Original Research Article

Beyond Treatment: Confronting Cancer at Its Roots

Olivia I. Thompson

Athens Drive Magnet High School, 1420 Athens Dr, Raleigh, NC 27606, United States

ABSTRACT

Cancer remains one of the most complex and persistent diseases in modern medicine, claiming millions of lives each year despite remarkable advances in treatment. While therapies such as chemotherapy, radiation, surgery, and immunotherapy have improved survival and extended life for many patients, they frequently fail to provide a permanent cure and often carry substantial physical, emotional, and economic costs. Increasingly, researchers and public health experts argue that treatment alone cannot sufficiently reduce the global cancer burden. In this perspective article, I examine the growing body of literature suggesting that greater emphasis should be placed on cancer prevention by addressing environmental and lifestyle risk factors that contribute to disease development. Drawing on insights from cancer biology, epidemiology, and public health research, I explore the biological complexity that makes cancer difficult to cure, the limitations of treatment-centered approaches, and the powerful impact of prevention strategies such as smoking cessation, vaccination, and screening. Evidence from major public health interventions demonstrates that reductions in carcinogenic exposures have already prevented millions of deaths. These findings suggest that preventing cancer before it begins may offer the most effective long-term strategy for reducing human suffering and alleviating strain on healthcare systems. Ultimately, I argue that while treatment will always remain essential, shifting research priorities toward prevention, particularly through federal funding agencies such as the National Institutes of Health, could substantially reduce cancer incidence and reshape the future of cancer control.

Keywords: Cancer prevention; public health; environmental carcinogens; cancer screening; health policy; research funding

INTRODUCTION

"I have been given a diagnosis that indicates I am running out of one of life's most precious commodities, TIME." John Alexander Thompson, a devoted father, husband, and cherished friend of many, wrote these words while fully aware that treatment could extend his life for only a limited time (1).

Cancer remains among the most formidable and relentless diseases in modern medicine, often forcing patients and their families to confront not only physical suffering but the finite nature of time itself. While medical treatment can slow disease progression and extend life for some, it frequently cannot offer permanence, underscoring the limitations of treatment-centered approaches and the urgency of preventing cancer before it begins.

Leading thinkers in oncology and public health increasingly emphasize that cancer is not a single disease, but a complex collection of diseases driven by diverse genetic, environmental, and behavioral

Corresponding author: Olivia I. Thompson, E-mail: oithompson@students.wcpss.net.

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factors. Siddhartha Mukherjee, in *The Emperor of All Maladies*, characterizes cancer as an "expansionist disease," capable of adapting and evolving within the body in ways that make it extraordinarily difficult to control (2). Similarly, cancer biologist Sui Huang argues that conventional treatment strategies often overlook the complex biological dynamics of tumor evolution, sometimes unintentionally promoting tumor resistance or progression (3).

These perspectives point to a growing recognition that treatment alone cannot sufficiently address the cancer burden, making prevention an essential part of any meaningful solution. I argue that federal research funding agencies, particularly the National Institutes of Health and the National Cancer Institute (NCI), should formally shift a greater proportion of cancer research investment toward prevention. I recognize that this recommendation confronts real structural barriers, including political resistance, economic incentives favoring treatment, and institutional inertia that preserves the status quo within the research enterprise itself. Nevertheless, I contend that the epidemiological evidence makes this shift not only justified but necessary.

The evidence and policy recommendations I present in this article are grounded primarily in the United States healthcare and research context, drawing on data from the NCI, Department of Health and Human Services (HHS), and leading American public health institutions. While the biological and epidemiological principles discussed may have broader relevance, the specific funding and policy arguments are most directly applicable to the United States. Drawing on literature from cancer biology, epidemiology, and public health policy, I explore the biological complexity of cancer, the limitations of treatment-centered strategies, and the demonstrated success of prevention-focused interventions such as tobacco control, vaccination, and early screening programs. Prevention in this context encompasses both primary prevention, reducing exposure to known carcinogens before disease develops, and secondary prevention, detecting disease early through screening before it becomes advanced (4).

The Biological Complexities of Cancer

Cancer presents a unique challenge because it is not a single disease, but a broad family of diseases characterized by uncontrolled cellular growth and mutation. Mukherjee describes cancer as a disease capable of invading tissues, colonizing distant organs, and evolving through processes similar to natural selection. This evolutionary behavior allows tumors to rapidly adapt to therapeutic interventions, often developing resistance to treatments designed to eliminate them (2).

These biological challenges are real and significant. Yet they have not stopped medicine from achieving genuine breakthroughs. Immunotherapy has produced remarkable, and in some cases, potentially curative outcomes for individual patients. In advanced melanoma, for example, 82 percent of patients who responded to combination nivolumab and ipilimumab were alive at five years (5) and a real-world cohort of heavily pretreated metastatic melanoma patients treated with pembrolizumab demonstrated that 17 percent survived nearly a decade, with 84 percent disease-free at follow up (6). In hematologic malignancies, chimeric antigen receptor T-cell (CAR-T) therapy has shown potentially curative results in relapsed and refractory multiple myeloma, with one third of patients remaining progression-free five years after a single infusion (7). These are genuine and meaningful advances in the lives of individual patients.

Yet I contend that even these successes operate within the biological constraints that cancer biologist Sui Huang describes. Huang emphasizes that modern medicine frequently relies on linear cause-and-effect models when studying disease. However, cancer operates through highly interconnected biological systems in which interventions may produce both beneficial and harmful outcomes. As Huang observes, "The perceived results [sic] of treatment is the net effect of two opposing forces: on the one hand, the desired cancer-reducing effect of the therapeutic intervention and, on the other hand, tumor progression promoted by the very treatment" (3). These dynamics help explain why the search for a universal cure has remained elusive, as therapies capable of eliminating one tumor type may create conditions for more aggressive variants to emerge. Treatments such as surgery, radiation, and drug therapies can eliminate tumor cells but may also provoke inflammatory responses or selective pressures that allow resistant cells to survive and proliferate (3). Even the most advanced treatments reach patients only after the disease has already advanced (8). My concern here is not with the clinical value of these therapies, which is significant, but with the limits of treatment as a population-level solution to cancer incidence. If no therapy can reliably prevent this cascade of disease from beginning, then I believe the most rational investment of research resources lies in stopping it before it starts.

The Limitations and Costs of Treatment-Centered Approaches

The development of increasingly sophisticated therapies has produced meaningful progress, but that progress has come with profound physical, emotional, and financial costs. Patricia Ganz of the National Academy of Medicine, a respected organization of health experts, published a statement reflecting this view: "[M]ore effective treatments due to better understanding of the biology of cancer have improved survival and patient outcomes, but these advances have not come without substantial personal and economic costs to patients and their families" (9). Treatment diminishes quality of life and restricts access to care, underscoring the need for approaches that consider not only survival but also the broader human and economic burden.

These burdens are not shared equally. As noted in *Gale Global Issues*, a trusted academic database, "While advances have been made in developing new cancer medications and treatments, the newest drugs are often extremely expensive, limiting their use outside the wealthiest countries" (10). If effective cancer treatment is accessible only to the wealthiest nations, a true cure will never be within reach; cancer remains a global problem marked by unequal access and unreliable outcomes. If advanced treatment is inconsistent, inaccessible, and detrimental for countless patients, then it is necessary to confront cancer through a different strategy.

Even when treatment is accessible, its goals reveal inherent limitations. The primary aim of cancer therapy is cure; when cure cannot be achieved, treatment shifts toward managing symptoms and prolonging life (11). For many patients, "prolongation" is experienced as a finite extension rather than a solution. As Lawrence Kushi and Graham Colditz of the Harvard T.H. Chan School of Public Health conclude: "We will always need good treatments…But we can't treat our way out of this problem. To make a dent in a public health sense, we must prevent cancer" (12). Before examining the evidence for prevention, it is worth addressing the most common objections to prioritizing it.

Addressing Counterarguments

A common counterargument to prioritizing prevention suggests that not all cancers are preventable, particularly those linked to inherited genetic risk. Critics contend that because some individuals develop cancer due to genetic predisposition, these prevention-focused strategies cannot fully address the disease. However, statistical evidence indicates that genetic predisposition accounts for only approximately 10 percent of all cancer cases at most (13). While genetic risk is important to recognize, it does not explain the majority of cancer incidence (Figure 1). Moreover, genetic susceptibility does not eliminate the value of proactive approaches: individuals with inherited risk typically rely heavily on early detection and risk monitoring, demonstrating that proactive strategies remain essential even when genetics are involved.

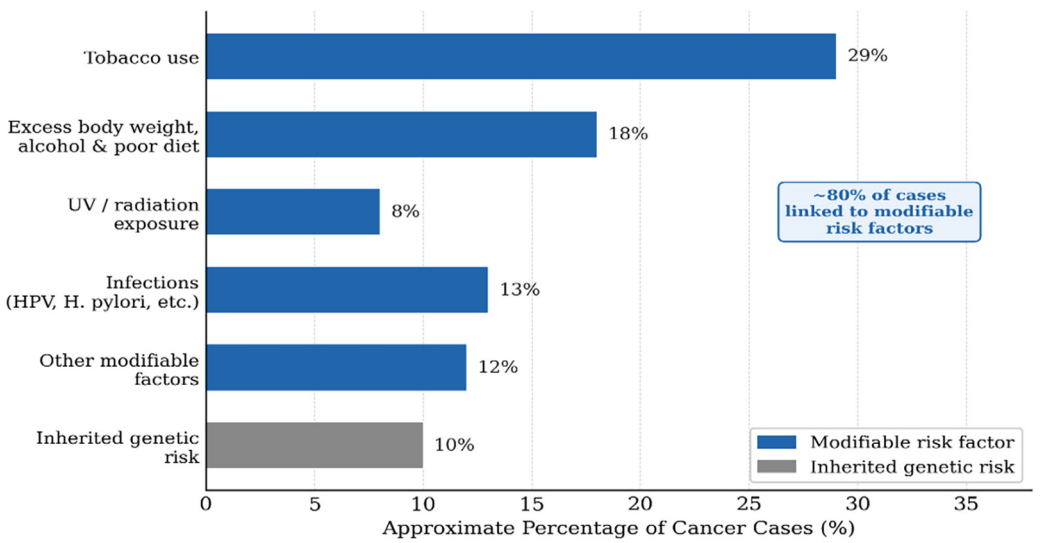

Figure 1. *Approximate percentage of global cancer cases attributed to major risk factor categories. Modifiable factors (blue) collectively account for approximately 80 percent of cases, while inherited genetic risk (gray) accounts for approximately 10 percent. Data drawn from Kushi & Colditz (12), and Mogg (13). Percentages are estimates; categories may overlap.*

A second counterargument holds that continued investment in treatment is sufficient, pointing to improvements in survival and disease management. Indeed, "Investments in basic and clinical/translational research, clinical trials, and a surge in new cancer treatments are propelling improvements in survival, and many patients are living cancer-free or managing their disease as a chronic condition" (9). It is also true that approximately 30 percent of all cancers are now routinely cured (11). These are genuine and important gains. However, the goals of treatment itself reveal their limits: when cure cannot be achieved, treatment shifts toward palliating symptoms rather than eliminating disease (11). Treatment that extends life by months falls short of that goal, and extending life does not guarantee permanent freedom from the disease. Furthermore, if only 30 percent of cancers are routinely cured after decades of intensive research investment, the case for redirecting a meaningful share of that investment to prevent the other 70 percent from arising at all becomes difficult to dismiss. As Kushi and Colditz observe, the only path toward a genuine reduction in the cancer burden is prevention (12).

I recognize that redirecting federal research priorities toward prevention is not simply a policy decision, and intellectual honesty requires acknowledging why this shift has not already occurred. The barriers are real, structural, and well-documented, and engaging with them strengthens the case for change. Political resistance represents perhaps the most persistent obstacle. Colditz and Emmons document that prevention strategies have faced not only institutional inertia but active political efforts to reduce their impact on private industries, with tobacco control at the state level receiving less than 50 percent of Centers for Disease Control and Prevention (CDC) recommended funding level despite decades of evidence supporting its effectiveness (8). When political will is captured by industries with financial stakes in maintaining the status quo, these programs are underfunded regardless of what the scientific evidence supports. This is not a reason to abandon the argument for investment; it is the reason the argument must be made more publicly.

Economic and institutional factors compound political challenges. Colditz and Emmons note that the NCI spends over $500 million per year funding its 45 comprehensive cancer centers yet does not mandate that those centers provide these evidence-based services (8). Only about half of NCI-designated cancer centers provide tobacco cessation treatment, even with evidence of its life-saving value. This represents a striking contradiction: federal dollars fund the evidence base for prevention while the same institutions receiving those dollars are not held accountable for implementing it. As they conclude, if a cancer center failed to use evidence-based chemotherapy protocols, it would not be considered competitive for NCI funding (8). The same standard, they and I argue, should apply to prevention.

Finally, the structure of public-private partnerships in cancer research further skews priorities toward treatment. Herbst and colleagues document that private entities in cancer research partnerships are driven by market forces and may prioritize investments with the greatest commercial potential rather than those with the greatest public health impact (14). Regulatory complexity, intellectual property concerns, and industry revenue factors all shape what research gets pursued and funded. I do not argue that these forces can be eliminated, but I contend that acknowledging them is essential to understanding why these efforts remain underfunded relative to their known and demonstrated population-level impact, and why a deliberate policy correction, rather than market-driven piecemeal reform, is required to close that gap. With these structural realities in mind, the case for reorientation rests not on idealism but on demonstrated evidence.

The Power of Prevention and Risk Reduction

Cancer prevention operates across three distinct levels. Primary prevention aims to stop cancer before it develops by eliminating or reducing exposure to known risk factors such as tobacco and carcinogenic agents; secondary prevention focuses on early detection through screening programs that identify disease before it becomes symptomatic or advanced; and tertiary prevention seeks to reduce the impact of established disease and prevent recurrence (4). I present evidence here drawing on primary and secondary strategies, where I believe population-level impact has been most clearly and consistently demonstrated in the research.

With these distinctions in mind, the evidence for primary and secondary prevention demonstrates that the tools to dramatically reduce cancer incidence exist and are already working. Because cancer so often develops silently before symptoms appear, the most powerful intervention is to trace the disease back to its origins, identifying and reducing exposure to carcinogenic factors that cause it. Decades of research suggest that smoking tobacco raises the risk of cancer practically everywhere in the body (13). Tobacco use is responsible for as much

as 90 percent of all lung cancer deaths (10). If that single factor were to be eliminated, millions of malignancies would never occur. Similarly, once scientists identified human papillomavirus (HPV) as the primary cause of cervical cancer, they developed a vaccine that averts infection, dramatically reducing the risk of the disease before it ever develops (9).

Statistical evidence demonstrates the scale of what is already possible. A 2020 HHS report revealed that quitting smoking for five to ten years reduces the risk of mouth, throat, or voice box cancer by half, and quitting for ten to fifteen years lowers the risk of lung cancer equally (10). According to Kushi and Colditz, "85 to 100 percent of new cases could be eliminated through smoking cessation, avoidance of ultraviolet radiation exposures, and vaccination against HPV… Such a reduction… will only come about if research priorities are changed" (12). A 2022 World Health Organization fact sheet concluded that avoidance of key risk factors and improvements in public health could prevent between 30 and 50 percent of cancer cases (10). Goddard *et al*. found that prevention and screening accounted for 80 percent of cancer deaths averted across five major cancer sites over 45 years and concluded that future efforts must continue to invest significantly in prevention and screening strategies as part of a comprehensive plan to reduce cancer mortality (15). This is precisely the reorientation of research priorities I advocate.

This is not a theoretical argument. Cancer trends from recent decades show the answer through population-level outcomes, not laboratory breakthroughs. As Mukherjee observed, "The sharp decline in lung cancer deaths in men beginning in the 1990s was not the result of a breakthrough drug or a novel therapy, but of a steady, decades-long reduction in smoking rates following public health interventions" (2). This decline illustrates that reducing exposure to known carcinogens can yield far-reaching benefits that treatment alone has not been able to replicate.

Goddard and colleagues quantified these gains precisely. A single prevention intervention, smoking cessation, eliminated 3.45 million lung cancer deaths over the past 45 years. In cervical cancer, 160,000 deaths were prevented entirely through screening and removal of precancerous lesions, not through treatment of advanced disease. In colorectal cancer, screening and removal of precancerous polyps accounted for 79 percent of lives saved, while treatment advances were responsible for the remaining 21 percent. Taken together, eight out of ten lives saved across five major cancer types over four and a half decades were due to advances in prevention and screening (15). No single therapeutic breakthrough comes close to matching these figures (Figure 2).

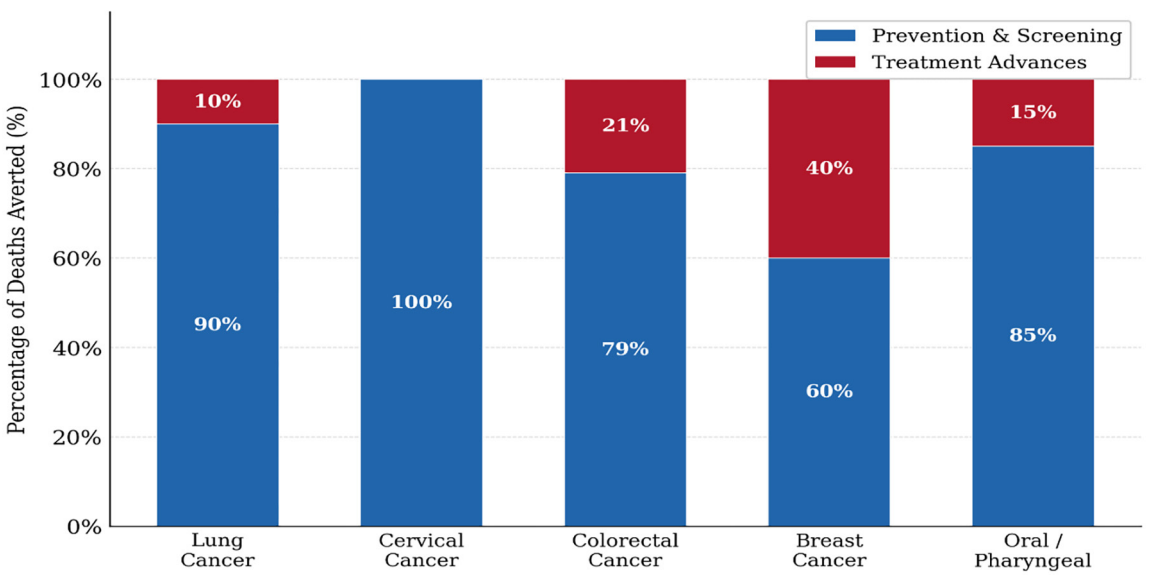

Figure 2. *Estimated contributions of prevention/screening versus treatment advances to cancer deaths averted across five major cancer types over the past 45 years. Data derived from Goddard et al. (15). Percentages represent the proportion of total averted deaths attributed to each strategy.*

The effectiveness of primary and secondary prevention strategies depends not only on their existence but on whether individuals have access to them. Structural factors, including socioeconomic circumstances, geographic location, and racial and ethnic inequities, shape whether prevention is a realistic option for any given population. Colditz and Emmons document this gap precisely: HPV vaccination rates among adolescent girls range from 24.4 percent in Mississippi to 68.0 percent in Rhode Island, with higher rates consistently found in states with higher income and education levels. Colorectal cancer screening rates vary from 55.7 percent in Arkansas to 76.3 percent in Massachusetts, and within-state variation is even more pronounced than variation between states. The CDC funds breast and cervical cancer screening programs nationally, yet those programs served only 6.5 percent of eligible women for cervical screening and 10.6 percent of those eligible for mammography in 2015. Despite current guidelines recommending chemoprevention with selective estrogen receptor modulators for high-risk women, only 16 percent of eligible women receive this intervention, representing approximately 7.8 million women who could benefit but do not (8). As Ganz observes, "While implementing more strategic prevention, screening, and early detection efforts, we must not overlook important disparities in the receipt of evidence-based care that can reduce the burden of cancer in high-risk and vulnerable populations" (9).

The consequences of this unequal access are measurable and significant. Tehranifar and colleagues analyzed over 580,000 cancer cases in the Surveillance, Epidemiology, and End Results (SEER) program and found that racial and ethnic survival disparities do not remain constant across cancer types. Instead, they widen precisely for cancers that are most amenable to early detection and treatment. For African Americans, the hazard ratio for cancer mortality relative to white patients was lower for non-amenable cancers than for mostly amenable cancers, even after adjusting for age, stage, gender, and socioeconomic status. In other words, as medicine becomes better at detecting and treating cancer, the gap between who survives and who does not grows larger along racial and socioeconomic lines. They conclude that medical advances that improve overall survival may not only fail to narrow disparities but, when combined with existing social inequalities, can actively widen them (16). I contend that this finding carries a direct implication for prevention policy: if the benefits of screening and early detection accrue disproportionately to those with greater social and economic resources, then investing in prevention without simultaneously investing in equitable access to prevention will reproduce and potentially deepen the very disparities we seek to eliminate. Any serious reorientation of federal research priorities toward prevention must therefore go beyond funding new discoveries. It must also invest in understanding why proven prevention strategies fail to reach the populations that need them most, and in building the infrastructure necessary to close that gap.

CONCLUSION

The evidence here leads to a clear conclusion. Cancer treatment has advanced dramatically over the past century, offering new hope to those facing a devastating diagnosis. However, the complexity and adaptability of cancer continue to challenge the limits of treatment-centered approaches. While therapies can extend life and sometimes achieve cures, they often arrive only after disease has already caused considerable damage, and they remain inaccessible to many patients around the world.

Evidence from cancer biology, epidemiology, and public health research suggests that prevention offers the most promising path for reducing the cancer burden in the United States and beyond. By addressing environmental exposures, promoting healthy behaviors, and expanding access to screening and vaccination programs, researchers and policymakers can reduce the number of individuals who develop cancer in the first place.

The tools already exist. The 3.45 million lung cancer deaths averted by smoking cessation alone demonstrate what is achievable when research priorities include prevention. Eight out of ten lives saved across five major cancer types over 45 years came from prevention and screening, not from new drugs. The data make the case.

Treatment will always remain an essential component of cancer care. Yet medicine cannot treat its way out of the public health crisis. A stronger emphasis on prevention, confronting cancer at its roots rather than chasing it once it has taken hold within the body, represents the most effective strategy for reducing human suffering and reshaping the future of cancer control. No one understood this more plainly than John Thompson. In the obituary he wrote for himself, he offered the most direct public health advice of all: "Wear sunscreen, because KARMA can be a B****!"

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CONFLICT OF INTEREST

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