

Fluoride-related YouTube videos: A cross-sectional study of video contents by upload sources

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Abstract

Purpose: The aim of this study was to describe characteristics of the most widely viewed fluoride-related videos on the video sharing website, YouTube, and to compare the content of videos uploaded from different sources.

Methods: Using a cross-sectional design, a total of 100 fluoride-related, English language videos were manually coded and statistically analyzed.

Results: A majority of videos were consumer-generated. Videos that were consumer-generated had the most views of any source (9,737,845 views; 69.32%). Compared to consumer-generated videos, videos uploaded by a professional source were 15.52 times as likely to mention fluoridated toothpaste (Odds ratio, OR=15.52, 95% CI, 1.92, 125.35), 5.04 times as likely to mention the need for training of health personnel (OR=5.04, 95% CI, 1.15, 22.02), 9.69 times as likely to mention the benefits of fluoride on teeth (OR=9.69; 95% CI, 2.01, 46.81), 3.52 times as likely to mention that too much fluoride is negative (OR=3.52, 95% CI, 1.06, 11.73), and 3.44 times as likely to mention the dangers of fluoride use in children 1-5 years old (OR=3.44, 95% CI, 1.05, 11.23).

Conclusion: Widely-viewed fluoride-related information on YouTube has an anti-fluoride sentiment, focusing more on the danger of fluoride rather than its benefits.

Keywords: fluoride, fluoridated toothpaste, caries prevention, social media, YouTube

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Introduction

Dental caries are common in the United States,¹ and affect all age groups.²⁻⁵ Fluoride, a mineral that naturally occurs in the environment, is often added to water supplies to address the high prevalence of dental caries.⁶ Fluoridation of drinking water was first introduced in 1945 as a clinical trial to help prevent and lessen the severity of tooth decay,^{6,7} and is considered a safe and cost-effective way to prevent dental disease in the population.^{8,9} Some individuals and groups argue against the fluoridation of water, however, claiming that government fluoridation of water violates one's right to consent, and cite detrimental side effects including increased risk of arthritis, hip fractures, and decreased intelligent quotient in children.¹⁰ Dental fluorosis, defined as changes in the enamel of the teeth, is another concern with the use of

fluoridated water, yet is most often associated with ingestion of toothpaste.¹¹ According to a recent study using National Health and Nutrition Examination Survey (NHANES) data of 2011-12, the prevalence of dental fluorosis (very mild and above) was as high as 61.3% in the United States.¹²

Social media's influence in the dissemination of information and misinformation has been noted in the literature, but research on the topic of fluoride in social media is sparse. In 2014, Mertz and Allukian found that anti-fluoridation sentiments dominated Twitter, Facebook, and YouTube, and overall exceeded pro-fluoridation content.¹³ Seymour et al. investigated anti-fluoride network sociology using conversations surrounding sample publications, and found that this network of individuals were more connected than overall users and that they had a 50% chance of encountering

messages that were negative and not based on data from the sample publication.¹⁴

YouTube is a popular social media site that uses videos to communicate, with over one billion users worldwide.¹⁵ There is a gap in the literature pertinent to the content of fluoride-related YouTube videos. Understanding what type of information about fluoride is being disseminated on social media can help public health practitioners when assessing concerns of fluoride and identify needs for educating the public. The aim of this study was to describe the characteristics of the most widely viewed fluoride-related videos on the video sharing website YouTube, and to compare the content of videos uploaded from different sources.

Methods

Data Collection

The term “fluoride” was searched on YouTube.com on October 20, 2016. Videos were sorted by their total number of views. The top 100 videos in English were retrieved as a sample for analysis. Videos in other languages were excluded. Three additional videos that did not pertain to human health, but rather focused on liquid fluoride thorium reactors were also excluded. In addition to the universal resource locator (URL) of the videos, meta-data of the videos were also collected, including the length of each video (in minutes), the total number of views, and the date of upload.

Manual Coding of Videos

The sample of the 100 most widely viewed fluoride-related videos were manually coded for their source and a delimited scope of content. The three source categories were: “consumer” (a member of the lay public without any health-related professional credentials who uploads a video to provide information on the topic of fluoride), “professional” (a health professional with qualifications to provide information on this topic, such as a dentist or dental hygienist), and “media” (such as episodes from television shows or documentaries and content that originates from Internet-based media outlets). Based on online information provided by the American Dental Association and other sources on fluoride,¹⁶⁻¹⁸ the following content categories were created: community water fluoridation programs; fluoridation of toothpaste; the need for training of health personnel; the need for parent awareness; fluoride supplements; benefits of fluoride on teeth; fluoride does not benefit teeth; too much fluoride is negative; dangers of fluoride; specific dangers to the body; danger in children ages 1 to 5; fluoride is poisonous; conspiracy theory; treatment of fluorosis; and removing fluoride from the body.

Statistical Analysis

All statistical analysis was performed using R statistical software, version 3.2.3.¹⁹ Continuous variables in this dataset (number of views and length of videos) were first analyzed using the Kruskal-Wallis test to look for differences of the continuous variables across the three sources of upload. The number of views and length of videos were also analyzed for pairwise correlations using Spearman’s rho test. Statistical significance was determined at the level of $\alpha=0.05$.

Each content category was a binary variable, with “0” for no (the video did not meet the criteria for that category) and “1” for yes (the video met the criteria for that category). An odds ratio of each type of source uploading in a specific content category was then calculated, using “consumer” as the reference category. Univariate logistic regression analysis was performed for each of the manually coded binary content categories as the outcome variable, with the source of the video as the predictor variable.

Ethical approval

The Institutional Review Board at William Paterson University deems all studies that do not involve human subjects to be exempt. The Institutional Review Board at the Teachers College, Columbia University approved this study.

Results

Of the 100 most frequently viewed, English language fluoride-related videos, 68 were consumer-generated, 14 were professional, and 18 were media videos. One video had a title in both Spanish and English, but the video was in English, with a Spanish subtitle. Table I provides descriptive statistics for the total number of views, number of views per day and video length. Collectively, the videos in this dataset were viewed a total of 14,047,906 times. Videos uploaded by a consumer source had 9,737,845 views (69.32%), followed by media videos (2,572,328 views, 18.31%) and professionally sourced videos (1,737,733 views, 12.37%). The distribution of the number of views per day was skewed, with a mean of 111.01 and a median of 56.54. Some of the most frequently watched videos were in the consumer category (e.g., the video with 648.87 views per day). Professional videos had a lower median of views per day posted on-line (32.61) as compared to consumer (57.92) and media (58.96) videos. Median of the length of the videos was 6.12 minutes. No difference was found between the videos of the aforementioned sources in terms of number of views ($\chi^2=1.467$, $p=0.4802$), views per day ($\chi^2=1.701$, $p=0.4272$) or length of videos ($\chi^2=2.950$, $p=0.2288$). No correlation was found between the number of

Table I. Descriptive statistics for number of views and length of videos by source category of 100 most widely watched English language fluoride-related YouTube videos.

	Consumer (n=68)	Professional (n=14)	Media (n=18)	Overall (n=100)
Total number of views				
Mean [SE*]	143,203.6 [16,789.88]	124,123.8 [26,873.91]	142,907.1 [21,969.32]	140,479.1 [12,584.36]
Median	82,945.5	70,699	128,225.5	93,778
Range	39,418 – 718,943	46,054 – 358,655	46,222 – 445,189	39,418 – 718,943
95% CI**	109,690.9 – 176,716.3	66,066.24 – 182,181.3	96,555.9 – 189,258.3	115,509 – 165,449.2
Total (%)	9,737,845 (69.32)	1,737,733 (12.37)	2,572,328 (18.31)	14,047,906 (100)
Number of views per day				
Mean [SE]	129.50 [18.26]	63.54 [16.29]	78.04 [12.69]	111.01 [13.07]
Median	57.92	32.61	58.96	56.54
Range	12.64 – 648.87	23.95 – 239.86	20.80 – 220.61	12.64 – 648.87
95% CI	93.06 – 165.94	28.35 – 98.74	51.26 – 104.83	85.08 – 136.94
Length of video (minute)				
Mean [SE]	6.64 [0.65]	6.95 [1.22]	8.30 [1.15]	6.98 [0.52]
Median	5.34	6.58	8.31	6.12
Range	0.47 – 21.88	0.47 – 14.88	0.9 – 14.98	0.47 – 21.88
95% CI	5.34 – 7.94	4.30 – 9.59	5.88 – 10.71	5.96 – 8.01
Total (%)	451.67 (64.68)	97.25 (13.93)	149.35 (21.39)	698.27 (100)

*SE: Standard error.

**CI: Confidence interval.

views and video length (Spearman's rho=0.1066, p=0.1455), or between number of views per day and video length (Spearman's rho=0.0619, p=0.2704). As expected, a strong correlation was found between views per day and the total number of views (Spearman's rho=0.7225, p<0.0001).

Table II presents frequencies of each content category grouped by upload sources. Of the 100 videos analyzed, 89 discussed community water fluoridation and 52 mentioned fluoridation of toothpaste. A total of 11 mentioned the need for training of health personnel with regard to fluoridation. Six videos mentioned the need for parent awareness, and only three videos mentioned the need for fluoride supplements.

While 44 videos mentioned the benefits of fluoride on teeth, 20 videos claimed that fluoridation offers no benefit to the teeth, and 40 videos mentioned that too much fluoride has negative effects. Seventy-five of the videos mentioned the dangers of fluoride, 50 mentioned specific dangers that fluoride can cause, and 31 mentioned the dangers of fluoride

in children ages 1-5 years old. Fifty-five videos mentioned that fluoride is poisonous. Thirty-two percent (32/100) of videos mentioned a conspiracy theory. Twenty-nine mentioned the need for treatment of fluorosis, and 22 discussed removing fluoride from the body once it is consumed (Table II).

Using consumer-generated videos as the reference category, the odds ratios of professional videos and media videos showing certain categories of content were obtained (Table III). Univariate logistic regression resulted in significant differences for six content categories. Compared with consumer-generated videos, videos uploaded by a professional source were 9.69 times as likely to mention the benefits of fluoride on teeth (Odds ratio, OR=9.69, p=0.005), 15.52 times as likely to mention fluoridation of toothpaste (OR=15.52, p=0.010), 3.44 times as likely to mention the dangers of fluoride use in children 1-5 years old (OR=3.44, p=0.041), 3.52 times as likely to mention that too much fluoride is negative for the teeth (OR=3.52, p=0.040), and 5.04 times as likely to mention the need for

Table II. Frequencies (and column percentage) of each binary content category of the 100 most widely watched English language fluoride-related YouTube videos by source category.

Content category	Source of Upload (n(% of column N))			
	Consumer (n=68)	Professional (n=14)	Media (n=18)	Total (n=100)
Discusses community water fluoridation programs	58 (85)	14 (100)	17 (94)	89 (89)
Mentions fluoridation of toothpaste	31 (46)	13 (93)	8 (44)	52 (52)
Mentions the need for training of health personnel	5 (7)	4 (29)	2 (11)	11 (11)
Mentions the need for parent awareness	4 (6)	1 (7)	1 (6)	6 (6)
Mentions fluoride supplements	2 (3)	1 (7)	0 (0)	3 (3)
Mentions benefits of fluoride on teeth	26 (38)	12 (86)	6 (33)	44 (44)
Mentions that fluoride does not benefit teeth	13 (19)	5 (36)	2 (11)	20 (20)
Mentions that too much fluoride is negative	23 (34)	9 (64)	8 (44)	40 (40)
Mentions dangers of fluoride	48 (71)	12 (86)	15 (83)	75 (75)
Mentions specific dangers to the body	31 (46)	10 (71)	9 (50)	50 (50)
Mentions danger in children 1-5 years old	19 (28)	8 (57)	4 (22)	31 (31)
Mentions that fluoride is poisonous	35 (51)	8 (57)	12 (67)	55 (55)
Mentions a conspiracy theory	24 (35)	4 (29)	4 (22)	32 (32)
Mentions treatment of fluorosis	25 (37)	0 (0)	4 (22)	29 (29)
Mentions removing fluoride from body	19 (28)	1 (7)	2 (11)	22 (22)

*If all videos belong to one category of contents (i.e., all “Yes”s or all “No”s), then the other category has zero cell count.

training of health personnel (OR=5.04, p=0.032).

Discussion

Findings from this study indicate that fluoride is a prevalent topic on the YouTube platform, with the collective number of video views included in this sample reaching over 14 million. Many of these popular videos were uploaded by consumers, and had an anti-fluoride sentiment. Across all sources of upload, more videos mentioned the dangers of fluoride than the benefits of fluoride. This research is consistent with the findings of others, which have indicated that there is an anti-fluoridation attitude present on social media.^{13,14} In this sample of videos, there was a lack of emphasis on the need to train health care personnel (i.e. dentists, dental hygienists, pediatricians, etc.) about issues related to fluoridation, and a lack of emphasis on the need to increase parents’ awareness about the safety and efficacy of using fluoride properly to prevent the occurrence of dental caries in their children.

Controversy about water fluoridation has a long history in the United States¹⁹ and continues to persist in the both the United States as well as abroad.²⁰⁻²² Social media can play an influential role in supporting groups who are for or against a particular issue and is likely to play an increasingly important role related to support or opposition for fluoridation of public water. Seymour and colleagues illustrated how social media may influence consumers’ attitudes and behaviors and can facilitate connectedness and engagement around opposition to water fluoridation.¹⁴

Nearly 60% of all adults have used the Internet to search about a health issue, about half of which report having read about another person’s medical condition online.²³ Roughly one in five adults have watched a video about a medical issue online.²⁴ In one study, findings indicate that of those who use the Internet, over half are searching about issues for another person.²⁵ Caregivers are often the ones seeking information.²⁵ Fluoride use is an issue that has been debated and discussed in social media forums, and anti-fluoridation movements continue to generate a great deal of discussion. Hence, parents seeking information for their children regarding fluoride may be exposed to information that is inconsistent with current science and recommendations by multiple professional organizations and governmental agencies.¹⁻⁹ Studies on YouTube video content on a variety of topics ranging from vaccination^{26,27} to cancer screening^{28,29} have identified videos discouraging viewers from practices that have been recommended by public health agencies. This has been further confirmed by a review of YouTube studies, which has recommended proceeding with caution when using this medium for patient education purposes.³⁰

Table III. Odds ratios of Professional and Media sources uploading the 100 most widely watched English language fluoride-related YouTube videos compared to Consumer-generated videos.

Content Category (Reference category: Consumer)	Odds Ratio (95% CI)	p-value	Content Category (Reference category: Consumer)	Odds Ratio (95% CI)	p-value
Discusses community water fluoridation programs			Mentions dangers of fluoride		
Professional*	-	-	Professional	2.50 (0.51, 12.20)	0.257
Media	2.93 (0.35, 24.55)	0.321	Media	2.08 (0.54, 8.00)	0.285
Mentions fluoridation of toothpaste			Mentions specific dangers to the body		
Professional	15.52 (1.92, 125.35)	0.010	Professional	2.98 (0.85, 10.46)	0.088
Media	0.95 (0.34, 2.72)	0.931	Media	1.19 (0.42, 3.38)	0.739
Mentions the need for training of health personnel			Mentions danger in children 1-5 years old		
Professional	5.04 (1.15, 22.02)	0.032	Professional	3.44 (1.05, 11.23)	0.041
Media	1.58 (0.28, 8.88)	0.607	Media	0.74 (0.22, 2.52)	0.627
Mentions the need for parent awareness			Mentions that fluoride is poisonous		
Professional	1.23 (0.13, 11.93)	0.858	Professional	1.26 (0.39, 4.01)	0.699
Media	0.94 (0.10, 8.98)	0.958	Media	1.89 (0.63, 5.60)	0.254
Mentions fluoride supplements			Mentions a conspiracy theory		
Professional	2.53 (0.21, 30.10)	0.460	Professional	0.73 (0.21, 2.59)	0.630
Media*	-	-	Media	0.52 (0.16, 1.77)	0.298
Mentions benefits of fluoride on teeth			Mentions treatment of fluorosis		
Professional	9.69 (2.01, 46.81)	0.005	Professional*	-	-
Media	0.81 (0.27, 2.41)	0.702	Media	0.49 (0.15, 1.66)	0.252
Mentions that fluoride does not benefit teeth			Mentions removing fluoride from body		
Professional	2.35 (0.67, 8.20)	0.180	Professional	0.20 (0.02, 1.62)	0.131
Media	0.53 (0.11, 2.59)	0.432	Media	0.32 (0.07, 1.54)	0.156
Mentions that too much fluoride is negative					
Professional	3.52 (1.06, 11.73)	0.040			
Media	1.57 (0.54, 4.50)	0.406			

*Zero cell count in the category resulted in invalid odds ratio estimates and standard errors, thus the corresponding p-values were not meaningful.
CI: Confidence interval.

This study had several limitations. Analysis was limited to the 100 most viewed English-language fluoride-related videos on YouTube. It is acknowledged that this was an arbitrary cutoff point for the sample selection, which was based on prior studies.³¹⁻³⁵ Sampling of videos was confined to English, given the language abilities of the coders. However, limiting by language does not allow for a full picture of what is available on YouTube on the topic of fluoride. The cross-sectional design of the study limits the ability to generalize the findings over time. Given the popularity of YouTube, uploads occur on a daily basis, and view counts are changing continuously. Additionally, demographic information on income, education, and age of those who viewed these particular videos is unknown to the researchers. Future research is warranted on the characteristics of people seeking information about fluoride, and in particular, the negative

aspects of fluoride. Further, only a delimited scope of content was coded and analyzed. Despite these limitations, this study begins to offer some insights into an important topic affecting oral health in the United States and beyond.

Conclusion

Among the 100 most popular English-language fluoride videos on YouTube, there were many more videos uploaded by consumers as compared to professionals. Widely-viewed fluoride-related information on YouTube has an anti-fluoride sentiment, focusing more on the dangers of fluoride rather than the benefits. These data suggest that finding ways to conceptualize and produce videos that attract views is challenging for professionals attempting to disseminate information about the benefits of water fluoridation. Given the widespread reach of YouTube, improving the understanding

of how to communicate accurate information in ways that are acceptable and accessible to at risk audiences warrants consideration as an oral public health research priority.

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