



6 Pivotal Role of Environmental Protection Agencies in Global Cancer Control

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Background

Environmental pollution is one of three interlinked threats to human health, alongside loss of biodiversity and climate change, together constituting the triple planetary crisis.¹ Its scale is reflected in the fact that air pollution alone is the third leading cause of death globally, with pollution accounting for one in six deaths worldwide today. Prompted by growing concern about water and air quality highlighted in the writings of scientist and patient with breast cancer Rachel Carson,² the US Environmental Protection Agency (EPA) was established in December 1970 by President Richard Nixon.³ The EPA consolidated the environmental responsibilities of the federal government into a single agency. Its impact has been profound. US emissions of the commonest pollutants have fallen by 71% although the population grew by 105 million people and the economy tripled.⁴ The agency has played a pivotal role in addressing environmental injustice through pollution reduction in communities with people of color, low-income populations, and indigenous populations.⁵

In the United Kingdom, the Environment Agency was established in 1996 to provide an integrated approach to protecting air, land, and water. In Europe, the European Environment Agency (EEA), established in 2002, coordinates with 38 member and cooperating countries to manage environmental data and concerns. These and other global EPAs (Table 1), charged with regulating the air we breathe, the water we drink, and the soil in which our food grows, sit at the front line of both cancer prevention and the response to the triple planetary crisis. Their legislative reach, enforcement capacity, and scientific authority make them uniquely powerful instruments. These policy, surveillance, and mitigation frameworks are increasingly needed as deaths attributable to modern forms of pollution, including ambient air pollution from fossil fuel combustion, industrial emissions, traffic-related pollutants, synthetic chemicals, and hazardous waste, have risen by 7% since 2015 and by more than 66% since 2000.⁶ The recent decision by the US EPA to revoke climate change and pollution legislation⁷ prompted us to reflect on the pivotal role these organizations play in safeguarding cancer care and reducing the global cancer burden.

The Environmental Dimensions of Cancer

The relationship between environmental pollution and cancer is well-established.⁸ The International Agency for Research on Cancer (IARC) classified outdoor air pollution, specifically particulate matter (PM), as a Group 1 human carcinogen in 2013, a class that includes tobacco smoke and asbestos.⁹ Long-term exposure to fine particulate matter (PM_{2.5}) with an aerodynamic diameter of ≤ 2.5 μm plays a significant role in lung cancer progression, driver mutation activation, and treatment resistance.¹ Mechanistically, PM induces oxidative stress, DNA damage, inactivation of tumor suppressor genes, and activation of oncogenes.⁸ PM_{2.5} also drives inflammation via interleukin-1 β , which can activate alveolar type 2 cells harboring pre-existing epidermal growth factor receptor mutations.¹⁰

Air pollution is, however, only one facet of the environmental cancer burden. Benzene, diesel exhaust, formaldehyde, volatile organic compounds (VOCs), heavy metals, asbestos, radon, and

TABLE 1. Country Agency Core Environmental Functions Relevant to Cancer Prevention

Country	Agency	Core Environmental Functions	Potential Contributions to Cancer Prevention Through Environmental Regulation
Brazil	IBAMA; CONAMA; ANVISA; Ministry of Health (SVSA)	Environmental licensing, inspection, and enforcement of federal regulations; establishment of environmental quality standards (air, water, and soil); monitoring and control of industrial emissions and hazardous substances; coordination within the National Environmental System; environmental health surveillance including air pollution-related programs (eg, VIGIAR), encompassing population health monitoring, assessment of short- and long-term health effects, environmental risk, and vulnerability analysis	Reduced exposure to airborne carcinogens (eg, PM _{2.5}); better identification of populations at risk from air pollution; support for policies that reduce exposure to environmental carcinogens; integration of environmental and health data to guide cancer prevention strategies
India	MoEFCC	National environmental policy; air and water quality monitoring; pollution standards; enforcement; coordination with state boards; climate-health programs	Sets National Environmental Policy that prevents environmental-related cancers by strictly regulating carcinogens under the National Clean Air Programme and National Ambient Air Quality Standards and reducing waterborne toxins through the National Water Quality Monitoring Programme
Ireland	EPA	Radon surveillance and mapping; air quality monitoring; industrial emission regulation; climate risk assessment	Direct reduction of lung cancer risk via radon mitigation; broader reduction of exposure to airborne carcinogens
Kenya	NEMA	Environmental licensing (EIA/EA); hazardous waste management; air quality regulation; chemical control	Critical for reducing urban and industrial carcinogenic exposures in rapidly growing settings
Nigeria	NCCC	Climate policy coordination; national adaptation and mitigation planning; stakeholder engagement	Addresses climate-environment-cancer nexus, reducing indirect carcinogenic exposures from environmental degradation
New Zealand	EPA	Regulation of hazardous substances and new organisms; emission trading oversight; marine and environmental permitting; compliance with environmental laws	Controls exposure to hazardous chemicals and pollutants; reduces cancer risk from environmental and occupational exposures
Philippines	EMB	EIA; air and water pollution control; ecosystem protection	Limits exposure to industrial and environmental carcinogens through regulatory oversight
United Kingdom	Environment Agency	Industrial emission regulation; water quality protection; climate adaptation; environmental permitting	Strong regulatory framework reduces long-term exposure to pollutants linked to cancer
United States	EPA	Air and water regulation; chemical safety; hazardous waste management; radiation control	Reduces exposure to air toxics; regulates carcinogenic chemicals; manages contaminated sites

Abbreviations: ANVISA, National Health Surveillance Agency; CONAMA, National Council for the Environment; EIA, Environmental Impact Assessment; EMB, Environmental Management Bureau; EPA, Environmental Protection Authority; IBAMA, Brazilian Institute of Environment and Renewable Natural Resources; MoEFCC, Ministry of Environment, Forest and Climate Change; NCCC, National Council on Climate Change; NEMA, National Environment Management Authority; SVSA, Secretariat of Health and Environmental Surveillance.

polycyclic aromatic hydrocarbons collectively compose an environmental exposome with carcinogenic consequences across multiple organ systems.¹¹ The Global Burden of Disease (GBD) 2022 analysis estimated that, of the 20 million new cancer cases diagnosed worldwide, approximately 7.1 million (37.8%) were attributable to modifiable risk factors. Among these, air pollution was identified as one of the leading contributors to the global cancer burden.¹² GBD projections to 2050 suggest that ambient PM_{2.5}-attributable cancer burden will continue to rise without decisive intervention, concentrated disproportionately in middle sociodemographic index countries where industrialization has outpaced regulatory capacity.¹³

People exposed to traffic-related air pollution face an increased risk of lung cancer even as never-smokers; each 10 µg/m³ increase in PM_{2.5} is associated with a 13% increase in lung cancer mortality, rising to 27% among never-smokers.¹⁴ A growing body of evidence also links air pollution to breast, colorectal, brain, bladder, and liver cancers in

adults and to brain, kidney, and bone cancers and leukemia in children living near heavy-traffic roads or industrial sites.¹⁵

Water and soil pollution represent additional carcinogenic pathways: nitrates from agricultural runoff are associated with colorectal cancer; arsenic, a Group 1 IARC carcinogen, contaminates groundwater in many low- and middle-income settings; and persistent organic pollutants including polychlorinated biphenyls and pesticide residues have been implicated in breast, liver, and hematologic malignancies.¹⁶

The Legislative Architecture of Environmental Cancer Protection

EPAs derive their cancer control relevance primarily from their mandate to regulate pollution at source and play a critical upstream role in cancer prevention by regulating environmental exposures to carcinogens, including air

pollutants, radiation, industrial chemicals, and climate-related hazards. [Table 1](#) summarizes selected environmental regulatory agencies and their potential contributions to cancer prevention through reduction of environmental carcinogenic exposures.

Collectively, these agencies illustrate varying approaches to environmental governance that have the potential to contribute to cancer control through primary prevention. However, the effectiveness of these institutions depends on adequate resourcing, regulatory authority, scientific independence, and enforcement of environmental standards. Consequently, reductions in population-level exposure to environmental carcinogens are determined not simply by the existence of an agency, but by its capacity to implement and sustain effective environmental protections.

Many sponsor holistic projects consistent with circular economy principles—including renewable energy zones and smart city initiatives—and several countries have launched regional collaborations such as the ASEAN Agreement on Transboundary Haze Pollution.

The legislative successes of robust environmental regulation are demonstrable. High-income regions with stricter air quality frameworks—notably North America and Western Europe—have seen declining PM-attributable cancer disability-adjusted life years, in stark contrast to some middle-income regions where regulatory enforcement remains weak.² The US Clean Air Act is estimated to prevent hundreds of thousands of premature deaths annually, with cancer prevention comprising a significant share—a compelling natural experiment for global advocacy.¹⁷

Climate Change as an Amplifier of Carcinogenic Exposure

While EPAs have historically focused on controlling industrial pollutants, the accelerating climate crisis presents a qualitatively new challenge. Climate change does not merely add to environmental cancer risk, it amplifies it through multiple interacting pathways while simultaneously threatening the resilience of health care systems.¹⁸ Higher temperatures accelerate atmospheric photochemical reactions involving nitrogen oxides and VOCs, leading to increased formation of secondary fine PM_{2.5} and ground-level ozone. Wildfires, increasing in frequency and severity, produce acute concentrated exposures to PM_{2.5} and hazardous air pollutants that current regulatory frameworks, designed for chronic industrial emissions, are poorly equipped to address, with smoke affecting air quality thousands of miles from fire sites.¹⁹ Flooding events mobilize soil-bound pollutants, agrochemicals, and industrial toxins, contaminating water supplies. Disruption to food chains increases reliance on potentially contaminated subsistence sources. When communities are battered by climate events, health care professionals often relocate, leaving

behind older, less mobile, and lower socioeconomic patients, further exacerbating health disparities.¹⁸

The ASCO policy statement on climate change and cancer care identifies three mediating factors worsening cancer outcomes: increased carcinogenic exposure, increased individual sensitivity, and decreased adaptive capacity, all disproportionately concentrated in marginalized and low-income populations.²⁰ This equity dimension is structural: those least responsible for historical emissions bear the greatest climate-amplified cancer risk. This will affect populations where (1) there are already barriers to health services (geographical or others); (2) climate change will affect developing countries, where the health system is already overburdened; and (3) climate change will damage the existing health infrastructure. Modeling studies demonstrate that meeting the Paris Agreement target of 1.5°C warming would prevent approximately one million premature deaths annually by 2050 through air quality improvements alone, with a substantial cancer-preventable component, particularly in lung cancer.²¹

The Oncology Community and the Path Forward

EPAs cannot fully realize their cancer prevention potential without active engagement from the oncology community. Scientific evidence from cancer epidemiology must inform regulatory processes such as the National Ambient Air Quality Standards and air quality directives, which are often contested without sufficient health-based advocacy. Oncologists, as trusted societal voices, have both an opportunity and a responsibility to influence these decisions by contributing to public consultations, environmental impact assessments, and global platforms such as IARC and the WHO.

The oncology community must be at the table and the podium when regulatory decisions affecting carcinogenic exposures are made. This means active participation in public comment periods on air quality standards, advocacy for cancer end points in environmental impact assessments, support for environmental justice frameworks, and engagement with international bodies, including IARC, the WHO, and the Intergovernmental Panel on Climate Change. We would frame this as a moral and professional obligation: as oncology health care professionals, we have a duty and a responsibility to ensure that patients' health is protected.²²

EPAs must be adequately resourced, independent, and shielded from political and industrial pressures to prevent turning the clock back on important environmental and public health regulations. For example, stringent emission-control policies have dramatically reduced transportation-related air pollution in high-income countries; for example, modern US vehicles emit approximately 99% less common air pollutants than comparable 1970 models.^{3,4,23}

This shielding from external pressures includes legally codifying scientific integrity policies at EPAs. Giving scientific-integrity policies the force of law would raise the stakes for governments and make it illegal for leaders to reverse them unilaterally. The burden of environmentally related cancers reflects a systemic failure of prevention, disproportionately

affecting vulnerable populations. Strengthening environmental regulation, enforcing emission standards, and addressing climate-related exposures are therefore not peripheral issues; they are central to cancer prevention. Ultimately, the most effective cancer control strategy is preventing exposure before disease occurs.

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