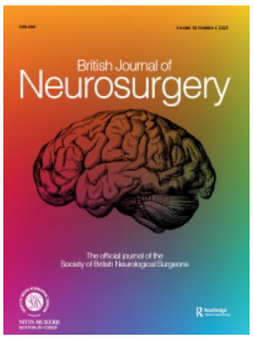

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# YouTube videos for describing Deep Brain Stimulation: a comprehensive and quantitative review

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**ABSTRACT**

**Introduction:** Patients use online videos to learn about their condition and potential treatments. Operative techniques in Deep Brain Stimulation (DBS) vary significantly between institutions. This poses challenges to ensuring patients are adequately and accurately informed. We performed a comprehensive review of YouTube videos describing Deep Brain Stimulation.

**Methods:** Text searches for DBS-related search strings were performed on YouTube. The top 25 de-duplicated videos per search were included. Each video was assessed for differences in procedural technique, educational quality using the JAMA benchmark and DISCERN tools, and audio-visual or editing quality.

**Results:** We identified 91 DBS-related YouTube videos with 44% of videos uploaded by academic institutions and 15% by hospitals. Parkinson's disease was the most frequently described condition in 65% of videos. Variations in procedure impacting patient experience and expectations, were discussed in varying proportions: head shaving in 14.3% of videos, potential complications in 23.1%, number of stages in 33.0%, and awake vs asleep surgery in 46.2%. The JAMA benchmark criteria was fulfilled in 12% of videos and the median total DISCERN score was 46, an 'average' quality rating. High-quality images ($N = 69$, 75.8%), audio/music ($N = 73$, 80.2%), accessible language ($N = 84$, 92.3%), and professional production quality ($N = 72$, 79.1%) were present in most videos.

**Discussion and conclusion:** YouTube videos describing DBS are visually appealing but lack scientific quality and present potentially misleading content for future DBS recipients and caregivers. They should be viewed with caution as a source of medical communication or information for patients.

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Neurosurgery; Deep Brain Stimulation; Patient Education; Webcasts; Informed Consent

## Introduction

Deep Brain Stimulation (DBS) is a common procedure in functional neurosurgery. It has been proved effective for several neurological and psychiatric conditions and approved in the U.K. for the treatment of Parkinson's disease (PD), tremor and dystonia. Over the past two decades, there have been significant developments in DBS technology, with DBS practice being delivered in many different ways worldwide. These significant differences in practice concern not only the condition being treated and target location but also procedural differences including anaesthetic (awake versus asleep), use of robotic or frame guidance, the degree of head shaving, or even the number of stages that the procedure will involve.

This has clear implications for patients, as being well informed about a disease and its treatments can influence patient decision-making and empower them to decide whether to opt for DBS.[1] However, preconceived conceptions or misunderstandings of DBS can affect informed consent and patient and caregiver expectations. Misconceptions or unrealistic expectations are not uncommon among potential DBS recipients and are largely considered to stem from DBS-related information in the public sphere.[2–4] A

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large majority of patients look for health information online, with the internet being one of the main sources of information on DBS for patients with PD.[5,6] In addition to providing procedure-related information, the internet and social media can facilitate the formation of online communities and social media groups allowing patients and caregivers to share experiences, ask questions, find support and raise awareness about DBS. A study on social media usage for DBS in children and youths found that posts with videos generated the greatest amount of engagement whilst another study showed that surgery and procedure-related videos were the most shared.[7,8]

YouTube is currently the largest video sharing platform and one of the most popular social media platforms. Two and a half billion users login per month from over one hundred countries, viewing over a billion hours of video daily.[9] YouTube is used as an educational resource not only by medical students and doctors but also increasingly by patients to gain a greater understanding of their symptoms, condition and potential treatments.[8,10,11] Previous research has sought to quantify and assess the quality of medical educational content on YouTube.[12,13] A systematic review of YouTube videos relating to neurosurgery identified 713 unique uploads with over 90 million total views aimed at patients and professionals - with educational videos (25%), procedural overviews (20%) and patient experience videos (16%) forming a significant proportion.[8] Further examination of specific neurosurgical conditions such as glioblastoma and spinal kyphosis has found that the quality of information in these videos is highly variable and often of poor quality.[14,15] This is consistent with the results of a systemic review of 431 publications relating to social media in neurosurgery showing that factual accuracy of most videos was poor to inadequate.[16] Similar findings have been shown in studies on procedure-related videos such as robotic spine surgery, radiosurgery and lateral lumbar interbody fusion, leading to authors calling for a continuous need for assessment of the accuracy of the health care-related videos on YouTube and for medical institutions to publish evidence-based and peer-reviewed informational videos.[15,17,18] Patients themselves are also wanting to combat medical misinformation, highlighting in one instance inaccurate information and content regarding movement disorders on YouTube.[19]

Within the field of functional neurosurgery, various studies have evaluated the quality of YouTube content as an educational resource.[20,21] Only two studies, both from the U.S.A, have evaluated the accuracy and reliability of information provided on DBS in YouTube videos. Both publications applied the DISCERN criteria to evaluate video quality. Ward *et al.*[22] searched terms including neuromodulation, DBS and spinal cord stimulation, and found that videos that were sponsored, uploaded by board-certified physicians and gave details of the credentials of the video producer had higher DISCERN scores, indicating overall better quality educational content. Tripathi *et al.*[23] analysed DBS-specific YouTube videos but only those uploaded by universities, tertiary care centres and university hospitals, and found that only 24% of videos were considered 'good' (scoring above a 3 on the DISCERN scoring scale). Given that YouTube results are dependent on the geographic location of users' IP addresses, it is not known whether U.K.-based users seeking DBS-related information are presented with similar results.

In this study, we sought to undertake a comprehensive review of YouTube videos for DBS surgery, evaluating the specific procedural details described, the educational quality using the Journal of the American Medical Association (JAMA) benchmark and DISCERN tools, and the audio-visual and editing quality.

## Materials and methods

### Data collection

On the website YouTube (www.YouTube.com), text searches for 'Deep Brain Stimulation', 'Deep Brain Stimulator', 'DBS', 'DBS Surgery' and 'Deep Brain Neuromodulation' were undertaken in December 2021. No changes or additional filtering were made, therefore as standard the results were ranked by YouTube's own relevance algorithm.

### Inclusion and exclusion criteria

The top 25 de-duplicated video results per search were included for analysis. This included videos with animated, text or slideshow, and filmed video content. Spoken English and videos subtitled in English were included, other languages were excluded.

Fictional depictions of DBS were excluded. Videos greater than 20 minutes in duration or aimed at a solely professional audience discussing technical aspects of DBS surgery were reviewed but removed from final analysis (Figure 1).

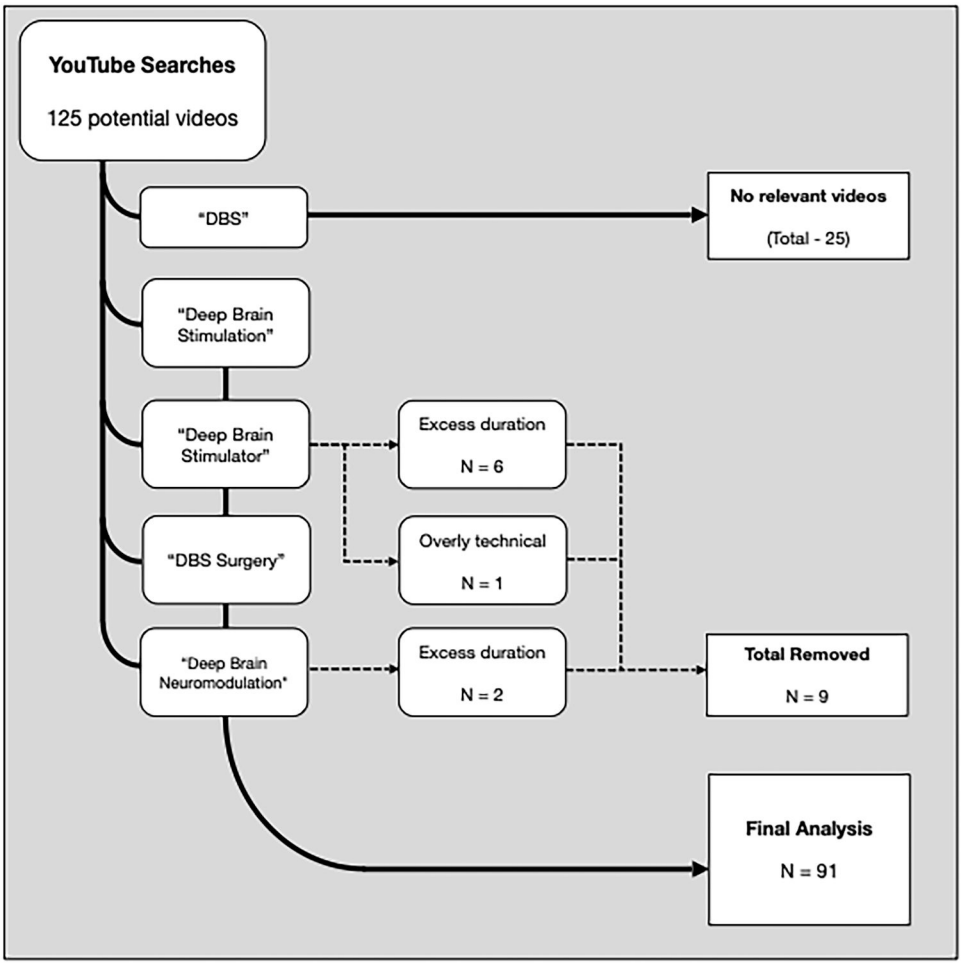


**Figure 1.** Flowchart illustrating the selection process for the final dataset, starting from the number of potential videos and search strings and ending with the number of videos analysed following exclusions per search string.

### *Video review and data extraction*

Using a data scrapping tool,[24] upload date, view count, likes, dislikes and the number of comments were recorded. Three assessors (DR, BGS and SWYF) watched and reviewed each video independently using the criteria below. Assessors were medical students with neurology and neurosurgery training who had observed DBS procedures, and received informal instruction on implantation methods from a functional neurosurgeon. Equivocal assessments were referred to AA (a neurosurgery registrar) for arbitration.

### *Channel classification*

Uploaders were categorised into different channel types; 'Academic centres', 'Hospitals', 'News Services', 'Industry', 'Charity', 'Professional Societies', 'Patient channel', 'Patient group', 'Popular Science' and 'Non-profit'. Universities were described as 'Academic Centres' whilst healthcare provider networks and individual hospitals were categorised as 'Hospitals'. News channels included both online-only and national broadcasters. Medical technology, pharmaceutical and device manufacturers were categorised as 'Industry'. Registered charities were classified as 'Charity' whilst non-charitable entities were categorised as non-profit or professional society dependent upon their main function. Unofficial common interest groups run by patients were categorised as 'Patient Group' whilst single uploaders were described as 'patient channels'. Channels without any industry, academic, professional, or patient affiliations describing DBS for entertainment purposes alone were described as popular science.

### *Procedural variation*

The following aspects of procedural variation were identified as areas which lead to diversity in procedure experience for both surgeon and patient: Condition(s) being treated; Brain area targeted; Pre-operative imaging method; Awake versus asleep; Frame or robotic guidance; Head shaving; Burr-hole or twist drill;

Intra-operative image guidance; Intra-operative neurophysiology; How many stages (operations); Description of complications.

### Educational quality

The quality of each video's content was assessed using the JAMA Benchmark and DISCERN instrument system which receive continued use by research teams evaluating online material and have previously been applied in similar studies.[25,26]

The JAMA Benchmark is a simple and well validated checklist for evaluating the quality of health-related information, comprised of four parts: (1) Authorship, (2) Attribution of sources, (3) Disclosure of funding and (4) Information currency. To score a maximum of four points the video must include information clearly describing who authored the article, references or sources of information, disclosure of any financial incentives and currency (the date of upload and whether any required updates have been made).

The DISCERN questionnaire, developed by the University of Oxford and the British Library, is a validated instrument for evaluating the reliability and quality of information around specific treatment choices. Formed of a battery of 16 questions which are divided into 3 sections (Table 1), it critically appraises key aspects of material which would be expected in a high-quality consumer medical publication. The first 8 questions examine the reliability of the information, questions 9–15 focus on the details surrounding the treatment options presented, and question 16 is an 'intuitive summary' question, giving an overall quality rating based on the previous 15 responses. According to the DISCERN handbook,[27] each item in the first two sections is scored 1–5: failure to address an item is scored 1, partial addressing of an item scores 3 and completely addressing an item scores 5. Question 16 provides an overall content quality of the videos and is scored based on a 5-point scale ranging from 'low' to 'moderate' to 'high'. A 'moderate' (3) overall quality rating indicates that a resource is a useful source of information about treatment choices but additional information would definitely be required. In view of the limited guidance provided on interpreting total DISCERN scores and lack of agreement on definitive subdivision of the DISCERN score,[28] the current study used predetermined cut-off points defined by Weil *et al.*[29] Scores for the first two sections are summed with a total score of 15–75 possible. A score of equal or less than 27 is classified as 'very poor', 28–38 'poor', 39–50 'average', 51–62 'good' and 63–75 as 'excellent'.

### Audio-visual quality

Finally, each video was assessed for audio and visual quality. Spoken language or subtitles and overall production value was also assessed. We characterised 'high-quality' video as those with High-Definition or

**Table 1.** DISCERN criteria with median scores.

| | Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| Question | No | | Partially | | Yes | Median score | |
| 1. Are the aims clear? | 1 | 2 | 3 | 4 | 5 | **4** | Reliability |
| 2. Does it achieve its aims? | 1 | 2 | 3 | 4 | 5 | **4** | |
| 3. Is it relevant? | 1 | 2 | 3 | 4 | 5 | **4** | |
| 4. Is it clear which sources of information were used to compile the publication (other than the author or producer)? | 1 | 2 | 3 | 4 | 5 | **2** | |
| 5. Is it clear when the information used or reported in the publication was produced? | 1 | 2 | 3 | 4 | 5 | **2** | |
| 6. Is it balanced and unbiased? | 1 | 2 | 3 | 4 | 5 | **3** | |
| 7. Does it provide details of additional sources of support and information? | 1 | 2 | 3 | 4 | 5 | **2** | |
| 8. Does it refer to areas of uncertainty? | 1 | 2 | 3 | 4 | 5 | **3** | |
| 9. Does it describe how each treatment works? | 1 | 2 | 3 | 4 | 5 | **4** | Treatment Choices |
| 10. Does it describe benefits of each treatment? | 1 | 2 | 3 | 4 | 5 | **4** | |
| 11. Does it describe risks of each treatment? | 1 | 2 | 3 | 4 | 5 | **2** | |
| 12. Does it describe what would happen if no treatment is used? | 1 | 2 | 3 | 4 | 5 | **2** | |
| 13. Does it describe how the treatment choices affect overall quality of life? | 1 | 2 | 3 | 4 | 5 | **3** | |
| 14. Is it clear there may be more than one possible treatment choice? | 1 | 2 | 3 | 4 | 5 | **3** | |
| 15. Does it provide support for shared decision-making? | 1 | 2 | 3 | 4 | 5 | **2** | |
| | **Low** | | **Moderate** | | **High** | | |
| 16. Based on the answers to all the above questions, rate the overall quality of the publication as a source of information about treatment choices. | 1 | 2 | 3 | 4 | 5 | **2** | |

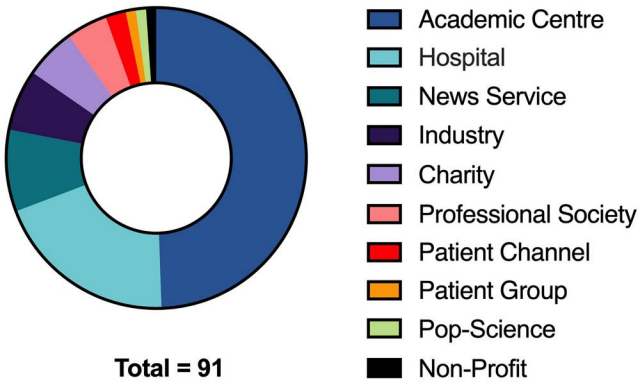


Figure 2. Doughnut chart demonstrating the proportion of uploads by different channel types.

4K images or video, 'low-quality' videos featured lower resolutions (240, 480p), reduced frame rates or other image degradations. Likewise, a similar rating of high- or low-quality audio would be made based upon bitrate, audio-levelling and quality of voiceover and/or music. Ratings for language accessibility were made based upon whether it was audible and intelligible, or whether the subtitles were comprehensible. Production value was a global assessment of the video with 'high-quality' describing professional filming and editing and low-quality describing little or no evidence of filming or editing.

### *Statistical analysis*

SPSS (Version 28.0) and Prism (Version 9.5) were used for data analysis and graphics production. Descriptive statistics including frequencies, mean and/or medians and measures of variance were calculated prior to tests of reliability and normality. Reliability of ratings was assessed through Intraclass Correlation Coefficient and Fleiss Multirater Kappa. Data normality was assessed using Q-Q plots and Shapiro-Wilk tests. Kruskal-Wallis was performed as a non-parametric test of difference for all variables with an alpha of 0.05.

### *Ethics and registration*

No institutional approval was sought prior to this review as all information included is freely available online. The review was not registered with a systematic review database prior to commencement.

### *Data availability*

The authors are happy to provide access to the data, upon reasonable request.

## Results

One hundred videos were identified. From these, nine were excluded due to excess duration (8) and/or overly technical (1), three of these videos were duplicates (Figure 1). From the terms, it was clear that 'DBS' was too generic, generating hundreds of unrelated videos, none were included in review or analysis.

Videos were uploaded from 2008 to 2021 by a variety of channel types, with academic centres (40), hospitals (14), news channels (6) and industry (6) being the most common uploaders (Figure 2). All channels were based in the U.S.A, Canada, Australia or India.

The mean duration of videos was 4.92 minutes, with a mean of 26,817 views per video. The top 5 most watched videos were from academic centres ($N = 4$) and a patient channel ($N = 1$) representing 1,299,608 views. Average 'Likes', 'Dislikes' and 'Comments' were 306, 18, and 16 respectively. 'Likes' and 'Dislikes' were disabled in 10 videos and 'Comments' disabled in 48 videos.

### *Procedural variations*

The majority of videos made no specific descriptions of the procedural aspects assessed (Figure 3). Every video described an intended condition to treat. The most treated condition was Parkinson's Disease ($N = 60$, 65.9%). Tremor ($N = 27$, 29.7%), Epilepsy ($N = 9$, 9.9%), Dystonia ($N = 8$, 8.8%), Obsessive compulsive disorder ($N = 4$, 4.4%), Tourettes ($N = 3$, 3.3%), Alzheimer's Disease ($N = 3$, 3.3%) Schizophrenia ($N = 2$, 2.2%), Stroke ($N = 2$, 2.2%) and Lubag syndrome ($N = 1$, 1.1%) were also described.

Most videos did not describe a stimulation target ($N = 68$, 74.7%). In those which did, the Subthalamic Nucleus (STN) was most common ($N = 11$, 12.1%). Globus Pallidus internus (GPi, $N = 6$, 6.6%), thalamus ($N = 6$, 6.6%), ventral intermediate nucleus ($N = 3$,

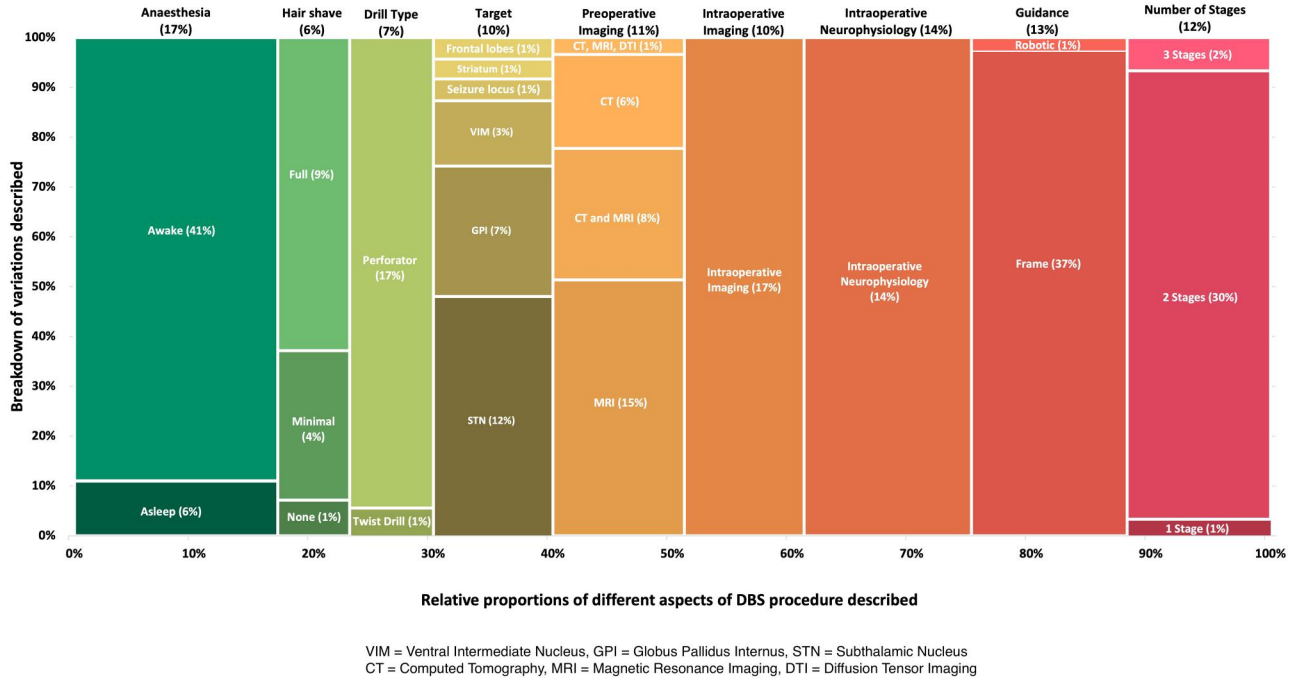


**Figure 3.** Marimekko chart illustrating variation in DBS operative techniques. Proportion of videos (/91) describing specific aspect of surgery in X-axis, e.g. Anaesthesia. Breakdown of different techniques described in Y-axis, e.g. 'Awake'.

3.3%), striatum ($N = 1$, 1.1%), frontal lobes ($N = 1$,1.1%) and seizure locus ($N = 1$, 1.1%) were also referenced.

Preoperative imaging was not described in 64 videos (70.3%). Preoperative imaging was described as MRI ($N = 14$, 15.4%), CT ($N = 5$, 5.5%), or both ($N = 7$, 7.7%). Tractography was described in a single video. Use of intraoperative neurophysiology was described in 33% of videos, and intraoperative imaging in 16.7% of videos.

A full head-shave ($N = 8$, 8.8%), minimal head shave ($N = 4$, 4.4%) and no head shave ($N = 1$, 1.1%) were described but the need for head shaving or hair preparation was not mentioned in 77 videos (89.7%) of videos. Perforator usage was reported in 16 (17.6%) of videos and the use of a twist drill was described in a single video. Frame guidance was described in 34 (37.4%) videos, robotic guidance in 2 videos (2.2%), the rest of videos did not mention guidance ($N = 55$, 60.4%).

Only 5 videos (5.5%) described asleep DBS with 37 (40.7%) performed awake. The remaining 49 (53.9%) videos did not mention anaesthesia at all. The DBS procedure was performed in a single stage in a single video, two-stage ($N = 27$, 29.7%) and three-stage ($N = 2$, 2.2%) procedures were also described. In 61 (67%) videos, number of stages was not discussed. Potential risks or complications were not described in 70 (76.9%). In a single video it was explicitly stated that DBS surgery was 'without risk'.

Kruskal-Wallis (K independent samples) comparison of procedure variation by uploader type demonstrated no significant differences in conditions treated ($p = 0.52$), stimulation target ($p = 0.75$), preoperative imaging ($p = 0.62$), intraoperative neurophysiology ($p = 0.60$) or imaging ($p = 0.80$), head shave ($p = 0.93$), drill type ($p = 0.95$), guidance type ($p = 0.64$), asleep or awake ($p = 0.15$), number of stages ($p = 0.60$) or complications ($p = 0.84$).

## Educational quality of content

### JAMA benchmark

Attribution of source ratings were significantly different ($p < 0.001$) across reviewers. There were no other differences in ratings. Information pertaining to authorship ($N = 66$, 72.5%) and information currency ($N = 85$, 93.4%) were present in the majority of videos. Disclosure of funding was absent in 74 (81.3%) videos and attribution of sources absent in 84 (92.3%) videos. Fulfilment of all four criteria was achieved in 11 (12%) videos. Comparison of JAMA benchmark by channel type demonstrated significant differences in attribution of sources ($p < 0.001$). Academic journals, charities, patient channels and popular science channels had greater proportions of attributed sources in

their videos compared to hospitals, professional societies, news services and academic centres. There were also significant differences in information currency ($p < 0.001$) between channel types, with news services, patient owned channels, industry and academic centres uploading videos without the dates that content was posted and uploaded clearly visible. Differences in authorship ($p = 0.16$) or disclosure ($p = 0.34$) criteria was non-significant. Proportions of videos attaining JAMA benchmarks is displayed in Figure 4.

### DISCERN

The interclass correlation coefficient between reviewers was 0.924 ($p < 0.001$), indicating high levels of agreement between reviewers. Scores were non-normally distributed. Median DISCERN scores for questions 1–16 are shown in Table 1. Breakdown of total DISCERN scores was 'very poor' = 14 (15.9%), 'poor' = 19 (21.6%), 'average' = 36 (41.0%), 'good' = 14 (15.9%) and 'excellent' = 5 (5.7%). Median total DISCERN score was 46, an 'average' overall quality rating. No video achieved a maximum score (highest = 72/75).

Comparison between channels demonstrated significant differences in relevance ($p = 0.004$) and aims ($p = 0.044$) with 'pop-science' channels scoring the highest, supporting shared decision-making also significantly differed ($p = 0.039$) with 'Charity' channels scoring highest. The lowest scoring in both categories were news channels. There were no other significant differences between channels in other DISCERN items. Total scores did not significantly differ ($p = 0.237$). Median total scores by channel type are displayed in Figure 5. The top 5 most viewed videos represents 1,299,604 views, with a median DISCERN score of 55 (range = 29–70) and represents four academic centres and a patient owned channel.

### Video production

High-quality images ($N = 69$, 75.8%), audio and music ($N = 73$, 80.2%), accessible language ($N = 84$, 92.3%), and professional production quality ($N = 72$, 79.1%) were present in most videos. There were significant differences in overall production quality ($p = 0.029$), audio-visual quality ($p = 0.042$) with academic centres, hospitals, industry, news and television services providing professional quality production. Journals,

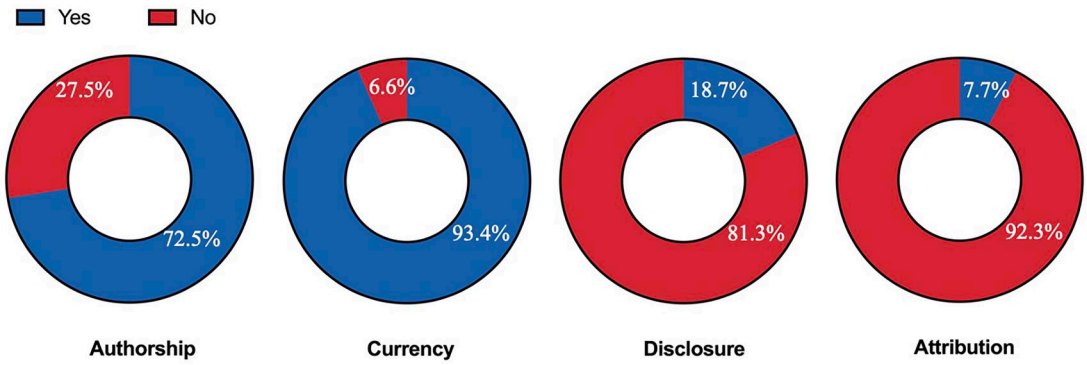


Figure 4. Doughnut chart demonstrating the proportions of videos achieving JAMA Benchmarks.

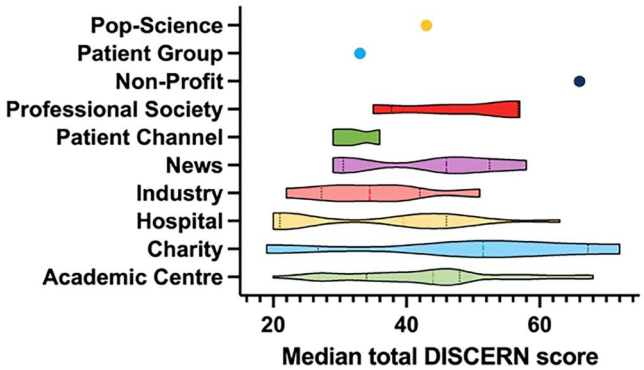


Figure 5. Violin plot illustrating probability distributions for Overall DISCERN scores organised by channel. Median measure of central tendency.

patient channels and pop-science provided lower audio-visual quality videos. There was no significant difference in the accessibility of language used across all channels ($p = 0.599$).

## Discussion

To our knowledge this is the first study to examine differences in portrayals of DBS surgical practice on YouTube. This study also examines the largest number of DBS videos, including those uploaded by patient channels and charities, and uses validated assessment tools to evaluate their educational quality.

Channel types varied greatly with the most common being academic centres, hospitals and DBS equipment manufacturers. There were also numerous uploads from news channels and charities as well as several patient interest groups and patient own-experience channels. This reflects the rich and diverse nature of YouTube content and highlights its potential as a social media platform, with patients and caregivers able to form online communities and share their experiences. Despite the not insignificant functional neurosurgery practice in the U.K., there was not a single upload from a U.K.-based channel, with the majority of content uploaded from North American channels. A similar finding was found in a study assessing YouTube videos pertaining to neurosurgery in general: the highest percentage of uploads was from the United States (68.3%), followed by India (7.8%) and Canada (3.9%) and only 1.7% uploaded from the U.K.[8]

Almost all videos featured clips of patients undergoing DBS procedures. However, these were often presented without any context. There was often no explanation of key patient impacting aspects of the DBS procedure such as the need for preoperative imaging (absent in 70.3%), the number of stages (absent in 67%), and the use (or not) of general anaesthesia (absent in 53.9%). Based on the video content, the most common DBS method is for Parkinson's disease targeting the STN, with preoperative MRI followed by a two-stage, awake procedure. The patient undergoes a full head shave, a perforator drill is used, followed by frame guided placement of electrodes under intraoperative neurophysiology with intraoperative imaging. This method is unlikely to be representative of all neurosurgical units as surgical practices vary greatly from one hospital to another, even within the U.K. As a result, patients considering DBS and looking to YouTube for more information will be presented with potentially conflicting and confusing videos, not necessarily representative of the procedure they may undergo.

It is also important to highlight the lack of candour within these videos with respect to risks and complications. Whilst DBS is well tolerated compared to other neurosurgical procedures, there are still risks. A recent review estimated a risk of 0–15% for infection, 0–15% for lead fracture, 0–19% for lead migration, a 0–2% risk of stroke and 0–4.4% of death.[30] In 80% of videos there was no explanation of any form of risks or complications. Given that patients undergoing DBS require discussion of risks and complications as part of the process of consent, these videos present an unbalanced or unclear safety profile of the procedure. As a result, patients and caregivers are likely to require clarification and active management of expectations in clinic.

Objective assessment of educational quality through JAMA and DISCERN revealed disparities in quality between peer-reviewed media or literature traditionally provided to patients in clinic, and YouTube. The JAMA benchmark requires details of authorship, information currency, clear attribution of sources and disclosure of funding. Only 12% of YouTube videos achieved this benchmark. Likewise, patterns of scores within DISCERN present videos which clearly explained the function and benefits of DBS but scored poorly for bias (3/5), additional information (2/5), or alternative treatments (2/5).

The vast majority of videos presented patient journeys or 'transformations' disguised as general educational pieces providing information about DBS when in many cases the intended focus of the video was completely different, for example to raise awareness of a newly established DBS service at a healthcare provider. None of the videos reviewed included any references to published neurosurgical research or links to academic literature. Whilst such information may not be appropriate for or accessible to a lay audience, the lack of peer review, or of any requirement to publish sources, or funding, or content disclosure in what is effectively an advert contrasts with other forms of media that patients will routinely use. As a result, there is a high probability that patients believe they are viewing educational content when in fact a product is being advertised. This is not dissimilar to issues identified in other forms of social media.[31]

Our DISCERN scores are in line with those of a previous study by Ward *et al.*[22] who reported an average overall DISCERN score of 39 for the top 20 DBS YouTube videos. Tripathi *et al.*[23] analysed 42 DBS-

specific videos uploaded by universities, tertiary care centres and university hospitals. They grouped scores into DISCERN $>$ 3 (good) and DISCERN $\leq$ 3 (moderate/poor) and found that only 24% of YouTube videos were classified as 'good'. The lack of a definitive subdivision of total DISCERN scores makes comparison and interpretation of results across studies challenging. What is more, researchers have recently started to adopt modified and abbreviated versions of the DISCERN criteria despite the DISCERN tool being developed as an appraisal process, to be used in its entirety according to the handbook.[20,21,27] In any event our findings support a growing consensus that health-related content on YouTube is of average to below-average quality, is unreliable as a source of patient information and can obstruct patient care.[32,33] Nevertheless, YouTube remains a powerful platform for patients to gain insight on neurosurgical procedures and share their experiences. This study highlights the need to address the growing issue of medical misinformation on YouTube and calls for academic centres and hospitals to upload more evidence-based and peer-reviewed patient information videos.

### *Limitations*

There are several limitations to this study. Whilst the objective was to systematically review YouTube videos describing DBS, inevitably uploads with differing or obscure titles, private or link only access videos may not have been captured through this review. It is possible that there are high-quality videos describing DBS surgery, but we are not aware of them, and likewise lay-persons will have no means of accessing them either. Another limitation is that the DISCERN criteria was developed before YouTube came to prominence and was not designed for video, or specifically videos hosted on large semi-social media websites such as YouTube.

## Conclusions

There is an increasing awareness within the neurosurgical community that patients should have high-quality information about their procedure pre-operatively. However, this can be a time-consuming endeavour and there are very few high-quality educational resources available for patients. YouTube is a free, easily accessible for both content uploaders and consumers, and therefore represents an ideal repository for patient information videos.

We suggest that future work should include the production of an exemplary video for YouTube, explaining DBS at a degree of detail appropriate for patients and covering the breadth and variety of DBS practice. In parallel to this, a set of criteria needs to be identified and used to create a database of 'trusted' videos which clinicians can use, and direct patients towards, in the knowledge that they are providing high-quality information to patients.

## Disclosure statement

The authors report there are no competing interests to declare.

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## ORCID

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