

## YOUTUBE AS A SOURCE OF INFORMATION ON FLUORIDE THERAPY

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**ABSTRACT:** Internet platforms, such as YouTube, are gaining in importance as interfaces where health-related information can be stored and quickly accessed by people. The aim of this study was to assess the video content of YouTube videos about fluoride ion (F) therapy. A search of YouTube was performed using the keywords “fluoride treatment for kids,” which is one of the most frequently terms for searching on F therapy. The data in the videos were extracted using a YouTube video application programming interface. For all the videos, the video length, date of upload, total views, number of likes/dislikes, and comments were collected. Calculations were made of the views per day, viewing rate, and viewers interaction. Two dentists independently reviewed the first 200 videos and evaluated their content, comprehensiveness, and accuracy. One hundred and fifty-five videos were included the study. The majority of the videos (n=69, 44.5%) were uploaded by a dentist/hygienist/specialist. The most mentioned subject was F varnish (n=66, 42.6%). Fourteen videos (9%) were assessed as being “very useful,” 53 videos (34.2%) as “useful,” 56 videos (36.1%) as “slightly useful,” and 32 videos (20.6%) as “not useful.” In our opinion, provided consideration is given to the source of an upload, YouTube can be a useful tool for learning about F therapy.

Keywords: Fluoride; Fluoride therapy; YouTube.

### INTRODUCTION

Dental caries is still a major health problem in even the most developed countries with approximately 60–90% of school-aged children and the large majority of adults being affected.<sup>1,2</sup> Global priority action on dental caries is now considered necessary because it is the most common chronic childhood disease and its prevalence has increased worldwide in children aged 2–5 yr.<sup>3,4</sup> Although dental caries has been considered a childhood disease, in reality, it continues into adulthood.<sup>3</sup>

There is a broad consensus that the fluoride ion (F) prevents dental caries in all age groups, including children and adults.<sup>5</sup> In addition to be considered as a preventive method, F therapy, particularly when applied topically, is also commonly used to arrest the progress of active dental carries. There are various types and forms of F agents such as F tablets, tooth paste, varnish, gels, and F rinses.<sup>6</sup> Professionally applied F therapy is a relatively low-cost and easily operated treatment and the efficacy of F in preventing dental caries has been reported in many studies.<sup>7-9</sup>

Video-sharing sites are often used as a source of information. The most commonly used video sharing site YouTube accrues more than 2 billion views per day. On YouTube, a new video is being uploaded every minute and the average user spends at least 15 min per day viewing.<sup>10</sup> Platforms like YouTube are gaining importance for the sharing of health-related information as they provide an interface where information can be stored and quickly accessed by people. Unfortunately, the down side of the medium is the uncontrolled nature of YouTube so that, even though

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correct information is available in numerous videos, many videos contain misinformation.

As it has been reported that the information people use to make decisions about their health, or those they take care of, is often wrong,<sup>11</sup> it is important for healthcare professionals to evaluate the information that people have been receiving.

Although the content of patient education YouTube videos in various subjects and disciplines has been studied,<sup>12-16</sup> to the best of our knowledge there has not been any study investigating the usefulness of YouTube videos as a source of patient information about F therapy. The purpose of the present study was to assess the content of publicly accessible YouTube videos that discuss F therapy.

### MATERIAL AND METHODS

This study was exempted from ethical approval due to its observational nature and the use of publicly accessible data.

*YouTube search query:* Various search terms such as fluoride, toothpaste, and fluoride varnish were used in lieu of F therapy in YouTube. We examined related keywords in the Google Trends and selected keywords according to their usage frequency.<sup>17</sup> We searched YouTube (<https://www.youtube.com>) using the term “fluoride treatment for kids” which was one of the most frequently terms for searching on F therapy. We extracted metadata from the YouTube videos using a YouTube video application programming interface (API). The YouTube API video feed data elements include video uniform resource locator (URL), title, video length, date of upload, total views, number of likes/dislikes, and comments.<sup>18</sup> Code was written using the Python programming language to the YouTube interface and the data was converted to Excel. The data extraction from the YouTube API video feed was performed on 24 December 2018.

It is reported in the literature that users do not continue to search after the first 5 pages of results.<sup>15,19</sup> After the third page, only 10% users click on results.<sup>20</sup> Accordingly, we only viewed the first 200 videos. The links for the videos were saved for the future analysis. Only videos in English were included. Exclusion criteria were: videos in other languages, videos which had no audio or visual, videos which lasted greater than 15 min, duplicate videos, and videos which were not relevant to the search term (such as comics, songs).

*Video evaluation:* For all the videos, the date of upload, total views, number of likes/dislikes, and number of comments were collected, and the views per day were calculated. The viewing rate and interaction index were calculated based on the methods described in the previous studies.<sup>14</sup>

The upload source was modified from the method used in previous studies and divided into 5 groups: (i) dentist/hygienist/specialist, (ii) hospital/university, (iii) website/TV channel, (iv) commercial (dental manufacturing company), and (v) lay person/other.<sup>15</sup> The type of F therapy (F gels/foams, F toothpaste, F varnish, silver diamine fluoride (SDF), F rinses, water fluoridation, F supplements, and F in general) and video content (information about F, application procedure, post-operative instructions, application interval, F amount, and recommended age) in the videos were recorded and reviewed. We developed a scoring log to evaluate the individual

videos based on a study by Singh et al.<sup>21</sup> In addition, we determined a usefulness score by summing the content score, comprehensiveness score, and accuracy score (Table 1).

**Table 1.** Evaluation tools for content, comprehensiveness, accuracy and usefulness score

Content (One point for each question if answered yes)	Usefulness score
1. Information about F	0–2 Not useful
2. Application procedure	3–5 Slightly useful
3. Post-operative instructions	6–8 Useful
4. Application interval	9–12 Very useful
5. F amount	
6. Recommended age	
Comprehensiveness score	
0. No information provided	
1. Poor–lacking information	
2. Average–covers most relevant information	
3. Excellent–covers all relevant information	
Accuracy score	
0. Inaccurate	
1. Poor–less accurate information	
2. Average–overall correct information	
3. Excellent–professional level, highly accurate	

*Data collection analysis:* Two authors (E.E. and G.A.Ş.) evaluated each video independently and their scores for each question were weighted equally to determine an overall score. Then, the overall score was used for the final results and statistical analysis.<sup>21</sup> Two examiners randomly selected twenty videos per each examination and based on this examination, the Cohen’s weighted kappa coefficient was calculated with the significance set at 0.8.

*Statistical analysis:* Statistical analysis was performed using the IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp. Released 2017. Armonk, NY: IBM Corp.). The normality of the continuous variables was investigated by the Shapiro-Wilk’s test. The descriptive statistics were presented using the mean and standard deviation for the normally distributed variables and the median and minimum-maximum for the non-normally distributed variables. Non-parametric statistical methods were used for the values with a skewed distribution. For the comparison of more than two non-normally distributed groups, the Kruskal-Wallis test was used. The Bonferroni correction was used for *post-hoc* pairwise comparisons. Statistical significance was accepted when the two-sided p value was lower than 0.05.

## RESULTS

Our search term “fluoride treatment for kids” captured a total of 116,872 videos. We evaluated the first 200 videos on YouTube and, of these, 155 videos were included in the study for further analysis. Twenty-nine videos were excluded because

they were irrelevant to the topic, 5 videos were excluded because they are not in English, and 6 videos were excluded because they were longer than 15 min. Four videos were excluded because they were duplicates of another video that had already been watched. Thirteen of the first 100 videos and 32 of the next 100 videos were excluded.

The majority of the videos (44.5%, n=69,) were uploaded by a dentist/hygienist/specialist, 20.6% (n=32) of the video sources were a stand-alone health information website/TV channel, 16.1% of the videos (n=25) were uploaded by a lay person, and for 11% of the videos (n=17) the source was a hospital/university. Most of the videos (20.6%, n=32) were uploaded in 2017. Sixty-six videos (42.6%) were about F varnish, followed by 44 videos (28.4%) with about information about all the types of F types, and 19 videos (12.3%) about the service delivery framework (SDF).

The YouTube videos contained various content about the F application procedure, post-operative instructions, application interval, and recommended age. The information about the application procedure was the most mentioned subject (n=104, 67.1%), followed by information about F (n=98, 63.2%), post-operative instructions (n=52, 33.5%), recommended age (n=22, 14.2%), and application interval and F amount (n=18, 11.6%).

When we evaluated the F types according the upload source, dentists were the most mentioned for information on F varnish (n=30, 19.4%) and lay persons were the most mentioned for information on F in general (n=11, 7.1%).

The mean length of the videos was 3.39 min  $\pm$  3.38 (range from 0.17 min to 15 min). The mean of the total number of views for F treatment for kids-related videos was 10,672 (range 3–605322 views) and each video was viewed for an average of 9.5 views per day (range 0.01–43114 views per day). The mean interaction index score was 0.71  $\pm$  0.12 (range from –5 to 8.89).

No correlations were found between the upload source and the number of views (p=0.389), views per day (p=0.625), likes (p=0.284), dislikes (p=0.448), number of comments (p=0.341), and viewing rate (p=0.619). There was a significant difference between the upload source and video length. The upload source was significantly related to the video length (p=0.016) and interaction index (p=0.035). A *post-hoc* analysis revealed that the video length and interaction index was usually similar, but there was a significant difference (p=0.004) between having a “dentist” or a “lay person” as the upload source with the interaction index being significantly higher with the upload source being a “dentist” rather than a “lay person.”

When we evaluated according the comprehensiveness score, 22 videos (14.2%) were “no information,” 65 videos (41.9%) were “poor,” 57 videos (36.8%) were “average,” and 11 videos (7.1%) were “excellent.” According to the accuracy score, 25 videos (16.1%) were “inaccurate,” 53 videos (34.2%) were “poor,” 63 videos (40.6%) were “average,” and 14 videos (9%) were “excellent.” According to the content score, all of the videos mentioned at least one topic while only one video mentioned all the topics. F in general was the most mentioned topic by lay persons (44%). When we assessed the accuracy score according the F therapy type, the most inaccurate information was about F in general.

Out of 155 assessed videos, 14 videos (9%) were “very useful,” 53 videos (34.2%) were “useful,” 56 videos (36.1%) were “slightly useful,” and 32 videos (20.6%) were ‘not useful.’ When we evaluated the usefulness according to the upload source, it was found that all of the videos uploaded by hospitals/universities (n=17) were useful and 43.8% (n=34) of the videos uploaded by lay persons were not useful.

The usefulness was related significantly to views, views per day, likes/dislikes, and the viewing rate (Table 2).

**Table 2.** Video demographics according to usefulness

	"Not useful" (n=32)	"Slightly useful" (n=56)	"Useful" (n=53)	"Very useful" (n=14)	p value
Views	24943.13 ± 107677	4399.75 ± 9037.76	8357.83 ± 2140.68	11907.36 ± 2502.02	<b>0.025*</b>
Mean views per day	18.48 ± 76.42	3.85 ± 7.06	8.90 ± 21.48	14.37 ± 25.02	0.10
Mean video length	4.34 ± 4.23	2.42 ± 2.96	3.46 ± 2.88	4.89 ± 3.68	<b>0.001*</b>
Mean likes	276.19 ± 1236.79	24.29 ± 78.23	40.42 ± 105.72	58.43 ± 131.93	<b>0.019*</b>
Mean dislikes	106.66 ± 588.58	1.59 ± 3.33	4.53 ± 7.826	4.07 ± 8.371	0.060
comments	215.09 ± 1165.26	5.75 ± 19.517	5.60 ± 11.777	1.79 ± 2.359	0.681
Mean interaction index	1.24 ± 2.17	0.50 ± 1.69	0.62 ± 1.06	0.64 ± .65	<b>0.066*</b>
Mean viewing rate	1851.31 ± 7644.41	385.01 ± 706.34	890.77 ± 2148.67	1437.88 ± 2502.01	<b>0.011*</b>

*Post-hoc* analysis revealed that views, video length, likes/dislikes and viewing rate were generally similar, but that the views differed significantly between the “slightly useful” and “useful” groups, and that the video length, likes/dislikes and the viewing rate differed significantly between the “slightly useful” and “very useful” groups (Table 3).

The inter-rater reliability was calculated for the content, comprehensiveness, and accuracy score. The kappa value for the inter observer agreement was found to be 0.857 which shows a good agreement between these three components.

**Table 3.** Post-hoc analysis of video demographics according to usefulness

	"Not useful" vs "Slightly useful"	"Not useful" vs "Useful"	"Not useful" vs "Very useful"	"Slightly useful" vs "Useful"	"Slightly useful" vs "Very useful"	"Useful" vs "Very useful"
Mean views	0.338	0.204	0.166	<b>0.007*</b>	0.032	0.497
Mean video length	0.073	0.978	0.283	0.000	<b>0.001*</b>	0.096
Mean likes	0.142	0.802	0.259	0.014	<b>0.005*</b>	0.259
Mean interaction index	0.042	0.158	0.783	0.259	0.028	0.184
Mean viewing rate	0.165	0.394	0.053	0.012	0.008	0.152

The Mann Whitney U test was used as a *post-hoc* test. For interpreting the results the Bonferroni correction was used. Clinical significance was set at 0.0083.

## DISCUSSION

Our literature review showed that there were only a limited number of studies that evaluated YouTube video content in dentistry. Previous studies have evaluated YouTube as a source of information about root canal treatment, mouth cancer, dental implants, orthognathic surgery, water fluoridation, and early childhood caries.<sup>14-16,22-24</sup> To the best of our knowledge, our study is the first that evaluates the content of YouTube videos about F.

Although YouTube was designed for entertainment, in recent years health specialists and patients have used YouTube to teach and learn about medical conditions and YouTube provides a large number of easily reachable videos about F therapy. When Google Trends search titles were assessed, we observed that, although the popular search titles about F have changed periodically, the number of searches on F have been stable and highly popular.

The effect of F applications against dental caries has been proven in clinical trials. Topical F adheres to the biofilm adjacent to the tooth, decreases enamel demineralization, and increases enamel remineralization.<sup>4</sup> The advantages of systemic F have been two-fold. First, this type of F becomes a part of the tooth structure and second, it also forms a reservoir in saliva and oral mucosa.<sup>25</sup> While some studies<sup>26,27</sup> have found no relationship between fluoridated water, intelligence quotient (IQ) levels, and cognitive ability, other studies<sup>28,29</sup> have reported a

correlation between F and IQ levels. We considered that this phenomena was due to exposure to higher concentrations of F than those used in water fluoridation and accordingly when a YouTube video linked fluoridated water with a lower IQ it was given a lower accuracy rating. However, we are aware that a variety of views exist on the relationship between F and IQ and that a recent review<sup>30</sup> considered that the threshold for the development of fluoride-induced neurotoxicity was approximately 0.22 mg/L, a level below that used in water fluoridation of approximately 0.7 mg/L. When we analyzed the YouTube videos based on their accuracy scores, the topic on which the most incorrect information was given was F in general and the upload source of the videos on F in general was often a lay person. In our view, some of the information mentioned in these videos on F in general had not been proven scientifically.

When we examined the excluded videos, the number of videos excluded in the last 100 videos was more than twice of the number of videos that were excluded from the first 100 videos. This result may indicate that the number of irrelevant videos increases as the page number of the results increases.

Our study showed that YouTube offers diverse information about F therapy that ranges from highly specific information to accounts of personal experiences. F varnish was the most common topic (n=66) that was discussed and most of the videos on this topic were uploaded by a dentist/hygienist/specialist. This could be an indicator of the patients' interests and the selection of F application type as a YouTube topic may have been the result of this being the area most asked about by patients. Thus, F varnish could be a contender for being one of the most widely used and preferred F applications in dental clinics.

In our study, we found no correlation between the demographics (views, likes, and dislikes) of the videos and the upload source. This result is in an agreement with a previous similar study of YouTube videos, which found no correlation between the viewer's reaction and the upload source.<sup>31</sup>

When we evaluated by the upload source we found that hospitals/universities uploaded only 11% of the videos. Despite this relatively small proportion, the videos uploaded by the hospitals/universities had the highest usefulness (42.9%), and that most of the videos uploaded by lay persons were not useful (43.8%). This is similar to the results of previous studies, which suggested that the upload source is a predictor of quality.<sup>10,19,21</sup> We found a correlation between the usefulness and viewer's reactions. The views, video length, likes/dislikes, and viewing rate increase in a direct proportion to usefulness. This means that useful videos might be ranked first in a viewing list and might be watched by more users, because YouTube ranks the videos based on the views and interaction scores. This result could also be associated with the increase in the number of excluded videos in the pages following the first page in our study.

Our study has several limitations. First, we included videos from YouTube API and although this was an effective method that allowed automatic data capture, it did not reflect the process of a manual search within YouTube. Hence, we did not consider the viewing order of the videos that would have been found with manual searching.

This could affect the probability that an individual would ever see a video. The importance and impact of this difference should be examined in further studies.

Second for some videos, it was challenging to classify the video according the categories. When the video entered more than one category (e.g., the difference in source between “dentist” and “web-site”), the decision to divide into categories may contain a certain amount of bias. However, for most videos, the source was usually clear.

Third, study results may show a variation according to the keywords used in the research. In this study, we used the keywords that were most preferred by lay persons when searching on this topic. The results might vary with the search term. In addition to this, YouTube is a highly dynamic platform where videos uploaded and deleted all the time. Therefore, the study results may vary according the date and time of a search.

### **CONCLUSIONS**

In conclusion, our results suggest that, provided consideration is given to the source of an upload, YouTube videos could be used as an effective learning sources for F therapy. There is a positive correlation between video usefulness and viewing rates. Thus, the higher viewing rate is, the more likely it could be considered as a useful video.

### **ACKNOWLEDGMENTS**

The authors wish to thank Dr. Ediz Şaykol and Özgür Özkan Kar (Faculty of Computer Engineering, Beykent University) who provided the dataset of videos from the YouTube API on which this analysis was conducted.

### **CONFLICT OF INTERESTS**

The authors declare that they have no conflict of interests resulting from any relationships or the financial support received.

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