pdf
- The Canadian Coalition for Green Health Care has also published *Canadian Coalition for Green Health Care: Success Stories*, which describes 10 case studies of health care facilities that have undertaken greening programs: <http://www.c2p2online.com/documents/BOOKLET.pdf>
- Hospitals for a Healthy Environment (H2E) is a U.S. organization creating a national movement for environmental sustainability in health care: <http://cms.h2e-online.org/about/>

COSMETIC USE OF PESTICIDES

THE ISSUE

Over the past few years the scientific community and the general public have expressed concern about pesticide use on lawns. This is because this use of pesticides is seen as providing a primarily cosmetic benefit that does not justify potential risks to health. The precautionary approach would indicate that pesticides should not be used on lawns so that potential health effects can be prevented. These concerns have led to the establishment of bylaws banning the use of cosmetic pesticides on lawns in over 100 municipalities across Canada. A list of these communities can be found at <http://www.flora.org/healthyottawa/BylawList.pdf>.

BACKGROUND

Pesticides are a diverse group of substances that are used to control or eliminate unwanted or harmful organisms, including insects (e.g., insecticides to kill mosquitoes and thus reduce the risk of transmission of West Nile virus), rodents (e.g., rodenticides to kill rats and thus reduce the risk of typhoid), fungi and moulds (e.g., fungicides to reduce growth of mould in the home) and weeds that compete with food crops (e.g., herbicides to promote greater crop yields).

The use of pesticides expanded greatly after the Second World War, until the publication of Rachel Carson's *Silent Spring* in 1962 alerted the public to the harmful effects of pesticide use, particularly on the environment. *Pesticides in the Diets of Infants and Children*, released by the National Academy of Sciences in 1972, documented the vulnerability of children to pesticides owing to the potential of pesticides for disrupting growth and development processes, and the report led to tighter control of pesticide residues on foods (Wigle, 2003). More recently, concern has been expressed about acute pesticide poisoning of children in Canada, often by pesticides used in their homes (David Suzuki Foundation, 2007).

Countries around the world have taken steps to ensure that people can benefit from pesticides with minimal or no harm to the environment and human health. In Canada, the Pest Management Regulatory Agency (PMRA) is the federal agency responsible for regulating pest control products, and it enforces compliance with the Pest Control Products Act. PMRA's mandate is to prevent unacceptable risks to people and the environment from the use of pest control products. PMRA has prepared information for the public on the responsible use of pesticides and on alternative products and lawn care methods. This information is available on their website at <http://www.pmra-arla.gc.ca/english/consum/consum-e.html>.

According to a survey by Toronto Public Health (2002), "approximately 45% of Toronto homeowners with lawns had treated their yards with pesticides in the past two years. This figure reflects both homeowner application and those performed by a professional lawn care company." The use of pesticides on lawns is ubiquitous, and it would be anticipated that a similar proportion of homeowners in other urban settings would use pesticides as part of lawn care.

EVIDENCE OF THE IMPACT OF PESTICIDES ON HEALTH

A large body of research evidence has indicated that the benefits of pesticides come with risks, particularly for children (Sanborn et al., 2004; Toronto Public Health, 2002; Wigle, 2003). As a review of the literature on the effects of pesticides and human health published by the Toronto Health Department (p. 1, 2002) concluded, "These substances are intended to be harmful to living organisms and because they are released into the environment, they pose an exposure and potential health risk to other organisms, including humans."

Exposures to pesticides can come from the air, water, soil, house dust and food and would be anticipated to be increased among those who are occupationally exposed, such as agricultural workers and those who work for pest control companies, landscapers, ornamental horticulture, etc. However, these workers are trained in the safe application of pesticides, which means that exposures may be higher for people who are in the vicinity of the pesticide application but are not wearing protective clothing and masks. Where biomonitoring has been done, concentrations of pesticides in



children are associated with parental occupational exposure and residential proximity to treated farmland (Fenske et al., 2000; Fenske, Kedan, Lu, Fisker-Andersen & Curle, 2002).

An analysis of the literature on the impact of pesticide exposure is beyond the scope of this introductory guide. The reader is invited to consult two Canadian reviews to increase understanding of the state of the science in this area.

- Sanborn, M., Cole, D., Kerr, K., Vakil, C., Sanin, L., & Bassel, K. (2004). *Pesticides literature review*. Toronto: Ontario College of Family Physicians. Available at: <http://www.ocfp.on.ca/local/files/Communications/Current%20Issues/Pesticides/Final%20Paper%2023APR2004.pdf>
- Toronto Public Health. (2002). *Lawn and garden pesticides: A review of human exposure and health effects research*. Available at: http://www.toronto.ca/health/pesticides/pdf/pesticides_lawnandgarden.pdf

IMPLICATIONS FOR NURSING

Nursing practice

The goal of nursing practice in this area is to decrease exposure to pesticides by individuals (particularly pregnant women and children), families and communities. Teaching points for parents to minimize their children's exposure to pesticide from Health Canada (2004c) include:

To protect your children from coming in contact with pesticides:

- Wash fruits and vegetables under running water before eating them.
- Avoid the use of pesticides in and around your home. Check for alternatives such as sealing cracks to prevent pests from entering your home.

If you do need to use a pesticide product:

- Review the pesticide product label or safety sheet carefully before every use.
- Keep children, pets and toys away when pesticides are applied either inside or outside your home. If a pesticide comes into contact with toys, wash them with water before using.
- Read the label or information sheet to find out when children can return to the treated area. If you are unsure of the recommended time, keep them away from the area for at least 24 hours.
- Put up signs to notify neighbours where a pesticide has been used so their children may also be kept away from the treated area.
- Store pesticides in their original containers. Children may mistake other containers for food or drink.
- Store pesticides in a locked area out of the sight and reach of children.

If your child has swallowed a pesticide:

- Call a Poison Control (Information) Centre immediately and seek medical attention if you suspect your child has swallowed a pesticide.
- Keep the phone number of the Poison Control (Information) Centre by the phone.
- Phone numbers of Poison Control (Information) Centres can be found at the front of your local telephone directory.
- When you call the Poison Control (Information) Centre, you need to know the name of the product, amount taken, and the time of the incident.
- Follow the first aid statement on the pesticide label and take the pesticide container or label with you to the emergency facility or physician.



Nursing policy

Nurses have been actively involved in campaigns to introduce bylaws to ban cosmetic use of pesticides in their community. In Toronto, nurses worked with the Registered Nurses Association of Ontario (RNAO), Toronto Public Health and the Canadian Association of Physicians for the Environment to successfully introduce a cosmetic pesticide bylaw. Given the potential impact of pesticides on health, nurses may wish to become involved in comparable campaigns in their communities.

For more information

- PMRA has information on its website on the responsible use of pesticides, which includes information on pesticide-free lawn care: <http://www.pmra-arla.gc.ca/english/consum/consum-e.html>
- The Responsible Pest Management website (www.pestinfo.ca) is operated by the Canadian Centre for Pollution Prevention and the Federation of Canadian Municipalities with funding from Environment Canada. The site provides municipal governments and communities with information, tools and networks to aid in pesticide reduction. There are links to case studies of municipal pesticide campaigns and activities at <http://pestinfo.ca/main/session//lang/EN/ns/13/doc/10> and outreach resources at <http://www.pestinfo.ca/main/ns/12/doc/8/lang/EN>
- Information on developing pesticide bylaw campaigns may also be found at <http://www.sierraclub.ca/atlantic/programs/healthycommunities/pesticides/index.htm>
- The Canadian Centre for Pollution Prevention reports on an in-depth study of the strategies used by nine communities in Canada, the United States and Europe that were successful in reducing their pesticide use. *The Impact of By-Laws and Public Education Programs on Reducing the Cosmetic / Non-Essential, Residential Use of Pesticides: A Best Practices Review* is available at <http://www.c2p2online.com/documents/PesticidesBestPracticeReview-FINAL040324.pdf>
- RNAO has been active in pesticide bylaw campaigns in Ontario. An action alert from one of their campaigns is found at <http://www.rnao.org/Page.asp?PageID=924&ContentID=1975>
- Information on the City of Toronto's pesticide bylaw is found at <http://www.toronto.ca/health/pesticides/index.htm>



Conclusions and Further Resources

Some nurses are already actively engaged in environmental health issues, while others may wonder how they can add a focus on environmental health to their nursing practice, research, education and policy work. As part of its centennial activities, CNA is planning to create tools that can be used by Canadian nurses to strengthen their focus on environmental health. Part of this work includes increasing awareness of resources that are already available. To this end, CNA has created a list of environmental health websites, which is available on its website.

Other resources include:

Thomlinson, E. (2003). Environmental health and nursing. In M. McIntyre, E. Thomlinson, & C. McDonald (Eds.), *Realities of Canadian nursing: Professional, practice, and power issues* (2nd ed.), (pp. 382–397). Philadelphia: Lippincott, Williams and Wilkins.

This chapter provides a good overview of environmental health issues for Canadian nurses. It would be of interest to nurses practising in a variety of settings, and nurse educators could use it as the basis for a class on environmental health or as background reading for their students.

Sattler, B., & Lipscomb, J. (Eds.). (2003). *Environmental health and nursing practice*. New York: Springer Publishing.

This book provides detailed information, with each chapter focusing on a different component of environmental health. It is written from a U.S. perspective, however, and some of the issues and all of the environmental legislation and regulations are different in Canada.

American Public Health Association. (2005). *Environmental health principles and recommendations for public health nursing*. http://astdn.org/downloadablefiles/Principles%20and%20Recommendations%20Document_4-06.doc

Standards of Canadian Occupational Health Nurses: <http://www.cohna-aciist.ca/english/>

Wigle, D. (2003). *Child health and the environment*. New York: Oxford University Press.

This book provides a detailed examination of environmental threats to children's health.

Information on advocacy and policy work:

ICN statement on nurses' involvement in policy-making: <http://www.icn.ch/pspolicydev00.htm>

Canadian Policy Research Networks has published *Fostering Canadians' Role in Public Policy: A Strategy for Institutionalizing Public Involvement in Policy*, which is available at http://www.cprn.org/documents/42670_en.pdf.

The Environmental Innovations Branch of the Nova Scotia government has advice on creating an environment policy: http://www.gov.ns.ca/enla/pollutionprevention/docs/ENV_POLICY_factsheet.pdf

“This we know...the earth does not belong to man, man belongs to the earth. All things are connected, like blood which connects one family. Whatever befalls the earth befalls the children of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.”

– attributed to Chief Seattle, 1854

CNA's online guide for engaging policy-makers, *Nursing and the Political Agenda*, is available at http://www.cna-aiic.ca/CNA/issues/matters/default_e.aspx

RNAO has an action kit on their website, *Taking Action! Political Action and Information Kit for RNs*: <http://www.rnao.org/Page.asp?PageID=122&ContentID=1448&SiteNodeID>

The following international sites have excellent resources for nurses in the field of environmental health:

National Environmental Education Program <http://www.neefusa.org/health/index.htm>

This U.S. program has published *Nurses and Environmental Health: Success through Action, Illustrations from across the Nation*, which provides case studies of nurse activities in nursing practice, education, research and federal environmental initiatives.

EnviRN, University of Maryland School of Nursing, has nursing education modules on environmental health: <http://envirn.umaryland.edu/>

Luminary Project: "*The Luminary Project: Nurses Lighting the Way to Environmental Health* is a web-based effort to capture the illuminating stories of nurses' activities to improve human health by improving the health of the environment. The shining stories on this website show how nurses are creatively and strategically addressing environmental problems and illuminating the way towards safe hospitals, communities with clean air, land and water and children born without toxic chemicals in their bodies." <http://www.theluminaryproject.org/>

World Health Organization, Environmental Health Section: http://www.who.int/topics/environmental_health/en/

Finally, Fiona Hanley of Dawson College has prepared a list of suggestions of what nurses can do to reduce their own environmental footprint. These include:

- Be conscious of the energy and water you consume, and aim to reduce them.
- Wear warmer clothing in winter and cooler clothing in summer to minimize heat and air conditioning needs.
- Close curtains and blinds on hot sunny days to cool your house and reduce the need for air conditioning.
- Open windows to allow air ventilation to cool down your home.
- Use public transport when possible, or cycle, walk or carpool.
- Don't idle the car engine.
- Advocate for improved funding of public transport and bicycle lanes.
- Minimize paper and plastic use: buy recycled unbleached paper when possible, avoid disposables, and bring your own shopping bags to the grocery store.
- Buy local foods and products when possible to reduce transportation requirements and consequent emissions.
- Buy organic goods when possible, and advocate for healthier practices in food production.
- Choose non-toxic cleaning products.
- Use your clothesline whenever possible.
- Use cotton diapers – there is likely a diaper service in your area.
- Compost kitchen waste.
- Stop cosmetic pesticide use.
- Make green spaces where you can and advocate for them in your community.
- Use a manual lawn mower or grass trimmer.
- Follow guidelines set by organizations such as Greenpeace for paper products.

- Use rechargeable batteries and advocate for battery recycling at source.
- Find out where in your community to recycle old electronics equipment.
- Join groups such as Friends of the Earth, Sierra Club, the Urban Ecology Centre, CAPE, Greenpeace, Health Care Without Harm that advocate for a healthier environment.
- Urge politicians to undertake environmental initiatives.
- Inform yourself, become conscious of the consequences of all your actions on the environment, and speak out.



References

- Agency for Toxic Substances and Disease Registry. (1999). *ToxFAQs for chlorinated dibenzo-p-dioxins (CDDs)*. Retrieved June 15, 2007, from <http://www.atsdr.cdc.gov/tfacts104.html>
- Agency for Toxic Substances and Disease Registry. (2005). *ToxFAQs for lead*. Retrieved June 15, 2007, from <http://www.atsdr.cdc.gov/tfacts13.html>
- American Lung Association. (2005). *American Lung Association State of the Air: 2005 report calls on Congress to stop siding with corporate polluters*. Retrieved June 15, 2007, from <http://www.lungusa.org/site/pp.asp?c=dvlu90e&b=564421>
- American Nurses Association. (2001). *Code of ethics for nurses with interpretative statements*. Washington, D.C.: Author.
- American Public Health Association. (2005). *Environmental health principles and recommendations for public health nursing*. Washington, D.C.: Author.
- Bai, N., Khazaei, M., van Eeden, F., & Laher, I. (2007). The pharmacology of particulate matter air pollution-induced CVD dysfunction. *Pharmacology and Therapeutics*, 113 (1), 16–29.
- Barclay, J., Hillis, G., & Ayres, J. (2005). Air pollution and the heart: CVD effects and mechanisms. *Toxicology Review*, 24 (2), 115–123.
- British Columbia Nurses Union. (2005). *Protecting patient health: Reducing the use of PVC*. Retrieved October 2, 2007, from http://www.bcnu.org/health_and_safety/pdfs/Polyvinal-Chloride.pdf
- Brook, R. D., Franklin, B., Cascio, W., Hong, Y., Howard, G., Lipsett, M., et al. (2004). Air pollution and CVD: A statement for healthcare professionals from the expert panel on population and prevention science of the American Heart Association. *Circulation*, 109 (21), 2655–2671.
- Butterfield, P. (2002). Upstream reflections on environmental health: An abbreviated history and framework for action. *Advances in Nursing Science*, 25 (1), 32–49.
- Canadian Centre for Pollution Prevention. (n.d.). *Healthcare EnviroNet – Case studies*. Retrieved October 2, 2007, from http://www.c2p2online.com/main.php3?session=§ion=88&doc_id=174
- Canadian Council of Ministers of the Environment. (2001). *Canada-wide standards for dioxins and furans*. Retrieved June 19, 2007, from http://www.ccme.ca/assets/pdf/d_and_f_standard_e.pdf
- Canadian Council of Ministers of the Environment. (2007). *Review of dioxins and furans from incineration in support of a Canada-wide standard review*. Retrieved October 2, 2007, from http://www.ccme.ca/assets/pdf/df_incin_rvw_rpt_e.pdf
- Canadian Nurses Association & Canadian Medical Association. (2005). *Joint CNA/CMA position statement on environmentally responsible activity in the health sector*. Ottawa: CNA.
- Canadian Nurses Association & Friends of the Earth. (1995). *Healing the sky: Strategies for health and ozone layer protection*. Ottawa: CNA.
- Canadian Strategy for Cancer Control. (2005). *Prevention of occupational and environmental cancers in Canada: A best practices review and recommendations*. Ottawa: Author. Retrieved June 18, 2007, from <http://209.217.127.72/csccl/pdf/BestProactiseReview.pdf>
- Carson, R. (1962). *Silent spring*. Boston: Houghton-Mifflin.

- Chaudhuri, N. (1998). Child health, poverty and the environment. *Canadian Journal of Public Health, 89* (Suppl. 1), S26–S30.
- David Suzuki Foundation. (2007). *Northern exposure: Acute pesticide poisoning in Canada*. Retrieved September 17, 2007, from http://www.davidsuzuki.org/Publications/Northern_exposure.asp
- Environment Canada. (2007). *Government of Canada five-year progress report: Canada-wide standards for particulate matter and ozone*. Retrieved June 13, 2007, from http://www.ec.gc.ca/cleanair/airpur/caol/pollution_issues/cws/toc_e.cfm
- Feldman, W., & Randel, P. (1994). Screening children for lead exposure in Canada. In *The Canadian guide to clinical preventive health care* (pp. 268–288). Ottawa: Health Canada.
- Fenske, R., Kedan, G., Lu, C., Fisker-Andersen, J., & Curle, C. (2002). Assessment of organophosphorus pesticide exposures in the diets of preschool children in Washington State. *Journal of Exposure Analysis and Environmental Epidemiology, 12* (1), 21–28.
- Fenske, R., Kissel, J., Lu, C., Kalman, D., Simcox, N., Allen, E., & Keifer, M. (2000). Biologically based pesticide dose estimates for children in an agricultural community. *Environmental Health Perspectives, 108* (6), 515–520.
- Fraser, G. (2004). Environmental health and nursing. *Canadian Nurse, 100* (1), 17–19.
- Gilbert, S. G., & Weiss, B. (2006). A rationale for lowering the blood lead action level from 10 to 2 microg/dL. *Neurotoxicology, 27* (5), 693–701.
- Government notices, Department of the Environment. (2006, October 21). *Canada Gazette, 140* (42). Retrieved June 15, 2007, from <http://gazetteducanada.gc.ca/partI/2006/20061021/html/notice-e.html#i3>
- Guenther, R., & Hall, A. G. (2007, May 31). Healthy buildings: Impact on nurses and nursing practice. *OJIN: The Online Journal of Issues in Nursing 12* (2). Retrieved July 19, 2007, from <http://www.nursingworld.org/ojin>
- Hancock, T. (2001). *Doing less harm: Assessing and reducing the environmental and health impact of Canada's health care system*. Toronto: The Canadian Coalition for Green Health Care. Available at http://www.c2p2online.com/documents/CCGHC_DoingLessHarm.pdf
- Health Canada. (1998). *The health and environment handbook for health professionals*. (Cat. no. H46–468/1999E). Ottawa: Minister of Public Works and Government Services.
- Health Canada. (2000). *Statistical profile on the health of First Nations in Canada*. Retrieved June 12, 2007, from http://www.hc-sc.gc.ca/fnih-spni/pubs/gen/stats_profil_e.html
- Health Canada. (2004a). *Smog and your health*. Retrieved June 18, 2007, from http://www.hc-sc.gc.ca/iyh-vsv/enviro/smog_e.html
- Health Canada (2004b) *What is lead and where is it found?* Retrieved October 2, 2007, from http://www.hc-sc.gc.ca/ewh-semt/contaminants/lead-plomb/lead-plomb_e.html#1
- Health Canada. (2004c). *Health environments for children: What you can do!* Retrieved July 24, 2007, from http://www.hc-sc.gc.ca/hl-vs/pubs/child-enfant/child_safe-enfant_sain_e.html
- Health Canada. (2005a). *Your health and a changing climate: Information for health professionals*. Ottawa: Minister of Health.
- Health Canada. (2005b). *Dioxins and furans*. Retrieved June 19, 2007, from http://www.hc-sc.gc.ca/iyh-vsv/enviro/dioxin_e.html

- Health Canada. (2006a). *A health-based national air quality index*. Retrieved June 18, 2007, from http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/air_quality_e.html
- Health Canada. (2006b). *Biomonitoring of environmental chemicals in the Canadian Health Measures Survey*. Retrieved June 18, 2007, from http://www.hc-sc.gc.ca/ewh-semt/contaminants/health-measures-sante_e.html
- Heart and Stroke Foundation of Canada (2002). *Incidence of cardiovascular disease*. Retrieved September 14, 2007, from <http://ww2.heartandstroke.ca/Page.asp?PageID=33&ArticleID=1077&Src=news&From=SubCategory>
- Heart and Stroke Foundation of Canada. (2003). *The growing burden of heart disease and stroke in Canada 2003*. Retrieved June 18, 2007, from http://dsp-psd.pwgsc.gc.ca/Collection/H1-10-2003_E.pdf
- Intergovernmental Panel on Climate Change. (2007). *Climate change 2007: the physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- Jameton, A., & Pierce, J. (2001). Environment and health: Sustainable health care and emerging ethical responsibilities. *Canadian Medical Association Journal*, 164 (3), 365–369.
- Khattak, S., K-Moghtader, G., McMartin, K., Barrera, M., Kennedy, D., & Koren, G. (1999). Pregnancy outcome following gestational exposure to organic solvents: A prospective controlled study. *Journal of the American Medical Association*, 281 (12), 1106–1109.
- Kinney, P. L., Thurston, G. D., & Raizenne, M. (1996). The effects of ambient ozone on lunch function in children: a reanalysis of six summer camp studies. *Environmental Health Perspectives*, 104 (2), 170–174.
- Lanphear, B. (2005). Childhood lead poisoning prevention: Too little, too late. *Journal of the American Medical Association*, 293, 2274–2276.
- Lewenson, S. B. (2006). A historical perspective on policy, politics and nursing. In D. J. Mason, J. K. Leavitt & M. W. Chaffee (Eds.), *Policy and politics in nursing and health care* (pp. 21–33). St. Louis: W.B. Saunders.
- Lung Association. (2006). *Pollution & air quality*. Retrieved June 14, 2007, from http://www.lung.ca/protect-protegez/pollution-pollution/outdoor-exterior/smog-smog_e.php.
- Mason, D. J., Leavitt, J. K., & Chaffee, M. W. (2006). Policy and politics: A framework for action. In D. J. Mason, J. K. Leavitt & M. W. Chaffee (Eds.), *Policy and politics in nursing and health care* (pp. 1–16). St. Louis: W.B. Saunders.
- Myres, A., & Betke, K. (2002). Healthy Environments = Healthy People. *Health Policy Research Bulletin*, Issue 4, 5–8.
- National Academy of Sciences. (1972). *Pesticides in the diets of infants and children*. Washington, D.C.: National Academy Press.
- Nightingale, Florence. (1860). *Notes on nursing: What it is and what it is not*. New York: Appleton & Co.
- Pike-MacDonald, S., Best, D., Twomey, C., Bennett, L., & Blakely, J. (2007). Promoting safe drinking water. *Canadian Nurse*, 103 (1), 14–19.
- Poffitt, J. (1993). Environment and health. In R. Donaldson & L. Donaldson (Eds.), *Essential Public Health Medicine* (pp. 465–495). Dordrecht: Kluwer Academic Publishers.
- Pope, A., Snyder, M., & Mood, L. (1995). *Nursing, health and the environment: Strengthening the relationship to improve the public's health*. Washington, D.C.: National Academy Press.

- Pope, C. A., & Dockery D. W. (2006). Health effects of fine particulate air pollution: Lines that connect. *Journal of Air and Waste Management Association*, 56, 709–742.
- Registered Nurses Association of Ontario. (2007). *Creating a healthier society: RNAO's challenge to Ontario's political parties: Building medicare's next stage, focusing on prevention*. Retrieved July 24, 2007, from http://www.rnao.org/Storage/29/2398_RNAO_Election_Platform_2007.pdf
- Routledge, H. C., & Ayres, J. G. (2005). Air pollution and the heart. *Occupational Medicine*, 55 (6), 439–447.
- Sackett, D. L., Haynes, R. B., Guyatt, G. H., & Tugwell, P. (1991). *Clinical epidemiology: A basic science for clinical medicine* (2nd ed.). Boston: Little, Brown & Company.
- Sanborn, M., Cole, D., Kerr, K., Vakil, C., Sanin, L., & Bassel, K. (2004). *Pesticides literature review*. Toronto: Ontario College of Family Physicians. Available at <http://www.ocfp.on.ca/local/files/Communications/Current%20Issues/Pesticides/Final%20Paper%2023APR2004.pdf>
- Sattler, B., & Lipscomb, J. (Eds.). (2003). *Environmental health and nursing practice*. New York: Springer Publishing.
- Stevens, P., & Hall, J. (1993). Environmental health. In J. Swanson & M. Albrecht (Eds.), *Community health nursing: Promoting the health of aggregates* (pp. 567–596). Philadelphia: W.B. Saunders.
- Thomlinson, E. (2003). Environmental health and nursing. In M. McIntyre, E. Thomlinson, & C. McDonald (Eds.), *Realities of Canadian nursing: Professional, practice, and power issues* (2nd ed.), (pp. 382–397). Philadelphia: Lippincott, Williams and Wilkins.
- Tiedje, L. B., & Wood, J. (1997). Sensitizing nurses for a changing environmental health role. In B. Spradley & A. Allender (Eds.), *Readings in community health nursing* (5th ed.), (pp. 20–29). Philadelphia: Lippincott.
- Toronto Public Health. (2002). *Lawn and garden pesticides: A review of human exposure and health effects research*. Retrieved June 19, 2007, from http://www.toronto.ca/health/pesticides/pdf/pesticides_lawnandgarden.pdf
- United Nations. (1992). *Rio declaration on environment and development* (principle 15). Rio de Janeiro: United Nations Conference on Environment and Development, June 3–14. Retrieved July 24, 2007, from <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163>
- Wigle, D. (2003). *Child health and the environment*. New York: Oxford University Press.
- World Health Organization. (2006). *Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease*. Geneva: Author.
- World Health Organization. (2007). *Public health and environment*. Retrieved June 12, 2007, from <http://www.who.int/phe/en/>



CANADIAN NURSES ASSOCIATION
ASSOCIATION DES INFIRMIÈRES ET INFIRMIERS DU CANADA