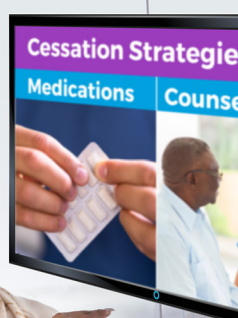**5 A's of smoking cessation**
Ask about tobacco use.
Advise tobacco user to quit.
Assess willingness to make a quit attempt.
Assist with the quit attempt.
Arrange follow-up contact care.

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NCI TOBACCO CONTROL
MONOGRAPH SERIES

23

Treating Smoking in Cancer Patients: An Essential Component of Cancer Care

Executive Summary

About the National Cancer Institute Tobacco Control Monograph Series

The National Cancer Institute established the Tobacco Control Monograph series (formerly the Smoking and Tobacco Control Monograph series) in 1991. The series provides comprehensive scientific reviews of tobacco use, treatment, and prevention topics to inform the work of researchers, clinicians, and public health practitioners working to reduce cancer morbidity and mortality. All 23 Tobacco Control Monographs and their supplemental materials can be downloaded from cancercontrol.cancer.gov/monographs.

Citation

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This monograph and its supplemental materials may be found electronically at cancercontrol.cancer.gov/monograph23 or by scanning the QR code.

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Foreword

The National Cancer Institute's (NCI's) role in tobacco control has been long, broad, and deep. The uniqueness of NCI's role is due, in part, to the National Cancer Act of 1971, which granted special authorities and responsibilities to the institute, including a determination that NCI's director be appointed directly by the President—the only institute director at the National Institutes of Health with this special status.

The recognition of the 50th anniversary of the National Cancer Act in 2021 illustrated that the dissemination mission assigned by Congress to NCI continues to be manifested in a variety of ways. In the case of tobacco control, the Tobacco Control Monograph series is one key vehicle that NCI uses to disseminate research evidence to a global audience. The monograph series leverages the scientific independence afforded by NCI's authorities with the institute's firmly established credibility throughout the international biomedical and public health communities. In an era plagued by rampant misinformation, the value of authoritative, peer-reviewed summaries of the research literature has never been higher. The rigorously transparent, data-driven, and self-corrective nature of the scientific enterprise enables both medicine and public health to evolve and adapt to ever-changing threats, but only if the latest scientific evidence is provided in a clear and actionable manner to those in a position to use it. This monograph seeks to fulfill that goal by providing clinicians with the latest knowledge concerning smoking among their patients, while providing scientists with clear descriptions of research gaps remaining to be filled.

This monograph describes a variety of research efforts conducted over a span of decades that have sought to describe, explain, and address the nature and consequences of smoking among patients with cancer. Long-standing, recalcitrant problems in medicine and public health can persist for many years until a catalyst (often in the form of a person or people) meets a special opportunity (often in the form of new funding). In the case of tobacco use among patients with cancer, the catalysts were two members of NCI's advisory boards, Karen Emmons, Ph.D., and Graham Colditz, M.D., Dr.P.H. The opportunity was the Beau Biden Cancer Moonshot[SM], a special 7-year initiative supported by the 21st Century Cures Act, which was passed by Congress in 2016. During a discussion at a meeting of the NCI advisory boards, Emmons and Colditz suggested that addressing the lack of tobacco use assessment and treatment among all patients treated for cancer at NCI-Designated Cancer Centers would be a worthy goal of the Cancer Moonshot. This author, then serving as the Director of NCI's Division of Cancer Control and Population Sciences, was charged by the then-Acting NCI Director, Douglas R. Lowy, M.D., to propose a major effort to support the enhancement and evaluation of research-based smoking cessation programs within NCI-Designated Cancer Centers. This led to NCI's funding of the Cancer Center Cessation Initiative (C3I), the largest-ever effort to evaluate and improve the quality of care for patients with cancer who use tobacco products.

Although C3I is only one of many research initiatives discussed in this monograph, its launch led to a broader revitalization of NCI's efforts concerning tobacco use among patients with cancer. This monograph is an important component of this broader set of efforts, that have included the strengthening of collaborations with other agencies and organizations; sustained support for Smokefree.gov, the federal government's primary digital health resource for tobacco cessation; and expanded support through research grants to study tobacco cessation program implementation in clinical settings.

The slow rate of progress in providing all patients with cancer with high-quality smoking cessation services is the result of a complex set of barriers at the level of the practitioner, the health care organization, the payer, and the policymaker. Both institutional and sociological barriers are discussed within the chapters that follow. However, it is clear that the lack of financial incentives (i.e., low reimbursement rates for these services) and an insufficient appreciation of the importance of smoking cessation among clinicians and their service line managers have played a role. We hope that the compilation of evidence provided by this monograph will serve as an important catalyst to action through enhancements in payment incentives, professional training, the structure of healthcare systems, and through underscoring the moral imperative of providing the highest quality cancer care to every patient. It is never too late to quit, nor is it too late for all of us to complete the task of enabling every patient with cancer to rid themselves of the most devastating carcinogen known to humanity.

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Division of Cancer Control and Population Sciences
National Cancer Institute

Introduction

Patients with cancer deserve the highest level of care from their clinicians and health care systems. As described in the 2020 Surgeon General's report, smoking cessation may result in improved all-cause mortality in patients with cancer who quit smoking. The evidence presented in the report strengthens the rationale for "aggressively promoting and supporting smoking cessation in cancer patients and survivors."[1,p.213] Unfortunately, patients with cancer who smoke do not often receive the appropriate level of care needed to adequately address their tobacco use.[2] It is important for clinicians treating patients with cancer, and for patients themselves, to realize that quitting smoking improves cancer outcomes, that it is never too late to quit smoking at any stage of the cancer care continuum, and that benefits to doing so are clear[3–5] regardless of cancer type.

This monograph builds upon the conclusions of the 2014 and 2020 Surgeon General's reports and recent research findings, including from the National Cancer Institute's (NCI) Moonshot℠ Cancer Center Cessation Initiative (C3I) program, to heighten the focus on smoking cessation in patients with cancer. The 2020 Surgeon General's report offers a powerful impetus for intervening with cancer patients who smoke. This monograph expands upon that prior work to inform clinicians and their patients with cancer about the science and practice of quitting smoking. It gives an up-to-date synthesis of evidence that clarifies the need to intervene with smoking in cancer care, informs decision-making about such intervention, identifies effective smoking cessation intervention methods, and describes how such methods can be implemented effectively in cancer care. To this end, this monograph presents evidence on:

- Smoking and the biology of cancer.
- The effectiveness of smoking cessation treatment in the general population of individuals who smoke and in cancer populations specifically.
- How smoking cessation treatments can be modified to address the special challenges and needs of individuals with cancer.
- How smoking cessation treatment can be implemented in health care contexts generally and in cancer care contexts specifically.
- The opportunities for and challenges to enhancing smoking cessation success in medically underserved and vulnerable populations with cancer who smoke.

This monograph is intended to provide a strong evidence base for treating smoking in people with cancer by helping health care systems, clinicians, health insurers, funding agencies, patients with cancer, and policymakers optimize and prioritize the treatment of smoking in cancer care. It also is intended to facilitate research by identifying important research gaps regarding the development, evaluation, and implementation of smoking cessation interventions for people with cancer who smoke.

The monograph also shows that addressing smoking cessation in the cancer care setting has the potential to yield multiple benefits, including better tolerance of cancer treatment, better cancer treatment outcomes, reduced development of second primary tumors, reduced all-cause and cancer-specific mortality, and a better quality of life.

Smoking Among Cancer Patients and Survivors

This monograph presents up-to-date information on rates of smoking and smoking cessation across the cancer care continuum, from the prevention of cancer, to screening for and treatment of cancer, through survivorship. National survey data show that current or former smoking is common among cancer patients and survivors, with the prevalence of current smoking varying by factors such as sex, age, and cancer site (Table 1).[6–9]

Table 1   Current and Former Smoking Among Adult Cancer Survivors, 2020

	Current Smoking Weighted % (95% CI)	Former Smoking Weighted % (95% CI)
Total	12.2% (10.7–13.9)	36.4% (34.4–38.4)
Sex		
Male	11.5% (9.4–14.1)	43.0% (39.7–46.3)
Female	12.4% (10.5–14.6)	30.8% (28.3–33.4)
Age		
18–44 years	21.3% (15.4–28.6)	20.0% (13.8–27.9)
45–64 years	18.0% (14.8–21.7)	27.9% (24.5–31.7)
65 years and older	7.4% (6.1–8.9)	44.0% (41.5–46.6)

Note: Estimates are weighted to the civilian, noninstitutionalized U.S. population and age-adjusted based on the age distribution of cancer patients' diagnoses in 2000 in the Surveillance, Epidemiology, and End Results Program (SEER) Registry, using the following age groups: 18–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75–84, 85 and older. Cancer survivors are defined as any person with a history of cancer, not including nonmelanoma skin cancer. Abbreviations: CI = confidence interval.
Sources: National Cancer Institute 2020,[6] National Center for Health Statistics 2020.[7]

The monograph also presents strong evidence that patients with cancer often are motivated to quit smoking following a cancer diagnosis, and many make quit attempts; however, these attempts are often unsuccessful. Using data from the 2017 National Health Interview Survey, Gritz and colleagues found that, among cancer survivors, 309 current smokers at cancer diagnosis (44.0%) reported having successfully quit smoking while 372 (56.0%) reported that they continued to smoke.[10] Similarly, a 2019 review found that although most patients with lung cancer who smoke cigarettes attempt to quit smoking after a lung cancer diagnosis, only about half succeed.[11] Failure to quit smoking is typically associated with high levels of nicotine dependence[1] but among cancer patients, factors such as depression, pain, anxiety, or cancer treatment side effects may also negatively affect both the motivation to quit and maintenance of cessation.[11]

The Consequences of Continued Smoking After a Cancer Diagnosis

Smoking at the time of a cancer diagnosis increases the risk of mortality caused by cancer and the risk of mortality due to other causes, such as heart disease, noncancer pulmonary disease, and stroke.[12] Further, smoking increases risk of second primary cancers and can increase the risk of cancer recurrence and adverse treatment-related outcomes, including postoperative pulmonary

complications, poor surgical healing, and decreased response to chemotherapeutic medications and radiation.[13]

Table 2   Findings From the 2014 and 2020 Surgeon General's Reports

Findings regarding smoking and cancer outcomes from the 2014 Surgeon General's report[12]	
In patients with cancer, the evidence is sufficient to infer a causal relationship between:	• Cigarette smoking and adverse health outcomes. Quitting smoking improves the prognosis of patients with cancer. • Cigarette smoking and increased all-cause mortality. • Cigarette smoking and increased cancer-specific mortality. • Cigarette smoking and increased risk for second primary cancers known to be caused by cigarette smoking, such as lung cancer.
In patients with cancer, the evidence is suggestive, but not sufficient, to infer a causal relationship between:	• Cigarette smoking and risk of recurrence. • Cigarette smoking and poorer response to cancer treatment. • Cigarette smoking and increased treatment-related toxicity.
Findings regarding smoking and cancer outcomes from the 2020 Surgeon General's report[1]	
The evidence is sufficient to infer that:	• Smoking cessation reduces the risk of lung cancer, laryngeal cancer, cancers of the oral cavity and pharynx, esophageal cancer, pancreatic cancer, bladder cancer, stomach cancer, colorectal cancer, liver cancer, cervical cancer, kidney cancer, and acute myeloid leukemia.
In patients with cancer, the evidence is suggestive, but not sufficient, to infer a causal relationship between:	• Smoking cessation and improved all-cause mortality in patients who are currently smoking at the time of a cancer diagnosis.

The 2014 Surgeon General's report concluded that there was sufficient evidence to infer a causal relationship between cigarette smoking and adverse health outcomes among patients with cancer and cancer survivors. However, the evidence was less clear that quitting smoking after a cancer diagnosis improved all-cause mortality rates.[12] The 2020 Surgeon General's report formally evaluated the evidence comparing all-cause mortality between patients who quit smoking versus patients who continue to smoke after diagnosis. The 2020 Surgeon General's report concluded that the evidence was suggestive, but not sufficient, to infer a causal relationship between smoking cessation and improved all-cause mortality among patients currently smoking at the time of their diagnosis.[1] The latter conclusion was based on 10 studies published between 2000 and 2016 that compared the risk of all-cause mortality among cancer patients who continued smoking after diagnosis or treatment with that of patients who quit.

Research on this topic has continued to expand. This monograph includes an additional eight studies published between 2017 and 2020 that address this topic (Table 3). Six of these studies directly compared continued smoking versus quitting smoking with regard to their association with all-cause mortality.[4,14–18] Three of these studies reported statistically significant findings consistent with a higher rate of all-cause mortality among individuals who continued to smoke in contrast to those who quit smoking.[4,15,17] The remaining studies showed trends indicative of higher risk due to continued smoking in comparison with quitting smoking. For example, Romaszko-Wojtowicz and colleagues found that patients who quit smoking lived significantly longer after their first cancer diagnosis (i.e., an average of 6.57 years) than patients who continued to smoke.[18]

Two studies compared the all-cause mortality rates of two groups of ovarian cancer patients that were defined based on their post-diagnosis smoking status, where one group had quit smoking after their cancer diagnosis and the other had continued smoking post-diagnosis. Each of these groups was compared with individuals who had never smoked or had quit smoking prior to their cancer diagnoses. Both studies[19,20] found that individuals who continued smoking after their diagnosis had significantly poorer survival rates than individuals who were never smokers or former smokers. In contrast, in both studies, individuals who had quit smoking after their cancer diagnoses had all-cause mortality rates that were similar to and not statistically different from those of individuals who had formerly or never smoked. In summary, evidence continues to mount that smoking cessation improves outcomes in patients with cancer, compared with continued smoking after a cancer diagnosis. Therefore, cessation should be a high priority for patients and their clinicians.

The documented beneficial effect of smoking cessation on all-cause mortality is becoming even more meaningful as improved treatments for some cancers, including several of the most common cancers, have resulted in increased long-term survivorship.[21] For patients with these types of cancers, continued smoking can increase overall mortality by increasing risk for cardiovascular and pulmonary disease, in addition to directly affecting cancer-specific mortality.[12]

Not only does quitting smoking improve the health outcomes of patients with cancer but it improves their quality of life as well.[22] Further, continued smoking after a cancer diagnosis results in a substantial added financial burden, which could increase cancer-related financial stress to patients and their caregivers, resulting in increased psychosocial distress, diminished patient outcomes, and poorer quality of life. Warren and colleagues estimated an annual burden of approximately $3.4 billion in added cancer treatment costs in the United States due to patients' continued smoking after a cancer diagnosis.[23]

Cancers, and tobacco-related cancers in particular, impose a high burden on individuals, families, and society. Moreover, this burden can be particularly onerous in certain patient populations, such as socioeconomically disadvantaged populations and racial and ethnic minority populations.[24] Greater knowledge of health disparities caused by tobacco can provide useful information to health care systems and clinicians about population-specific needs for cigarette smoking cessation treatment, especially among patients with cancer. This monograph reviews the challenges face by medically underserved and vulnerable populations that experience disparities in cancer outcomes related to smoking.

Table 3   **Studies That Compare All-Cause Mortality in Patients Who Quit Smoking After a Cancer Diagnosis With Patients Who Continued After Diagnosis (2017–2021)**

Study	Design/population	Follow-up period	Definition of groups	All-cause mortality findings
Barnett et al. 2020[14]	• Retrospective cohort • 369 patients with nonmetastatic cancer who were current smokers at time of diagnosis • United States	3 years	• *Quit:* Smoking cessation within 6 months of diagnosis • *Continued smoking:* No smoking cessation within 6 months of diagnosis	Adjusted RR: • Quit: 0.72 (95% CL, 0.37–1.4) • Continued smoking: 1.0 (referent)
Day et al. 2020[15]	• Prospective cohort • 117 patients with head and neck squamous cell carcinoma who were current smokers and enrolled in a tobacco treatment program • United States	Median follow-up of 5.2 years (among survivors)	• *Quit*: Abstinence (7-day point prevalence) at 9 months after tobacco treatment program enrollment • *Continued smoking*: Nonabstinence at 9 months	Adjusted HR, Stage I-II patients: • Quit: 0.15 (95% CI, 0.03–0.82) • Continued smoking: 1.0 (referent) Adjusted HR, Stage III-IV patients: • Quit: 1.51 (95% CI, 0.75–3.07) • Continued smoking: 1.0 (referent)
Gemine et al. 2019[16]	• Prospective cohort • 1,124 patients with newly diagnosed non-small cell lung cancer, including 364 patients who were current smokers at the time of diagnosis • United Kingdom	1 year	• *Quit*: Smoking cessation within 3 months of diagnosis and sustained abstinence during the follow-up period • *Continued smoking*: No smoking cessation within 3 months of diagnosis	Adjusted HR: • Quit: 0.75 (95% CI, 0.46–1.20) • Continued smoking: 1.0 (referent)
Hansen et al. 2020[19]	• Prospective cohort • 678 patients with invasive epithelial ovarian cancer, including 512 patients with postdiagnosis data available • Australia	4 years	• *Quit*: Smoking cessation after diagnosis • *Continued smoking*: No smoking cessation after diagnosis • *Never or former smoking*: Never or former smoking before and after diagnosis	Adjusted HR: • Quit: 0.99 (95% CI, 0.57–1.72) • Continued smoking: 1.90 (95% CI, 1.08–3.37) • Never or former smoking: 1.0 (referent)

Table 3 (continued)

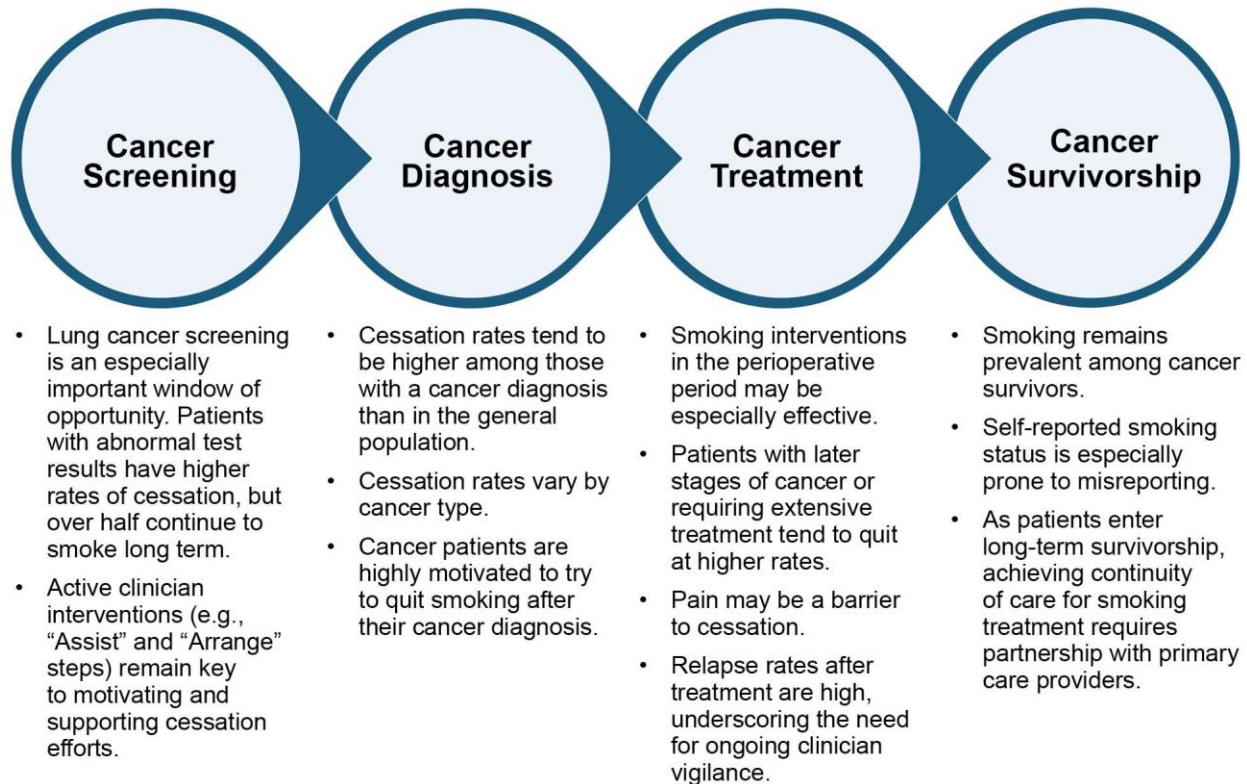| Study	Design/population	Follow-up period	Definition of groups	All-cause mortality findings
Hawari et al. 2019[17]	• Retrospective cohort • 2,387 cancer patients who were current smokers with survival data available • Jordan	2 years	• *Quit at two or more time points*: More than one visit to smoking cessation clinic and smoking abstinence at two or more follow-up points (3, 6, and 12 months) • *Quit at one time point*: More than one visit to smoking cessation clinic and abstinence at only one-follow-up point • *Continued smoking*: More than one visit to smoking cessation clinic and no abstinence recorded at any follow-up point • *No follow-up*: No visits or only one visit to smoking cessation clinic, or smoking cessation clinic visit occurred more than a year after diagnosis	Adjusted HR: • Quit at two or more time points: 1.0 (referent) • Quit at one time point: 1.3 (95% CI, 0.65–2.6) • Continued smoking: 2.7 (95% CI, 1.4–5.0) • No follow-up: 2.8 (95% CI, 1.7–4.6)
Romaszko-Wojtowicz et al. 2018[18]	• Retrospective cohort • 111 patients with multiple primary malignancies, including 108 ever-smokers • Poland	Survival assessed for eligible patients identified from 2013 to 2017	• *Quit*: Quit smoking after first cancer and before new cancer • *Continued smoking*: Continued to smoke after first cancer • *Nonsmoking*: Never-smoker or smoked fewer than 100 cigarettes in lifetime	Average survival time after first cancer: • Quit: 13.75 years • Continued smoking: 6.57 years
Sheikh et al. 2021[4]	• Prospective cohort • 517 patients with non-small cell lung cancer who were current smokers • Russia	Average 7 years	• *Quit*: Smoking cessation during follow-up period (annual follow-ups) • *Continued smoking*: No smoking cessation during follow-up	Adjusted HR: • Quit: 0.67 (95% CI, 0.53–0.83) • Continued smoking: 1.0 (referent)

Table 3 (continued)

Study	Design/population	Follow-up period	Definition of groups	All-cause mortality findings
Wang et al. 2020[20]	• Prospective cohort (NHS and NHS II) • 1,279 patients with ovarian cancer, including 1,133 patients with postdiagnosis data • United States	Median survival time of 4.5 years in NHS and 6.6 years in NHS II	• *Quit smoking*: Smoking status of current smoking before diagnosis and former smoking after diagnosis • *Continued smoking*: Smoking status of current smoking at both pre- and post-diagnosis assessments • *Former smoking*: Former smoking at both pre- and post-diagnosis assessments • *Never smoking*: Never smoking at both pre- and post-diagnosis assessments	Adjusted HR: • Quit smoking: 0.91 (95% CI, 0.62–1.35) • Continued smoking: 1.43 (95% CI, 1.11–1.86) • Former smoking: 1.19 (95% CI, 1.01–1.40) • Never smoking: 1.0 (referent)

Note. CI = confidence interval, CL = confidence limit, HR = hazard ratio, NHS = Nurses' Health Study, RR = risk ratio

Addressing Smoking Cessation in Cancer Care Settings

Quitting smoking is important for patients with all types of cancer, both those that are tobacco-related and those that are not. Smoking cessation is also important for patients across the cancer care continuum. Patients across the cancer care continuum interact with clinicians in multiple health care settings (Figure 1) and each of these clinical encounters offers the opportunity to integrate smoking cessation treatment into routine cancer care.[25]

Figure 1   Opportunities for Smoking Intervention Across the Cancer Care Continuum

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Cancer          Cancer          Cancer          Cancer
Screening       Diagnosis       Treatment       Survivorship
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- Lung cancer screening is an especially important window of opportunity. Patients with abnormal test results have higher rates of cessation, but over half continue to smoke long term.
- Active clinician interventions (e.g., "Assist" and "Arrange" steps) remain key to motivating and supporting cessation efforts.

- Cessation rates tend to be higher among those with a cancer diagnosis than in the general population.
- Cessation rates vary by cancer type.
- Cancer patients are highly motivated to try to quit smoking after their cancer diagnosis.

- Smoking interventions in the perioperative period may be especially effective.
- Patients with later stages of cancer or requiring extensive treatment tend to quit at higher rates.
- Pain may be a barrier to cessation.
- Relapse rates after treatment are high, underscoring the need for ongoing clinician vigilance.

- Smoking remains prevalent among cancer survivors.
- Self-reported smoking status is especially prone to misreporting.
- As patients enter long-term survivorship, achieving continuity of care for smoking treatment requires partnership with primary care providers.
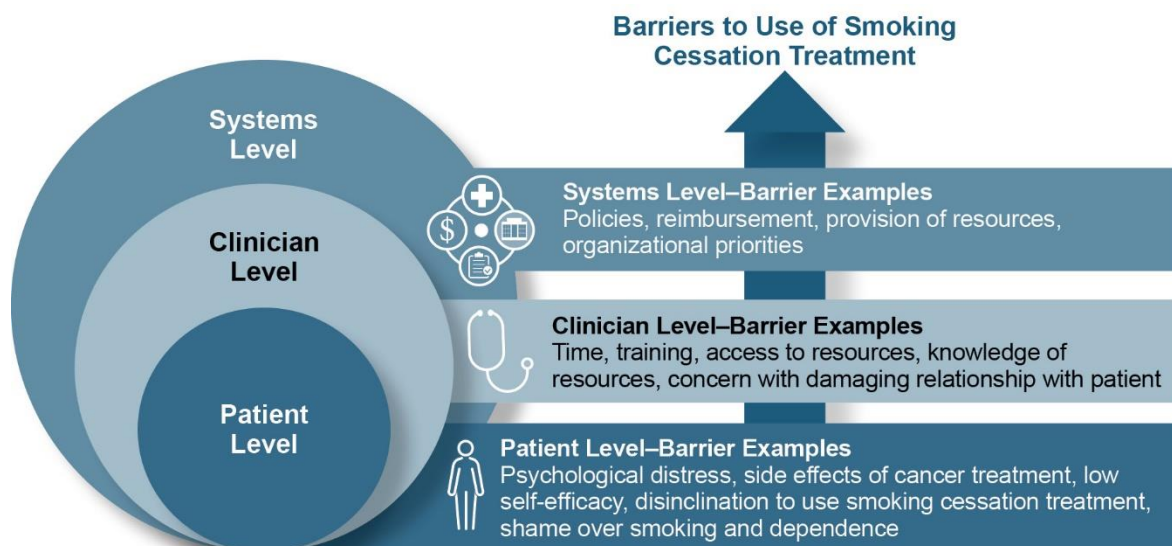
Note: Intervention to promote smoking cessation is critical across the cancer care continuum. Cancer screening, diagnosis, treatment, and survivorship are all candidate stages for "teachable moments" that hold the potential for positive behavior change. Specific challenges to smoking cessation treatment implementation may vary by stage.

At present, effective smoking cessation treatments are too rarely implemented in oncologic care,[26,27] and tobacco use is not consistently treated in cancer treatment settings.[15,28] For example, tobacco cessation programs are not consistently offered in all hospitals providing oncology services.[29] Further, fewer than 30% of oncology care clinicians report adequate training in cessation interventions.[30]

Among the factors responsible for the inadequate treatment of smoking in cancer centers are the multiple barriers at the patient, clinician, and health care systems levels.[31] Understanding barriers at each of these levels can aid health care systems in their efforts to reach, engage, and effectively treat patients with cancer who smoke (Figure 2). This knowledge can also assist health care systems in allocating resources to best meet the needs of their patient populations.

Health care systems should address barriers to clinicians' delivery of effective smoking cessation treatment to ensure patients are offered and able to access high-quality smoking cessation treatment. Clinicians can also take actions to address barriers. For instance, they can learn about available smoking cessation treatment resources and how to refer patients to them. In addition, they can help their patients address their own barriers to using cessation treatment, for example, by helping them overcome their shame and guilt over smoking.

Figure 2   Examples of Patient-, Clinician-, and Systems-Level Barriers to the Use of Smoking Cessation Treatment in Cancer Care Settings

Barriers to Use of Smoking Cessation Treatment

Systems Level

Clinician Level

Patient Level

Systems Level–Barrier Examples
Policies, reimbursement, provision of resources, organizational priorities

Clinician Level–Barrier Examples
Time, training, access to resources, knowledge of resources, concern with damaging relationship with patient

Patient Level–Barrier Examples
Psychological distress, side effects of cancer treatment, low self-efficacy, disinclination to use smoking cessation treatment, shame over smoking and dependence

Treating Cigarette Smoking in Cancer Care Settings

Effective Smoking Cessation Treatments

Importantly, many national and international cancer organizations recommend treating tobacco use among patients with cancer, including the International Association for the Study of Lung Cancer, the American Society of Clinical Oncology, the American Association for Cancer Research, and the National Comprehensive Cancer Network.[13,32–35] Consistent with these many recommendations, in a 2019 *JAMA Oncology Commentary,* Fiore and colleagues called for the designation of smoking cessation as the "Fourth Pillar of Cancer Care," joining surgery, chemotherapy/immunotherapy, and radiation therapy as an essential treatment component for patients with cancer who smoke.[36] This monograph uses evidence from cancer populations and the general population to evaluate the effectiveness of smoking cessation treatments with a goal of identifying those that might be especially effective in cancer care.

This monograph identifies multiple smoking cessation treatments that have been shown to be consistently effective in promoting smoking cessation in the general population. In particular, the combination of counseling with either varenicline or combination nicotine replacement therapy produces especially large increases in abstinence in the general population of individuals who smoke. This evidence strongly suggests that smoking cessation treatment will be effective and yield important benefits in cancer patients. However, the monograph also identifies important

gaps in the research evidence with regard to smoking interventions in cancer care. For example, while it is clear that quitting smoking can greatly benefit cancer patients, too little is currently known about which smoking cessation treatments are most effective and cost-effective in cancer patient populations and how they affect cancer outcomes, such as cancer treatment effectiveness, toxicity, and survival. Thus, there is a clear need to gather additional data on smoking cessation treatment effectiveness and outcomes in cancer patients.

Implementing Smoking Cessation Treatment Programs

This monograph describes opportunities and strategies to expand smoking cessation treatment in oncology care. These strategies include electronic health record (EHR) referral to state tobacco cessation quitlines or text-message–based interventions, such as NCI's SmokefreeTXT; use of trained tobacco treatment specialists to work collaboratively with the oncology team[37]; expanded access to cessation counseling and medications; reimbursement for smoking cessation treatment; and others.[38] The monograph also shows how NCI's C3I initiative furnishes real-world scientific evidence and examples of how to address the multilevel challenges involved in integrating smoking cessation treatment into cancer care. Below are examples of strategies to support the identification of tobacco users and the delivery of smoking cessation treatment in clinical cancer care settings.

Strategies That Support the Dissemination, Adoption, and Reach of Smoking Cessation Treatment Programs in Cancer Care Clinical Settings

- Establish an evidence-based standard of smoking cessation care across cancer clinical delivery systems that includes tobacco user identification, advice to quit, provision of or referral to evidence-based tobacco treatment, and patient follow-up.

- Measure and report the delivery of smoking cessation treatment as performance metrics for clinicians, hospitals, and health care system leadership.

- Emphasize the delivery of smoking cessation treatment as an important evaluation criterion for oncologists and cancer clinics by professional oncology organizations.

- Implement changes in health care systems, such as using electronic health record tools and other workflow adaptations that facilitate the consistent delivery of smoking cessation interventions in cancer care.

- Develop resources that enable universal implementation of smoking cessation treatment programs in cancer care settings, including strategies that:
  - Reduce clinician burden,
  - Enhance clinical workflow integration, and
  - Provide patients with easy access to multiple treatment options.

Purpose of the Monograph

This monograph is the 23rd volume in the series of monographs on tobacco control produced by the NCI of the National Institutes of Health, an agency of the U.S. Department of Health and Human Services. The goals of this tobacco control monograph are to: (1) give a brief overview

of the relationship of smoking to the biology of cancer, (2) review and evaluate the evidence that smoking cessation interventions enhance cessation rates for patients who smoke in general and for patients with cancer in particular, (3) identify health care strategies that have the potential to enhance the delivery of smoking cessation treatment in the cancer care context, (4) discuss medically underserved and vulnerable populations that typically have higher cancer burdens and face unique challenges in quitting smoking, and (5) identify important research gaps related to these topics. The monograph is intended to inform clinicians, health care systems, cancer patients who smoke, researchers, policymakers, funding agencies, community-based organizations, caregivers who support cancer patients and survivors, and other stakeholders with interests in cancer and cancer care. It is intended to present these audiences with a rigorous summary of the science regarding effective smoking cessation treatments, implementation models for those treatments, and clear research needs that can enhance cessation treatment in cancer care.

Monograph Chapters

Specifically, the monograph examines the following areas:

- **Introduction and Overview: Chapter 1** reviews the evidence that smoking by cancer patients is associated with adverse outcomes and that smoking cessation improves those outcomes.

- **Smoking in Patients With Cancer: Biological Factors: Chapter 2** provides a brief overview of the relationship of smoking to the biological aspects of cancer, including the relationship between tobacco smoke and tumorigenesis, biological characteristics of lung cancers in smokers and never-smokers, and the effects of tobacco smoke exposure on cancer cells.

- **Treating Tobacco Use and Dependence in Cancer Populations: Chapter 3** describes the evidence regarding smoking cessation treatment effectiveness. It draws from literature on the general population of people who smoke as well as studies that examine cessation among patients with cancer who smoke to identify effective counseling and medication treatments. It also reviews evidence on the specific needs of cancer patients and potential modifications of smoking cessation treatment to address such needs.

- **Implementing Smoking Cessation Treatment in Cancer Care Settings: Challenges, Strategies, Innovations, and Models of Care: Chapter 4** evaluates evidence on health care system strategies that can be used to implement smoking cessation treatments in cancer care settings, building on the extant literature, the 2020 Surgeon General's report, and published findings from C3I. Topics reviewed include extending the reach of smoking cessation treatment and enhancing its effectiveness, ease of implementation, and maintenance over time.

- **Addressing Smoking in Medically Underserved and Vulnerable Populations: Chapter 5** identifies populations that experience especially high levels of harm from both cancer and smoking. For example, some racial groups (e.g., American Indian or Alaska Native), people of lower socioeconomic status, sexual and gender minority communities, and individuals with mental health conditions and/or co-occurring substance use disorders have significantly higher rates of tobacco use. This chapter reviews evidence on smoking cessation in these populations and challenges to cessation, and considers strategies to treat members of these, and other, vulnerable populations who smoke.

- **Monograph Conclusions and Future Research Directions: Chapter 6** describes the monograph's major conclusions and the conclusions from each chapter. It also outlines key research needs to clarify the challenges and opportunities to intervening with smoking in cancer care settings.

Major Conclusions

Based on the evidence reviewed, the monograph makes the following eight overall conclusions regarding smoking cessation treatment across the cancer care continuum:

1. **Smoking cessation after the diagnosis of cancer is highly likely to reduce all-cause mortality and cancer-specific mortality.** Evidence continues to mount that quitting smoking after a cancer diagnosis is causally associated with reduced all-cause mortality and cancer-specific mortality, in comparison with continued smoking. The studies reviewed in this monograph confirm and expand upon findings of the 2014 and 2020 Surgeon General's reports regarding this topic. Laboratory studies provide insight into the mechanisms by which smoking may increase tumor aggressiveness and decrease cancer treatment effectiveness.

2. **Research from the general population indicates that patients with cancer who smoke will benefit from smoking cessation treatments, including both counseling and U.S. Food and Drug Administration (FDA)–approved medications.** Smoking cessation counseling and medication have been shown to be effective in diverse populations of people who smoke. This substantial evidence, including some studies with cancer patients, clearly supports the delivery of evidence-based smoking cessation treatment as an essential component of cancer care.

3. **Effective strategies exist to increase the delivery of smoking cessation treatment in cancer care settings.** Barriers identified by cancer care clinicians include lack of time, lack of specialized training to deliver smoking cessation treatment options, misconceptions about patients' intentions to quit, and difficulties with health insurance reimbursement. Multiple strategies, including use of EHR-based clinical workflow tools, can be adopted to address tobacco use for every patient across the cancer care continuum, including those who are screened for or diagnosed with cancer. These strategies can improve the identification of patients who smoke, the offer of smoking cessation treatment, and the delivery of or referral for smoking cessation treatment and can do so in a low-burden, efficient manner.

4. **Evidence-based smoking cessation treatment should be systematically provided to all patients with cancer, regardless of the type of cancer. However, patients with cancer are not consistently offered and provided such treatment.** Many national and international cancer organizations recommend addressing smoking among patients with cancer and provide guidance to cancer care clinicians for effectively delivering smoking cessation treatment. However, the implementation of these evidence-based recommendations has been inconsistent and incomplete, highlighting the need to identify and address barriers to providing smoking cessation intervention that exist for both cancer care clinicians and health care systems.

5. **Continued smoking after a cancer diagnosis is associated with higher health care utilization and greater health care costs in comparison with quitting smoking.** Direct

non–health care costs, such as transportation and caregiving, may also be increased with continued smoking after a cancer diagnosis. Smoking cessation interventions in patients with cancer are highly likely to be cost-effective.

6. **Medically underserved and vulnerable populations of cancer patients who smoke are very likely to benefit from using the evidence-based smoking cessation treatments identified as effective in the general population of people who smoke.** Medically underserved and vulnerable populations are faced with multiple factors at the individual, community, institutional or health care system, and societal levels that may impede access to smoking cessation treatment and cessation success. Importantly, substantial evidence indicates that medically underserved and vulnerable populations overall (i.e., noncancer populations) benefit from evidence-based smoking cessation treatment, providing evidence that these populations with cancer will benefit as well.

7. **The tobacco product marketplace and consumer use patterns are changing for both the general population and for patients with cancer, posing challenges for researchers and cancer care clinicians.** Research is needed to monitor the use and effects of diverse tobacco products, both conventional and new, by patients with cancer, including their effects on smoking cessation and relapse and their potential deterrence of patients' using evidence-based smoking cessation treatments such as counseling and FDA-approved medications.

8. **Continued research is needed to identify effective cessation interventions for patients with cancer who smoke and to better understand the effects of smoking cessation on cancer outcomes.** Relatively few well-powered randomized controlled trials of smoking cessation treatments in patients with cancer have been conducted. Additional research is needed to identify: the effectiveness of smoking cessation interventions in increasing abstinence among patients with cancer, including which intervention strategies are most effective; the effects of smoking cessation treatment and resulting abstinence on cancer-related outcomes (e.g., all-cause and cancer-specific mortality); and health care system changes and implementation strategies that are especially effective in engaging patients with cancer in evidence-based smoking cessation treatment.

Conclusion

Quitting smoking improves the likelihood of survival, quality of life, and overall health of people with cancer. The monograph affirms that all patients with cancer should have access to evidence-based smoking cessation treatment as a standard component of their care.

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