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Health Literacy and Web-Based Audiovisual Multimedia in Pituitary and Endoscopic Skull Base Surgery

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Abstract

Introduction The internet presents a rich milieu of multimedia options relating to pituitary and endoscopic skull base surgery (ESBS). Misinformation can create discordance between patient and provider expectations. The purpose of this study is to analyze the understandability and actionability of available ESBS and pituitary surgery audiovisual information on YouTube and Google.

Methods The top 50 videos generated by searching "pituitary surgery/transsphenoidal surgery" and "endoscopic skull base surgery" in both YouTube and Google were sorted by relevance. Two independent reviewers evaluated each for understandability and actionability based on the Patient Education Materials Assessment Tool for audiovisual material (PEMAT-A/V). Source, authorship, audience, and education/advertisement variables were collected. Chi-square test followed by univariate and multivariate regression analyses assessed the association between these variables and quality.

Results A total of 85 videos (52 YouTube and 33 Google) met inclusion criteria for analysis. There was no significant difference in the presence of the aforementioned variables between YouTube and Google ($p < 0.05$). Also, 72% of videos targeted patients and 28% targeted surgeons. Academic institutions uploaded 58% of videos. Surgeon-targeted videos were more educational ($p = 0.01$) and patient-targeted videos involved more advertisement ($p = 0.01$). Understandability and actionability scores were below the 70% threshold for both YouTube (65 ± 15, 38 ± 33, $p = 0.65$) and Google (66 ± 12, 38 ± 26, $p = 0.94$). Patient-targeted videos ($p = 0.002$) were more understandable, while surgeon- ($p < 0.001$) and education-focused videos ($p < 0.001$) were more actionable.

Conclusion Understandability and actionability of YouTube and Google audiovisual patient information on ESBS and pituitary surgery is poor. Consideration should be given to the formation of a standardized patient information resource.

Keywords
- endoscopic
- endonasal
- skull base
- audiovisual
- pituitary
- health literacy

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Introduction

With 164 million average monthly users, YouTube is the most popular online video streaming web site in the world.[1] Similarly, Google is the most popular online search engine.[2] The popularity of the internet and social media as a medical information resource among health care users is undeniable.[3,4] Studies demonstrate that 59% of adults in the United States[4] and up to 63% of otolaryngology patients use the internet to obtain medical information.[5,6] The expansion of medical audiovisual consumption among health care users has been met with concern from health care providers regarding the quality and accuracy of this material.[7] The sheer volume of health care–related information on the internet can be challenging for patients to navigate. Misinformation and poor comprehensibility of online material can create discordance between patient and provider expectations.[8–11]

Health literacy is defined by the Health Resources and Services Administration as the "degree to which individuals have the capacity to obtain, process, and understand basic health information needed to make appropriate health decisions."[12] Employing this definition, health literacy rates in the United States may be as low as 12%.[13] Online sources of written patient education materials designed to improve patient health literacy in pituitary and neurological surgery have been shown to lack readability and understandability, demonstrating the challenge of developing strategies to improve the understanding of complex health decision-making processes.[14–17] The health literacy burden of audiovisual material concerning ESBS and pituitary surgery on YouTube and Google has not yet been objectively evaluated.

Approximately 260,000 sinus operations are performed annually in the United States,[18] and 40% of patients undergoing endoscopic sinus surgery (ESS) have indicated using YouTube before surgery to obtain more information.[19] Given that ESBS procedures are more complex and difficult to understand,[20] it is likely that a similarly large proportion of ESBS patients will examine written or audiovisual educational material prior to surgery. The purpose of the present study is to analyze the understandability and actionability of available ESBS and pituitary surgery audiovisual material on both YouTube and Google.

Methods

Institutional review board (IRB) approval was obtained for this study; as the study did not involve patient involvement, no patient consent was necessary. YouTube and Google were searched in April 2020, using "pituitary surgery/transsphenoidal surgery" and "endoscopic skull base surgery." The top 50 videos for each search, in each platform were sorted primarily by "relevance" which is the default setting or algorithm used by each platform.[21,22] The search was limited to the top 50 videos based on data suggesting that 90% of internet users stick to the first three pages of any online search.[23]

Data suggest that learners prefer videos to be less than 15 minutes.[24] Educators and researchers have posited that the ideal video length is between 6 and 10 minutes, arguing this is the longest period of time viewers remain engaged in the video.[25,26] Famously, TED (Technology, Entertainment, and Design) talks has argued that 18-minute videos allow their authors to find an optimal balance between having sufficient time to communicate information, while also maintaining the attention of the viewer.[27] For these reasons, and based on a priori methodology, videos >1 minute and <20 minutes in length were included.[28] Additional inclusion criteria included videos in the English language that were both searchable and accessible for full viewing. Duplicate videos and those not meeting these criteria were excluded.

Two independent reviewers (P.C.B. and G.H.) evaluated each video for understandability and actionability using the validated Patient Education Materials Assessment Tool for audiovisual material (PEMAT-A/V).[29] The reviewers were selected with the target audience in mind; the first reviewer had no formal medical training, while the second reviewer was an otolaryngology resident in training. The PEMAT-A/V is a systematic method to evaluate and compare the understandability and actionability of audiovisual material. Understandability is evaluated using a 13-point scale.[29] Each criteria is marked as either agree (1 point), disagree (0 points), or not applicable (N/A). The criteria are designed to assess five main topics as follows: (1) content, (2) word choice and style, (3) organization, (4) layout, and (5) use of visual aids. The overall score for understandability is a percentage of the sum score of the 13 criteria.[29] Actionability is evaluated using four criteria, each of which is similarly scored: agree (1 point), disagree (0 points), or N/A.[29] The overall score is a percentage of the sum score of the four criteria.[29] The reviewer is instructed to select "agree" only if the variable is present in at least 80% of the video.[29] The final score for each of these criteria is an average of the individual scores calculated by each reviewer. Understandability and actionability scores less than 70% are considered poor.[29]

The following variables were collected for each video: source affiliation (academic vs. private institution), year uploaded, running time, authorship (skull base surgeon (otolaryngologist or neurosurgeon), other medical doctor (MD; non-MD health care provider, nonmedical professional, or patient), target audience (patient vs. surgeon), and number of views. Videos were assessed for their focus on education and advertisement; the latter was defined as any attempt to solicit the business of the viewer and was delineated as a hospital, company, or surgeon advertisement. Educational audiovisual material was defined as material that contained either surgical instruction or patient-oriented procedural information in at least 80% of the video. Chi-square test was used for categorical data. Univariate and multivariate regression analyses were used to assess the association between the aforementioned variables and understandability and actionability. Significance threshold was set at $p < 0.05$.

Results

Audiovisual Characteristics

The initial search criteria led to the identification of 200 videos in both YouTube and Google. One hundred and fifteen

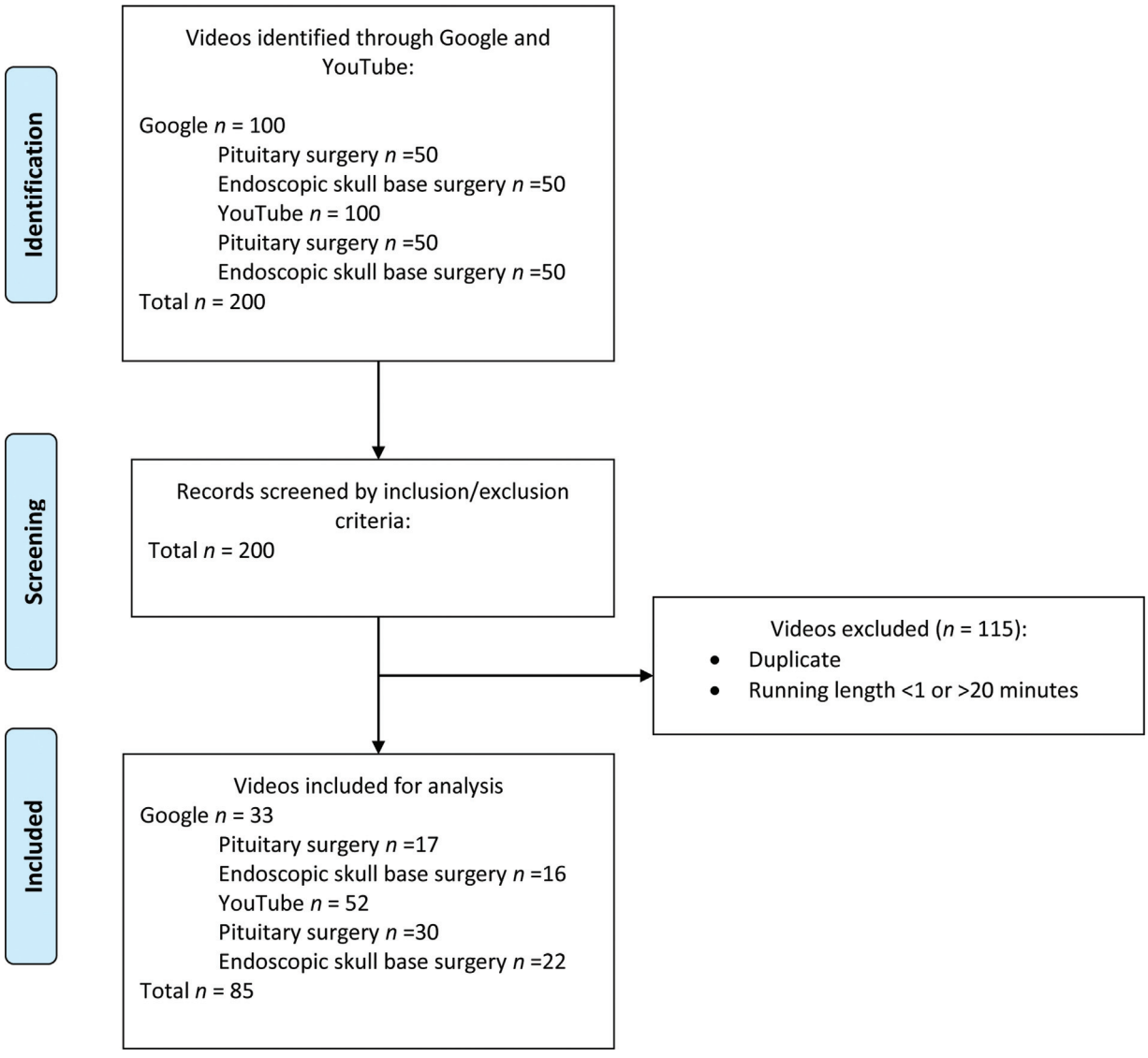


Fig. 1 Inclusion and exclusion criteria.

videos were excluded because they were duplicates or <1 minute or >20 minutes in length; 85 videos (52 YouTube and 33 Google) met the inclusion criteria for final analysis (►**Fig. 1**). There was no significant difference in source affiliation ($p = 0.373$), year uploaded ($p = 0.437$), running time ($p = 0.782$), authorship ($p = 0.565$), target audience ($p = 0.252$), or educational ($p = 0.728$) and advertisement ($p = 0.365$) variables between the YouTube and Google platforms (►**Table 1**). Seventy-two percent of videos targeted patients and 28% targeted surgeons. Academic sources uploaded 58% of videos, while private sources uploaded 42% (►**Table 1**). Sixty-six percent of videos were educational, and 42% involved an advertisement. When present, advertisements primarily promoted hospitals (34%), with only 5% promoting individual physicians (►**Table 1**).

Patient- versus Surgeon-Targeted Video Characteristics

Patient-targeted videos were more likely to contain advertisements (51%) than surgeon-targeted videos (21%; $p = 0.01$). Surgeon-targeted videos were identified as educational in 88% of cases, whereas patient-targeted videos were identified as educational in only 57% of cases; this difference was statistically significant ($p = 0.01$; ►**Table 2**). Patient-targeted videos were more likely to be short (1–6 minutes) in length (90%) compared with surgeon-targeted videos (50%; $p < 0.001$; ►**Table 2**). Patient-targeted videos ($p = 0.002$) were more understandable; surgeon- ($p < 0.001$) and education-focused videos ($p < 0.001$) were more actionable (►**Table 2**).

Understandability and Actionability

Understandability and actionability scores were 65 ± 15 and 38 ± 33 for YouTube and 66 ± 12 and 38 ± 26 for Google videos, respectively (►**Table 1**). The scores did not significantly differ between the two platforms ($p = 0.65$ and 0.94). The individual scores for each criteria of the PEMAT-A/V can be found on ►**Fig. 2**. Understandability was significantly and positively associated with a patient-targeted audience on both univariate ($p = 0.002$) and multivariate regression analysis ($p = 0.001$; ►**Tables 3** and **4**). Longer running time ($p = 0.003$) and educational focus ($p < 0.001$) was significantly associated

Table 1 Audiovisual characteristics of Google and YouTube videos

	Total $n = 85$ (%)	YouTube $n = 52$ (%)	Google $n = 33$ (%)	*p*-Value
Source				0.373
Academic	49 (57.6)	28 (53.8)	21 (63.6)	
Private	36 (42.4)	24 (46.2)	12 (36.4)	
Year uploaded				0.437
2005–2010	7 (8.2)	4 (7.7)	3 (9.1)	
2011–2015	33 (38.8)	23 (44.2)	10 (30.3)	
2016–2020	45 (52.9)	25 (48.1)	20 (60.6)	
Running time				0.782
1–6 minutes (short)	67 (78.8)	42 (80.8)	25 (75.8)	
7–12 minutes (medium)	15 (17.6)	8 (15.4)	7 (21.2)	
13–20 minutes (long)	3 (3.5)	2 (3.8)	1 (3.0)	
Authorship				0.565
MD, skull base surgeon	74 (87.1)	44 (84.6)	30 (90.9)	
MD, other	3 (3.5)	2 (3.8)	1 (3.0)	
Non-MD health care provider	0 (0)	0 (0)	0 (0)	
Nonmedical professional	5 (5.9)	3 (5.8)	2 (6.1)	
Patient	3 (3.5)	3 (5.8)	0 (0)	
Target audience				0.252
Patient	61 (71.8)	35 (67.3)	26 (78.8)	
Surgeon	24 (28.2)	17 (32.7)	7 (21.2)	
Educational				0.728
Yes	56 (65.9)	35 (67.3)	21 (63.6)	
No	29 (34.1)	17 (32.7)	12 (36.4)	
Advertisement				0.365
Physician	4 (4.7)	3 (5.8)	1 (3.0)	
Hospital	29 (34.1)	14 (26.9)	15 (45.5)	
Company	3 (3.5)	2 (3.8)	1 (3.0)	
None	49 (57.6)	33 (63.5)	16 (48.5)	
Number of views				<0.001
Unavailable	31 (36.5)	0 (0)	31 (93.9)	
< 500	5 (5.9)	5 (9.6)	0 (0)	
500–1,000	10 (11.8)	10 (19.2)	0 (0)	
1,000–20,000	23 (27.1)	21 (40.4)	2 (6.1)	
20,000–40,000	11 (12.9)	11 (21.2)	0 (0)	
40,000–100,000	1 (1.2)	1 (1.9)	0 (0)	
> 100,000	4 (4.7)	4 (7.7)	0 (0)	
Understandability (%)	65 ± 14	65 ± 15	66 ± 12	0.646
Actionability (%)	38 ± 31	38 ± 33	38 ± 26	0.941

Abbreviation: MD, doctor of medicine.

with actionability on univariate analysis (►**Table 5**). On multivariate regression analysis, increased actionability was associated with recent year uploaded ($p = 0.033$), skull base surgeon authorship ($p = 0.035$), surgeon-targeted audience ($p = 0.003$), and the presence of an educational focus in the video ($p = 0.013$) (►**Table 6**).

Discussion

The current study demonstrated that, on average, pituitary surgery and ESBS audiovisual material on Google and YouTube have poor understandability and actionability as characterized by the PEMAT-A/V tool. Despite this finding, the use of the

Table 2 Comparison of patient versus surgeon-targeted videos on Google and YouTube

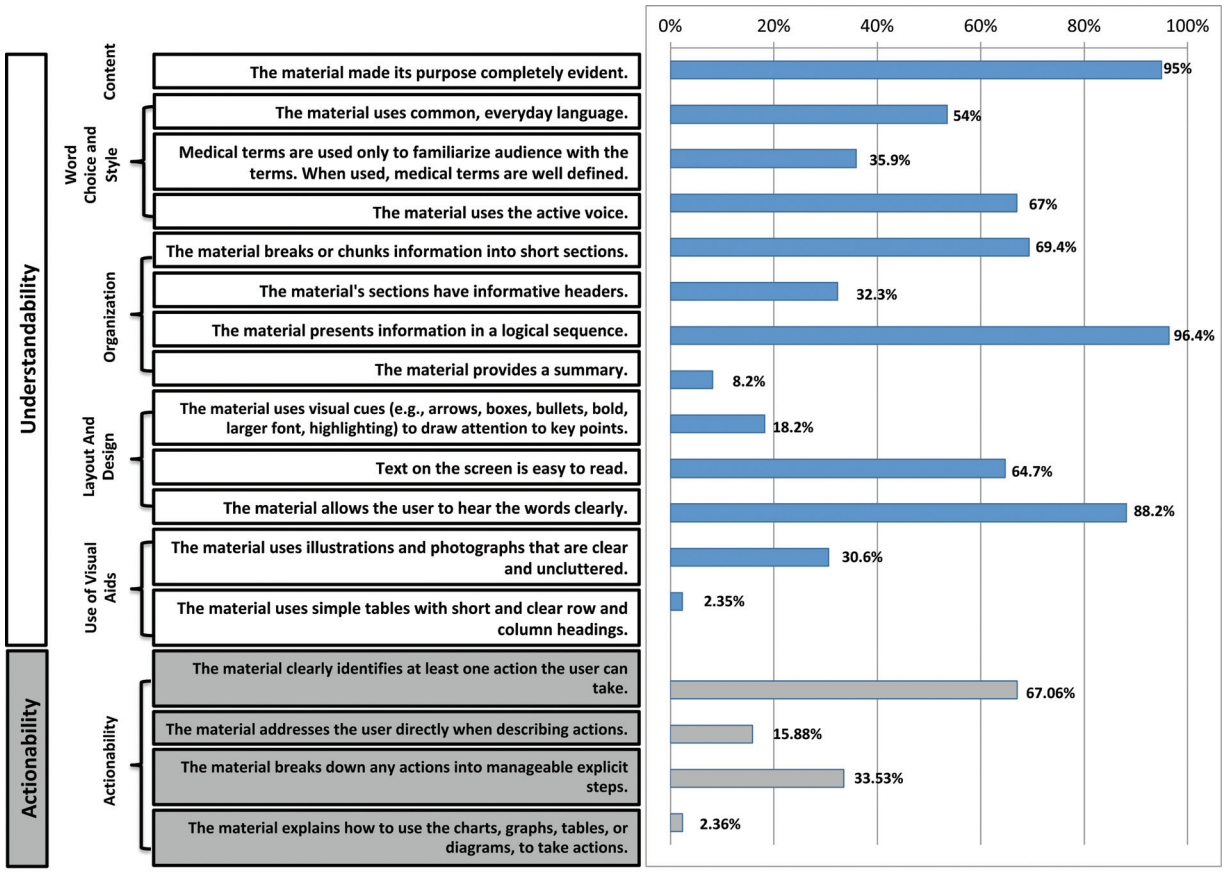
	Patient targeted $n = 61$ (%)	Surgeon targeted $n = 24$ (%)	*p*-Value
Source			0.684
Academic	36 (59.0)	13 (54.2)	
Private	25 (41.0)	11 (45.8)	
Year uploaded			0.563
2005–2010	6 (9.8)	1 (4.2)	
2011–2015	22 (36.1)	11 (45.8)	
2016–2020	33 (54.1)	12 (50.0)	
Running time			<0.001
1–6 minutes (short)	55 (90.2)	12 (50.0)	
7–12 minutes (medium)	4 (6.6)	11 (45.8)	
13–20 minutes (long)	2 (3.3)	1 (4.2)	
Authorship			0.144
MD, skull base surgeon	52 (85.2)	22 (91.7)	
MD, other	1 (1.6)	2 (8.3)	
Non-MD health care provider	0 (0)	0 (0)	
Nonmedical professional	5 (8.2)	0 (0)	
Patient	3 (4.9)	0 (0)	
Educational videos			0.008
Yes	35 (57%)	21 (87.5)	
No	26 (42.6)	3 (12.5)	
Advertisement videos			0.010
Physician	3 (4.9)	1 (4.2)	
Hospital	27 (44.3)	2 (8.3)	
Company	1 (1.6)	2 (8.3)	
None	30 (49.2)	19 (79.2)	
Number of views			0.027
Unavailable	25 (41.0)	6 (25.0)	
< 500	2 (3.3)	3 (12.5)	
500–1000	9 (14.8)	1 (4.2)	
1000–20,000	11 (18.0)	12 (50.0)	
20,000–40,000	10 (16.4)	1 (4.2)	
40,000–100,000	1 (1.6)	0 (0)	
> 100,000	3 (4.9)	1 (4.2)	
Understandability	68 ± 12	57 ± 16	0.001
Actionability	29 ± 27	60 ± 28	<0.001

Abbreviation: MD, doctor of medicine.

Table 3 Video characteristics associated with video understandability: univariate analysis

	p-Value
Source	0.849
Academic	
Private	
Year uploaded	0.125
2005–2010	
2011–2015	
2016–2020	
Running time	0.003
1–6 minutes (short)	
7–12 minutes (medium)	
13–20 minutes (long)	
Authorship	0.138
MD, skull base surgeon	
MD, other	
Non-MD health care provider	
Nonmedical professional	
Patient	
Target audience	<0.001
Patient	
Surgeon	
Educational videos	<0.001
Yes	
No	
Advertisement videos	0.368
Physician	
Hospital	
Company	
None	
Number of views	0.603
Unavailable	
< 500	
500–1000	
1000–20,000	
20,000–40,000	
40,000–100,000	
> 100,000	

internet to research medical information is frequent and impactful for many patients. Fifty-five percent of patients who performed online research reported a change in perspective on their disease, and 46% claimed their findings made an impact on health care–related behaviors.[30] Patient education can play a critical role in establishing appropriate expectations. For example, recent data demonstrated the persistence of unrealistic patient expectations despite routine preoperative



Summary of understandability and actionability scores using the PEMAT-A/V.

Fig. 2 Summary of understandability and actionability scores using the Patient Education Materials Assessment Tool for audiovisual material (PEMAT-A/V).

Table 4 Video characteristics independently associated with video understandability: multiple regression analysis

	Model fit (*R*)	R^2	Model (F-statistics)	*p*-Value	Predictor variable *p*-Value	
Multivariate regression model	0.449	0.202	2.112	0.039	Target audience	0.001

counseling and utilization of written educational material.[31] Moreover, patient satisfaction was shown to depend significantly on the meeting of preoperative patient expectations.[32] Consequently, by creating audiovisual and written material that is both understandable and actionable, patient education can empower patients, improve patient counseling, and bolster patient satisfaction.

Poor quality of online audiovisual patient material in otolaryngology is not a new finding. A recent study examining videos on YouTube relating to "sinusitis" demonstrated poor understandability and actionability.[28] Additionally, YouTube videos relating to pediatric adenotonsillectomy and ear tube surgery are of low quality and composed largely of testimonials.[33] Several studies examining the role of YouTube as a patient resource in other surgical subspecialties have similarly demonstrated low quality and the potential for bias.[34–38] A large portion of videos are testimonials created by patients and not medical professionals.[34–38]It is important to note the significant risk for misinformation on patient-targeted online audiovisual material.[37,39–42] Authors have communicated concern regarding the lack of an official and formal vetting process prior to the public posting of videos covering medical information.[43,44]

Understanding the health literacy demand of audiovisual material is as important as understanding the accuracy and bias of the information being presented. A strong association has been shown between low health literacy and poor health outcomes, medication adherence, and use of health care resources.[45,46] Individuals with low health literacy are more likely to struggle with instruction interpretation, to misconstrue information, and/or to miss medical contex.[47] Moreover, these patients are likely to forgo written materials in favor of audiovisual resources.[47] Although data examining the health literacy demand of online audiovisual material relating to surgical subspecialties is limited, two recent studies demonstrated both poor understandability and

Table 5 Video characteristics associated with video actionability: univariate analysis

	p-Value
Source	0.849
Academic	
Private	
Year uploaded	0.125
2005–2010	
2011–2015	
2016–2020	
Running time	0.003
1–6 minutes (short)	
7–12 minutes (medium)	
13–20 minutes (long)	
Authorship	0.138
MD, skull base surgeon	
MD, other	
Non-MD health care provider	
Nonmedical professional	
Patient	
Target audience	<0.001
Patient	
Surgeon	
Educational videos	<0.001
Yes	
No	
Advertisement videos	0.368
Physician	
Hospital	
Company	
None	
Number of views	0.603
Unavailable	
< 500	
500–1000	
1000–20,000	
20,000–40,000	
40,000–100,000	
> 100,000	

Abbreviation: MD, doctor of medicine.

actionability.[28,43] These findings, along with that of the present study signal a trend in audiovisual material that is concerning for patients seeking understandable information online.

In addition to understandability and actionability, the present study also sought to investigate characteristics that were specific to patient-targeted and surgeon-targeted videos. This was done with the hope of identifying source, author, and content type that could be targeted to better suit patients and/or professionals. For example, it was noted that patient-targeted videos were less educational (57%) than surgeon-targeted videos (88%) and more frequently included advertisements. Additionally, 42% of the videos in the present study were uploaded by private sources rather than professional societies. An association between private videos and advertisement is seen throughout the literature and may portend poor quality of information. Singh et al demonstrated that although videos created by academic or professional sources were useful and accurate, they represented only 13% of the total videos in their study.[48] The majority were produced by private organizations, contained medical advertisements (74%), and were determined to be misleading.[48]

Collectively, these studies highlight the impact of the video source on quality and reliability of medical information. There is evidence that material created by professional societies is not only more accurate but also more useful.[48] Implementation of the following key philosophies can facilitate understanding: engaging the audience, eliciting active participation, and balancing the "cognitive load.[20,49] Several additional principles are useful for videos designed to prepare patients for threatening situations such as surgical procedures.[50] These include (1) providing information that will prepare the patient for the procedure, (2) reviewing evidence-based knowledge, and (3) promoting patient confidence.[50] As an example, researchers achieved the latter by modeling the act of undergoing chemotherapy and then managing the side effects.[50] When these principles were applied to create an educational DVD for chemotherapy-naïve patients, the cohort receiving the DVD demonstrated improved self-efficacy of coping with the side effects and higher satisfaction compared to the control group.[51]

Simulation of a relevant patient scenario or desirable behavior through audiovisual material can be powerful.[52] Abu Abed et al noted the following common theme in 10 studies that were successful in using audiovisual material to change patient behavior. Videos that simulated the recommended intervention (narrative presentation), rather than those that simply lectured about it, achieved the greatest success.[52] This may be extrapolated to surgical procedures, videos that narrate live surgery may be more effective in educating trainees than those that simply outline or discuss the steps. Thus, the aforementioned studies make it clear that it is possible to create audiovisual material that is effective, educational, and satisfactory. The key principles highlighted above should be incorporated during the creation of a standardized and peer-reviewed patient education online platform in ESBS, so that the material created is both reliable and understandable.

A major strength of this study is the use of a validated tool to examine the health literacy demand of audiovisual material. This is the first time the PEMAT-A/V criteria have been applied to online pituitary and ESBS audiovisual material; however, the study does not evaluate the accuracy of the information communicated in the videos. Additionally, there is a degree of subjectivity built into the grading of the videos using the

Table 6 Video characteristics independently associated with video actionability: multiple regression analysis

	Model fit (*R*)	R^2	Model (F-statistics)	*p*-Value	Predictor variable *p*-Value	
Multivariate regression model	0.632	0.339	5.523	<0.0005	Year uploaded Authorship Target audience Educational	0.033 0.035 0.003 0.013

PEMAT-A/V criteria. To minimize this effect, the study incorporated responses from two independent reviewers who were specifically selected to model the target audience. Both reviewers had at least undergraduate degrees, and thus their baseline medical knowledge or reading level may not reflect that of the average American. Nevertheless, this bias would only serve to increase the understandability scores in the present study as compared with the general American public, and further strengthen the results and conclusion of this study.

Additionally, while an educational video was defined as either surgical instruction or patient-oriented procedural information in this study, there is a multitude of approaches that can be applied when defining "educational." The cross-sectional nature of the study does not reflect the large amount of information available on the internet; however, by including the two most popular and frequented platforms on the internet, the authors hoped to minimize the potential for selection bias. The search was done in the United States and with videos that were in English; consequently, the search may not be generalizable to other parts of the world.[44]

Conclusion

There is a clear deficiency in the understandability and actionability of online audiovisual resources for patients undergoing ESBS and pituitary surgery. Similarly, audiovisual material targeted toward surgeons seeking to learn or improve surgical principles and technique is poor. These deficiencies represent an opportunity for health care providers and professional societies to create effective and standardized peer and patient audiovisual educational resources.

Conflict of Interest
None declared.

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