Understandability and Actionability of Audiovisual Patient Education on Epinephrine Auto-Injector

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ABSTRACT

Objective: The internet and social media, which have become a part of daily life, have also become critical sources for obtaining health information. Anyone can upload videos on any topic on Youtube; however, Youtube does not guarantee that the uploaded videos contain the correct information. Failure to use or the misuse of epinephrine auto-injectors (EAIs) can lead to fatal results. The aim of this study was analyze the reliability, understandability, and actionability of the videos on the use of epinephrine auto-injectors published on Youtube.

Materials and Methods: The search term 'how to use epinephrine auto-injectors' was searched on YouTube™ (http://www.youtube.com) on 04.10.2022 and the first 200 videos were reviewed. Information about the video was recorded and the Global Quality Scale (GQS), DISCERN (DISCERN is a brief questionnaire that provides users with a valid and reliable way of assessing the quality of written information on treatment choices for a health problem) and Patient Education Materials Assessment Tool (PEMAT) were evaluated.

Results: Of the 112 videos, 86.6% of those included in the study were educational for the public. The duration of understandable videos was found to be significantly higher than non-understandable videos (p<0.001). A moderately positive correlation was found between the GQS scores and understandability scores (p<0.001) and between actionability scores (p<0.001). A moderately positive correlation was found between the DISCERN scores and understandability (p<0.001) and actionability scores (p<0.001). The understandability rate of the videos uploaded by physicians and non-physician health workers was found to be significantly lower than the other video uploaders (p<0.01). In the performed linear regression analysis, it was seen that the number of understandable videos published by physicians and non-physician healthcare professionals was significantly lower than the videos uploaded by other users. The number of understandable videos was significantly higher in long videos.

Conclusion: There are severe problems regarding the videos' quality, reliability, understandability and actionability. It is thought that Youtube content on the use of EAIs in case of anaphylaxis should be improved.

Keywords: Anaphylaxis, epinephrine auto-injector, Youtube, education

INTRODUCTION

A study conducted by an international group of experts has revealed that the prevalence of anaphylaxis may reach up to 2% (1). It is estimated that approximately 49 million people in the United States (USA) are at risk of a hyperallergic reactions and that the annual cost of anaphylaxis is 1.2 billion (2). It is indicated that 1.6-5.1% of citizens in the USA have anaphylaxis, which leads to fatal consequences in the 1% of hospitalizations due to anaphylaxis and in 0.1% of those admitted to the emergency department (3,4). Death occurs in 0.65-2% of severe cases of anaphylaxis (5). Publications reveal that anaphylaxis is poorly diagnosed, its prevalence and incidence are increasing, and the figures may vary by geographic region and exposure (6,7).

Intramuscular (IM) epinephrine should be used as the first-line therapy for anaphylaxis (8). Epinephrine is the only drug that prevents hospitalization and death in an anaphylactic event (9). Since the symptoms of anaphylaxis usually occur in the community setting, auto-epinephrine auto-injectors (EAIs) are prescribed to provide rapid IM administration to people at risk (10,11). However, epinephrine auto-injectors are drugs that non-healthcare professionals can also administer. The fact that most patients prescribed epinephrine auto-injectors cannot reach someone to administer the drug during exposure to an allergen increases the risk of progression of severe anaphylaxis (3,12,13). An appropriate level of knowledge is required for proper administration, and the level of knowledge of people regarding this issue was found to be low in various studies (14,15).

The Internet and social media, which have become a part of daily life, have also become critical sources for obtaining health information, and the percentage of those doing health-related research on the internet is approximately 70% (16). According to a study conducted in the USA, YouTube attracted attention as the most popular social media provider, with a usage rate of 73% (17). With more than 2 billion users, YouTube has the potential to serve as an essential tool for distributing health-related information promptly, with its video storage and as a social network interface where users can interact and socialize (18).

Since failure to use or misuse epinephrine auto-injectors may lead to fatal consequences, it is an issue that large public masses should learn. Therefore, YouTube has an important place in reaching the masses. Nevertheless, due to the possibility of incorrect information that may lead to misuse, this study aimed to analyze the accuracy, reliability, understandability and actionability of the videos published about the use of epinephrine auto-injectors published on YouTube.

MATERIALS and METHODS

The search term 'how to use epinephrine auto-injector' was searched on YouTube™ (http://www.youtube.com) on 04.10.2022. The search history was deleted before the search, and a new YouTube account was created to prevent previous search results from affecting the search. According to studies, the first ten pages are scanned by 97.5% of Internet users (19). In accordance with this information, the first 200 videos that appeared according

to the search results were recorded for later evaluation. One of 6 duplicated videos, four non-English videos, 63 irrelevant videos, and 15 videos shorter than 30 seconds were excluded from the study. The remaining 112 videos were evaluated by an allergy immunologist (Merve Erkoc) and a public health specialist (Yavuzalp Solak) in terms of the target audience of videos (public education, academic education), video source (physician, non-physician health worker, independent user, organization, drug company), number of likes, video duration, number of comments, and video content (how to use an epinephrine auto-injector, how and when to use). The videos for which there was disagreement between the researchers were reevaluated by another allergy immunologist (Gurgun Tugce Vural Solak), and the final decision was made. Kappa scores of the raters for the Global Quality Scale (GQS), DISCERN (DISCERN is a brief questionnaire which provides users with a valid and reliable way of assessing the quality of written information on treatment choices for a health problem), and Patient Education Materials Assessment Tool (PEMAT) scales ranged from 0.79 to 0.91. The search term 'how to use epinephrine auto-injectors' was searched on YouTube™ (http://www.youtube.com) on 04.10.2022 and the first 200 videos were reviewed (Figure 1).

Scoring System

The videos' daily views were calculated based on the time elapsed from the day the video was uploaded, and the number of likes and comments per 1000 views was also calculated. After the authors read the video evaluation guidelines, the videos were rated between 1-5 points
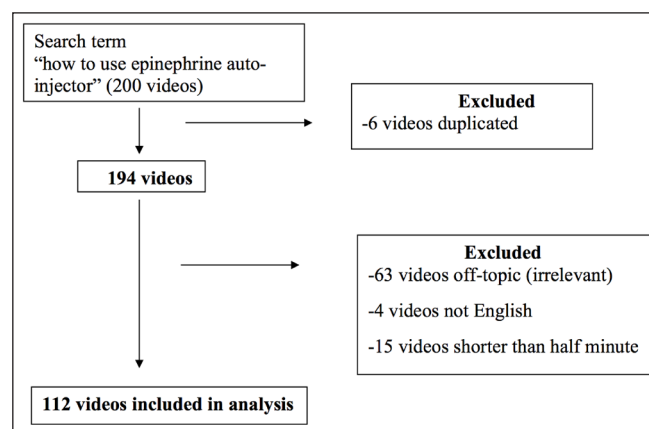

Figure 1. Shows the number of videos examined within the scope of the study, the number of videos not included and the reasons for exclusion, and finally the number of videos included in the study.

and in such a way that the quality increased as the score increased based on three different scales, including The Global Quality Scale (GQS) developed by Bernard et al. (20), in which the quality of videos is evaluated, the DIS-CERN scale developed by Singh et al. (21), which evaluates the reliability of videos and in which the videos are scored between 0 and 5 points according to the answers to the questions asked by the scale and where the reliability increases as the score increases, and finally, the Patient Education Materials Assessment Tool (PEMAT) developed by Shoemaker (19) in which the understandability and actionability of the videos are evaluated. The videos are classified as understandable or actionable if the mean scores on each scale are greater than 70%, according to the PEMAT score (19,22).

Score categories of the GQS

1. Poor quality, poor flow of the site, most information missing, not at all useful for patients

2. Generally poor quality and poor flow, some information listed but many important topics missing, of very limited use to patients

3. Moderate quality, suboptimal flow, some important information is adequately discussed but others poorly discussed, somewhat useful for patients

4. Good quality and generally good flow, most of the relevant information is listed, but some topics not covered, useful for patients

5. Excellent quality and excellent flow, very useful for patients

Questions expected to be answered about videos in the DISCERN

· Is the video clear, concise, and understandable?

· Are reliable sources of information used?

· Is the information presented balanced and unbiased?

· Are additional sources of information listed for patient reference?

· Are areas of uncertainty/controversy mentioned?

PEMAT has two versions, including PEMAT_P, in which written materials are evaluated, and PEMAT-A/V, in which audio-visual materials are evaluated. We used the PEMAT-A/V version. PEMAT-A/V classifies videos as understandable when they can process and explain basic messages for people with different levels of health literacy

and as actionable when they determine what patients can do in an information-oriented manner. PEMAT consists of 13+4 items, and the higher the percentage, and the more understandable or actionable the video is, after the scores of all items are calculated and the percentages are taken.

Understandability

Content

The material made its purpose completely evident.

Word Choice and Style

The material uses common, everyday language.

Medical terms are used only to familiarize audience with the terms. When used, medical terms are well defined.

The material uses the active voice.

Organization

The material breaks or "chunks" information into short sections.

The material's sections have informative headers.

The material presents information in a logical sequence.

The material provides a summary.

Layout and Design

The material uses visual cues (e.g., arrows, boxes, bullets, bold, larger font, highlighting) to draw attention to key points.

The text on the screen is easy to read.

The material allows the user to hear the words clearly.

Use of Visual Aids

The material uses illustrations and photographs that are clear and uncluttered.

The material uses simple tables with short and clear row and column headings.

Actionability

Actionability

The material clearly identifies at least one action the user can take.

The material addresses the user directly when describing actions.

The material breaks down any action into manageable, explicit steps.

The material explains how to use the charts, graphs, tables or diagrams, to take actions.

Statistical Analysis

The data were evaluated using the SPSS 20.0 package program, and p<0.05 was considered significant. The suitability of the data for normal distribution was evaluated by Kolmogorov-Smirnov analysis. The mean± standard deviation and median (minimum-maximum) values of the data were calculated. The categorical and ordinal variables were evaluated using the Chi-Square and Mann-Whitney-U tests, respectively. Furthermore, linear regression analyses of the variables were performed.

RESULTS

The duration of the videos included in the study was between 30 and 3447 seconds, with a median duration of 158.0 seconds. The one hundred twelve videos included in our study were watched a total of 5735286 times, and the time elapsed after the videos were uploaded varied between 43 and 4495 days, with a median time of 1328.5 days. The number of likes the videos received from the viewers varied between 0 and 153000, with a median value of 32.0 likes. There were 27 videos (24.1%) that were closed to comments by the uploader; the number of comments of the videos that could be commented on was between 0 and 1900, and the median number of comments was 1.0. The videos we reviewed were viewed between 3 and 4332567 times, and the median number of views was 5538. The upload date of the first video we included in our study on the subject was 15.06.2010, and the last uploaded video was dated 23.08.2022. The median upload date was 14.02.2019, and the mean upload date was 02.08.2018.

We found that 86.6% (n=97) of the videos were educational for the public, while 13.4% (n=15) were prepared for academic education. Furthermore, while the rate of videos that were determined to be prepared by physicians was found to be 18.8% (n=21), the rate of videos prepared by non-physician health workers was 25.0% (n=28), the rate of videos prepared by the organization/administration was 27.7% (n=31), and the rate of videos prepared by independent users was 16.1% (n=18). Thirty-four videos (30.3%) were identified as patient case presentations. Among the videos, 66.1% (n=74) were about how to use epinephrine auto-injectors, and 38 (33.9%) provided information on how and in which situation epinephrine auto-injectors could be used. Most of the videos (55.4%, n=62) were uploaded from the United States (US), followed by the United Kingdom at 15.2%, and Canada at 10.7%, respectively.

Upon reviewing the GQS scores of the videos, the GQS scores ranged from 1 to 5 points, and the median score was 4.0. The quality was poor in 8 videos, generally poor in 6 videos, moderate in 30 videos, good in 45 videos, and excellent in 23 videos (Table I).

Upon evaluating the PEMAT scores of the videos, 25 videos were found to be understandable and 61 videos to be actionable. The understandability scores of the videos evaluated as understandable varied between 73 and 100, and the median understandability score was 90.0. The minimum, maximum and median values of the actionability scores of the videos found to be actionable were 100 points.

A highly positive correlation was found between the GQS scores and the DISCERN scores of the videos (r=0.753, p=0.000). A moderately positive correlation was found between the GQS scores and the understandability (r=0.694, p=0.000) and actionability scores (r=0.615, p=0.000). A moderately positive correlation was found between the DISCERN scores and the understandability (r=0.677, p=0.000) and actionability scores (r=0.502, p=0.000). A moderately positive correlation was found between the understandability and actionability scores of the videos (r=0.599, p=0.000) (Table II).

Table I: Target, source, content, and country of publication of the videos

Variable name	%	n
Video Target		
Public Education	86.6	97
Academic Education	13.4	15
Video Source		
Physician	18.8	21
Non-physician Health Worker	25.0	28
Organization/Administration	27.7	31
Independent User	16.1	18
Drug Company	12.5	14
Video Content		
How to use the epinephrine auto-inj.	66.1	74
How and when use an auto-inj.	33.9	38
Country of publication		
USA	55.4	62
United Kingdom	15.2	17
Canada	10.7	12
Australia	4.5	5
South Korea	0.9	1
South Africa	0.9	1
Ireland	0.9	1
Unknown	11.6	13

The duration of the understandable videos was found to be significantly higher than those of the non-understandable videos, with a median (min-max) duration of 266 (109-3447) seconds (p=0.000). The duration of actionable videos was found to be significantly higher than of non-actionable videos, with a median (min-max) duration of 190 (46-3447) seconds (p=0.028). The understandability rate of the videos uploaded by physicians and non-physician health workers was found to be 10.2%, which was significantly lower compared to other video uploaders (31.7%) (p=0.007), and no significant correlation was found with actionability (p=0.007). The number of comments per 1000 views was found to be lower for understandable and actionable videos, and the difference was not significant. The Discern scores of the videos were found to be significantly higher in understandable videos with a median (min-max) score of 3.0 (2.0-5.0) compared to non-understandable videos (p=0.000). In the comparison of Discern scores with actionable states, the median (min-max) values of actionable videos were found to be significantly higher, with a score of 3.0 (1.0-5.0) (p=0.000). The GQS scores were found to be significantly higher in understandable videos with a median (min-max) score of 5.0 (3.0-5.0) (p=0.000). The GQS scores of actionable videos were found to be significantly higher, with a median (min-max) score of 4.0 (3.0-5.0) compared to non-actionable videos (p=0.000) (Table III).

In the linear regression analysis performed, the number of understandable videos in the videos published by physicians and non-physician health workers was found to be significantly lower compared to the videos uploaded by other users (OR:-0.333; %95 Cl -1.028 – -0.307; p=0.000). The number of understandable videos was significantly higher in videos with longer duration (OR:0.238; %95Cl 0.053 – 0.423; p=0.012). No significant correlation was found between the content of the videos, the number of views, the video targets and the number of understandable videos (Table IV).

DISCUSSION

The quality, reliability, understandability, and actionability of videos on epinephrine auto-injector usage on YouTube, which is popular in social media, were evaluated in the current study, which is the first study in which the relevant, valid, reliable, and objective scales according to the literature review were used.

Considering that most cases of anaphylaxis occur outside the hospital and that deaths due to anaphylaxis occur in the absence of adrenaline administration, it is vital for patients to carry their epinephrine autoinjectors with them and know how to use them. Unfortunately, a study conducted in a group of 102 patients, indicated that only 16% of the patients correctly applied all steps of epinephrine autoinjector use (23). While the most common mistake was not holding the drug in place for at least 10 seconds after triggering, other common mistakes were not placing the needle tip in the thigh area, not pressing the device strongly enough, and not opening the cover of the device before the application (23). This situation suggests that the problems arising from the misuse of epinephrine can be easily avoided if the usage of the device is fully understood and applied correctly.

The one hundred twelve videos included in our study were watched a total of 5735286 times. This high number of views suggests that YouTube videos are a vital tool in increasing the general public's awareness and level of knowledge and reaching specific patient populations. It was indicated in a study that individuals started to use social media for support purposes at an increasing rate if their needs were not sufficiently met by healthcare professionals (24,25). With the number of users increasing daily, YouTube is one of the most extensive platforms patients prefer in healthcare applications due to its visualization and easy accessibility. However, YouTube may usually

Table II: The Characteristics scores of understandable vs. non understandable and actionable vs. non- actionable.

Scores		Overall n (%)	Mean	Median (Min, Max)	p
Understandability	Understandable	25 (22.4)	85.6 ± 8.4	90. 0 (73.0-100.0)	0.000
	Non-Understandable	87 (77.6)	53.2 ± 14.3	60.0 (10.0-70.0)	
	All	**112**	**60.4 ± 18.9**	**60.0 (10.0-100.0)**	
Actionability	Actionable	61 (54.4)	100.0 ± 0.0	100.0 (100.0-100.0)	0.000
	Non- Actionable	51 (45.6)	55.0 ± 20.0	67.0 (0.0-67.0)	
	All	**112**	**79.5 ± 26.1**	**100.0 (0.0-100.0)**	

Table III: The Possible independent factors for understandability and actionability.

Video Characteristic		Overall	Understandable	Non-Understandable	p	Actionable	Non-Actionable	p
		n (%)	n (%)	n (%)		n (%)	n (%)	
Type of Source	Physician/Non physician Health Personnel	49 (43.75)	5 (10.2)	44 (89.8)	0.007	24 (49.0)	25 (51.0)	0.304
	Company/Independent/Drug	63 (56.25)	20 (31.7)	43 (68.3)		37 (58.7)	26 (41.3)	
Target Type	Public Education	97 (86.6)	22 (22.7)	75 (77.3)	0.817	56 (57.7)	41 (42.3)	0.077
	Academic Education	15 (13.4)	3 (20.0)	12 (80.0)		5 (33.3)	10 (66.7)	
Video Content	How to use epinephrine	74 (66.0)	13 (17.6)	61 (82.4)	0.092	40 (54.1)	34 (45.9)	0.903
	How and when	38 (34.0)	12 (31.6)	26 (68.4)		21 (55.3)	17 (44.7)	
		Median (Min-Max)	Median (Min-Max)	Median (Min-Max)		Median (Min-Max)	Median (Min-Max)	
Video Length (seconds)		158 (30-3447)	266 (109-3447)	142 (30-1509)	0.000	190 (46-3447)	132 (30-1509)	0.028
Views		5538 (3-4332567)	9774 (27-473067)	5275 (3-4332567)	0.434	5576 (16-473067)	5284 (3-4332567)	0.724
Views per day		4.1 (0.01-5484.2)	3.7 (0.02-291.5)	4.4 (0.01-5484.2)	0.642	4.6 (0.01-321.6)	3.8 (0.05-5484.2)	0.737
Likes per 1000 views		5.4 (0.0–245.3)	4.2 (0.0 – 245.3)	6.2 (0.0 – 74.0)	0.349	5.1 (0.0- 245.3)	5.8 (0.0-74.0)	0.260
Comments per 1000 views		0.08 (0.0-21.7)	0. (0.0-13.6)	0.17 (0.0-21.7)	0.439	0.09 (0.0-21.7)	0.11 (0.0-18.5)	0.588
DISCERN		2.0 (0-5)	3.0 (2.0-5.0)	2.0 (0.0-5.0)	0.000	3.0 (1.0-5.0)	2.0 (0.0-5.0)	0.000
GQS		4.0 (1.0-5.0)	5.0 (3.0-5.0)	4.0 (1.0-5.0)	0.000	4.0 (3.0-5.0)	3.0 (1.0-5.0)	0.000

Chi-Square and Mann-Whitney U tests were performed.

Table IV: Model for understandability and actionability by performed by linear regression analysis.

Model	Understandability			Actionability		
Variables	Coefficient	95% Cl	p- value	Coefficient	95% Cl	p- value
Constant	0.507	-	0.007	0.093	-	0.641
Video Length	0.238	0.053–0.423	0.012	0.161	-0.038–0.359	0.111
Video Content (How to use auto-inj. - How and when use auto-inj.)	-0.155	-0.716–0.064	0.100	0.012	-0.394–0.444	0.907
Video Source (Physician and non-physician health worker-other)	-0.333	-1.028–0.307	0.000	-0.125	-0.638–0.138	0.204

convey false and misleading information. Two studies evaluating the use of inhaled corticosteroids and nasal corticosteroids in YouTube videos have revealed that the use of these drugs was correctly demonstrated only by 15% and 7.7%, of the videos, respectively (26,27). Although many studies evaluate social media, some of these studies need more objective evaluation criteria. Our study is the first in which YouTube videos are evaluated with known and defined scales regarding epinephrine autoinjector use. In 2017, Alataş et al. investigated the reliability of YouTube videos on the use of epinephrine autoinjectors. Their study used the scoring system they developed and indicated that 40% of the videos scored above the average and were useful for education (28).

Upon evaluating the PEMAT scores of the videos included in our study, it was found that 22.4% (n=25) and 54.4% (n=61) of the videos were understandable and actionable, respectively. In another study in which YouTube videos were evaluated concerning hypospadias and the same assessment tool was used, the rate of understandable videos was 5.6%; however, the rate of actionable videos was 15.1% (29). In another study on YouTube evaluating urinary incontinence, the rate of understandable and actionable videos was 12.5% (30). There are some reasons for the difference between study results. Although the same scales are used in video assessment, a subjective assessment is made. Furthermore, the content of the videos and the number of videos included are different from each other. Because of all these differences, detecting understandable and actionable videos at varying rates is understandable. Therefore, although the number of understandable and actionable videos on the use of epinephrine autoinjectors in our study was higher than in other studies, it is evident that this rate should be further increased.

While the mean understandability value of the videos was 60.4, the mean actionability value was 79.5. In another study evaluating YouTube videos with regard to urinary incontinence, these values were found to be 57.9 and 44.7, respectively (30). Additionally, in a study evaluating YouTube videos about sinusitis, the overall average understandability score of the videos was found to be 57.7% and the overall average actionability score was 45.6% (31). Considering the vital importance of using epinephrine autoinjectors, this data suggests that the relevant YouTube videos constitute an area open to improvement in patient education. In our study, the number of actionable videos was higher than the number of understandable videos. In the use of epinephrine autoinjectors, it is recommended to demonstrate the application visually with demo devices and provide verbal explanation to the patients for proper and correct use of the device. Therefore, it is acceptable that the Youtube videos with visual applications at the forefront scored higher in terms of actionability.

The duration of understandable videos was statistically longer compared to non-understandable videos, and the duration of actionable videos was statistically longer compared to non-actionable videos. This was an expected result considering that the video content was enriched and the information to be conveyed was given to the patient in a clearer and more detailed manner as the duration of the video increased, and is also supported by our study. There are also other studies in the literature revealing that the quality and reliability of the video increases as its duration increases (32).

The total number of views, likes, and comments per view are evaluated to determine the popularity of videos published on social media (33). In our study, the total number of views and views per day of understandable and actionable videos were lower than non-understandable and non-actionable videos, but this difference was not significant. Upon analyzing the number of comments and likes per 1000 views, it was observed that there was no statistical difference between understandable videos and non-understandable videos and between actionable videos and non-actionable videos. In a similar study, it was revealed that there was no significant correlation between the numbers of likes, dislikes, views, and comments and the PEMAT scores (33). Following these results, it can be concluded that the videos were not considered an educational tool by the patients and that the popular video content needed to contribute more to patient education. The fact that the videos that were watched and liked more by the patients needed to be more understandable and actionable suggested that the patients were not actually interested in the content and quality of the videos. As indicated in previous studies, it results from health-related videos uploaded to social media reaching the audience without a certificate quality assessment (33,34). Future social media studies in the field of health should be developed to deliver videos with the right content to patients.

Interestingly, the rate of understandable videos uploaded by physicians and non-physician health workers was significantly lower by 10.2% compared to other video uploaders (31.7%) in our study; however, no significant correlation was found with actionability. In the linear regression analysis, the rate of understandable videos uploaded by physicians and non-physician health workers was also lower. A similar study in which YouTube videos on penile prostheses were evaluated using the PEMAT scale, no statistically significant difference was found between the PEMAT scores of the physicians and the others (33). After prescribing, epinephrine autoinjector training is primarily provided to the patients by the prescribing physician and non-physician health workers in the clinic. The relevant YouTube videos published by physicians and non-physician health workers are expected to be more understandable and actionable and have higher quality. In

the literature, studies show that physicians create higher-quality video content (32,35). This may have been due to the fact that the number of immunology specialists around the world is less than the number of specialist doctors in other health fields, and therefore social media applications have lagged behind (36), physicians cannot spare enough time for social media applications due to intense working conditions and lack of technical knowledge in the field of technology, and healthcare professionals publish papers about a health practice in their field by using professional language in a way that no one outside the health sector can understand. Physicians and non-physician health workers should use social media more actively to inform patients and their relatives about the use of epinephrine autoinjectors and pay attention to creating content in a way that the public can understand. Physicians and related associations/organizations should contribute more to online access sites since they are more likely to spread quality information on social media content for patient education in the field of allergy/immunology.

The GQS and DISCERN scores of understandable videos were significantly higher than those of non-understandable videos, and the GQS and DISCERN scores of actionable videos were significantly higher than those of non-actionable videos. The correlation analysis determined that the GQS, DISCERN, PEMAT Understandability and PEMAT Actionability scores were also positively and significantly correlated. This data showed that the videos' understandability and actionability features increased as the quality and reliability of the videos increased. A positive correlation found between the PEMAT scores and DISCERN scores in a study evaluating YouTube videos on stuttering, which indicated that users producing reliable and quality content produced more understandable and actionable videos (37).

Our study has some limitations. Considering the dynamic development of YouTube, our study was conducted in a short period. The results may vary with the uploaded and deleted videos. However, our study will guide other studies to be conducted in a broader period. Furthermore, another limitation was that only English videos were evaluated in our study. Another limitation was that other widely used social media platforms were not evaluated.

The popularity of all social media services, and especially Youtube, concerning health education and knowledge is increasing, and patients use social media services as reference points for their diseases and treatments. However, there are severe problems regarding the videos' accuracy, quality, reliability, understandability and actionability. Using an epinephrine autoinjector in case of anaphylaxis is the most urgent intervention in the field of allergy/immunology. We found that YouTube content needed to be improved in this regard. In the literature, there are very few studies on how social media applications affect patient behaviour and allergy/immunology practice. Professional organizations and allergists should try to distribute accurate and quality information. Moreover, they should focus on improving social media practices in their future studies.

Ethics Approval

The YouTube platform is free and accessible to everyone. Since no humans or participants were included in our study, ethics committee approval was not necessary.

Conflict of Interest

The authors have no conflicts of interest to declare.

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Author Contributions

Concept: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak,** Design: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak,** Data collection or processing: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak,** Analysis or Interpretation: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak,** Literature search: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak,** Writing: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak,** Approval: **Gurgun Tugce Vural Solak, Merve Erkoç, Yavuzalp Solak.**

REFERENCES

1. Lieberman P, Camargo CA Jr, Bohlke K, Jick H, Miller RL, Sheikh A, et al. Epidemiology of anaphylaxis: findings of the American College of Allergy, Asthma and Immunology Epidemiology of Anaphylaxis Working Group. Ann Allergy Asthma Immunol 2006;97(5):596-602.

2. Sclar D, Cohen L, Robison L. Economic burden of anaphylaxis in the United States. in Allergy And Asthma Proceedings. 2012. Ocean Side Publications Inc 95 Pitman St, Providence, Ri 02906 USA.

3. Wood RA, Camargo CA Jr, Lieberman P, Sampson HA, Schwartz LB, Zitt M, et al. Anaphylaxis in America: the prevalence and characteristics of anaphylaxis in the United States. J Allergy Clin Immunol 2014;133(2):461-7.

4. Ma L, Danoff TM, Borish L. Case fatality and population mortality associated with anaphylaxis in the United States. J Allergy Clin Immunol 2014;133(4):1075-83.

5. Moneret-Vautrin DA, Morisset M, Flabbee J, Beaudouin E, Kanny G. Epidemiology of life-threatening and lethal anaphylaxis: a review. Allergy 2005;60(4):443-51.

6. Ross MP, Ferguson M, Street D, Klontz K, Schroeder T, Luccioli S. Analysis of food-allergic and anaphylactic events in the National Electronic Injury Surveillance System. J Allergy Clin Immunol 2008;121(1):166-71.

7. Sheikh A, Hippisley-Cox J, Newton J, Fenty J. Trends in national incidence, lifetime prevalence and adrenaline prescribing for anaphylaxis in England. J R Soci Med 2008;101(3):139-43.

8. Muraro A, Worm M, Alviani C, Cardona V, DunnGalvin A, Garvey LH, et al. EAACI guidelines: Anaphylaxis (2021 update). Allergy 2022;77(2):357-77.

9. Simons FE, Ebisawa M, Sanchez-Borges M, Thong BY, Worm M, Tanno LK, et al. 2015 update of the evidence base: World Allergy Organization anaphylaxis guidelines. World Allergy Organ J 2015;8(1):32.

10. Simons FE, Ardusso LR, Bilò MB, Cardona V, Ebisawa M, El-Gamal YM, et al. International consensus on (ICON) anaphylaxis. World Allergy Organ J 2014;7(1):9.

11. Lieberman P, Nicklas RA, Randolph C, Oppenheimer J, Bernstein D, Bernstein J, et al. Anaphylaxis--a practice parameter update 2015. Ann Allergy Asthma Immunol 2015;115:341-84.

12. Song T, Worm M, Lieberman P. Anaphylaxis treatment: current barriers to adrenaline auto-injector use. Allergy 2014;69(8):983-91.

13. Ring J, Beyer K, Biedermann T, Bircher A, Duda D, Fischer J, et al. Guideline for acute therapy and management of anaphylaxis. Allergo J Int. 2014;23(3):96-112.

14. Dumeier HK, Richter LA, Neininger MP, Prenzel F, Kiess W, Bertsche A, et al. Knowledge of allergies and performance in epinephrine auto-injector use: a controlled intervention in preschool teachers. Eur J Pediatr 2018;177(4):575-81.

15. Ercan H, Ozen A, Karatepe H, Berber M, Cengizlier R. Primary school teachers' knowledge about and attitudes toward anaphylaxis. Pediatr Allergy Immunol 2012;23(5):428-32.

16. Haslam K, Doucette H, Hachey S, MacCallum T, Zwicker D, Smith-Brilliant M, et al. YouTube videos as health decision aids for the public: An integrative review. Can J Dent Hyg 2019;53(1):53-66.

17. Perrin A, Anderson M. Share of US adults using social media, including Facebook, is mostly unchanged since 2018. Access date: 10.11.2022, Available from: https://pewrsr.ch/2VxJuJ3.

18. Madathil KC, Rivera-Rodriguez AJ, Greenstein JS, Gramopadhye AK. Healthcare information on YouTube: A systematic review. Health Informatics J 2015;21(3):173-94.

19. Shoemaker SJ, Wolf MS, Brach C. Development of the Patient Education Materials Assessment Tool (PEMAT): a new measure of understandability and actionability for print and audiovisual patient information. Patient Educ Couns 2014;96(3):395-403.

20. Bernard A, Langille M, Hughes S, Rose C, Leddin D, Veldhuyzen van Zanten S. A systematic review of patient inflammatory bowel disease information resources on the World Wide Web. Am J Gastroenterol 2007;102(9):2070-7.

21. Singh AG, Singh S, Singh PP. YouTube for information on rheumatoid arthritis--a wakeup call? J Rheumatol 2012;39(5):899-903.

22. Şahin M, Kaya E. Understandability and Actionability of Education Materials About Syphilis on YouTube. Sex Res Social Policy 2022;19(4):1989-95.

23. Bonds RS, Asawa A, Ghazi AI. Misuse of medical devices: a persistent problem in self-management of asthma and allergic disease. Ann Allergy Asthma Immunol 2015;114(1):74-6.

24. Smailhodzic E, Hooijsma W, Boonstra A, Langley DJ. Social media use in healthcare: a systematic review of effects on patients and on their relationship with healthcare professionals. BMC Health Serv Res 2016;16(1):1-14.

25. Benetoli A, Chen TF, Aslani P. Consumer health-related activities on social media: exploratory study. J Med Internet Res 2017;19(10): e7656.

26. Gonzalez-Estrada A, Cuervo-Pardo L, Ghosh B, Smith M, Pazheri F, Zell K, et al. Popular on YouTube: a critical appraisal of the educational quality of information regarding asthma. Allergy Asthma Proc 2015;36(6):e121-6.

27. Joshi S, Dimov V, Eidelman FJ. Youtube videos for patient education on how to use nasal sprays associated with insufficient reliability. J Allergy Clin Immunol 2015;135(2):AB136.

28. Alataş ET, Alataş ÖD, Acar E. Epinephrine Auto-injector Use on YouTube: Is It Really Useful? Eurasian J Emerg Med 2019;18(2):68-71.

29. Salama A, Panoch J, Bandali E, Carroll A, Wiehe S, Downs S, et al. Consulting "Dr. YouTube": an objective evaluation of hypospadias videos on a popular video-sharing website. J Pediatr Urol 2020;16(1):70.e1-70.e9.

30. Baran C, Baran SY. Youtube videos as an information source about urinary incontinence. J Gynecol Obstet Hum Reprod 2021;50(10):102197.

31. Rubel KE, Alwani MM, Nwosu OI, Bandali EH, Shipchandler TZ, Illing EA, et al. Understandability and actionability of audiovisual patient education materials on sinusitis. Int Forum Allergy Rhinol 2020;10(4):564-71.

32. Kaya E, Solak Y, Koçyiğit BF. Youtube as a source of information about gonorrhea. Cent Asian J Med Hypotheses Ethics 2022;3(2):103-10.

33. Capece M, Di Giovanni A, Cirigliano L, Napolitano L, La Rocca R, Creta M, et al. YouTube as a source of information on penile prosthesis. Andrologia 2022;54(1):e14246.

34. Fode M, Nolsøe AB, Jacobsen FM, Russo GI, Østergren PB, Jensen CFS, et al; EAU YAU Men's Health Working Group. Quality of Information in YouTube Videos on Erectile Dysfunction. Sex Med 2020;8(3):408-13.

35. Carrillo-Martin I, Kallur L, Cuervo-Pardo L, et al. 'What is anaphylaxis': a critical appraisal of the quality of anaphylaxis information on YouTube. J Allergy Clin Immunol 2019;143(2): AB173.

36. Association of American Medical Colleges (AAMC). Physician specialty data report, 2020. Access date: 15.11.2022. Available form: https://www.aamc.org/data-reports/workforce/report/physician-specialty-data-report

37. Yaşar ÖC, Birol NY, Erensoy İ. Kekemelik hakkında bilgi kaynağı olarak YouTube. Hacettepe University Faculty of Health Sciences J 2021;8(3):637-54.