Moving Further Upstream: From Toxics Reduction to the Precautionary Principle

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SYNOPSIS

Early policies to reduce the amount of toxic waste in the environment focused on cleaning up downstream sources of pollution, such as toxic disposal sites. Public attention in the 1980s encouraged both industry and government to develop an alternative to this command-and-control approach. This article describes the emergence of that alternative—pollution prevention—and its application in Massachusetts through the 1989 Toxics Use Reduction Act. Pollution prevention focuses on the sources of pollution, both metaphorically and physically, more upstream than its predecessors. The success of the Toxics Use Reduction Act in Massachusetts helped create an opportunity where an alternative pollution prevention paradigm could develop. That paradigm, the precautionary principle, is popular among environment activists because it focuses further upstream than pollution prevention by calling attention to the role the social construction of risk plays in decisions regarding the use of hazardous substances. The authors examine the evolution of the precautionary principle through an investigation of three major pathways in its development and expansion. The article concludes with a discussion of the increased potential for protecting public health and the environment afforded by this new perspective.

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There is widespread agreement that our society should reduce the amount of toxic substances in use and circulation. Cleaning up toxic waste sites is difficult, disheartening, and often too little and too late for individuals afflicted with diseases attributed to toxic exposure. The toxics reduction approach seeks to prevent toxics from entering the environment rather than cleaning up after their release—eliminating problems downstream by actions taken upstream. People's economic and political standpoints will, of course, dictate what gets defined as toxic, what are the trade-offs in reducing or removing particular toxics, and who should make decisions about this process.

The starting point for this research is Massachusetts' unique and successful state-mandated toxics reduction program, which was established in 1989. Its novel approach to toxics reduction fostered a collaborative relationship between industry, state officials, and scientists, leading to a reduction of the state's toxic emissions by two-thirds over a 10-year period. We were intrigued by the toxic reduction program's origins in social movement pressure, its institutionalization in state government, its ability to work with business, its continued support by environmentalists, and its success in reducing toxic emissions. While examining these features of the Toxic Use Reduction Act (TURA) and the Toxic Use Reduction Institute (TURI), set up by the Act, we became aware that an alternative means of reducing toxics—the precautionary principle—was developing, in part as an outgrowth of toxics reduction. Though loosely defined, the precautionary principle is a set of guidelines that contend that society should take preventive action in the face of uncertainty in order to safeguard human health.

Our primary goal in this article is to examine the transformation of a narrower toxics reduction policy to the more extensive precautionary principle. Second, we wish to show how other environmental alternatives lead to the precautionary principle as well, and how the path from toxics reduction to the precautionary principle is aided by those other approaches. Consequently, our examination of the precautionary principle is less detailed than the factors contributing to its development.

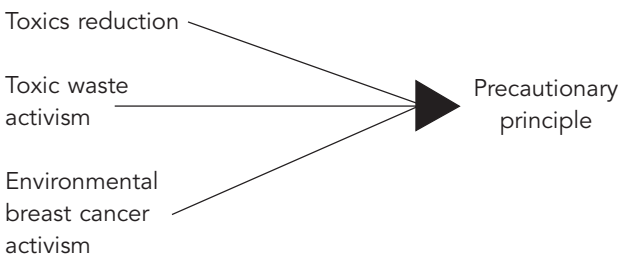
We begin with a discussion of the precautionary principle's function as a public paradigm. Next, we examine TURI and the transformation of toxics reduction to the precautionary principle. To situate our analysis in a broader historical context, we also provide some background on environmental regulation of toxics. Investigating the earlier conversion from pollution control to pollution prevention reveals the logic behind the subsequent shift from pollution prevention to toxics reduction, and then from toxics reduction to precautionary action.

Aside from the specific relationship between the precautionary principle and toxics reduction in Massachusetts, the precautionary principle is becoming a guiding force for many national and international organizations concerned with environmental health. This includes breast cancer activists examining the environmental causation of breast cancer, citizens' groups addressing concern over pesticide spraying for West Nile virus, and children's health advocates seeking legislation to apply the precautionary principle to child health and disease prevention.

We have identified at least three major sources of the development and expansion of the precautionary principle. As the Figure shows, toxics reduction is one such avenue. This pathway is not widely framed in terms of health, and health is often deliberately left out. Toxics reduction leads to the precautionary principle because it is a logical extension of the idea of reducing the amount of dangerous substances used in production processes. Much of toxics reduction takes place in an economic milieu in which reduction is seen as preferable to end-of-pipe, command-and-control regulatory approaches and cleanups.

The second pathway is toxic waste activism. Since Love Canal in 1978, toxic waste activists have organized around toxic contamination episodes and siting proposals for hazardous facilities. State laws that require activists to provide conclusive evidence of a toxic substance disease relationship through epidemiological studies are difficult and time-consuming to satisfy. Ironically, many of the substances are already known occupational health hazards and animal toxicology studies may have already demonstrated unequivocal health risk. Thus, knowledge of a toxic substance's hazardous nature has repeatedly been insufficient to motivate change. As a result, activists now turn to the precautionary principle because it advocates preemptive action in the face of uncertainty, whether scientific evidence is conclusive or not.

Figure. Three pathways to the precautionary principle



The third pathway to the precautionary principle is through environmental breast cancer activism—the subset of the larger breast cancer movement that is concerned with potential environmental causation. Many environmental breast cancer activists are alarmed at the proliferation of chemicals with estrogenic properties, at mounting evidence that chemicals affect reproductive health through disruption of the endocrine system, and at the potential for endocrine disrupters to cause breast cancer.[1] They are convinced that the steady rise in breast cancer incidence in the post-WWII era is not the result of rapid genetic changes, lifestyle decisions, or better detection, but is due in great part to the increase of chemicals, specifically endocrine-disrupting chemicals, in our environment. In response, environmental breast cancer activists endorse a precautionary approach to the use of such chemicals.[2]

Though we focus on the extension of toxics reduction to the precautionary principle, its development would not be as pronounced without the other two pathways. The rapid expansion of applications of the precautionary principle stems from its connections with a variety of environmental and health concerns. Indeed, several key participants in its development are also involved in other arenas of environmental activism. Activist organizing around the precautionary principle gives the public more input in science, both through citizen participation and through challenges to the dominant ideas and practices regarding chemicals and other toxic substances.

THE PRECAUTIONARY PRINCIPLE AS A PUBLIC PARADIGM

Activist organizing around the precautionary principle seeks more public input in science, through citizen participation and through popular challenges to the dominant ideas and institutional practices regarding the use and disposal of chemicals and other toxic substances. For these reasons, the precautionary principle is a public paradigm. The creation of a public paradigm is a clear example of how public participation in scientific discourse leads to the democratization of science. Our notion of a public paradigm builds upon Krimsky's concept of a public hypothesis, i.e., "that stage in the development of a scientific hypothesis during which segments of the public feel they have a stake in the outcome of the scientific debates and therefore make increasing demands in order to establish a clearer understanding of the conflicting views."[3] A public paradigm is an expanded perspective that goes beyond a specific scientific argument to take up a broad critique of underlying scientific and societal processes that shape current worldviews.

A public paradigm is broader than a public hypothesis. It seeks to transform large and multifaceted aspects of social belief. The original formulators of the paradigm, as well as others who join once paradigm development is in progress, may not intend their actions to be so far-reaching, but the practical ramifications of their actions are of such magnitude that the effect is a massive challenge to a broad existing paradigm.

In this case, the existing paradigm which the precautionary principle challenges, includes: (*a*) an unalloyed belief in the positive benefits of chemical and plastic production; (*b*) the assumption that industrial products are safe until proven dangerous, and such danger is defined by very narrow technical terms; (*c*) professional dominance of science in matters of science policy; and (*d*) the belief that private profit is more important than social benefits and overall health and safety.

As a public paradigm, the precautionary principle synthesizes the concerns of diverse social sectors: environmental policy, health policy, economic planning and development, transportation, community planning and development, international treaties, protocols, cooperation, and the general democratization of society. One could argue that the entirety of public concern for the environmental causation of diseases is an extended public paradigm that emerged from Rachel Carson's *Silent Spring* and from a long tradition of occupational health activism.[4] After the infamous Love Canal episode launched a reformulation of the public's understanding of the impact of chemicals, this broadened public paradigm grew rapidly.

The precautionary principle includes all of the past paradigm development, but seasons it with a larger view. In the scientific realm, we see a proactive, rather than reactive approach to toxic hazards. In pushing for screening programs, such as the Environmental Protection Agency's (EPA) Endocrine Disruptor Screening and Testing Advisory Committee, for actual measurements of body burden, such as the Centers for Disease Control and Prevention's (CDC) program Health Tracking: The Behavioral Risk Factor Surveillance System for Health Monitoring,[5] and tracking programs, such as the Pew Commission's Health-Track,[6] scientists and activists are recasting the way we look at environmental health.

METHODS AND DATA

This article stems from a larger project that also examines disputes over environmental factors in asthma, breast cancer, and Gulf War-related illnesses. For this component, 12 interviews were conducted with personnel at the Massachusetts TURI and with affiliated individuals. Eleven ethnographic observations were conducted with participants of the Massachusetts Precautionary Principle Project and TURI to supplement the interviews. These observations included TURI staff meetings, public presentations of the precautionary principle, meetings with public health officials, and two conferences on the precautionary principle and toxics activism. Printed materials from TURI, the Precautionary Principle Project, and non-affiliated organizations espousing the precautionary principle were analyzed in order to better understand their political stance and public activities. Interview and observation material from the other components of the larger project were used as well, since the precautionary principle was important to many activists and scientists dealing with asthma and breast cancer (though usually not those dealing with Gulf War-related illnesses). Unreferenced quotes and data come from our interviews and observations.

BRIEF HISTORY OF TOXICS REGULATION

Although Rachel Carson's *Silent Spring* called attention to the harmful effects of toxic chemicals, direct regulation of toxics and hazardous waste did not begin until the early 1970s.[4] Prior to this time, hazardous or toxic waste was not well articulated as a public policy issue, and widespread public awareness of toxics in the United States was limited.[7] In addition, there was little scientific information regarding health and environmental risks available, due in part to the absence of a national mechanism for monitoring use and disposal of hazardous waste. In the 1970s, the federal government passed several incipient environmental laws. These laws (particularly the National Environmental Protection Act and the Clean Air Act) created a new executive agency responsible for monitoring the disposal of hazardous waste. In addition, regulatory experimentation of hazardous waste at the state level paved the legislative path to the federal enactment of the Resource Conservation and Recovery Act (RCRA) and the Toxic Substance Control Act (TSCA) in 1976. Despite these legislative efforts, there was little public attention or federal implementation of the laws until a string of toxic disasters catalyzed a national toxic waste movement.

A pollution control paradigm

Though the combination of the RCRA and TSCA bills was intended to track toxic chemicals from cradle to grave, Congressional endorsement of two separate policies reflected the limited medium by medium approach (e.g., air, water, land) that Congress would adopt for many environmental issues. Instead of creating one comprehensive hazardous waste bill, Congress created two bills that divorced the tracking and disposal of hazardous chemicals from the testing and risk assessment process.[8] Furthermore, while TSCA was supposed to track the production and importation of toxic chemicals, it was overshadowed by RCRA and poorly enforced because the difficulties of implementing RCRA overwhelmed the already besieged EPA. Of the toxic chemicals on the EPA's High Production Volume list (chemicals that are produced in high volumes by industry), 93% lacked basic chemical screening tests, and even more serious, 43% had no basic toxicity test.[9] In 1984, the Hazardous and Solid Waste Amendments modified RCRA's cradle to grave policy giving the EPA the authority to require that hazardous waste disposal facilities improve their treatment and disposal procedures.[8]

RCRA's focus on the transport, treatment, and disposal of hazardous waste continued the limited end-of-pipe focus of environmental legislation established earlier in major bills, such as the Clean Air Act and the Clean Water Act, while TSCA's focus on tracking the production of toxics was further overshadowed by the passage of the Comprehensive Environmental Response, Compensation, and Recovery Act (Superfund) in 1980. In response to the Love Canal crisis, the Carter administration created Superfund in hopes of preventing that community's struggle from becoming a common experience. The success of the Superfund program is questionable however, since relatively few sites have been identified and remediated.[10] By establishing the compensatory and liability mechanisms for the federal government to respond to future discovery of toxic waste, Superfund also focused on the end-of-pipe discovery and cleanup of toxic waste characteristic of the pollution control paradigm. Thus, by the end of the 1980s, the pollution control paradigm was firmly embedded in the EPA's regulatory mechanisms, though challenges to implementation persisted.

Toxic waste disasters and growing negative public sentiment of pollution control highlighted weaknesses in the government's end-of-pipe approach to controlling pollution while simultaneously allowing (under the risk assessment approach) "acceptable" levels of hazardous waste to enter communities. But the public

was not satisfied with the concept of acceptable risk, and made toxic waste a major public issue during and after the Love Canal disaster,[11] and led to some environmentalists labeling the 1980s America's first "toxic decade."[12] Other environmental disasters in the 1980s, such as the chemical leaks in Bhopal, India, and Institute, West Virginia, further galvanized the need for stricter regulations. Frustrated with the principle of acceptable risk associated with the pollution control paradigm, environmental activists sought an alternative approach.[7]

The size of national and local production of hazardous waste revealed by the creation of the Toxics Release Inventory (TRI) surprised citizens and corporate leaders alike. In response to this discovery, many industrial firms pledged to reduce emissions in order to be removed from the list of large polluters. Citizens in many localities demonstrated that although releases to certain mediums were being reduced, the overall discharge of hazardous waste was not declining. Many firms were simply shifting type of pollution or simply storing the waste onsite. This led many community groups to mobilize against the construction of new disposal facilities and further utilize the TRI data to focus attention on existing hazardous waste sites.

As the number of communities taking action against toxics grew, an informal national network developed linking activists together through national groups, such as the Citizen's Clearinghouse for Hazardous Waste (now Center for Health, Environment and Justice) and the National Toxics Campaign, and state/regional groups like the Toxics Action Center (originally Massachusetts Campaign to Cleanup Hazardous Waste). This new infrastructure enabled activists to move beyond the individual-focused, not-in-my-backyard (NIMBY) mentality and form the national anti-toxics movement.

Near the end of the first "toxic decade," public policy and public attention continued to grow, but in divergent directions. Public policy encouraged industrial firms to control their pollution and treat and dispose hazardous waste safely. But, public attention on toxic waste made it difficult for industrial firms to construct waste treatment facilities and new disposal sites. Industrial firms faced a dilemma: expend capital for costs related to constructing new waste storage sites, such as public relation expenses, or store toxic waste onsite risking liability in the future.

A pollution prevention paradigm

In the 1980s, as criticism of the pollution control paradigm heightened, an alternative paradigm began to form. Using metaphors such as the upstream approach to pollution, the pollution prevention paradigm grew in popularity because of its stark contrast to pollution control strategies.[8] Faced with this new development, some companies voluntarily chose the pollution prevention path.[10] But pollution prevention developed slowly, and in two directions. One, a market-based strategy, emphasizes waste minimization through monetary incentives while the second encourages companies to find alternatives to toxic chemicals.[8]

Companies that voluntarily adopted pollution prevention strategies were anomalies within the widespread use of command-and-control methods. In an analysis of the toxics waste movement, Szasz explains these anomalies by linking the development of future policy initiatives with the mass resistance to siting.[7] He argues that the resistance to the construction of new disposal sites combined with the strengthening of pollution regulations forced industries to adopt pollution prevention strategies. These concurrent political struggles, combined with the closure of the international market for waste disposal, created the ideal conditions for promoting pollution prevention. Szasz's formulation of a "scissor" effect linking siting resistance with stricter state regulations is strikingly similar to conditions under which pollution prevention was adopted by Massachusetts in 1989.

In response to the pressures for a new approach to address pollution, Congress passed the 1990 Pollution Prevention Act (PPA), which sets prevention as the highest goal of environmental policy. The PPA is not a particularly effective piece of legislation because implementing pollution prevention is voluntary. Thus, a detailed examination of the production process only provides, in most cases, a cursory attempt at pollution prevention.[8] Though companies can make progress towards pollution prevention and precaution, focusing on end-of-pipe strategies limits the development of preventive options. Alternative strategies, such as raw material substitution or alterations in the production process, can be economically beneficial, but are largely overlooked. The transition from the end-of-pipe mentality toward a source reduction ideology would require a nationwide examination and cost-benefit analysis that compared current production processes with alternative pollution prevention methods.

Although the 1990s witnessed the rise of pollution prevention and environmental justice, effective federal regulatory mechanisms incorporating these themes never materialized.[12] Thus, state governments were the first to act on pollution prevention. In Massachusetts, pollution prevention has become a popular and successful approach to reducing the state's production of toxic waste. This is largely due to a strong anti-toxics

movement, a history of progressive politics, and the lack of a chemical industry in the state. Building on the popular frustration with the legislative focus on cleaning up existing toxic waste sites, incidents of contaminated communities, and the prospect of siting new hazardous waste incinerators in the state, environmental activists generated significant popular support for reducing toxic chemicals in Massachusetts. One major source of frustration for environmental activists was the lack of information about toxics contained within finished products. Believing that the comprehensive elimination of toxic chemicals would avert future contamination, activists rallied behind a new ideology of production process change that would provide new opportunities for future pollution prevention efforts.

TOXICS USE REDUCTION IN MASSACHUSETTS

The origins of the 1989 Toxics Use Reduction Act (TURA) can be traced to environmental activism in the early 1980s. Environmental activists across the nation were pushing right-to-know laws as a mechanism for investigating possible health risks to their communities and exposing polluting companies. Environmental activists in Massachusetts introduced a right-to-know bill in the state legislature in 1983 that was eventually passed. Although they achieved a limited right-to-know privilege, the bill failed to achieve any major improvements in Massachusetts' environmental regulations. However, the experience proved invaluable for future lobbying efforts. Activists realized that pollution statistics gained from community right-to-know laws were insufficient to prevent the toxic contamination, and that they needed an alternative, upstream approach. The activists turned to pollution prevention, requiring industrial firms to evaluate their production processes for alternative techniques that use less or no toxic chemicals.

Situated in the nascent paradigm of pollution prevention, state and national activists developed the basic principles of pollution prevention into toxics use reduction. Drawing upon recognition of the power of industrial innovation as a tool for change, toxics use reduction is based on the principle that the knowledge of how to remove toxic substances from the production process is best found within the industrial firm itself. The process of internally reviewing production processes creates an opportunity for procedural change. Thus, toxics use reduction encourages individual firms to develop pollution prevention strategies rather than relying on a state agency to enforce prevention.

The Massachusetts TURA was passed in 1989, after three years of debate and negotiations. Participants in the negotiation process attribute the passage of TURA to the threat presented by a ballot initiative sponsored by the Massachusetts Public Interest Research Group (MASSPIRG). Operating at the peak of Massachusetts' environmental fervor, MASSPIRG had gathered enough public support in the period since the 1983 right-to-know law to potentially pass a ballot initiative that would set strict state standards for the use of toxic substances. Fearful of this possibility, industry leaders and state officials met with environmental activists and negotiated a compromise, incorporating the principles of toxics use reduction. In 1989, the Massachusetts state legislature voted unanimously to pass TURA, creating a new regulatory framework for the enforcement of the new TURA law. Specifically, TURA created the TURI and the Office of Technical Assistance (OTA), who work with the Massachusetts Department of Environmental Protection (MADEP). Together these agencies work to reduce toxics throughout Massachusetts by providing technical assistance to industry.

Toxics use reduction planning

The TURA program is funded through a structured fee system for the use of a selected list of toxic chemicals used by industrial firms. TURA requires that each industrial firm submit biannual plans, which must include pollution prevention opportunities addressing each toxic chemical used, to MADEP. These toxics use reduction plans must be certified and approved by a toxics use reduction planner. One of TURI's biggest roles is the training of these state toxics use reduction planners. Training seminars and certification tests are offered by TURI, along with extension classes to keep planners informed of new pollution prevention technologies and strategies.

OTA and TURI provide technical information for companies to consider when selecting proposed alternatives. TURI also acts as a research laboratory and often designs and tests alternative cleaning processes at the request of industrial firms. TURI's function as a research institution, in addition to its technical assistance role, is to challenge the notion that pollution prevention is too costly and also to fund research developing innovative production methods.[13]

Both themes of pollution prevention discussed earlier operate in conjunction with toxics use reduction: market forces are used to discourage the use of toxic chemicals, while an upstream focus on production processes encourages industrial firms to consider the advantages of process change. The advantages include the cost-benefits of reducing expensive chemical use,

reduced need for compliance with complex regulatory programs, and an improved public image. Many companies were previously unaware of the extent of their toxics usage; TURA provided them with this awareness, much as the federal Toxic Release Inventory has educated firms at the national level.

Toxics use reduction networking

During the first five years of operation (1990 through 1995), TURI focused exclusively on achieving the 50% reduction of toxics in Massachusetts through collaboration with industry. While their work with industrial companies attends to the largest producers of toxic waste, TURI is also directed to work with and inform the general public about toxics reduction. In response to industry demands to spread responsibility for toxics reduction to the public and to governmental units, and based on its own recognition of the lack of programs directed at the general public, TURI created the Toxics Use Reduction Networking (TURN) program. This program offers small grants and toxics use reduction training to community and municipal groups for projects applying toxics use reduction at the community level. Many groups have participated in the program, including the Boston Police Department; the environmental justice group, Alternatives for Community and Environment, in Roxbury (one of Boston's largest minority neighborhoods); and a garden club in an affluent community on Massachusetts's north shore. Creating the TURN program was important because it built a broader public constituency who supports toxics use reduction. By expanding the toxics use reduction program to include community groups, TURI further integrates the principles of pollution prevention into society.

The future of toxics use reduction

Massachusetts has visibly benefited from toxics use reduction. Toxic chemical use, waste, and emissions are down, and industrial firms are saving money rather than leaving Massachusetts as some industry representatives initially feared. Though most industry members are reported to have an amicable relationship with the TURA program, tensions (which began during the bill's negotiations) with industrial trade groups, such as the Associated Industries of Massachusetts and the Massachusetts Alliance for Chemical Technology, persist.

Despite the success of TURA, there are limitations to the toxics use reduction approach. Most significantly, health effects are not a central concern, though this may have been a calculated decision. Toxics use reduction, like pollution prevention, is driven by general priority setting for important sources of waste and by opportunities to reduce them. The TURA legislation was enacted in order to prevent more stringent regulation, higher toxic disposal costs, potential liability, and higher insurance premiums. Incorporating health issues might have appeared to be finger-pointing at industry, potentially jeopardizing participation in the toxics use reduction (TUR) program.[14] Furthermore, the incorporation of health issues in the TUR process may have provided an obstacle by blocking action if sufficient health effects in the workplace and community could not be reported. By excluding health from the debate around toxics use reduction, TURI works toward the goal of reducing toxics for the sake of making reductions. This ideology of prevention for prevention's sake is a significant step toward implementing the precautionary principle in U.S. environmental policy.

TURI is currently working to expand its mandate to a broader range of environmental policy. Ken Geiser, TURI's director, helped start the Lowell Center for Sustainable Production, founded on the principle that clean production is a logical step after toxics reduction. The expansion into new applications of toxics reduction in environmental policy at TURI and the Lowell Center created an ideal place for the precautionary principle to develop into a widespread approach. The precautionary principle takes the concepts of pollution prevention and toxics use reduction forward, incorporating a broader array of actors in the effort to protect human health and the environment. Local activism based on the precautionary principle is the best example of this logical extension.

MOVING FURTHER UPSTREAM: THE PRECAUTIONARY PRINCIPLE

Similar to the development of pollution prevention as an alternative paradigm to pollution control, the new paradigm espoused by the precautionary principle is gaining popularity in the United States. Yet, the precautionary principle remains an underdeveloped concept in American politics. Although no definition has been agreed upon, leading proponents cite four primary elements: (1) taking preventive action in the face of uncertainty; (2) shifting the burden of proof to the proponents of an activity; (3) exploring a wide range of alternatives to possibly harmful actions; and (4) increasing public participation in decision-making.[15]

These components are derived in part from recent European countries' laws and international treaties and protocols, but they are also a direct outgrowth of decades of general environmental action. People con-

cerned with environmental degradation and human disease are impatient with a process that puts the burden on real or potential victims to show the hazards of chemicals and other substances. They know that scientific procedure makes it hard to demonstrate hazards and that such efforts take too long. Citizens have increasingly insisted on lay participation in science and health policy, as evidenced by citizen involvement around toxic wastes, breast cancer, and AIDS. Beginning in the late 1990s, a growing number of environmental organizations and health groups have found the precautionary principle to be a useful foundation for extending environmental health concerns. The most notable precautionary principle actions involve children's environmental health legislation efforts, activism around environmental factors in breast cancer, criticism of widespread pesticide spraying, and organizing to educate scientists and citizens about the potential to curtail many chemicals.

Although the precautionary principle is not explicitly cited in U.S. legislation, activists argue that there is implicit reference to the use of precaution in protecting health in several major policies. Environmental, worker safety and health, and food quality laws often imply erring on the side of caution. For instance, the 1970 Occupational Safety and Health Act (OSHA) requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards."[16] OSHA's success in using precaution is limited however, as Ashford and Caldart[17] demonstrate with the failure of the draft *Carcinogen Standard* that requires precautionary action whenever a chemical is suspected of being carcinogenic to animals. An important component of the precautionary principle—the reversal of the burden of proof—is reflected in the federal Food, Drug, and Cosmetics Act (FDCA). The FDCA requires pharmaceutical manufacturers to demonstrate the safety of a product, rather than rely on limited government testing or public health officials to demonstrate negative health effects.[16] Perhaps the most fundamental application of precaution in federal legislation can be found in the National Environmental Policy Act (NEPA), which implicitly advances the precautionary principle's focus on exploring alternatives through the provision of information prior to making decisions.

Applying the precautionary principle

Activists and academics are working to bring the precautionary principle, centered on the protection of public health, to the forefront of environmental policy. In January 1998, an interdisciplinary group of creative thinkers gathered at the Wingspread Conference Center in Wisconsin to discuss the precautionary principle and how to understand the environmental and public health threats facing the world. The conference produced the Wingspread Statement, which situated uncertainty at the heart of the need for precaution: ". . . as discussed by the Wingspread participants, uncertainty becomes the reason for taking action to prevent harm and for shifting the benefit of the doubt to those beings and systems that might suffer harm."[18] The Wingspread Statement highlights threats to human health and the direct link between the failures of risk assessment in protecting public health and the importance of implementing the precautionary principle as an alternative.

In Massachusetts, the precautionary principle is centered in the work of the Massachusetts Precautionary Principle Project: a joint effort of the Massachusetts Breast Cancer Coalition, Clean Water Fund, Lowell Center for Sustainable Production, and the Science and Environmental Health Network. The Precautionary Principle Project is the only statewide organization designed to spread knowledge about and to implement the precautionary principle as a guide to health policy. The Project developed an organizational structure of its own, including statewide conferences (one conference, in December 2000, attracted more than 200 people). The Project has conducted a variety of public educational forums, held meetings with scientists and scholars on university campuses, developed outreach materials, encouraged state and local public health officials to be more cautious on West Nile virus spraying, and worked with state officials to develop model policies to address broad public health concerns. Following on the success of these efforts, the Precautionary Principle Project initiated the advocacy campaign-oriented Alliance for a Healthy Tomorrow (http://www.healthytomorrow.org), which now has a much larger and expanding organizational core, including public health advocates, health affected organizations, environmental groups, environmental justice organizations, and labor unions.

In autumn 2001, the Lowell Center (with support from the Precautionary Principle Project) held an international conference focused mainly on building the scientific base for the precautionary principle. The role of TURI and its affiliated units is central in these kinds of precaution-related activities. Both TURI's director, Ken Geiser, and Joel Tickner of the Lowell Center for Sustainable Production and the Department of Work Environment, who have held leadership roles in the Project, provide advice and research support to the Alliance. We believe these interorganizational connections stem from two sources: (1) their

transformation of toxics reduction into precautionary principle activities; and (2) their participation in a long legacy of other environmental activism in the state. We now briefly examine some of the directions taken by precautionary principle activism in Massachusetts: action on West Nile virus spraying, child health organizing, and environmental breast cancer organizing.

West Nile virus activities. In 2000, the mosquito-borne West Nile virus was confirmed in 21 people, two of whom died. The previous year, seven people died in the New York City area. As a result, state and local governments sprayed insecticides widely. Environmental activists and scientists employed the precautionary principle in organizing around the risks of pesticide spraying. (Many activists believe that the virus is a cyclical event that might not be controllable through spraying. They also believe that the government response is exaggerated, founded on a poor knowledge base, and lacking sufficient regard to potential health effects of the spraying.)[19]

Scientists supportive of the precautionary principle and activists throughout the East Coast formed town, city, and state groups to educate citizens and public health officials about the issues. The Massachusetts Precautionary Principle Project convened a meeting attended by the state deputy public health commissioner, and several major city commissioners and deputy commissioners, who were willing to engage in such discussions and to re-evaluate hazards. Similar meetings were held at town and city levels. These meetings provided a neutral place for scientists, officials, and advocates to talk about the possible public health trade-offs in insecticide spraying. Some officials admitted that spraying was due to political pressure from mayors rather than a calculated public health assessment. Others were cognizant of how the crisis mentality surrounding West Nile virus was causing unnecessary public alarm.

Although malathion was never sprayed in Massachusetts, there was widespread use elsewhere. Activists pointed out that malathion was the second leading cause of hospitalization for occupational pesticide poisoning in the United States during the period 1977 through 1982. Prior research indicated that malathion may compromise the immune system, cause reproductive harm, and cause genetic mutations or interfere with normal cell replication.[20] Resmethrin and d-phenothrin (sumithrin), the other pesticides used, are synthetic pyrethroids. Though less toxic than malathion, they affect the nervous system, and allergic responses have been reported. Activists were especially concerned with the synergist included in the spraying, piperonyl butoxide (PBO), which has been classified by the EPA as a possible human carcinogen. Importantly, many local and state health departments neglected to discuss potential PBO risk, only addressing malathion and resmethrin.

These activist efforts were quite successful at a national level. In April 2001, a 65-page draft by the CDC outlined new guidelines for addressing West Nile virus. Despite the expectation of more cases in summer 2001, pesticide spraying is only suggested as a last resort. Instead, the CDC urged a preventive approach aimed at eliminating mosquito breeding grounds—spreading larvicide to kill mosquitoes before they emerge as adults—and educating the public on mosquito avoidance. The CDC acknowledged flaws in its previous approach, when it suggested spraying in a two-mile radius each time health officials found an infected bird, mammal, or mosquito. CDC action is critical, since many state and local health agencies base their programs on CDC guidelines. New York health officials announced that the state's revised plan would resemble the new federal guidelines. The actual decision on spraying will still be left to local health officials,[21] but many local officials used CDC's pro-spraying guidelines in summer 2000, and they may now accept CDC's more cautious suggestions.[18]

There is no way to conclusively credit precautionary principle advocates with this success. However, they were extremely visible and active in Massachusetts under the banner of the precautionary principle. Precautionary principle activists realized that the public health officials had their own form of precaution in spraying, as indeed there were real risks to those contracting West Nile virus. Some activists in other parts of the country used an explicit precautionary principle approach, and for those that did not, the overall activism is clearly in line with the precautionary principle, even when only implicit.

Children's environmental health activities. Proponents of the precautionary principle have focused considerable energy on children's health. Childhood is the most susceptible time for environmental agents to damage development, especially neurological development.[22] Also, children's slower metabolic rates leave the toxic agents in their bodies for longer periods of time. Relative to body weight, children are exposed to a greater amount of toxic materials than adults. Recent rises in asthma, developmental disorders, and cancer in children sparked renewed attention on children's environmental health, including the EPA's 1996 National Agenda to Protect Children's Health, the Food Quality Protection Act of 1996, and the 1997 Executive

Order 13045 on Children's Environmental Health. The EPA, CDC, and the National Institute of Environmental Health Sciences funded eight university-based centers for children's environmental health, and HUD's Healthy Homes project has supported many urban efforts. But, despite the number of bills and attention paid to children's health, most of the funding is directed toward screening and quantification of risk rather than to examining, banning, and restricting chemicals, or to alternative, substitutive production approaches.[23]

Precautionary principle activists implicitly fought for the application of the precautionary principle when trying to pass the Massachusetts Children's and Families' Protection Act in 2000 (though the bill does not use the term *precautionary principle*). The Children's and Families' Protection Act prohibits use of the most toxic pesticides at schools and day care centers, and requires them to develop integrated pest management solutions designed to reduce the amount of pesticides used to manage pests through a combination of enhanced monitoring, biological controls, and limited chemical usage. The Precautionary Principle Project played an active role in developing a bill, filed at the end of 2000 by Senator Pamela Resor, in the Massachusetts legislature. The bill would establish the Massachusetts Commission to Protect Child Health and Development—a broad children's environmental health program that is based on the precautionary principle. Senator Resor's announcement of this bill was a highlight of the December 2000 statewide conference of the Precautionary Principle Project. The Alliance for a Healthy Tomorrow has prioritized the development of executive branch policies and legislation to protect children's health as a centerpiece of its efforts to implement precaution in Massachusetts.

Precautionary principle actions by other organizations. Activists in the environmental breast cancer movement employ the precautionary principle in their efforts to prevent cancer. The Massachusetts Breast Cancer Coalition is one of the component groups in the Alliance for a Healthy Tomorrow, and their breast cancer organizing is based on the precautionary principle. Using the precautionary principle as a strategic frame means advocating for the reduction and, eventually, the elimination of chemicals suspected of causing breast cancer. The Coalition started the Silent Spring Institute, the nation's only research institute specifically designed to investigate environmental factors in breast cancer.[24] Community groups elsewhere, such as Breast Cancer Action (BCA) in San Francisco, use the precautionary principle in their campaign for a research agenda that focuses on identifying and eradicating the causes of breast cancer. BCA evokes the precautionary principle to argue against the preventive use of drugs such as tamoxifen and raloxifene. Although the media portrays tamoxifen and raloxifene as "prevention pills," BCA argues that the drugs have serious side effects; in particular, tamoxifen is a known uterine carcinogen.[25] BCA also argues, within the context of the precautionary principle, that the medical community interested in preventing breast cancer should "first, do no harm." Applying precaution in medicine, BCA believes, "encourages the use of environmentally-safe alternatives to ways of doing business that we know—or have reason to believe—are harmful."[25]

One breast cancer activist group, the Women's Community Cancer Project (WCCP) in Cambridge, Massachusetts, utilizes the precautionary principle in their critique of traditional risk assessment.[26] WCCP echoes the precautionary principle's tenet of action based on suspicion rather than proof, as the rate of new chemical production by industry greatly outweighs the government's ability to test them. WCCP advances the precautionary principle as an alternative to risk assessment, as risk becomes a means of weighing alternatives. WCCP identifies TURA as a salient example of a precautionary alternative to risk assessment. Also, they cite toxics use reduction as an example of the precautionary principle because it "instructs firms to identify ways to reduce their waste and, subsequently, use of those chemicals—any amount of use is considered too much."[27] WCCP's focus on alternatives to toxic chemicals reflects their critical approach to finding a cure for breast cancer, where attention is often focused on socioeconomic risk factors that are overlooked by medical researchers.

Democratization of information and science. Public participation in matters concerning scientific decision-making is an integral part of the precautionary principle.[18] Community members and activists are often excluded from traditional risk assessment processes that devalue the lay understanding of threats to public health. Through the education of community members and the democratization of science, the precautionary principle encourages public participation. Undemocratic science maintains that technical matters are to be addressed solely by experts. Democratizing science means including laypeople in the scientific process, whether it be in establishing research priorities or involvement in the production of scientific knowledge.[28] Though TURI does not explicitly frame public participation in toxics use reduction under the precautionary principle, the role of the community-based TURN grants

in increasing public participation is a significant step toward creating public support for implementing the precautionary principle.

Toxics use reduction efforts in Massachusetts and actions to implement the precautionary principle elsewhere have begun democratizing scientific knowledge and increasing participation of lay people in the scientific process. The TURN grants enable the implementation of toxic use reduction at the community organization or municipal government level, offering lay people access to information and resources. Recipients of TURN grants receive pollution prevention education so that they can train other individuals in their community to reduce toxics both in the workplace and at home. Recent collaboration between TURI and the Massachusetts Department of Public Health seeks to increase availability of scientific data to the public, as well as teach people how to utilize the data in their toxics reduction efforts. In this instance, the joint effort reflects a recognition that lay people are more likely to err on the side of public health in the face of uncertainty. In other words, citizens will be less willing to accept potentially dangerous substances in their environment, merely because those substances have not yet been proven hazardous.

By encouraging the public to become involved in the scientific community, the social ownership of risk assessment becomes less an elitist tool and more a public tool. Because traditional approaches to risk assessment assume that the scientific knowledge required to conduct objective research does not involve the public, alternative ways of understanding risk are excluded. The impact of this is explored in Brown and Mikkelsen's[29] work on popular epidemiology, which explores the role of social structural factors in public health. Similar work, such as Epstein's[30] study of AIDS activists, demonstrates that laypersons can successfully immerse themselves in the scientific community and become informed participants in research design.

Informed citizens are capable of intelligent participation in matters of scientific decision-making. By creating the opportunities for citizens to become informed, precautionary principle advocates are transforming the role of community members from victims of pollution to empowered activists capable of combating corporate and state scientific authority. This public empowerment, widely found in literature by precautionary principle supporters, reinforces the basic human right to life, which is often overridden by the right to private property.[31] The incorporation of community activists and community leaders into scientific decision-making increases the significance of the public understanding, or public paradigm, of the risks to public health.

CONCLUSION

We have argued that a new public paradigm has been evolving since the publication of *Silent Spring,* and is continually developing through current activism concerning toxic chemicals. Whereas the pollution control approach employed during the early years of environmental policy focused on the limited goal of regulating emissions, the pollution prevention approach targets toxics before they pose a risk. Through encouragement of industrial companies, governmental units, and individuals to reduce their consumption of toxic chemicals, pollution prevention represents a more upstream alternative to pollution control.

As we have seen in the case of Massachusetts' pollution prevention strategies, there are limits to the ability of pollution prevention to protect the environment. The exclusion of public and environmental health from the terminology of toxics use reduction is an example of such a limitation. In order to work efficiently with industrial firms, the toxics use reduction advocates adopted the language of economics. Subsequently, to move beyond toxics use reduction, toxics advocates initiated the Precautionary Principle Project (subsequently transformed into the Alliance for a Healthy Tomorrow), which, through its focus on alternatives to risk assessment, moves further upstream than pollution prevention. More broadly, the environmentalism that sparked the state's toxics reduction approach has expanded to new and broader areas of environmental protection.

Today we see the precautionary principle as the logical outcome of current social problems such as toxic pollution, environmental threats to children's health, and the growing breast cancer epidemic. The precautionary principle, in the forms we presently see in the United States, has developed out of three overlapping pathways: toxics reduction, toxic waste activism, and environmental breast cancer activism. The democratization of science is an integral part of the precautionary principle, empowering environmental activists and encouraging community participation in decisions regarding public health. In the process, informed citizens are continually demonstrating their ability to employ informed arguments against toxic exposure, and to pursue creative alternatives.[12,28] Examples of activists and scientists working together through what we term "citizen-scientist alliances," such as West Nile activists and environmental breast cancer

activists, demonstrate the successful integration of social responsibility with science, often under the rubric of the precautionary principle. Successes, such as these, pave the way for further implementation of the precautionary principle, as exemplified by the great success in applying the alternative paradigm in Europe.

One significant policy direction that could derive from the precautionary principle approach is health tracking and monitoring, something that has been generally absent in public health. There are some promising moves in this direction. In March 2001, the Centers for Disease Control and Prevention released the first-ever report on toxic chemicals present in our bodies. The tests measured 27 substances, including mercury, organophosphates (found in pesticides), and phthalates (found in children's toys, cosmetics and medical devices). While some of these chemicals had been tested for in soil, air and water, levels in humans had not been directly measured before. The CDC plans to continue testing and will add more chemicals to the screen, reaching 100 substances by 2003. The CDC points out that the new data details exposure of the U.S. population to toxins; it does not present new data on health risks caused by different exposure levels.[5] But it is a step in the right direction, and the information collected can and should be used to promote more research into environmental links to diseases, as proposed by Health-Track. The mission of Health-Track, supported by The Pew Charitable Trusts, is to identify and track the links between environmental hazards and illnesses and to provide researchers and public health officials with the necessary tools to prevent disease. Beyond the process of health tracking, of course, is the application of its findings toward reducing or eliminating toxic substances.

Health tracking and monitoring, developing sustainable production techniques, using the least toxic alternative, and taking precaution with potentially dangerous substances are elements of a growing public paradigm that grows out of the precautionary principle. It is a paradigm that helps us to realize that we all live downstream, and that we must raise the questions of what is happening upstream. Sandra Steingraber's book, *Living Downstream*, takes its title from the oft-used metaphor about preventive health: villagers notice people floating downstream and pull them out, developing new rescue techniques as time goes by.[2] But no one thinks to look upstream to see why the people are in the river in the first place. Often we cannot pinpoint the exact upstream location, since many of the suspected toxics are ubiquitous. So we have to go further upstream until we remove these toxics altogether. The metaphor may be commonly employed, but there is nothing more apt when we talk about environmental health.

The authors thank Theo Luebke, Joshua Mandelbaum, Sabrina McCormick, and Stephen Zavestoski for their involvement in the larger project, of which this is one component. They thank Joel Tickner and Steve Kroll-Smith for comments on the manuscript. The authors are grateful to the staff of the Toxic Use Reduction Institute for granting us access to their work. This research is supported by grants to the second author from the Robert Wood Johnson Foundation's Investigator Awards in Health Policy Research Program (Grant #036273) and the National Science Foundation Program in Social Dimensions of Engineering, Science, and Technology (Grant # SES-9975518).

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