



HEALTH PROMOTION

Is social media our new quitline? A descriptive study assessing youtube coverage of tobacco cessation

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Keywords

Smoking cessation • Quit smoking • Social media • YouTube • Health education • Health communication • Smoke-free

Summary

Background. Tobacco use and exposure are leading causes of morbidity and mortality worldwide. In the past decade, educational efforts to reduce tobacco use and exposure have extended to social media, including video-sharing platforms. YouTube is one of the most publicly accessed video-sharing platforms.

Purpose. This cross-sectional descriptive study was conducted to identify and describe sources, formats, and content of widely viewed YouTube videos on smoking cessation.

Methods. In August to September 2023, the keywords “stop quit smoking” were used to search in YouTube and identify 100 videos with the highest view count.

Results. Collectively, these videos were viewed over 220 million times. The majority ($n = 35$) were posted by nongovernmental/organization sources, with a smaller number posted by consumers ($n = 25$), and only eleven were posted by governmental agen-

cies. The format used in the highest number of videos was the testimonial ($n = 32$ videos, over 77 million views). Other popular formats included animation ($n = 23$ videos, over 90 million views) and talk by professional ($n = 20$ videos, almost 43 million views). Video content included evidence-based and non-evidence-based practices. Evidence-based strategies aligned with U.S. Public Health Service Tobacco Treatment Guidelines (e.g. health systems approach in tobacco treatment, medication management). Non-evidence-based strategies included mindfulness and hypnotherapy. One key finding was that environmental tobacco exposure received scant coverage across the videos.

Conclusions. Social media such as YouTube promises to reach large audiences at low cost without requiring high reading literacy. Additional attention is needed to create videos with up-to-date, accurate information that can engage consumers.

Introduction

Tobacco use is one of the leading preventable causes of disease, premature death, lost productivity, and healthcare costs. Tobacco use exerts an immense financial burden on the healthcare system in the United States. Costs incurred for treatment from illnesses and lost productivity attributed to tobacco use exceed \$300 billion yearly. Tobacco dependence is a significant risk factor for acute and chronic diseases across both the pediatric and adult patient populations [1].

Many educational efforts have helped to heighten knowledge and awareness of tobacco dependence and cessation across the world. The scope of these efforts has substantially varied, and many have had a translational impact. Health communication is at the heart of delivering clear and persuasive messages about quitting tobacco use and can take many forms on both micro and macro levels. Efforts at the local, state, national, and global levels have been made to promote tobacco reduction and cessation across different patient populations. Examples of these efforts include smokefree policies in homes, vehicles, and buildings; price increases in tobacco products; and health education campaigns that target specific groups at higher risk for adverse health effects [2-24]. Some of these campaigns have extended

into different sources of media, including mass media and social media platforms.

Social media in our digital era is ubiquitous. Across the trending social media platforms, YouTube is the major one that provides the greatest degree of public video-sharing, thereby making it increasingly easier to find videos as well as extend onto different social media platforms. Unlike Twitter or X that requires more time-intensive mechanisms to locate words across tweets, as well as Facebook and Instagram which may not have as much content publicly available, YouTube itself offers a wealth of data mining with more efficiency which can yield data from the time of its inception. In fact, multiple health-related topics have already received thorough coverage on YouTube including vaccinations, developmental disabilities, skin cancer, and much more [25-27]. For this reason, tapping into YouTube to uncover content that engages viewers is crucial to strengthen the delivery and precision of this communication medium that continues to increase its visibility and prominence in our contemporary digital times. In addition, YouTube is a communication medium that disseminates knowledge and practice on not only health-related topics but also national and global topics trending across the country and world.

Several studies have provided education centered on

tobacco reduction and cessation by publishing videos. Given that YouTube is one of the most prevalent social media platforms at this time [28], this study examined widely viewed YouTube videos related to tobacco cessation. One benefit of YouTube videos is the range of diverse learners who can access information on this medium through narration, closed captioning, and/or visually engaging content at any time anywhere across the globe. Another benefit is how it enables access for people who prefer to learn through video versus print because they cannot or do not want to read.

Notably, there is a paucity of research exploring the impact of YouTube on smoking cessation education, promotion, and resource provision. Among the few studies conducted, most of the videos were more than a decade old. As the basis of informing the direction of this present research, it is crucial to extend the current literature on smoking cessation coverage via YouTube by critically assessing content across videos published over the past decade. The goals of the present study are the following: 1) Describe sources, formats, and content of the widely viewed YouTube videos on smoking cessation; and 2) present implications and recommendations for future research and practice.

Methods

The research design was cross-sectional and involved collecting observational data at one conceptual point in time from the YouTube social media platform. In August to September 2023, the browser history on the computers of the researchers was cleared. Next, with a clean history on the computer, the researchers conducted a search on YouTube using a specific string of key words. Piloting various key words (smoke-free, quit smoking, stop smoking) was helpful in determining which phrase(s) yielded the most relevant videos, highest view counts across videos, and greatest cumulative views for the top 30, 60, and 100 videos, respectively. The key words that formed the search strategy were “stop quit smoking” which ultimately yielded the most widely viewed videos that were directly relevant to smoking cessation. The results were sorted by view count, and the URLs for the 100 most widely viewed videos were copied and saved in a separate file. Overlapping URLs were deleted and replaced. Only one URL for each video was kept for coding.

The researchers then created a codebook based on a review of literature and guidelines from authoritative agencies such as the U.S. Public Health Service and the World Health Organization (WHO). The researcher viewed and coded all videos during August and September 2023. Inter- and intra-rater reliability of the coding was demonstrated. The following information was coded for each video: (a) source of upload, (b) format, (c) number of views, (d) length (in minutes), (e) year of upload, and (f) content.

ELIGIBILITY CRITERIA

One inclusion criterion was that the videos be in English. Videos that did not have English narration or written content were excluded from analysis. A second criterion was that the video center on smoking cessation. Each researcher viewed the full video, which constituted the unit of analysis. Music videos not centered on smoking cessation were excluded. No requirements were specified based on length of time.

MEASUREMENTS AND CODING SPECIFICATIONS

The instrument included the following basic information: coder, video identification number (which was assigned), date the video was uploaded, date the video was coded, length of video (in minutes), number of views, and title of the video. Following this general information, the instrument comprised the following three sections: (a) source of upload, (b) format, and (c) content. Content included many variables (discussed below), all of which were coded dichotomously (*i.e.*, either yes or no) to indicate presence or absence in the respective video.

The source of upload for each video was coded into one of the following four categories: organizational, consumer, governmental, and other sources. The categories for coding Format included Documentary; Interview; Demonstration/ Experiment; Talk by Professional; TV Talk Show/Discussion panel; Animation; Still images; News report with anchor; V-blog; Advertisement; Testimonial/Story; Multiple formats; and “Other formats.” The content categories were formulated based on guidelines, recommendations, or related anticipatory guidance from the U.S. Department of Health and Human Services, CDC, WHO, and Healthy People 2030. A total of 11 content categories was created in this codebook: (a) aesthetic effects; (b) health effects; (c) environmental tobacco exposure; (d) stressors/triggers that encompass intrinsic psychological factors; (e) tips, strategies, and resources to quit; (f) outcomes; (g) ingredients in tobacco products; (h) kinds of tobacco products; (i) health benefits of quitting; (j) social/environmental benefits of quitting; and (k) open-ended comments on misinformation or disinformation conveyed in the video. Conceptualization of the codebook involved developing these content categories to account for the depth and breadth of targets for intervention from smoking cessation efforts.

DEMONSTRATION OF INTRA- AND INTER-RATER RELIABILITY

The researchers demonstrated the intra- and inter-rater reliability of the data regarding coding of the presence of content in the videos. To demonstrate intra-rater reliability, each researcher randomly selected 10 videos and recoded them within 2 weeks of the original coding. All of the dichotomously coded (Yes versus No) content variables in the instrument were included in this analysis. Intra-rater reliability was found to be high (Kappa = 0.942). Inter-rater reliability was demonstrated as well. Five videos were randomly selected from the 100 in the sample, and Inter-rater agreement was also found to be high (Kappa = 0.931).

STATISTICAL ANALYSIS

The analysis required calculating descriptive statistics for the different variables under study. Data describing the characteristics of videos were summarized by calculating frequencies and percentages regarding source, format, number of views, length, and content. For each content category, the number of videos that covered the content was identified, and then the number of collective views from those videos covering each particular content area was determined. In addition, the proportion of total cumulative views was determined by dividing the number of views received by the particular videos covering each content area by the total cumulative views received by all videos ($N = 334,299,907$ views). This analysis was conducted for all content categories specified in the codebook.

Results

The total number of views for the sample of the 100 most widely viewed videos was 334,299,907. The view counts ranged from 205,772 to 44,286,440. These widely viewed videos were posted between 2006 to 2023. Length of videos ranged from 0.25 minutes to 541.42 minutes. The median length of the widely viewed videos was 5.17 minutes. The interquartile range for the sample ranged from 2.52 minutes to 11.40 minutes.

The majority of the widely viewed videos were uploaded by nongovernmental/organizational sources ($n = 35$), which garnered over 80 million views representing approximately 25% of the cumulative views (Tab. I). Although fewer videos ($n = 25$) were published by consumer sources, these videos comprised greater than 35% of the cumulative views (greater than 125 million views). 29 videos were uploaded by other sources including talk shows, TV shows, radio shows, or news shows, which garnered less than 30% of cumulative views (~87 million views). 11 videos were uploaded by governmental sources; collectively, these eleven videos accounted for less than 12% of cumulative views (nearly 37 million views).

There was substantial variation in the formats of the widely viewed videos on smoking cessation (Tab. II). The greatest number of videos were in the form of testimonials, generating greater than 77 million views (~20% of the cumulative views). Although animation was

Tab. II. Frequencies, view counts, and cumulative view count percent of widely viewed smoking cessation videos by format.

Format	N	View count	Cumulative view count percent (%)
Testimonial	32	77,871,704	23.29
Animation	23	90,285,821	27
Talk by professional	20	42,569,819	12.73
Other formats	14	20,346,984	6.09
Still images	13	36,866,284	11.03
Demonstration/experiment	11	112,671,550	33.7
V-blog	8	43,036,794	12.87
TV talk show/discussion panel	7	27,437,728	8.21
News report with anchor	5	9,014,217	2.7
Multiple formats	4	6,081,661	1.82
Interview	4	2,690,753	0.8
Documentary	2	5,662,144	1.69
Advertisement	0	0	0

¹ More than one response is possible across videos.

covered in fewer videos ($n = 23$), these videos culminated in nearly 90 million views, accounting for 27% of the cumulative views. Other popular formats included talk by professional ($n = 20$) which yielded greater than 42 million views, representing nearly 13% of the cumulative views. 14 videos were in other nontraditional formats and garnered ~20 million views (approximately 6% of the cumulative views). Although still images were also covered in a comparable number of videos ($n = 13$), these videos generated nearly 37 million views (~11% of the cumulative views). Notably although demonstrations/experiments were depicted in solely eleven videos, they collectively garnered greater than 112 million views, representing almost 34% of the cumulative views. 8 videos were in the form of v-blogs and accounted for ~40 million views (about 13% of the cumulative views). In addition, although seven videos included content on TV talk shows and discussion panels, these videos yielded greater than 27 million views, comprising approximately 8% of the cumulative views. Other formats (news report with anchor, more than two combined formats, interviews and documentaries) accounted for fewer than 24 million views collectively and about 7% of the cumulative views. Advertisements were not covered in any of the widely viewed videos on smoking cessation.

A total of 10 aesthetic effects were coded for each of the 100 widely viewed videos. These 10 aesthetic effects were mentioned in 3 videos for nails and stains up to as many as 14 videos for the aesthetic effect of smell (garnering over 45 million views). In addition to smell, aesthetic effects of smoking that were covered in more videos included effects on taste (13 videos garnering nearly 50 million views), skin (12 videos garnering over 28 million views), teeth (8 videos garnering over 40 million views), hair (8 videos garnering approximately 20 million views), and wrinkles (7 videos garnering ~25 million views). Notably although 7 videos also included

Tab. I. Frequencies, view counts, and cumulative view count percent of widely viewed smoking cessation videos by upload source.

Classification of the source of video upload	N	View count	Cumulative view count percent (%)
Nongovernmental/organizational	35	83,632,718	25.02
Consumer	25	125,584,143	37.57
Other	29	87,481,657	26.17
Governmental	11	37,601,389	11.25

Tab. III. Frequencies, View Counts, and Cumulative View Count Percent of Widely Viewed Smoking Cessation Videos by Health Effects

Health Effects	N	View count	Cumulative view count percent (%)
Illness/mortality	53	213,153,640	63.76
Signs and symptoms	37	156,127,114	46.7
Healthcare utilization	14	27,663,708	8.28
Reproductive effects	4	19,421,021	5.81
Use of durable medical equipment	3	22,070,434	6.6
Health effects on infants	3	2,209,693	0.66

¹ More than one response is possible across videos.

content on breath, these videos yielded fewer than 6 million views. In contrast, a smaller number of videos presented content on voice ($n = 4$) which garnered substantially more views (nearly 24 million views and ~7% of the cumulative views). Nails and stains were each integrated in 3 videos each, collectively accounting for approximately 20 million views and 6% of the cumulative views.

6 health effects were examined to determine the extent to which they were covered in the sample of widely viewed videos (Tab. III). Illness and mortality were depicted in 53 videos, generating greater than 200 million views (~64% of the cumulative views). Signs and symptoms were integrated in 37 videos, garnering ~156 million views (~47% of the cumulative views). Healthcare utilization was covered in 14 videos, accounting for more than 27 million views (~8% of the cumulative views). 4 videos covered reproductive effects, representing 19 million views and about 6% of the cumulative views. Although 3 videos included content on durable medical equipment, these videos populated greater than 22 million views and about 7% of the cumulative views. Lastly, 3 videos presented content surrounding health effects on infants, generating greater than 2 million views and less than 1% of the cumulative views.

3 levels of environmental tobacco exposure were coded in each of the videos—namely, firsthand, secondhand, and thirdhand smoke. The vast majority of the 100 widely viewed YouTube videos covered content on firsthand smoke exposure ($n = 85$), which attracted over 300 million views (~90% of total cumulative views). In contrast, coverage of secondhand and thirdhand smoke exposure was significantly scant across videos, with only 9 videos mentioning secondhand smoke (garnering under 19 million views representing ~6% of total cumulative views); and only 1 video referencing thirdhand smoke exposure (attracting under 1 million views and less than one-half of 1% of the total cumulative views).

11 stressors/triggers were included in the codebook for this study; however, 8 were not mentioned in a single video. The only Stressor/Trigger that was mentioned in a substantial portion of the videos (15 of 100) involved peer influence. These videos attracted ~30 million views

(~9% of total cumulative views). Poor coping skills were covered in 8 of the videos, generating ~8 million views and less than 3% of the cumulative views. Coverage of mood and anxiety disorders was included in 6 of the

Tab. IV. Frequencies, view counts, and cumulative view count percent of widely viewed smoking cessation videos by tips, strategies, and resources to quit.

Health benefits	N	View count	Cumulative view count percent (%)
Exercise	28	59,700,689	17.86
Testimonials/success stories	24	39,056,885	11.68
Curb cravings	22	30,627,398	9.16
Quitting cold turkey	18	38,664,398	11.57
Support networks	15	50,748,458	15.18
Nicotine patches	15	30,896,422	9.24
Nicotine gum	14	30,267,576	9.05
Hypnosis	14	19,199,356	5.74
Identifying alternatives to mediate triggers	13	12,400,618	3.71
Distraction	9	23,192,581	6.94
Quitline	9	22,922,508	6.86
Individual counseling	8	33,435,289	10
Mindfulness	8	26,586,373	7.95
Nicotine spray	8	24,789,142	7.42
Nicotine lozenges	7	24,238,056	7.25
Prescription medications	7	6,622,004	1.98
Vaping/e-cigarettes for quitting or as harm reduction strategy	6	50,713,216	15.17
Stay busy/active	6	7,503,331	2.24
Tobacco treatment clinic	6	2,731,587	0.82
Quitting incrementally/gradually through a weaning process	5	29,797,158	8.91
Yoga/meditation	5	6,403,873	1.92
Quit date	5	2,418,442	0.72
Deep breathing	4	10,023,721	3
Chewing	4	7,146,512	2.14
Preparation/planning	4	4,703,425	1.41
Cognitive behavioral therapy	3	23,221,189	6.95
Acupuncture	3	5,604,541	1.68
Contemplation	3	4,526,276	1.35
Laser therapy	2	5,286,922	1.58
Action	2	4,111,724	1.23
Coloring/drawing	2	1,231,189	0.37
Support groups	1	17,211,328	5.15
Intergenerational	1	5,692,242	1.7
One or more of the 5as	1	3,570,242	1.07
Lollipop	1	1,716,680	0.51
Music	1	1,002,950	0.3
Massage	1	1,002,950	0.3
Wellness coach	1	1,002,950	0.3
Change in environment	1	274,082	0.08
Inspirational text messages	0	0	0
Prayer	0	0	0
Group counseling	0	0	0
Motivational interviewing	0	0	0

¹ More than one response is possible across videos.

videos attracting over 26 million views (8% of total cumulative views). Stressful job was mentioned in 1 video, comprising ~2 million views (less than 1% of the total cumulative views).

There were 43 distinct tips, strategies and resources coded in this study (Tab. IV). The one covered in the greatest number of videos was exercise, which was mentioned in 28 videos attracting over 59 million views (~18% of cumulative views). Testimonials/success stories were featured in 24 videos, culminating in ~39 million views (about 12% of cumulative views). 22 videos covered content on curbing cravings, yielding greater than 30 million views (~9% of the cumulative views).

18 videos presented content on quitting cold turkey which collectively comprised greater than 38 million views and about 12% of cumulative views. Support networks were included in 15 videos, garnering ~50 million views (approximately 15% of cumulative views). Although nicotine patches were also integrated in a comparative 15 videos, their cumulative views were substantially smaller (~31 million views), accounting for about 9% of the cumulative views. Nicotine gum was depicted in 14 videos, culminating in ~30 million views and comprising approximately 9% of the cumulative views. Although a comparative number of videos ($n = 14$) presented content on hypnosis, these videos yielded fewer views (~19 million) which represented about 6% of the cumulative views. In addition although a similar number of videos ($n = 13$) presented content on identifying alternatives to mediate triggers, these videos populated ~12 million views which accounted for around 4% of the cumulative views.

9 of the videos presented content on distraction, comprising ~23 million views and approximately 7% of the cumulative views. Similarly, 9 videos yielded content on quitline as a resource, garnering also a comparative 23 million views which represented also nearly 7% of the cumulative views. Individual counseling was covered in 8 videos, generating nearly 33 million views and 10% of the cumulative views. In addition, a comparative 8 videos included content on mindfulness (garnering greater than 26 million views and 8% of cumulative views). Nicotine sprays were accounted for in 8 videos (representing ~25 million views and approximately 7% of cumulative views). Similarly, nicotine lozenges were present in 7 videos and culminated in nearly 24 million views, also representing around 7% of cumulative videos. 7 videos depicted content on prescription medications, accounting for greater than 6 million views and a miniscule 2% of the cumulative views.

Notably although only 6 videos presented content on vaping/e-cigarettes for quitting or as a harm reduction strategy, these videos culminated in greater than 50 million views, representing nearly 15% of the cumulative views. In contrast, a comparative 6 videos covering content on staying busy and active generated substantially fewer views (less than 8 million), accounting for ~2% of the cumulative views. 6 videos which also comparatively included content on tobacco treatment clinics yielded ~3 million views which represented less than 1% of the

cumulative views. Notably although 5 videos depicted content on quitting incrementally/gradually through a weaning process, collectively these videos garnered nearly 30 million views and ~9% of the cumulative views. In addition, yoga/meditation and quit date were each covered in 5 videos, collectively comprising fewer than 10 million views and also less than 3% of cumulative views.

Although 4 videos presented content on deep breathing, these videos garnered ~10 million views, representing 3% of cumulative views. Chewing was also covered in 4 videos, yielding ~7 million views (2% of the cumulative views). Preparation/planning was included in 4 videos, generating ~5 million views (around 1% of cumulative views). In addition, although 3 videos integrated content on cognitive behavioral therapy, these videos populated 23 million views and 7% of the cumulative views. In addition, a comparative 3 videos depicted content on acupuncture; however, these videos garnered substantially fewer views (greater than 5 million views and less than 2% of cumulative views). Similarly, contemplation was portrayed in 3 videos, generating ~5 million views (1% of cumulative views). Lastly, laser therapy, action and color/drawing were collectively presented in 6 videos, yielding ~10 million views and less than 3% of cumulative views.

Notably although 1 video covered content on support groups, this video generated ~17 million views, comprising nearly 5% of cumulative views. Only 1 video also covered intergenerational considerations; however, this video yielded substantially fewer views (greater than 5 million, ~2% of cumulative views). 6 videos collectively integrated content on one or more of the 5As, lollipops, music, massages, wellness coaches, and changes in environment, culminating in fewer than 10 million views and also fewer than 3% of the cumulative views. Of note, none of the videos covered content on inspirational text messages, prayer, group counseling and motivational interviewing.

A total of 87 videos included content on Quit as an outcome. This topic, not surprisingly, was among those most widely covered in the sample and garnered more than 233 million views (nearly 70% of the total views). The rest of the outcomes, Quit Attempt, Relapse, and Setback were covered in fewer videos, and each of these outcomes accounted for approximately 20% of the cumulative views.

6 specific ingredients in tobacco smoke were examined in the study. A total of 41 videos presented content on nicotine yielding greater than 142 million views (almost 43% of cumulative views). 20 videos depicted content on toxic chemicals, culminating in greater than 65 million views (20% of the cumulative views). Fewer videos ($n = 14$) delineated content on tar, attracting almost 56 million views which represented ~17% of total views. 6 videos depicted content specifically on carcinogens, generating more than 5 million views (2% of cumulative views). Three videos presented content on household chemicals, accounting for almost 2 million views (less than 1% of total views). Lastly, 3 videos included coverage of

Tab. V. Frequencies, view counts, and cumulative view count percent of widely viewed smoking cessation videos by tobacco products.

Tobacco products	N	View count	Cumulative view count percent (%)
Cigarettes	68	245,631,989	73.48
Marijuana/weed	18	39,103,603	11.67
Vape products	18	75,958,304	22.72
Smokeless tobacco	2	2,904,527	0.87
Cigars	2	2,786,450	0.83

¹ More than one response is possible across videos.

vaping flavors, garnering nearly 2% of cumulative views (~7 million views).

5 specific tobacco products were examined in the study (Tab. V). There were 68 videos, attracting almost 245 million views (> 73% of total views) that provided coverage of cigarettes. Although vape products were only covered in 18 of the videos, these videos accounted for nearly 76 million views, which comprised almost 23% of the cumulative views. A comparative number of videos (n = 18) delineated content on marijuana/weed, which accounted for nearly 39 million views and approximately 12% of cumulative views. Fewer than 5 videos covered content on cigars, smokeless tobacco, and other kinds of products, which generated less than 2% of cumulative views.

9 health benefits of smoking cessation were examined. There were 37 videos that presented content on healthy lifestyle, garnering nearly 72 million views (~22% of the cumulative views). Comparatively, there were 33 videos that depicted content on improved quality of life, yielding approximately 66 million views (about 20% of the cumulative views). 26 videos included content on reduced risk of chronic disease, culminating in ~87 million views (26% of the cumulative views). 16 videos integrated content on breathing easier, accounting for nearly 22 million views and ~6% of the cumulative views. Increased life expectancy was covered in 14 videos, generating ~36 million views and 11% of the cumulative views. Lastly, 10 videos portrayed content on activities of daily living which garnered greater than 20 million views (~6% of the cumulative views). Increased cognition/intellect was covered in 7 videos, populating ~13 million views (almost 4% of the cumulative views). Reduced risk of chronic disease was comparatively included in 7 videos which yielded ~7 million views (about 2% of the cumulative views). Lastly, fertility received scant coverage across the widely viewed videos, accounting for nearly 1 million views (less than 1% of the cumulative views).

In general, the 8 social/environmental benefits of smoking cessation did not attract a large proportion of total views. There was a wide dispersion across social and environmental benefits. 24 videos presented content on optimizing fitness and exercise, accounting for nearly 33 million views (10% of the cumulative views). Increased finances were covered in 18 videos, generating almost 43 million views (~13% of cumulative

views). 17 videos depicted content on positive coping strategies which yielded nearly 19 million views (about 6% of the cumulative views). 6 videos included content on increased socialization, generating nearly 10 million views (around 3% of the cumulative views). Notably, there was increasingly scarce content covered across the videos on smoke-free and vape-free environmental considerations. Only 2 videos accounted for smoke-free and vape-free buildings and vehicles, garnering fewer than 5 million views and less than 2% of the cumulative views. There was no coverage on smoke-free and vape-free homes as well as reduced risk of children smoking or vaping across the widely viewed videos on smoking cessation. Tables I-V present a breakdown of number of views and cumulative views for sources, formats and content among the widely viewed videos on smoking cessation.

Discussion

This is one of a few studies to assess the sources, formats, and content of widely viewed YouTube videos on tobacco cessation. Tobacco dependence continues to be a significant risk factor in the onset and progression of a range of harmful illnesses. Education for individuals, families, and communities about tobacco cessation care can be instrumental in helping people achieve cessation. In this digital era, the utilization of social media such as YouTube is a promising way to reach large audiences at very low cost. Given the global reach of YouTube, an assessment of who is disseminating different tobacco-related content revealed information that is relevant to public health education for individuals attempting to stop using tobacco as well as for their families.

COMPARISON WITH PRIOR STUDIES

The findings on sources of widely viewed videos on health topics are consistent in some ways with prior studies. Videos uploaded by consumers comprised the primary source of the most widely viewed videos [25, 29-34]. High prevalence of consumer sources may suggest that individuals with tobacco dependence or anyone in their networks will likely draw on non-expert sources to obtain guidance on smoking reduction and cessation. In addition, the cumulative views generated by this study (approximately 334 million) were comparatively greater than several of these content analysis studies on YouTube, many of which yielded fewer than 80 million views. This finding suggested that many consumers have some interest, stake, and contribution in mitigating the tobacco epidemic in one or more ways, potentially from either being closely affected or more distally affected by it. Furthermore, this finding is line with additional prior studies that garnered greater than 300 million views and involved topics that also pertained to individualized health needs (*e.g.*, weight loss, DNA testing) [31, 35]. A significant difference between the present study and these past studies pertains to accounting for environmental tobacco exposure in the coding instrument. In this study,

content categories on environmental tobacco exposure – along with variables pertaining to social engineering, smoke-free homes, vehicles, and buildings – were included in the coding instrument. In the prior studies, environmental tobacco exposure was not accounted for in the coding of content.

CONSISTENCY WITH OFFICIAL GOVERNMENTAL GUIDELINES

Across the most widely viewed videos on smoking cessation, a range of content was covered, including strategies and resources to support individuals with tobacco dependence in their efforts to quit. Notably, two of the clinical modalities, the 5As Model and Motivational Interviewing supported by the U.S. Public Service Tobacco Treatment Clinical Guidelines [36], received minimal coverage. Both models are supposed to be implemented through clinical interventions delivered by healthcare professionals. Additional resources recommended such as Nicotine Replacement Therapy products were covered to a much greater extent and included in some of the videos by non-expert sources or healthcare providers with their own video channels. Given evidence of their efficacy, there is a need to include information about these topics in YouTube videos.

An issue identified in the findings that warrants attention is that some widely viewed videos convey information about cessation strategies that are not recommended by official agencies such as the CDC or U.S. Public Health Service. Almost 9% of the videos covered content on curbing cravings, while 4% included content on alternatives to mediate triggers; these are apparently relevant and engaging for different segments of the consumer population. Other topics such as hypnosis and mindfulness received coverage across the widely viewed videos, but neither is supported by the U.S. Public Health Service as efficacious tobacco treatment interventions in the clinical guidelines. These approaches have demonstrated some promising success in supporting patients in achieving tobacco cessation [37-39], but the data are not yet sufficiently compelling for them to be included as part of the Clinical Guidelines. Thus, it is crucial for the government to examine the existing tobacco cessation Clinical Guidelines critically in order to account for content that matches patient preference, acceptability, affordability, and accessibility.

VAPING AS A HARM REDUCTION STRATEGY

Several of the widely viewed videos covered vaping as a strategy for tobacco reduction and cessation. In light of the growing vaping epidemic, controversy surrounding vaping as a harm-reduction strategy persists [40-42]. It should be noted that while the researcher considers vaping a flawed approach to smoking cessation, many would not consider this misinformation. Of note, the vaping epidemic emerged nearly 5 to 10 years ago. There are still many unknowns about the long-term health effects (beyond EVALI) of vaping, given insufficient knowledge about possible long-term toxicity. One

argument in favor of vaping is that, compared with burning tobacco, it does not have the equivalent impact on vapers and their surroundings [43,44]. Nevertheless, the U.S. Public Health Service does not recommend vaping in its tobacco treatment guidelines. As more knowledge is disseminated over time about the impact of vaping on human health, it is possible that perceptions pertaining to its efficacy as a harm-reduction strategy for many could change.

ENVIRONMENTAL TOBACCO EXPOSURE

One of the most important findings from this study related to what was not found in the widely viewed videos. Hardly any videos covered content on secondhand and thirdhand smoke exposure, both forms of environmental tobacco exposure that significantly impact nonsmokers [45]. In addition, none of the videos presented content on supporting tobacco-free homes, vehicles, and buildings along with social engineering, all of which also contribute significantly to reducing environmental tobacco exposure for smokers and nonsmokers [46-50]. Tobacco exposure is one of the leading environmental exposures for a host of acute and chronic diseases [50, 51]. Oftentimes, coverage of content on social media matches trends in communities across both national and global levels. This finding suggested that since tobacco exposure was not widely covered in social media, it is possible that it also does not receive coverage in other publicly visible modalities (*e.g.*, outdoor advertisements, billboards, print materials). It follows that integrating content that addresses tobacco exposure in prominent social media could lay the foundation for addressing more seriously this leading environmental exposure as a significant health hazard for both smokers and nonsmokers. Furthermore, viewers who are smokers accessing this content could gain insight into the impact of their smoking on those around them. This gap in coverage warrants further research to find ways to integrate this content into education, especially for specialized populations such as children, pregnant women, and nonsmokers. Greater attention to environmental tobacco smoke may benefit smokers as well by heightening their awareness of how their tobacco use has harmful consequences not only for themselves but for others in their family and community.

IMPLICATIONS FOR IMPROVING ACCESS TO TOBACCO CESSATION RESOURCES

The findings revealed a wealth of self-help tips and strategies to support individuals with tobacco dependence, along with their social, familial, and professional networks. Since these videos are reaching so many people, they may have the potential to help those who are not interested or able to seek cessation care in healthcare and community settings. While the ease of accessing these videos on their own terms and time is a significant benefit, it should also be recognized that the efficacy of social media platforms such as YouTube has not been established as an evidence-based practice in mitigating tobacco dependence on individual and population levels.

Nevertheless, some of the videos included evidence-based guidelines (*e.g.*, from the U.S. Public Health Service's Treating Tobacco Use and Dependence Clinical Practice Guidelines), and it is reasonable to expect that increasing awareness of such guidance can mitigate the global tobacco epidemic. Establishing credibility in cessation messaging could also contribute to the larger goal of the WHO in creating the next tobacco-free generation worldwide, the goals of Healthy People 2030 on a national level, and the United Nations Sustainable Development Goals on a global level.

IMPLICATIONS FOR HEALTH AND REGULATORY POLICIES

Tobacco control recommendations by the WHO, U.S. Public Health Service, Healthy People 2030, and United Nations Sustainable Development Goals have the potential to inform legislation, taxation, and social engineering. Findings from the WHO's MPOWER report revealed that 23 countries (Seychelles, Mauritius, Costa Rica, Brazil, Panama, Surinam, Colombia, Canada, Uruguay, Argentina, United Kingdom, Turkey, Portugal, Russia, Ireland, Romania, Estonia, Denmark, Spain, Norway, Iran, Australia, and New Zealand) obtained the highest scores for the implementation and enforcement of their tobacco control policies and legislation, including smoke-free regulations, advertising bans, taxation, and uptake in the visibility of health warnings on cigarette packages [52]. Integrating this content into the widely viewed videos can align and promote contemporary policies intended to promote smoke-free environments across the world.

In addition, integrating increased smoke-free environment content into videos could also benefit two specialized populations, infants and pregnant women. After the enactment of smoke-free legislation in Brazil, the average infant mortality rate declined substantially from 24.5 to 13.0 deaths per 1,000 live births from 2000 to 2016, and the neonatal mortality rate declined from 15.6 to 9.0 deaths per 1000 live births [53]. While these declines may not be entirely attributable to the enactment of smoke-free legislation, it is likely that such legislation made a meaningful contribution to saving lives. In Norway, ever since tobacco prohibition was implemented across restaurants, public transport, schools, healthcare institutions, and all public office spaces in 2004, the prevalence of smoking in pregnancy decreased significantly from 26% in 1999 to nearly 2% in 2021 [54]. It follows, then, that integration of these tobacco control measures into videos on social media can translate to normalizing such social customs and addressing environmental tobacco exposure more comprehensively for children and pregnant women as well as the global population of smokers and nonsmokers. It is important to note that the U.S. Public Health Service is responsible for protecting the public health of citizens across the country; this agency created the Tobacco Treatment Clinical Practice Guidelines, which presented recommendations to address tobacco use and exposure as the single most preventable leading cause of death.

While creating policies and guidelines is important, they will not confer maximum benefits to the public unless they are implemented. Review of the most widely viewed YouTube videos posted over the past 16 years suggested that the government has not sufficiently succeeded in creating communications about their guidelines that engage consumers. In turn, this may limit the extent to which the public is aware and supportive of such guidelines. Part of this disconnect could pertain to the content covered, which may not be perceived as directly relevant to the audience's preferences and acceptable for health behavior change. In short, this content may not spark engagement for this lay audience and fails to appeal to them.

EXPANDING THE REACH OF TOBACCO CESSATION CAMPAIGNS

Only four videos among all the widely viewed ones on smoking cessation accounted for content pertaining to a tobacco cessation campaign. In fact, the deliverer of these videos was the only source originating from a campaign. In these videos, the TIPS campaign spearheaded by the CDC featured testimonials from survivors of tobacco-related illnesses. Other campaigns are not directly centered on promoting reduction and cessation (*e.g.*, Safe-to Sleep and American Cancer Society campaigns); however, components of these campaigns can involve delivery of information surrounding tobacco use and support of cessation. The Safe-to-Sleep campaign in particular follows recommendations by the American Academy of Pediatrics to optimize safe sleep conditions for infants. One of these recommendations is to encourage all caregivers of infants to reduce environmental tobacco exposure for infants. Further, as part of this campaign, tobacco use and exposure are environmental and behavioral determinants that are targets for intervention, both prenatally (reduce or stop tobacco use during pregnancy) and postnatally (stop tobacco use and, in turn, reduce or eliminate environmental tobacco exposure for infants); this can reduce the risk of Sudden Infant Death Syndrome (SIDS), which is a leading cause of infant mortality.

Tobacco use and exposure are causal factors that adversely impact response to treatment for many kinds of cancer and can increase both morbidity and mortality for cancer patients. Cessation of tobacco use and reduction of environmental tobacco exposure are targets in a variety of cancer prevention and control campaigns. Future content on YouTube could provide more coverage of tobacco-related content across these campaigns, which could increase their visibility. As previously mentioned, much of the content found in one social media platform can be disseminated to others. Given that YouTube continues to be the most popular public video-sharing platform, publishing messages on YouTube can extend onto different social media platforms as well.

RECOMMENDATIONS FOR FURTHER RESEARCH

As tobacco continues to be a leading cause of environmental exposure, it is crucial to find ways to

increase awareness and interest among consumers to address this problem. Additional research is needed to improve understanding about ways to incorporate this topic into videos that will engage consumers. Given the scant coverage of environmental tobacco exposure as well as firsthand smoke exposure for specialized populations, additional research is needed to increase awareness of how and why environmental tobacco smoke exposure has particularly harmful effects on certain people. Future study designs involving non-evidence-based practices for tobacco cessation could account for prospective and longitudinal studies as the basis to assess the efficacy of these interventions over timespans, settings, and patient populations. Consistency in findings that support the efficacy of these non-evidenced-based practices over time could increase consideration of their inclusion into existing evidence-based practices on tobacco cessation. Given that viewers have the opportunity to post comments for YouTube videos and since there were many comments across the videos in this sample, a closer examination of the comments could yield insights into consumers' reactions to different topics or formats in the videos. A thematic analysis of the comments might also yield information related to viewer engagement, perspectives on content, and acceptance of content.

LIMITATIONS

This study was limited in several important ways that must be considered when interpreting the results and conclusions. First, the design was cross-sectional, which limits generalizability over time. This is particularly important because the nature of the videos on YouTube and the views they attract are changing constantly. A second limitation was related to the sample. While the videos were selected using a cleared browsing history, the algorithm that generated the resulting sample is not known. It is possible that some widely viewed videos were not included. Delimiting the scope to videos in English further limits generalizability, which is important since smoking rates are high in many parts of the globe where English is not the dominant language. Also, the sample size of 100 videos was arbitrary. A third limitation is related to the nature of the data themselves. The main outcome in this study was number of views, as based on the premise that reach is an important way to assess health communications. However, there was no way to distinguish between number of views versus number of viewers. Another issue was that the results regarding content coverage were disproportionately influenced by a comparatively small number of videos that attracted a comparatively large proportion of views. A fourth limitation pertained to the limitations of the search strategy. It is possible that substantially fewer videos among the widely viewed covered environmental tobacco exposure (*e.g.*, secondhand smoke, thirdhand smoke, social engineering, smokefree, *etc.*), given the inherent nature of the search strategy. Despite these limitations, the findings are significant for several reasons. The videos in this study received over 334 million views,

suggesting that people are searching YouTube to learn about ways to stop smoking. Given this wide reach, descriptions of information that are and are not being conveyed are vital for public health education.

Conclusions

Tobacco dependence continues to be a significant risk factor in the onset and progression of a range of harmful illnesses. Education for individuals, families, and communities about tobacco cessation care can be instrumental in helping people achieve cessation. In this digital era, the utilization of social media such as YouTube is a promising way to reach large audiences at very low cost. Given the global reach of YouTube, an assessment of who is disseminating different tobacco-related content revealed information that is relevant to public health education for individuals attempting to stop using tobacco as well as for their families. This study produced several findings that have implications for improving public health. Videos posted by nongovernmental/organizational sources attracted the largest number of views. Some of the content in these videos was not in line with evidence-based practices for tobacco treatment established by governmental guidelines. Nevertheless, public health educators need to learn from a variety of sources how to create videos that are engaging. Videos currently posted by governmental agencies are not sufficiently appealing to consumers. Finding ways to deliver content that is not only up-to-date and accurate but also engaging, appealing, and relevant to diverse specialized populations affected by tobacco use and exposure can align and achieve the goals of reducing the public health burden caused by tobacco use and environmental exposure.

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Conflict of interest statement

The authors declare that they have no conflicts of interest.

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with human

participants or animals performed by any of the authors.

Authors' contributions

AJ: conceptualization. AJ: data curation. AJ: formal analysis. AJ, AH: Investigation. AJ: methodology. AJ: writing original draft. AJ, AH: writing review & editing.

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