YouTube as a Source of Information on Neurosurgery

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BACKGROUND: **The importance of videos in social media communications in the context of health care and neurosurgery is becoming increasingly recognized. However, there has not yet been a systematic analysis of these neurosurgery-related communications. Accordingly, this study was aimed at characterizing the online video content pertaining to neurosurgery.**

METHODS: **Neurosurgery-related videos uploaded on YouTube were collected using a comprehensive search strategy. The following metrics were extracted for each video: number of views, likes, dislikes, comments, shares, date of upload, and geographic region of origin where specified. A quantitative and qualitative evaluation was performed on all videos included in the study.**

RESULTS: **A total of 713 nonduplicate videos met the inclusion criteria. The overall number of views for all videos was 90,545,164. Videos were most frequently uploaded in 2016 (n = 348), with a 200% increase in uploads compared with the previous year. Of the videos that were directly relevant to clinical neurosurgery, the most frequent video categories were "educational videos" (25%), followed by "surgical and procedure overview" (20%), "promotional videos" (17%), and "patient experience" (16%). The remainder of the videos consisted primarily of unrealistic simulations of cranial surgery for entertainment purposes (20%).**

CONCLUSIONS: **The findings from this study highlight the increasing use of video communications related to neurosurgery and show that institutions, neurosurgeons, and patients are using YouTube as an educational and promotional platform. As online communications continue to evolve, it will be important to harness this tool to advance patient-oriented communication and knowledge dissemination in neurosurgery.**

INTRODUCTION

The importance of social media communications in the context of health care is becoming increasingly recognized.[1] Videos are among the most powerful social media tools because they enable visualization of experiences and dialogues and also allow user-generated communications through comments. YouTube is the largest online platform for open access video content and has more than 1 billion users.[2] The Web site can be navigated in 76 different languages, making it the most widely used video-based social media platform.[3] For neurosurgery in particular, YouTube has arisen as an outlet to promote academic and hospital institutions and to enable neurosurgeons and health care professionals to disseminate appropriate patient education.[4] For example, the American Association of Neurological Surgeons and Journal of Neurosurgery Publishing Group have been some of the many organizations to use online videos as a tool to disseminate surgical education and enhance learning.[4]

Despite the increasing use and relevance of online videos pertaining to neurosurgery, to our knowledge, there has not yet been a systematic analysis of the online video content in this arena. This type of analysis is needed to ascertain the characteristics of such videos that attract users and how neurosurgeons and academics can harness social media to use it in the best way possible. To address this gap, the present study details the first comprehensive analysis of YouTube video content pertaining to neurosurgery and identifies several important themes emerging from the types of videos uploaded and viewed by the online neurosurgical community.

Key words
- Neurosurgery
- Online video content
- Social media
- YouTube

Abbreviations and Acronyms
IQR: Interquartile range

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METHODS

Search Strategy and Data Collection

A comprehensive YouTube search strategy was performed using the following terms: "neurosurgery," "neurological surgery," "neurosurgical," "brain surgery," OR "spine surgery."[4] As a result of the last search term, some videos were included because they pertained to spinal surgery but were also within the scope of orthopedic procedures. The search was conducted (by N.S.) in November and December 2016 and included videos uploaded on or before December 4, 2016. Data pertaining to the following metrics were extracted from each video: date of upload, number of views/likes/dislikes/comments, shares, and country or region of upload origin (where specified within the video content or in the video description).

Quantitative Analysis

Descriptive statistics that comprise mean, median, standard deviation, and interquartile range (IQR) for video metrics were calculated. All metrics were not normally distributed, which was also seen in previous studies on social media.[5,6] Therefore, we report our metrics using medians and IQR values. All calculations and figures were produced using Microsoft Office Excel 2007 (Microsoft Corporation, Redmond, Washington, USA).

Video Categorization and Qualitative Analysis

Videos were categorized according to their goal or purpose based on content within the video and title. After initial screening of most videos, common categories/themes that combine videos into qualitative themes were formulated. Axial and open coding was used to facilitate thematic analysis.[7,8] Open coding comprises identifying common grouping based on shared ideas within the videos assessed. Axial coding necessitates organization of information identified in the open codes into overarching themes. Videos were categorized first by one author (N.S.) and then followed by further review and verification from a second author (N.M.A.) during January–February 2017. Discrepancies between the 2 authors were resolved by discussion, and if needed, a third reviewer decided on the final category listed for the video.

Ethical Considerations

The cross-sectional data extraction methodology used in this study is in compliance with the Canadian Tri-Council Policy Statement for research that requires institutional ethics review. Data collected for this study were obtained from publicly available YouTube videos. There was no interaction or attempt to contact any YouTube users and user names were not identified or collected.

RESULTS

Quantitative Analysis

After removal of 16 duplicate videos, 713 unique uploads met the search criteria. A list of all 713 videos found in our search, with Uniform Resource Locators (URLs) and respective metrics, is provided in the **Online Supplementary Materials**. Descriptive statistics of all metrics on the 713 videos analyzed are summarized in **Tables 1** and **2**. The overall number of views for all videos was 90,545,164 (median, 1209; IQR, 161–24,553). The number of likes on all videos was higher than dislikes (1 million vs. 25,000). These videos were shared more than 100,000 times and received more than 40,000 comments. The region of origin was noted, where available, and users from the United States comprised the highest number of uploads by geographic region (17%). Videos that were categorized as "irrelevant to clinical neurosurgery" had the highest number of views (44,073,770), whereas videos detailing a "surgical and procedure overview" generated the highest number of shares (24,942) (**Table 2**). **Table 3** lists all uploads by country in our analysis. The upload timeline of these videos is provided in **Figure 1**, highlighting gradual increase in uploads over time, as well as temporal peaks in video uploads pertaining to neurosurgery.

Table 1. Video Metrics Among All Videos Included in Our Analysis

Video Metric	Total	Median (Interquartile Range)
Views	90,545,164	1209 (161–24,553)
Likes	1,045,965	8 (1–79)
Dislikes	25,931	0 (0–4)
Comments	148,579	11 (2–77)
Shares	43,206	5 (1–24)

Video Categorization and Thematic Analysis

A summary of the video categories found in our analysis and their respective frequencies is provided in **Figure 2**. The most frequent video category was "educational videos" ($n = 177$, 24.8%), with most of these videos containing educational content relevant to neurosurgical trainees ($n = 67$). These videos primarily pertained to details of surgical techniques, as well as principles of management of neurosurgical patients. For example, the most highly viewed video in this category (>86,000 views) was uploaded from the University of California, Los Angeles Health channel, and featured Dr. Neil Martin, showing "Unruptured aneurysms: when and how to treat." University of California, Los Angeles neurosurgery also contributed numerous educational videos for neurosurgical trainees within this category. Other highly viewed videos for trainees include details

Table 2. Cumulative Metrics by Video Category, Ranked by Highest Number of Views

Category	Views	Likes	Dislikes	Comments	Shares
Irrelevant to clinical neurosurgery	44,073,770	549,914	16,371	69,964	6605
Surgical and procedure overview	23,241,074	127,148	3984	29,146	24,942
Patient experience	20,979,639	358,636	5141	47,948	6262
Educational video	1,870,350	8674	362	1327	4743
Promotional video	356,825	1502	63	142	547
Other	24,618	91	10	52	41

Table 3. Country or Region of Origin for Videos Included in Our Analysis (Where Specified or Inferred)

Country or Region	Frequency	Percentage*
Africa	1	0.6
Australia	3	1.7
Azerbaijan	2	1.1
Brazil	2	1.1
Canada	7	3.9
Egypt	1	0.6
England	1	0.6
Finland	1	0.6
France	1	0.6
Germany	3	1.7
Ghana	1	0.6
India	14	7.8
Indonesia	1	0.6
Iran	1	0.6
Israel	1	0.6
Japan	1	0.6
Malaysia	1	0.6
Mexico	5	2.8
Saudi Arabia	1	0.6
Slovenia	1	0.6
South Africa	1	0.6
Turkey	2	1.1
United Kingdom	3	1.7
United States	123	68.3
Venezuela	2	1.1
Unknown	533	—
Total	713	100.0

*Calculated as a percentage of total videos with known country of upload (n = 180).

of basic neurosurgical techniques, such as pterional craniotomy and placement of an external ventricular drain. Many videos in this category were also geared toward patient education (n = 51), which included basic overviews of both cranial and spine surgical procedures.

"Surgical and procedure overview" videos comprised the second most common category (n = 146, 20.5%) and the category with the highest number of shares (24,942). More than half of these showing cranial procedures in the intraoperative setting (n = 82). With more than 3.9 million views, a representative example of videos in this category details the removal of a metastatic lesion under the surgical microscope, with text-based explanations. Although most videos in this category were generated by institutions, medical professionals, or surgical instrument companies, 1 notable video that was highly viewed (>2.7 million views) was created by a patient who gave an overview of his awake craniotomy and also featured intraoperative clips as well as his immediate postoperative course.

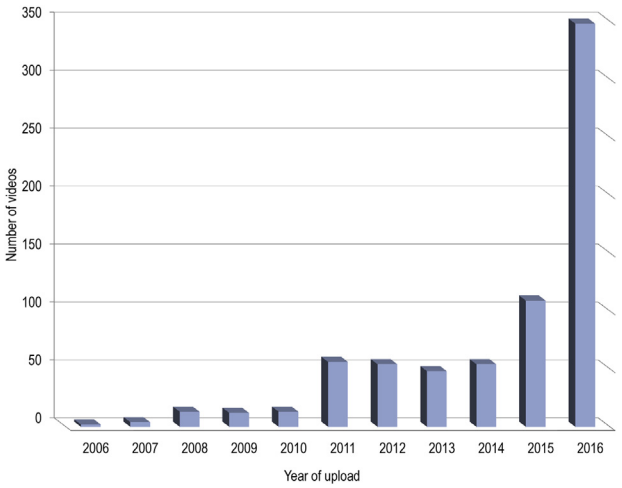

Figure 1. Timing of video uploads by year since 2006. The horizontal axis shows the year of upload and the vertical axis indicates the number of videos uploaded in the respective year.

The next most commonly viewed categories of videos were nearly parallel in frequency: "promotional videos" (n = 119, 16.7%) and "patient experience" (n = 112, 15.7%). Of the promotional videos, the emerging theme was promotional content for academic institutions (n = 80), with most being from institutions in the United States. Many of these videos featured 1 or more neurosurgeons as spokespersons for the institution (n = 51). Other videos in this category were geared toward promoting educational materials such as apps, books, and academic courses (n = 23). Within the category of patient experience, the emerging theme of institutional promotion was also relevant; however, these videos

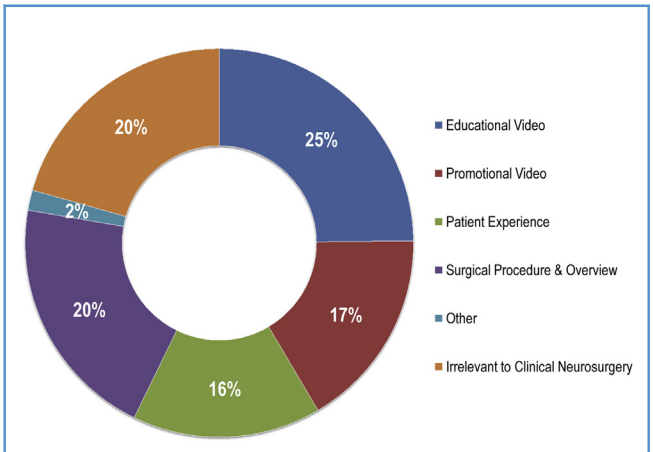

Figure 2. Distribution of video categories of all nonduplicate videos included in the analysis. The nearest whole percentage value is shown.

were chiefly centered on the experience of the patient. The most highly viewed video featuring a patient experience on behalf of an institution was from the Mayo Clinic and showed a violinist continuing to make music after deep brain stimulation surgery (>900,000 views). Qualitatively, videos on patient experience were predominantly patient-generated video blogs. These videos garnered some of the highest number of views of all videos in the study and ranged from patients filming their surgeries to speaking about their experiences and even watching an intraoperative recording of their cranial surgery.

The remainder of the videos were either "irrelevant to clinical neurosurgery" ($n = 147$, 20.6%) or classified as "other" ($n = 12$, 1.7%) because they were not relevant to the previously mentioned categories. Of the videos that were irrelevant, most ($n = 60$) were recordings of video games for entertainment, which included the video with the highest number of views in this study (>11 million).

DISCUSSION

This study was aimed at characterizing the online video content pertaining to neurosurgery on the online video platform YouTube and, to our knowledge, comprises the largest study sample in the literature to date.[9] The findings from our study highlight several important considerations. It is necessary to determine the extent to which video content online is accurate and reliable, because previous reports have shown that online medical content (e.g., pertaining to movement disorders) may be unreliable and can obstruct appropriate patient care.[10] In the present study, although there exists some content pertaining to "brain surgery" or "neurosurgery" that is not directly relevant to the specialty, there are many high-quality videos pertaining to neurosurgery that do exist online and can have wide-reaching impact.

Educational Video Content from Academic Organizations and Institutions

The most frequent category of video in our analysis was educational videos, many of which were geared toward neurosurgical trainees. Although the accuracy was not formally validated, the educational content of the videos surveyed in the present study were from reliable academic sources, showing the usefulness of YouTube as a supplementary educational platform. The extent to which surgical residency programs and medical schools will formally incorporate online video materials into curricular learning has still to be determined.[11,12] However, as discussed earlier, the American Association of Neurological Surgeons/Journal of Neurosurgery Publishing Group channel has been committed to providing peer-reviewed online videos for neurosurgical residents and had the highest number of subscribers among the neurosurgery YouTube channels. Although videos detailing surgical procedures generated the greatest number of shares, it is unclear if users accessing these videos are predominantly medical trainees or lay persons interested in viewing intraoperative videos. Future studies aimed at characterizing the benefit of such videos to medical students and residents may be helpful in better understanding the impact of these videos as educational tools for trainees.

It is evident from our results that academic institutions, primarily those in the United States, are using YouTube as a promotional platform. The nonsocialized health care infrastructure of the United States may explain the prevalence of these videos, because patients and caregivers likely want to make informed decisions regarding where to seek neurosurgical care.[13] This may also be a contributing factor to the high overall prevalence of YouTube videos released from the United States in this study. Previous work from our group[5] has shown that a social media presence correlated with institutions' bibliometric profiles and perhaps more academic institutions may be inclined to engage in social media endeavors, which, in turn, may enhance patient recruitment. In this regard, it is also important to consider putative detrimental effects of having neurosurgical professionals and academic neurosurgical programs increase their social media presence. For example, if a neurosurgical department is not able to maintain upkeep of a social media profile, a lack of sustained presence may be perceived as stagnancy of the program. However, it is likely be that the benefits of keeping up the pace with evolving modes of communication will benefit the field to remain current and relevant to the next generation of trainees and patients alike. It will be necessary to ascertain if there is a point of diminishing returns at which increased social media engagement by institutions does not yield increasing benefit or productivity in outcome metrics, although this outcome may be difficult to assess.[14]

Patient-Generated Online Video Content

One of the additional insights that was garnered from this study is that YouTube is a powerful platform for patients to share their experiences. Patient experience videos primarily comprised video blogs and promotional videos for institutions. Video blogs likely have a cathartic impact on patients because they enable them to share their story and experience with others during a challenging time.[15] Patient-generated videos may also be driven by altruistic motives because current and prospective patients and families likely benefit and learn from watching the experiences of others. One caveat is that it cannot be inferred whether this is an effect specific to neurosurgery or if other fields of medicine also have many patient experience videos. Similarly, patient experience videos can be influential for prospective patients to select hospitals and may explain why patient education videos were also geared toward institutional promotion.

Neurosurgery in Popular Culture

Twenty percent of videos in our analysis were irrelevant to clinical neurosurgery and these videos also yielded the highest number of views among all categories. Most of these videos were unrealistic simulations of cranial surgery used in the form of video games for entertainment purposes. The interest in neurosurgery as a specialty within popular culture could be driven by recently published best-seller books (e.g., *When Breath Becomes Air*, *Do No Harm: Stories of Life, Death, and Brain Surgery*, and *Gray Matter*), as well as Hollywood movies/television series (e.g., *Doctor Strange*, *Grey's Anatomy*, and *Concussion*) and even political news (e.g., Dr. Ben Carson). The effect of media on society's interests and behavior is a well-recognized phenomenon[16-18] and this may also explain the abrupt increase in the number of neurosurgery-related videos in 2016. Future work on qualitative

analyses of the comments within these videos may aid in characterizing the demographic of users accessing these videos, as well as the themes that emerge from such user-generated comments.

Privacy and Legal Considerations Pertaining to Online Videos

In analyzing the role of publicly available online videos in the realm of neurosurgery, there are important privacy and legal issues. Salient considerations include patient privacy and potential liabilities for copyright infringement or falsification. Videos from hospitals and academic institutions must ensure that patient privacy is maintained and that all patients included in online content have provided consent and release. Copyright infringement may encompass inclusion of academic material that has not been approved for use in videos. Because there is no formal mechanism of verification of authenticity of the individuals or organizations producing online video content, educational content should include a statement regarding the credibility of sources used to generate a video.

Limitations

Some study limitations should be noted. First, because of the cross-sectional nature of the primary analysis, the findings from our study capture the landscape of online videos at 1 time point, yet this subject is dynamic and will continue to evolve. Importantly, for videos uploaded before 2012, limited data on number of subscriptions driven and shares were available. Second, the country or region of origin was not always feasible to infer and in some instances, it was not clear if a video was filmed and uploaded in different countries. We aimed to include videos of any language, although most videos were in English. There may exist some differences in video content that is posted in other languages. Although video categorization was performed independently by the authors, there is considerable overlap among categories. For example, some "surgical procedure and overview" videos could also secondarily serve as educational videos and similarly, many "patient experience" videos were also promotional. For the purposes of conducting a systematic analysis, we endeavored to select the categories that were most highly relevant to the video.

CONCLUSIONS

This study is the first to comprehensively examine online video content pertaining to neurosurgery. Our findings show a high user engagement in this sector, with academic institutions and patients increasingly using online video platforms. These results show that online video content can serve as a powerful educational, promotional, and interactive tool. Given the high reach of online social media videos, maintaining social media engagement is essential to keep neurosurgery relevant in the evolving landscape of online communications.

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