Live, Love, Juul: User and Content Analysis of Twitter Posts about Juul

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Objectives: In this study, we identified patterns of communication around Juul use and users on Twitter. **Methods:** Public tweets were collected from April 27, 2018 until June 27, 2018. We categorized 1008 randomly selected tweets on 4 dimensions: user type, sentiment, genre, and theme. **Results:** Most tweets were through personal accounts followed by ones of the tobacco industry. Participation by anti-tobacco campaigners, educational, and governmental entities was limited. Posts were mostly about first-hand use, use intentions, and personal opinions. Tweets advocating Juul were most common; meanwhile a handful of tweets discouraged Juul use. Young women, young men, and the tobacco industry expressed positive sentiments about Juul. **Conclusions:** Twitter data are a rich source of public communication to complement surveillance of emerging tobacco products. Youth actively and positively communicate about Juul on Twitter. Educational content and strategies must be examined for curtailing dissemination of positive sentiments and advocacy that normalize and promote Juul use among youth and non-smokers. We observed limited evidence supporting a claim for Juul to be a smoking cessation adjunct.

Key words: JUUL; electronic cigarettes; smoking; Twitter, social media; content analysis
Am J Health Behav.™ **2019;43(2):326-336**
DOI: https://doi.org/10.5993/AJHB.43.2.9

The past decade has seen rapid evolvement of ENDS (electronic nicotine delivery systems) commonly known as electronic cigarettes, e-cigarettes, or vaporizers. Although the use of tobacco products such as combustible cigarettes, cigars, snus, and pipes has decreased significantly in this same time period, there has been an uptick in the use of e-cigarettes particularly among adolescents (12-17 years old) and young adults (18-21 years old).[1-4] A 2015 report by the United States (US) Centers for Disease Control and Prevention (CDC) and the US Food and Drug Administration (FDA) on tobacco use estimates 2.39 million high school students and 620,000 middle school students have used e-cigarettes at least once during the past 30 days.[4] Since 2006, the estimated usage of e-cigarettes has soared from 3% to 20% among 6-12 graders.[5]

The surge in use of e-cigarettes (also referred as vaping) has created a major public health concern as it can create a new generation dependent on nicotine.[6] Like traditional cigarettes, e-cigarettes also contain toxins and nicotine, a powerful addictive chemical, harmful to adolescent brain development with negative consequences for their attention and learning abilities.[7,8] Although e-cigarettes are less toxic than traditional combustible cigarettes, they could facilitate transition to other smoking products and illicit substances. One study carried out among 808 students of 3 public schools in Connecticut indicates that e-cigarettes use was associated with combustible cigarette use.[9] Simi-

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larly, other studies found substantial evidence that e-cigarette use increases the risk of transitioning to the habitual use of combustible cigarettes.[3,10-12] Moreover, studies also specify that increased exposure to e-cigarettes also could facilitate transition from e-cigarettes to consuming illicit substances such as marijuana.[13,14]

Whereas smoking combustible cigarettes among youth has declined steadily during the last decade, use of e-cigarettes has increased.[3,15] Despite numerous efforts to regulate the sales and promotion of e-cigarettes, many adolescents and young adults perceive vaping as a healthier and safer substitute to combustible cigarettes.[16-18] Moreover, these devices have extended traction due to their perceived socially desirable characteristics that helps them in avoiding the "smoker" tag. For instance, perception of being cool, supporting one's social image, and peer validation are some salient social attributes linked to the popularity of e-cigarettes.[12,14,16,19] Studies also suggest that marketed wellness (ie, less harmful and less addictive), easy accessibility, price, and an assortment of flavors further make e-cigarettes more appealing to adolescents and young adults.[2,3,12,18,20]

Juul, a product developed by Pax Labs and launched in 2015, has provided a strong boost to the vaping industry. Juul is a closed-system vaping device that has become the largest e-cigarette brand in the US capturing approximately 55% of the e-cigarette market.[21] The company actively markets Juul as a smoking cessation device and harm reduction alternative through messages, such as: "Juul is an alternative to all the distasteful elements of smoking" and "Our mission is to eliminate cigarettes by offering existing adult smokers a true alternative."[22] Despite these targeted promotions to adult smokers, measures such as age verification for online ordering (over 21 years), and awareness and prevention campaigns by the parent company, Juul's popularity has increase rapidly among adolescents and young adults. In addition to Juul's novelty and design aesthetics, its ease of use, portability, marginal smell, and ease of concealment from parents and teachers has been attributed for this surge.[23,24] For instance, its size (L= 9.48 cm, W= 1.51 cm) makes it slightly larger than a combustible cigarette and easy to hide. The device looks like a USB flash drive and can be recharged through a USB port. It is virtually smokeless and the smell of its vapor can be mistaken for fruits or candies. The disposable nicotine pods (5% by weight), are almost the size of a thumb and available in different flavors including mango, mint, cucumber, and fruit medley. A single Juul pod contains about the same amount of nicotine as supplied by a pack of 20 combustible cigarettes.[25] The high dose of nicotine in a single pod of Juul can have negative consequences for adolescents' attention and learning abilities.[7,8] Moreover, sleek design of the device itself and the disposable pods being available in a variety of fruity favors entice minors toward its use. Flavored nicotine in Juul pods is not only attractive, but also can mislead users about the harmfulness of the product.[26]

Traditional media, campus newspapers, school and college websites/social media accounts, and more recently, scholarly work have initiated stressing the penetration and consequences of underage Juul use.[24,27,28] An active discussion on a number of social media platforms also highlights the popularity of Juul among school and college students. For instance, Twitter is used by students to discuss different places for using Juul at school including class rooms, bathrooms, and libraries.[28] Anecdotal evidence further suggests that it is easy for these groups to access Juul through peers as well as purchase the device and accessories through a breading underground marketplace on social platforms such as Reddit.[29] The popularity and widespread adoption of Juul has been labeled as alarming and a catastrophic public health crisis as it holds a strong potential of creating a new generation of smokers addicted to nicotine.[30] To curb Juul use among students, a principal of an Annapolis, Maryland high school ordered removal of bathroom doors. Likewise, a New Jersey School System installed detectors to alert school administration about Juul use (as well as other forms of e-cigarettes) in school. Meanwhile, a school district in eastern Pennsylvania has banned USB flash drives to effect control of Juul use by minors.[30] The urgency around use of Juul by teens has reached such proportions that the parent company is purported to be scrutinizing the use of Bluetooth technology to combat use among teenagers by regularly verifying age as well as automatically shutting down the devices by geo-fencing around schools.[31]

Twitter is one of the leading microblogging social media platforms where users can share personal opinions or information appended by a photo, video, or a URL. In addition to other popular social media platforms such as Facebook and Instagram, Twitter has been used for tobacco-related conversations, not only by the public, but also by the tobacco industry (eg, @RAI_News, @the_tma), public health agencies (eg, @CDCTobaccoFree, @FDATobacco), smoking advocacy groups (@CASAAmedia, @AVABoard) and anti-tobacco campaigners (@TobaccoPrev, @truthinitiative).[32] As a rich data source, Twitter also has been used by researchers for investigating use and perceptions of tobacco-related products in the general public and among vulnerable population such as adolescents, young adults, African Americans, and Hispanics.[16,23,33,34] Furthermore, Twitter has been considered an important data source for addressing emerging issues and products in public health surveillance or epidemiological research.[16] Social media platforms provide novel data streams that can support public health surveillance, survey development, educational campaigns, and policymaking.[16] Tobacco-related research has started to leverage Web-based data streams (including social media platforms) to bridge the gap in tobacco-related research – use and trends in e-cigarettes and tobacco-control campaigns, for example.[19,35-37]

Presently, the popularity of a given product or service among youth is increasingly tied to social media use as new products and services are actively followed, discussed, and reviewed on platforms such as Facebook, Instagram, and Twitter. Due to the high acceptance and acclaim of e-cigarettes, adolescents and young adults, enthusiastically research them on various social media platforms where they familiarize themselves with new flavors, devices, and different hacks and tricks.[17] As Juul adoption has increased, data from social media platforms can be a potential source to gather the societal as well as the environmental context in which the device is being used, perceived, and debated by various entities. Despite a strong prevalence of Juul among youth, highlights in broadcast media, and alarming concerns among school authorities, parents, and the public health community, formal research documenting relevant conversations and communication to improve understanding of the shared perceptions and attitudes about Juul has been scarce. Furthermore, the current surveillance systems for tobacco use that primarily rely on traditional methods fail to capture the rapid developments of emerging products such as Juul.[17] In addition, many young adults and adolescent e-cigarette users do not identify themselves as being smokers.[38] Considering these challenges in tracking and monitoring the use of emerging smoking substitutes and accessories marketed by the tobacco industry, the focus of the present study is to examine and understand the snapshots of dialogues on Twitter by different entities surrounding Juul. The key objective of our analysis is to identify key user groups and conversational patterns about Juul by conducting a content analysis of relevant tweets. Findings from this study can inform the assessment and design of control and prevention campaigns for use of tobacco alternatives and the development of future regulatory policies. Furthermore, findings from the current study pose several significant implications for research investigations associated with emergent tobacco industry-inspired commodities, and the public health community interests in tobacco use surveillance, particularly among minors and young adults.

METHODS

Data Collection Strategy

We used Twitter API for data collection by querying the keywords juul, juuls, juuled, and juuling, and hashtags #juul, #juuls, #juuled, and #juuling. Using this approach, during 2 months (April 27, 2018 until June 27, 2018), we were able to retrieve 69,374 original tweets (excluding retweets and retweets with comments).

Analytical Sample and Coding Approach

Of the total sample (N = 69,374), 2% of the randomized tweets (N = 1387) were selected for analysis. The coding process consisted of 2 stages. First, drawing on prior work related to e- cigarettes and smoking communication on social media platforms, a tentative coding category list was established.[33,34,39] The first author then read 200 randomly selected tweets from the collected data; categories identified from the literature were revised to ensure that they appropriately represented the Juul dataset. The final codebook consisted of 4 primary dimensions: user type, sentiment, genre,

and theme. Concurrent with this process, exclusion criteria for the analytical sample were established (eg, non-English tweets, inaccessible tweets, meaningless/irrelevant tweets, and tweets originating from social bots).

During the second stage, 1387 tweets were hand-coded by one of the authors. In the coding process, 379 tweets were excluded from the analytical sample: tweets not in English (N = 52), deleted tweets or suspended accounts (N = 177), tweets containing tags only (N = 27), tweets not directly related to Juul or unable to comprehend (N = 30), and spammed tweets, presumably from social bots (N = 93). The final analytical sample consisted of 1008 tweets. To validate coding reliability, a randomly selected sub-sample (N = 200) from the analytical sample was coded by another author. Based on the coding process of 2 reviewers, a substantial agreement was reached across all the assessed dimensions as calculated using Cohen's kappa (user type: k = 0.89, sentiment: k = 0.95, genre k = 0.90, theme k = 0.87).

Assessed Topics

User type. User type represents the tweet sender and is determined based on the information gathered through the description and picture provided in the respective user profile. Within user type, personal accounts were sub-categorized as young women, young men, adult women, adult men, and unclassified individuals. In the profile image, if a person appeared to be under 21 years old, he/she was categorized as young, otherwise an adult. If the profile description did not provide relevant information, or the profile picture was difficult to comprehend (eg, avatar), or there was no profile picture, or there were multiple persons in the profile picture, then it was categorized under unclassified individual user type. As mass media, educational institutes, anti-tobacco campaigners, healthcare units, and government entities are vital in smoking prevention and control efforts,[40] pertinent categories also were included to assess their participation in Juul related conversations on Twitter (Table 1).

Sentiment. This dimension refers to the stance in a tweet whether positive, negative, or neutral (Table 2). Sentiment observed in the tweets can be helpful in evaluating whether the conversation positively or negatively supports Juul in general, Juul users, Juul use, or anti-tobacco efforts. These observations can help us understand the prevailing social norms about Juul.[41] To determine the sentiment in a post, we subjectively assessed whether the tweet was supportive, against, or neutral towards Juul. Any tweet dominantly expressing positive emotions, feelings, or reactions (eg, great, excited, relaxing, enjoying, admiration, etc) signified support for Juul in general, and its use was categorized as having a positive sentiment. Conversely, tweets emphasizing negative emotions, feelings, or reactions (eg, disgust, guilt, unpleasant, ashamed, etc) were classified as posts with negative sentiment. Finally, the tweets that did not portray either a positive or negative sentiment were categorized as having neutral sentiment. While carrying out the sentiment analysis, we specifically focused on Juul; we disregarded sentiment towards any other concept or topic beyond Juul.

Genre. Tweet genre characterizes the tweet format,[33] whether it's about Juul's first-hand use or intention to use, personal opinion, news story, or related to marketing. Overall, there were 6 categories for genre classification as presented along with the corresponding definition and a representative tweet in Table 3.

Theme. The dimension of theme refers to the topic of the actual content presented in the tweet. Fourteen categories were established that represent non-exclusive topical domains such as advocacy, youth health and safety, promotion, flavors, and smoking cessation (Table 4).

In addition to individual assessment of the aforementioned dimensions, an inter-category relationship among all 4 coding dimensions (use type, sentiment, genre, and theme) was carried out (See Appendix A; Appendices can be retrieved by contacting lead author, malikaqdas@gmail.com). The inter-category analysis enabled assessment of the relationship of each study dimension with the other dimensions to provide additional insights about Juul communication on Twitter.

RESULTS

As Table 1 shows, over 72% of the coded tweets originated from personal accounts. Almost one-fourth of the coded tweets (22.4%) were from young women followed by young men (15.8%).

Table 1
Distribution of Tweets by User Type

Category		Definition	User count (%)
Personal account	Young women	Twitter account used by an individual for personal use	226 (22.4%)
	Young men		159 (15.8%)
	Adult men		137 (13.6%)
	Adult women		86 (8.5%)
	Unclassified		120 (11.9%)
Tobacco Industry		Manufacturer, retailer, vendor or any other company involved in sales and promotion of tobacco products or industry	131 (13.0%)
Business		A non-tobacco related for-profit company	14 (1.4%)
News		A media company broadcasting TV programs (eg, BBC, Al Jazeera), or involved in physical printing (eg, New York Times, Forbes), or web-based publishing (eg, WebMD, Mashable)	37 (3.7%)
Government		A governmental agency or organization	9 (0.9%)
Private healthcare		A private hospital, care unit, agency or organization working for public health and safety	29 (2.9%)
Educational		A school, college, university or other entity involved in educating	8 (0.8%)
Non-profit/foundation (Anti-tobacco)		A non-business entity advocating against the use of tobacco products or smoking	26 (2.6%)
Non-profit/foundation (Other)		A non-business entity advocating a particular social cause not related to tobacco products or smoking	14 (1.4%)
Miscellaneous		Any other account/user that cannot be classified in the above categories	12 (1.2%)

Adult men and adult women represent 13.6% and 8.5% of the coded tweets respectively. Tweets from the tobacco industry accounted for 13% of the coded data.

Overall, a majority of the sampled coded tweets presented a positive sentiment (57.4%). Less than one-third of the tweets were deemed negative (30.1%); the remaining tweets (12.5%) conveyed a neutral sentiment (Table 2).

With respect to genre, first-hand use or intent to use was the most common genre at 41.9%. About 16.4% of the coded tweets were categorized as a personal opinion; news and information genres accounted for around 14% tweets in each category. Tweets related to marketing made up 12.3% of the coded tweets (Table 3).

In the themes category (Table 4), the largest proportion of coded tweets were related to advocacy

Table 2
Distribution of Tweets by Sentiment

Category	Definition	Example	Sentiment count (%)
Positive	Tweet that supports or favors Juul, its usage, or its user(s)	Juuling with @jonesandjills. We are always in a party mode, so is our #juul.	579 (57.4%)
Negative	Tweet that is against or condemns Juul, its usage, or its user(s)	First shot of a #juul and tbh this is absolutely disgusting. Never gonna try this again….ever…	303 (30.1%)
Neutral	Tweet that cannot be categorized either under positive or negative category	Debating juul with my buddies at our weekend meetup in downtown #Fairfax #Virginia.	126 (12.5%)

Table 3
Distribution of Tweets by Genre

Category	Definition	Example	Genre count (%)
Personal opinion	Personal thought or opinion about Juul in general or use by others	I have always thought of #Juul as a portable charge for mobile phones (emojis)	165 (16.7%)
First-hand use or intent to use	Reporting personal use, intent, or interest in julling	Having a great time with my second juul in a month	422 (41.9%)
Marketing	Marketing or advertising Juul, vaping, or other smoking products for commercial purposes	Run fast. Fresh delivery of #juul and #juulpods including #mango and #mint just landed.	124 (12.3%)
News	A news story about the latest trend, current event, or happening to inform and educate the online user	@News_of_the_day story: #juuling among school students across different states of #USA is on the rise with a potential of a new generation of #nicotine #addicts	144 (14.3%)
Information	General information about Juul or link to an online source (eg, forum, blog, website, video)	A new documentary created by @AlfaSchoolsto educate parents and educators about #Juul and other #vaping products: https://t.co/abcdef12345	145 (14.4%)
Miscellaneous	Any other tweet that cannot be classified in the above categories	Grandpapa, hit the juul please, yooohooo	8 (0.8%)

(28.2%) followed by tweets with a youth health and safety theme (16.2%). Other tweets were about prevention (8.1%), tips and queries (8%), promotion (7.9%), and flavors (6.9%).

Inter-category analysis among all the 4 coding dimensions provided further insights (Appendix A). Whereas young women, young men, and the tobacco industry predominantly provide positive sentiments towards Juul, adult women and adult men largely offer a negative sentiment. First-hand use or intent to use tweets and marketing-related tweets were primarily positive; tweets coded as news and information genres were mostly negative in sentiment. Tweets about advocacy, flavors, promotions, and tips and queries were largely positive; negative sentiment tweets related to discouraging use, prevention, youth health and safety, and general health and safety themes. Tweets coded as first-hand use or intent to use mostly advocated Juul use, discussed tips, tricks, and flavors; most of the news and information tweets discussed youth health and safety as well as prevention. Finally, young women followed by young men were the most vocal user groups advocating for Juul use; tweets originating from adult women, adult men, and private healthcare providers primarily voiced concerns related to youth health and safety. With respect to the tobacco industry, most of the tweets were promotional in nature.

As tweets of individuals (rather than organizations) comprised most of the data of the present study, they allowed us to investigate the relationships between the demographic variables of age and sex on the sentiment of the tweets. A cross-tabulation and chi-square test was performed to examine the relation of tweeter age (younger than 21 years vs 21 or older), tweeter sex (female or male), and tweet sentiment (negative, neutral, or positive). The relation between age and sentiment was statistically significant [χ^2 (2, N = 608) = 104,016, p < .000]; however, the effect of sex was not statistically significant [χ^2 (2, N = 608) = 2.845, p = .241]. Examination of the cross-tabulation tables (Appendix A) shows that the effect of the age of the tweeter is pronounced – ie, the discrepancy between frequencies and expected frequencies. However, although the effect of tweeter sex was not statistically significant, it can be observed that in neutral and positive tweet sentiments, the discrepancies of frequencies and expected frequencies are inverse for men versus women, suggesting that there may be a slight tendency for men to display positive sentiment.

Therefore, we further performed a tiered cross-tabulation and chi-square test to investigate whether there was a significant difference in tweet sentiments when age and sex were combined in the analysis. The results show that for tweets made by

Table 4
Distribution of Tweets by Theme[a]

Category	Definition	Example	Theme count (%)
Promotional	Sale, coupon, voucher, discount, offer, review or other activities promoting Juul in general	10% off on #juul and #juulpods plus 15% off on all #vapes and #juices	89 (7.9%)
Flavors	Tweet discussing or promoting different flavors	I am falling in love with the #mango #juul #pod. This is absolutely refreshing	78 (6.9%)
Features	Tweet highlighting or promoting design related aspects of Juul (eg, size, usb charging etc.)	Just bought a super charging kit for my #juul as a backup ;) this thing charges quick	43 (3.8%)
Advocacy	Tweet glorifying or signifying Juul use by attributing it as not harmful, attractive, cool, or trendy	Fully charged and a new pod. @myfriend lets meet at the #Lisbongrounds to rock and roll with #juul.	319 (28.2%)
Tips and queries	Tweet mentioning tips, trick, hacks, and support related to Juul	Is it possible to get the cheap refills for #juul as the original ones are too expensive? And how to refill?	91 (8.0%)
Smoking cessation	Using Juul to quit smoking or other tobacco products	#Juuling has been great so far. It's been 3 weeks since I smoked a cigarette, and the credit goes to #juul	42 (3.7%)
Fun	Joke, humor, meme, or funny tweet	A new rhyme in our club: Lets juul and be cool at the school. (emojis)	37 (3.3%)
Prevention	Preventive measures, legislations, policy, regulations, educational programs	Please mark your calendar for our latest webinar on #juuling among #teenagers and #FDA. August 16, 12-2 pm Eastern hosted by Abraham Wellford and Jenny Krispock. Register: https://t.co/Njy64645sde2	92 (8.1%)
General health and safety	Health consequences, concerns, dangers, threats, or risks in general	It is quite risky to engage in #juuling as we are still not sure about the long term side effects of #vaping products. Stay safe	43 (3.8%)
Youth health and safety	Health consequences, concerns, dangers, threats, or risks among underage/youth in schools/colleges	Just met a panel of principals from @Mills_county_ schools and all of them synonymously agreed that #juul and #vaporizer is likely to cause health epidemic among our new generation.	183 (16.2%)
Illicit substance use	Mention of an illicit substance use with Juul	My sister who is still 16 recently started using #CBD with her #juul. Is this dangerous?	17 (1.5%)
Discouraging use	Tweet discouraging or rejecting the use and adoption of Juul	#Juul is one of the most hated, unattractive, and dangerous piece of technology I have ever seen. Stay away from #juuling	46 (4.1%)
Research	Research / scientific information / publication / statistics	The latest results from our survey reveal that #juuling among youth has increased gradually since its launch in 2015. https://t.co/ee9434dfgh6	13 (1.1%)
Miscellaneous	Tweet that cannot be classified in any of the above categories	I was sitting at the beach and heard guys playing volley and having juul.	40 (3.5%)

Note.
a: Non-exclusive category

young people, there was no significant difference in tweet sentiment by sex [χ^2 (2, N =608) = 2.598, p = .273], indicating that tweets made by both young men and women exhibit similar sentiment. However, for tweets made by adults, there was a statistically significant difference in tweet sentiment by sex [χ^2 (2, N =608) = 11.517, p = .003]; whereas tweets made by adult men were less likely than expected to display negative sentiment, and more likely to display positive sentiment, tweets made by adult women were more likely to display negative sentiment and less likely to display positive sentiment than expected. Tweets that expressed neutral sentiment were similarly likely by both sexes.

DISCUSSION

Our study extends current understanding about Juul by examining communication regarding use, attitudes, and acceptability. Adopting the manual coding approach, thorough insights from our results complement other work that deployed automated methods to understand the ongoing communication about Juul on Twitter.[27,28] By leveraging data from one of the popular social media platforms, ie, Twitter, insightful observations about various user groups, public sentiments, and conversational themes are identified and expanded. Our findings will further inform e-cigarette surveillance, regulations, and future research. Juul's proliferation among youth in the US has spawned a lively debate among citizens, the media, and the public health community.

Most tweets in our dataset communicated firsthand use or intent to use as well as marketing by conveying a positive sentiment towards Juul. These tweets predominantly originate from youth, and address affiliation/advocacy or flavors (pods), and inquire about Juul's features and relevant aspects. Similar observations citing communication by young students about Juul pods, various forms of inquires about Juul (tips and tricks), as well as its discrete features that may facilitate its use at school/college also have been by others.[28] It is also likely that the positive perceptions, social image building, and validation often depicted in Juul-related tweets might influence non-smokers as well as youngsters (who are more prone to peer influence) to experiment the device.

We also observed an active participation by the tobacco industry through its positive portrayal of Juul. Most of the entities in this category are retailers involved in marketing Juul, flavored pods (and related accessories), as well as bestowing it as a smoking cessation device. Despite e- cigarettes being promoted and asserted as a smoking cessation device by the tobacco industry,[6] only a few individuals tweeted about Juul as a smoking alternative, thereby exhibiting only week evidence in support of this claim. These findings also echo work that found a few Twitter users communicating about using Juul to quit smoking.[28] Further investigation of this argument frequently used by the tobacco industry is required, as tweets from the tobacco industry have strong potential for reaching a large audience, including vulnerable populations such as adolescents, as these groups are the most active users of social media platforms, including Twitter.[42] Studies also show that e-cigarette promotions can give rise to interest among youth and non-smokers in experimenting with the product.[43,44] Given that Juul, and the tobacco industry overall, is utilizing online platforms (as well as offline channels) for promoting their products with few restraints,[45,46] marketing regulations might be judiciously considered to mitigate the interest and reach among youth and non-smokers.

The overall positive sentiment and patronage with respect to Juul-related tweets suggests that a dominant proportion of the content on Twitter intentionally normalizes and promotes its use. Our findings confirm the notion that social media, especially Twitter, has emerged as a platform for individuals to express their attitudes and perceptions about various trends and topics. Social media are communal conversational spaces that provide affinity groups, such as people interested in Juul, an opportunity to share their experiences. These findings align with prior literature suggesting most of the tweets related to use of different tobacco products (eg, e- cigarettes, hookah) normalize or make smoking appear common by portraying positive experiences with smoking.[19,33,34] Similar to the filter bubbles that form around political issues, by interacting with those who have positive experiences or attitudes related to Juul, other individuals can gain self-affirmation.

On the other hand, the negative sentiment (less than one-third of the coded tweets) is expressed mostly by adults who are likely to be parents, teachers, and other concerned individuals. These tweets communicate information and news stories concerning the threats and relevant implications for youth health, preventive measures, and discouraging use. Consistent with prior findings highlighting the addictive characteristics associated with Juul use,[27] we also observed a few disclosures that depict frequent cravings and difficulties in quitting Juul among users. Given that Juul is designed as a closed-system device, that is, being non-modifiable,[27] a small number of tweets also mention usage of illicit substances such as marijuana and cannabidiol in Juul pods.

We also observed an active role of media com-

panies (predominantly online print media) in presenting stories concerning youth/general health and safety as well as various preventive measures. This finding shadows prior literature highlighting the significance and reach of media outlets on Twitter for different campaigns.[47,48] In contrast, antitobacco campaigners, educational institutions, and governmental agencies have low participation in the observed data. Also consistent with prior studies,[27,28,33] despite the concerns expressed by public health authorities and educational institutions in print media regarding Juul use among youth, analysis of ongoing discourse on Twitter fails to reflect those apprehensions. The overall positive inclination of Twitter posts related to Juul advocates a stronger need for educational content and strategies that not only can reduce the misconceptions about Juul, but also support curtailment of the prevalent positive social norms and acceptance of the product. Tobacco control programs engaged in risk communication may devise mechanisms to circumvent positive sentiments by posting messages and information amplifying negative sentiments. Furthermore, these messages can be targeted to the individuals involved in these positive sentiments (eg, adolescents and young adults). Social media platforms especially Twitter, Facebook, and Instagram offer a strong potential of reaching certain vulnerable and difficult to access communities (eg, youth, African Americans, and Latinos) and can deliver health-related information and communication about the risks associated with tobacco use.[49] One study has shown that interventions through different social media platforms have potential for getting the general public to consider smoking cessation.[50] Finally, current surveillance systems on tobacco use should rigorously build upon the existing investigations that employ novel data streams from various social media platforms for tracking and monitoring behavior of users of emerging tobacco products in the fast-paced tobacco market.[19,28,35,51-53]

Limitations and Future Research

First, we used a limited number of hashtags and keywords (juul, juuls, juuled, juuling) for 2 months. Even though these are the most frequently used terms, observing a more exhaustive list of Juul-related terms over an extended period of time could have provided a further nuanced analysis of users, sentiments, and themes. Although within 2 months we were able to retrieve a sizable analytical sample, other work on Juul communication over Twitter collected data for a slightly longer period.[27,28] The larger timeframe can be attributed to the automated classification adopted by these studies that usually require a much larger analytical sample.

Second, for the content analysis, we did not conduct a systematic analysis and categorization of image, video, or URL appended to the tweet. Furthermore, the current study did not account for the reach and popularity indices such as the number of retweets, number of favorites, and number of followers, etc. A detailed analysis of these indices could have provided additional insights. Finally, as the current study specifically focused on Twitter data, the results might not be generalizable to other social media platforms due to diverse forms of communication and demographics. A quick search of Juul on different social media outlets reveals an active debate on YouTube, Instagram, and Reddit. Future research might delve into these platforms to supplement our findings.

Another useful avenue for future research might be a comparison of Juul's uptake among youth with that of traditional cigarette smoking in the past when smoking came to be associated with being "cool." We find evidence from our data that Juul's image as being a "cool" activity stems from the fact that it is seen as *not* smoking, because smoking cigarettes is now perceived as an uncool activity that causes harm; Juul, and vaping more broadly, has been appropriated as activity in opposition to smoking. Yet, there is a large component of peer pressure and peer endorsement attached to it, similar to the uptake of smoking in past. Social media have just become a bigger arena in which these dynamics are playing out. Finally, the extent of Juul usage among cigarette smokers as a harm reduction (or smoking cessation) alternative predominantly among adult smokers needs to be investigated further.

Conclusion

Social media can be a potential source for seeking public health information. The data streams originating from these channels can help in exploring and understanding user attitudes, adoption patterns, and public sentiments towards emerging and critical health-related phenomena. Data from plat-

forms such as Twitter can help us understand real-time public opinions and sentiments by listening to what people are commenting about and in their own words. Social media data streams can support tobacco surveillance and guide social media campaigns as well as inform policies and strategies for tobacco control by numerous entities. Despite a few limitations of the current study, we demonstrated using data from a popular social media platform, ie, Twitter to understand the pulse of public opinions about a prevailing phenomenon (Juul) particularly among youth. The current investigation informs and supports policymakers, the public health community, anti-tobacco campaigners, and educators in their efforts to understand users' attitudes towards Juul and counteract its growing reach, popularity, and acceptance.

Human Subjects Statement

The current research exclusively focused on freely and publically available social media data. In accordance with George Mason's University IRB policy such public information does not meet the regulatory requirements for Human Subjects Research.

Conflict of Interest Disclosure Statement

There is no conflict of interest for any of the authors.

Acknowledgements

The National Science Foundation (NSF - 1707837) provided support for this research.

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