#Neurosurgery: A Cross-Sectional Analysis of Neurosurgical Content on TikTok

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Key words
- DISCERN
- Neurosurgery
- Social media
- TikTok
- Video bias

Abbreviations and Acronyms
HCP: Health care provider

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OBJECTIVES: **TikTok is a social media platform that has gained popularity and become a powerful engine to disseminate public health and medical information. To date, no study has characterized the qualities of popular TikTok videos related to neurosurgery, or assessed biases in the content of these videos.**

METHODS: **The TikTok web browser application was queried using "#neurosurgery" to identify neurosurgery-related videos. The top 100 videos meeting inclusion criteria were analyzed and video characteristics determined. Bias was assessed by the DISCERN scoring system using 3 independent reviewers. A Kruskal–Wallis H test was used to correlate video popularity with video characteristics and to correlate bias with creator and video type.**

RESULTS: **The 100 videos evaluated totaled 8.8 million likes, 104,718 comments, and 100,856 shares. The oldest video was posted February 2020 and the most recent March 2022. Videos were most commonly entertaining (n = 64, 64%), and educational (n = 46, 46%). Video popularity was associated with videos that aimed to entertain, and least associated with videos depicting neurosurgery lifestyle. Low DISCERN scores, indicating more biased content, were seen across the neurosurgical content with the entertaining video category demonstrating the highest bias.**

CONCLUSIONS: **Neurosurgical content on TikTok contains a high degree of bias across all creator and video types. Entertaining videos are associated with the highest numbers of likes but also the greatest bias. These data may be used to guide institutions and neurosurgeons to grow interest in the field of neurosurgery and disseminate unbiased information while expanding their social media presence.**

INTRODUCTION

Social media platforms, especially TikTok (ByteDance Ltd., Beijing, China; formerly known as musical.ly), have gained popularity and become a powerful engine to disseminate public health and medical information.[1] Today, 21% of adults report using TikTok,[2] and the app has been downloaded more than 3 billion times.[3] The use of video-based platforms for the exchange of academic and medical information is not a novel phenomenon, as platforms such as YouTube and Vimeo have been widely used previously for such purposes.[4-6] However, TikTok differs from these other platforms as audiovisual segments are limited in duration, with distinct target audiences, user bases, and video content.[1] Furthermore, the use of hashtags to "tag" videos allows users to view and interact with multiple audiovisual clips in succession on the same topic, allowing the user to view a thread of related posts on a topic of interest.

TikTok has been used to disseminate health care–related information with content created by academic institutions, health care providers (HCPs), students, and laypeople. In neurosurgery in particular, several academic organizations (Lenox Hill Hospital, Northwestern) and neurosurgeons (ladyspinedoc, garcesmd, neurocirurgiabr, drjuanmanuelriestra) host active TikTok accounts with substantial followings and viewership. However, social media has been known to propagate incorrect information and biased content,[7] which is likely to be also prevalent on TikTok.[1] An analysis of pediatric urology content on TikTok recently demonstrated that TikTok can be a valuable source of accurate and inaccurate medical information.[8] Such information can impact perceptions of medical information and public health.[9]

Neurosurgical content has been analyzed on video-based platforms such as YouTube[6] but, to date, no literature has characterized the quality of neurosurgical content on TikTok. Given TikTok's substantial user base, rapid growth, and distinctions from other video and social media platforms, it is imperative to better understand the landscape of neurosurgical content on this platform, especially the content and information quality of these videos. We analyzed the characteristics of popular neurologic TikTok videos and investigated the presence of bias, as these data may

Table 1. Video Characteristics Stratified by Account Type and Video Aim

	Video Count	Video Length, seconds	Videos using Audios	Videos Using Duets	Number of Hashtags	Likes	Comments	Shares	Account Followers (Thousands)	Account Likes (Thousands)
Account type										
Academic/institutional	5	32.8 ± 38.7	3	0	8.8 ± 2.2	35.3 ± 44.5	646 ± 481	874 ± 873	29.7 ± 12.7	198.6 ± 23.5
Neurosurgeon	45	24.0 ± 61.7	35	1	9.0 ± 4.1	111.5 ± 4.1	1053 ± 174	1302 ± 220	124.8 ± 81.4	3724.3 ± 3547.5
Non-neurosurgeon physician	10	28.0 ± 18.6	5	0	6.0 ± 2.0	67.0 ± 81.4	1388 ± 2035	1006 ± 1286	113.9 ± 193.1	1993.8 ± 3340.6
Nonphysician HCP	20	25.7 ± 18.5	15	0	7.5 ± 2.8	26.0 ± 19.4	301 ± 350	234 ± 291	1139.3 ± 1391.4	2467.9 ± 2922.7
Non-HCP	20	43.0 ± 46.7	15	0	8.0 ± 2.7	121.7 ± 196.7	1710 ± 2675	1156 ± 2237	331.8 ± 667.3	9550.6 ± 17,056.1
Video aim										
Entertainment	64	24.0 ± 25.2	52	0	8.0 ± 3.3	111.6 ± 258.8	1082 ± 1996	784 ± 1608		
Educational	46	37.0 ± 33.1	30	1	9.0 ± 3.2	64.0 ± 82.7	1163 ± 1851	1331 ± 3575		
Procedural video	15	39.0 ± 30.4	9	1	8.0 ± 3.4	76.8 ± 129,433	710 ± 718	856 ± 1142		
Lifestyle	11	41.4 ± 46.5	7	0	7.9 ± 2.8	20,845 ± 12,461	400 ± 320	449 ± 558		

Numbers are presented as number of videos or mean number of videos ±standard deviation.
HCP, health care provider.

provide guidance to institutions and HCPs looking to create unbiased content on TikTok.

METHODS

The use of hashtags enables individuals on TikTok to search audiovisual clips on specific topics of interest. The resulting inventory of clips are sorted by view count. The TikTok web-browser application was queried on April 1, 2022, for videos tagged with "#neurosurgery." As the algorithm that TikTok implements to select videos for viewing may depend on the user's prior viewing and search history, a new account was created for identifying and examining videos. The resulting videos were presented as organized by TikTok's proprietary algorithm, and the top 100 videos meeting inclusion criteria were considered for analysis. Video rank correlated to number of "likes" and was used to assess popularity. We defined rank by the order in which videos appeared under "#neurosurgery."

Qualitative characteristics were abstracted for each video. The type of account posting the video was determined and categorized as either academic/institutional, neurosurgeon, non-neurosurgeon physician, non-physician HCP or medical student, or non-HCP. Additional account characteristics were recorded, including number of followers as well as total number of likes. Upon discussion and consensus decision of 3 authors (J.M., A.M., H.S.), video content was categorized as either entertainment, educational, procedural, or lifestyle. These categories were based on the perceived intent of the creator. Entertainment videos were those that included a popular dance trend, humor, or other characteristics clearly meant to entertain an audience. Educational videos were those that aimed to teach the audience about a topic and included, among others, videos explaining radiographic findings. Procedural videos attempted to demonstrate a procedure, for example, operative videos. Lifestyle videos contained information about the daily life and/or career path of a neurosurgeon. The number of likes, comments, and shares for each video were recorded, along with video length, number of hashtags used, and date posted. In addition, implementation of overlying audio, stitches (a

TikTok tool that enables users to combine 2 audiovisual clips), or duets (enables users to create an audiovisual clip that is played alongside another clip) were recorded. Notably, for the purposes of analyses, videos may have fallen under several categories, i.e., a video depicting a surgery with audio commentary explaining relevant anatomy would be categorized as both procedural and educational.

Three independent reviewers (J.M., A.M., and H.S.) reviewed the content categorizations and assessed content quality using DISCERN criteria, a reliable and valid method of assessing treatment-related health information that has been previously applied to video content.[6,10] The DISCERN metric is a validated instrument for evaluating the reliability of health information, and although designed for written content, has been previously applied to audiovisual formats.[6,11] It consists of 15 questions aiming to investigate characteristics of the information source. Each question is scored from 1 to 5 points (total score range 15–75), with greater scores indicating a source of high-quality information where individuals can learn more about a given process or condition and all available options; in contrast, videos with lower scores exhibit greater bias and do not provide valuable information regarding medical conditions. Based on the dataset and the number of independent raters (3), a 2-way mixed-effects model was implemented to compare the reliability between raters.[12,13] For the evaluation of DISCERN ratings, the DISCERN handbook provides a categorization method: videos with total DISCERN of 63–75 are of "excellent" quality; 51–62, "good" quality; 39–50, "fair" quality; 27–38, "poor" quality; 15–26, "very poor" quality.[10]

Linear regression was performed to identify if the creator type of the video was correlated with video rank. Separate linear regressions were performed to identify whether video category was correlated and whether video characteristics were correlated.

All statistical analysis and the construction of models was performed using custom scripts in MATLAB R2021a (MathWorks Inc., Natick, Massachusetts, USA). All data collected and custom script used for the study may be provided upon reasonable request.

RESULTS

Analysis of Videos

The top 100 videos tagged with "#neurosurgery" meeting inclusion criteria were examined. The oldest video was posted February 2020, and the most recent in March 2022. These videos totaled 8.8 million likes, 104,718 comments, and 100,856 shares with a median of 25,600 likes, 362 comments, and 272 shares. Of these 100 videos, 64 were entertaining, 46 were educational, 15 were procedural videos, and 11 focused on lifestyle in neurosurgery. The mean duration of all videos was 29.2 ± 30.2 seconds. Overlying audio was used in 73 videos. Duets/stitches were used in 1 video, and the mean number of hashtags implemented was 8.0 ± 3.3 hashtags. Further video characteristics by category are presented in **Table 1** and **Supplementary Table 1**. Characteristics of the 6 most popular content creator accounts are detailed in **Table 2**.

Investigation of Factors That Correlate to Higher Video Rank

Linear regression was performed to identify if the creator type of the video was correlated with video rank. Separate linear regressions were performed to identify if video category or characteristics were correlated. A generalized linear regression model indicates that entertaining videos ($B = -17.276$, $P = 0.052$) are more popular (i.e., of higher rank) and neurosurgery lifestyle videos ($B = 19.7$, $P = 0.061$) are less popular (i.e., of lower rank). The classification of content creator and video characteristics were not found to significantly correlate with video rank. The results of these regressions are further detailed in **Table 3**.

Comparison of Content Validity

Of the 100 initial videos analyzed for characteristics, 16 were excluded from further analysis due to a lack of discernable speech or text. A total of 84 videos were assessed for content validity (**Figure 1**). The interclass correlation coefficient for consistency in DISCERN was 0.881 (95% confidence interval 0.828–0.919) indicating good inter-rater reliability.[13] A Kruskal–Wallis H test was performed to identify any differences in DISCERN score by content creator type. The test indicated that there is a significant difference in the DISCERN score between the videos created by different creator types ($H = 9.98$, $P = 0.041$). The mean rank score was 54.5 for academic/institutional content creators ($n = 4$ videos), 44.6 for neurosurgeons ($n = 34$ videos), 49.2 for non-neurosurgeons ($n = 10$ videos), 27.6 for nonphysician HCPs ($n = 19$ videos), and 48.2 for non-HCPs/medical students ($n = 17$ videos). To further examine these differences, a post-hoc Mann–Whitney U test using an alpha of 0.05 suggests that nonphysician HCPs and medical students created videos that have a lower DISCERN bias score as compared with all other groups. No other groups showed significantly different bias score with one another. Mean DISCERN scores by group are presented in **Table 4**.

A Kruskal–Wallis H test was performed to identify any differences in DISCERN

Table 2. Characteristics of the Six Most Represented Creator Accounts Among the Videos Analyzed

Account Name	Account Type	Number of Followers	Number of Likes	Number of Top 100 Videos
ladyspinedoc	Neurosurgeon	178,500	7,200,000	20
fightingforbabytessa	Non-neurosurgeon HCP	2,800,000	59,500,000	9
garcesmd	Neurosurgeon	48,000	1,100,000	8
neurocirurgiabr	Neurosurgeon	123,200	1,400,000	7
drjuanmanuelriestra	Neurosurgeon	268,900	1,100,000	4
neurosurgerynm	Academic/institution	35,400	209,200	4

HCP, health care provider.

score by video category (entertainment; educational; procedural; and lifestyle). The test indicated that there is a significant difference in the DISCERN score between the videos created by different creator types ($H = 20.62$, $P < 0.001$). The mean rank score was 42.1 for entertaining videos ($n = 50$ videos), 69.3 for educational videos ($n = 45$ videos), 79 for procedural videos ($n = 9$ videos), and 62 for lifestyle videos ($n = 10$ videos). To further examine these differences, a post-hoc Mann–Whitney U test using an alpha of 0.08 suggests that the DISCERN score of videos that were entertaining have a lower DISCERN score as compared to the other three categories of video aims. Hence, despite being the most prevalent video aim in the dataset, entertainment videos were found to be the most biased. Mean DISCERN scores by video aim are presented in Table 4, and video counts may add to more than 100 due to videos being placed into multiple categories.

Table 3. Results of Linear Regression

	Estimate	SE	t	*P* Value
Account type				
Intercept	65.8			
Academic/institutional	0	0		
Neurosurgeon	−10.6	15.302	−0.6927	0.490
Non-neurosurgeon HCP	−17.2	17.78	−0.9674	0.336
Non-physician HCP	0.6	16.231	0.0369	0.971
Non-HCP/medical student	−17.1	16.231	−1.0536	0.295
Video aim				
Intercept	68.979			
Entertainment	−17.276	8.7622	−1.9717	0.052
Educational	−6.8774	8.0636	−0.8529	0.396
Procedure	−6.106	9.2004	−0.6637	0.509
Lifestyle	19.7	10.388	1.8965	0.061
Video characteristics				
Intercept	59.983			
Video length	−0.0299	0.11484	−0.26019	0.795
Video hashtags	0.31378	0.99555	0.31518	0.753
Use of audio	−7.6832	7.7031	−0.99742	0.321

SE, standard error; HCP, health care provider.

DISCUSSION

TikTok is a social media platform that has a growing user base and the potential to rapidly convey information and messages to a wide audience. There have been multiple studies investigating medical content on TikTok in other fields, most notably aesthetic surgery,[14] dermatology,[15,16] plastic surgery,[17] pediatric urology,[8] and radiology.[18] One study by Zheng et al.[16] has suggested that acne health content on TikTok is of low overall quality. However, there are very few such studies and, to our knowledge, no studies investigating the neurosurgical content on TikTok. We analyzed the characteristics of popular neurosurgical TikTok videos and assessed the content for bias using the DISCERN score. The results of this study suggest that entertainment videos are correlated with higher popularity whereas neurosurgical lifestyle videos are correlated with lower popularity. Our results also suggest that neurosurgical content on TikTok is of overall high bias with entertainment videos being of higher bias than other categories.

There have been very few studies investigating what creates a successful video on TikTok, and knowledge from other social media sources (e.g., Instagram, Facebook, etc.) or video-based platforms (e.g., YouTube, Vimeo) may not directly translate to TikTok due to its unique audiovisual presentation and user interaction interface.[19] With respect to factors that drive user engagement, one recent study indicated that humor and first-person view may influence user immersion and entertainment in short, TikTok-like audiovisual clips.[20] Another study indicated that users gravitate toward medical information presented in conjunction with comedy.[21] Furthermore, several psychological studies have identified factors that influence TikTok content consumption; recent work in this field has suggested that passive consumption of content is predominantly driven by self-gratification,[22,23] the need for escapism,[24] and self-expression.[25] Taken together, videos that aim to entertain and that contain humor are more likely to garner user consumption. The results of the present study corroborate this, as we found that entertaining videos were more correlated with higher popularity and generally contained humorous content or dances that aligned with popular TikTok trends at the time they were posted. Conversely, lifestyle videos were correlated with lower popularity and often discussed the extent of training required to become a neurosurgeon or the day-to-day schedule of resident or attending physicians in neurosurgery.

Work in this field is scarce, and there is very little empirical evidence in the literature suggesting factors that influence TikTok user media consumption. However, knowledge of user preferences and of content that is more likely to draw in users is imperative for the propagation of medical information to a wide audience. To this end, we were not able to identify any relation between video popularity and video content characteristics (e.g., filters, sound, special effects) or video length.

Although the DISCERN tool was originally designed for written content, it has been utilized previously to analyze content bias in TikTok medical content[16] and has been previously implemented to analyze neurosurgical content on YouTube.[6]

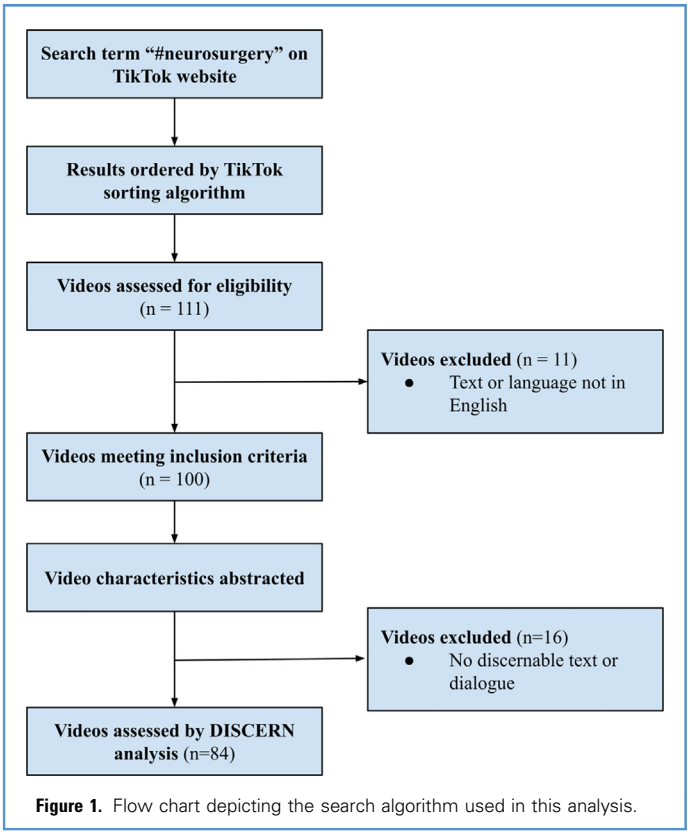

Figure 1. Flow chart depicting the search algorithm used in this analysis.

Results from this study indicate that most highly-viewed neurosurgical videos found on TikTok are of very poor quality and with high bias, which is in line with previous study on neurosurgical content on YouTube[6] and similar analysis on acne content on TikTok.[16] However, these scores are much lower than a similar analysis investigating DISCERN score on chronic obstructive pulmonary disease TikTok content.[11]

Table 4. DISCERN Scores Stratified by Account Type and Video Aim

	Number of Accounts	Mean DISCERN	SD
Account type			
Academic/institutional	4	25.9	6.05
Neurosurgeon	34	23.9	6.75
Non-neurosurgeon physician	10	24.9	6.90
Non-physician HCP	19	20.0	5.66
Non-HCP/medical student	17	24.2	6.20
Video aim			
Entertainment	50	20.7	4.24
Educational	45	26.4	6.90
Procedural	9	30.4	9.66
Lifestyle	10	25.2	7.20

SD, standard deviation; HCP, health care provider.

Further, our results suggest entertainment content on TikTok is particularly susceptible to containing biased content despite the category being the most represented in the top 100 neurosurgical videos. These videos suffered lower scores because they failed to provide sources for information, present balanced viewpoints of alternative treatments, clarify long-term consequences of treatments, highlight areas of uncertainty, and provide clear aims. This is likely attributable to the nature of the content to entertain and not necessarily educate. Although, alternatively, this may be related to the complexity of neurosurgery and the difficulties of conveying the nuances of neurosurgical content in a short audiovisual presentation. These data highlight areas that creators can target to create more unbiased videos especially when content aims to deliver education or otherwise informative content, and hence improve the quality of the neurosurgical content.

Social media presence by institutions and neurosurgeons has been shown to positively influence patient reviews in neurosurgery.[26,27] In an increasingly digital age, it is imperative for practicing neurosurgeons and academic institutions to maintain a positive online presence. Given TikTok's massive user base, it presents an opportune platform for physicians and institutions to amass interest in the field of neurosurgery and maintain a positive social media presence. TikTok has already been used for educational purposes in neurosurgery and through its use was able to generate remarkable interest in a summer neurosurgical webinar.[5] Results of the present study indicate that creating videos that are entertaining may lead to a wider audience and more visibility on the platform. At present, there are many neurosurgeons creating TikTok content, and further examination of these profiles would provide insight into their impact.

The average age of a TikTok user is younger than 30 years of age, and users skew toward female users and underrepresented minorities.[19] The implementation of TikTok can hence enable neurosurgery to reach a much younger audience. This may be an opportunity for neurosurgery to increase awareness in the field and garner mass academic interest, especially in female users[28] and underrepresented minorities.

Neurosurgery stands to benefit from adopting TikTok as a medium for conveying information, both for the individual neurosurgeon or institution (in improving patient satisfaction and outcomes) and for the field as a whole (in moving towards a more diverse future and improving the content that the layperson may interact with).

The present study has several limitations. It is largely descriptive in nature and not intended to comment on the factual accuracy of information presented in videos. Further, it should be noted that the DISCERN metric was initially designed for written content and scores may be been lower across all categories due to the stringent nature of the questions posing limitations when applied to video-based content.[10] The DISCERN metric was designed to assess health care information, and may skew toward low scores in entertaining content compared with informative content categories including procedural and educational videos.[8] Although inter-rater reliability was high, DISCERN scores were still subject to the interpretation of each individual reviewer and may vary between different groups of reviewers. Furthermore, all analysis was performed retrospectively from a single time point; however, we believe these findings to be generalizable to future content created. TikTok relies on an algorithm that is based on videos that users have previously interacted with or watched; from the moment that the application is opened, TikTok begins to make assumptions about the user's preferences, and hence, content that is delivered is heavily filtered and modified. As this approach used a new profile, such algorithms were likely less in play, but this also means that a typical user may interact with different content. Finally, videos that were not tagged with #neurosurgery were not examined; however, these videos would be difficult to identify and access for the common user. It should be noted that the videos examined that were tagged with #neurosurgery do not encompass all of the neurosurgical content on TikTok, and this tag can be freely implemented on any type of video (including non-neurosurgical in focus). We did not come across any such videos that were unrelated to neurosurgery in this analysis. Future study may investigate the impact of applying hashtags on view count, and the extent to which such hashtags are implemented by users.

CONCLUSIONS

TikTok is a social media platform with a large audience base, and content creators should be cautious in the way they disseminate neurosurgical content and information to their viewers. Given the power of social media, adoption of such platforms by academic institutions and neurosurgeons is essential to thrive in this increasingly digital world. Neurosurgery as a field should aim to provide high-quality, low-bias educational content and may benefit from the use of entertainment content to boost popularity and content interest. Viewers should take caution when garnering medical information regarding neurosurgery from TikTok and rely primarily on trusted sources of information, including university entities and scientific societies.

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Supplementary Table 1. Categorization of Assessed Neurosurgical Videos on TikTok

Video Category	Video Count (n = 100)
Single category	
Entertainment only	41
Educational only	21
Procedure only	3
Lifestyle only	2
Two categories	
Entertainment and educational	13
Entertainment and procedural	5
Entertainment and lifestyle	3
Educational and procedural	5
Educational and lifestyle	4
Three categories	
Entertainment, educational, and procedural	1
Entertainment, educational, and lifestyle	1
Educational, procedural, and lifestyle	1

In total, 100 unique videos were assessed by 3 raters as "Entertainment," "Educational," "Procedure," and/or "Lifestyle."