

# Evaluation of a Web-Based Training in Smoking Cessation Counseling Targeting U.S. Eye-Care Professionals

Taghrid Asfar, MD, MSPH<sup>1</sup>, David J. Lee, PhD<sup>1</sup>,  
Byron L. Lam, MD<sup>1</sup>, Ann P. Murchison, MD, MPH<sup>2</sup>,  
Eileen L. Mayro, BA<sup>2</sup>, Cynthia Owsley, PhD, MSPH<sup>3</sup>,  
Gerald McGwin, MS, PhD<sup>3</sup>, Emily W. Gower, PhD<sup>4</sup>,  
David S. Friedman, MD, MPH, PhD<sup>5</sup>, and Jinan Saaddine, MD, MPH<sup>6</sup>

## Abstract

**Background.** Smoking causes blindness-related diseases. Eye-care providers are uniquely positioned to help their patients quit smoking. **Aims.** Using a pre-/postevaluation design, this study evaluated a web-based training in smoking cessation counseling targeting eye-care providers. **Method.** The training was developed based on the 3AIR protocol: “Ask about smoking, Advise to quit, Assess willingness to quit, and Refer to tobacco quitlines,” and made available in the form of a web-based video presentation. Providers ( $n = 654$ ) at four academic centers were invited to participate. Participants completed pretraining, posttraining, and 3-month follow-up surveys. Main outcomes were self-reported improvement in their motivation, confidence, and counseling practices at 3-month follow-up. Generalized linear mixed models for two time-points (pretraining and 3-month) were conducted for these outcomes. **Results.** A total of 113 providers (54.0% males) participated in the study (17.7% response rate). At the 3-month evaluation, 9.8% of participants reported improvement in their motivation. With respect to the 3AIR, 8% reported improvement in their confidence for Ask, 15.5% for Advise, 28.6% for Assess, and 37.8% for Refer. Similarly, 25.5% reported improvement in their practices for Ask, 25.5% for Advise, 37.2% for Assess, and 39.4% for Refer to tobacco quitlines ( $p < .001$  for all except for Refer confidence  $p = .05$ ). **Discussion.** Although participation rate was low, the program effectively improved providers’ smoking cessation counseling practices. **Conclusions.** Including training in smoking cessation counseling in ophthalmology curriculums, and integrating the 3AIR protocol into the electronic medical records systems in eye-care settings, might promote smoking cessation practices in these settings.

## Keywords

eye-care providers, smoking and blindness, smoking cessation counseling, system-level change, tobacco quitlines, training program evaluation

Approximately 3.4 million Americans 40 years of age and older are visually impaired or blind (Congdon et al., 2004). Evidence indicates that smoking increases the risk of the most common sight-threatening eye diseases. *The 2004 Surgeon General’s Report* on smoking and health confirmed the causal relationship between smoking and cataract (U.S. Department of Health & Human Services, 2004). Current smokers are 3 times more likely to develop cataract than nonsmokers (Kelly, Thornton, Edwards, Sahu, & Harrison, 2005), and quitting smoking reduces the risk for developing cataract by 23% among ex-smokers (Christen et al., 2000; Weintraub et al., 2002). In the *2014 Surgeon General’s Report* (U.S. Department of Health & Human Services, 2014), the causal relationship between smoking and age-related macular degeneration

(AMD) was confirmed. Smokers are 3 to 4 times more likely to develop AMD than nonsmokers, and quitting smoking

<sup>1</sup>University of Miami, Miami, FL, USA

<sup>2</sup>Wills Eye Hospital, Philadelphia, PA, USA

<sup>3</sup>University of Alabama at Birmingham, AL, USA

<sup>4</sup>Wake Forest School of Medicine, Winston-Salem, NC, USA

<sup>5</sup>Johns Hopkins University, Baltimore, MD, USA

<sup>6</sup>Division of Diabetes Translation, Centers for Disease Control and Prevention, Atlanta, GA, USA

## Corresponding Author:

Taghrid Asfar, Department of Public Health Sciences, University of Miami Miller School of Medicine, Clinical Research Building 1120 NW 14th Street, Miami, FL 33136, USA.  
Email: [tasfar@miami.edu](mailto:tasfar@miami.edu)

reduces the risk for developing AMD by 6.7% (Neuner et al., 2009; Thornton et al., 2005). Beyond this, other conditions such as diabetic retinopathy, Graves's ophthalmopathy, glaucoma, dry-eye syndrome, and contact lens-related keratitis are other possible smoking-related ocular morbidities (odds ratio ranged from 1.4 to 2.4; Bonovas, Filioussi, Tsantes, & Peponis, 2004; Lee et al., 2002; Morgan et al., 2005; Prummel & Wiersinga, 1993; Solberg, Rosner, & Belkin, 1998).

Health care settings are an important venue for promoting smoking cessation, and health care providers are seen as a credible source of cessation advice (Fiore et al., 2008). A meta-analytic review indicated that patients who receive advice to quit smoking from health care professionals are more successful in quitting smoking (Gorin & Heck, 2004). Fear of blindness can serve as a powerful motivation for eye patients to quit smoking (Bidwell et al., 2005), offering eye-care providers a unique teachable moment to encourage their patients to quit smoking and to offer assistance (Asfar, Lam, & Lee, 2015). The U.S. Public Health Service clinical practice guidelines on tobacco use and dependence stipulate that all smokers who come in contact with the health care system receive smoking cessation intervention as an integral part of routine clinical care (Fiore et al., 2008). The guidelines recommend an evidence-based technique codified as the "5As" approach: *Ask* about tobacco use, *Advise* them to quit, *Assess* willingness to quit, *Assist* with quitting attempts, and *Arrange* for follow-up. However, some of the elements of the 5As, especially *Assist* and *Arrange*, have often proved difficult for busy clinicians to implement. Fortunately, the most accessible resource for assisting with quit attempts in clinical practice are telephone tobacco quitlines (QLs). Tobacco QLs are effective in delivering evidence-based tobacco treatment to tobacco users and have been widely disseminated in the United States (Anderson & Zhu, 2007; Stead, Perera, & Lancaster, 2007). One approach to improve the efficiency of clinician-based smoking cessation practice is to streamline the counseling process by training the clinician to: *Ask*, *Advise*, *Assess*, and *Refer* to tobacco QLs (3A1R). This strategy is also known as *Refer 2 Quit*, *Ask-Advise* and *Refer* or *Ask-Advise* and *connect* (Vidrine et al., 2013; Warner et al., 2008). Compared with the full "5As" approach, 3A1R is easier and faster for clinicians to implement, particularly in busy clinic environments such as the eye-care settings. The 3A1R has been shown to be effective in several health care settings (e.g., surgery, anesthesiology; Carpenter, Carlini, Painter, Mikko, & Stoner, 2012; Warner, 2009; Warner et al., 2008); however, it has not been evaluated in eye-care settings.

While several studies investigated eye-care providers' attitudes and behaviors in delivering smoking cessation counseling in Canada (Kennedy, Spafford, Schultz, Iley, & Zawada, 2011; Spafford, Iley, Schultz, & Kennedy, 2010), Australia (Sheck, Field, McRobbie, & Wilson, 2009), and the United Kingdom (Thompson et al., 2007), only one study has been conducted in the United States. Gordon et al. (2002)

found that few U.S. eye-care providers (16% to 30%) regularly advise patients to quit smoking in real-life clinical practice. One of the main barriers for providing smoking cessation counseling was providers' lack of training in smoking cessation counseling. Therefore, addressing this factor is important to enhance smoking cessation counseling practices among eye-care providers.

A notable training gap in smoking cessation counseling exists among eye-care providers. For example, several studies have been conducted to provide and evaluate training programs in smoking cessation counseling among number of health care providers (e.g., dentists, pharmacists, nurses); however, eye-care providers remain a relatively neglected group (Corelli et al., 2005; Gordon, Lichtenstein, Severson, & Andrews, 2006; Kennedy et al., 2014). We found only one small study conducted in the United Kingdom which evaluated the impact of an educational program on the delivery of a brief smoking cessation intervention by optometrists (Lawrenson, Roberts, & Offord, 2015). Addressing this gap, the current study aims to evaluate the impact of a 3A1R web-based training program on improving eye-care providers' motivation to deliver smoking cessation counseling, confidence in their ability to deliver the counseling, and their tobacco-related counseling and referral practices. Based on results from prior research, we anticipate that the intervention will enhance smoking cessation counseling practices among eye-care providers (Gordon et al., 2006).

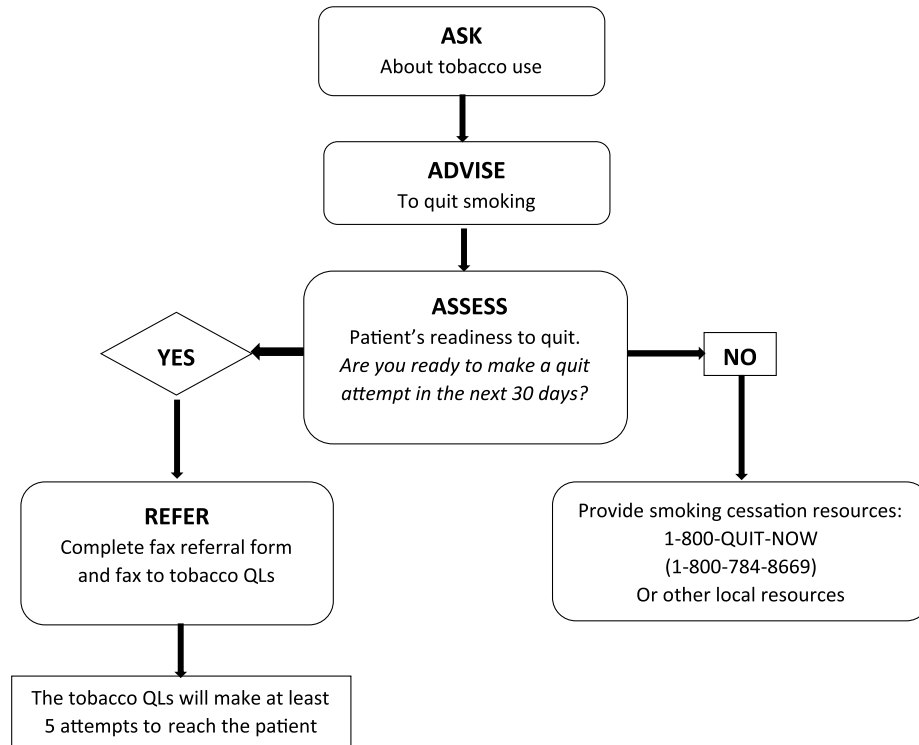
## Method

### Setting

The study was conducted at four academic institutions that comprise the Innovative Network for Sight Research (INSIGHT, 2016), a collaborative vision research network funded by the Centers for Disease Control and Prevention: Bascom Palmer Eye Institute at the University of Miami, Wilmer Eye Institute at Johns Hopkins University, Department of Ophthalmology at the University of Alabama at Birmingham, and Wills Eye Hospital in Philadelphia. All eye-care providers including ophthalmologists, optometrists, fellows, and residents in training at the four institutions were invited to participate ( $n = 654$ ). The study procedures were approved by all participating institutional review boards, and informed consent was obtained electronically (by e-mail). No participation incentives were provided.

### Developing and Implementing the Web-Based Training Program

The training program was developed by a team of experts in smoking cessation treatment and eye-care providers from the four participating institutions, with support from the Office on Smoking and Health at the CDC. The content of the training was based on the U.S. Public Health Service clinical



**Figure 1.** Smoking cessation training program flowchart based on the 3A1R: Ask about tobacco use, Advise to quit, Assess willingness to quit, and Refer to telephone tobacco quitlines (QLs).

practice guidelines on tobacco use and dependence (Fiore et al., 2008) and the 3A1R research literature (Carpenter et al., 2012; Warner, 2009; Warner et al., 2008). The training was designed to (a) briefly review existing evidence about the relationship between smoking and eye diseases; (b) emphasize the important role of eye-care providers in helping patients quit smoking; (c) discuss aspects of nicotine addiction (social, behavioral, psychological, and physical/biochemical); (d) demonstrate the “3A1R” protocol; (e) educate providers about the tobacco QLs services, in particular, the fax referral service (Figure 1); and (f) provide a list of other national and local smoking cessation resources. The training program was then made available in the form of a 30-minute video presentation integrated into the Wills Eye Knowledge Portal (2016).

### Design and Procedures

We evaluated the program using a pre-/postevaluation design. Each respective site sent a preannouncement e-mail to potential participants to announce the study. A week later, each site sent a recruitment e-mail (and up to three follow-up reminders) to all eye-care providers at the site. The e-mail introduced the study and invited eye-care providers to participate. The e-mail also included a link to participate in the study. The link provided access to the electronic consent

form followed by a 10-minute pretraining survey. At the end of the survey, participants were asked to click a link to watch the 30-minute educational video. We provided a link to complete the posttraining survey on the final screen of the training video. One week after receiving the training, we sent a follow-up reminder e-mail (up to 3 times after no response) to enroll participants who did not complete the posttraining survey. Three months following completion of the training, we contacted all participants by e-mail (up to 5 times after no response) to request completion of the final 3-month follow-up survey.

### Measures

At the baseline survey, we collected information on eye-care providers’ demographics characteristics including age, sex, race/ethnicity, and cigarette smoking history. We also collected information about providers’ institution, position, and current clinical smoking-related practices (based on the 5As approach). We used the 5As approach in our baseline assessment for three reasons: (a) the current clinical practice guidelines continue to recommend the 5As approach, (b) to be able to evaluate providers’ counseling practices based on the current clinical practice guidelines as the most recent assessment of these practices was published in 2002 (Gordon et al., 2002), and (c) using the 5As model does not prevent us from

assessing the 3As in the 3A1R protocol as they are embedded within the 5As model. Additional questions were used to evaluate providers' knowledge and use of the tobacco QLs.

We utilized a standard set of questions to assess providers' motivation, confidence, and practice to assist patients in quitting smoking (Warner, 2009). Each question had response options of *very*, *somewhat*, *not very*, and *not at all*. We assessed motivation by asking "How motivated are you to help patients stop using tobacco?" We assessed confidence in ability to deliver smoking cessation counseling "How confident are you in . . . ?" and smoking cessation counseling practices "How often do you . . . ?" with four items based on the 3A1R protocol: (a) ask patients about smoking; (b) assess patient willingness to quit; (c) advise patients to quit; and (d) refer patients to smoking cessation resources.

The motivation to and confidence in ability to deliver smoking cessation treatment were assessed at all 3 time points (pretraining, posttraining, and 3-month follow-up), while the smoking cessation practices and referral to tobacco QLs were assessed only at pretraining and at 3-month follow-up to allow time for changes in clinical practices.

### **Statistical Analysis**

We utilized a unique anonymous identifier to link baseline and follow-up records for each participant. Because the evaluation was designed to assess program impact, analyses presented here only include those who completed pretraining, posttraining, and 3-month follow-up survey instruments. We conducted a descriptive analysis on the demographic items and current smoking cessation practices at baseline. The primary outcomes were the percentage improvement in eye-care providers' motivation to and confidence in their ability to deliver smoking cessation counseling, and counseling practices with respect to the 3A1R protocol from the baseline to the 3-month follow-up. Improvement was defined as a one unit or more change in providers' response in a positive direction from *not at all* to *very* from pretraining to posttraining and from pretraining to the 3-month follow-up (improvement vs. no improvement). We used generalized linear mixed models for 3 time points (pretraining, posttraining, and 3-month) and for 2 time points (pretraining and 3-month) for these binary outcomes. The independent variable was the fixed effect of time. Because the evaluation was designed to assess program impact, analyses presented here are based on only the 91 respondents who had completed the posttraining survey and the 97 respondents who had completed the 3-month follow-up surveys. We included a random effect for subject. We adjusted the *p* values from the statistical tests to control for multiple testing by using the adaptive false detection rate (Benjamini & Hochberg, 2000). All analyses were conducted using SAS version 9.3 (SAS Institute Inc., Cary, North Carolina).

## **Results**

### **Recruitment**

Between August and October 2014, we enrolled 116 providers (17.7% response rate; 54% male). We excluded three participants from the analysis, two because they did not provide direct care to patients and one who was consented but did not complete the pretraining survey. Of the 113 participants in the pretraining survey, 80.5% completed the posttraining survey and 85.8% completed the 3-month follow-up survey and were linked successfully to their baseline assessment. The higher response rate at the 3-month follow-up compared with the posttraining evaluation could be attributable to the extra efforts we took to reach participants (i.e., sending up to five reminders compared with sending up to three reminders at the posttraining evaluation).

### **Participant Characteristics**

Half of the participants were male (54.0%), 69.0% were White, 16.8% Asian, 3.5% Black, 4.4% Hispanic, and 9.7% other (Table 1). The average age was 38 years (standard deviation, 11.8; range 24-74). Most participants were ophthalmologists (40.0%) or were residents in ophthalmology training programs (37.2%), followed by fellows (11.5%), and optometrists (8.8%). Most participants never smoked cigarettes (90.7%) and none reported being current smokers.

### **Participants' Smoking Cessation Counseling Practices at Baseline (Pretraining)**

Approximately 32% of participants reported that they did not know the percentage of their patients who smoked (Table 1). Based on the 5As protocol, 55% of the participants reported routinely asking their patients about their smoking status, 48.7% advised their patients to quit, 24% assessed patients' motivation to quit, 2.7% assisted patients in quitting, 2.7% referred patients to other smoking cessation resources, 4.4% recommended nicotine replacement therapy, and none reported arranging follow-up care to address smoking. When participants were asked about smoking-related support systems currently used in their practice, 40.4% reported not having such a system in place. Most participants (71.8%) reported that they were not familiar with tobacco QLs, and only 8% sometimes referred patients to tobacco QLs.

### **Posttraining Improvements in Participants' Motivation to and Confidence in Their Ability to Deliver Smoking Cessation Counseling**

At the posttraining evaluation, 13.5% (95% confidence interval [CI: 7.6, 22.8]; *p* < .0001) of participants reported

**Table 1.** Eye-Care Providers' Sociodemographic Characteristics and Current Smoking Cessation Counseling Practices at Baseline (N = 113).

| Sociodemographic characteristics of participants                                        | n (%)       |
|-----------------------------------------------------------------------------------------|-------------|
| Gender                                                                                  |             |
| Male                                                                                    | 61 (54.0)   |
| Female                                                                                  | 52 (46.0)   |
| Race/ethnicity                                                                          |             |
| Non-Hispanic White                                                                      | 78 (69.0)   |
| Non-Hispanic Black                                                                      | 4 (3.5)     |
| Hispanic                                                                                | 5 (4.4)     |
| Asian                                                                                   | 19 (16.8)   |
| Other                                                                                   | 11 (9.7)    |
| Institution                                                                             |             |
| Wills Eye Hospital in Philadelphia                                                      | 38 (33.6)   |
| Wilmer Eye Institute at Johns Hopkins University                                        | 28 (24.8)   |
| University of Alabama at Birmingham                                                     | 25 (22.1)   |
| University of Miami Bascom Palmer Eye Institute                                         | 22 (19.5)   |
| Position                                                                                |             |
| Ophthalmologist                                                                         | 47 (41.6)   |
| Optometrist                                                                             | 10 (8.8)    |
| Resident in training                                                                    | 42 (37.2)   |
| Fellow (clinical or research)                                                           | 13 (11.5)   |
| Number of hours involving direct patient care                                           |             |
| 1-20 Hours per week                                                                     | 14 (12.4)   |
| 21+ Hours per week                                                                      | 99 (87.6)   |
| Smoking status of eye-care providers                                                    |             |
| Never smoker                                                                            | 98 (90.7)   |
| Ever smoker                                                                             | 9 (8.3)     |
| Current smoker                                                                          | 0           |
| Mean age (years) ± SD                                                                   | 38.0 ± 11.8 |
| Providers' current knowledge and smoking cessation counseling practices                 |             |
| Providers' estimate of percentages of patient currently smoke                           |             |
| 1% to 10%                                                                               | 13 (11.5)   |
| 11% to 20%                                                                              | 38 (33.6)   |
| >20%                                                                                    | 26 (23.0)   |
| Don't know                                                                              | 36 (31.9)   |
| Providers' estimate of percentages of patient with eye disease related to smoking       |             |
| 1% to 10%                                                                               | 15 (13.3)   |
| 11% to 20%                                                                              | 14 (12.4)   |
| >20%                                                                                    | 59 (52.2)   |
| Don't know                                                                              | 25 (22.1)   |
| Providing smoking cessation counseling based on the 5As model <sup>a</sup> (very often) |             |
| Ask about smoking status                                                                | 62 (55.0)   |
| Assess patients' willingness to quit                                                    | 27 (24.0)   |
| Advise patients to quit smoking                                                         | 55 (48.7)   |
| Assist patients in quitting smoking                                                     | 3 (2.7)     |
| Arrange follow-up visits to address smoking                                             | 0           |

(continued)

**Table 1. (continued)**

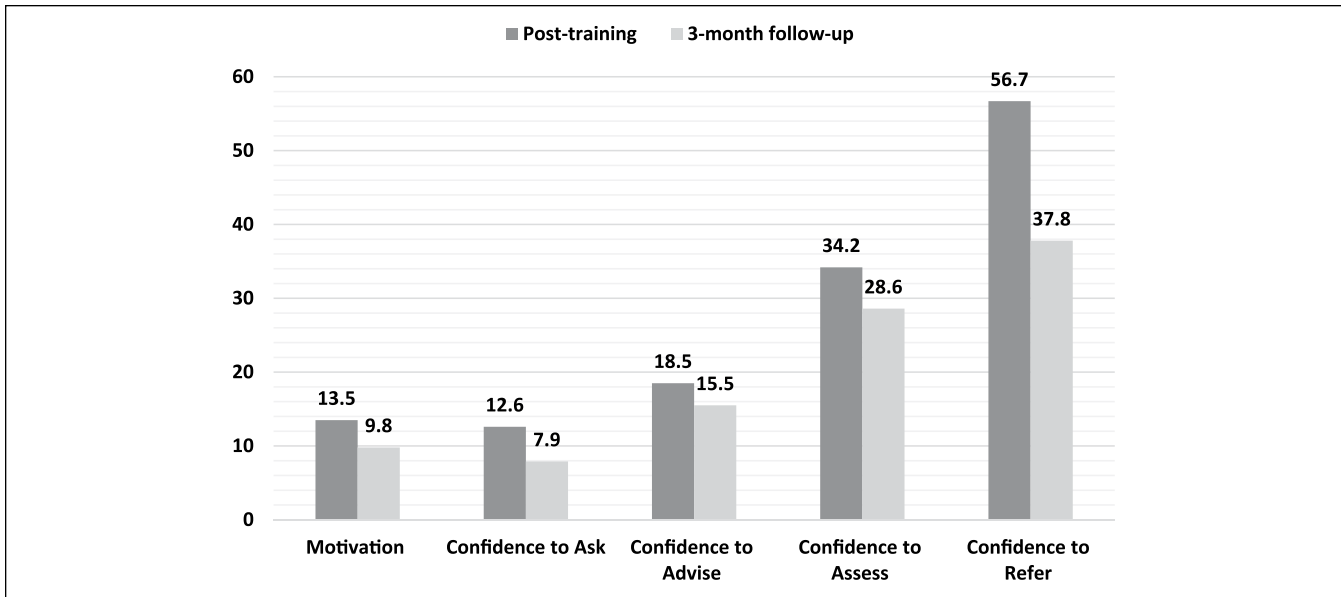
| Sociodemographic characteristics of participants             | n (%)     |
|--------------------------------------------------------------|-----------|
| Refer patients to other smoking cessation resources          | 3 (2.7)   |
| Recommend nicotine replacement therapy                       | 5 (4.4)   |
| Support systems currently used                               |           |
| Tobacco user identification system                           | 51 (45.1) |
| Provider reminder system                                     | 25 (22.1) |
| Informational poster about smoking in waiting room           | 5 (4.4)   |
| Informational handout about quitting smoking in waiting room | 6 (5.3)   |
| Electronic referral system to other resources                | 5 (4.4)   |
| Fax referral system to state tobacco quit lines              | 4 (3.5)   |
| None                                                         | 46 (40.7) |
| Experience with tobacco quitline                             |           |
| Not familiar                                                 | 80 (70.8) |
| Aware but did not refer                                      | 24 (21.2) |
| Sometimes refer                                              | 9 (8.0)   |
| Always refer patients to a quitline                          | 0         |

<sup>a</sup>5As model: Ask about tobacco use, Advise them to quit, Assess willingness to quit, Assist with quitting attempts, and Arrange for follow-up.

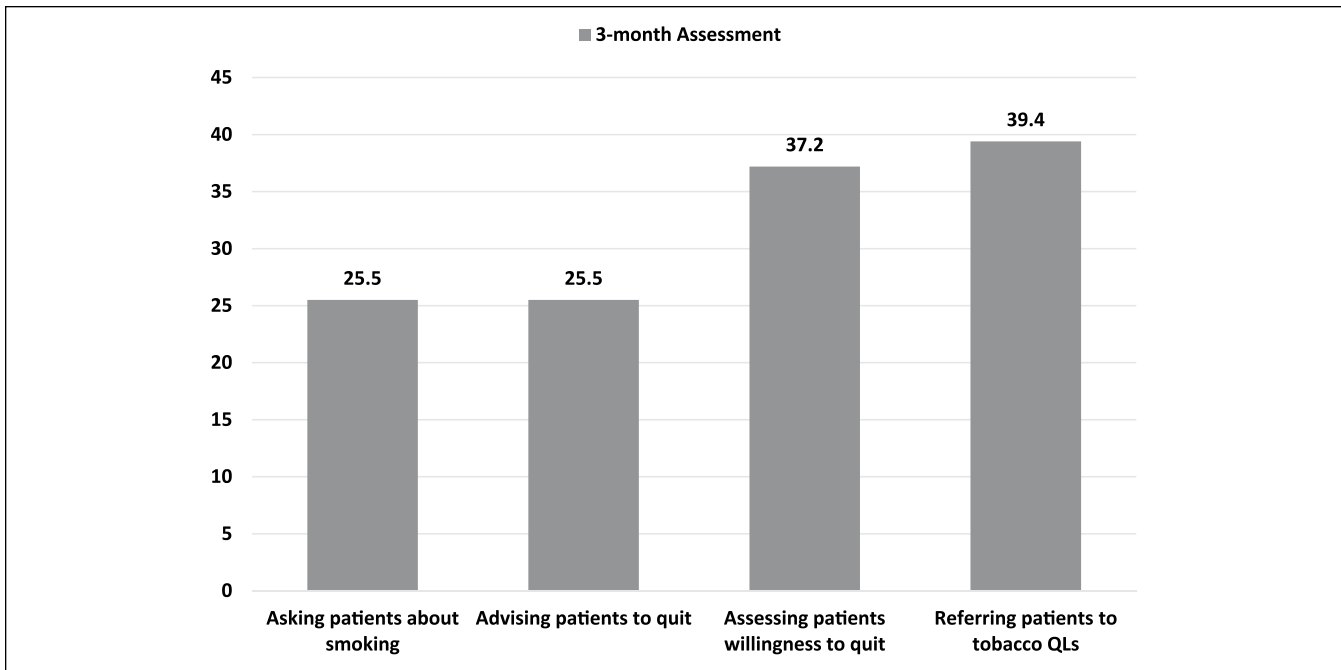
improvement in their motivation to deliver smoking cessation treatment (Figure 2). Similarly, and with respect to the 3A1R approach, 12.6% (95% CI [6.8, 22.2];  $p < .0001$ ) of participants reported improvement in their confidence for Ask; 18.5% (95% CI [11.1, 29.2];  $p < .0001$ ) for Advise; 34.2% (95% CI [24.2, 45.7];  $p = .008$ ) for Assess; and 56.7% (95% CI [44.4, 68.2];  $p = .29$ ) for Refer (Figure 2).

### *Three-Month Improvements in Participants' Motivation to and Confidence in Their Ability to Deliver Smoking Cessation Counseling, and Counseling Practices Based on the 3A1R*

Compared with the baseline assessment, 9.8% (95% CI [5.1, 18.0];  $p < .0001$ ) of participants reported improvement in their motivation to deliver smoking cessation treatment (Figure 2). Similarly, and with respect to the 3A1R approach, 8% (95% CI [3.8, 16.0];  $p < .0001$ ) of participants reported improvement in their confidence for Ask; 15.5% (95% CI [9.0, 25.3];  $p < .0001$ ) for Advise; 28.6% (95% CI [19.6, 39.6];  $p < .001$ ) for Assess; and 37.8% (95% CI [27.2, 49.7];  $p = .05$ ) for Refer (Figure 2). Finally, regarding improvement in providers' smoking cessation counseling practices; 25.5% (95% CI [16.5, 34.5];  $p < .0001$ ) reported improvement in their practices for Ask; 25.5% (95% CI [16.5, 34.5];  $p < .0001$ ) for Advise; 37.2% (95% CI [27.3, 47.2];  $p < .0001$ ) for Assess; and 39.4% (95% CI [29.3, 49.4];  $p < .0001$ ) for Refer (Figure 3).



**Figure 2.** Percentage of eye-care providers who reported improvement in their motivation to deliver tobacco treatment, and confidence to deliver each 3AIR smoking cessation element at the posttraining and 3-month follow-up evaluations after receiving the training. Note. Improvement is relative to the pretraining assessment (baseline).



**Figure 3.** Percentage of eye-care providers who reported improvement in their tobacco treatment practices for each 3AIR smoking cessation element at 3-month evaluation after receiving the training. Note. Improvement is relative to pretraining assessment (baseline). QLS = quitlines.

## Discussion

Previous research has documented the urgent need for promoting smoking cessation practices in U.S. eye-care settings (Asfar et al., 2015; Gordon et al., 2002; Hoppe, 1998). To

address this need, we developed and evaluated a brief web-based educational smoking cessation training program with 113 eye-care providers at four academic centers. Results show that implementing the training program in several institutions is feasible; however, the fact that only 17.7% of

the providers chose to participate in the study raises questions about eye-care providers' motivation to be involved in delivering smoking cessation counseling (Kennedy et al., 2011). Similar low participation rates were documented among eye-care providers in other countries such as Canada (Kennedy et al., 2014). Despite the low response rate to the training, the program had a significant positive influence on eye-care providers' motivation and confidence in ability to deliver smoking cessation counseling, and their counseling practices with respect to the 3A1R protocol, although changes from pretraining to posttraining evaluation were slightly decreased at the 3-month follow-up. Moreover, changes in practices were larger than changes in motivation and confidence. This could be explained by the fact that providers' motivation and confidence were already high at baseline which allowed for very little improvement. To our knowledge, the current study is the first to target eye-care providers in the United States. Further work is needed to conduct feasibility assessments of the project at the system level (e.g., supportability, usability, affordability, and maintainability) to enhance providers' participation in the training and prioritize and reinforce their smoking cessation counseling practices. In addition, it is important to determine the number of fax referrals made to the tobacco QIs and the actual increase in smoking cessation rates among patients. Integrating the training in the ophthalmology curriculums, in addition to implementing system-level change to integrate the 3A1R protocol into electronic medical records (EMR) systems might improve eye-care providers' competency and compliance in addressing their patients' smoking behavior (Asfar et al., 2015; Bentz et al., 2006; Gordon et al., 2006).

This study suggests that there is a potential benefit from training eye-care providers in smoking cessation counseling. Consistent with prior research among other professions (e.g., dentists, pharmacists, nurses), our results indicate that a brief web-based tobacco cessation training module is likely to have a positive impact on eye-care providers' self-reported motivation, confidence, and counseling practices for assisting patients with quitting smoking (Corelli et al., 2005; Gordon et al., 2006; Pederson, Dever, & McGrady, 2009). To date, only one pilot study has been conducted in the United Kingdom to test the impact of an educational intervention on the delivery of a brief smoking cessation intervention by optometrists (Lawrenson et al., 2015). Compared with our study, this study reported better improvements in providers' practices for Ask (51% vs. 25.5%), and Advise (33% vs. 25.5%). However, number of participants in this study was relatively smaller (36 vs. 96) and the follow-up response rate was lower (45% vs. 86%) than our study.

At baseline assessment, one third of providers were unaware of the smoking status of their patients. Of note, those who participated were a substantial minority of those who were invited. The resulting sample may therefore underestimate the proportion of providers unaware of the smoking status of their patients, given their motivation to participate

in the study. Besides, only half of our participants reported routinely asking patients about smoking and advising them to quit. Of these, less than 5% were involved in other activities (assisting in quitting or referring to other cessation services). Similarly, a U.S. study reported that only 6% of optometrists collected information from patients about smoking habits (Gordon et al., 2002). A survey of U.K. ophthalmologists also found that asking patients about smoking status was not part of routine ophthalmic practice, and that the use of brief interventions and referral to other smoking cessation resources was uncommon (Sahu, Edwards, Harrison, Thornton, & Kelly, 2008). Given the fact that tobacco use is an important modifiable risk factor for several serious eye conditions that can lead to blindness, more public health efforts are needed to promote smoking cessation practices in eye-care settings (Asfar et al., 2015).

After receiving the training, only 26% of providers reported referring their smoking patients to tobacco QIs. This could be related to the absence of resources needed to provide this service. Evidence suggests that increasing fax referrals to tobacco QIs may require organizational changes (Bentz et al., 2006). For instance, integrating smoking cessation treatment into the EMR increased the identification of smokers and provision of counseling assistance (Bentz et al., 2007; Linder, Ma, Bates, Middleton, & Stafford, 2007). Using this technology in eye-care settings could result in the integration of tobacco use treatment into the standard of care for eye patient management. EMR-assisted counseling and referral has the potential to increase guideline adherence by eye-care providers by offering a structured approach. Additionally, once the smoking cessation counseling has been integrated in the EMR, data about the delivery of and compliance with the smoking cessation protocol can be captured and stored electronically. Such information can be used for tracking outcomes and evaluating quality improvement initiatives in the future.

There are several study limitations that should be addressed. First, because the response rate was low, results are not generalizable to the larger population of eye-care providers in the United States. The self-report nature of the data is an additional limitation. However, prior research has demonstrated that real changes in practices mirrored self-reported practice behavior among health care providers (Prochaska et al., 2008). Our study did not evaluate the improvement in providers' knowledge of the impact of smoking on eye conditions because the main focus of the study was the improvement in their smoking cessation counseling delivery practices, and prior research indicated that eye-care providers are very knowledgeable about the effects of smoking on the eye (Kennedy et al., 2014). We also did not collect data on smoking cessation rates among patients. However, the fact that our intervention improved the compliance of physicians with the 3A1R is promising. A follow-up study to document evidence on change in providers' practices and to determine rates of smoking cessation among their patients is needed to further prove the efficacy of the training.

## Implications for Practice

The current study presents the first systematic attempt to promote the delivery of tobacco use treatment in eye-care settings in the United States. The study provides a potential model for implementing a shared online evidence-based tobacco educational program in multiple institutions (Hudmon, Prokhorov, & Corelli, 2006). Integrating the training program in the ophthalmology curriculums and the 3A1R smoking cessation counseling protocol into EMR systems in eye-care settings might promote smoking cessation practices in these settings.

## Authors' Note

Taghrid Asfar and David Lee were responsible for the study concept and design. Taghrid Asfar wrote the first draft of the manuscript, and all authors participated in critically revising and editing the manuscript. All authors contributed to and have approved the final manuscript. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention, the funding agency.

## Declaration of Conflicting Interests

The authors declared no potential conflicts of interests with respect to the research, authorship, and/or publication of this article.

## Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported through Centers for Disease Control and Prevention (CDC) cooperative agreements with Johns Hopkins University, University of Alabama at Birmingham, University of Miami, and Wills Eye Hospital (5U58DP002651, 5U58DP002652, 5U58DP002653, and 5U58DP002655).

## References

- Anderson, C. M., & Zhu, S.-H. (2007). Tobacco quitlines: Looking back and looking ahead. *Tobacco Control, 16*(Suppl. 1), i81-i86.
- Asfar, T., Lam, B. L., & Lee, D. J. (2015). Smoking causes blindness: Time for eye care professionals to join the fight against tobacco. *Investigative Ophthalmology & Visual Science, 56*, 1120-1121.
- Benjamini, Y., & Hochberg, Y. (2000). On the adaptive control of the false discovery rate in multiple testing with independent statistics. *Journal of Educational and Behavioral Statistics, 25*, 60-83.
- Bentz, C. J., Bayley, K. B., Bonin, K. E., Fleming, L., Hollis, J. F., Hunt, J. S., . . . Siemieniczuk, J. (2007). Provider feedback to improve 5A's tobacco cessation in primary care: A cluster randomized clinical trial. *Nicotine & Tobacco Research, 9*, 341-349.
- Bentz, C. J., Bayley, K. B., Bonin, K. E., Fleming, L., Hollis, J. F., & McAfee, T. (2006). The feasibility of connecting physician offices to a state-level tobacco quit line. *American Journal of Preventive Medicine, 30*, 31-37.
- Bidwell, G., Sahu, A., Edwards, R., Harrison, R., Thornton, J., & Kelly, S. (2005). Perceptions of blindness related to smoking: A hospital-based cross-sectional study. *Eye, 19*, 945-948.
- Bonovas, S., Filioussi, K., Tsantes, A., & Peponis, V. (2004). Epidemiological association between cigarette smoking and primary open-angle glaucoma: A meta-analysis. *Public Health, 118*, 256-261.
- Carpenter, K. M., Carlini, B. H., Painter, I., Mikko, A. T., & Stoner, S. A. (2012). Refer2Quit: Impact of Web-based skills training on tobacco interventions and quitline referrals. *Journal of Continuing Education in the Health Professions, 32*, 187-195.
- Christen, W. G., Glynn, R. J., Ajani, U. A., Schaumberg, D. A., Buring, J. E., Hennekens, C. H., & Manson, J. E. (2000). Smoking cessation and risk of age-related cataract in men. *Journal of the American Medical Association, 284*, 713-716.
- Congdon, N., O'Colmain, B., Klaver, C., Klein, R., Muñoz, B., Friedman, D. S., . . . Mitchell, P. (2004). Causes and prevalence of visual impairment among adults in the United States. *Archives of Ophthalmology (Chicago, Ill.: 1960), 122*, 477-485.
- Corelli, R. L., Kroon, L. A., Chung, E. P., Sakamoto, L. M., Gundersen, B., Fenlon, C. M., & Hudmon, K. S. (2005). Statewide evaluation of a tobacco cessation curriculum for pharmacy students. *Preventive Medicine, 40*, 888-895.
- Fiore, M. C., Jaén, C. R., Baker, T. B., Bailey, W. C., Benowitz, N. L., Curry, S. J., . . . Wewers, M. E. (Eds.). (2008). *Treating tobacco use and dependence: 2008 Update: Clinical Practice Guideline*. Rockville, MD: U.S. Department of Health & Human Services.
- Gordon, J. S., Andrews, J. A., Lichtenstein, E., Severson, H. H., Akers, L., & Williams, C. (2002). Ophthalmologists' and optometrists' attitudes and behaviours regarding tobacco cessation intervention. *Tobacco Control, 11*(1), 84-85.
- Gordon, J. S., Lichtenstein, E., Severson, H. H., & Andrews, J. A. (2006). Tobacco cessation in dental settings: Research findings and future directions. *Drug and Alcohol Review, 25*, 27-37.
- Gorin, S. S., & Heck, J. E. (2004). Meta-analysis of the efficacy of tobacco counseling by health care providers. *Cancer Epidemiology, Biomarkers & Prevention, 13*, 2012-2022.
- Hoppe, E. (1998). A model curriculum for teaching optometry students about smoking cessation education. *Optometric Education, 24*, 12-26.
- Hudmon, K. S., Prokhorov, A. V., & Corelli, R. L. (2006). Tobacco cessation counseling: Pharmacists' opinions and practices. *Patient Education & Counseling, 61*, 152-160.
- INSIGHT. (2016). Retrieved from [https://www.cdc.gov/visionhealth/projects/extramural\\_research.htm](https://www.cdc.gov/visionhealth/projects/extramural_research.htm)
- Kelly, S. P., Thornton, J., Edwards, R., Sahu, A., & Harrison, R. (2005). Smoking and cataract: Review of causal association. *Journal of Cataract & Refractive Surgery, 31*, 2395-2404.
- Kennedy, R. D., Spafford, M. M., Douglas, O., Brûlé, J., Hammond, D., Fong, G. T., . . . Schultz, A. S. (2014). Patient tobacco use in optometric practice: A Canada-wide study. *Optometry and Vision Science, 91*, 769-777.
- Kennedy, R. D., Spafford, M. M., Schultz, A. S., Iley, M. D., & Zawada, V. (2011). Smoking cessation referrals in optometric practice: A Canadian pilot study. *Optometry and Vision Science, 88*, 766-771.
- Lawrenson, J., Roberts, C., & Offord, L. (2015). A pilot study of the feasibility of delivering a brief smoking cessation



- intervention in community optometric practice. *Public Health*, 129, 149-151.
- Lee, A., Lee, J., Saw, S., Gazzard, G., Koh, D., Widjaja, D., & Tan, D. (2002). Prevalence and risk factors associated with dry eye symptoms: A population based study in Indonesia. *British Journal of Ophthalmology*, 86, 1347-1351.
- Linder, J. A., Ma, J., Bates, D. W., Middleton, B., & Stafford, R. S. (2007). Electronic health record use and the quality of ambulatory care in the United States. *Archives of Internal Medicine*, 167, 1400-1405.
- Morgan, P. B., Efron, N., Brennan, N. A., Hill, E. A., Raynor, M. K., & Tullo, A. B. (2005). Risk factors for the development of corneal infiltrative events associated with contact lens wear. *Investigative Ophthalmology & Visual Science*, 46, 3136-3143.
- Neuner, B., Wellmann, J., Dasch, B., Dietzel, M., Farwick, A., Stoll, M., . . . Hense, H.-W. (2009). LOC387715, smoking and their prognostic impact on visual functional status in age-related macular degeneration: The Muenster Aging and Retina Study (MARS) cohort. *Ophthalmic Epidemiology*, 15, 148-154.
- Pederson, L. L., Dever, A., & McGrady, G. (2009). A web-based smoking cessation and prevention curriculum for medical students: Why, how, what, and what next. *Drug and Alcohol Review*, 25, 39-47.
- Prochaska, J. J., Fromont, S. C., Leek, D., Hudmon, K. S., Louie, A. K., Jacobs, M. H., & Hall, S. M. (2008). Evaluation of an evidence-based tobacco treatment curriculum for psychiatry residency training programs. *Academic Psychiatry*, 32, 484-492.
- Prummel, M. F., & Wiersinga, W. M. (1993). Smoking and risk of Graves' disease. *Journal of the American Medical Association*, 269, 479-482.
- Sahu, A., Edwards, R., Harrison, R., Thornton, J., & Kelly, S. (2008). Attitudes and behaviour of ophthalmologists to smoking cessation. *Eye*, 22, 246-250.
- Sheck, L. H., Field, A. P., McRobbie, H., & Wilson, G. A. (2009). Helping patients to quit smoking in the busy optometric practice. *Clinical and Experimental Optometry*, 92, 75-77.
- Solberg, Y., Rosner, M., & Belkin, M. (1998). The association between cigarette smoking and ocular diseases. *Survey of Ophthalmology*, 42, 535-547.
- Spafford, M. M., Iley, M. D., Schultz, O. A. S., & Kennedy, R. D. (2010). Tobacco dependence education in optometry: A Canadian pilot study assessing practices and opportunities. *Strategies*, 39, 44.
- Stead, L. F., Perera, R., & Lancaster, T. (2007). A systematic review of interventions for smokers who contact quitlines. *Tobacco Control*, 16(Suppl. 1), i3-i8. doi:10.1136/tc.2006.019737
- Thompson, C., Harrison, R., Wilkinson, S., Scott-Samuel, A., Hemmerdinger, C., & Kelly, S. (2007). Attitudes of community optometrists to smoking cessation: An untapped opportunity overlooked? *Ophthalmic & Physiological Optics*, 27, 389-393.
- Thornton, J., Edwards, R., Mitchell, P., Harrison, R. A., Buchan, I., & Kelly, S. P. (2005). Smoking and age-related macular degeneration: A review of association. *Eye*, 19, 935-944. doi:10.1038/sj.eye.6701978
- U.S. Department of Health & Human Services. (2004). *The health consequences of smoking: A report of the Surgeon General*. Atlanta, GA: Author.
- U.S. Department of Health & Human Services. (2014). *The health consequences of smoking—50 Years of progress: A report of the Surgeon General*. Atlanta, GA: Author.
- Vidrine, J. I., Shete, S., Cao, Y., Greisinger, A., Harmonson, P., Sharp, B., . . . Wetter, D. W. (2013). Ask-Advise-Connect: A new approach to smoking treatment delivery in health care settings. *JAMA Internal Medicine*, 173, 458-464.
- Warner, D. O. (2009). Feasibility of tobacco interventions in anesthesiology practices: A pilot study. *Journal of the American Society of Anesthesiologists*, 110, 1223-1228.
- Warner, D. O., Klesges, R. C., Dale, L. C., Offord, K. P., Schroeder, D. R., Vickers, K. S., & Hathaway, J. C. (2008). Telephone quitlines to help surgical patients quit smoking: Patient and provider attitudes. *American Journal of Preventive Medicine*, 35(6), S486-S493.
- Weintraub, J. M., Willett, W. C., Rosner, B., Colditz, G. A., Seddon, J. M., & Hankinson, S. E. (2002). Smoking cessation and risk of cataract extraction among US women and men. *American Journal of Epidemiology*, 155, 72-79.
- Wills Eye Knowledge Portal. (2016). Retrieved from <http://www.willseyeonline.org/>