REDUCING ENVIRONMENTAL CANCER RISK

What We Can Do Now

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Despite overall decreases in incidence and mortality, cancer continues to shatter and steal the lives of Americans. Approximately 41 percent of Americans will be diagnosed with cancer at some point in their lives, and about 21 percent will die from cancer. The incidence of some cancers, including some most common among children, is increasing for unexplained reasons.

Public and governmental awareness of environmental influences on cancer risk and other health issues has increased substantially in recent years as scientific and health care communities, policymakers, and individuals strive to understand and ameliorate the causes and toll of human disease. A growing body of research documents myriad established and suspected environmental factors linked to genetic, immune, and endocrine dysfunction that can lead to cancer and other diseases.

Between September 2008 and January 2009, the President's Cancer Panel (the Panel) convened four meetings to assess the state of environmental cancer research, policy, and programs addressing known and potential effects of environmental exposures on cancer.

The Panel received testimony from 45 invited experts from academia, government, industry, the environmental and cancer advocacy communities, and the public.

This report summarizes the Panel's findings and conclusions based on the testimony received and additional information gathering. The Panel's recommendations delineate concrete actions that governments; industry; the research, health care, and advocacy communities; and individuals can take to reduce cancer risk related to environmental contaminants, excess radiation, and other harmful exposures.

Key Issues for Reducing Environmental Cancer Risk

Issues impeding control of environmental cancer risks include those related to limited research on environmental influences on cancer; conflicting or inadequate exposure measurement,

assessment, and classification; and ineffective regulation of environmental chemical and other hazardous exposures.

Environmental Cancer Research

Research on environmental causes of cancer has been limited by low priority and inadequate funding. As a result, the cadre of environmental oncologists is relatively small, and both the consequences of cumulative lifetime exposure to known carcinogens and the interaction of specific environmental contaminants remain largely unstudied. There is a lack of emphasis on environmental research as a route to primary cancer prevention, particularly compared with research emphases on genetic and molecular mechanisms in cancer.

Environmental Exposure Measurement, Methodologic, Assessment, and Classification Issues

Efforts to identify, quantify, and control environmental exposures that raise cancer risk, including both single agents and combinations of exposures, have been complicated by the use of different measures, exposure limits, assessment processes, and classification structures across agencies in the U.S. and among nations. In addition, efforts have been compromised by a lack of effective measurement methods and tools; delay in adopting available newer technologies; inadequate computational models; and weak, flawed, or uncorroborated studies.

Some scientists maintain that current toxicity testing and exposure limit-setting methods fail to accurately represent the nature of human exposure to potentially harmful chemicals. Current toxicity testing relies heavily on animal studies that utilize doses substantially higher than those likely to be encountered by humans. These data—and the exposure limits extrapolated from them— fail to take into account harmful effects that may occur only at very low doses. Further, chemicals typically are administered when laboratory animals are in their adolescence, a methodology that fails to assess the impact of in utero, childhood, and lifelong exposures. In addition, agents are tested singly rather than in combination.

Regulation of Environmental Contaminants

The prevailing regulatory approach in the United States is reactionary rather than precautionary. That is, instead of taking preventive action when uncertainty exists about the potential harm a chemical or other environmental contaminant may cause, a hazard must be incontrovertibly demonstrated before action to ameliorate it is initiated. Moreover, instead of requiring industry or other proponents of specific chemicals, devices, or activities to prove their safety, the public bears the burden of proving that a given environmental exposure is harmful. Only a few hundred of the more than 80,000 chemicals in use in the United States have been tested for safety.

U.S. regulation of environmental contaminants is rendered ineffective by five major problems: (1) inadequate funding and insufficient staffing, (2) fragmented and overlapping authorities coupled with uneven and decentralized enforcement, (3) excessive regulatory complexity, (4) weak laws and regulations, and (5) undue industry influence.

Too often, these factors, either singly or in combination, result in agency dysfunction and a lack of will to identify and remove hazards.

Sources and Types of Environmental Contaminants

The line between occupational and environmental contaminants is fine and often difficult to demarcate. Many known or suspected carcinogens first identified through studies of industrial and agricultural occupational exposures have since found their way into soil, air, water, and numerous consumer products. People from disadvantaged populations are more likely to be employed in occupations with higher levels of exposure (e.g., mining, construction, manufacturing, agriculture,

certain service sector occupations) and to live in more highly contaminated communities. The reality of this unequal burden is not just a health issue, but an issue of environmental justice. While all Americans now carry many foreign chemicals in their bodies, women often have higher levels of many toxic and hormone-disrupting substances than do men. Some of these chemicals have been found in maternal blood, placental tissue, and breast milk samples from pregnant women and mothers who recently gave birth. Thus, chemical contaminants are being passed on to the next generation, both prenatally and during breastfeeding. Some chemicals indirectly increase cancer risk by contributing to immune and endocrine dysfunction that can influence the effect of carcinogens.

Children of all ages are considerably more vulnerable than adults to increased cancer risk and other adverse effects from virtually all harmful environmental exposures. In addition, some toxics have adverse effects not only on those exposed directly (including in utero), but on the offspring of exposed individuals.

Exposure to Contaminants from Industrial and Manufacturing Sources

Manufacturing and other industrial products and processes are responsible for a great many of the hazardous occupational and environmental exposures experienced by Americans. Many of these contaminants— even substances banned more than 30 years ago—remain ubiquitous in the environment because they break down very slowly, if at all. Other industrial chemicals or processes have hazardous by-products or metabolites. Numerous chemicals used in manufacturing remain in or on the product as residues, while others are integral components of the products themselves. Further, in the ongoing quest for more effective and efficient ways of making industrial and consumer products, new chemicals and other substances are being created continually and existing substances are being put to new uses. Limited research to date on unintended health effects of nanomaterials, for example, suggests that unanticipated environmental hazards may emerge from the push for progress.

Exposure to Contaminants from Agricultural Sources

The entire U.S. population is exposed on a daily basis to numerous agricultural chemicals, some of which also are used in residential and commercial landscaping. Many of these chemicals have known or suspected carcinogenic or endocrine- disrupting properties. Pesticides (insecticides, herbicides, and fungicides) approved for use by the U.S. Environmental Protection Agency (EPA) contain nearly 900 active ingredients, many of which are toxic. Many of the solvents, fillers, and other chemicals listed as inert ingredients on pesticide labels also are toxic, but are not required to be tested for their potential to cause chronic diseases such as cancer. In addition to pesticides, agricultural fertilizers and veterinary pharmaceuticals are major contributors to water pollution, both directly and as a result of chemical processes that form toxic by-products when these substances enter the water supply. Farmers and their families, including migrant workers, are at highest risk from agricultural exposures. Because agricultural chemicals often are applied as mixtures, it has been difficult to clearly distinguish cancer risks associated with individual agents.

Environmental Exposures Related to Modern Lifestyles

Conveniences of modern life—automobile and airplane travel, dry cleaning, potable tap water, electricity, and cellular communications, to name a few—have made daily life easier for virtually all Americans. Some of these conveniences, however, have come at a considerable price to the environment and human health, and the true health impact of others is unconfirmed. For example, mobile source air emissions (e.g., from cars, trucks, other passenger vehicles, ships), especially diesel particulate pollution, are responsible for approximately 30 percent of cancer resulting from air pollution. Disinfection of public water supplies has dramatically reduced the incidence of waterborne illnesses and related mortality in the United States, but research indicates that long-term exposure to disinfection by-products such as trihalomethanes may increase cancer risk. Chemicals used for household pest control can become a component of carpet dust, posing a risk

to children when they play on the floor.

Sharp controversy exists in the scientific community as to possible adverse health effects from exposure to low frequency electromagnetic energy. The use of cell phones and other wireless technology is of great concern, particularly since these devices are being used regularly by ever larger and younger segments of the population. At this time, there is no evidence to support a link between cell phone use and cancer. However, the research on cancer and other disease risk among long-term and heavy users of contemporary wireless devices is extremely limited. Similarly, current and potential harms from extremely low frequency radiation are unclear and require further study. In addition, ultraviolet radiation from excess sun exposure and tanning devices has been proven to substantially increase skin cancer risk.

Exposure to Hazards from Medical Sources

In the past two decades, improved imaging technologies, nuclear medicine examinations, and new pharmaceutical interventions have made possible significant strides in our ability to diagnose and treat human disease, including cancer. It is becoming increasingly clear, however, that some of these same technologies and drugs that have contributed so greatly to health status and longevity also carry risks.

While ionizing radiation exposures from radon, occupational, and other sources have remained essentially stable over the past 30 years, Americans now are estimated to receive nearly half of their total radiation exposure from medical imaging and other medical sources, compared with only 15 percent in the early 1980s. The increase in medical radiation has nearly doubled the total average effective radiation dose per individual in the United States. Computed tomography (CT) and nuclear medicine tests alone now contribute 36 percent of the total radiation exposure and 75 percent of the medical radiation exposure of the U.S. population. Medical imaging of children is of special concern; compared with adults, children have many more years of life during which a malignancy initiated by medical radiation can develop. Many referring physicians, radiology professionals, and the public are unaware of the radiation dose associated with various tests or the total radiation dose and related increased cancer risk individuals may accumulate over a lifetime. People who receive multiple scans or other tests that require radiation may accumulate doses equal to or exceeding that of Hiroshima atomic bomb survivors. It is believed that a single large dose of ionizing radiation and numerous low doses equal to the single large dose have much the same effect on the body over time.

Moreover, radiation dose for the same test can vary dramatically depending on the equipment used, technologist skill, application of dose-reduction strategies, and patient size, age, and gender. Licensure of imaging and radiation therapy technologists varies depending on the type of test performed by the technologist. Some states have only partial regulation; six states and the District of Columbia have no licensure or regulatory provisions of any kind.

In addition, pharmaceuticals have become a considerable source of environmental contamination. Drugs of all types enter the water supply when they are excreted or improperly disposed of; the health impact of long-term exposure to varying mixtures of these compounds is unknown.

Exposure to Contaminants and Other Hazards from Military Sources

The military is a major source of toxic occupational and environmental exposures that can increase cancer risk. Information is available about some military activities that have directly or indirectly exposed military and civilian personnel to carcinogens and contaminated soil and water in numerous locations in the United States and abroad. However, we may never know the full extent of environmental contamination from military sources. Nearly 900 Superfund sites are abandoned military facilities or facilities that produced materials and products for or otherwise supported military needs. Some of these sites and the areas surrounding them became heavily

contaminated due to improper storage and disposal of known or suspected carcinogens including solvents, machining oils, metalworking fluids, and metals. In some cases, these contaminants have spread far beyond their points of origin because they have been transported by wind currents or have leached into drinking water supplies.

Hundreds of thousands of military personnel and civilians in the United States received significant radiation doses as a result of their participation in nuclear weapons testing and supporting occupations and industries, including nuclear fuel and weapons production, and uranium mining, milling, and ore transport. Hundreds of thousands more were irradiated at levels sufficient to cause cancer and other diseases. These populations include the families of military and civilian workers, and people—known as "downwinders"—living or working in communities surrounding or downstream from testing and related activities, and in relatively distant areas to which nuclear fallout or other radioactive material spread. Federal responses to the plight of affected individuals have been unsatisfactory. Those affected lack knowledge about the extent of their exposure or potential health problems they may face. Similarly, most health care providers are not aware of cancer and other latent radiation effects and therefore are unlikely to adequately monitor patients for these health conditions. Exposure to ionizing radiation related to nuclear weapons testing is an underappreciated issue worldwide.

Exposure to Environmental Hazards from Natural Sources

Most environmental hazards with the potential to raise cancer risk are the product of human activity, but some environmental carcinogens come from natural sources. For example, radon gas, which forms naturally from the breakdown of uranium mineral deposits, is the second leading cause of lung cancer in the United States and the leading cause of lung cancer among people who have never smoked. Radon-induced lung cancer is responsible for an estimated average of 21,000 deaths annually. People who smoke and also are exposed to radon have a higher risk of lung cancer than from either exposure alone.

Although human activities such as mining, ore processing, use of arsenic-containing pesticides, and burning of fossil fuels are major contributors to waterborne arsenic in the U.S., most inorganic arsenic in drinking water is from natural sources. Inorganic arsenic in drinking water has been linked to skin, lung, bladder, and kidney cancer in both sexes and with prostate cancer in men, as well as numerous non-cancerous conditions including endocrine, reproductive, and developmental effects.

Reducing Environmental Cancer Risk: A Call to Action

The burgeoning number and complexity of known or suspected environmental carcinogens compel us to act to protect public health, even though we may lack irrefutable proof of harm. Action is possible at several levels: conducting scientific research to enhance our understanding and by extension, our ability to prevent and respond to environmental carcinogens; enforcing existing policies and regulations that protect workers and the public; implementing policy and regulatory changes that support public health and reduce the burden of cancer; and taking personal action.

The Panel concludes that:

We Need to Determine the Full Extent of Environmental Influences on Cancer.

At this time, we do not know how much environmental exposures influence cancer risk and related immune and endocrine dysfunction. Environmental contamination varies greatly by type and magnitude across the nation, and the lifetime effects of exposure to combinations of chemicals and other agents are largely unstudied. Similarly, the cancer impact of exposures

during key “windows of vulnerability” such as the prenatal period, early life, and puberty are not well understood. Nonetheless, while these diverse effects often are difficult to quantify with existing technologies and research methods, in a great many instances, we know enough to act.