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## Exposure and Engagement With Tobacco- and E-Cigarette-Related Social Media

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### Abstract

**Purpose**—Little is known about the nature and extent of adolescents' exposure to tobacco- and e-cigarette-related communications on social media. In this study, we describe the prevalence and correlates of youth exposure and engagement with tobacco- and e-cigarette-related social media.

**Methods**—Data are from the baseline survey of the Texas Adolescent Tobacco and Marketing Surveillance system, a cross-sectional sample of sixth, eighth, and 10th graders ( $n = 3907$ ,  $N = 461,097$ ). Weighted logistic regression models were used to examine associations between demographic characteristics, sensation seeking, tobacco use, and exposure and engagement with tobacco-related social media.

**Results**—Overall, 52.5% of students reported exposure to tobacco-related social media in the past month, whereas < 6% reported engagement. Exposure and some forms of engagement were more common among high school students, girls, those with friends who use tobacco, and high sensation seekers ( $p < .05$ ). The odds of exposure were significantly higher among students susceptible to combustible tobacco (adjusted odds ratio [AOR] = 1.71,  $p < .05$ ), e-cigarettes (AOR = 2.10,  $p < .01$ ), and both combustible tobacco and e-cigarettes (AOR = 2.24,  $p < .001$ ). The odds of engaging with social media was higher among those who were susceptible to, had ever, or currently use both combustible tobacco and e-cigarettes (AOR = 2.10–3.46,  $p < .05$ ).

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**Conclusions**—About 1 in every 2 adolescents in Texas are exposed to tobacco-related social media. Adolescents who are susceptible to or use e-cigarettes and/or combustible tobacco are exposed to and engage with tobacco-related social media more than their peers. Social media appears to be an important venue when targeting vulnerable youth in prevention campaigns.

In recent years, the declining rate of tobacco use among U.S. middle and high school students has stagnated, due largely to an increased prevalence of the use of nonconventional products such as e-cigarettes and hookah [1]. Socioenvironmental factors such as peer influence and tobacco marketing are strong predictors of tobacco use among adolescents [2]. Tobacco marketing has historically exploited themes of social acceptance and popularity in product advertisements [3], and studies have demonstrated that increased awareness and receptivity to tobacco marketing is associated with initiation of smoking among youth and young adults [4]. Likewise, exposure to protobacco imagery in movies and on television is strongly predictive of youth tobacco use initiation [5,6].

The roles of media, marketing, and peer influence in the development of adolescent smoking have become especially salient in recent years with the pervasiveness of social media. Social media use is extremely common among adolescents, with 76% of youth between the age of 13 and 17 years reporting use of a site such as Facebook, Twitter, Instagram, Snapchat, or Tumblr [7]. As an extension of in-person peer groups, social media can also be a powerful tool for communicating social norms and influencing risk behaviors. For example, Litt and Stock [8] reported that viewing Facebook profiles portraying alcohol use as positive and normative was associated with increased willingness to use alcohol and favorable attitudes toward alcohol use among adolescents.

An increasing body of literature has documented tobacco-related activity on social media [9–12]. Protobacco content and advertising have been observed on a multitude of social networking sites such as YouTube [9], Instagram [13], and Facebook [14]. Web sites like Reddit have multiple forums dedicated to the topics of e-cigarettes and vaping, where users share information about their favorite e-liquid flavors and how to modify e-cigarette devices [15]. Likewise, content analyses of e-cigarette discussions on Twitter have found that many tweets focus on sharing information, personal opinion, and first-person use or intent, and such tweets tend to have positive sentiments [16]. Also popular on social media are videos or images depicting the performance of smoke or vape “tricks,” such as blowing smoke rings [17,18], which have been cited in several studies as one of the main attractions of e-cigarette use among adolescents [19,20].

While the presence of protobacco messages on social media is well-documented, thus far, research has been limited to either small, descriptive studies [9,21], or studies examining overall characteristics or trends of tobacco-related social media communications [22,23]. To date, only one study has examined the relationship between exposure to tobacco-related social media and tobacco use behaviors [24]. Depue et al. [24] reported that among young adults aged 18–24 years, exposure to depictions of tobacco use on social media was predictive of later cigarette smoking. Notably, in this study, social media had a stronger influence on later smoking behavior than did television or movie depictions [24]. Despite social media’s potential influence on youth health behaviors, no studies have documented

the overall prevalence of youth exposure to and engagement with tobacco-related social media or the impact of social media on youth tobacco use behaviors. Using data from the 2011 National Youth Tobacco Survey, researchers reported that 11.0% of youth aged 11–18 years had reported receiving promotions from tobacco companies via Facebook or Myspace in the past 30 days [25]. However, that study focused solely on industry-sponsored promotions, a practice that is no longer allowed by many social network policies [26,27], and social media has grown dramatically in scope since the data were collected in 2011 [7]. In this study, we seek to fill important gaps in knowledge by describing the prevalence and correlates of youth exposure to and engagement with tobacco- and e-cigarette-related social media among a large, representative sample of Texas adolescents.

## Methods

### Study design and participants

The current study was a cross-sectional analysis of the baseline survey of the Texas Adolescent Tobacco and Marketing Surveillance System (TATAMS). TATAMS is a 3-year longitudinal study that measures use of tobacco products and exposure to marketing of tobacco products in Texas adolescents every 6 months. TATAMS was reviewed and approved by the University of Texas School of Public Health Committee for the Protection of Human Subjects (HSC-SPH-13-0377) and by local school district review committees. Participants included adolescents in sixth, eighth, and 10th grades at baseline from a representative sample of 79 schools in five counties that surround the four largest cities in Texas: Austin, San Antonio, Houston, and Dallas/Fort Worth. These major metropolitan areas are among the fastest growing cities in the United States at present [28] and represent 43% of the state's population [29]. The sampling design and school recruitment are described in detail elsewhere [30]. Cognitive interviewing was conducted from April to July 2014 with 27 students (11–18 years old) to ensure clear understanding of questions. Data collection for the baseline survey included in the present analysis began in October 2014 and was completed in June 2015 (n = 3,907; N = 461,069 when generalized back to the entire population of youth in the sampling frame). At baseline, 49% of participants were female; 54.5% were Hispanic, 27.9% non-Hispanic white/Other, and 17.6% non-Hispanic black. Participants were evenly distributed across the three grade levels.

### Measures

**Exposure to tobacco- and e-cigarette-related social media**—Participants were asked, “During the past 30 days, have you seen any tobacco, electronic cigarette, vape pen, or e-hookah related posts on sites like Tumblr, Vine, Facebook, Twitter, Instagram, or YouTube? Examples that are common are pictures of people smoking or using e-cigarettes on Instagram or Facebook, or videos of blowing smoke rings on Vine or YouTube.” A dichotomous variable was created corresponding to those participants who reported exposure to tobacco- and e-cigarette-related social media during the past 30 days versus those who did not.

**Engagement in tobacco- and e-cigarette-related social media**—Two different types of engagement were assessed: (1) posted videos or pictures of tricks and (2) written,

responded to, or reblogged about tobacco or e-cigarette products. For the first type of engagement, participants were asked, “During the past 30 days, have you posted pictures or videos of yourself or a friend blowing smoke rings or performing tricks with tobacco products or electronic cigarettes, vape pens, or e-hookahs on Facebook, Twitter, Tumblr, Vine, and Instagram?” For the second type of engagement, participants were asked, “During the past 30 days, have you written, responded to, or reblogged a post about tobacco products or electronic cigarettes on sites like Facebook, Twitter, Tumblr, Vine, and Instagram?” For each item, dichotomous variables were created corresponding to those participants who indicated engaging in tobacco- and e-cigarette–related social media during the past 30 days versus those who did not.

**Susceptibility to use**—Susceptibility to tobacco and e-cigarette use was assessed among never users of any tobacco product [31]. For cigarettes, cigar products (large cigars, cigarillos, and little filtered cigars), hookah, and e-cigarettes, participants were asked if they thought they would use the product in the next year, if they would use the product if it were offered by a close friend, and if they had ever been curious about using the product [32,33]. Response options were “definitely not [1],” “probably not [2],” “probably yes [3],” and “definitely yes [4].” Participants who responded “definitely not” to all three questions were classified as nonsusceptible for that product. From these responses, four categories of susceptibility were created: nonsusceptible to any tobacco product, susceptible to combustible tobacco (cigarettes, cigar products, and hookah) only, susceptible to e-cigarettes only, and susceptible to both combustible tobacco and e-cigarettes (“dual use”).

**Ever use**—Ever use was assessed for cigarettes, hookah, cigar products, and e-cigarettes and was defined as ever having used or smoked the product, even one or two puffs. Four ever use categories were created: never users of any product, combustible tobacco (cigarettes, cigar products, and hookah) only users, e-cigarette only users, and dual users of both combustible tobacco and e-cigarettes.

**Current use**—Similar to ever use, current use was assessed for the same four products and was defined as using or smoking the product on at least 1 day in the past 30 days. Four current use categories were created: noncurrent users of any product, current combustible tobacco (cigarettes, cigar products, and hookah) only users, current e-cigarette only users, and dual users of both combustible tobacco and e-cigarettes.

**Demographic factors**—Demographic factors included gender (male vs. female), grade level (sixth/eighth vs. 10th), race (white, African-American, Asian, American Indian/Alaska Native, Native Hawaiian or Pacific Islander, and Other), and ethnicity (Hispanic or non-Hispanic).

**Sensation seeking**—Sensation seeking was measured using responses to four items, which were adapted from the Brief Sensation Seeking Scale-4 [34]. Response options for each of the four items ranged from “strongly disagree [1],” to “strongly agree [5].” A composite variable was created by summing responses across all completed items and dividing by the number of completed items. Participants who completed at least two of the items were included in the analyses. Those who scored at or above the median (3.0) were

classified as high sensation seekers, and those who scored below the median were classified as low sensation seekers [35].

**Friend use of tobacco products**—Friend use was assessed for four different products, including cigarettes, hookah, cigar products, and e-cigarettes. These one-item measures were adapted from the Population Assessment of Tobacco and Health (PATH) survey [36]. For each product, participants were asked, “How many of your close friends use (product type)?” Response options included “none,” “a few,” “some,” “most,” and “all.” A dichotomous variable was created for participants who indicated that none of their friends used any of the products versus those who responded that “a few,” “some,” “most,” or “all” of their friends used one or more of the products.

### Statistical analysis

To examine the prevalence of exposure and engagement with tobacco-related social media, weighted descriptive statistics were generated for the three outcome variables (exposure to tobacco/e-cigarette–related social media, posted videos/pictures of tricks, and written/responded/reblogged about tobacco/ e-cigarettes). Differences in the prevalence of each of the variables by gender, grade level, race/ethnicity, susceptibility to use, sensation seeking, and friend use were examined using chi-square analyses. To examine behavioral correlates of exposure to and engagement with tobacco-related social media, weighted logistic regression analyses were conducted using unadjusted models and models adjusted for covariates. Separate models were employed for each of the three different outcome variables (i.e., susceptibility, ever use, and current use) and three different exposure variables (i.e., exposure to tobacco/ e-cigarette–related social media, posted videos/picture of tricks, and written/responded/reblogged about tobacco/e-cigarettes). Covariates for all models included gender, school grade level, race/ethnicity, sensation seeking, and friend use of tobacco products. Missing data were handled using listwise deletion for each of the logistic regression models. Missing data differed for each model, with the prevalence of missing data ranging from 3.6% to 3.7%. All analyses included sampling weights to generalize the findings to sixth, eighth, and 10th graders living in the sampling frame and to account for school-level clustering. Analyses were conducted using Stata 14.0 (College Station, TX).

### Results

The majority of respondents had never used combustible tobacco or e-cigarettes (75.8%) and had not used combustible tobacco or e-cigarettes in the past month (89.8%). However, over one third of the sample reported being susceptible to combustible tobacco or e-cigarettes (34.1%) (Table 1).

#### Exposure to tobacco-related social media

Overall, 52.5% of students reported exposure to tobacco- or e-cigarette–related social media in the past month. Table 1 presents the weighted characteristics of participants by social media use category. Female students were significantly more likely than males to report exposure, as were high school students compared with middle school students ( $p < .001$ ). Students who were susceptible to combustible tobacco and/or e-cigarette use were more

likely to report exposure to tobacco-related social media than students who were not susceptible ( $p < .001$ ). The same finding was observed for current use ( $p < .05$ ), while students who had ever used e-cigarettes (alone or with combustible tobacco) were significantly more likely than those who had never used a tobacco product to have seen tobacco-related social media ( $p < .001$ ). Students who were high sensation seekers were also significantly more likely to report greater exposure than their low sensation seeking counterparts ( $p < .001$ ).

Logistic regression analysis revealed a significant relationship between susceptibility to use and exposure to tobacco- or e-cigarette-related social media (Table 2). After adjusting for covariates, the odds of being exposed to tobacco- or e-cigarette-related social media were 1.72 times (95% confidence interval [CI] = 1.05–2.81) higher among students susceptible to combustible tobacco use only, 2.08 times (95% CI = 1.31–3.30) higher among students susceptible to e-cigarette use only, and 2.30 times (95% CI = 1.59–3.30) higher among students who were susceptible to both combustible tobacco and e-cigarette use, compared with students who were not susceptible to any product. No significant associations between ever or current e-cigarette and/or combustible tobacco use and exposure to social media were observed after adjusting for gender, school level, race/ethnicity, sensation seeking, and friends' use of tobacco.

### Engagement with tobacco-related social media

Engagement with tobacco-related social media was less common than exposure. Overall, only 5.7% of students reported posting videos or pictures of smoke tricks and 5.0% of students reported writing, responding, or reblogging posts about tobacco or e-cigarettes. Those who were susceptible to, ever tried, or currently used both tobacco and e-cigarettes were significantly more likely to report posting tricks than exclusive users of these products and those who were not susceptible to, had never tried, or were not current users of these types of tobacco product (Table 3). Furthermore, those who were susceptible to and those who had ever tried both e-cigarettes and combustible tobacco were significantly more likely to report writing/responding to tobacco-related social media ( $p < .001$ ) compared with other categories of susceptibility and ever use. Among current users, those who used combustible tobacco only or used both combustible tobacco and e-cigarettes were significantly more likely than nonusers and other categories of users to write, respond to, or reblog tobacco-related social media ( $p < .001$ ).

After adjusting for covariates, the odds of posting videos or pictures of smoke tricks on social media was 2.10 times (95% CI = 1.04–4.25) higher among ever dual users as compared with never users. Similarly, the odds of posting smoke tricks was 3.59 times (95% CI = 1.95–6.60) higher among current dual users as compared with noncurrent users. Susceptibility to use was not associated with posting videos or pictures of smoke tricks in the adjusted model. The odds of writing/responding/reblogging tobacco- and e-cigarette-related social media was 3.56 times (95% CI = 1.39–9.09) higher among students who were susceptible to both e-cigarettes and combustible tobacco compared with students who were not susceptible. For current use, the odds of writing/responding/reblogging tobacco- and e-cigarette-related social media was 3.07 times (1.04, 9.07) higher for combustible only users



as compared with noncurrent users. No other significant relationships were observed after adjusting for gender, school level, race/ethnicity, sensation seeking, and friends' use of tobacco.

## Discussion

Our results suggest that over half of all middle and high school students are exposed to tobacco- or e-cigarette–related social media. Girls, high school students, high sensation seekers, and students with friends who use tobacco were the most likely to report exposure to tobacco- or e-cigarette–related social media, as well as the most likely to report writing, responding, or reblogging tobacco-related posts. In multivariate models, those who were susceptible to e-cigarettes, combustible tobacco, or both were significantly more likely to report exposure to social media. Students who were susceptible to dual use of both e-cigarettes and combustible tobacco and those who had used only combustible tobacco were more likely to report writing, responding, or reblogging tobacco-related posts.

Posting videos or pictures of smoke tricks was not significantly related to demographic characteristics or sensation seeking but was common among students who have friends who use tobacco. In multivariate models, no significant relationships with susceptibility to use e-cigarettes and/or combustible tobacco products were observed, but students who were ever or current dual users of both combustible tobacco and e-cigarettes were more likely to engage with social media in this way. Unlike responding or reblogging about tobacco on social media, posting videos or pictures of smoke tricks requires access to combustible tobacco or e-cigarettes, which may explain why only ever or current dual use was significantly associated with this form of engagement with social media.

These findings are reflective of national trends of social media use among adolescents. Girls and boys are both equally likely to use Facebook; however, girls are significantly more likely than boys to use other social media such as Instagram, Snapchat, Twitter, Vine, and Tumblr [7]. Adolescents between the age of 13 and 17 years are also more likely to use social media than their younger counterparts [7]. Thus, the demographic differences in exposure and engagement in our study may simply be representative of differences in social media use than of characteristics specific to tobacco-related social media.

Our findings are consistent with those of Depue et al. [24] who found that sensation seeking and having friends who use tobacco were significantly associated with exposure to tobacco-related social media among young adults aged 18–24 years. The present study builds on Depue's work in several important ways. First, our population of middle and high school students are an important focus since first use of tobacco typically occurs in adolescence [2]. Second, we examined e-cigarettes in addition to combustible tobacco, which is becoming increasingly important given the notable increase in e-cigarette use among middle and high school students [1], and the prevalence of e-cigarette-related material on social media [15]. Third, we evaluated susceptibility and ever use in addition to current use, which allows us to explore the stages of progression of combustible tobacco and e-cigarette use from nonuser to user. Finally, we also examined engagement with social media instead of exposure alone, which allows for a more in-depth exploration of the ways that adolescents communicate and

interact with their peers about tobacco-related topics and how this might affect use behaviors.

This study has several limitations. First, the cross-sectional data does not allow us to draw conclusions about the potential causal influence of exposure or engagement with tobacco-related social media on tobacco use behaviors. It is likely that youth who use tobacco and e-cigarettes are engaging with tobacco-related social media after they start using these products; thus, future longitudinal research is needed to adequately explore temporal relationships. Second, the study population was limited to students in middle and high schools within five Texas counties; therefore, the findings may not be generalizable outside of this population. Third, exposure and engagement with social media was evaluated via a dichotomous self-report of past 30-day recall, which may be subject to recall bias and does not allow us to examine the relationship between different levels of exposure and engagement with tobacco use. Finally, it is possible that some portion of the tobacco-related social media encountered by participants was antitobacco in nature (e.g., counter-marketing or negative comments about tobacco). However, our measures of exposure and engagement of tobacco-related social media do not allow us to clearly distinguish between positive versus negative social media and how valence may be related to tobacco susceptibility or use.

Despite these limitations, this study demonstrates that tobacco- and e-cigarette-related social media is prevalent, with 52.5% of all students and 67.3% of high school students reporting exposure. Given the overwhelming popularity of social media within the adolescent population and the finding of Depue et al. [24] that social media was more influential on future smoking behaviors than television or movie depictions of smoking, additional research is greatly needed to explore the prevalence, nature, and impact of social media on youth tobacco use. The body of literature on the relationship between smoking in the movies and smoking behaviors is large [3,6] and given the pervasiveness of social media in young people's lives [7], no doubt there is a great need for more studies like that presented here.

There are several importation implications for regulation and intervention. While there are currently no federal laws restricting the advertisement of tobacco products online, many of the major social networking services (e.g., Facebook and Twitter) have policies that restrict tobacco advertising or related content [26,27]. Although legislation limiting online content is problematic for both practical and legal reasons, the existence of social networking policies that already restrict tobacco-related content presents a promising opportunity for the encouragement of self-regulation. For example, social networking services could be encouraged to include e-cigarettes in their antitobacco advertising policy. Furthermore, while users of social media will always be free to post any tobacco-related content, there is precedent for content policies that involve the flagging, removal, or filtering of inappropriate content. One potential implementation could be age-related filters preventing minors from seeing content that has tobacco- or e-cigarette-related keywords associated with it, with the option for users to flag content that falls under the restricted guidelines.

In addition, our findings suggest interventions should focus on social media as a venue for counter-marketing communications. We found that students who were susceptible to tobacco and e-cigarette use were more likely to be exposed to tobacco-related social media and ever



and current users were more likely to engage with social media. Thus, any counter-marketing campaigns that utilize social media and its tools to target ads by age and/or related keywords [37,38] are likely to reach the most valuable target audience for prevention efforts. Recently, The Real Cost campaign [39] and the truth campaign have both used social media, including a recent advertising spot at the 2016 Grammy Awards referencing Internet cat videos, replete with a hashtag to encourage its spread on Twitter and other tagged social media [40].

The present study highlights a critical need for additional research focusing on the influence of tobacco- and e-cigarette-related social media on adolescent tobacco use behaviors. Adolescent exposure to tobacco-related content is likely prevalent on a national scale, and social media provides a unique venue for both industry-sponsored advertising as well as influential user-generated messages from peers. A better understanding of the nature, source, and content of social media messages encountered by adolescents is needed for the development of an effective public health intervention, as is a more refined understanding of the impact of these messages on youth tobacco use behaviors.

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## References

1. Singh T. Tobacco use among middle and high school studentsdUnited States, 2011–2015. *Morb Mortal Weekly Rep.* 2016; 65:361–7.
2. U.S. Department of Health and Human Services. Preventing tobacco use among youth and young adults: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012.
3. National Cancer Institute. The role of the media in promoting and Reducing tobacco Use. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; 2008.
4. Lovato C, Watts A, Stead LF. Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours. *Cochrane Database Syst Rev.* 2011:CD003439. [PubMed: 21975739]
5. Wellman RJ, Sugarman DB, DiFranza JR, et al. The extent to which tobacco marketing and tobacco use in films contribute to children's use of tobacco: A meta-analysis. *Arch Pediatr Adolesc Med.* 2006; 160:1285–96. [PubMed: 17146027]
6. Charlesworth A, Glantz SA. Smoking in the movies increases adolescent smoking: *A review.* *Pediatrics.* 2005; 116:1516–28. [PubMed: 16322180]
7. Lenhart, A. Teens, social media & Technology Overview 2015. Pew Research Center; 2015.
8. Litt DM, Stock ML. Adolescent alcohol-related risk cognitions: The roles of social norms and social networking sites. *Psychol Addict Behav.* 2011; 25:708. [PubMed: 21644803]
9. Bromberg JE, Augustson EM, Backinger CL. Portrayal of smokeless tobacco in YouTube videos. *Nicotine Tob Res.* 2012; 14:455–62. [PubMed: 22080585]

10. Luo C, Zheng X, Zeng DD, Leischow S. Portrayal of electronic cigarettes on YouTube. *BMC Public Health*. 2014; 14(1):1028.doi: 10.1186/1471-2458-14-1028. [PubMed: 25277872]
11. Richardson A, Vallone DM. YouTube: A promotional vehicle for little cigars and cigarillos? *Tob Control*. 2014; 23:21–6. [PubMed: 23047887]
12. Liang Y, Zheng X, Zeng DD, et al. Exploring how the tobacco industry presents and promotes itself in social media. *J Med Internet Res*. 2015; 17:e24. [PubMed: 25608524]
13. Richardson A, Ganz O, Vallone D. The cigar ambassador: How Snoop Dogg uses Instagram to promote tobacco use. *Tob Control*. 2014; 23:79–80. [PubMed: 23748187]
14. Freeman B, Chapman S. British American tobacco on Facebook: Undermining article 13 of the global World Health Organization framework convention on tobacco control. *Tob Control*. 2010; 19:e1–9.
15. Wang L, Zhan Y, Li Q, et al. An examination of electronic cigarette content on social media: Analysis of e-cigarette flavor content on Reddit. *Int J Environ Res Public Health*. 2015; 12:14916–35. [PubMed: 26610541]
16. Cole-Lewis H, Pugatch J, Sanders A, et al. Social Listening: A content analysis of e-cigarette discussions on twitter. *J Med Internet Res*. 2015; 17:e243. [PubMed: 26508089]
17. Forsyth SR, Malone RE. “I’ll be your cigarette—Light me up and get on with it”: Examining smoking imagery on YouTube. *Nicotine Tob Res*. 2010; 12:810–6. [PubMed: 20634267]
18. Primack BA, Carroll MV, Shensa A, et al. Sex differences in hookah-related images posted on Tumblr: A content analysis. *J Health Commun*. 2016; 21:366–75. [PubMed: 26890733]
19. Wagoner KG, Cornacchione J, Wiseman KD, et al. E-cigarettes, hookah pens and vapes: Adolescent and young adult perceptions of Electronic Nicotine Delivery Systems. *Nicotine Tob Res*. 2016; 18:2006–12. [PubMed: 27029821]
20. Kong G, Morean ME, Cavallo DA, et al. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine Tob Res*. 2015; 17:847–54. [PubMed: 25481917]
21. Seidenberg AB, Rodgers EJ, Rees VW, et al. Youth access, creation, and content of smokeless tobacco (“dip”) videos in social media. *J Adolesc Health*. 2012; 50:334–8. [PubMed: 22443835]
22. Myslin M, Zhu SH, Chapman W, et al. Using Twitter to examine smoking behavior and perceptions of emerging tobacco products. *J Med Internet Res*. 2013; 15:e174. [PubMed: 23989137]
23. Richardson A, Ganz O, Vallone D. Tobacco on the web: Surveillance and characterisation of online tobacco and e-cigarette advertising. *Tob Control*. 2015; 24:341–7. [PubMed: 24532710]
24. Depue JB, Southwell BG, Betzner AE, et al. Encoded exposure to tobacco use in social media predicts subsequent smoking behavior. *Am J Health Promot*. 2015; 29:259–61. [PubMed: 24670071]
25. Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, et al. Hazards of new media: Youth’s exposure to tobacco ads/promotions. *Nicotine Tob Res*. 2014; 16:437–44. [PubMed: 24163285]
26. Facebook. Facebook Advertising Guidelines. Available at: [https://www.facebook.com/ad\\_guidelines.php](https://www.facebook.com/ad_guidelines.php). Accessed January 24, 2017.
27. Twitter Inc. Twitter Ad Policies - Tobacco and tobacco accessories. Available at: <https://support.twitter.com/articles/20170424>. Accessed January 24, 2017.
28. United States Census Bureau. Five of the Nation’s Eleven Fastest-Growing Cities are in Texas, Census Bureau Reports. Available at: <http://www.census.gov/newsroom/press-releases/2016/cb16-81.html>. Accessed July 21, 2016.
29. U.S. Census Bureau. Four Texas Metro Areas Collectively Add More Than 400,000 People in the Last Year, Census Bureau Reports. Available at: <https://www.census.gov/newsroom/press-releases/2016/cb16-43.html>. Accessed July 20, 2016.
30. Perez A, Harrell MB, Malkani R, et al. Texas adolescent tobacco and marketing surveillance System’s design. *Tob Regul Sci*. 2017; 3:151–67.
31. Pierce JP, Farkas AJ, Evans N, Gilpin E. An improved surveillance measure for adolescent smoking? *Tob Control*. 1995:S47–56.

32. Bunnell RE, Agaku IT, Arrazola R, et al. Intentions to smoke cigarettes among never-smoking US middle and high school electronic cigarette users, National Youth Tobacco Survey, 2011-2013. *Nicotine Tob Res.* 2015; 17:228–35. [PubMed: 25143298]
33. Strong DR, Hartman SJ, Nodora J, et al. Predictive validity of the enhanced susceptibility to smoke index. *Nicotine Tob Res.* 2015; 17:862–9. [PubMed: 25481915]
34. Stephenson MT, Hoyle RH, Palmgreen P, et al. Brief measures of sensation seeking for screening and large-scale surveys. *Drug Alcohol Depend.* 2003; 72:279–86. [PubMed: 14643945]
35. Sargent JD, Tanski S, Stoolmiller M, et al. Using sensation seeking to target adolescents for substance use interventions. *Addiction.* 2010; 105:506–14. [PubMed: 20402995]
36. National Institutes of Health; National Institute on Drug Abuse, Federal Drug Administration. Population Assessment of tobacco and health (PATH) study. 2015
37. Facebook. Targeting. Available at: <https://www.facebook.com/business/help/633474486707199>. Accessed January 18, 2017.
38. Twitter Inc. Keyword targeting on Twitter. Available at: <https://business.twitter.com/en/targeting/keywords.html>. Accessed January 18, 2017.
39. Duke JC, Alexander TN, Zhao X, et al. Youth's awareness of and reactions to The Real Cost national tobacco public education campaign. *PLoS One.* 2015; 10:e0144827. [PubMed: 26679504]
40. Chen, A. Can smoking kill cat videos? A bold public health ad says yes. *NPR Health.* 2016. Available at: <http://www.npr.org/sections/health-shots/2016/02/16/466956513/can-smoking-kill-cat-videos-a-bold-public-health-ad-says-yes>. Accessed June 5, 2017.

### **IMPLICATIONS AND CONTRIBUTION**

Adolescents susceptible to tobacco and/or e-cigarettes are more likely to report exposure to tobacco-related social media, and adolescents susceptible to both are more likely to engage with social media by responding or reblogging. Based on these findings, social media is an ideal venue to target vulnerable youth in prevention campaigns.

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**Table 1**  
Weighted characteristics of adolescents by social media exposure and engagement, TATAMS (2014–2015)

Characteristics	Overall sample (n = 3,907/N <sup>a</sup> = 461,069)		Exposure to tobacco/e-cigarette social media (n = 3,887/N <sup>a</sup> = 457,883)		Posted videos/pictures of tricks (n = 3,885/N <sup>a</sup> = 457,329)		Written/responded/reblogged about tobacco or e-cigarettes (n = 3,886/N <sup>a</sup> = 457,829)	
	% (95% CI) <sup>f</sup>	% (95% CI) <sup>g</sup>	p value <sup>h</sup>	% (95% CI) <sup>g</sup>	p value <sup>h</sup>	% (95% CI) <sup>g</sup>	p value <sup>h</sup>	% (95% CI) <sup>g</sup>
Overall	n/a	52.46 (48.32–56.57)		5.72 (4.39–7.40)		5.03 (4.05–6.22)		
Sex								
Female	48.88 (43.73–54.07)	61.76 (57.14–66.19)	<.001	6.97 (4.58–10.17)	>.05	7.23 (5.64–9.24)	<.001	
Male	51.12 (45.93–56.27)	43.58 (38.38–48.94)		4.62 (3.33–6.37)		2.92 (2.16–3.94)		
Race/ethnicity								
White	21.43 (15.16–29.4)	54.92 (48.98–60.71)	>.05	4.18 (2.39–7.20)	>.05	3.21 (2.01–5.10)	<.05	
Hispanic	54.77 (47.33–62.0)	50.22 (45.12–55.32)		6.57 (4.65–9.19)		6.05 (4.62–7.88)		
Black, non-Hispanic	17.24 (13.3–22.06)	55.82 (48.72–62.68)		5.11 (3.67–7.08)		4.73 (3.29–6.77)		
Other <sup>b</sup>	6.56 (5.39–7.96)	54.28 (48.73–59.71)		5.23 (2.72–9.80)		3.24 (1.94–5.36)		
Grade level <sup>c</sup>								
Middle school	66.92 (53.95–77.74)	44.90 (41.08–48.80)	<.001	4.74 (3.17–7.04)	>.05	4.02 (2.99–5.38)	<.01	
High school	33.08 (22.26–46.05)	67.75 (62.39–72.69)		7.69 (5.77–10.18)		7.07 (5.24–9.46)		
Susceptibility to use								
Not susceptible	66.15 (63.1–69.07)	41.26 (36.70–45.97)	<.001	3.89 (2.50–6.01)	<.05	2.68 (1.79–4.01)	<.001	
Combustible tobacco <sup>d</sup>	6.30 (5.21–7.59)	64.37 (55.66–72.21)		2.85 (1.11–7.13)		5.10 (2.71–9.41)		
E-cigarettes	9.09 (7.54–10.92)	65.22 (55.45–73.87)		3.98 (1.95–7.96)		3.92 (2.03–7.43)		
Dual <sup>e</sup>	18.47 (16.01–21.21)	67.84 (61.65–73.46)		9.18 (5.38–15.23)		10.44 (6.94–15.41)		
Ever use								
Never tried	76.02 (71.32–80.15)	49.14 (45.18–53.12)	<.001	4.35 (2.95–6.38)	<.001	3.61 (2.50–5.19)	<.001	
Combustible tobacco	4.47 (3.41–5.84)	54.99 (39.70–69.40)		5.89 (2.40–13.73)		8.16 (4.16–15.37)		
E-cigarettes	8.54 (6.77–10.71)	68.51 (61.16–74.79)		7.84 (4.30–13.89)		6.75 (3.43–12.84)		
Dual	10.98 (8.64–13.86)	62.46 (53.58–70.58)		13.78 (9.28–19.98)		12.50 (8.40–18.21)		
Current use								
Nonusers	89.54 (86.67–91.85)	51.12 (46.95–55.27)	<.05	4.85 (3.57–6.57)	<.001	4.27 (3.24–5.59)	<.001	
Combustible tobacco	2.86 (1.81–4.48)	67.98 (54.31–79.13)		10.18 (4.48–21.50)		22.33 (10.22–42.07)		

Characteristics	Overall sample (n = 3,907/N <sup>a</sup> = 461,069)	Exposure to tobacco/e-cigarette social media (n = 3,887/N <sup>a</sup> = 457,883)	Posted videos/pictures of tricks (n = 3,885/N <sup>a</sup> = 457,329)	Written/responded/reblogged about tobacco or e-cigarettes (n = 3,886/N <sup>a</sup> = 457,829)	p value <sup>g</sup>
	% (95% CI) <sup>f</sup>	% (95% CI) <sup>g</sup>	% (95% CI) <sup>g</sup>	% (95% CI) <sup>f</sup>	
E-cigarettes	4.29 (3.30–5.55)	63.18 (49.87–74.74)	9.09 (5.05–15.83)	6.68 (3.44–12.55)	
Dual	3.31 (2.48–4.41)	63.26 (48.84–75.64)	22.94 (14.86–33.67)	9.82 (5.42–17.15)	
Sensation seeking					
Low	53.97 (50.49–57.42)	45.16 (40.85–49.54)	5.47 (3.97–7.50)	3.27 (2.18–4.87)	<.01
High	46.03 (42.58–49.51)	61.68 (56.83–66.30)	6.11 (4.40–8.41)	7.17 (5.51–9.29)	
Friend use					
No	53.88 (47.26–60.37)	40.79 (36.50–45.23)	2.68 (1.57–4.53)	1.71 (.97–2.99)	<.001
Yes	46.12 (39.63–52.74)	66.97 (62.85–70.85)	9.37 (7.33–11.90)	9.04 (7.51–10.84)	

CI = confidence interval.

<sup>a</sup>The weighted N's generalize back to the entire population of youth in the sampling frame.

<sup>b</sup>Includes Asians, American Indians or Alaskan Natives, Native Hawaiians or Other Pacific Islanders, and persons of two or more races.

<sup>c</sup>Middle school = sixth and eighth grades; high school = 10th grade.

<sup>d</sup>Cigarettes, cigar products, or hookah.

<sup>e</sup>Defined as both combustible tobacco and e-cigarettes.

<sup>f</sup>Percentage by column.

<sup>g</sup>Percentage by cell.

<sup>h</sup>p value for  $\chi^2$  of demographic category by social media use category.



**Table 2**

Cross-sectional associations between tobacco use behaviors and exposure to tobacco-related social media among Texas adolescents (n = 3,887, N<sup>a</sup> = 457,883), TATAMS (2014–2015)

<b>Exposure to tobacco/electronic nicotine delivery systems on social media</b>		
	<b>OR unadjusted (95% CI)</b>	<b>OR adjusted (95% CI)<sup>b</sup></b>
Susceptibility to use <sup>c</sup>		
Nonsusceptible (n = 1,882)	–	–
Combustible tobacco only (n = 236)	2.63 (1.69–4.08)***	1.72 (1.05–2.81)*
E-cigarettes only (n = 315)	2.72 (1.79–4.19)***	2.08 (1.31–3.30)**
Combustible tobacco and e-cigarettes (n = 537)	3.50 (2.43–4.86)***	2.30 (1.59–3.30)***
Ever use		
Never users (n = 2,977)	–	–
Combustible tobacco only (n = 128)	1.26 (.71–2.24)	.88 (.53–1.44)
E-cigarettes only (n=312)	2.25 (1.64–3.09)***	1.16 (.82–1.63)
Dual users (n = 347)	1.72 (1.16–2.55)**	.83 (.59–1.16)
Current use		
Noncurrent users (n=3,457)	–	–
Combustible tobacco only (n = 60)	2.03 (1.16–3.55)*	1.06 (.62–1.81)
E-cigarettes only (n = 155)	1.64 (.93–2.90)	.92 (.54–1.55)
Dual users (n = 93)	1.65 (.92–2.95)	.92 (.50–1.69)

CI = confidence interval; OR = odds ratio.

\*  $p < .05$ ,

\*\*  $p < .01$ ,

\*\*\*  $p < .001$ .

<sup>a</sup>The weighted N's generalize back to the entire population of youth in the sampling frame.

<sup>b</sup>All models adjusted for gender, school level, race/ethnicity, sensation seeking, and friend use of combustibles/e-cigarettes.

<sup>c</sup>Restricted to nonusers of any combustible/e-cigarette product.

**Table 3**

Cross-sectional associations between tobacco use behaviors and engagement in tobacco-related social media among Texas adolescents, TATAMS (2014–2015)

<b>Engagement: posting videos/pictures of tricks on social media (n = 3,885/N<sup>d</sup> = 457,329)</b>		
	<b>OR unadjusted (95% CI)</b>	<b>OR adjusted (95% CI)<sup>b</sup></b>
Susceptibility to use <sup>c</sup>		
Nonsusceptible (n = 1,882)	–	–
Combustible tobacco only (n = 236)	.99 (.31–3.22)	.67 (.20–2.30)
E-cigarettes only (n = 315)	1.32 (.59–2.91)	.89 (.38–2.07)
Dual use (n = 537)	3.16 (1.35–7.39) <sup>*</sup>	1.97 (.75–5.19)
Ever use		
Never users (n = 2,977)	–	–
Combustible tobacco only (n = 128)	1.38 (.49–3.87)	1.05 (.41–2.69)
E-cigarettes only (n = 311)	1.87 (.88–3.98)	1.26 (.59–2.66)
Dual users (n = 346)	3.51 (1.84–6.73) <sup>***</sup>	2.10 (1.04–4.25) <sup>*</sup>
Current use		
Noncurrent users (n = 3,456)	–	–
Combustible tobacco only (n = 60)	2.22 (.88–5.64)	1.17 (.42–3.27)
E-cigarettes only (n = 155)	1.96 (.93–4.15)	1.29 (.61–2.75)
Dual users (n = 92)	5.84 (3.38–10.09) <sup>***</sup>	3.59 (1.95–6.60) <sup>***</sup>
<b>Engagement: written/responded/reblogged about tobacco products/electronic nicotine delivery systems on social media (n = 3,886/N<sup>d</sup> = 457,829)</b>		
	<b>OR unadjusted (95% CI)</b>	<b>OR adjusted (95% CI)<sup>b</sup></b>
Susceptibility to use <sup>c</sup>		
Nonsusceptible (n = 1,882)	–	–
Combustible tobacco only (n = 236)	2.79 (.93–8.39)	1.64 (.52–5.22)
E-cigarettes only (n = 315)	2.84 (1.66–4.88) <sup>***</sup>	1.73 (.95–3.15)
Dual use (n = 537)	7.04 (3.05–16.27) <sup>***</sup>	3.56 (1.39–9.09) <sup>**</sup>
Ever use		
Never users (n = 2,977)	–	–
Combustible tobacco only (n = 128)	2.37 (.99–5.66)	1.54 (.68–3.51)
E-cigarette only (n = 312)	1.93 (.83–4.51)	1.02 (.46–2.25)
Dual users (n = 346)	3.81 (2.01–7.24) <sup>***</sup>	1.87 (.94–3.73)
Current use		
Noncurrent users (n = 3,456)	–	–
Combustible tobacco only (n = 60)	6.45 (2.22–18.72) <sup>**</sup>	3.07 (1.04–9.07) <sup>*</sup>
E-cigarette only (n = 155)	1.61 (.77–3.37)	.89 (.41–1.96)
Dual users (n = 93)	2.44 (1.25–4.79) <sup>*</sup>	1.26 (.57–2.74)

CI = confidence interval; OR = odds ratio.

\*  
 $p < .05$

\*\*  
 $p < .01$ ,

\*\*\*  
 $p < .001$ .

<sup>a</sup>The weighted N's generalize back to the entire population of youth in the sampling frame.

<sup>b</sup>All models adjusted for gender, school level, race/ethnicity, sensation seeking, and peer use of combustibles/e-cigarettes.

<sup>c</sup>Restricted to nonusers of any combustibles/e-cigarette product.

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