

PRECAUTION AND PREVENTIVE PUBLIC HEALTH POLICY

The precautionary principle encourages policies that protect human health and the environment in the face of uncertain risks. In this broad sense, it is not a new concept. Precaution is at the heart of centuries of medical and public health theory and practice. The first principle of medicine, “First, do no harm,” underscores a duty to prevent damage to health. Every public health practitioner knows the story of John Snow and why he, basing his decision solely on observation and informed judgment, removed the handle from the Broad Street pump.

Florence Nightingale noted that pure air and pure water—“removing the offensive thing, not its smell”—were critical to a healthy home.¹ Sir Austin Bradford Hill noted that a lack of perfect evidence “does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time.”² He also advised caution by noting that causal judgments must be considered in the context of available knowledge, prior experience, uncertainty, and a responsibility to prevent impacts to health.

Public health seeks to improve the health of the population by addressing the root causes of disease and attempting to understand its complex web of interconnected determinants. The Institute of Medicine has defined public health as:

What we, as a society, do collectively to assure the conditions for people to be healthy. This requires that continuing and emerging threats to the health of the public be successfully countered. These threats include the immediate crises such as the AIDS epidemic; enduring problems, such as injuries and chronic illness; and growing challenges, such as the aging of our population and the toxic by-products of a modern economy, transmitted through air, water, soil, or food.³

According to most definitions of public health, it is a social responsibility of government, and subsequently public health professionals, to assure the conditions for the population’s health—both its protection and promotion.⁴ This includes acting to prevent harm to health in the face of complex and uncertain risks. Public health has a long history of primary prevention and advocacy to protect those most vulnerable in the population, which is consistent with this precautionary duty.⁵

As a principle of decision-making, the precautionary principle has its roots in the German word *Vorsorgeprinzip*. An alternative translation of this word is the “foresight principle”: a phrase that has the advantage of emphasizing anticipatory action—a proactive idea rather than precaution, which to many sounds reactive and even negative. Over the past 20 years, the principle has served as a central element in international treaties addressing North Sea pollution, ozone-depleting chemicals, fisheries, climate change, and sustainable development. The European Union has espoused precaution, along with prevention of pollution at source and the “polluter pays” principle, as a central element of environmental health policy.^{6,7}

DEFINING PRECAUTION

The precautionary principle is increasingly discussed in debates about threats to health and the environment because the nature of these threats, such as climate change, are becoming more complex, uncertain, and global in nature, with the potential to disrupt the free flow of trade. The principle originated in response to concerns about the limitations of science and policy structures to adequately address these evolving risks, and to recognize the severe consequences to health and the economy of not taking precaution.

The principle was characterized in the 1998 Wingspread Statement on the Precautionary Principle as follows: “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.” The statement listed four central components of the Principle: (a) taking preventive action in the face of uncertainty; (b) shifting burdens onto proponents of potentially harmful activities; (c) exploring a wide range of alternatives to possibly harmful actions; and (d) increasing public participation in decision-making.⁷ Precaution is underscored by a duty to uphold the basic right of individuals (and future generations) to a healthy, life-sustaining environment. Indeed, Jonathan Mann and colleagues have noted that public health and human rights are synergistic in nature.⁸

Implementing the precautionary principle in order to protect health and ecosystems from risks demands a broad reorganization of both environmental science and policy to make them more effective at anticipating those risks and at promoting cost-effective alterna-

tives to risky products and processes. Some principles to guide the application of the precautionary principle in public health policy include:

1. *Shifting the questions asked in environmental and health policy.* One fundamental change the precautionary principle requires is for scientists and policy makers to begin to ask a different set of questions about activities and potential hazards. Instead of asking, "What level of risk is acceptable?" or "How much contamination can a human or ecosystem assimilate?", we must ask, "How much contamination can we avoid while still achieving our goals?", "What are the alternatives or opportunities for prevention?", and "Is this activity needed in the first place?" This change requires tools to comprehensively analyze not only risks, but also feasibility of alternative technologies and products. Acceptability of risk thus becomes a function of the strength of evidence of risk, magnitude of potential effects, uncertainty, and availability of feasible alternatives or opportunities to prevent the risk in the first place.

This shift reorients the focus of environmental policy and regulations from analysis of problems to analysis of solutions and establishment of goals. It allows for an examination of a product or activity as a whole and whether its purpose can be served in a less harmful and possibly more effective way, rather than simply a narrow examination of one aspect of that activity, i.e., the amount of harm it might cause.⁹ A focus on alternatives may also allow decision makers to partially bypass contentious and costly debates over proof of harm and causality, thereby dedicating scarce resources to solutions.

2. *Shifting presumptions.* In addition to modifying the questions decision makers ask about environmental risks, the adoption of the precautionary principle shifts the presumptions used in decision-making. Rather than presume that specific substances or economic activities are safe until proven dangerous, the precautionary principle establishes a presumption in favor of protecting the environment and public health in the face of uncertain risks. This places the responsibility for developing information, regular monitoring, demonstrating relative safety, analyzing alternatives, and preventing harm, on those undertaking potentially harmful activities. It also empowers government agencies to create disincentives for those who undertake potentially harmful activities.

3. *Transparent and inclusive decision-making processes.* Environmental health decisions tend to be primarily policy decisions, informed by science and values. A more participative process for decision-making, using the precautionary principle, could improve the ability of decision makers to anticipate and prevent harm to ecosystems and human health. There are several main reasons for more democratic environmental decision-making processes: non-experts—by thinking more broadly and not being bound by disciplinary constraints—see problems, issues, and solutions that experts miss; lay judgments reflect a sensitivity to social and political values and commonsense that experts' models do not acknowledge; and the lay public may have a better capacity than experts alone for accommodating uncertainty and correcting errors.¹⁰ Openness brings different perspectives, which may reduce the danger of an unintended consequence. Finally, broader public participation processes may increase the quality, legitimacy, and accountability of complex decisions.¹¹

TOOLS FOR APPLYING PRECAUTION

Applying the precautionary principle should be considered a continuous process of seeking out economically sustainable means to reduce impacts on public health. This includes: (a) reducing and eliminating exposures to potentially harmful substances, activities, and other conditions; (b) redesigning production processes, products, and human activities so as to minimize risks in the first place; (c) establishing goals for restoring human and ecosystem health; and (d) establishing a research agenda designed to provide "early warnings" to make possible rapid interventions to prevent damage to health and to understand potential unintended consequences of activities. Precautionary actions can range from informing the public about risks and uncertainties while further study is undertaken to characterize them, to phasing out activities that have been found to be particularly harmful. Some policy tools for implementing a precautionary approach to public health include:

- *Goal-setting.* Foresight involves the establishment of long-term goals for protection of health—a practice that is fairly common in public health. Examples are the smallpox eradication campaign, the U.S. Public Health Service Healthy People 2010 goals, and smoking cessation goals. Goal-setting focuses not on what futures are likely to happen, but rather on how desirable futures can

be obtained.¹² Once established, goals help to focus attention on the development of policies and measures to achieve goals while minimizing social disruption and unintended consequences (also known as “backcasting”). The Scandinavian countries have pioneered goal-setting for environmental health by focusing on goals for reductions in hazardous substances and activities, and by the establishment of “red flags”—deterrent signals as to which activities might harm health.

- *Clean production and pollution prevention.* Clean production and pollution prevention involve changes to production systems and products to reduce pollution at the source (in the production process or product development stage). This includes reducing the raw material, energy, and natural resource inputs (dematerialization) as well as reducing the quantity and harmful characteristics of toxic substances used (detoxification) in production systems and products.^{13,14} In the state of Massachusetts, a precautionary approach embodied in its Toxics Use Reduction program has led to a 75% reduction in chemical emissions and a 57% reduction in chemical waste, while saving industry more than \$15 million.¹⁵ The pollution prevention approach can also be applied to the use of pesticides in agriculture and general pest control—integrated pest management. Also, there is an enormous need to apply these concepts to the design of cities, living spaces, and building materials as well.
- *Methods for measuring and understanding impacts on health and ecosystems.* Decisions made under the precautionary principle should not be considered permanent, but rather part of a continuous process of increasing understanding of human impacts on health and the environment. The realization that what cannot be measured cannot be managed is critical for applying the precautionary principle. Progress toward more sustainable forms of production and living requires indicators and metrics. Such metrics provide important information in understanding the improvements or declines in the health status of the population and the impacts of activities (including precautionary actions) as well as provide early warnings of potential harm. They can also stimulate continuous improvement in environmental performance and technological innovation. Surveillance has long been a critical part of public health. Recent initiatives, such as the Pew-sponsored Health Track and the recent Institute

of Medicine discussions on health-indicators, will help augment the ability of public health professionals to track environmentally related chronic illness.¹⁶

PRECAUTION AND THE ROLE OF SCIENCE IN PUBLIC HEALTH

When the precautionary principle is discussed in the context of its relationship to science, it is often portrayed either as anti-science or as a risk-management principle that is implemented only after objective scientific inquiry takes place. In practice, this is not the case. There are ways in which the current focus and methods of scientific inquiry can often implicitly work against action in the face of uncertainty by narrowly focusing on single disciplines and phenomena, though the problems we face are much more complex than any single set of research methods can evaluate. Current scientific practice also often minimizes uncertainties and focuses on those aspects of a problem that are quantifiable or researchable with limited resources. This may often mean narrowing the research focus so much that important aspects of the problem are missed.¹⁷ Worse, scientists and policy makers might mistakenly conclude that there is no evidence of harm when in fact the problem is a lack of evidence.

Science plays a critical role in implementation of the precautionary principle by providing insights into the normal functioning of natural systems, the ways that they are disrupted by technologies, and gaps in our understanding of phenomena. A shift to more precautionary policies creates opportunities and challenges for scientists to think differently about the way they conduct studies and communicate results.¹⁷ In September 2001, the Lowell Center for Sustainable Production hosted the International Summit on Science and the Precautionary Principle (<http://www.uml.edu/centers/lcsp/precaution>) to explore the role of science in implementing the precautionary principle. A Summit statement and a book of essays by leading scientists, legal scholars, and analysts outline changes in science and science policy that would more effectively address uncertain and complex risks, including:

- A more dynamic interface and communication between science and policy;
- A more effective linkage between research on hazards and expanded research on primary prevention, safer technological options, and restoration;
- Increased use of interdisciplinary approaches to science and policy, including better integration of qualitative and quantitative data;

- Innovative research methods for analyzing the cumulative and interactive effects of various hazards to which ecosystems and people are exposed; for examining impacts on populations and systems; and for analyzing the impacts of hazards on vulnerable sub-populations and disproportionately affected communities;
- Systems for continuous monitoring and surveillance to avoid unintended consequences of actions, and to identify early warnings of risks; and
- More comprehensive techniques for analyzing and communicating potential hazards and uncertainties (what is known, not known, and can be known).¹⁸

A precautionary public health research agenda would inform preventive policies and interventions. It would focus on rapid identification of hazards and development, and comparison of alternative courses of action that would minimize impacts. It would broaden our understanding of the unique susceptibility of particular populations to environmental degradation. It would take a holistic look at categories of risks—the lifecycle impacts of activities—and examine interacting determinants, root causes and broad-based measures for prevention. It would ask broader questions about risks to include cumulative and interactive exposures, and the effects of long-term low-level exposures and exposures during “windows of vulnerability.” Finally, it would attempt to build an understanding of the linkages between risks—nutrition, environmental contamination, poverty, urban sprawl, and so on.

AVOIDING TRADE-OFFS

Avoiding the creation of new problems while solving existing ones is an important aspect of the precautionary principle. Some public health professionals note how well intended precautionary public health interventions can result in serious adverse consequences.¹⁹ Further, a potentially hazardous activity may benefit public health, as in the case of pesticide spraying to reduce transmission of a mosquito-borne virus. In recent years, there have been vigorous debates on the role of the precautionary principle in pesticide spraying for malaria²⁰ and West Nile virus control. Often these debates revolve around trade-offs between short-term, well recognized viral risks and uncertain, less understood chronic pesticide risks.

Unintended consequences are a serious concern in all precautionary public health interventions and should be thoroughly considered. However, concern about these trade-offs should not keep public health

practitioners from taking preventive actions in the face of uncertainty. Not taking action on accumulating knowledge has consequences of its own, as demonstrated in the recent European Environment Agency (<http://www.eea.eu.int>) report, “Late Lessons from Early Warnings: the Precautionary Principle 1896–2000.”²¹ Rather, trade-offs should be considered in their broadest possible sense. Such trade-offs can be minimized or avoided by exploring and implementing a wide range of preventive options (e.g., the choice is not just between the use of DDT and people dying from malaria), including a broad range of perspectives in decision-making processes, using a multidisciplinary scientific lens and systems perspective to examine risks, and developing methods to monitor public health interventions for signals of problems.

PUBLIC HEALTH REPORTS ISSUE ON PRECAUTION

The goal of this issue of *Public Health Reports* is to explore the philosophy, application, and implications of the precautionary principle in public health. It is critical that public health practitioners—as a community of professionals whose work embodies the concept of precaution—understand and become involved in debates around the precautionary principle. Promoting precautionary decisions is easier when there is relatively strong evidence of hazard and little economic interest at stake. It becomes much more challenging and potentially dangerous for public health professionals to promote strong precautionary measures when evidence is uncertain, potential impacts are subtle or in the future, and action will affect the economic interests of some vocal constituency. Given the challenges of public health decision-making—the need for rapid, often politically charged decisions in the face of highly uncertain risks and consequences—it is useful to step back for a moment and examine some of the ways in which public health practice can more effectively address complex risks and promote precautionary, preventive decisions.

Through various case studies, the articles in this issue of *Public Health Reports* draw on years of practical experience of leading public health and environmental professionals who work at the crossroads of science and policy. We have found that case studies provide the most effective way for practitioners to understand the very complex concept of precaution. Although most of the case studies in this issue address environmental health concerns, the lessons learned are applicable to every public health field. The case studies are supplemented with historical perspectives on the role

of precaution in public health practice, and the nexus of science, public health policy, and public health advocacy.

In this issue, David Rosner and Gerald Markowitz present a historical analysis of how the ability of public health to address environmental and occupational health risks has been eroded during the past 100 years. Using the recent anthrax episode in the United States, David Ozonoff explores the difficulties in, and what lessons can be learned from, applying the precautionary principle. Andy Stirling and David Gee investigate the complex relationship among science, precaution, and public policy. Based on various examples, they propose means for more effectively applying precaution in science policy.

Through an examination of the Institute of Medicine Committee on Agent Orange, Joel Tickner explores how science and policy can come together to support precautionary decisions in the face of uncertainty. Case examples of swine flu and HIV in the blood supply are examined by Michael Stoto to illustrate the difficulties of the application of the precautionary principle and decision-making in public health. Raymond Neutra and Vincent Delpizzo present a case study of an innovative California program to examine risks from electro-magnetic fields, and the policy options to address those risks. The decreasing role of primary prevention in cancer hazard investigation at the federal level in the United States is examined by Rafael Moure-Eraso.

Finally, Brian Mayer and colleagues examine the evolution of the precautionary principle in toxic chemicals policy, and in its relationship to science. Together, the articles in this issue of *Public Health Reports* provide a broad introduction to the precautionary principle and its application in public health. We hope that they will contribute to the ongoing dialogue about ways in which public health can more effectively respond to complex and uncertain risks.

Joel A. Tickner, ScD

REFERENCES

1. Nightingale F. Notes on nursing: what it is and what it is not. Commemorative ed. Philadelphia (PA): Lippincott Williams & Wilkins; 1992.
2. Hill AB. The environment and disease: association or causation. *Proc R Soc Med* 1965;58:295-300.
3. Institute of Medicine. The future of public health. Washington: National Academies Press; 1988.
4. Gostin L. Public health law: power, duty, restraint. Berkeley: University of California Press; 2000.
5. Rosen G. A history of public health. New York: MD Publications; 1958.
6. Kriebel D, Tickner J. Re-energizing public health through precaution. *Am J Public Health* 2001;91:1351-5.
7. Raffensperger C, Tickner J, editors. Protecting public health and the environment: implementing the precautionary principle. Washington: Island Press; 1999. p. 162-86.
8. Mann J, Gruskin S, Grodin M, Annas G. Health and human rights. New York: Routledge; 1999.
9. O'Brien M. Making better environmental decisions: an alternative to risk assessment. Boston: MIT Press; 2000.
10. Fiorino D. Citizen participation and environmental risk: a survey of institutional mechanisms. *Sci Technol Hum Val* 1990;15:226-43.
11. Tickner J. Democratic participation: a critical element of precautionary public health decision-making. *New Solutions* 2001;11:93-111.
12. Dreborg K. Essence of backcasting. *Futures* 1996;28:813-28.
13. Jackson T. Clean production strategies. Boca Raton: Lewis Publishers; 1993.
14. Geiser K. Materials matter. Cambridge (MA): MIT Press; 2001.
15. Massachusetts Toxics Use Reduction Institute (US). Toxics Use Reduction Institute online documents. Available from: URL: <http://www.turi.org>
16. For example: Trust for America's Health (US). Trust for America's Health online documents. Available from: URL: <http://healthyamericans.org/>
17. Kriebel D, Tickner J, Epstein P, Lemons J, Levins R, Loechler E, et al. The precautionary principle in environmental science. *Environ Health Perspect* 2001 Sept; 109:871-6.
18. Tickner J, editor. Precaution, environmental science, and preventive public policy. Washington: Island Press; 2002.
19. Goldstein BD. The precautionary principle also applies to public health actions. *Am J Public Health* 2001;91: 1358-61.
20. Schettler T, Raffensperger C, McCally M, Orris P, Tickner J. The DDT question. *Lancet* 2000 Sep 30;356:1189.
21. Gee D, Harremoës P, Keys J, MacGarvin M, Stirling A, Vaz S, Wynne B, editors. Late lessons from early warnings: the precautionary principle 1896-2000. Copenhagen: European Environment Agency; 2001.

Dr. Tickner is a Research Assistant Professor in the Department of Work Environment, University of Massachusetts Lowell, Lowell, MA.

Address correspondence to: Joel A. Tickner, ScD, Dept. of Work Environment, Univ. of Massachusetts Lowell, One University Ave., Lowell, MA 01854; tel. 978-934-2981; fax 978-934-2025; e-mail <joel_tickner@uml.edu>.