Online tobacco websites and online communities—who uses them and do users quit smoking? The quit-primo and national dental practice-based research network Hi-Quit studies

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Abstract

Online tobacco cessation communities are beneficial but underused. Our study examined whether, among smokers participating in a web-assisted tobacco intervention (Decide2quit.org), specific characteristics were associated with navigating to BecomeAnEx.org, an online cessation community, and with subsequent quit rates. Among smokers ($N=759$) registered with Decide2quit.org, we identified visitors to BecomeAnEx.org, examining associations between smoker characteristics and likelihood of visiting. We then tested for associations between visits and 6-month cessation (point prevalence). We also tested for an interaction between use of other online support-seeking (Decide2quit.org tobacco cessation coaches), visiting, and 6-month cessation. One quarter (26.0 %; $n=197$) of the smokers visited BecomeAnEx.org; less than one tenth (7.5 %; $n=57$) registered to participate in the online forum. Visitors were more likely to be female (73.0 vs. 62.6 % of non-visitors, $P<0.01$) to have visited a cessation website before (33.0 vs. 17.4 %, $P<0.01$) and to report quit attempts in the previous year (62.0 vs. 53.0 %, $P=0.03$). In analyses of all participants, BecomeAnEx.org visiting was not associated with 6-month quit completion. Among participants who communicated with a coach, BecomeAnEx.org visiting also lacked a significant association with 6 month quit completion, although a non-significant trend toward quit completion in visitors was noted (OR 2.21, 95 % CI 0.81–3.1). Online cessation communities attract smokers with previous cessation website experience and recent quit attempts. Community visiting was not associated with quit rates in our study, but low use may have limited our power to detect differences. Further research should explore whether an additive effect can be achieved by offering community visitors support via online coaches.

Implications

Practice: Medical and behavioral practitioners who refer smokers to web-assisted tobacco interventions (WATIs) should be aware that cessation online communities (reachable through WATI links) may hold particular appeal for women aged 55 and older, for smokers with recent quit attempts, and for smokers who have prior experience with online cessation websites.

Policy: Investment in developing WATIs with links to online communities should address methods for appealing to broader audiences (e.g., those contemplating a first quit attempt and those considering online engagement in cessation activities for the first time.)

Research: Further research is needed to explore the impact of providing cessation community visitors with additional support via online coaches.

Keywords

Internet, Smoking cessation, Social network, Social support, Health services research, Online behavior change systems

INTRODUCTION

Smoking is a major preventable cause of morbidity and mortality in the USA, with over 480,000 deaths per year attributable to tobacco use [1]. In 2012, over \$133 billion was spent on direct medical care of adults for tobacco-related conditions [1]. Identifying effective and innovative approaches to smoking cessation is a top healthcare priority [2].

Adults of all ages are turning increasingly to online social networks for health information and support [3, 4]. Online social networks and online communities can promote and propagate public health interventions via several mechanisms [5–11]. Peer-to-peer communication can enable information exchange, provision of social support (emotional and instrumental), and establishment of group norms [12]. National guidelines have highlighted the utility of smoking cessation interventions that offer person-to-person contact and provide social support [13]. However, evidence on the effectiveness of online communities for tobacco cessation is limited. Lower-than-anticipated use has prevented these communities from realizing their full potential [14, 15]. Online communities in tobacco cessation are often included as an adjunct to a complex intervention [14], which has made it difficult to determine their individual effects [8].

Identifying the differences between users and non-users of these communities may be valuable as we refine recruitment and engagement strategies. Prior studies exploring online communities have only been able to analyze registrants [16] and cannot provide a denominator reflecting the total number of smokers invited to join. In Decide2quit.org, our web-assisted tobacco intervention (WATI) [17–21], shown in Appendix A, we offered smokers an opportunity to participate in the BecomeAnEx.org tobacco cessation online community. Smokers were provided a link to navigate directly to BecomeAnEx.org from our WATI. Our study had two important goals. We gathered data on smokers who chose not to visit the BecomeAnEx.org website and on those who visited, either by clicking on the link (allowing for viewing of entries but no posts) or by registering (allowing for viewing and posting). We then examined whether there was an association between navigation to BecomeAnEx.org and 6-month smoking cessation. Because these smokers also had the opportunity to engage asynchronously with a certified tobacco treatment coach, and access interactive information about quitting smoking, we tested for an interaction between use of coaches, use of BecomeAnEx.org, and 6-month cessation.

METHODS

Study design, setting, and sample

We conducted a prospective cohort study of 759 smokers participating in Decide2quit.org [18–21], a WATI containing tobacco cessation tools. Smokers were recruited June 2010–March 2012. Smoker recruitment was conducted through medical and dental practice patient referrals as well as through Google ads [19, 21]. Primary care medical practices were recruited from a registered database of internal medicine and family/general practitioners. Dental practices were recruited from state lists of registered dentists and through the Dental Practice-Based Research Network

[22]. At these practices, we implemented an e-referral program that allowed providers to recruit smokers to Decide2Quit.org at the point-of-care by entering their email addresses into an online form [19, 20]. When e-referred, smokers were sent up to 10 email messages encouraging registration over an 8 week period or until the patient registered. To recruit smokers through Google advertisements, three ads were posted on Google AdWords [23]. Advertisements were linked to searches for keywords related to smoking (e.g., smoking, quit smoking, stop smoking, quit, quit smoking tips, and quit smoking programs) and included a link that took participants directly to the Decide2Quit.org home page where they could choose to register as new participants. Of the 759 smokers recruited, 489 (64.4 %) were medical practice referrals, 121 (15.9 %) were dental practice referrals, and 149 (19.6 %) were respondents to Google ads.

To participate on Decide2Quit.org, all smokers completed an online consent and registered on the website. Each smoker had access to Decide2quit.org for 6 months. Our study was approved by the Institutional Review Boards of the University of Alabama at Birmingham and the University of Massachusetts Medical School.

The intervention: access to BecomeAnEx.org from Decide2Quit.org

The Decide2Quit.org WATI was designed to support cessation induction and maintenance [18, 19]. Functions available on the Decide2Quit.org homepage (Appendix A) included online educational content accessed via a top navigation bar and divided into the following five categories: Family Tools (how to get help from family), Healthcare Provider Tools (how to include your healthcare provider in quit plans), The Library (cessation articles), My Health Risks (information on smoking risks/symptoms), and Thinking About Quitting (motivational recommendations, interactive calculators). The Decide2Quit.org homepage visually displayed the top navigation bar with tools described above; in addition, the page highlighted three main functions. These were (a) a motivational, pushed-email messaging system tailored to readiness to quit; (b) secure asynchronous messaging with a certified tobacco cessation coach (described further below); and (c) a column entitled “Your Online Community” with a link to BecomeAnEx.org, a free smoking cessation website.

Within this third column, BecomeAnEx was introduced to Decide2quit website visitors as follows: “Decide2quit partnered with BecomeAnEx—an online community of people helping others quit.” From this column, smokers were able to read the beginning of several posts from the BecomeAnEx.org community, with a link following each post allowing access to the BecomeAnEx.org website, bringing smokers directly to a view of the online community. BecomeAnEx

averaged 64,178 unique visitors per month between March 2008 and March 2010 and provides practical counseling, medication information, and social support [16, 24]. Those who visit BecomeAnEx.org receive social support by reading blogs written by other smokers; those who register can additionally participate in an online social community by posting messages.

Role of trained tobacco cessation coaches

Smokers were able to select from three trained coaches. When smokers registered, they were presented with the counseling philosophies of the three coaches and were allowed to choose one. Participants were given the option to send a message at the time of registration or proceed to the website and send a message at a later time. The coach logged into the administrative portal daily to view any messages they had received. Each message on the administrative portal listed the assigned coach. The coach would then read the message and reply. Messages were typically replied to by the coach within a 48-h window.

Each coach created their philosophies from personal experiences and from what they learned during training. Each coach participated in a week-long accredited Tobacco Treatment Specialist Training. Content included Bio/Psycho/Social determinants of nicotine dependence, pharmacotherapy, counseling theory and practice, including motivational interviewing Techniques, treatment strategies, and program and system issues. When replying to messages, coaches used motivational interviewing techniques and knowledge about the best ways to assist people in quitting smoking.

Data collection

All smokers completed an online consent and then completed an online survey during registration on the Decide2quit.org website.

Patient characteristics

We collected baseline information including demographics (sex, age, race, education, Internet usage) as well as smoking status, whether smoking is allowed in the respondent's home, quit history, and readiness to quit. For smoking in the home, respondents were asked "Do you allow smoking in your home" (yes/no). Quit history was assessed as follows: "During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?" (yes/no). Readiness to quit was assessed by asking patients to indicate which of the following five statements best described them: "I am not thinking about quitting," "I am thinking of quitting," "I have set a quit date," "I have already quit," or "I quit today." For analyses, those not thinking of quitting (<5 % of sample) were combined with those thinking of quitting; also, the latter two

categories were combined to represent those actively quitting or maintaining cessation, yielding three categories (Table 1). Baseline variables (collected on every smoker) were used as independent variables when testing for an association between patient characteristics and use of BecomeAnEx.org.

Use of online tobacco cessation tools

Logins and online activity were tracked through web page scripts. For each smoker, we collected longitudinal information over a 6-month period on use of the Decide2Quit.org website, engagement with trained tobacco coaches, and engagement with BecomeAnEx.org. We identified Decide2quit.org users who navigated from Decide2quit.org to BecomeAnEx.org and classified them as "visitors." These included "lurkers" (smokers who clicked on the hyperlink to BecomeAnEx.org allowing them the ability to read online discussions, but not to post), and "registrants" (smokers who clicked on the hyperlink to BecomeAnEx.org and registered with the site, allowing for both reading and posting on the online social network). Smokers who did not navigate to Decide2quit.org were classified as "non-visitors." We used variables representing BecomeAnEx.org visit status as dependent variables when testing for an association between patient characteristics and use of this online social network. BecomeAnEx.org visit status was then treated as an independent variable when we examined association of online community engagement and 6-month cessation.

We captured limited information on BecomeAnEx site engagement including site registration (as detailed above) and number of visits to the site by registered users. We were not able to track the number of visits to the site by lurkers (those who did not register). To estimate exposure, we created a continuous measure representing the number of visits to BecomeAnEx. Non-visitors were considered to have visited zero times; lurkers were considered to have visited once, those who registered but never returned to the site were assigned a "2." Subsequent returns were tracked (for instance, a registrant who returned once to BecomeAnEx.org would be assigned a "3," a registrant returning twice would be assigned a "4," etc.).

Six-month smoking cessation

To assess smoking cessation, we conducted a 6-month follow-up survey, with 6 months calculated from the time of first login into Decide2Quit.org. Participants were emailed up to five times and given the option of completing the survey online. Those not completing surveys online received a follow-up telephone survey. Given the challenges in attaining high rates of follow-up for Internet-based tobacco interventions [25–28], we worked to maximize the number of participants reached. Participants received calls twice a week until they were reached once or until the call limit (twenty)

was reached. Up to (but no more than) five voice mails were left.

Surveys confirmed general demographic characteristics and assessed 6-month smoking behavior (point prevalence) as follows: did you smoke any cigarettes during the past 30 days (yes or no)?

We conducted analyses incorporating this 6-month cessation variable according to published guidelines drawn from the tobacco cessation literature [29–31]. We used variables representing 6-month cessation status as dependent variables when testing for an association between use of BecomeAnEx.org and cessation and also when testing for an interaction between the impacts of BecomeAnEx.org use and coach engagement on 6-month cessation.

Statistical methods

We analyzed bivariate associations between patient characteristics and level of engagement in BecomeAnEx.org using Pearson χ^2 tests. We compared non-visitors to visitors and also (within the group of visitors) compared lurkers to registrants. We then performed multivariable modeling (logistic regression) using BecomeAnEx.org use as a binary dependent variable (non-visitors vs. visitors), adjusting for variables found through bivariate analyses to be significantly associated with BecomeAnEx.org engagement level or to demonstrate a trend toward association ($p \leq 0.2$). Variables included in this analysis were sex, age, education, readiness to quit, visited a smoking cessation website before and quit attempt in previous 12 months.

We conducted a descriptive analysis examining use of Decide2quit online tools by smokers at each level of BecomeAnEx use (non-visitor, lurker, registrant). We calculated the percentage of smokers at each level using the tool. We also created a summary score representing the cumulative number of times online tools were used. We also conducted a descriptive analysis examining use of BecomeAnEx.org tools by registered smokers.

We calculated the percentage of BecomeAnEx.org non-visitors, lurkers, and registrants who completed 6-month follow-up surveys. Among smokers for whom data were available at 6 months, we measured percentage of those in each of these three groups who reported having quit.

We then performed multivariable modeling (logistic regression) using BecomeAnEx.org use as a binary independent variable (non-visitors vs. visitors), with 6-month smoking cessation as our outcome (quit: yes/no). We analyzed this outcome using the best available guidelines within the nicotine and tobacco research community [29–31]. These guidelines provide appropriate techniques for addressing loss to follow-up in smoking cessation interventions. Applicable analytic approaches in these situations include logistic regression analyses limited to complete cases and logistic regression analyses in which smokers lost to follow-up are

assumed to have been unsuccessful in their quit efforts (i.e., any participant not completing a 6-month survey would be considered a smoker at the completion of the study). However, for studies with loss to follow-up greater than 10–20 %, experts recommend a third approach: using selection models to examine the robustness of findings [29]. Since this recommendation applied to our study, we also implemented a selection model using inverse probability weighting to determine the potential effect of missing data. First, based on covariates available within the dataset, we developed a logistic regression model to predict loss to follow-up. Then, we calculated the inverse probability of completing 6-month follow-up surveys and repeated the main analysis weighting by this probability.

In all these models, we adjusted first for socio-demographic characteristics judged to be clinically relevant and for smoker-reported readiness to quit (expressed as a binary variable including those in the precontemplation or contemplation phases vs. all others). We then added those variables found through bivariate analyses to be significantly associated with BecomeAnEx.org engagement level or to demonstrate a trend toward association ($P \leq 0.2$). We then adjusted for use of components of the tobacco cessation website (Decide2quit.org) by including the summary score described above. Finally, in an exploratory model examining the impact of exposure (number of site visits by registered BecomeAnEx users) on cessation, we included our measure of exposure in place of the non-visitor/visitor binary variable.

Using the three multivariable approaches described above, using BecomeAnEx.org use as a binary independent variable (non-visitors vs. visitors) and using 6-month smoking cessation as our outcome (quit smoking: yes/no), we tested for an interaction between use of a trained tobacco cessation coach (yes/no) and use of BecomeAnEx.org.

RESULTS

One quarter (26.0 %) of all smokers ($n=759$) who used Decide2quit.org also visited BecomeAnEx.org. Of all 759 smokers, 7.5 % ($n=57$) clicked on the link and then registered and 18.4 % ($n=140$) lurked, i.e., clicked on the link without subsequently registering (see Table 1). Compared to smokers who did not visit BecomeAnEx.org, visitors were more likely to be female (73.0 % of those who visited were female vs. 62.6 % of non-visitors, $P < 0.01$) and older (34.5 % were aged ≥ 55 years vs. 27.9 %; $P = 0.03$). Visitors were more likely to have visited a smoking cessation website before (33.0 % of visitors vs. 17.4 % of non-visitors, $P < 0.01$) and to report quit attempts in the previous year (62.0 vs. 53.0 %, $P = 0.03$). These relationships remained significant on multivariable analysis (Table 2).

In our comparison of lurkers to registrants, neither sex nor age was significantly different between groups

Table 1 | Smokers who accessed a web-assisted tobacco intervention (Decide2quit.org): baseline characteristics of those who visited an online cessation community (BecomeAnEx.org) compared to those who did not visit and characteristics of subgroups among those who visited

	Decide2quit users who did not visit BecomeAnEx.org N (%)	Decide2quit users who visited BecomeAnEx.org N (%)	P value	Decide2quit users who visited BecomeAnEx.org		P value
				Lurkers ^a N (%)	Registrants ^a N (%)	
Total	562 (74.0)	197 (26.0)		140 (71.1)	57 (28.9)	
Sex						
Men	210 (37.4)	53 (26.9)	<i>P</i> 0.01	39 (27.9)	14 (24.6)	<i>P</i> 0.64
Women	352 (62.6)	144 (73.0)		101 (72.1)	43 (75.4)	
Patient age						
19–34	129 (23.0)	29 (14.7)	<i>P</i> 0.03	22 (15.7)	7 (12.3)	<i>P</i> 0.44
35–54	276 (49.1)	100 (50.8)		67 (47.9)	33 (57.9)	
55+	157 (27.9)	68 (34.5)		51 (36.4)	17 (29.8)	
Patient race						
White	484 (86.1)	168 (85.3)	<i>P</i> 0.77	121 (86.4)	47 (82.5)	<i>P</i> 0.48
Non-white	78 (13.9)	29 (14.7)		19 (13.6)	10 (17.5)	
Patient education ^b						
≤High school diploma	360 (64.9)	138 (70.4)	<i>P</i> 0.16	96 (68.6)	42 (75.0)	<i>P</i> 0.37
>High school diploma	195 (35.1)	58 (29.6)		44 (31.4)	14 (25.0)	
Used online social networks before						
No	254 (45.2)	79 (40.1)	<i>P</i> 0.22	62 (44.3)	17 (29.8)	<i>P</i> 0.06
Yes	308 (54.8)	118 (59.9)		78 (55.7)	40 (70.2)	
Readiness to quit ^c						
Smokers considering quitting	410 (73.0)	136 (69.0)	<i>P</i> 0.35	102 (72.9)	34 (59.7)	<i>P</i> 0.16
Smokers with a quit date	71 (12.6)	24 (12.2)		16 (11.4)	8 (14.0)	
Smokers actively quitting or maintaining cessation	81 (14.4)	37 (18.8)		22 (15.7)	15 (26.3)	
Smoking allowed in home						
No	324 (57.7)	106 (53.8)	<i>P</i> 0.35	68 (48.6)	38 (66.7)	<i>P</i> 0.02
Yes	238 (42.4)	91 (46.2)		72 (51.4)	19 (33.3)	
No. of cigarettes per day						
0	22 (3.9)	5 (2.5)	<i>P</i> 0.61	2 (1.4)	3 (5.3)	<i>P</i> 0.36
1–10	149 (26.5)	50 (25.4)		39 (27.9)	11 (19.3)	
11–20	282 (50.2)	95 (48.2)		68 (48.6)	27 (47.4)	
21–40	102 (18.2)	45 (22.8)		30 (21.4)	15 (26.3)	
40+	7 (1.1)	2 (1.0)		1 (0.7)	1 (1.8)	

Visited smoking cessation website before					
No	464 (82.6)	132 (67.0)	100 (71.4)	32 (56.1)	$P=0.04$
Yes	98 (17.4)	65 (33.0)	40 (28.6)	25 (43.9)	
Quit attempt in previous 12 months					
No	264 (47.0)	75 (38.1)	56 (40.0)	19 (33.3)	$P=0.38$
Yes	298 (53.0)	122 (62.0)	84 (60.0)	38 (66.7)	

^a "Lurkers" are smokers who clicked on the hyperlink to BecomeAnEx.org allowing them the ability to read online discussions but not to post; "Registrants" are smokers who clicked on the hyperlink to BecomeAnEx.org and registered with the site, allowing for both reading and posting on the online community

^b Information on educational level was missing for 8 smokers (7 non-visitors and 1 registered visitor to BecomeAnEx.org)

^c Readiness to quit was assessed by asking patients to indicate which of the following 5 statements best described them: "I am not thinking about quitting," "I am thinking about quitting," "I have set a quit date," "I have already quit," or "I quit today." Less than 5 % of the overall sample responded that they were not thinking of quitting; for this reason (and because they were visiting a cessation website), this group was combined with those thinking of quitting. Additionally, the latter two categories were combined to represent those actively quitting or maintaining cessation, yielding 3 categories: (1) smokers considering quitting, (2) smokers with a quit date set, (3) smokers actively quitting or maintaining cessation

(Table 1). Registrants were significantly more likely to have visited smoking cessation websites in the past (43.9 % of registrants vs. 28.6 % of lurkers; $P=0.04$) and less likely to have homes where smoking was allowed (33.3 % of registrants vs. 51.4 % of lurkers; $P=0.02$). Registrants demonstrated a non-significant trend toward greater likelihood of prior use of online social networks (70.2 % of registrants vs. 55.7 % of lurkers, $P=0.06$). Visitors to the BecomeAnEx.org website reported greater use of other online resources. As shown in Fig. 1, among smokers accessing Decide 2 Quit, BecomeAnEx.org visitors were more likely to take advantage of the opportunity to exchange asynchronous electronic messages with trained coaches (communication with a coach was exhibited by 68.4 % of registrants, 46.4 % lurkers, and 28.8 % of non-visitors) and overall tended toward greater engagement in other online cessation tools on the Decide 2 quit website.

Examining exposure, we found that, among the 57 who registered, 12.3 % ($n=7$) did not return after registration, and an additional 71.9 % ($n=41$) returned only 1–2 more times, yielding an overall low rate of documented exposure. We were not able to capture exposure among lurkers.

Among BecomeAnEx.org registrants, 80.7 % clicked on the link entitled "community" from which blogs can be read and 50.9 % viewed at least one blog; registrants viewed a median of four blog posts (IQR 1–9.5). Tracking data suggest that few smokers posted to the website.

Of the 386 smokers who responded to the 6-month follow-up survey, successful smoking cessation was reported by 24.3 % of non-visitors (65/267 respondents), 23.8 % of lurkers (19/80 respondents), and 28.2 % of registrants (11/39 respondents). Non-visitors were disproportionately represented among those lost to follow-up at 6 months (Appendix B). Therefore, a model assigning those missing follow-up to the status of "still smoking" would have different levels of assignment across groups, a bias that was judged to be misleading and therefore results are not presented. In multivariable logistic regression analyses with selection modeling, users of BecomeAnEx.org were no more likely than non-users to report having quit at 6 months (OR 1.02, CI 0.62, 1.68) (Table 3). For our exploratory model, when we included our continuous measure of exposure among registrants (in place of the binary visitor/non-visitor variable), we found visit frequency was not associated with likelihood of cessation (OR 0.99, CI 0.79, 1.25 for each incremental increase in visit frequency). In addition, we conducted multivariable logistic regression analyses as described above but without use of selection modeling (i.e., not assigning weights); no appreciable difference in odds ratios was found (results not shown).

We found a marginal interaction ($P=0.06$) between use of trained tobacco treatment coaches and likelihood of having used BecomeAnEx.org. Thus, we stratified our analysis by coach use. In analyses limited to those who exchanged messages with a coach ($N=150$),

Table 2 | Smokers who accessed a web-assisted tobacco intervention (Decide2quit.org): characteristics associated with navigation from Decide2Quit.org to an online tobacco cessation community (BecomeAnEx.org) ($n=751$)

Odds ratio (95 % confidence interval)	
Sex	
Men	REF
Women	1.60 (1.11–2.31)
Age	
19–34	REF
35–54	1.71 (1.07–2.75)
55+	2.07 (1.25–3.44)
Education	
>High school diploma	REF
≤High school diploma	0.86 (0.60–1.24)
Readiness to quit	
Smokers considering quitting	REF
Smokers with a quit date	0.94 (0.56–1.58)
Smokers actively quitting or maintaining cessation	0.99 (0.62–1.60)
Visited smoking cessation website before	
Yes	2.19 (1.48–3.23)
No	REF
Quit attempt in previous 12 months	
Yes	1.44 (1.01–2.04)
No	REF

visitors to BecomeAnEx.org tended toward greater likelihood of tobacco cessation at 6 months compared to non-visitors (OR 2.21, CI 0.81, 3.1). Smokers who did not communicate with a coach ($N=236$) did not appear to benefit from BecomeAnEx.org visits (OR for 6-month cessation among visitors compared to non-visitors: 0.69; 95 % CI 0.3, 1.58). Neither of these results was statistically significant.

DISCUSSION

Among the 759 smokers recruited to Decide2quit.org, one quarter used the link on our Intervention website to visit BecomeAnEx.org but less than one in ten

registered with the BecomeAnEx.org site. Visitors were more likely to be female and older, to have visited a smoking cessation website previously and to report quit attempts in the past year.

There were few significant differences between lurkers and registrants, possibly due to smaller numbers overall. Registrants were less likely to allow smoking at home and more likely to have visited a smoking cessation website previously.

Low rates of registration and content creation

The proportion of Decide2Quit.org smokers registering with BecomeAnEx.org was low. Our study demonstrates

Fig 1 | Smokers accessing a web-assisted tobacco intervention (Decide2quit.org): use of Decide2quit (D2Q) online tools (percent) by those who visit an online cessation community (BecomeAnEx.org) compared to those not visiting

Table 3 | Likelihood of having quit smoking 6 months after visiting Decide2quit.org, (a web-assisted tobacco cessation intervention); multivariable selection model ($n=384$)

Odds ratio (95 % confidence interval)	
BecomeAnEx.org visitor	
No	REF
Yes	0.98 (0.54–1.77)
Sex	
Men	REF
Women	1.24 (0.73–2.13)
Age	
19-34	REF
35-54	0.38 (0.19, 0.73)
55+	0.50 (0.24, 0.99)
Race	
White	1.32 (0.61, 2.87)
Non-white	REF
Education	
>High school diploma	REF
≤High school diploma	0.82 (0.47–1.41)
Readiness to quit	
Smokers considering quitting	REF
Smokers with a quit date	1.61 (0.77, 3.37)
Smokers actively quitting or maintaining cessation	3.54 (1.86, 6.75)
Visited smoking cessation website	
No	REF
Yes	1.41 (.79, 2.50)
Quit attempt in previous 12 months	
No	REF
Yes	1.02 (0.61,1.72)
Summary score representing online WATI tool use	
	1.00 (0.98–1.01)

“Lurkers” are smokers who clicked on the hyperlink to BecomeAnEx.org allowing them the ability to read online discussions, but not to post; “Registrants” are smokers who clicked on the hyperlink to BecomeAnEx.org and registered with the site, allowing for both reading and posting on the online community

a drop of almost 20 % between visitors and registrants and is consistent with previous publications outside of the preventive health field [32] that describe successively lower percentages of people at increasingly more active levels of online content creation. For online tobacco cessation communities, previous studies have documented the small percentage of users who engage either actively by contributing content or passively by reading content that others have created [24, 33–35]. Low registration rates meant that few WATI-recruits placed themselves in a position in which they could contribute to online community discussions; smokers may derive some benefit from “lurking” or passive receipt of social support and influence. Lurking, sometimes an initial step toward active participation, is common on online social networks and other social media platforms [36, 37]. Of note, for our study, it is possible that the need to register twice (once for Decide2Quit.org and then again for BecomeAnEx.org) acted as a deterrent to full participation in the online community.

Demographic characteristics of becomeAnEx.org visitors

Our study’s findings are consistent with previous studies which show that women are more likely than men

to use online social networks [38–40]; our study expands this research by showing that women are also more likely to visit without registering. While previous studies have shown that young adults, particularly those under age 30, are the group most likely to use social networks [39], smokers in this age group were underrepresented in our BecomeAnEx.org visitor group. Younger smokers may already be a part of other social networks and may have found alternate ways to connect to smokers attempting to quit (e.g., online functions that promote smaller sub-networks) thus may be disinclined to join a new online community. It is also possible that younger smokers find the type of platform offered by BecomeAnEx to be less appealing, as compared to other social media/network platforms.

BecomeAnEx.org visitors and quit rates

Among smokers recruited to Decide2quit.org, we did not find an association between BecomeAnEx.org use and tobacco cessation at 6 months. It is possible that communicating with other smokers had a mixed impact on those trying to quit, providing support for some but negatively impacting others [41]. It is also

possible that, given the low frequency of documented visits to BecomeAnEx, the level of engagement and exposure was too low to create a clinically meaningful impact.

Role of trained coach

In our study, there was a combined effect (not reaching statistical significance) of trained tobacco treatment coaches and BecomeAnEx.org use. Limited statistical power may have prevented us from finding a significant difference. Among smokers not using coaches, BecomeAnEx.org visitors were no more likely to quit than non-visitors; among those who used the coach, BecomeAnEx.org visitors were twice as likely to have quit at 6 months. Although not statistically significant, these results highlight the need for future research on the impact of online cessation coaches.

Our study has several limitations. Our assessment of cessation only addresses smoking during the past 30 days, not capturing smoking activity over the entire 6-month period. Similar to inclusion of a grace period, this approach allows for capture of delayed effects of an intervention, clearly shown to occur in cessation-induction studies [42, 43]. In contrast to a continuous measure over 6 months, this approach additionally recognizes that patients who relapse after initial attempts at abstinence may still be able to achieve prolonged abstinence [44]. We assessed smoking cessation using self-report, not biochemical verification. Recommendations from the Society for Research on Nicotine and Tobacco on the need for biochemical verification state that the degree of misclassification is moderated by characteristics of the smoking cessation intervention [30, 31]. Ours is a light-touch, low-intensity exposure study. In such studies, misclassification and differential misclassification are expected to be lower and biochemical verification is less needed and can introduce other problems, including refusal to participate [45]. We used best available practice for analyzing 6-month cessation in a setting with greater than 20 % loss to follow-up; however, it is possible that those lost to follow-up may have demonstrated cessation rates different from those estimated through our selection modeling. Finally, while this is not a randomized study and may represent a population more inclined toward social media use, substantial recruitment (greater than three quarters of participants) was done through medical or dental referrals in order to include a more generalizable population. Due to the small number of registrants with BecomeAnEx.org, we had limited power to detect differences in the effect of BecomeAnEx registration on cessation; we also had limited power to detect differences between registrants and lurkers. We provide information on exposure (number of site visits by registered BecomeAnEx users), but interpretation of this analysis is limited by the lack of available information on number of visits by non-registrants (lurkers).

Our findings suggest possibilities for targeting future resources. One could consider tailoring resources either toward those with greater past use of web offerings (i.e., those more likely to use the resource) or one could tailor to non-users. In the case of the former, one might design the resources to attract and engage more computer savvy individuals; in the case of the latter, one would simplify resources and greatly increase outreach efforts to the less engaged population. Engagement in online communities might also be encouraged by providing incentives for registration (for example, access to online games designed to distract smokers during times of craving) or reaching smokers at a pivotal moment (for example, providing access to a handheld device with direct links to the online community during hospitalization for smoking-related illness).

Online communities can influence motivation to quit, provide support in the face of cessation-related stressors, enhance coping skills, and reinforce social norms that favor nonsmoking status [6, 46]. Our study demonstrates that smokers visiting a WATI are more likely to navigate to an online cessation community tool (and more likely to register) if they have previously visited cessation websites and if they have tried to quit in the past year. Future WATIs should consider presenting online networks in ways that appeal to smokers for whom online engagement is a new activity or who have not attempted recent quit efforts. While our study did not find an association between BecomeAnEx.org visits and cessation, further research is needed to explore the impact of providing community visitors with additional support via online coaches.

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Compliance with ethical standards

Conflict of interest: During the study period, Dr. Cobb was employed by Legacy, a non-profit organization that owns and operates the BecomeAnEx.org website. Dr. Cutrona has received grant funding from Pfizer Independent Grants for Learning & Change.

Adherence to ethical principles: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Appendix A. Screenshot of the home page
of the decide2quit.org web-assisted tobacco intervention

Functions available on the Decide2quit.org homepage included online educational content accessed via a navigation bar: Family Tools (how to get constructive help from family), Healthcare Provider Tools (how to include your healthcare provider in quit plans), The Library (cessation articles and other tools), My Health Risks (information on smoking risks, symptoms and harmful chemicals), and Thinking About Quitting (motivational recommendations, interactive calculators assessing triggers).

The Decide2Quit.org homepage highlights three main functions. The first is a motivational, pushed-email, tailored messaging system. The second is a

secure asynchronous messaging with a certified tobacco cessation coach. Coaches completed the University of Massachusetts 4-day Tobacco Treatment Specialist Core Training, an intensive, evidence-based training program designed to address core competencies for tobacco treatment specialists. The third is a column entitled "Your Online Community" which provided a link to BecomeAnEx.org, a free smoking cessation website. Those who visit BecomeAnEx.org receive social support by reading blogs written by other smokers; those who register can additionally participate in an online social network by posting messages.

Appendix B. Smokers accessing a web-assisted tobacco intervention (Decide2quit.org): proportion of those with missing data at 6 month follow-up among those who do not visit an online cessation social network (BecomeAnEx.org) compared to those who visit (including Lurkers and Registrants).

Lurkers' are smokers who clicked on the hyperlink to BecomeAnEx.org allowing them the ability to read online discussions, but not to post; "Registrants" are smokers who clicked on the hyperlink

to BecomeAnEx.org and registered with the site, allowing for both reading and posting on the online social network. 95 % confidence intervals are shown.

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