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## JUUL on Twitter: Analyzing Tweets about Use of a New Nicotine Delivery System

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### Abstract

**Background**—The Food and Drug Administration (FDA) has targeted the JUUL nicotine vaporizer as particularly appealing to young people. Initial reports suggest that JUUL is being used in schools and other locations in which cigarette smoking is illegal or discouraged. However, there is little scholarly research documenting this. We aimed to systematically analyze JUUL use themes and sentiment on Twitter.

**Methods**—Data were collected from Twitter’s Filtered Streams Application Programming Interface from April 12 to May 10, 2018. Excluding re-tweets, this yielded 67,934 tweets, from which a random sample of 2% was selected for coding. After removing irrelevant tweets, the final dataset included 1209 tweets. Inter-rater reliability ranged  $\kappa = 0.64$ – $0.85$ .

**Results**—The majority (71.5%) of tweets expressed positive sentiment toward JUUL, while 14.1% expressed negative sentiment. JUUL use in places where cigarette smoking is illegal or

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Human subjects approval statement

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discouraged appeared in 111 tweets (9.2%), with approximately one-third of these tweets referring to using the device in school. Nearly 20% of tweets mentioned using the device at home and/or directly in front of responsible adults.

**Conclusions**—This study confirms anecdotal reports of JUUL use in places where cigarette smoking is illegal or discouraged. Positive sentiment about use of JUUL in these places suggests that the product is being normalized among young people. It may be valuable for educators and other responsible adults to discuss the addictive nature of nicotine delivered through JUUL with younger populations. This study supports policy implications introduced by the FDA aimed at curbing youth use.

### Keywords

JUUL; Twitter; Nicotine; Smoking & Tobacco

## BACKGROUND

The use of electronic nicotine delivery systems (ENDS) increased by 78% among high schoolers and 48% among middle schoolers from 2017 to 2018, contributing to an increase in overall tobacco product use among youth.<sup>1,2</sup> ENDS use by previously nicotine-naive youth has been associated with increased odds for traditional cigarette initiation.<sup>3,4</sup> Exposure to tobacco-related media and advertising increases the probability that young people will initiate tobacco use,<sup>5</sup> including ENDS.<sup>6</sup> Young people may also be exposed to ENDS messaging through online social networks. A study of middle and high school students found that 6% had posted videos or images depicting smoke or vapor tricks and that 52% had engaged with posts about tobacco or ENDS.<sup>7</sup> Previous research found that propagation of substance use messages via youth-oriented social networks such as Facebook and MySpace may be particularly potent because of powerful peer-to-peer communication.<sup>8</sup> An emerging methodology to determine public sentiment about tobacco and nicotine products involves analysis of Twitter data (i.e., tweets). Twitter use among teens has increased substantially in the past few years, from 14% in 2015 to 47% in 2017.<sup>9</sup> Analysis of Twitter data has successfully helped to determine knowledge about, discussion around, and sentiment toward nicotine and tobacco products and other substances.<sup>10,11</sup> Thus, Twitter may be useful in investigating ENDS use among youth.

One ENDS product that has received much public attention is JUUL.<sup>12,13</sup> JUUL is currently one of the largest ENDS brands, encompassing almost three-quarters of the ENDS market share in 2017.<sup>14</sup> JUUL's multi-million dollar "Vaporize" campaign, launched in 2015, featured bright colors and images of young adults holding the device, which resembles a USB or flash drive.<sup>15,16</sup> The sleek packaging—and the ability to charge the device through a computer via a magnetic USB charger—have led media outlets to consider JUUL the "iPhone of e-cigarettes."<sup>15,17,18</sup> The discreet, USB-like design of JUUL devices allows them to be easily hidden in schools from teachers or other responsible adults.<sup>19</sup> JUUL devices are marketed online as high-tech (e.g., "smoking evolved"<sup>16</sup>), messaging that may be particularly attractive to young people, who tend to be earlier adopters of new technology.<sup>20</sup> However, the JUUL website ([www.juul.com](http://www.juul.com)) specifically states that its product is not meant for youth. On November 15, 2018, the US Food and Drug Administration (FDA) announced

an action plan to limit sales of flavored e-cigarette products in retail outlets.<sup>1</sup> Simultaneously, JUUL announced that it was curbing retail sales of certain flavored pods and reducing its commercial presence on social media.<sup>21</sup> Nevertheless, these actions may be considered “too little, too late” to address youth use of JUUL. National and local news stories have detailed instances of young people using JUUL devices in school, with anecdotal reports of use in bathrooms and classrooms.<sup>22</sup> Preliminary research using Twitter suggests that JUUL is used on school property and that the device’s resemblance to a USB drive is compelling to youth.<sup>23,24</sup> A study examining JUUL’s official Twitter account found that 25% of those who follow the account are adolescents and approximately 9% of adolescents shared content from the account with other adolescents.<sup>25</sup> Therefore, we sought to expand upon prior research by systematically examining online discussions related to where and how individuals use JUUL and how they may be hiding JUUL use from parents, teachers, and other responsible adults. The purpose of this study was to examine a sample of JUUL-related tweets to determine (1) sentiment toward JUUL, (2) whether JUUL is being used in places where cigarette use is illegal or discouraged, and (3) whether JUUL is being hidden from parents/responsible adults or whether these adults are permissive of use.

## METHODS

### Participants

Data were collected from Twitter’s Filtered Streams Application Programming Interface (API), accessed using Real-time Inveillance of Twitter Health Messages (RITHM) data collection.<sup>26</sup> Data collection spanned April 12, 2018 to May 10, 2018. Uninterrupted data collection retrieved 100% of real-time tweets matching three search terms: “juul,” “juuls,” or “juuling,” selected to maximize specificity of results as they relate to JUUL products. This returned 67,934 original tweets (i.e., not re-tweets), as we determined a priori to focus only on original tweets.

### Instrumentation

For coding feasibility, we then selected a 2% random subsample of original tweets, stratified by tweet prevalence per day. Stratification ensured better credibility of these data among the broader context of Twitter content by preserving natural fluctuations in tweets over a given period of time, which is preferable to non-random or simple random sampling.<sup>26</sup> To facilitate human coding, a spreadsheet included textual content of the original tweet, quoted content, and indicators for links or images. Additionally, emoji (in-text symbols depicting facial expressions or common objects) were coded according to their descriptive text. For example, the emoji of a face with hearts for eyes was replaced with “emoji\_heart\_eyes.”

### Procedure

To achieve the aims of our study, tweets were coded for *relevance* (e.g., if “juul” referred to the ENDS product JUUL and not being used as a nickname or an acronym for a company unrelated to JUUL); tweets that were not relevant were removed before analysis. Additionally, tweets were coded for *news* (i.e., news headlines or stories related to JUUL) or *commercial* content (i.e., marketing and/or sales-related tweets). We decided a priori to include separate codes that indicated positive sentiment toward JUUL (*pro-JUUL*) and

negative sentiment toward JUUL (*anti-JUUL*) based on prior research.<sup>26,27</sup> These codes were dichotomous and were not mutually exclusive, so a tweet could be coded as *pro-JUUL*, *anti-JUUL*, both *pro-* and *anti-JUUL*, or neither *pro-* nor *anti-JUUL*. The remainder of codes emerged from an inductive process that examined random sub-sets of 100 tweets separate from the primary data set. These included a code related to *use* of JUUL in places where cigarette use is illegal or discouraged, which included sub-codes of *home*, *school*, and *bathroom*. While traditional cigarette use is generally banned in most schools and bathrooms, we included *home* as a location in which cigarette use is generally discouraged considering rising public support for smoking bans within the home.<sup>28,29</sup> The *school* code included mention of locations or circumstances that are typically associated with school, such as the classroom, the presence of a teacher, or attending a prom or other school event. We also developed a dichotomous code for *adult permissiveness*, which we defined as parents or other responsible adults condoning JUUL use and/or using it with them. For the purposes of this study, “responsible adult” was considered to be a parent (e.g., mom or dad) or a teacher. Because we were only interested in tweets from individuals, if a tweet was coded as primarily *commercial* or *news* or *not relevant*, the coders were instructed to not code the tweet for other categories. However, if the tweet contained *commentary* about any *commercial-* or *news-*related content, the commentary was coded further. The final codebook contained comprehensive descriptions of each code and examples to assist coders. Code descriptions and examples from the data are provided in Table 1. In order to protect the anonymity of individual Twitter users, the examples provided exclude Twitter handles, do not disclose personally identifying information, and may have been slightly edited to reduce the likelihood of disclosing quotes that are reverse identifiable.<sup>30</sup> After de-identification by one researcher, another researcher reviewed the edited version to ensure that it reflected the essential concept of the tweet. This process was only applied to the reporting of example tweets; the tweets that were coded were left in their original form.

The coding process included independent double-coding and adjudicating disagreements with senior researchers prior to adding, collapsing, or adjusting codebook definitions. To assess inter-rater agreement, we used Cohen’s  $\kappa$ .<sup>31</sup> Our iterative process resulted in final Cohen’s  $\kappa$  scores ranging 0.64–0.85 for *pro-JUUL*, *anti-JUUL*, and *use*, well within established guidelines.<sup>31</sup> It was decided a priori to remove all tweets that were not relevant to JUUL ( $n=50$ ), that were commercial/marketing ( $n=17$ ), and that were news stories ( $n=109$ ) from the final dataset so that non–first-person tweets could be excluded from final analyses. Additionally, Twitter users have the ability to tweet a comment on another user’s tweet with the original tweet in quotes. If the original tweet contained a reference to JUUL, but the tweet from the user that we were coding did not, that tweet was considered irrelevant. Therefore, 1209 tweets were included for final analysis.

## Data analysis

Frequencies and percentages were calculated for each code. For a more granular analysis of tweets related to use of JUUL and adult permissiveness, we qualitatively assessed the tweets that were coded as including *use* and/or *adult permissiveness*. It was decided a priori to conduct this analysis using a grounded theory approach, in order to identify salient themes beyond those conceptualized within the existing coding framework.<sup>32</sup> The grounded theory

approach included axial coding of tweets within identified categories, synthesizing the codes into major themes and subthemes. As a part of this iterative process, coders reviewed all tweets coded as “use” and identified emergent themes among these tweets. This resulted in the identification of five sub themes (school, home, bathroom, transportation, and other public place). Coders then re-reviewed the tweets within that thematic framework to identify and note additional emergent themes related to context of use (e.g., “hospital” within public place). Tweets were reviewed a third time to ensure thematic saturation (i.e., no additional themes emerged). For adult permissiveness, the above process was used, but required only two cycles of review due to low tweet frequency.

## RESULTS

Positive sentiment appeared in the majority of the 1209 JUUL-related tweets (n=864, 71.5%). Only 14.1% (n=171) of tweets were coded as having negative sentiment. A total of 174 JUUL-related tweets (14.4%) contained neither positive nor negative sentiment.

One major theme that emerged for positive sentiment was light-hearted commentary, which included statements such as “*we need a Disney princess who juuls...*” and “*currently juuling in the bathroom—sorry juul room—at school.*” Other major themes that emerged for positive sentiment were passive acceptance of JUUL, such as “[redacted] *is in the car juuling while she’s driving lol,*” and expressions of desire to obtain a JUUL or to participate in using JUUL. One major theme for negative sentiment was expressing disdain toward the practice and those who use JUUL, such as “*all of these high schoolers tried smoking juul...y’all just dumb.*” Another major negative sentiment theme indicated a preference for other substances, such as cigarettes, over JUUL.

A total of 111 tweets (9.2%) mentioned use of JUUL in places where cigarette use is illegal or discouraged, with the remainder including other non-use themes such as general opinions about the JUUL product or the individuals who use JUUL. Among the use tweets, 82.9% contained positive sentiment. Forty-four (39.6%) of *use* tweets mentioned using JUUL in school, specifically in the classroom, hallways, school assemblies, and library. However, most school-related tweets referenced using JUUL in bathrooms, with many of them repeating various sarcastic renditions of “*why are people peeing in the JUUL room?*” One-quarter (n=28) of *use* tweets mentioned using JUUL in a bathroom. Almost 20% (n=22) of tweets related to using JUUL mentioned using JUUL at home or in front of parents. A common theme among these tweets was use of JUUL while lying in bed. For example, “*... juuling in bed is literally the best.*” The remainder of the tweets (n=31, 28%) related to using JUUL mentioned using the device in a public place or in a mode of transportation (generally a car). One tweeter complained about not being allowed to use JUUL in a healthcare facility. Other locations included in the workplace, at concerts and other public events, movie theaters, restaurants, public pools, and on public transportation. Tweets coded as mentioning *use* of JUUL could contain multiple subthemes (i.e., tweets may mention use in *school* and a *bathroom*).

Eleven tweets included text coded as *adult permissiveness*. Only one of these tweets expressed negative sentiment; it mentioned a parent breaking the tweeter’s JUUL device.

The other 10 tweets expressed positive sentiment, with 5 mentioning that the adult obtained JUUL for his/her own use and/or used JUUL either in front of or with the tweeter. For example, “*my mom woke me up...to ask if she could borrow my juul.*” The other 5 mentioned that the adult purchased JUUL devices or pods for the tweeter or otherwise indicated acceptance of its use.

## DISCUSSION

Our analysis of tweets related to JUUL found that almost three-quarters (71.5%) expressed positive sentiment toward the product or using the product. Almost 9% of JUUL-related tweets discussed using the product in places where traditional cigarette smoking is illegal or discouraged, and these tweets were overwhelmingly positive. Additionally, almost 20% of these tweets mentioned use of JUUL in the home and/or in front of parents or other responsible adults. These tweets generally indicated that the adult condoned the use of JUUL and/or purchased JUUL for the individual.

The finding that sentiment toward JUUL was overwhelmingly positive is consistent with other research focused emerging tobacco products on Twitter.<sup>33</sup> This reflects overall sentiment toward emerging tobacco products among young people, such as e-cigarettes and hookah, who find the flavoring, accessibility, and social acceptability of these products to be particularly appealing.<sup>34,35</sup> Consistent with this, JUUL markets itself on social media through posts that portray it as part of an individual’s lifestyle and tend to focus on the array of flavors available to users.<sup>36</sup>

This study found that almost 10% of JUUL-related tweets discussed using the product in places where traditional cigarette smoking is illegal or discouraged. This is consistent with another study examining JUUL-related tweets that discussed use of the product in school, including the classroom, bathroom, and library.<sup>23</sup> This current study extends prior research by discovering additional locations in which JUUL is being used, including healthcare facilities, public bathrooms, public events, and at home in front of parents. Additionally, the current study found that these tweets were overwhelmingly positive in sentiment. One tweeter discussed being surprised that JUUL use was prohibited in a healthcare facility, despite the fact that cigarette smoking has been prohibited in these facilities since 1993. This is consistent with perceptions about use of ENDS in general;<sup>37</sup> adolescents report that one benefit of using ENDS is that they can be used in public, unlike cigarettes.<sup>38</sup> The finding that most tweets about using JUUL in places where cigarette smoking is illegal or discouraged is also concerning because it suggests that use of ENDS—in particular JUUL—is becoming normalized. Even the lighthearted complaining about “peeing in the JUUL room” suggests recognition of a reality in which using vaping devices in a bathroom is commonly acceptable behavior. This is potentially problematic, as studies of high school students suggest that viewing one’s social environment as favorable to e-cigarette use is associated with greater susceptibility to traditional cigarette initiation.<sup>39</sup>

We also found evidence that some parents and/or responsible adults permit—or even encourage—use of JUUL. These adults may be unaware of the ingredients of the e-liquid in JUUL pods, or that the e-liquid delivers a high level of nicotine. Indeed, focus groups with

adults have found that most were unaware of the ingredients in ENDS.<sup>40</sup> Although most of these adults knew that ENDS usually contain nicotine, they were generally unaware that the amount of nicotine varies among products.<sup>40</sup> This is also true for younger users; in a survey of 15–24 year olds, only 37% of past 30-day users of JUUL and one-quarter of those who recognized JUUL reported that they believe JUUL always contains nicotine.<sup>41</sup> This misinformation is particularly problematic considering the nicotine content of JUUL is higher than that of other ENDS products used by young people.<sup>42</sup> Of tweets indicating permissiveness of parents or other responsible adults, half indicated that the adult used JUUL and/or used it with the tweeter. Considering young people who had ever used ENDS selected “use by friend or family member” as the top reason for their own use,<sup>43</sup> tweets indicating this type of permissiveness are particularly concerning. Messages about the link between modeled behavior and ENDS susceptibility may be valuable to include in educational programs for parents and other adults who interact with youth.

It should be noted that there is no assurance that all of the tweets in this study came from school-aged youth. Considering Twitter does not require users to report their ages in their profiles, it is not necessarily feasible to know with certainty the age of the author of the tweet. Although some age prediction models are being developed to assess the age of Twitter users, these processes generally include in-depth examinations of profile content,<sup>25,44</sup> and are still in relatively early stages of development. However, considering the popularity of JUUL use among young people,<sup>22,24</sup> the discussion surrounding JUUL on Twitter is likely to include a substantial amount of younger Twitter users. Additionally, the results of this study—that suggest that JUUL use is being discussed on Twitter as normalized behavior—are useful for designing prevention and educational programming for young populations that may be particularly susceptible to this type of messaging. Although it may be challenging, assessing age of the Twitter user through advanced techniques such as machine learning may be valuable for future research in this area.

The finding that use of JUUL in places where cigarette use is illegal or discouraged is being discussed in a positive way has implications for public health policy and regulation. While many states have passed laws banning cigarette smoking in public places, inclusion of ENDS in comprehensive smoke-free laws has been inconsistent.<sup>45</sup> Health-related claims made by ENDS manufacturing companies tend to minimize harms, such as nicotine addiction, while focusing on the benefits of their products as a “healthier” alternative to conventional cigarettes.<sup>46</sup> The debate over the potential benefits and harms of ENDS has slowed regulation of these products and allowed for rapid growth in their use. To date, only 16 states have adopted legislation banning the use of ENDS in public places where conventional cigarettes are prohibited.<sup>47</sup> Although the FDA now regulates ENDS as tobacco products, it recently delayed the deadline for product review until 2022.<sup>48</sup>

## Limitations

It is important to note that the collected tweets are not necessarily representative of the full scope of opinions around this topic. For example, our content included a substantial number of “peeing in the JUUL room” type tweets, which might be regarded as a meme or a viral trend (i.e., a popular joke that spreads through social networks). While this is a qualitatively

salient social theme, its presence may skew our overall results toward quantitatively more pro-JUUL sentiment. Further, because tweets were collected over the span of one continuous month, the results may indicate ephemeral trends. Therefore, it will be important for replication of these results. Finally, these findings are not necessarily generalizable to populations of non-Twitter users. However, our results do serve to further confirm the existence of salient social trends (e.g., JUULing in school restrooms and healthcare environments), which may have important public health promotion and health policy implications.

## Conclusion

In conclusion, sentiment toward JUUL devices and use of JUUL is largely positive among this general sample of Twitter users. This study extends research regarding use of JUUL in places where cigarette smoking is illegal or discouraged, including schools, healthcare facilities, public transportation, and other public places. Finally, this study indicates that parents or other responsible adults may be permissive of JUUL use, including purchasing JUUL for youth. Therefore, it may be valuable for educators and other responsible adults to discuss JUUL with their respective audiences, including the fact that JUUL contains large amounts of nicotine. Additionally, this study has policy implications for regulators and public institutions such as schools, which may consider issuing stronger guidance prohibiting the use of JUUL on their property.

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### IMPLICATIONS FOR SCHOOL HEALTH

To fill the gap in federal and state regulation, local jurisdictions and school districts are passing a myriad of rules on where and when products like JUUL can be used,<sup>22</sup> but our study of JUUL-related tweets suggests that regulatory gaps persist. As awareness about JUUL increases, schools can capitalize upon the wealth of information coming from tobacco control and education groups to educate teachers, parents, and students about the negative aspects of JUUL, including using the product in places where cigarette use is illegal or discouraged. Schools will certainly have to combat the misperception that ENDS are safe to use—a message to which young people are susceptible,<sup>43</sup> and which has been perpetuated by the industry. For example, on July 10, 2018, the official JUUL Twitter account tweeted that their product “is not an e-cigarette” with a link to their webpage discussing why JUUL is “not your average e-cigarette.”<sup>24,49</sup> This type of mixed messaging can be confusing for consumers—especially young people—and should be carefully considered by school officials and teachers when designing policies and educational initiatives to curb youth use of ENDS products.

**Table 1.**

Definitions for Categorical Codes and Example Tweets

Code Sub-code	Definition	Example Content
Sentiment		
<i>Pro-JUUL</i>	JUUL is associated with positive emotions or contexts	<ul style="list-style-type: none"> <li>• <i>i want to ask the random kid juuling in my class if i can use his juul</i></li> <li>• <i>what if the green light that gatsby saw across the water was daisy hitting her juul</i></li> </ul>
<i>Anti-JUUL</i>	JUUL is associated with negative emotions or contexts	<ul style="list-style-type: none"> <li>• <i>if you're secretly hitting juul in class you've hit a low in your life</i></li> <li>• <i>the guy next to me hit his juul and the teacher thought it was me i want to die</i></li> <li>• <i>my 13 yr old cousin asked me to buy him a juul; apparently i'm the cool crackhead cousin</i></li> </ul>
Personal Use		
<i>Home</i>	Refers to personal use of JUUL in a home, in front of a parent, or concealment in a home or in front of a parent	<ul style="list-style-type: none"> <li>• <i>i need a waterproof juul so i can use it in the tub.</i></li> <li>• <i>if you're reading this; bring mango juul pods to my house pls</i></li> <li>• <i>finding a half full juul cart behind your bed is a simple blessing in life</i></li> </ul>
<i>School</i>	Refers to personal use of JUUL in school, school event, in front of an instructor, or concealment in school or in front of an instructor	<ul style="list-style-type: none"> <li>• <i>if anyone found a juul at prom please let me know</i></li> <li>• <i>so apparently there's "no juuling allowed" during the ap test</i></li> <li>• <i>i want to ask the random kid juuling in my class if i can use his juul</i></li> </ul>
<i>Bathroom</i>	Refers to use of JUUL/concealment of JUUL in a bathroom	<ul style="list-style-type: none"> <li>• <i>woah they put toilets in the juuling room</i></li> <li>• <i>at my high school ur only cool if you juul in the bathrooms</i></li> </ul>
<i>Other</i>	Refers to use of JUUL in public places not included above	<ul style="list-style-type: none"> <li>• <i>lmfaoooo these kids at the skatepark must be like 13 smoking a juul what is life</i></li> <li>• <i>my nurse just told me i can't have my juul out because of the oxygen. wtf will it do? blow up? that's a legit question.</i></li> </ul>
Permissiveness	Refers to a parent/supervisor-like figure who uses a JUUL or allows the use of JUUL by the tweeter	<ul style="list-style-type: none"> <li>• <i>my mom just came in and said "juul" and threw a box of pods at me.</i></li> </ul>