TBM

Reach and effectiveness of the NCI Cancer Moonshot-funded Cancer Center Cessation Initiative

Heather D'Angelo,[1,4] Sarah D. Hohl,[1] Betsy Rolland,[1,2] Robert T. Adsit,[3] Danielle Pauk,[1] Michael C. Fiore,[1,3] Timothy B. Baker[1,3]

[1]Carbone Cancer Center, University of Wisconsin–Madison, Madison, WI, USA

[2]Institute for Clinical and Translational Research, University of Wisconsin–Madison, Madison, WI, USA

[3]Center for Tobacco Research and Intervention, University of Wisconsin–Madison, Madison, WI, USA

[4]Present address: National Cancer Institute, Behavioral Research Program, Rockville, MD, USA

Correspondence to: H D'Angelo,
heather.dangelo@nih.gov

Abstract

Smoking cessation results in improved cancer treatment outcomes. However, the factors associated with successful implementation of cessation programs in cancer care settings are not well understood. This paper presents the reach the reach and effectiveness of cessation programs implemented in NCI-Designated Cancer Centers in the Cancer Center Cessation Initiative (C3I). An observational, cross-sectional study was conducted among C3I Cancer Centers from July 1, 2019 and December 31, 2019 (*N* = 38). Reach was calculated as the proportion of patients reporting current smoking that received cessation treatment and was analyzed overall and by organizational characteristics. Smoking abstinence rates were determined by the proportion of participants self-reporting smoking abstinence in the previous 7 and 30 days at 6 months after treatment. On average, nearly 30% of patients who smoked received any cessation treatment. In-person counseling was most implemented but reached an average of only 13.2% of patients who smoked. Although less frequently implemented, average reach was highest for counseling provided via an interactive voice response system (55.8%) and telephone-based counseling (18.7%). Reach was higher at centers with more established programs, electronic health record referral systems, and higher smoking prevalence. At 6-month follow-up, about a fifth of participants on average had not smoked in the past 7 days (21.7%) or past 30 days (18.6%). Variations in reach by organizational characteristics suggest that leadership engagement and investment in technology-facilitated programs may yield higher levels of reach. Understanding which implementation and intervention strategies facilitate greater cessation treatment reach and effectiveness could lead to improved outcomes among cancer patients who smoke.

Keywords

Smoking cessation, Cancer centers, Implementation outcomes

INTRODUCTION

Smoking before and after a cancer diagnosis is causally associated with increased risk of overall and cancer-specific mortality and is a risk factor for cancer recurrence [1]. Smoking cessation during or after cancer treatment is associated with physical benefits, including a decrease in treatment-associated side effects and greater treatment efficacy [2]. These risks and benefits highlight the importance of providing cancer patients ready access to evidence-based smoking cessation treatment, especially given

Implications

Practice: Smoking cessation programs delivered in cancer care settings can reach cancer center patients who smoke and help them quit smoking, improving cancer treatment outcomes.

Policy: Policies and resource investment at the organizational level could facilitate the integration of technology to deliver smoking cessation services to more cancer center patients.

Research: Future research should be aimed at understanding which implementation and intervention strategies facilitate greater cessation treatment reach among cancer patients who smoke.

that current smoking was reported by nearly 20% of survivors of smoking-related cancers compared with 14% of those without cancer in the 2017 National Health Interview Survey [3].

Research outside the cancer care context shows that consistent tobacco use screening and referral to smoking cessation treatment is essential for engaging patients in cessation treatment [4, 5]. However, too few cancer patients receive smoking treatment in cancer care settings, due to such factors as a lack of coordinated cessation treatment programs, clinician time constraints, inadequate clinician training in cessation counseling and pharmacotherapy [6] and limits on insurance reimbursement and covered services [7]. To address this gap in cancer care, the National Cancer Institute created the Cancer Center Cessation Initiative (C3I) [8] to create or expand evidence-based smoking cessation treatment programs [9]. To date, the program has funded three successive cohorts totaling 52 NCI-Designated Cancer Centers to fulfill these goals. The C3I program encourages system-level changes, including optimizing the use of electronic health records (EHRs) to identify and refer patients who smoke to cessation treatment [10−12].

The effectiveness of evidence-based cessation interventions has been well established in general

smoking populations [1]; however, the challenge lies in successful implementation of these interventions in cancer care [13]. Evaluation frameworks such as RE-AIM [7] provide metrics that can capture the implementation outcomes of cessation programs delivered in cancer care settings, yielding information that is critical to decisions about adopting and implementing such programs [14], and about how to change clinical workflows and EHR systems to achieve greater treatment reach and effectiveness [10]. Cancer centers may vary on the level of resources available for implementing cessation treatment [15]; therefore, implementation outcomes may also be related to differences in organizational characteristics [16]. This brief report presents data on the reach and effectiveness of cessation programs implemented in NCI-designated Cancer Centers and examines reach in association with organizational characteristics.

METHODS

An observational, cross-sectional study was conducted among 38 C3I Cancer Centers that completed data reports for the period between July 1, 2019 and December 31, 2019. The study was deemed IRB exempt and categorized as quality improvement and evaluation at the University of Wisconsin–Madison. Program leads from each funded cancer center submitted aggregate data extracted from the EHR for adults aged 18 and older. Reach was defined as the proportion of patients who smoke (past 30-day cigarette use) that received at least one type of cessation treatment (in-person counseling, telephone-based counseling, Quitline referrals, Interactive Voice Response counseling, pharmacotherapy). Reach was calculated overall, and by cessation treatment type; however, patients could have received more than one treatment type and were counted for each type they received. Each program assessed self-reported smoking status among cessation program participants 6 months after beginning smoking cessation treatment. Follow-up methods varied among centers and included program staff-initiated follow-up, EHR data extraction, or a combination of both methods. Smoking abstinence rates (7 and 30 days) at 6-month post-treatment were calculated, with patients missing follow-up data counted as currently smoking. Differences in reach by program and organizational characteristics were examined using t-tests. Organizational characteristics included length of time cessation program was established (<1 year indicated a less well-established program, ≥1 year), program use of EHR-based referrals (yes/no), program bills to insurance (yes/no), and patient smoking prevalence (<8%, ≥8%, split based on median). Descriptive statistics were calculated using StataSE 16.0.

RESULTS

On average, 28.3% of patients who smoked received at least one type of cessation treatment (Table 1). Interactive Voice Response systems to automatically identify and contact patients who smoked to provide treatment were employed at four Centers and resulted in the highest average reach (55.8%), with one Center reaching 88.7% of patients who smoked with this method. Telephone counseling (delivered by program staff) reached 18.7% of patients who smoked, on average. In-person counseling was offered at 26 Centers and reached 13.2% of patients who smoked on average. Twenty Centers reported on smoking abstinence at 6-month follow-up visits among patients who received cessation treatment. On average, at 6-month postcessation treatment, 21.7% of participants reported that they had not smoked in the past 7 days, and 18.6% reported that they had not smoked in the past 30 days.

Reach varied by organizational characteristics, although there was not sufficient power to detect statistical significance for all comparisons (Table 2).

Table 1 | Cessation program reach and effectiveness at NCI-designated cancer centers in the Cancer Center Cessation Initiative, July 1–December 31, 2019. (N = 38)

	Centers reporting (N)	Mean	Median	Min	Max
Reach, any program type[a] (%)	38	28.3	25.1	0.8	88.7
Interactive voice response (automated calls)	4	55.8	40.2	2.6	88.7
Telephone counseling(program delivered)	21	18.7	17.8	0.2	77.6
Cessation medication (prescribed or given)	24	14.4	8.9	0.9	33.0
In-person counseling (group or individual)	26	13.2	14.8	1.4	67.7
Quitline (referred by fax or EHR)	18	3.7	4.4	0.1	17.8
Effectiveness, 6-month post-treatment (%)[b]					
7-Day abstinence rate	20	21.7	13.8	0.0	60.0
30-Day abstinence rate	20	18.6	11.0	0.0	40.0

Cancer centers are the units of analysis so that means and medians reflect occurrence across the participating cancer centers.
[a]Program types are not mutually exclusive. Reach = proportion of current smokers receiving cessation treatment.
[b]Proportion of patients who have not smoked in the last 7 or 30 days at 6-month postcessation treatment. Missing responses were counted as current smoking.

Table 2 | Differences in cessation program reach by program and Cancer Center characteristics, July 1–December 31, 2019. (*N* = 38)

Organizational characteristic	Centers reporting (*N*)	Reach: patients receiving cessation treatment (%)				
		Mean	Med	Min	Max	*p*-Value
Length of time cessation counseling program established						
Less than 1 year	10	21.1	11.1	0.8	86.4	.3
One year or longer	28	30.9	25.1	3.6	88.7	
EHR-based referrals to cessation program						
None	4	9.7	9.8	4.5	14.8	‹.001
Yes, clinician-initiated or automatic	34	30.5	25.1	0.8	88.7	
Cessation program bills to insurance						
No	16	25.8	21.0	2.5	86.4	.6
Yes, for counseling, cessation medications, or both	22	30.2	21.8	0.8	88.7	
Patient smoking prevalence[a]						
Less than 8%	19	20.2	14.8	2.5	78.7	.03
8% or greater	18	38.0	32.5	0.8	88.7	

[a]One center did not report smoking prevalence.

Programs that had been established for at least one year had higher average reach than programs that were established less than a year prior to the report (30.9% vs. 21.1%, *p* = .3). Programs using EHR-based referrals, either automatic or clinician-initiated, had significantly higher reach compared with programs not referring via the EHR (30.5% vs. 9.7%, *p* < .001). Reach among programs billing to insurance for counseling or cessation medications was 30.2% on average, compared with 25.8% among programs that did not bill for these services (*p* = .6). Programs located at Centers with a patient smoking prevalence of at least 8% had significantly higher reach compared with programs where the smoking prevalence was less than 8% (38.0% vs. 20.2%, *p* = .03).

DISCUSSION

The 38 NCI-designated cancer centers receiving funding through C3I implemented a variety of evidence-based cessation interventions that attained varying levels of reach. Nearly 30% of patients who smoked were reached with at least one type of cessation treatment, on average. Counseling housed within healthcare systems, either in-person or phone-based counseling, was more commonly used than Quitline referral. Enhancing Quitline referrals might increase reach with a widely available resource that has consistently been shown to be effective [17, 18]. However, recent data show that a sizable percentage of primary care patients do not accept Quitline calls even though they have agreed to a referral [4, 5, 19]. Using a combination of outreach methods such as proactive calls and email referrals shows promise in increasing reach [20]. Although less frequently implemented, interactive voice response counseling achieved higher reach than in-person counseling. This is promising because prior studies have found that cessation counseling delivered using interactive voice response is feasible for providing cessation

support after discharge for hospitalized patients who smoked [21–24]. Telephone-based counseling delivered by program staff also achieved high levels of reach and, when used in combination with cessation medications, has been shown to be effective in supporting smoking cessation for recently diagnosed cancer patients [25].

Abstinence rates among the 20 cancer centers reporting in this study were about 20%, on average, similar to prior studies among hospitalized patients and among patients newly diagnosed with cancer [23–25]. Taken together, the average impact at those 20 Centers (reach × effectiveness) was about 6%. Continuing to increase reach by improving outreach methods and providing more options for treatment remains a critical step for helping cancer center patients quit smoking.

It is notable that some Centers reported that none of the patients had achieved smoking abstinence, and future research will examine abstinence rates in association with the types of tobacco treatment patients received. The number of counseling sessions attended by patients is an important determinant for smoking abstinence yet was unavailable in the data from the current study. A limitation is also the low reporting of abstinence rates as 18 of the Centers did not provide these data. More recently established programs may not have reached the 6-month follow-up point, and many established programs have challenges with patient follow-up due to limited resources and staffing. As cancer centers continue participation in the initiative, future analyses will include effectiveness data for more centers, and future research will address how dose and fidelity to intervention components is related to smoking abstinence.

Organizational characteristics were associated with reach. Only 4 of the 38 Centers had not implemented an EHR-based referral system and those

that had implemented such a system achieved higher reach on average compared with centers relying on other referral methods. The apparent benefits of EHR-based referral should encourage the adoption of this strategy by cancer care programs despite the significant resources and leadership engagement that are needed to enhance EHR systems and ensure their compatibility with clinical workflows [26]. Patient smoking prevalence was also associated with reach. Centers with a higher smoking prevalence reached a greater proportion of patients who smoked with treatment. Centers with fewer patients who smoke in cancer care may need to employ multiple outreach methods and options for cessation treatment to increase reach.

Not surprisingly, centers with more established programs had higher levels of reach. Implementation readiness has been associated with greater likelihood of providing tobacco treatment in cancer care settings [27]. Future research is needed to examine how centers address early-stage implementation barriers. This information could enhance implementation readiness among cancer care settings that are implementing new cessation programs. In addition, qualitative research is needed to identify specific implementation strategies employed, whether and how those strategies were adapted, and their association with reach and effectiveness. While this study captured only one 6-month time period, future research from C3I centers will also investigate the determinants of program sustainability and the maintenance of reach and effectiveness over time. Future research should also examine more organizational factors that may be important to understanding reach, such as clinician adoption rates (e.g., proportion of providers referring to a tobacco treatment service), and the size of the patient population or catchment area. The reach and effectiveness of smoking cessation delivered via telemedicine is also an important future direction.

Important limitations of this research include (i) aggregated data at the center level does not allow for an examination patient-level factors or the effect of individual or combinations of treatment types; (ii) the absence of randomized designs which prevents strong inference with regard to effectiveness; (iii) the lack of biochemical confirmation of smoking outcomes; and (iv) lack of information on the reasons for missingness at the patient level and therefore a lack of methods to address it. Another limitation is that not all patients may have been screened for tobacco use; however, average screening rates in 2019 among C3I centers were nearly 90% [28]. Further, depending on the type of tobacco treatment program offered (e.g., Quitline) it is not known whether the service was accepted or acted upon by the patient. As the C3I programs progress and increase capacity to report on patient outcomes, more data may become available. Finally, this study involved only NCI-designated cancer centers, and yet the vast majority of cancer care is delivered in community settings that may face different challenges or supports for implementing smoking cessation treatment; therefore, the results may not be generalizable to all cancer care settings.

In conclusion, the reach of cessation programs in cancer care varies by the types of programs offered and by the methods in which patients are referred to treatment. Variations in reach by organizational characteristics may indicate that high levels of leadership engagement and resource investment are needed to secure higher levels of reach. Understanding which cessation programs and implementation strategies facilitate greater cessation treatment reach and effectiveness should lead to superior cessation treatment programs and improve outcomes among cancer patients who smoke.

Compliance with Ethical Standards

Conflict of Interest: All authors declare that they have no conflicts of interest.

Human Rights: This article does not contain any studies with human participants performed by any of the authors.

Informed Consent: This study does not involve human participants and informed consent was therefore not required.

Welfare of Animals: This article does not contain any studies with animals performed by any of the authors.

Transparency Statements

1. Study registration: This study was not formally registered.
2. Analytic plan pre-registration: The analysis plan was not formally pre-registered.
3. Data availability: De-identified data from this study are not available in an a public archive. De-identified data from this study will be made available (as allowable according to institutional IRB standards) by emailing the corresponding author.
4. Analytic code availability: Analytic code used to conduct the analyses presented in this study are not available in a public archive. They may be available by emailing the corresponding author.
5. Materials availability: Materials used to conduct the study are not available in a public archive. They may be available by emailing the corresponding author.

References

1. United States Public Health Service Office of the Surgeon General National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. *Smoking Cessation: A Report of the Surgeon General.* Washington, DC: US Department of Health and Human Services; 2020.
2. Lucchiari C, Masiero M, Botturi A, Pravettoni G. Helping patients to reduce tobacco consumption in oncology: a narrative review. *SpringerPlus.* 2016; 5(1):1136. doi:10.1186/s40064-016-2798-9
3. Gritz ER, Talluri R, Fokom Domgue J, Tami-Maury I, Shete S. Smoking behaviors in survivors of smoking-related and non-smoking-related cancers. *JAMA Network Open.* 2020; 3(7): e209072. doi:10.1001/jamanetworkopen.2020.9072
4. Fiore M, Adsit R, Zehner M, et al. An electronic health record-based interoperable eReferral system to enhance smoking Quitline treatment in primary care. *J Am Med Inform Assoc.* 2019; 26(8–9): 778–786.

5. Baker TB, Berg KM, Adsit RT, et al. Closed-loop electronic referral from primary care clinics to a state tobacco cessation quitline: effects using real-world implementation training. *Am J Prev Med.* 2021; 60(3): S113–S122.

6. Rojewski AM, Bailey SR, Bernstein SL, et al. Considering systemic barriers to treating tobacco use in clinical settings in the United States. *Nicotine Tob Res.* 2019; 21(11): 1453–1461.

7. Bloom EL, Burke MV, Kotsen C, et al. Billing practices among US tobacco use treatment providers. *J Addict Med.* 2018; 12(5): 381–386.

8. Croyle RT, Morgan GD, Fiore MC. Addressing a core gap in cancer care—the NCI Moonshot Program to Help Oncology Patients Stop Smoking. *N Engl J Med.* 2019; 380(6): 512–515. doi:10.1056/NEJMp1813913

9. D'Angelo H, Rolland B, Adsit R, et al. Tobacco treatment program implementation at NCI cancer centers: progress of the NCI Cancer Moonshot-funded Cancer Center Cessation Initiative. *Cancer Prev Res (Phila)* 2019; 12(11): 735–740. doi:10.1158/1940-6207.Capr-19-0182

10. D'Angelo H, Ramsey AT, Rolland B, et al. Pragmatic application of the RE-AIM framework to evaluate the implementation of tobacco cessation programs within NCI-designated cancer centers. *Front Public Health.* 2020; 8: 221.

11. Ramsey AT, Chiu A, Baker T, et al. Care-paradigm shift promoting smoking cessation treatment among cancer center patients via a low-burden strategy, electronic health record-enabled evidence-based smoking cessation treatment. *Transl Behav Med.* 2020; 10(6): 1504–1514. doi:10.1093/tbm/ibz107

12. Jose T, Ohde JW, Hays JT, et al. Design and pilot implementation of an electronic health record-based system to automatically refer cancer patients to tobacco use treatment. *Int J Environ Res Public Health.* 2020; 17(11):4054.

13. Fiore MC, D'Angelo H, Baker T. Effective cessation treatment for patients with cancer who smoke-the fourth pillar of cancer care. *JAMA Netw Open.* 2019; 2(9): e1912264.

14. Glasgow RE, Estabrooks PE. Pragmatic applications of RE-AIM for health care initiatives in community and clinical settings. *Prev Chronic Dis.* 2018; 15: E02.

15. Salloum RG, D'Angelo H, Theis RP, et al. Mixed-methods economic evaluation of the implementation of tobacco treatment programs in National Cancer Institute-designated cancer centers. *Implement Sci Commun.* 2021; 2(1): 41.

16. Feldstein AC, Glasgow RE. A practical, robust implementation and sustainability model (PRISM) for integrating research findings into practice. *Jt Comm J Qual Patient Saf.* 2008; 34(4): 228–243.

17. Notier AE, Hager P, Brown KS, et al. Using a quitline to deliver opt-out smoking cessation for cancer patients. *JCO Oncol Pract.* 2020; 16(6): e549–e556.

18. Mustoe MM, Clark JM, Huynh TT, et al. Engagement and effectiveness of a smoking cessation quitline intervention in a thoracic surgery clinic. *JAMA Surg.* 2020; 155(9): 816–822.

19. Flocke SA, Seeholzer E, Lewis SA, et al. 12-Month evaluation of an EHR-supported staff role change for provision of tobacco cessation care in 8 primary care safety-net clinics. *J Gen Intern Med.* 2020; 35(11): 3234–3242.

20. Keller PA, Schillo BA, Kerr AN, et al. Increasing reach by offering choices: results from an innovative model for statewide services for smoking cessation. *Prev Med.* 2016; 91: 96–102.

21. Regan S, Reyen M, Lockhart AC, et al. An interactive voice response system to continue a hospital-based smoking cessation intervention after discharge. *Nicotine Tob Res.* 2011; 13(4): 255–260.

22. Nahhas GJ, Wilson D, Talbot V, et al. Feasibility of implementing a hospital-based "opt-out" tobacco-cessation service. *Nicotine Tob Res.* 2017; 19(8): 937–943.

23. Rigotti NA, Chang Y, Rosenfeld LC, et al. Interactive voice response calls to promote smoking cessation after hospital discharge: pooled analysis of two randomized clinical trials. *J Gen Intern Med.* 2017; 32(9): 1005–1013.

24. Rigotti NA, Regan S, Levy DE, et al. Sustained care intervention and postdischarge smoking cessation among hospitalized adults: a randomized clinical trial. *JAMA.* 2014; 312(7): 719–728.

25. Park ER, Perez GK, Regan S, et al. Effect of sustained smoking cessation counseling and provision of medication vs Shorter-term counseling and medication advice on smoking abstinence in patients recently diagnosed with cancer: a randomized clinical trial. *JAMA.* 2020; 324(14): 1406–1418.

26. Tong EK, Wolf T, Cooke DT, et al. The emergence of a sustainable tobacco treatment program across the cancer care continuum: a systems approach for implementation at the University of California Davis comprehensive cancer center. *Int J Environ Res Public Health.* 2020; 17(9):3241.

27. Ostroff JS, Copeland A, Borderud SP, et al. Readiness of lung cancer screening sites to deliver smoking cessation treatment: current practices, organizational priority, and perceived barriers. *Nicotine Tob Res.* 2016; 18(5): 1067–1075.

28. D'Angelo H, Webb Hooper M, Burris JL, et al. Achieving equity in the reach of smoking cessation services within the NCI cancer Moonshot-funded Cancer Center Cessation Initiative. *Health Equity.* 2021; 5(1): 424–430.