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Evaluation of the origin and educational quality of YouTube videos on adrenaline auto-injectors

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Key words

Adrenaline; epinephrine; anaphylaxis; auto-injector; YouTube.

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Impact statement

The adrenaline auto-injector is a potentially life-saving device in the treatment of anaphylaxis, but it has been shown that only a small percentage of patients can use it correctly. It is important to evaluate videos on YouTube from this perspective.

Summary

Background. *Guidelines highlight the pivotal role of adrenaline auto-injector (AAI) training. However, the standards of visual training platforms have not been determined. Our aim was to evaluate the reliability and quality of the AAI related videos on YouTube.* ***Methods.*** *After a search on YouTube about AAI, all videos were categorized into groups based on their origin and the aim of the content. The quality, reliability, understandibility, and actionability of the videos were evaluated using the Global Quality Scale (GQS), Patient Education Materials Assessment Tool Audovisiual (PEMAT-A/V), Quality Criteria for Consumer Health Information (DISCERN), and a modified DISCERN. In each video, the application steps of AAI were evaluated according to a scale of correct usage.* ***Results.*** *107 YouTube videos in English were included. No significant difference in terms of views, likes, duration and uploading time was observed between the health and non-health groups whereas the GQS (p = 0.001), DISCERN total (p = 0.02) and modified DISCERN (p = 0.001) scores were higher in the health group. It was found that scores tended to be higher in educational videos. AAI use was mentioned in 85% videos. The median number of mentioned steps was 6.* ***Conclusions.*** *YouTube is an effective platform for visual learning for the use of AAIs. Although the visibility of the videos is equal independent of the origin, the ones recorded by medical professionals seem to provide the most qualified and reliable information.*

Introduction

Anaphylaxis is a potentially life-threatening allergic reaction characterized by acute onset of symptoms affecting multiple organ systems, necessitating immediate intervention (1, 2) and adrenaline remains as the cornerstone of acute treatment (3). International guidelines recommend prompt self-administration of adrenaline auto-injector (AAI) as an initial step of treatment (2, 4). Accordingly, AAIs should be prescribed to individuals with a history of anaphylactic reactions triggered by food, latex or aeroallergens, exercise-induced anaphylaxis, idiopathic anaphylaxis, co-existing unstable or moderate to severe persistent asthma and food allergy, Hymenoptera venom allergy, or an underlying systemic mastocytosis in adults with any previous systemic reaction (2, 4). Prompt prehospital injection of adrenaline during anaphylaxis has been associated with a lower risk of hospitalization and mortality (5-8). Administering adrenaline has been also found to lower the risk of biphasic reactions (2,6,9-11). On the other hand, the patients during an acute attack can be reluctant to use the AAI. A study by Goldberg *et al.* showed that only 22% of venom allergy

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patients who were prescribed an AAI were able to use and among them, 44% demonstrated proper usage (12). Similarly, Gold *et al.* stated that parental knowledge regarding the usage of AAI was insufficient and in recurrent anaphylaxis, with only 29% demonstrating the ability to use an AAI (13).

The international guidelines emphasize the pivotal role of AAI training in people at risk of anaphylaxis (2, 4). However, the standards of the educational content on visual platforms have not yet been determined (2). Recently, where the internet provides easily accessible information, numerous videos on YouTube (https://www.youtube.com/) discussing the use of AAI can be found. These YouTube videos serve as an uncontrolled source of information regarding the utilization of AAIs and can potentially prove to be helpful. Therefore, we aimed to evaluate the characteristics of the YouTube videos for the use of AAIs.

Materials and methods

Study design

A search on YouTube (https://www.youtube.com/) was conducted using the terms of "adrenaline auto-injector", "epinephrine auto-injector" and the marketing names for AAI. The most relevant 157 videos in English were initially screened. The flowchart in **figure 1** shows the reasons and numbers for excluding videos.

Statement of ethics

This study protocol was reviewed and approved by Istanbul Faculty of Medicine Clinical Research Ethics Committee, Istanbul University, approval number 1815210, 2159248.

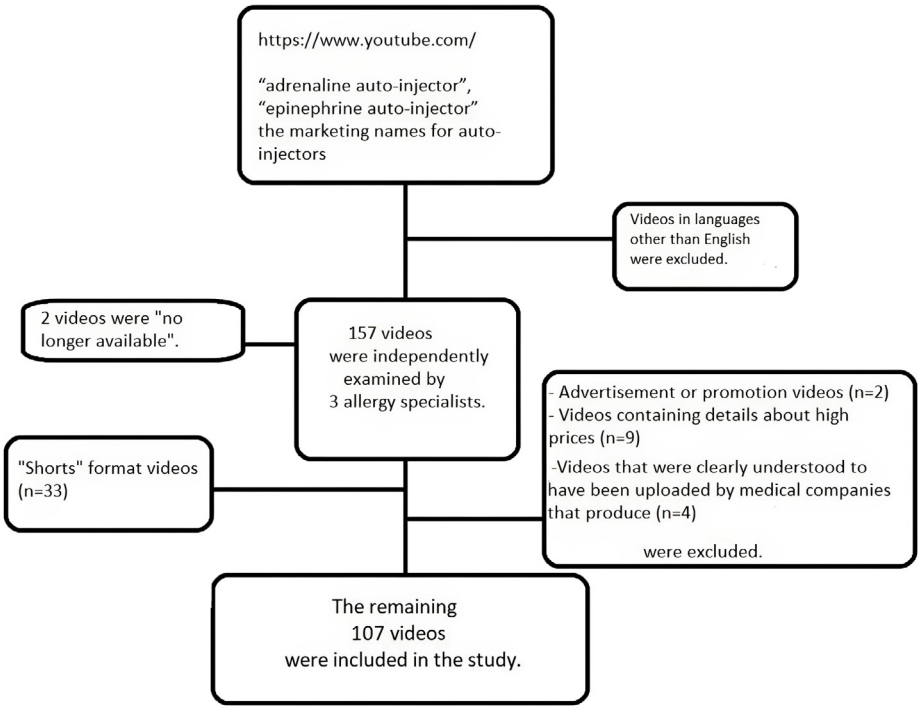
Evaluation of the videos

Data on views, likes, time of upload (in months), and duration (in minutes) were collected. Views and likes were also recorded by calculating the average views per month, likes per month, and likes/views ratio. The content of two identical videos were evaluated as two separate videos when the number of views, likes and links was different.

Categorization of the videos

The videos were categorized into two groups according to the presenter and/or the YouTube channel as the "health group" and the "non-health group". Accordingly, when the presenter was a medical doctor, a paramedic, a nurse or a pharmacist or an unspecified healthcare professional, the video was considered to belong to the health-group. Additionally, when the channel belonged to a medical doctor, a paramedic, a nurse or a pharmacist, a healthcare facility, training or education center/company, a non-profit medicial association or a governmental medical organization, the video was again considered within the health group. All other presenters and channels formed the non-health

Figure 1 *- Research methodology flowchart.*



group. All the videos were further classified into four subgroups based on their aim of content, as medical professional education (MPE), patient education (PE), patient experience, and awareness:

- MPE: The video's target audience is primarily healthcare professionals.
- PE: Patient education videos aim to educate the public.
- Patient experience: Patient experience videos focus on the experiences of patients or their relatives without educational purposes.
- Awareness: These videos aim only to raise awareness without any educational purpose or experience.

Content quality, reliability, understandibility and actionability of videos

The quality, reliability, understandability, and actionability of the videos were assessed using several tools: the Global Quality Scale (GQS), the Patient Education Materials Assessment Tool Audovisual (PEMAT-A/V), the Quality Criteria for Consumer Health Information (DISCERN), and a modified version of DISCERN. These tools were utilized to evaluate the videos (**table IS**). Video quality and streaming were assessed using a 5- question GQS score in which a higher GQS score indicated a greater content-quality and information (14-21). To evaluate the understandability and actionability of videos pertaining to the use of AAI the PEMAT-A/V score was applied (22-24).

For the evaluation of the quality, reliability, and detailed treatment options in the content of the videos, the DISCERN (25) and modified DISCERN (18, 26) scores were utilized. Each of these scoring systems was rated on a scale of 1-5, with higher scores indicating greater reliability.

In addition, an assessment was conducted to determine whether the videos contained any false information (17, 20, 21, 27-31). To ensure reliability and objectivity, the videos were reviewed by three allergists independently.

Scales used to evaluate the quality, reliability, understandibility and actionability of the video content are shown in detail in the supplementary **table I** (17, 18, 20-24, 26-31).

Evaluation of application steps of an adrenaline auto-injector presented in each video

The application steps of an AAI in each video were assessed according to a scale of correct usage as follows; step 1: checking the expiration date, step 2: removing the AAI from its container, step 3: removing the safety cap, step 4: displaying of the application area, step 5: stabbing of AAI, step 6: counting for 3-10 seconds, step 7: removing the AAI, step 8: massaging the application area and step 9: calling the first aid center (2, 4, 32-35).

Table I - *Comparison of quality reliability, understandability and actionability of the video content between the health and non-health groups.*

	Health (n = 96)	**Non-health (n = 11)**	**P-value**
Content, n (%)			< 0.001
Medical profession education	8 (8.3)	0	
Patient education	80 (83.3)	3 (27.3)	
Patient experience	3 (3.1)	7 (63.6)	
Awareness	5 (5.2)	1 (9.1)	
GQS, median (IQR)	3 (3-4)	2 (1-3)	0.001
PEMAT-A/V, median (IQR)			
PEMAT-A/V actionability	100 (100-100)	100 (0-100)	NS
PEMAT-A/V understandibility	78 (67-91)	67 (57-82)	NS
DISCERN, median (IQR)			
DISCERN total	31 (29-34.75)	30 (22-31)	0.02
DISCERN reliability	24 (22-25)	23 (15-24)	NS
DISCERN treatment	7 (7-9)	7 (7-7)	NS
DISCERN overall	4 (3-4)	3 (1-4)	NS
Modified DISCERN, median (IQR)	3 (3-4)	3 (0-3)	0.001

Statistical analysis

The data were analyzed using the Statistical Package for Social Sciences. Additionally, Microsoft PowerPoint was utilized to generate the figures.

The distribution pattern of the quantitative data was assessed using the Kolmogorov-Smirnov test.

Baseline characteristics were evaluated by descriptive analysis, and the interquartile range was presented as median percentages with 25-75 percent (IQR 25-75) according to the distribution of data. Continuous variables were compared between the two groups using either the independent t-test or the Mann-Whitney U test. Statistically significant differences were defined as p-values less than 0.05.

Videos were examined independently by three physicians working in the allergy and immunology unit. The two results that were closest to each other were selected for further analysis, and the Correlation Coefficient (ICC) was calculated as an average measure.

Results

General analysis of the data

A total of 9 hours and 21 minutes of video streaming was observed in 107 videos. Additionally, these videos received a total of 16,631,161 views and 193,050 likes. The median length of the videos was 2 (1-5) minutes; the median loading time was 55 (25-92) months; the median number of views was 4,362 (360-26,005) and the median number of likes was 18 (3-190). The views/months rate, the likes/months rate and likes/views rate were calculated as 68.50 (10.97-686.20), 0.37 (0.08-3.22) and 0.005 (0.002-0.012), respectively. The distribution of the videos depending on the presenter and channel are shown in **figure 2**. The majority was presented by a health advocate with unknown profession. The training or education center/company was the leading YouTube channels.

Comparison of general characteristics of the videos in health and non-health groups

No significant differences were found between the health and non-health groups in terms of views, likes, duration (in minutes), upload time, views/months rate, likes/months rate and likes/views rate ($p = 0.943$, $p = 0.833$, $p = 0.276$, $p = 0.186$, $p = 0.601$, $p = 0.482$, $p = 0.663$, respectively) (**table IIS**).

Comparison of quality, reliability, understandibility and actionability of the video content between the health and non-health groups

In terms of video content categories, there was a significant difference between the health and non-health groups. PE videos were found to be significantly more prevalent in the health group ($p < 0.001$). Furthermore, when evaluating video quality, the GQS score was significantly higher in the health group compared to the non-health group ($p = 0.001$).

However, there was no statistically significant difference between the health and non-health groups in terms of neither PEMAT-A/V

Figura 2 *- The distribution of the videos.*

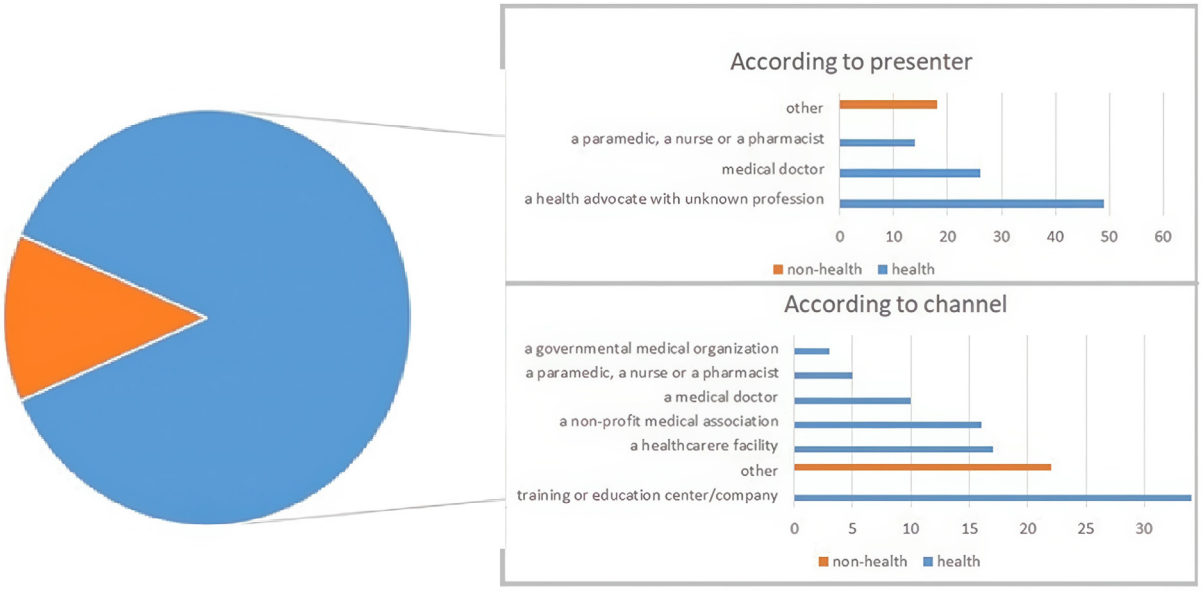


***Table II** - Comparison of the video quality, reliability, understandability and actionability depending on the aim of the content.*

	Medical profession education (n = 8)	Patient education (n = 83)	Patient experience (n = 10)	Awareness (n = 6)	P-value
GQS, median (IQR)	4 (3-4)	3 (3-4)	1.5 (1-3)	2 (1-3)	< 0.001
PEMAT-A/V, median (IQR)					
Actionability	67 (8.25-91.75)	100 (100-100)	33.5 (0-100)	16.5 (0-75.25)	< 0.001
Understandability	73 (47-91)	78 (67-91)	67 (55-82.25)	65 (45-82.75)	NS
DISCERN, median (IQR)					
Total	31.50 (30-42.75)	32 (30-34)	27 (20-31)	26 (25-31.25)	0.006
Reliability	22.5 (21.25-24.75)	24 (22-26)	19 (13-24)	19 (18-20.75)	0.001
Treatment	7.5 (7-16.25)	7 (7-8)	7 (7-7.5)	7 (7-10.5)	NS
Overall	3 (3-3.75)	4 (3-4)	2 (1-4)	2.5 (2-3.25)	< 0.001
Modified DISCERN, median (IQR)	4 (3-4)	3 (3-4)	1.5 (0-3)	1.5 (0-3)	< 0.001

actionability nor PEMAT-A/V understandability (p = 0.141, p = 0.122, respectively).

The health group demonstrated statistically significant higher score in DISCERN total (p = 0.02). However, there was no significant difference in DISCERN reliability, DISCERN treatment and DISCERN overall scores between the health and non-health groups (p = 0.057, p = 0.165, p = 0.094, respectively). It is worth noting that the median value for DISCERN treatment was 7 which was the lowest score in both groups. The modified DISCERN score was found to be significantly higher in the health group compared to the non-health group (p = 0.001) (**table I**). One (1%) video in the health group had the potential to be harmful, while 4 (4.1%) contained misleading information. In the non-health group, 2 (18.18%) videos had the potential to be harmful, and 1 (0.9%) video had misleading information.

Comparison of the general characteristics of the videos depending on their content

Among the four subgroups determined depending on different aims of the video content, there were no significant differences observed in terms of views, likes, views/months, likes/months, likes/views (p = 0.603, p = 0.956, p = 0.920, p = 0.929, p = 0.095, respectively). However, there were statistically significant differences in video duration (in minutes) and the time of upload (in months) (p = 0.002, p = 0.005, respectively) (**table IIIS**). Among the four subgroups, the patient experience videos were found to be the oldest, while the MPE videos were the newest (p = 0.005). Additionally, the MPE videos had the longest duration, whereas patient experience videos were the shortest (p = 0.002).

Comparison of quality, reliability, understandibility and actionability assessment of the videos depending on their content

When comparing video quality assessment according to GQS, the GQS score was significantly higher in the MPE subgroup (p < 0.001). The PEMAT-A/V actionability score was statistically higher in the PE subgroup (p < 0.001). However, there was no statistically significant difference in PEMAT-A/V understandability among four subgroups (p = 0.114).

The DISCERN total, reliability and overall scores were significantly higher in the PE subgroup (p = 0.006, p = 0.001 and < 0.001, respectively) whereas there was no difference in the DISCERN treatment (p = 0.348). On the other hand, the modified DISCERN score was significantly higher in the MPE subgroup (p < 0.001) (**table II**). In the PE group, four videos (4.8%) contained misleading information, and one video (1.2%) had the potential to provide harmful information. In the patient experience group, two videos (20%) had the potential to be harmful, while one video (10%) contained misleading information.

Analysis of the reliability between two reviewers for assessment of the videos

The intraclass correlation average measure for the following variables was determined: 0.959 for GQS; 1 for content; 0.949 for PEMAT-A/V actionability, 0.895 for PEMAT-A/V understandability, 0.872 for DISCERN reliability; 0.839 for DISCERN overall, 0.782 for DISCERN treatment, and 0.834 for modified DISCERN.

Table III - *Evaluation of adrenaline auto-injector application in a stepwise manner.*

Auto injector usage step	Presented n (%)
Step 1. Checking the expiration date	22 (20.6)
Step 2. Removing the autoinjector from its container	44 (41.1)
Step 3. Removing the safety cap	85 (79.4)
Step 4. Display of the application area	77 (72)
Step 5. Stab of autoinjector	84 (78.5)
Step 6. Counting 3-10 seconds	83 (77.6)
Step 7. Removing the autoinjector	76 (71)
Step 8. Massaging the application area	38 (35.5)
Step 9. Calling for first aid center	58 (54.2)

Evaluation of application steps for the correct use of adrenaline auto injectors

AAI use was mentioned in 91 (85%) videos. Each of the nine AAI application steps was evaluated independently by three allergists**.** The two closest results to each other were selected for the evaluation, and intraclass correlation average measure was determined as 1 among the two results.

The presence of each step in the videos are presented in rates in **table III**. All the steps were shown in only three videos. The median number of mentioned steps was 6 (5-7). The steps of AAI application were shown in similar numbers in health and non-health groups.

Discussion and conclusions

The AAI is a potentially life-saving device in the treatment of anaphylaxis. However, as shown in previous studies, only a small percentage of patients can correctly administer an AAI during anaphylaxis in daily practice (12, 13)**.** In line with this, the World Allergy Organization (WAO) 2020 guidelines recommend that patients should carry a written anaphylaxis emergency action plan with instructions on how to quickly inject AAI (4). It should be noted that the recent European Academy of Allergy and Clinical Immunology (EAACI) guideline has clearly stated that the issue of how patient education will be carried out has not yet been clarified (2). Therefore, an educational video on YouTube that describes the use of AAI can be life-saving, especially for patients and their relatives who have been prescribed an AAI but have never used it before. Our study provides a good evidence by evaluating the AAI videos found on YouTube.

One of the main strengths of our work was that it reflects real-life practical scenarios. When we conducted a search YouTube, we observed that patients or their relatives frequently watch the videos demonstrating the usage of AAI. We found a total of 9 hours and 21 minutes of video streaming and 16,631,161 views of these videos. This may serve as evidence have a need for visual instruction on how to use an AAI.

The quality of these videos, the adequacy of the narration regarding AAI usage, and the presence of any false information are all crucial factors to consider. Many studies have been conducted on informative and educational YouTube videos in the field of health (20, 36, 37). Alataş *et al.* found the videos useful in terms of training by evaluating the videos on YouTube between 2006 and 2015 (38). It is obvious that an up-to-date evaluation is necessary with the increasing use of social media.

Our study highlighted that the videos on patient experience were the oldest, while the MPE group contained the recently recorded videos. This finding provides clear evidence that there has been an increase in the uploading of educational videos on this subject in recent years. The predominance of PE videos indicates the availability of various choices for patients seeking information on the use of AAI. Our study demonstrated that YouTube videos concerning AAI, uploaded by professional healthcare workers were valuable sources for obtaining accurate and reliable information on the use of AAI. This conclusion is derived from multiple analyses we conducted, using GQS, DISCERN and PEMAT scores. We evaluated DISCERN in both its original and modified forms.

In previous studies examining the quality and reliability of YouTube videos in the field of health, it was found that the health-related videos had higher GQS and DISCERN scores (39). A similar outcome was observed in a study with anakinra, a medication administered by self-injection like AAI (40). Furthermore, a study focusing on urticaria, within the field of allergy, concluded that the videos uploaded by physicians demonstrated higher quality and reliability, as indicated by DISCERN and GQS scores (37). Similarly, in our study DISCERN-total, modified DISCERN and

GQS scores of the videos in the health group were statistically significantly higher than the non-health group. Another important result from these data is that DISCERN total and modified DISCERN yielded similar results. Consequently, we believe that in future studies assessing video reliability, it may be adequate to utilize the modified DISCERN tool without necessarily employing the original DISCERN tool.

In their study on the use of social media, Benetoli *et al.* stated that YouTube was particularly utilized for medical procedures (41). The PEMAT score has been commonly employed in literature, especially in YouTube evaluation studies on medical procedures (42-45). We believe that when evaluating the videos pertaining to medical devices that requires self-administration, it is important to determine the understandability and actionability. Therefore, we also evaluated the PEMAT score in the videos to enhance its validity and examine the videos' understandability and actionability separately. In this context, according to PEMAT-A/V, the median understandability and actionability scores were similar in both study groups. In fact, it was observed that the health-related group had higher rates of understandability, although the difference did not reach statistical significance (**table I**). Interestingly, Vural Solak *et al.*'s study about YouTube videos on epinephrine autoinjectors, found that understandability was lower in health-related videos (46). This difference may be attributed to the video grouping. They categorised the video sources in two major groups as health worker sources and other sources including organization/administrations, independent users and drug companies. In our study, we evaluated both the sources and presenter(s) separately and categorized them as either health or non-health related since we also consider the possibility of the presence of a health worker in a non-health video source. Therefore, in our categorization the rate of health-related videos was higher when compared to their study (46).

In the current study, the majority of the videos in the health group were intended for PE. Conversely, most of the videos in the non-health group focused on patient experience. The quality of the videos in the health group ranged from moderate and excellent. Since the videos exhibited higher GQS and DISCERN scores and are primarily aimed at PE, they represent a suitable choice for patients seeking information about the use of AAI.

In a previous study YouTube on rehabilitation, educational physician videos were found to have significantly higher GQS and DISCERN scores (47). Similarly, in our study, the GQS score, PEMAT actionability, DISCERN total, DISCERN reliability, DISCERN overall and modified DISCERN were found to be higher in the educational videos (MPE and PE group). Based on these findings in GQS, PEMAT-A/V and DISCERN, we can conclude that videos presented by healthcare professionals or volunteers, particularly for educational purposes, tend to offer better quality. However, we found no significant difference in terms of DISCERN-treatment scoring. This suggests that videos lacked sufficient information regarding how each treatment works, the associated benefits and risks, the consequences of not using the treatment, the impact on overall quality of life, and presenting multiple treatment options for shared decision-making.

In Peters-Geven *et al.*'s previous study on the use of intranasal spray, the application method was evaluated step by step (36). They concluded that only few instructional videos on YouTube provided correct instructions for the administration of nasal sprays to patients (36). In our study, while 85% of the videos mentioned the AAI usage steps, only 3 videos included all the steps. When we focused on the crucial steps of AAI application such as removing the safety cap, displaying the application area, activating the autoinjector, and counting 3-10 seconds for proper drug delivery, we found that more than 70% of the videos correctly mentioned these crucial steps for transferring the drug to the patient's body.

Our study had several limitations. Firstly, it was conducted exclusively in English. While English is a widely spoken language, conducting a more comprehensive analysis would involve examining videos of patients recorded in other languages as well. To achieve this, multicenter studies are necessary. Secondly, as the videos continue to be uploaded day by day, auto-injectors may struggle to keep up with the evolving designs. Thirdly, since the videos, clearly understood to have been uploaded by medical companies that produce AAI, were excluded, the videos with high scores and completely accurate application content may have been excluded.

In conclusion, YouTube is an effective platform for visual learning for the use of AAIs. Patients can conveniently access instructional videos by searching on YouTube in their daily lives. However, the uploaded videos should be of higher quality, regularly updated, should contain feature completely accurate narration and be approved by international association working groups. Therefore, healthcare professionals should be encouraged to provide educational videos for patients, and patients should be informed to exclusively watch professional training that have been approved videos approved by their doctors.

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Contributions

IDT, PK, ZK, DU, AG, SD: data curation, investigation, methodology. IDT, DU, AG, SD: project administration, formal analysis. IDT, PK, ZK: resources, software. IDT, DU, AG, PK, ZK, SD: supervision, validation, visualization. DU, AG, IDT, SD: writing – original draft, writing – review & editing.

Conflict of interests

The authors declare that they have no conflict of interests.

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