
Risk



RISK

While Canadians rely most heavily on television and newspapers for their information on health risks in the environment, they tend to believe the medical community to be the most **credible** source of information (*Health-Risk Perception in Canada*, Health Canada 1993). Health professionals hold a unique advantage of being trusted by the public regarding concerns on environmental health risks. As advocates and educators, health professionals can assist people to effectively take part in decision making on health risks that will affect their lives and their communities.

Risk can be defined as a measure of both the hazard to health from exposure to a substance and the probability of its occurrence. A **hazard** is the adverse impact on health that can result from exposure to a substance. The substance itself is sometimes referred to as the hazard, rather than the adverse effect that the substance can cause.

2.1 RISK DETERMINATION

People have always been exposed to deleterious agents in air, food, drinking water, and in the workplace. Although some of these agents were recognized many hundreds of years ago, scientific development has resulted in enormous advances in techniques for identifying environmental health hazards. Models to evaluate risk are always evolving and differ from country to country. There are a number of formal decision making frameworks, all of which involve identifying the hazard, examining dose-response data or toxicity in the case of chemicals, determining the nature and extent of exposure, evaluating various options for reducing the risk, and choosing and implementing options for risk reduction.

In Canada, the Health Protection Branch of Health Canada has developed a framework for **risk determination** by which the scientific determination of a hazard (such as chemical, radiological, microbial and physical) and its potential for damage to human health is evaluated against its benefits. The risk determination model developed by the Health Protection Branch is shown in Figure 2.1 and described in greater detail below. The overall process of risk determination has two phases: **risk assessment** and **risk management**.

Risk Assessment

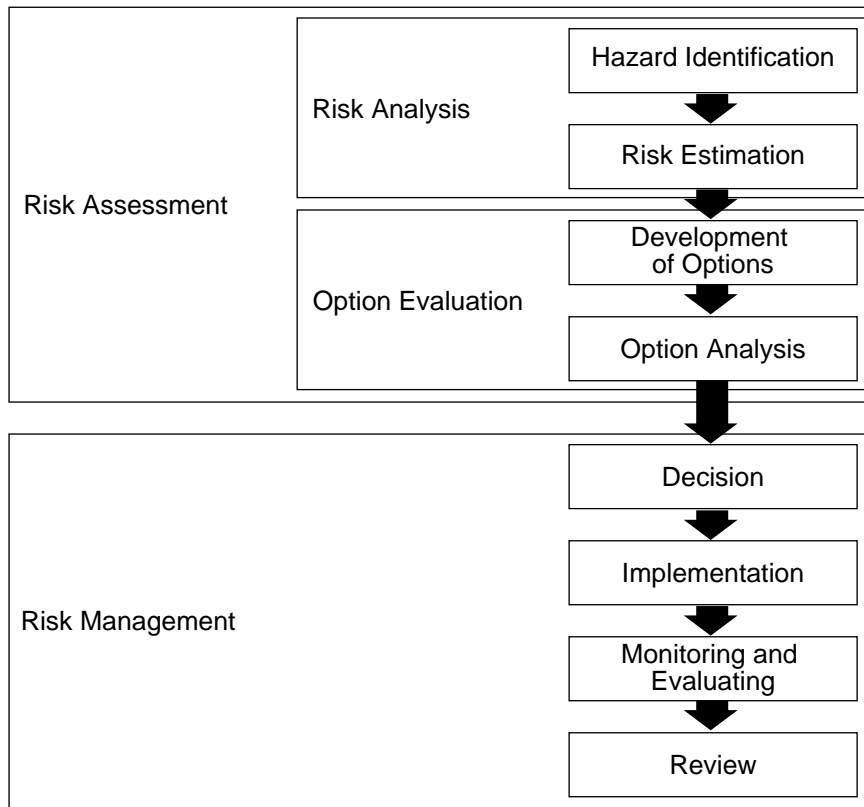
The risk assessment phase is subdivided into **risk analysis**, where health hazards are identified and their risks estimated, and **option evaluation**, where various strategies for dealing with the risks are developed and analysed.

Risk analysis begins with identification of health hazards (i.e., **hazard identification**) through case reports, epidemiological investigations, toxicological studies or analysis of a chemical's properties.

Once a hazard is identified, the probability or likelihood of an event occurring is estimated (i.e., **risk estimation**). "Estimation" is the key word; statements about human health risk are often subject to considerable uncertainty. For example, estimates of risks from chemicals frequently rely on quantitative analysis of epidemiological and toxicological data, as well as data on or

FIGURE 2.1

RISK DETERMINATION: A MODEL FOR RISK ASSESSMENT AND RISK MANAGEMENT



From *Health Risk Determination: The Challenge of Health Protection*, published by Health and Welfare Canada, 1993.

assumptions about human exposure and the frequent need to extrapolate the results of animal toxicology testing to humans. These analyses and assumptions are often incomplete, and our understanding of the relevant biological, chemical and physiological processes may be limited. (*Health Risk Determination*, Health Canada 1993)

Risk estimation techniques may measure and estimate things such as:

- levels at which the hazard poses a health risk;
- who is exposed (age, health status, gender etc.);
- probability of exposure to this hazard.

Risk estimates can be developed for situations where exposure is already occurring; i.e., to answer questions about the level of risk under existing conditions. They can also be developed when exposure has not yet occurred; i.e., to examine potential risks that may exist under different hypothetical scenarios. (See also Chapter 4. "Exposure" and Chapter 5. "Dose and Response for Chemicals.")

There are many ways to express the magnitude of a risk. These include:

- incidence of a disease in a population (e.g., number of estimated cases per 100 000 people);
- relative risk (e.g., the estimated difference in the incidence of disease in exposed versus unexposed populations); and
- population attributable risk (e.g., the percentage of cases of a disease that can be attributed to exposure to a particular agent).

Assessing Priority Substances under CEPA

The *Canadian Environmental Protection Act* (CEPA) was established in 1988 to provide a means of identifying, evaluating, and managing toxic chemicals. CEPA is administered jointly by Health Canada and Environment Canada. The act is designed to protect human health and the environment by reducing or eliminating toxic substances from the environment, and controlling the entry of new substances into Canada that may pose a threat to health and the environment.

An important part of CEPA's work is to provide the public with the results of assessments of priority substances, i.e., chemicals identified as priorities for evaluation, as well as to inform people of any health risks associated with these substances. CEPA also designs risk management strategies to effectively control exposure to these substances.

Option evaluation is the stage in which risk management options are developed (i.e., **development of options**) and then analysed (i.e., **option analysis**). Development of options may include regulatory (e.g., new regulations to curb or to eliminate emissions) or non-regulatory (e.g., guideline or exposure reduction advice, public education, economic incentives for new, less polluting technologies, voluntary actions) options to manage health risks; one option may be to leave things as they are. Option analysis may:

- weigh the health risks against the health benefits;
- examine the uncertainties in the risk estimate;
- apply principles such as ALARA ("as low as is reasonably achievable") or *de minimus* (i.e., the risk is so small, the consequences so slight, or where associated benefits are so great that society is willing to take or be subjected to that risk);
- look at the issue from an individual and a societal perspective;
- take into account the public's perception of the risk;
- consider the feasibility of the proposed options, their economic and environmental impact; and
- study the social, political and cultural implications of each option.

The Canadian Environmental Assessment Act (CEAA)

The *Canadian Environmental Assessment Act* (CEAA) of 1995, requires federal departments and agencies to assess the environmental implications of all of their projects. The act provides a means to integrate environmental, health and economic factors, as well as public concerns, into the decision-making process that occurs with any major government project.

The following are some of the risk assessment and risk management strategies used through CEAA:

- each year, approximately 100 federal projects are assessed in terms of their potential risk to human health;
- public review panels are informed of health risks associated with large-scale projects;
- risk assessment and management procedures are developed to effectively address health risks;
- a national guide on health assessment is being developed; and
- departmental projects are designed to prevent or minimize environmental damage.

Q. What are the limitations of risk assessment?

- A. Despite the increasing sophistication of analytical methods and mathematical modelling, the following factors contribute to the difficulty in proving that an environmental exposure has caused or may cause a health problem in a community:
- In the case of many chemicals found in the environment, human epidemiological studies and animal toxicological studies are not available.
 - Information about many of the long-term human health effects of mixtures of contaminants in the environment, which may interact or act in combination, is often not available.
 - While analytical techniques can now detect trace amounts of chemicals in human tissues, it is very difficult to assess the degree of health risk posed by these trace levels. The dose may be so small that dose-response relationships are difficult to quantify. Environmental exposures may be too low to cause immediate and easily identified health problems.
 - The effects of exposure may be delayed for many years. For example, the latency period can be as long as 30 years for some types of cancer.
 - Lifestyle activities such as smoking, alcohol use and the use of medications or other drugs can act as confounding factors, that is, they can interfere with our ability to relate health effects to environmental exposures because they cause the same effects.
 - It is difficult to measure overall exposure of a group of people to a substance because of differences between individuals in factors such as diet, residence, occupation, concentration of the substance, and other factors.

(See also Chapter 5. "Dose and Response for Chemicals.")

Risk Management

Risk management involves deciding (i.e., **decision**) upon and implementing (i.e., **implementation**) options to control health risks by the appropriate authority. The effectiveness of the risk control strategy undertaken is then monitored and evaluated (i.e., **monitoring and evaluation**) using such techniques as environmental sampling, human exposure monitoring, product surveillance, ongoing health studies, monitoring of public inquiries, formal reviewing of scientific publications and public opinion polls. New, pertinent information about the risks are reviewed (i.e., **review**) and fed back into previous steps in the risk management process, permitting the control decision to be reconsidered or changed in the light of new findings.

Effective risk communication should take place throughout the risk assessment and risk management process, and should be two-way in nature with those affected by the decision. (See also 2.3 Risk Communication.)

Q. What is “weight of evidence”?

- A. The weight of evidence approach to estimate human health risks from exposure to environmental contaminants recognizes the limitations of science and takes into account the combined results of many kinds of research investigating harm or the potential harm to living organisms. In this approach, evidence is collected across a wide range of circumstances and from a variety of research areas. Conclusions about the risks posed by a contaminant are based on data collected from laboratory animal studies, wildlife studies, human epidemiologic studies of acute exposure, studies of more subtle effects on humans from chronic low-level exposures, and socio-economic data and research as well.

The question of what qualifies as a standard of evidence arises, as it has in other fields such as law. The debate centres on defining the concept of acceptable probability, or in other words, how certain must the evidence be, before action is justified or required. Opinions differ, as do governments in their approach and practice on this issue.

The International Joint Commission, created to resolve issues facing boundary waters between Canada and the United States, is urging policy makers in government, industry and elsewhere to come to a consensus and codify a set of guidelines as to what factors should be taken into account when weighing evidence.

2.2 RISK PERCEPTION

Risk perception is defined by individuals and communities in terms of how they perceive personal and collective health in relation to changes or threats in the environment. Once people have expressed fears, questions or concerns, then the risk determination approach becomes a tool to more fully assess the problem and define appropriate action.

ATTITUDES AND PERCEPTIONS ABOUT HEALTH RISK HAVE IMPORTANT EFFECTS UPON INDIVIDUALS AND SOCIETY. AT THE INDIVIDUAL LEVEL THEY GIVE AND DENY PEACE OF MIND AND DETERMINE WHETHER OR NOT APPROPRIATE PROTECTIVE ACTIONS WILL BE TAKEN. AT THE SOCIETAL LEVEL, THEY DRIVE THE AGENDAS OF REGULATORY AGENCIES AND LEAD TO POLICIES THAT AFFECT THE SAFETY, COST, AND EVEN THE VERY EXISTENCE OF MANY PRODUCTS AND TECHNOLOGIES.
— *HEALTH-RISK PERCEPTION IN CANADA*, 1993

Risk perception is the subjective, intuitive process by which individuals assess risk. All activities involve risk. People make choices every day on whether to drive a car, go bungee jumping, smoke cigarettes, or sit in the sun. They may or may not know that they are “taking a risk” and they may or may not know the magnitude of risk, but they choose to take risks every day.

While scientific risk assessment strives to identify and quantify the physical risks to human health, individuals make decisions about risk based on many factors, not just scientific assessments.

In order for risk management decisions to be relevant and to gain public support, they must respond to the preferences and beliefs of the public. Decision makers study public perception of risk to better evaluate public concern and actions regarding certain risks.

Factors that Influence Perception of Risk

Some factors influencing risk perception.

- Hazards people hear about most often are perceived as more risky than those discussed less often.
- Effects that are more severe and/or that are immediate lead people to perceive a higher risk.
- Visible or detectable hazards lead people to perceive a higher risk than less apparent hazards.
- Situations involving greater uncertainty lead people to perceive a higher risk.
- Situations seen as being uncontrollable, created by humans (as opposed to natural), unfamiliar, involuntary, or catastrophic (affecting many people at once) lead people to perceive a higher risk.
- Opportunities to participate in the risk decision-making process can mitigate the perception of risk.
- Situations where the level of trust people have in public and private institutions is low lead to higher perceived risks.
- Situations that are highly politicized lead people to perceive a higher risk.

Public perception of risk and the manner in which both information and decisions are communicated are critical components in the evolving debate about the use of formal risk assessment procedures to determine public policy or response to an environmental concern.

Studies on Health Risk Perception

Data that describe the specific perceptions, attitudes and behaviours of Canadians living in the Great Lakes basin with regard to the health risks of environmental contaminants is very limited. While existing national, provincial, and community-based public opinion surveys all use differing methodologies (making them difficult to compare), they do provide us with interesting observations of the perceptions and attitudes on Great Lakes issues. Table 2.1 describes some of these recent Canadian studies. Highlights of the findings of these studies follow.

Table 2.1**RECENT STUDIES ON PERCEPTIONS AND ATTITUDES OF CANADIANS ON ENVIRONMENTAL QUALITY AND ITS IMPACT ON HUMAN HEALTH**

NAME OF STUDY	DESCRIPTION AND COMMENTS
<i>The Environmental Monitor</i> International Environmental Monitor Ltd. 1994, 1995, 1996	This quarterly report is based on the results of a phone survey of 1500 Canadians on public attitudes about environmental and natural resource issues. Data is broken down by province and includes a section on perceived health risks of environmental problems, actions the individual can take and how they feel this might influence the problem, and how they feel about the credibility of various sources of information.
<i>Health-Risk Perception in Canada</i> Health Canada 1993	This Health Canada report was based on a national survey of 1500 Canadians on their attitudes, perceptions, values, knowledge, and beliefs pertaining to environmental health issues. The report presents data by region as well as nationally.
<i>An Investigation of the Attitudes of Canadians on Issues Related to Health and the Environment</i> Decima Research 1992	This survey conducted by phone and in-home interviews focussed on perceived health effects of declining environmental quality, credibility of information sources, protective behaviours, and actions preferred to improve the situation. This study also included a children's questionnaire. The data were mostly national.
<i>A Decima Presentation to the Lung Association: Top Line Findings</i> Decima Research Nov. 1994.	This survey focussed on the awareness and perceptions of 750 Ontario residents of health problems, particularly the most serious and prevalent lung problems, with reference to the perceived influence of air quality on lung diseases. The survey investigated the kinds of actions people could take to protect their health and the type of information people prefer to receive on the subject.
<i>Evaluation of the Canadian Smog Advisory Program — Greater Toronto Area: Summary Report</i> Corporate Research Associates Inc. 1994	This study evaluated the Canadian Smog Advisory Program by surveying 413 residents of greater Toronto, focussing on ability to recall, understand and act on air quality advisories.

Some Perceptions About the Quality of the Environment and its Relationship to Human Health

A large majority (93.4 percent) of Canadians surveyed in the *Health-Risk Perception in Canada* study agreed with the statement "the land, air and water are more contaminated now than ever before" (Health Canada 1993). In *An Investigation of the Attitudes of Canadians on Issues Related to Health and the Environment* (Decima Research 1992), 92 percent of those surveyed said they were somewhat or very concerned about threats to their health from environmental pollution, and 58 percent thought their own health was already affected.

According to the International Environmental Monitor, there continues to be a steady increase in the proportion of Canadians who believe their health has been affected by pollution. Ontarians are among the Canadians most likely to believe their health has been affected by pollution in recent years, as are those who live in cities over one million. This finding is significant because past research has shown that the more people believe their health is being affected by pollution, the more activist they become both in their attitudes and in their

consumer choices (International Environmental Monitor Ltd. 1995).

Canadians feel that the greatest threat to their health is related to the quality of the air (International Environmental Monitor Ltd. 1994). The top environmental threats to health ranked by adults surveyed by Decima Research in 1992 were

- air quality
- drinking water quality
- toxic waste and waste disposal
- ozone depletion and ultraviolet (UV) radiation exposure
- vehicle emissions
- acid rain

In that survey, the health problems Canadians said were most severely affected by the environment were

- respiratory (62 percent)
- allergies (17 percent)
- stress (5 percent)
- cancers (35 percent)
- diseases (13 percent)
- poisoning (4 percent)

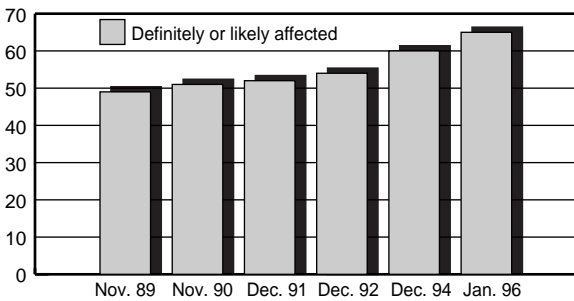
Although Canadians are concerned about the threats to their health from environmental pollution, the majority of respondents in the *Health-Risk Perception in Canada* study agreed that "lifestyle factors such as smoking and diet posed greater cancer risk than did chemicals in the environment" and 43 percent agreed that the use of chemicals has improved their health more than it has harmed health.

Many studies have found women to be more concerned than men about risks from nuclear power and chemicals. The differences between men and women found in the Health Canada study, *Health-*

Risk Perception in Canada, appear to be larger than differences observed previously. Women in this study were also found to be more likely than men to pay close attention to warning labels; to try to avoid contact with chemicals and chemical products; to express negative attitudes toward chemicals and their safety; and to rate most hazards as "high risk."

Figure 2.2

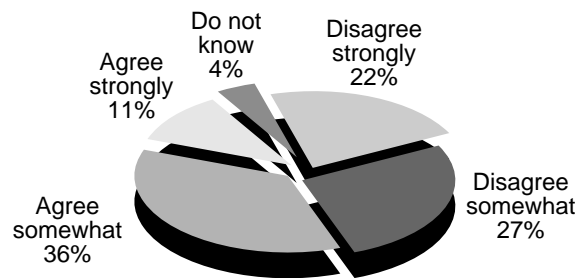
PERCEPTION THAT HEALTH HAS BEEN AFFECTED BY POLLUTION



Source: Adapted from *The Environmental Monitor*, International Environmental Monitor Ltd., 1995(4).

Figure 2.3

THE USE OF CHEMICALS HAS IMPROVED OUR HEALTH MORE THAN IT HAS HARMED IT



Source: *Health-Risk Perception in Canada*. Health Canada,

Some Perceptions of Water Quality

Over eight in 10 Canadians surveyed in the *Environmental Monitor* (1996(1) Report), rate the overall quality of the available tap water as high (30 percent) or acceptable (53 percent). Less than two in 10 consider their local tap water as being of poor quality (16 percent). Of Ontario respondents, 47.6 percent agreed that “if even a tiny amount of a substance that can cause cancer were found in my tap water, I wouldn’t drink it.” In addition, the proportion of Canadians who say they regularly use a water filter to remove chemicals from their drinking water increased from 20 percent in 1990 to 36 percent in 1996. A similar proportion of Canadians report regularly using bottled water to avoid chemical contamination from their drinking water (32 percent) or for other reasons (4 percent).

Some Perceptions of Air Quality

Sixty-one percent of the *Environmental Monitor* respondents in 1996 were very or somewhat concerned about the quality of air in their communities. A Decima presentation to the Lung Association in 1994 reported that 54 percent of their respondents were concerned about air quality in the workplace; and 53 percent were concerned about the air quality in their homes. On the other hand, a majority of participants (57 percent) in the *Evaluation of the Canadian Smog Advisory Program — Greater Toronto Area* reported that the air quality in their community is good or excellent.

Some Perceptions of Personal Actions to Reduce Pollution and Protect Health

According to the International Environmental Monitor (1996), an increasing majority of Canadians (64 percent) report that they have personally taken actions to reduce their exposure to hazardous chemicals in their food, water or the environment. Ontarians are more likely than other Canadians to participate regularly in municipal recycling programs and to regularly compost food and garden wastes. The proportion who compost in Ontario is up significantly from 1994. In *An Investigation of the Attitudes of Canadians on Issues Related to Health and the Environment*, Ontarians also reported a slightly higher rate of participation in environment/health related activities, especially those that can be done individually.

Close to three in 10 households in the *Evaluation of the Canadian Smog Advisory Program — Greater Toronto Area* reported some change in activity (e.g., reducing time spent outside) as a direct result of a smog advisory. A higher rate of behavioural change was noted among households where there were key health problems and by those individuals concerned about local air quality.

2.3 RISK COMMUNICATION



Estimating the risk to human health of exposures to trace amounts of persistent toxic chemicals such as polychlorinated biphenyls and DDT or other contaminants is a complex process. This can be confusing and frustrating for people relying on health professionals and governments to provide clear and simple answers and give consistent health advice. As Canadians become more knowledgeable about pollutants in their communities, the need for a common understanding of the methods of risk determination and communication is increasingly important.

Risk communication is the act of conveying or transmitting information between interested parties about levels of health or environmental risk; the significance of the risks; or decisions, actions, or policies aimed at managing or controlling such risks. It is more than just a one-way communication of risks from governments or health agencies to publics. It is a message and a process, involving the building of relationships among researchers, technical experts, industry, government representatives, media, interest groups, academia, and individuals; in other words, the **stakeholders**.

Different Kinds of Knowledge

Researchers and professionals sometimes tend to under-appreciate the non-numeric reasons (beliefs, values, perceptions and experience) for concern about environmental contaminants such as historical precedence and evident damage to wildlife. There are many “kinds of knowledge” — scientific/factual, intuitive/common sense, experiential/historical etc. There are also numerous ways of expressing this knowledge.

Sometimes lay persons understand the risks better than the experts. For example, the MacKenzie Valley Pipeline Inquiry revealed that Arctic residents knew more about the risks of ice-pack movements and sea-bed scouring than the engineers who planned the pipeline. Likewise, analyses of industrial accidents have shown that machine operators knew of flaws and operating problems which had been missed by designers. (U.S. National Research Council. *Improving Risk Communication*. Washington, 1989.)

Conversely, the public may not have enough access to or understanding of the complexities and results of scientific research to evaluate risks fully. They may also be swayed by media attention to an issue; confusion about the amount of scientific attention paid to an issue (versus its importance); and/or common psychological influences on risk perception such as the tendency to simplify complex issues or to hold on to old beliefs.

Factors such as these can lead to differences in both researcher’s and the public’s estimation of risk.

Principles of Risk Communication

The basic principles of effective risk communication include the following:

- **Involve people early in the process.** Effective community participation should include mechanisms for two-way communication. People have a right to be involved in decisions that affect their lives, property and values.
- **Establish credibility.** Deliver on promises and acknowledge limitations or mistakes. Collaborate with other credible sources and partners.
- **Understand the perceptions of the people involved.** There is no “general public.” There are many publics, each with differing views and perceptions of health and environment risks. There are no “unreal” fears or perceptions. All perceptions are real, they are not imaginary and must be accounted for in the risk communication process.
- **Listen to the concerns, avoid assumptions.** People place greater trust in your response if you listen carefully to all of their concerns.
- **Relate scientific information to public issues.** Provide good quality, simply expressed scientific information on the issue. Establish a common language; speak in terms that people can understand and avoid scientific jargon.

Communicating About Known and Unknown Risks

Government departments, health professionals and educators are trying to communicate two kinds of information regarding environmental health risks:

1. Information that is well understood and generally agreed on (e.g., covering up and reducing the amount of time people spend in the sun reduces exposure to UV radiation, which in turn results in a lower risk of developing skin cancer); and
2. Information that is still being debated by scientists, media and the public (e.g., the role that chemical pollution has in the development and incidence of breast cancer).

The following approaches on the part of health professionals will assist people in making educated personal choices regarding levels of risk of **known** hazards and in exerting more control over both personal and public decision making:

- tailoring messages to specific audiences;
- reaching the populations or individuals most at risk;
- being sensitive to socio-economic and cultural factors;
- providing clear and practical advice on reducing exposure; and
- providing uniform advisories.

Communicating the limitations of scientific knowledge (what isn't known) is equally important in establishing credibility and public trust. It is also more complex. An approach to conveying information about **unknown risk** might include communicating:

- a basic interpretation of the underlying assumptions and limits of risk estimation;
- information on current debates regarding controversial issues;

VERBAL CUES ARE IMPORTANT: A POLLUTANT THAT WILL GIVE CANCER TO 10 000 PEOPLE SOUNDS SERIOUS; ONE THAT WILL ADD LESS THAN ONE TENTH OF ONE PERCENT TO THE NATIONAL CANCER RATE SOUNDS ALMOST NEGLIGIBLE. SOCIAL CONTEXT IS A FACTOR. DO WE LIKE OR DISLIKE, TRUST OR DISTRUST THE PEOPLE OR INSTITUTIONS WHOSE DECISIONS ARE PUTTING US AT RISK?
 — PETER SANDMAN, PHD,
 RUTGERS UNIVERSITY

- new information as it becomes available;
- the risks and benefits of possible alternatives and choices;
- support/advocacy to assist lay persons make a case regarding a potential risk; and
- tailored packages of information to the news media.

As with other health education messages, health professionals must target environmental health messages in language and cultural terms that are relevant to their audience. Often this requires assistance and collaboration with leaders in various communities who can translate and transfer the messages in an understandable, credible form.

2.4 GROUPS MOST AT RISK

Certain individuals and groups are at higher risk of health problems from environmental contaminants either because of higher exposure (to higher concentrations of contaminants or for long periods) or because of greater susceptibility or both.

Fish Eaters

Some people are likely to eat more fish than the general population. Groups such as southeast Asian Canadians and Aboriginal peoples who may traditionally rely on freshwater fish as a dietary staple, sport anglers and their families, and those who subsist on fish out of financial necessity may all have higher exposure to persistent environmental pollutants. People who regularly consume large amounts of wild foods such as waterfowl eggs, turtles and turtle eggs, muskrat, otter, moose or deer may also be at higher risk.

Table 2.2

GROUPS MOST AT RISK FROM HEALTH EFFECTS OF CHEMICAL CONTAMINANTS

Those most exposed to contaminants	Those more susceptible to the effects of contaminants
<ul style="list-style-type: none"> • anglers and hunters; Aboriginal peoples, low-income groups who rely on sport fish or game for a large part of their food, others who eat large amounts of contaminated fish and wildlife 	<ul style="list-style-type: none"> • the elderly • the developing fetus • newborns and infants
<ul style="list-style-type: none"> • the developing fetus 	<ul style="list-style-type: none"> • young children
<ul style="list-style-type: none"> • people living in large or highly industrialized urban areas 	<ul style="list-style-type: none"> • people who are sick

Fetuses, Infants and Children

Fetuses can be exposed to contaminants that are stored in the mother and can cross the placenta, (e.g., lead, which is stored in the bone, can be released during pregnancy and transferred to the unborn child). Dioxins, organochlorine pesticides and PCBs stored in mother's fat are transferred to infants through the mother's milk during breast-feeding. Because children eat and drink more per kilogram of body weight, they can be exposed to and can absorb more of some chemicals than adults do. Young children are also more likely to ingest soil since they spend more time close to the ground and frequently place dirty hands and objects in their mouths. Therefore, children who live and play in areas where the soil is contaminated are at higher risk of exposure than adults.

In general, fetuses, infants, and children are also more susceptible to the adverse effects of contaminants than adults because their bodies are still developing and growing. During periods of rapid physical and mental growth many aspects of development can be affected. For example, fetuses of mothers who eat contaminated fish may be susceptible to developmental effects on the nervous system due to high exposure to certain organochlorine contaminants and mercury.

Young children are more susceptible to respiratory disease from airborne contaminants, in part because of the greater sensitivity of their tissues and the fact that their immune systems may not yet be fully developed.

Those Living in Cities

People living in cities are generally exposed to more pollutants at higher concentrations, especially air pollutants from vehicle exhaust.

People Who are Ill

People with immune systems that are already weakened through either medication or certain disease states may be more sensitive to particular groups of contaminants. For example, those with respiratory diseases (e.g., asthma, emphysema) are more sensitive to common air pollutants.

The Elderly

The elderly may be particularly sensitive to certain air pollutants. In general, older people are physically less resilient and more prone to illness.

People Who are Individually Sensitive

Sensitivity to the effects of any substance varies tremendously among individuals and settings (as well as among definable groups) and this may change with time. For example, those with particular skin types or using certain medications may be more susceptible to UV radiation.

THOSE AT MOST RISK TO ADVERSE HEALTH EFFECTS FROM AIR CONTAMINANTS ARE THE YOUNG, THE ELDERLY, AND THOSE WITH CARDIAC DISEASES OR RESPIRATORY DISEASES SUCH AS ASTHMA, EMPHYSEMA AND CHRONIC BRONCHITIS. EXPOSURE TO AIR POLLUTANTS CAN GENERALLY REDUCE LUNG FUNCTION AND AGGRAVATE THESE EXISTING CONDITIONS.

Q. Who else is at risk?

- A. High-risk groups may also be people least informed and supported in protecting themselves from exposure to toxic chemicals. For example, certain ethnic minorities, especially first generation immigrants, may not be able to read sport fish consumption advisories written in English or French or they may come from a culture where it is extremely difficult to change fish cooking customs. Added to this, a low income may result in the need to feed the family frequently on caught fish. Fish licences may seem too costly or people may not have heard about them. This in turn may force people to fish in remote, less popular areas where sport fish consumption advisories are not posted.

Assessing Risk to Individuals

Health professionals may have patients who are concerned about their exposure (or their family's exposure) to chemicals, either in the workplace or in the environment in general. Questions may arise such as: Can you tell me if I've been exposed to a chemical? Will I get sick from exposure to this chemical? Are these symptoms related to exposure? Is this level in my blood a risk to my health, etc.

Some important considerations include:

- evaluating and assessing the client's exposure to a particular contaminant. A quality patient history will include questions about the client's work environment, hobbies that might expose them to hazards, home surroundings etc. (see Chapter 4. "Exposure"). Examples of potentially useful questions:
 - Are symptoms more or less noticeable at work or at home?
 - Are home cleaning and other chemically based products being used safely?
 - Does the client live near a site releasing contaminants?
 - What is the quality of the drinking water supply?
 - Is the diet high in fish or wildlife caught in a polluted area?
 - What are the housing conditions?
 - Where do the children play?
 - Does a spouse bring home chemicals on shoes or clothing?
- understanding the human health risks associated with individual and mixtures of contaminants. It is important to recognize that risk assessments are generally done for populations, not for individuals. The final risk figure is a probability not a guarantee that something will happen. Also, symptoms of chemical burden may mimic those of other conditions such as stress and infections;
- being aware of factors that may affect an individual's risk such as: diet, allergic response to low doses of chemicals, lower response threshold for a chemical's toxic effects due to age, pregnancy, illness etc.;
- communicating the risk to the patient openly and honestly (i.e., what is and is not known); and
- providing advice that will reduce exposure and risk and/or promote public action to reduce environmental contamination.

The health professional involved will assess the need for further referral (i.e., to an occupational health specialist, clinical toxicologist, etc.).

Q. How do the social sciences relate to environmental health?

- A. There is increasing recognition that environmental contaminants can have both physical and non-physical effects on health. Increasingly, personal and public policy decisions on what are acceptable contaminant levels are based not only on facts derived from epidemiology and toxicology but also on economic, social and cultural factors. Integrating social sciences such as economics, sociology, and anthropology, through interdisciplinary research with the natural sciences provides a more complete picture of physical and non-physical health effects and contributes to more effective decision making.

Research from a range of social sciences is revealing that environmental contaminants have a profound impact on social and psychological health as well as on physical health, for example:

- people's attitudes, beliefs and culture may be a factor in their exposure to environmental contaminants;
- values, perceptions and social interactions have a great bearing on how people understand and take action on their health;
- social justice and equity questions play an important role in health. For example, people who are poor may be more highly exposed to environmental contaminants due to location of affordable housing, sub-standard living conditions, poor access to relevant health information, etc.;
- how social and political decisions are made in a community can define the nature and effectiveness of environmental health actions undertaken in that community.

Social impact assessments consider who is affected and how they are affected by exposure to environmental contaminants or by the results of environmental policy, regulation, and risk management processes.