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Social Media for Tobacco Smoking Cessation Intervention: A Review of the Literature

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Abstract

Purpose of Review Social media platforms have the potential to reach large audiences and deliver intervention content in an interactive format. Yet, little is known about the efficacy of social media for smoking cessation treatment or which specific features best promote participant engagement and behavior change. This article seeks to evaluate the current literature on the use of social media interventions to support smoking cessation.

Recent Findings Findings suggest that social media interventions are feasible and can be utilized effectively for smoking cessation treatment. Greater participant engagement with intervention content appears to be associated with positive changes in smoking behaviors in most, but not all studies reviewed.

Summary Smoking cessation interventions on social media hold promise to help smokers quit. Future randomized trials with longer follow-up intervals are needed to expand the current evidence base, as are studies that systematically investigate strategies to improve participant engagement with interventions.

Keywords Tobacco · Social media · Facebook · Intervention · Engagement · Smoking cessation

Introduction

Smoking is the leading cause of morbidity and mortality in the USA. While a number of evidence-based smoking cessation interventions are available, including nicotine replacement therapy, prescription medication, and behavioral counseling [1, 2], the uptake of these interventions in the general population has been less than optimal. Most smokers try to quit without assistance [3, 4], despite the fact that these unassisted quit attempts are frequently unsuccessful [5]. Novel approaches to reach smokers and deliver evidence-based cessation interventions are needed.

Increasingly, people are spending more time on social media, with 2018 data indicating that 69% of US adults currently use social media, and daily use is as high as 74% among Facebook users [6]. Thus, interventions using existing social media have the potential to deliver smoking cessation interventions to a large number of smokers who are already familiar with how to use these platforms. Frequently, these interventions assign participants to private groups on social media (e.g., Facebook, Twitter) and deliver intervention content to these groups. Other interventions post content to their social media profile (e.g., Facebook page of Smokefree.gov) for any visitor to see and engage with. Since social media platforms are built to foster communication, participants can engage with intervention content and each other at the same time. Despite this great potential of social media, previous research reported that low participant engagement with social media interventions for health behavior change can be a critical obstacle to improving participant outcomes [7].

The aim of this manuscript was to conduct a review of the current evidence for social media interventions for treatment of tobacco smoking. Moreover, we present strategies to improve participant engagement in social media interventions based on findings in the literature.

This article is part of the Topical Collection on *Tobacco*

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Methods

Eligibility Criteria

We included published studies that used a social media intervention to address tobacco use. The primary outcome of interest was tobacco use cessation with a secondary outcome of reduced tobacco use. We also included studies that investigated engagement with social media interventions for tobacco use treatment. Studies were required to have interventions that were delivered in part or entirely on a social media platform. We did not include other technology-based tobacco use treatment interventions (e.g., mobile apps) that merely link to social media or contained social networking components without evaluating these components in separate analyses.

Information Sources and Search Strategy

We searched two English-language electronic databases in September 2018: PubMed and Web of Science using the following search terms: ("social media" or "social network") + ("smoking" or "tobacco" or "cigarette") + ("quit" or "cessation") + ("intervention" or "treatment"). Similar searches were conducted by replacing social media or social network with the following social media platforms: Facebook, Twitter, Instagram, Snapchat, Pinterest, LinkedIn, WhatsApp, Reddit, and Tumblr.

Study Selection

Two investigators (K.T., M.M.) conducted the searches and removed duplicates. Each investigator then conducted an abstract review of 50% studies, with 45% of all abstracts reviewed in duplicate. Studies that were definitely or potentially within the inclusion criteria were then reviewed at the abstract and full manuscript level by a third investigator (J.T.).

Results

Study Selection

Overall, our search strategy produced 833 initial hits and 73 studies were selected for abstract review. Of these, 51 were excluded because they did not meet inclusion criteria (excluded—$n = 33$ were not an intervention; $n = 5$ did not focus on social media; $n = 5$ were reviews; $n = 4$ were protocols; $n = 2$ were not specific to to tobacco use, $n = 1$ reported no quantitative outcomes; $n = 1$ was only a conference abstract), leaving 22 studies for full manuscript review, of which 12 were selected for inclusion (excluded—$n = 5$ were not an intervention; $n = 4$ did not focus on social media; $n = 1$ had questionable study quality and outcome reporting).

Overview

A total of 12 studies were included in the review (Table 1). Of these, three were randomized controlled trials (RCTs). Four were feasibility or pilot studies, two of which were single-arm pilot studies for two of the randomized control trials. Five were secondary data analyses of existing studies or other social media pages and/or websites. There were a total of eight independent interventions. Facebook was utilized in 8 of 12 studies, one of which used WhatsApp in addition to Facebook. Two studies used Twitter. QuitNet, an online smoking cessation community, was used in two of the included studies. Intervention lengths ranged from 28 to 100 days, while the Facebook pages of *Tobacco Free Florida* and the NCI *SmokeFree Women* campaign were public and had no specified intervention duration. Follow-up assessment periods ranged from 2 weeks to 12 months. Nine of the 12 studies focused on current smokers, and the other 3 included a combination of current smokers, active quitters, recent quitters, and nonsmokers.

All studies directly implemented and/or tested interventions that targeted smoking cessation. Outcome measures for smoking cessation included both biochemically verified abstinence and self-reports (7- or 30-day abstinence). Other outcomes included smoking reduction, as well as reports of quit attempts and adherence to use of nicotine patches, and, among recent quitters, self-reported relapse. Measures for engagement included number of visits to a social media page/group, reading posts/tweets, making posts/comments/tweets, as well as content of posts/comments/tweets. Other measures included social support (e.g., post likes from other participants), as well as usability and satisfaction with the social media platform for intervention delivery.

Here, we describe more details about these studies, starting with an overview of the RCT findings and then examinations of engagement as related to both smoking cessation outcomes and ways to promote engagement.

Randomized Trials of Smoking Cessation and Relapse Prevention Interventions

A limited number of RCTs have been conducted to investigate the efficacy of social media interventions for smoking cessation or relapse prevention. The *Tobacco Status Project* [8••] is a 90-day Facebook intervention for young adult smokers, consisting of daily automated posts, weekly live-counseling sessions, and optional cognitive-behavioral therapy (CBT) for smoking cessation, compared to a control group referred to Smokefree.gov (trial protocol at [10]). Intervention content was based on clinical practice guidelines [1] and the Transtheoretical Model for behavior change [21]. Like automated posts, live counseling and CBT were delivered entirely on Facebook, using Facebook events. Biochemically

Table 1 Studies included in the review

Study	Origin	Social media platform	Study design	Sample description	Follow-up interval	Intervention and Control	Main outcomes
Randomized trials							
Ramo et al. [8••] [feasibility trial Ramo, Thrul, Chavez, et al. [9]; RCT protocol Ramo, Thrul, Delucchi, et al. [10]]	United States	Facebook	Two-group, randomized controlled trial	500 current smokers (mean age = 20.9 years; 44.8% male; 73.8% non-Hispanic White); 354/500 (70.8%) completed 12-month follow-up	3, 6, and 12 months	Tobacco Status Project (TSP) included (1) Facebook groups based on stage of change for quitting smoking: precontemplation, contemplation, or preparation; (2) targeted daily posts containing smoking-cessation strategies based on US Clinical Practice Guidelines ad Transtheoretical Model of Behavior Change for 90 days; (3) weekly live sessions with smoking cessation counselor delivered on Facebook, including motivational interviewing and cognitive-behavioral coping skills for smoking cessation; (4) six cognitive-behavioral treatment 45-min sessions for preparation groups delivered on Facebook; (5) groups randomly assigned to receive financial incentives (daily, weekly, monthly, or no incentive) for engagement. Control group received a referral to the National Cancer Institute's Smokefree.gov website	No difference in biochemically verified 7-day abstinence between intervention and control over 1 year (OR = 1.07, 95% CI 0.23, 4.97), but significant effect at 3-month follow-up in favor of the intervention (OR = 2.52, 95% CI 1.56, 4.04). Verified abstinence over time: 3 months (intervention 8.3% vs. control 3.2%), 6 months (intervention 6.2% vs. control 6.0%), 12 months (intervention 5.9% vs. control 10.0%)
Pechmann et al. [11••] [feasibility trial Pechmann et al. [12]]	United States	Twitter	Two-group, randomized controlled trial	169 current smokers (mean age = 35.7 years; 26.3% male; 88.7% non-Hispanic White); 135/160 (84.4%) completed 60-day follow-up	7, 30, and 60 days	Tweet2Quit: 100-day virtual closed peer support Twitter groups with 20 people each. Intervention contained automated emails encouraging daily tweets to group, daily discussion topics related to behavior change, and daily individualized engagement auto-feedback. Participants also received 56 days of nicotine patches, links to smokefree.gov website, and instructions to set a quit date within 7 days of intervention start. Control group participants were given nicotine patches and referred to smokefree.gov, smoking cessation website and received instructions to set a quit date within 7 days.	Sustained abstinence, defined by responding to and consistently self- reporting past 7-day abstinence at each 7-, 30-, and 60-day follow-up assessment, 60 days post-quit date (40% in intervention vs. 20% in control) (OR = 2.67, 95% CI 1.19, 5.99). 7-day point prevalence abstinence over time: 7 day post-quit date (41% for intervention vs. 38% for control), 30 days post-quit date (58% for intervention vs. 39% for control), 60 days post-quit date (55% for intervention vs. 41% for control)

Table 1 (continued)

Study	Origin	Social media platform	Study design	Sample description	Follow-up interval	Intervention and Control	Main outcomes
Cheung et al. [13]	Hong Kong	WhatsApp and Facebook	Pilot single-blinded, pragmatic, parallel 3-arm cluster RCT	136 recent quitters who completed 8-week treatment and reported abstinence for at least 7 days (mean age = 40.5 years; 76.5% male; race/ethnicity not reported); 100/136 (73.5%) completed 6-month follow-up	2 and 6 months	Intervention: (1) participation in 2-month WhatsApp or Facebook group including group discussion and 3 reminders per week sent by social worker or nurse with smoking cessation counseling experience to encourage abstinence and provide information about withdrawal, stress and mood management, and weight control; (2) received booklet with information on quitting and healthy diet. Control group participants were given the same self-help booklet and told to contact Integrated Centre of Smoking Cessation counselors if assistance is needed for a high-risk situation or for smoking lapses	Self-reported relapse rate (smoking at least 5 cigarettes in 3 consecutive days at each follow-up): Participants in WhatsApp group had lower relapse rate compared to control at 2-month (17.0% vs. 43.0%; OR = 0.27, 95% CI 0.10, 0.71) and 6-month follow-up (40.5% vs. 61.1%; OR = 0.43, 95% CI 0.19, 0.99). No significant differences between WhatsApp and Facebook group abstinence rates at 2-month (30.0% vs. 42.6%) or 6-month follow-up (52.5% vs. 61.1%). Biochemical abstinence did not significantly differ between groups.
Other studies							
Cole-Lewis et al. [14•]	United States	Facebook	Secondary data analysis of NCI's Smokefree Women Facebook page	4234 women; 875 posts and 4088 comments (1698 posts from 500 participants for content analysis)	N/A	Smokefree Women Facebook page: open-access smoking cessation community that is an extension of the NCIs' Web-assisted tobacco cessation intervention. On the page, individuals communicate with each other and a trained moderator that facilitates engagement, shares information, and provides smoking cessation support	Participants engaged in small clusters and moderator was a connector with every person in the network. Individuals with high-engagement used more terms of encouragement and congratulations. Less-engaged participants' discussions focused more on help seeking, smoking status, and cessation strategies. Most frequently recurring themes of posts and comments included support (45.5%), number of days smoke free (40.6%), and providing detailed advice (14.6%). Participants who had quit relatively recently (< 1 year) were more engaged compared to those who had quit less recently
Graham et al. [15•]	United States	Online smoking cessation community (QuitNet)	Secondary data analysis of iQUITT Study randomized trial	492 smokers (mean age 36.9 years; 49.2% male; 88.0% White; 3.9% Hispanic); 397 (81%) completed self-reported smoking status at 3-month follow-up	3 months	iQUITT enhanced internet arm: participants received free access to premium service of a web-based smoking cessation program (QuitNet), including online community that allows for	4.2% never visited the community, 22.4% engaged passively, and 37.4% engaged both passively and actively. Self-reported abstinence rates using average treatment effects (ATE)-weights

Table 1 (continued)

Study	Origin	Social media platform	Study design	Sample description	Follow-up interval	Intervention and Control	Main outcomes
						social support social influence to encourage smoking cessation and abstinence	were 4.2% for those in the "none" participation group, 15.1% in the "passive" participation group, and 20.4% in the "passive + active " participation group, indicating "passive" and "passive + active " groups have significantly higher abstinence rates compared to the "none" group. No statistically significant difference between "passive" and "passive + active " groups
Haines-Saah et al. [16]	Canada	Facebook	Feasibility study—prospective non--comparative design	60 smokers (mean age 21 years; 57% male; race/ethnicity not reported); 48/60 (80%) participated through the end of the study period	12 weeks	Picture Me Smokefree Intervention: private photo-posting group where participants posted photos and captions related to smoking or quitting once per week, interacted with other group members, and engaged in researcher-moderated posted photo challenges	70% of men and 69% of women contributed photo content at least 5 of 12 weeks. 7% of participants reported quitting smoking and 33% reported reductions in smoking at the 12-week follow-up
Kim et al. [17]	United States	Facebook	Feasibility study—prospective non--comparative design	16 smokers (mean age 34.8 years; 19% male; 94% White; ethnicity not reported); 16/16 (100%) completed all surveys	2 weeks	Smoking Reduction and Cessation Facebook Group: (1) 4 weeks of varying levels of antismoking Facebook post exposure; (2) participant engagement (e.g., availability of smoking cessation expert)	Self-reported smoking reduction: average of 60.6 fewer cigarettes per week compared to baseline; 25.0% of participants reported 7-day point smoking abstinence at follow-up. One-unit increase in Facebook engagement and social support score was associated with 0.56-unit decrease in past week cigarette use
Papandonatos et al. [18]	United States	Online smoking cessation community (QuitNet)	Secondary data analysis of iQUITT Study randomized trial—focused on internet/phone condition of trial	399 smokers (mean age 37.3 years; 47.1% male; 87.7% White; 2.5% Hispanic); 329 (82%) completed self-reported smoking status at 3-month follow-up	3 months (18 months for full trial)	iQUITT: QuitNet, web-based smoking cessation program that includes (1) online social network (e.g., messaging forums, chat rooms, and self-formed clubs and buddy lists); (2) five telephone calls in a relapse-sensitive schedule delivered by professional telephone counselors	36.3% ($n = 145$) of the sample never visited the online community, 20.6% ($n = 82$) engaged passively and 43.1% ($n = 172$) engaged both passively and actively. Short-term self-reported abstinence rates were 12.2% for non-community users, 25.2% for passive users and 35.5% for passive and active users using ATE-weighted analyses with missing outcomes coded as smoking. Any use leads to significant improvements over no use, but passive and active use did

Table 1 (continued)

Study	Origin	Social media platform	Study design	Sample description	Follow-up interval	Intervention and Control	Main outcomes
							not differ significantly from just passive use alone
Pechmann et al. [12]	United States	Twitter	Single group pilot trial	40 smokers (mean age 36.5 years; 40% male; 95% White; ethnicity not reported); 70% completed 60-day follow-up assessment	7, 30, 60 days	Tweet2Quit: (1) 100-day virtual closed peer support groups with 20 people with automated emails encouraging daily tweets to group; (2) daily discussion topics related to behavior change; (3) daily individualized engagement autofeedback. Participants received 56 days of nicotine patches, links to smokefree.gov website, and instructions to set a quit date within 7 or 14 days of intervention start	78% of participants sent at least one tweet and each member sent an average of 72 tweets in the 100-day period. 22.7% of tweets were responses to auto messages and the content of responses was related to suggested discussion topics ($r = 0.75$, $p = 0.012$). Tweeting was not significantly associated with abstinence (OR 1.03, $p = 0.086$). Sending tweets related to abstinence, including statements of abstinence, setting a quit date or use of patches, challenges associated with quitting, and confidence in quitting, were associated with increased odds of self-reported abstinence
Ramo et al. [9]	United States	Facebook	Single-group pilot trial	79 smokers (mean age 20.8 years; 80% male, 80% non-Hispanic White); 57/79 (72%) completed 12-month follow-up	3, 6, and 12 months	Tobacco Status Project (TSP) included (1) Facebook groups based on stage of change for quitting smoking: precontemplation, contemplation, or preparation; (2) targeted daily posts containing smoking-cessation strategies based on US Clinical Practice Guidelines and Transtheoretical Model of Behavior Change for 90 days; (3) weekly live sessions with smoking cessation counselor, including motivational interviewing and cognitive-behavioral coping skills for smoking cessation; (4) 7 optional cognitive-behavioral treatment 45-min sessions during the intervention through 12-month follow-up; (5) groups randomly assigned to receive incentives (personal, altruistic, and no incentive) for engagement	13.0% of participants reported 7-day abstinence at 12-month follow-up (8.0% verified biochemically). Engagement: 61.0% of participants commented on at least one post and 35.0% reported reading most/all of posts. Those who had biochemically verified abstinence at 3 months ($p = 0.036$) and those who received personal monetary incentive ($p = 0.015$) commented more

Table 1 (continued)

Study	Origin	Social media platform	Study design	Sample description	Follow-up interval	Intervention and Control	Main outcomes
Strekalova et al. [19]	United States	Facebook	Secondary data analysis of Tobacco Free Florida's Facebook page	Users of Tobacco Free Florida's Facebook page (smokers, non-smokers, active quitters, or mixed audience); 233 posts and associated data	N/A	Assessed posts for message framing (1) dominance-submissiveness (D-S): communication that aimed to influence or control; (2) affiliation-disaffiliation (A-D): communication that focused on similarities/differences in values and norms; (3) call for engagement (sharing or responding to post); (4) targeted audience	A-D frame received more comments when used for active quitters. Call for engagement had an effect on engagement among active quitters. D-S framing without call for engagement was associated with increased commenting from current smokers
Thrul et al. [20•]	United States	Facebook	Secondary data analysis of Tobacco Status Project intervention [11]	79 current smokers (mean age 20.8 years; 80% male; 80% non-Hispanic White); 512 TTM-based posts and 630 individual comments; 60/79 (75.9%) completed 3-month follow-up	3 months	Tobacco Status Project (TSP) included (1) Facebook groups based on stage of change for quitting smoking: precontemplation, contemplation, or preparation; (2) targeted daily posts containing smoking-cessation strategies based on US Clinical Practice Guidelines and Transtheoretical Model of Behavior Change for 90 days; (3) weekly live sessions with smoking cessation counselor, including motivational interviewing and cognitive-behavioral coping skills for smoking cessation; (4) 7 optional cognitive-behavioral treatment 45-min sessions during the intervention through 12-month follow-up; (5) groups randomly assigned to receive incentives (personal, altruistic, and no incentive) for engagement	Engagement (number of post comments of TTM posts): 52.3% of posts received at least one comment. Decisional-balance posts generated above-average engagement in precontemplation and contemplation groups. Dramatic-relief and self-liberation posts resulted in below-average engagement in contemplation. Conscious raising posts were associated with above average engagement in preparation groups. Intervention engagement with TTM posts decreased over time. Engagement differed between groups within precontemplation and contemplation stages

verified 7-day point prevalence abstinence at the 3-month follow-up was significantly higher in the intervention (8.3%) compared to the control group (3.2%). However, at the 12-month follow-up, there were no significant treatment effects on verified or self-reported abstinence, smoking reduction, or quit attempts [8••]. Compared to a previously conducted feasibility trial [9], biochemically verified and self-reported abstinence rates at 12 months were somewhat lower in the RCT [8••] intervention group (biochemically verified abstinence—feasibility trial (8%), RCT (4%); self-reported abstinence—feasibility trial (13%), RCT (10%)), which may suggest reduced intervention effects in large-scale implementation. With regard to intervention engagement on Facebook, 77% of participants commented on intervention content, with a median of 13 comments among all participants, and 31 among those commenting at least once [8••].

Twitter was used as an intervention platform in the *Tweet2Quit* smoking cessation RCT with promising outcomes [11••]. Participants in the intervention group were assigned to 20-person, 100-day Twitter groups and received nicotine patches, links to smokefree.gov, and instructions to set a quit date within 7 days of the intervention start date. The *Tweet2Quit* group intervention contained automated emails encouraging daily tweets, daily discussion topics related to smoking behavior change aimed to stimulate tweeting in the group's Twitter feed, and daily, individualized engagement auto-feedback sent via text message. Control group participants received the same intervention except for the Twitter group assignment. At the 60-day follow-up, there was a significant intervention effect with twice as many intervention group participants (40%) reporting sustained smoking abstinence, defined by responding to and consistently reporting past 7-day abstinence at each 7-, 30-, and 60-day assessment, compared to the control group (20%). A previously conducted feasibility study with 40 participants had reported 59% self-reported 7-day point prevalence abstinence at 60 days [12]. Twitter participants in the RCT contributed an average of 59 tweets over the duration of the study [11••].

The utility of *WhatsApp and Facebook groups for relapse prevention* after smoking cessation was tested in the third identified RCT [13]. Intervention group participants received a self-help booklet and were assigned to 2 months of either WhatsApp or Facebook groups with reminder prompts messaged (WhatsApp) or posted (Facebook) three times a week from a trained smoking cessation counselor. Participants could then reply to the messages or comment on Facebook posts. Control group participants received only the booklet and were advised to contact a smoking cessation counselor if they needed assistance. While WhatsApp is mainly a messaging platform, it can be used to share content with large groups of contacts. Participants were recruited into all male or female groups because women were concerned about harassment in pilot qualitative interviews. The self-reported relapse rate at the 6-month follow-up was lowest in the WhatsApp group (40.5%), followed by the Facebook group (52.5%), and control group (61.1%).

Intervention Engagement and Smoking Cessation Outcomes

Several studies examined the relationship between intervention engagement and smoking cessation outcomes using Facebook, Twitter, and an online smoking cessation community (QuitNet).

The feasibility study and RCT of the *Tobacco Status Project* (described above) reported conflicting results on associations between participant engagement and smoking cessation outcomes. Feasibility trial participants who commented more on intervention materials had a higher likelihood of reporting abstinence at 3-month follow-up [20•]. However, no associations between engagement and self-reported or biochemically verified abstinence at 3 months were found in the larger randomized trial [8••]. In another study using the Facebook platform, Kim et al. [17•] conducted a pilot study with 16 participants in a *Smoking Reduction and Cessation Facebook Group*. Participants were assigned to a single Facebook group and received intervention messages based on health communication and social support strategies for 4 weeks at varying frequencies (but at least daily). This study found that participant engagement and social support (composite score of posts made and likes received) in a Smoking Reduction and Cessation Facebook Group were associated with a reduction in number of cigarettes smoked per week at the 2-week follow-up.

Similar to the *Tobacco Status Project* studies, Pechmann et al. [11••, 13] reported conflicting results regarding the association between engagement and smoking outcomes in feasibility compared to full trial studies. The Twitter RCT of *Tweet2Quit* [11••] found a positive association between participant tweet volume (average of 59 tweets per participant) and sustained smoking abstinence, defined by responding to and consistently reporting past 7-day abstinence at each of the 7-, 30-, and 60-day follow-up assessments. However, in the feasibility study of the same intervention, tweet volume (average of 72 tweets per participant) was not significantly related to 7-day point prevalence abstinence longitudinally over the three follow-up timepoints [12]. With respect to specific tweet content, the feasibility study found that participant tweets containing assertions of abstinence, setting of a quit date, use of nicotine patches, countering roadblocks to quitting, and expressions of confidence about quitting were associated with abstinence over time [12].

Another study with its own social media platform [15•] analyzed participant use of an online smoking cessation community (QuitNet) and estimated the causal impact of

participant engagement on cessation outcomes (as part of the *iQUITT* study). Different engagement types were classified by the authors and included no engagement, passive engagement (e.g., reading posts), and passive + active engagement (e.g., writing posts). Findings indicated that any engagement with the online community versus no engagement was associated with smoking cessation (self-reported past 30-day smoking abstinence 3 months post-randomization), yet there was no difference between passive versus passive + active engagement. In a follow-up study that included additional telephone counseling, the same author group [18] found similar results. Analyses for three different community user groups (no use, passive, passive + active) showed 30-day self-reported abstinence outcomes at 3-month follow-up of 12.2% for non-users of the online community, 25.2% for passive users, and 35.5% for passive + active users. In line with previous findings, any use led to significant improvements over no use, but passive + active use did not differ significantly from passive use alone.

Participant Engagement Strategies

Several of the studies that used Facebook also examined the relationship between intervention components and participant engagement.

Role of Peer Support, Moderator, and Smoking Cessation Counselor

In their *smoking cessation Facebook study* (described above), Kim et al. [17] employed different approaches for post frequency (1 vs. 3 posts per day), as well as engagement and social support (e.g., only posting content vs. encouraging users to interact with content and including a smoking cessation counselor who engaged with participants). While the authors did not conduct significance tests of engagement, a visual inspection of engagement data showed that weeks in which participants received encouragement to engage or could interact with a smoking cessation counselor generated more participant engagement compared to other weeks.

Cole-Lewis et al. [14•] investigated user engagement with the National Cancer Institute's *Smokefree Women Facebook page* using social network analysis. Findings suggested that participants who were more engaged and connected to others in the social network were those who had quit relatively recently (< 1 year) and participated to provide support and potentially also to receive support. Moreover, their analyses demonstrated the importance of a page moderator, as most Facebook page interactions were between moderator-posted content and participants [14•].

Message Framing and Content

Strekalova and Damiani [19] examined participant engagement with posts on the *Tobacco Free Florida Facebook page*, investigating how engagement (number of comments per post) was related to message framing strategies (e.g., affiliate-disaffiliate, dominant-submissive, explicit calls for engagement) and implied audiences (smokers, non-smokers, active quitters, mixed audiences). For active quitters, affiliate-disaffiliate posts, which included content related to similarity/dissimilarity or communality/differences in values and norms (e.g., "Happy Parents' Day! Share if you are a tobacco-free parent.") resulted in more engagement compared to other implied audiences. Moreover, an active call for engagement ("We can help you quit any form of tobacco, including chew and dip. Ask us how!") resulted in more comments when the implied audience was active quitters. Posts without active calls for engagement generated more engagement among smokers compared to active quitters if the message was framed according to the dominant-submissive frame with content related to self-confidence, determination, or indirect and cautious language.

Investigators of the *Tobacco Status Project* smoking cessation intervention on Facebook analyzed how posts developed based on the Transtheoretical Model of Behavior Change (TTM) were associated with participant engagement [20•]. The authors assessed how young adult smokers in different stages of readiness to quit smoking (precontemplation, contemplation, preparation) engaged with posts based on the 10 principles of behavior change according to the TTM [21], and with posts based on decisional balance and motivational interviewing [22]. Participants in precontemplation and contemplation engaged most with Facebook posts based on decisional balance/motivational interviewing (e.g., elaborating on the pros and cons of smoking and quitting). Participants in preparation engaged most with posts providing information on how to quit smoking (e.g., how to use nicotine replacement therapy, how to best counter weight gain after quitting).

Other Novel Participant Engagement Strategies

A feasibility study of the *Picture Me Smokefree* intervention [16] used a novel approach that combined Facebook groups with an adapted photovoice approach to address smoking among young adults. Photovoice is a qualitative research method, frequently used in community-based participatory research, and combines participant-driven photography and narratives [23]. Groups in this intervention included both active smokers and quitters. Participants were encouraged to contribute their own picture material to the groups and engage with pictures posted by other participants. Of the 60

participants, 70% of men and 69% of women engaged by contributing photo content to the Facebook group during at least 5 out of the 12 weeks.

Discussion

Social Media Interventions and Tobacco Use Outcomes

Existing studies mainly used Facebook and Twitter to implement smoking cessation interventions, and demonstrated utility in leading to beneficial smoking cessation outcomes among participants. We identified evidence for smoking cessation interventions from randomized trials using Twitter [11••] and Facebook (although only short term benefits) [8••]. One trial reported benefits of using Facebook and WhatsApp for relapse prevention [13]. Moreover, a number of feasibility trials reported positive findings using Twitter [12] and Facebook [9, 17].

Participant Engagement and Intervention Outcomes

Although not consistent across all existing studies, evidence suggests that participant engagement in social media smoking cessation interventions can lead to positive smoking cessation outcomes; however, some studies found no association between engagement and outcomes. There are several potential reasons for conflicting results in this area. Definitions and measures of participant engagement are inconsistent across studies and platforms. While it may be difficult to standardize engagement across platforms, due to inherent differences in technology and user interfaces, some distinctions that should be made, in our opinion, are passive (e.g., viewing intervention content) compared to active engagement (e.g., commenting, liking, sharing/reposting). Moreover, researchers should consider depth and quality of engagement. For example, studies have yet to investigate qualitative content of participant engagement (e.g., positive or negative sentiment, participant comments that are on- vs. off-topic) beyond just counting the number of times a participant engaged. It is also possible that participants simply "liking" intervention content is different from more substantial engagement by commenting. Additionally, while active engagement is easier to measure, passive engagement (e.g., just seeing intervention content) may still have an effect on behavior [15•, 18]. The sometimes conflicting results between feasibility studies and randomized trials of the same intervention [8••, 11••, 12, 20•] suggest that the question of what constitutes effective participant engagement and how this engagement contributes to meaningful interventions outcomes remains to be addressed in future studies. A similar area of future study concerns whether certain types of engagement may be beneficial for certain types of social media users (e.g., intervention participants may have different preferences for how to use social media in general, like actively commenting vs. passive use).

Comparison of Findings with Existing Reviews

A recent review of social media interventions for smoking cessation concluded that interventions were feasible and acceptable, and suggested preliminary effectiveness [24]. Compared to the present review, this earlier work included only one of the three RCTs included and reviewed here [13]. Moreover, we included a number of more recent studies not available at the time of the previous review [17, 19] and older studies the previous review did not include [15•, 18, 14•]. Despite these differences in study base, conclusions of the current review largely agree with those drawn by Naslund et al. [24]. Randomized trials confirm efficacy of social media interventions for smoking cessation (compared to referral to smokefree.gov [8••, 11••] or a booklet [13]), despite the fact that intervention effects were not maintained over time in one of the trials [8••]. Our conclusions also agree with this previous review in that additional efforts are needed to determine effective strategies to promote user engagement in social media interventions as well as to investigate which type of engagement leads to sustained smoking cessation.

Limitations and Challenges

To date, only a few social media interventions have been tested in RCTs. Moreover, most assessments of cessation outcomes are based on participant self-reports and lack biochemical verification. Only two social media intervention studies to date have used biochemical verification of smoking cessation outcomes by mailing participants saliva cotinine test strips and instructing them to send back pictures of test results [8••, 9]. While completion rates of remote cotinine saliva testing in these studies were only around 50%, a recent study reported that the risk of systematic bias of results obtained using this method may be low [25]. Most of the research studies reviewed here used Facebook or Twitter to implement interventions. Research on interventions delivered through highly utilized platforms including Instagram and Snapchat is lacking. Moreover, existing studies thus far have predominantly used social media for smoking cessation intervention focusing on combustible cigarettes. Given high rates of multiple tobacco product use [26, 27], the use of novel tobacco products including e-cigarettes [28], and co-use of tobacco and cannabis [29, 30], future social media interventions may want to expand the products, substances, and outcomes they target. Lastly, the current review did not focus on using social media to recruit participants into smoking cessation interventions. Several other reviews have investigated this topic and can be consulted for reference [31–34].

Implications—Considerations of How to Best Design and Implement Social Media Interventions for Smoking Cessation

Existing studies have reported reduced engagement over time [11••, 20•]. More research is needed on how to improve engagement and how to best set up and design groups from the outset (e.g., size, people in different stages of change, how to spark engagement) to improve long-term engagement and outcomes. Below, we provide recommendations for intervention design based on the reviewed literature and open questions that still need to be addressed moving forward.

Participant Selection, Group Assignment, and Utilization of Peer Support

One of the most important questions regarding how best to design social media interventions is how to set up intervention groups, as well as how to assign and distribute participants, according to their baseline characteristics or preferences for using social media. Existing studies have used several approaches with success. The *Tobacco Status Project* assigned young adult smokers on Facebook according to their baseline stage of change/readiness to quit smoking [8••, 9], and a secondary analysis confirmed that intervention groups engaged differently with tailored intervention content [20•], confirming the utility of this assignment approach. Other studies have combined groups of participants consisting of people currently quit and active smokers [16]. This approach seems promising since one of the reviewed studies reported that recent quitters were highly active and provided support and encouragement to others [14•]. It should be noted, however, that the use of a moderator is of key importance, especially as groups may be heterogeneous in smoking patterns and intentions, and individual goals and challenges may not be aligned. To the best of our knowledge, no existing studies have systematically investigated the ideal groups size for intervention delivery, though interventions reviewed here assigned participants to Twitter groups of 20 participants [11••, 12] or Facebook groups ranging from 7 to 22 participants [9, 17]. In practice, the potential for running social media interventions with large groups has to be weighed against the risk of participants perceiving groups as too big and anonymous. The ideal group size for effective social media smoking cessation interventions remains to be investigated in future studies.

Improving Participant Engagement and Intervention Outcomes

One approach to develop engaging intervention content is to utilize formative research for intervention design. Innovative work in this area has used focus groups on Facebook to develop tailored social media interventions, for example, targeting sexual and gender minority smokers or smokers who also engage in risky alcohol use [35, 36•]. Additionally, having participants play a more active role in contributing intervention content [16] may increase engagement with interventions.

Engaging participants at different stages of readiness to quit smoking remains one challenge of social media interventions intending to reach a large audience [8••]. The use of decisional balance and motivational interviewing methods in social media holds promise for engaging smokers who are not currently ready to quit smoking [20•].

Additionally, most participant engagement in existing social media interventions reviewed was engagement between program posts/moderator posts and participants. Engagement between participants and peer support needs to be improved in future studies [14•]. This is in line with findings from other studies which found that participants reported wishing for more interaction with each other at the end of the intervention [16].

Another open question is related to the use of incentives, or paying participants for long term engagement, as this is frequently done in clinical trials or feasibility studies [8••, 16]. However, this approach is prohibitively expensive for population-level implementation of social media tobacco treatment interventions. Researchers and practitioners need to test and implement alternative strategies to incentivize participation and engagement, for example, virtual or game-based rewards [37], or contests [16] to generate initial interest, especially among smokers with low initial motivation to quit, and to encourage long-term engagement.

Extending interventions beyond what has been tested in randomized trials (3 months, 100 days) [8••, 11••] would present additional challenges to maintaining engagement, yet some studies suggest a reduction in effects over time, which could be ameliorated by longer intervention or boosters [8••]. One potential avenue to improve intervention outcomes could be blended interventions that use evidence-based smoking cessation materials in combination with long-term peer support.

Conclusions

Social media use is rapidly evolving and changing. Different age groups and segments of the population have preferences for different social media platforms (e.g., young people are much more likely than older age groups to use Instagram, Snapchat, and Twitter [38]), and it is difficult to predict how the most frequently used platforms of today will change in the future. With this in mind, researchers should be mindful about conducting studies that are translatable to other platforms and help illuminate basic principles of tobacco treatment

intervention efficacy on social media. Moreover, existing studies mainly recruited Non-Hispanic White samples. Future studies should strive for greater ethnic/racial diversity among included participants.

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Compliance with Ethical Standards

Declaration of Interests No conflicts of interest.

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