

1 **TITLE:** Content Analysis of YouTube Videos Related to E-cigarettes and COVID-19

2 **SHORT TITLE:** E-cigarettes and COVID-19 on YouTube

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21

22 **ABSTRACT**

23 **INTRODUCTION**

24 E-cigarettes are frequently promoted on social media and portrayed in ways that are attractive
25 to youth. While COVID-19 pandemic significantly affected people's lives, less known is how the
26 pandemic influenced e-cigarette-related marketing and information on social media. This study
27 identifies how e-cigarettes are portrayed during the COVID-19 pandemic on YouTube, one of
28 the most popular social media platforms.

29 **METHODS**

30 We searched for combinations of search terms related to e-cigarettes (i.e., "electronic cigarette",
31 "e-cigarette", "e-cig", "vape" and "vaping") and COVID-19 (i.e., "corona", "COVID", "lockdown"
32 and "pandemic"). To be included in the analysis, the video must be: uploaded after February 1,
33 2020, in English, related to e-cigarettes and COVID-19 and less than 30 minutes in length. We
34 assessed video themes related to e-cigarettes and COVID-19, uploader characteristics, and
35 featured e-cigarette products.

36 **RESULTS**

37 We examined N=307 videos and found that N=220 (73.6%) were related to the health effects of
38 e-cigarette use on COVID-19, followed by videos of how COVID-19 affects e-cigarette
39 access/sales (N=40, 12.9%), and face mask-related videos (N=16, 5.1%) which included
40 content regarding masks and e-cigarette use. Instructional videos on how to modify e-cigarettes
41 to use with masks had the highest number of likes (Median=23; IQR=32) and comments
42 (Median=10; IQR=7).

43 **CONCLUSIONS**

44 This study identified various e-cigarette contents on YouTube during the COVID-19 pandemic.

45 Our findings support the need for continuous surveillance on novel vaping-related content in

46 reaction to policies and events such as the global pandemic on social media is needed.

47

48 1. INTRODUCTION

49 E-cigarette use exposes youth to nicotine and other toxicants, which is associated with
50 nicotine addiction and progression to other tobacco product use.(1) Nevertheless, e-cigarette
51 use is frequently portrayed as glamorous on social media, which may appeal to young
52 people.(2,3) Manufacturers and retailers also use social media to market and sell e-
53 cigarettes.(4) For example, YouTube, one of the social media platforms most frequently used by
54 young people (95% among youth who aged 13-17 in 2022),(5) makes youth-appealing content
55 such as vape tricks highly accessible. Concerningly, 48% of such video content has been
56 posted by the tobacco industry accounts.(3,6) Given high social media use by youth and rapidly
57 evolving e-cigarette promotional content on social media, understanding how e-cigarettes are
58 portrayed on social media is urgently needed.

59 The COVID-19 pandemic affected all aspects of people's lives across the globe and
60 continues to do so. There is evidence that during the height of the COVID-19 pandemic, social
61 media was home to misleading content espousing therapeutic and preventive effects of
62 nicotine on COVID-19.(7) COVID-19 also appeared in the marketing content of e-cigarettes on
63 social media.(8) For example, Puff Bar posted photos of its factory workers in China wearing
64 masks and protective gear to demonstrate 'health reassurances' on Instagram.(8) One notable
65 change in the marketing environment with shop closures during the COVID-19 pandemic as
66 tobacco stores and vape shops were considered non-essential businesses. As such, some vape
67 shops posted social media offering 'contactless delivery' and 'curbside pickup'. Some posts
68 included health assurance themes (e.g., claiming health benefits from e-cigarette use during
69 COVID-19) and encouraging stockpiling of e-cigarette products during the pandemic.(8) This
70 shift to online retailers is concerning because they generally have less restrictive age
71 verification, which can lead to underage e-cigarette use.(9–11)

72 There is a dearth of work examining how COVID-19 is used in e-cigarette marketing on
73 social media. YouTube is an important source to understand e-cigarette promotion. Given that
74 YouTube is the most frequently used social media by all age groups,(5) and YouTube is a
75 popular source to obtain health-related information, including e-cigarettes,(12) examining how
76 COVID-19 and e-cigarettes are portrayed on YouTube is important. This information may
77 provide valuable insight into prohibiting the marketing content that promotes e-cigarette use and
78 identify misinformation to inform countermarketing and educational efforts. Understanding how
79 e-cigarettes are portrayed in the context of COVID-19 on YouTube is important as this content
80 may influence perception, attitudes, and even e-cigarette-related behaviors.(13,14)

81 This study developed a data collection and coding framework to identify and evaluate
82 how COVID-19 and e-cigarettes are portrayed in YouTube videos. Among the videos that
83 included e-cigarettes and COVID-19, we further identified the video's themes, who posted these
84 videos, what e-cigarette products were featured, and whether levels of engagement (e.g.,
85 number of views, comments, likes) differs by these video characteristics.

86 **2. METHODS**

87 **2.1. Data Collection**

88 We collected videos by combining search terms related to e-cigarettes and COVID-19 in
89 July 2021 on YouTube. We limited our search to videos uploaded after February 1, 2020, when
90 COVID-19 was widespread globally. E-cigarette-related terms included “electronic cigarette”, “e-
91 cigarette”, “e-cig”, “vape” and “vaping” and COVID-related terms included “corona”, “COVID”,
92 “lockdown” and “pandemic”. We included e-cigarette search words that have been shown to
93 have the most connections to e-cigarette content on YouTube based on our previous study.(15)
94 To be included in our dataset, the video had to: (1) be in English, (2) have content related to e-
95 cigarettes and COVID-19, and (3) be less than 30 minutes in length (to ensure that we are

96 capturing videos that people may watch). We also obtained video metadata (i.e., view counts,
97 likes, dislikes, and upload date).

98 2.2. Codebook Development

99 We adapted a codebook that had previously been used for the analysis of e-cigarette-
100 related content on YouTube for this study (**Table 1**).⁽¹²⁾ The lead author viewed the videos
101 and categorized themes (i.e., classified the major theme as it relates to e-cigarettes and
102 COVID-19), uploader type (who posted these videos), and featured e-cigarette products
103 (whether these videos portrayed e-cigarette products) based on prior research^(3,12) and added
104 new themes related to COVID-19. Another author reviewed and confirmed and/or modified the
105 themes. We determined interrater reliability by coding approximately 10% of videos (N=40
106 videos). Gwet AC1 statistics,⁽¹⁶⁾ which addressed the marginal predicted probability issues of
107 Cohen's kappa statistics,⁽¹⁷⁾ ranged from 0.8558 to 1, which indicates "almost perfect"
108 agreement.⁽¹⁸⁾

109 2.3. Data Analysis

110 We conducted descriptive statistical analyses of the number of views, comments, likes,
111 and upload years for each video theme, uploader type and featured e-cigarette product. Due to
112 the non-normality of our data, we calculated the median and the inter-quartile range (IQR) for
113 continuous variables (i.e., view, comment, like) and count and percentage for a categorical
114 variable (i.e., upload year). To assess whether themes, uploader types and featured e-cigarette
115 products had different levels of engagement (i.e., number of views, comments, likes) and upload
116 year, we conducted the Kruskal-Wallis test for continuous variables and Pearson chi-square test
117 for categorical variables. To assess whether video themes differed by uploader type, we also
118 conducted chi-square tests.

119 3. RESULTS

120 **Figure 1** illustrates our selection of e-cigarette- and COVID-19-related YouTube videos
121 and exclusion rules. We obtained N=3,796 videos using combinations of e-cigarette-related and
122 COVID-19-related terms (as described 2.1. *Data Collection*) and included N=307 unique videos
123 as final analytic sample per our inclusion criteria.

124 3.1. Video themes

125 There are five themes related to both e-cigarettes and COVID-19: (1) *health information*
126 *regarding e-cigarettes and COVID-19* (“*health information*”); these videos portrayed whether
127 vaping nicotine or other substances (e.g., CBD oils, propolis) increased the health risks related
128 to COVID-19 or discussed potential therapeutic effects of vaping on COVID-19. (2) *Face mask-*
129 *related* videos included content that links masks with vaping (“*face masking*”); these videos
130 portrayed vaping while wearing a mask (e.g., showing and comparing visible vape clouds
131 through different masks - KN95, N95, cloth masks, and surgical masks. (3) *Instructional – how*
132 *to modify/use e-cigarettes* (“*instructional*”) videos; these videos portrayed how to content,
133 including sanitizing vape devices during COVID-19 and demonstrated how to modify a vaping
134 device to use with face masks. (4) *how COVID-19 affects e-cigarette access/sales*
135 (“*access/sales*”) videos discussed how the COVID-19 pandemic changed the marketing and
136 sale of e-cigarettes. This included the vape shop closing and offering delivery of vape products.
137 (5) “*Other*” themes included videos that did not fit into these themes. These included videos of
138 vape parties abroad during the travel ban.

139 3.2. Uploader type

140 To determine the uploader type, we examined the Channel Pages (i.e., “profile” page of the
141 video uploader) of each YouTube video. There are six uploader types: (1) *Retailers* are any
142 Channel that is run by/for vape and other tobacco brick and mortar stores or online stores where
143 they sell e-cigarettes. (2) *Vape enthusiasts* are independent users who post almost exclusively

144 about vaping – over 50% of their videos are related to vaping but are not directly connected to
145 the vape industry. (3) *Medical communities* are any individual/organization with
146 medical/healthcare credentials or who/that conducts research related to vaping and smoking.
147 (4) *News Channels* are media outlets that focus on delivering news, such as traditional
148 broadcasting as well as new media channels. (5) *Private users* are YouTube creators (a single
149 person or a group) who post about a variety of topics, which can include vaping. (6) *Other*
150 include other Channels that do not fall into these categories such as a Channel focused on
151 fitness.

152 3.3. Featured e-cigarette products

153 We determined first whether an e-cigarette product was present, and if present, we attempted to
154 identify the depicted product. (1) “*Featured*”: when the video explicitly introduced or presented
155 an e-cigarette product including any types of e-cigarette device including cigalike, e-liquid (e-
156 juice), vaping kit, box mod, vape pen, closed pod system, disposable, or vape box of
157 subscription service. (2) “*Not featured*”: when videos did not feature a specific e-cigarette
158 product.

159 **Table 2** provides details of our results, including the number of views, comments, likes,
160 and published year for each of the video themes, uploader types, and featured e-cigarette
161 products. Among N=307 videos, 73.6% were “*health information*” videos (e.g., how e-cigarette
162 use affects COVID-19 diagnosis and prognosis), followed by “*access/sales*” and “*face mask-*
163 *related*” videos (e.g., experiment of vaping with different types of masks; 5.1%). 36.5% were
164 posted by *private users*, followed by *news channels* (36.2%), *medical communities* (16.9%), and
165 *retailers* (6.8%). Of note, the majority (89.3%) of the videos did not feature a specific e-cigarette
166 product.

167 There were significant differences between the video theme and the number of
168 comments and likes. “*Instructional*” videos had the highest like count (Median=23; IQR=32),
169 followed by “*access/sales*” videos (Median=22; IQR=76). Similarly, “*instructional*” videos had the
170 highest number of comments (Median=10; IQR=7), followed by “*access/sales*” videos
171 (Median=7; IQR=36). There was also a significant difference in view count by uploader type.
172 Videos uploaded by *retailers* had the highest view count (Median=520; IQR=1519), followed by
173 *medical communities* (Median=457; IQR=7229.5), and *news channels* (Median=319;
174 IQR=2003). There was no significant difference in view counts, comments, likes, and upload
175 year by featured e-cigarette product (all $ps>0.05$).

176 **Table 3** presented results related to video themes and uploader type. Importantly, we
177 found that there was a significant association between theme and uploader type. Specifically,
178 the majority of “*health information*” videos were uploaded by *medical communities* and *news*
179 *channels*, 98.1% and 90.1%, respectively. The proportions of videos that were uploaded by
180 *private users* were “*health information*” (59.8%), followed will by “*access/sales*” (16.1%) and
181 “*face mask related*” (13.4%). The association between video themes posted by *retailers* and
182 *vape enthusiasts* differed. For example, the most common videos that were uploaded by
183 *retailers* were “*access/sales*” (47.6%) and “*instructional*” (19.1%); while “*health information*”
184 (44.4%) and “*access/sales*” (22.2%) were most common videos that uploaded by *vape*
185 *enthusiasts*.

186 **4. DISCUSSION**

187 To the best of our knowledge, this study is the first to examine YouTube videos that are
188 related to both e-cigarettes and COVID-19. Moreover, our data represents the height of the
189 pandemic, between February 2020 and July 2021. In our collected data, the most common
190 theme was “*health information*”, which presented conflicting health information on whether

191 vaping exacerbated the risk of or was protective from COVID-19 infection. The second most
192 common theme was related to “*access/sales*”, which included the closure of vape shops and the
193 shift to online stores due to the pandemic. We also observed that videos uploaded by retail
194 stores showed the highest view counts, and “*instructional*” and “*access/sales*” videos showed
195 the highest comments and likes, respectively.

196 The “*health information*” videos reflected media coverage of research studies published
197 at the time, which conflicted over findings regarding the role of e-cigarette use on COVID-19.
198 Some studies indicated a greater risk of COVID-19 infection and worse prognosis(19–22) since
199 exposure to nicotine and other chemicals through e-cigarette use may affect the respiratory
200 system.(23–28) In contrast, other studies indicated that nicotine and e-cigarette use may not be
201 associated with COVID-19; rather, nicotine may even be a protective factor.(29–33) Only a few
202 videos, typically uploaded by e-cigarette brand and retailers, either suggested that vaping is
203 protective against COVID-19 or claimed no association. For example, one video uploaded by an
204 online e-cigarette retailer claimed that “*NIDA did not provide scientific evidence when NIDA had
205 advised quit vaping during pandemic.*” Of note, this video mimicked a news channel, including
206 hosts wearing suits and text scrolling at the bottom of the screen, which may have misled
207 viewers. This online retailer uploaded a follow-up video that claimed that FDA found no
208 connection between vaping and getting COVID-19. This video did not provide valid sources and
209 provided only a link to a pro-vaping organization blog with broken news links. A few videos
210 recommended vaping other substances (e.g., CBD, propolis) to protect themselves from
211 COVID-19 and to treat COVID-19. Some potential therapeutic effects of CBD on pain, nausea,
212 and epilepsy are confirmed by NIDA,(34) but there is no evidence to support that CBD protects
213 users against COVID-19. Another video suggested that vaping “bee juice” (propolis) can prevent
214 COVID-19. Propolis may be a healthy substance for strengthening immune systems(35);
215 however, there is no evidence to support that use of these substances or vaping these

216 substances can protect individuals from getting or treating COVID-19. Given that the effect of
217 vaping such substances on COVID-19 is still unclear,(36–40) these videos are disseminating
218 unconfirmed health information.

219 Notably, a number of “*face mask-related*” videos existed. For example, videos showed
220 comparisons of vaping with different types of cloth, surgical, and N95 masks and vaping while
221 wearing a mask. Some aerosols were retained in masks, which may cause re-inhalation. This is
222 concerning since re-inhalation may increase exposure to nicotine and chemicals from
223 vaping.(41) Further, we found a video instructing how to modify a vaping device for use while
224 wearing a mask. Consistent with prior studies,(12,42) e-cigarette modification videos still
225 persist, but are now related to COVID-19. Taken together, these results show that videos
226 endorsing risky behaviors and have gained attention from YouTube users. Surveillance is
227 warranted to continuously identify videos that might mislead or endanger viewers.

228 We observed more likes and comments for “*instructional*” and “*sales/access*” videos
229 than for videos with other themes. Even though the comments were not systematically
230 analyzed, it appeared that the comments were positive towards vape retailers and negative
231 towards governmental decisions regarding vape shop closure during COVID-19. For example,
232 the positive comments showed appreciation of entrepreneurship (e.g., “*amazing to see a*
233 *business going so far for their customers, respect!*”). The negative comments were geared
234 toward governmental decisions regarding vape shop closure during COVID-19 since vape
235 shops were considered “non-essential” businesses (e.g., “*all businesses are essential.*
236 *Regardless, telling a business they can't open is unconstitutional. Polis [sic.] should be sued*
237 *and arrested for illegally imposing orders that violate citizens constitutional rights*”).

238 Video themes in the “*other*” category included an upscale party (e.g., women wearing
239 formal gowns and jewelry, candlelight in the patio party room) in Bali Indonesia where party

240 attendees were vaping. A video in the “*other*” category of a party abroad that took place
241 during the travel ban was uploaded by a vape shop. Such videos are concerning because of the
242 portrayal of vaping as cool and glamorous, especially during the travel ban during COVID-19.

243 In summary, we identified a variety of e-cigarette-related content during the COVID-19
244 pandemic, which includes health information related to e-cigarettes and COVID-19, e-cigarette
245 sales and access during COVID-19 (e.g., vape shop closure), and face-mask-related e-cigarette
246 videos. Nonetheless, we acknowledge several limitations. First, we analyzed only videos in
247 English and there may be other content related to COVID-19 not captured in English. Since
248 YouTube is a social media platform used globally and e-cigarette use and COVID-19 are global
249 health issues, future studies would benefit from examining non-English content. Second, we
250 examined e-cigarettes and COVID-19-related content only on YouTube. Future studies should
251 examine other social media platforms as the content may differ. Third, future studies should
252 systematically analyze the sentiments of the comments to better understand perceptions related
253 to misinformation related to e-cigarettes and COVID-19 to communicate accurate health
254 information on social media.

255 Currently, COVID-19 is still widespread globally. As the health impacts regarding e-
256 cigarette use on COVID-19 are less known, future studies should examine the association
257 between them. Future studies should also examine how health information regarding e-
258 cigarettes and COVID-19 is portrayed on social media such as YouTube, and how COVID-19
259 was used for e-cigarette promotion. Continuous surveillance and the monitoring of novel vaping-
260 related content in reaction to policies and events such as the global pandemic on social media
261 are urgently needed.

262

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Table 1. Definitions and examples of categories

THEME	DEFINITION AND EXAMPLES
<i>Health information-how e-cigarette use affects COVID-19 diagnosis and prognosis (“health information”)</i>	Content featuring health risks and protection for COVID-19 through vaping nicotine or other substances Examples <ul style="list-style-type: none"> • Vaping nicotine increases the risk and worsens symptoms/prognosis of COVID-19 • Nicotine in tobacco product use may block the COVID-19 virus and protect from getting COVID-19 • Vaping CBD oils or propolis may be protective against COVID-19.
<i>Face mask related</i>	Content linking face mask with vaping such as showing exhaled aerosol from vaping while wearing a mask. Examples <ul style="list-style-type: none"> • Experiment of vaping with different types of masks – face shield, N95, K95, cloth mask, surgical mask and compare how clouds come out
<i>Instructional – how to modify/use e-cigarettes (“instructional”)</i>	Content on how to modify a vaping device to use with masks on (e.g. so that people can vape while wearing a mask on) and how to sanitize the vape devices during COVID-19 using Purell and Isopropyl Alcohol)
<i>How COVID-19 affects e-cigarette access/sales (“access/sales”)</i>	Content on how COVID-19 changed the marketing and sale of e-cigarettes Examples <ul style="list-style-type: none"> • Vape shop closed during COVID-19 pandemic as those are considered “non-essential” businesses • Vape shops offering delivery of e-cigarettes during COVID-19
<i>Other</i>	Content about vaping and COVID, but they do not fall into any of the other categories. Example: <ul style="list-style-type: none"> • Showing vape party in exotic resort place (e.g., Bali) during the travel ban
UPLOADER	
<i>Retailers</i>	Any Channel which is run by/for a vape shop with a brick and mortar store or an online store that sells e-cigarette products
<i>Vape enthusiasts</i>	Independent Channel who posts almost exclusively about vaping – over 50% of videos are related to vaping but are not directly connected to a vape industry.
<i>Medical communities</i>	Individual/organization with credentials in medicine or conducts research related to vaping and smoking (e.g., Cleveland Clinic, UW Health, Mayo Clinic, WHO). People who are clearly pretending or acting as if they had those qualifications were not included.
<i>News channels</i>	Channel that focuses on delivering news, such as mainstream broadcasting Channels (e.g., ABC, CNN, CBS)
<i>Private users</i>	YouTube creator (a single person or a group) who posts about a variety of topics, which can include vaping, as long as vaping is not the focus of the Channel.
<i>Others</i>	Any Channel which does not fall into one of the other categories (e.g, Fitness information Channel)
E-CIGARETTE PRODUCT FEATURED	
<i>Featured</i>	Videos that feature specific e-cigarette products such as cigalike, e-liquids (e-juice), vaping kit, box mod, vape pen, closed pod system, disposable, vape box or subscription service
<i>Not Featured</i>	Videos which do not present any specific e-cigarette devices.

Figure 1. Inclusion of YouTube videos on vaping and COVID-19 and reasons for exclusion.

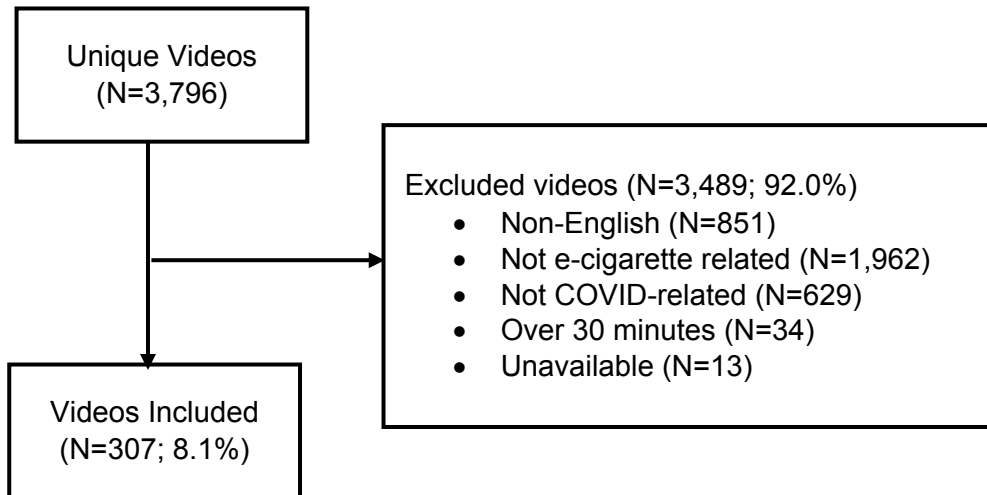


Table 2. Descriptive Characteristics of Videos Related to E-cigarettes and COVID-19 (N=307)

	Overall	1. View ^a	2. Comment ^a	3. Like ^a	4. year ^b	
					2020	2021
	N (%)	Median (IQR)	Median (IQR)	Median (IQR)	N (%)	
Theme ^e		<i>p</i> =0.179 ^c	<i>p</i> =0.044 ^c	<i>p</i> =0.009 ^c	<i>p</i> =0.099	
Health information-how e-cigarette use affects COVID-19 diagnosis and prognosis (“ <i>health information</i> ”)	229 (73.6)	219 (1625)	2 (8)	3 (19)	208 (76.7)	21 (58.3)
Face mask related	16 (5.1)	41.5 (835.5)	0 (1)	2.5 (8)	13 (4.8)	3 (8.3)
Instructional – how to modify/use e-cigarettes (“ <i>instructional</i> ”)	10 (3.2)	392 (1646)	10 (7)	23 (32)	6 (2.2)	3 (8.3)
How COVID-19 affects e-cigarette access/sales (“ <i>access/sales</i> ”)	40 (12.9)	680 (3698)	7 (36)	22 (76)	32 (11.8)	7 (19.4)
Other	16 (5.1)	146.5 (2670)	2.5 (6)	4 (54)	12 (4.4)	2 (5.6)
Uploader		<i>p</i> =0.001 ^c	<i>p</i> =0.054 ^c	<i>p</i> =0.609 ^c	<i>p</i> =0.420	
Retailers	21 (6.8)	520 (1519)	1 (7)	12 (29)	19 (7.0)	2 (5.6)
Vape enthusiasts	9 (2.9)	48 (336)	1 (6)	3 (24)	8 (3.0)	1 (2.8)
Medical communities	52 (16.9)	457 (7229.5)	1.5 (13.5)	5.5 (47)	47 (17.3)	5 (13.9)
News Channels	111 (36.2)	319 (2003)	3 (15)	3 (20)	102 (37.6)	9 (25.0)
Private users	112 (36.5)	101 (737)	1 (9.5)	3 (27)	93 (34.3)	19 (52.8)
Others	2 (0.7)	213 (382)	0 (0)	2 (4)	2 (0.7)	0 (0)
E-cigarette product featured		<i>p</i> =0.697 ^c	<i>p</i> =0.718 ^c	<i>p</i> =0.547 ^c	<i>p</i> =0.365	
Featured	33 (10.7)	197 (1643)	1 (11)	3 (21)	28 (10.3)	2 (5.6)
Not Featured	277 (89.3)	230 (2013)	2 (10)	4 (28)	243 (89.7)	34 (94.4)

a: Median (IQR) for continuous variables due to non-normality; b: N(%) indicated for categorical variables; c: Kruskal-Wallis test for continuous variables due to non-normality; d: Pearson chi-square tests for categorical variables; e: Themes are coded multiple times if the video presented different themes

TABLE 3. Proportions across themes and uploader types

	Uploader						P-value
	Retailers	Vape enthusiasts	Medical communities	News Channels	Private users	Others	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Theme							<0.001
Health information-how e-cigarette use affects COVID-19 diagnosis and prognosis (<i>“health information”</i>)	5 (23.8)	4 (44.4)	51 (98.1)	100 (90.1)	67 (59.8)	2 (100)	
Face mask related	0 (0)	1 (11.1)	0 (0)	0 (0)	15 (13.4)	0 (0)	
Instructional – how to modify/use e-cigarettes (<i>“instructional”</i>)	4 (19.1)	0 (0)	0 (0)	0 (0)	5 (4.5)	0 (0)	
How COVID-19 affects e-cigarette access/sales (<i>“access/sales”</i>)	10 (47.6)	2 (22.2)	0 (0)	9 (8.1)	18 (16.1)	0 (0)	
Other	2 (9.5)	2 (22.2)	1 (1.9)	2 (1.8)	7 (6.3)	0 (0)	