

Stem cells on YouTube: National vs international content

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Abstract

YouTube is one of the most popular video-based social media sites across the globe. The role of stem cell transplant has not been deeply explored on YouTube. The current narrative review was planned to assess the viewership of content available on YouTube related to stem cells. The videos were classified based on type of content, duration, number of views, comments and number of likes. A total of 40 videos were downloaded under the search terms "stem cells in Pakistan" and "stem cells". Of them, 6(15%) were repeat videos, and 34(85%) were unique. The findings revealed that in 10(25%) most viewed videos from Pakistan, 6(60%) contained opinions from non-expert physicians. Among the 10(25%) most viewed international videos, the information providers were science educators in 4(40%) videos and researchers in 2 (20%). Notably, no content from Pakistan was present among the top relevant international videos. Over 27 million views were included in the total number of videos that were analysed. YouTube is a powerful tool to spread knowledge and support public health decision-making. However, misleading information regarding stem cell can lead to adverse outcomes.

Keywords: Stem cells, YouTube, Social media, e-health, Internet.

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Introduction

The internet is a vital source of health information. Studies¹⁻⁴ have recently shown that users frequently look for specific information related to health issues that they may have themselves or others known to them. Users can self-diagnose, learn more about certain diseases, and search for treatment alternatives using the internet.³ Trends show that the majority of internet searches for health-related information take place on search engines, which then route users to a variety of social media platforms.⁴

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One such platform with video-based social media that is widely used globally is the YouTube.⁵ With billions of daily views and more than 1 billion registered users, it is the second most visited webpage worldwide. There are almost 30 million health-related videos on YouTube, posted by various individuals and institutions. It has been demonstrated that watching YouTube videos significantly impact people's knowledge and beliefs, leading to better patient care.⁶ With so many treatments available, many patients struggle to choose the best course of action and, therefore, are increasingly using YouTube for treatment-related information. Hundreds of millions of people have viewed videos on patients' stories and information about available treatments and outcomes.⁷

However, because YouTube is accessible to all users, anyone can post videos that may contain unreliable and erroneous information.^{6,7} Viewers should exercise caution regarding the accuracy and dependability of the health-related information presented in such videos. The quality of the information typically depends on the user who posted it.

Since YouTube videos are not ranked by the quality of the information they contain, highly valid videos may end up on the last pages of the site's watch-list. Consequently, people searching for health-related information on YouTube often view the most watched videos rather than those with the most supporting evidence. Furthermore, the lack of an upload criterion leads to varying video quality.⁸

The current narrative review was planned to assess the types of video content available on YouTube regarding stem cells. To the best of our knowledge, no previous study has analysed the video content available for stem cells on YouTube.

Materials and Methods

Data from YouTube was collected from February 14, 2005, the day of its launch, till September 25, 2022. The search terms used for the purpose of analysing video content were "stem cells in Pakistan" and "stem cells". These terms were selected after extensive literature review^{1,2,5,6} and discussion to ensure that the most relevant content was captured. These terms covered all general videos on topics related to stem cells. The selected search terms were used on YouTube through a separate search query with the default settings to return the "most relevant" and the "most viewed" results on the top, using the YouTube search filter.

Data was collected for the top 10 most relevant and most viewed videos returned for each search term in each category. Videos were then classified according to the format of content, information provider in the video about stem cells, duration, number of views, comments and the number of likes. The format of content was categorised into Vlog, talk show with physicians, patient testimonial, educational, promotional, animated explainer, academic lecture, documentary, conference talk and entertainment. Videos were also categorised based on information providers in the video about stem cells. Information providers were classified as 'medical professional', including physicians

who can provide information about stem cells application; 'medical centre', meaning treatment centres where stem cell therapy or research is done; 'non-physician', including those who have no medical background and expertise; 'product advertisement', meaning videos about any stem cell product; 'science educator', including videos by teachers, professors and educational institutions on the basics of stem cells; and 'researcher', meaning experts conducting studies and experiments in the field of stem cells.

Physicians and patients present in the videos associated with or uploaded by any medical centre were placed in the "medical centres" category. Data was collected and analysed using Microsoft Excel 2021. Frequencies and percentages of the type of videos in each list of most relevant and most viewed videos were calculated by dividing the number of each type of video with the total number of videos in each list, which was 10. Duration of video, number of views, comments and the number of likes were recorded directly from YouTube for every video.

Appendix A: List of youtube videos with URL:

S.No.	VIDEOS	Available on URL:
1.	Stem cells guide for Pakistanis	https://www.youtube.com/watch?v=KYu2xK2oDJl
2.	What is stem cell treatment?	https://www.youtube.com/watch?v=FyKdONRkC8c
3.	R3 stem cell Pakistan celebrates 100th procedure	https://www.youtube.com/watch?v=IEu7Ymvt6ok
4.	Stem cell therapy explained in Urdu	https://www.youtube.com/watch?v=DCX69RR-Yok
5.	Changing lives with stem cells Mrs. Ghazala Hafeez Patient Reviews	https://www.youtube.com/watch?v=fzEwqevs8
6.	Role of stem cell therapy in Kidney failure	https://www.youtube.com/watch?v=7xXzn0ynfSM
7.	Reproductive stem cells Good Morning Public	https://www.youtube.com/watch?v=Nr3LoU0E81A
8.	Advances in stem cells therapy	https://www.youtube.com/watch?v=_fmiQuaTToY
9.	R3 stem cells in headquarters in Islamabad	https://www.youtube.com/watch?v=mWjer_JnSsg
10.	PRP vs stem cells treatment	https://www.youtube.com/watch?v=dzZ0M6lvTso
11.	Dr Qamar Murtaza, knee pain treatment by stem cells, Karachi, Pakistan	https://www.youtube.com/watch?v=es8q7YuCOh4
12.	Breaking news for hopeless infertile males and females	https://www.youtube.com/watch?v=No5pDCDFIBk
13.	Stem cell therapy- The ultimate cure? Lecture 96	https://www.youtube.com/watch?v=o2qBZ1x4Tc8
14.	Stem Cell treatment kese kia jata hai? Qutb Online SAMAA TV 20 June 2019	https://www.youtube.com/watch?v=C18_LRMD1b8
15.	Azoospermia treatment stem cell therapy zero sperm count to millions	https://www.youtube.com/watch?v=RtQrQ_m2vg8
16.	Stem cell used in Pakistan	https://www.youtube.com/watch?v=Qzz0wdqkd1w
17.	Stem cells basics animation	https://www.youtube.com/watch?v=8xHWHg6YQA
18.	What are stem cells?- Craig A. Kohn	https://www.youtube.com/watch?v=evH07Coc54
19.	What are stem cells? Genetics Biology FuseSchool	https://www.youtube.com/watch?v=9db44fBrWrE
20.	23.Stem cells	https://www.youtube.com/watch?v=62FdhX-z52Y
21.	Stem cells	https://www.youtube.com/watch?v=i2pyDBMgjffM
22.	Stem cells Cells MCAT Khan Academy	https://www.youtube.com/watch?v=uUH5Y15dTOg
23.	What are STEM CELLS? And what can they do?	https://www.youtube.com/watch?v=eXO_DVMNLE
24.	How do stem cells work in the body?	https://www.youtube.com/watch?v=5-CvC4BAIlo&t=14s
25.	GCSE Biology-What are Stem cells? Difference between Embryonic and Adult stem cells # 11	https://www.youtube.com/watch?v=fp5H3SlskQ&t=2s
26.	How Stem Cells contribute to Aging and Age-related Diseases with Rob Signer	https://www.youtube.com/watch?v=f5H8KpfgGt5&t=736s
27.	How To cure aging-during your life time?	https://www.youtube.com/watch?v=MjdpR-TY6QU&t=344s
28.	The skin gun – National Geographic	https://www.youtube.com/watch?v=eXO_ApjKPal&t=52s
29.	The science of how the body heals itself with William Li, M.D.	https://www.youtube.com/watch?v=wIJEJv1UA
30.	Joe Rogan-Mel Gibson on how stem cell therapy saved his Dad's Life	https://www.youtube.com/watch?v=uUCJo1j059s
31.	Illegal injection of stem cells to cure paralysis? -Chicago Med	https://www.youtube.com/watch?v=ilwR0okp_b4
32.	How there could finally be a cure for Diabetes	https://www.youtube.com/watch?v=E5bacqobwY&t=231s
33.	Specialised cells: Significance and examples	https://www.youtube.com/watch?v=wNe6RuKOFFa
34.	Regenerate your telomeres: Stem cell production, Anti aging Binaural beats/ stay young forever	https://www.youtube.com/watch?v=GvMnrWqYlTQ

Pie charts were used to display the distribution of the videos with respect to the type from the total unique videos derived from each of the two search terms.

Results

A total of 40 videos were reviewed under the search terms "stem cells in Pakistan" and "stem cells". Of them, 6(15%) were repeat videos, and 34(85%) were unique; 16(47%) from Pakistan and 18(53%) from around the world. There were more than 27 million views overall.

Among the 10(25%) most relevant videos from Pakistan, 3(30%) were live TV talk shows uploaded after having been aired already, and 2(20%) were promotional videos about medical centres providing stem cell therapy to patients for different indications. No research centre was identified, while 2(20%) videos each were classified under 'educational' and 'Vlog' categories, and 1(10%) was a patient review about the stem cell treatment she had received.

Among the information providers, 5(50%) were physicians, but none of them had expertise in stem cells, while 4(40%) videos were uploaded by different medical centres, and

1(10%) was uploaded by a non-physician person, a film-maker. The lengthiest video in this list was a recorded TV talk show with running time of 01:04:46 hours (Table 1).

Among the 10(25%) 'most viewed' Pakistani videos, 4(40%) were Vlogs, (30%) were talk shows with a physician, 1(10%) each was educational, promotional and patient testimonial. The information provider in 6(60%) videos were non-expert

physicians, 2(20%) videos were made by medical centres, 1(10%) was made by a film-maker and 1(10%) was a product advertisement.

The most viewed video with the search term "stem cells in Pakistan" was about knee pain treatment by stem cells in Karachi. The length of this video was 02:22 minutes and there were 195,070 views. The second most viewed video

Table-1: Top 10 most relevant Pakistani videos about stem cells on YouTube.

S.No.	Video Title	Format	Information Provider	Duration Hr:min:sec	Views	Comments	Likes
1.	Stem cells guide for Pakistanis	Vlog	Non-physician	22:31	31,364	220	1.3 K
2.	What is stem cell treatment?	Talk show	Medical professional (Gynaecologist)	2:43	5,058	4	49
3.	R3 stem cell Pakistan celebrates 100 th procedure	Promotional	Medical centre	0:47	196	1	6
4.	Stem cell therapy explained in Urdu	Educational	Medical professional (Paediatric surgeon)	7:15	4,558	36	92
5.	Changing lives with stem cells Mrs. Ghazala Hafeez Patient Reviews	Patient testimonial	Medical centre	4:33	4,997	21	45
6.	Role of stem cell therapy in Kidney failure	Vlog	Medical professional (Nephrologist)	12:38	5,919	70	177
7.	Reproductive stem cells Good Morning Public	Talk show	Medical professional (Gynaecologist)	1:04:46	17,143	15	195
8.	Advances in stem cells therapy	Talk show	Medical professional (Radiologist)	24:22	17,677	123	741
9.	R3 stem cells in headquarters in Islamabad	Promotional	Medical centre	1:27	3,469	19	39
10.	PRP vs stem cells treatment	Educational	Medical centre	4:11	54,992	124	743

R3 Stem cell: Name of a medical centre, PRP: Platelet rich plasma

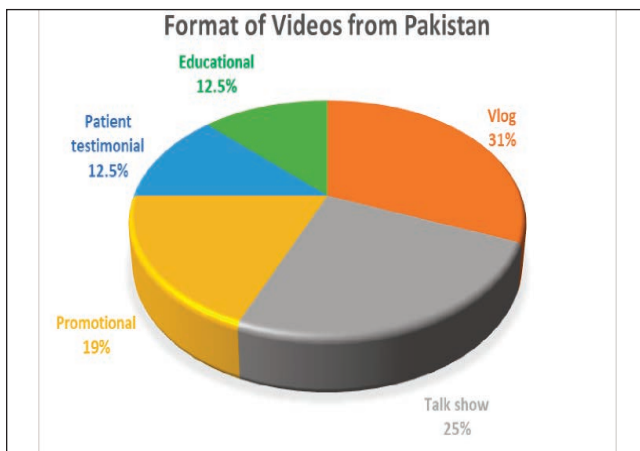


Figure-1: Various formats of videos on YouTube from Pakistan.

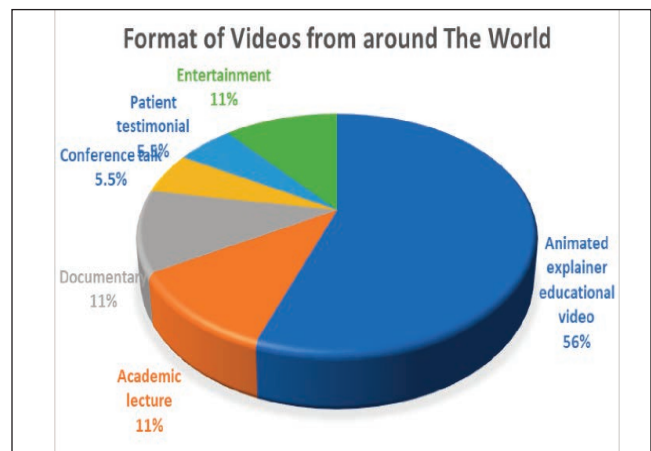


Figure-2: Carious formats of videos on YouTube from around the world.

Table-2: Top 10 most viewed Pakistani videos about stem cells on YouTube.

S.No.	Video Title	Format	Information Provider	Duration Hr:min:sec	Views	Comments	Likes
1.	Dr Qamar Murtaza, knee pain treatment by stem cells, Karachi, Pakistan	Patient's testimonial	Medical centre	2:22	195,070	23	235
2.	Breaking news for hopeless infertile males and females	Vlog	Medical professional (Gynaecologist)	26:21	113,837	676	2.4 K
3.	Stem cell therapy- The ultimate cure? Lecture 96	Vlog	Medical professional (Urologist)	5:22	91,947	348	2.1 K
4.	*PRP vs stem cells treatment	Educational	Medical centre	4:11	54,992	124	743
5.	*Stem cells guide for Pakistanis	Vlog	Non-physician	22:31	31,364	220	1.3 K
6.	Stem Cell treatment kese kia jata hai? Qutb Online SAMAA TV 20 June 2019	Talk show	Medical professional (Gynaecologist)	45:16	23,027	39	229
7.	*Advances in stem cells therapy	Talk show	Medical professional (Radiologist)	24:22	17,677	123	741
8.	*Reproductive stem cells Good Morning Public	Talk show	Medical professional (Gynaecologist)	1:04:46	17,143	15	195
9.	Azoospermia treatment stem cell therapy zero sperm count to millions	Vlog	Medical professional (not specified)	7:29	15,119	79	273
10.	Stem cell used in Pakistan	Promotional	Product advertisement	2:04	14,123	34	63

* Indicates videos also present in most relevant videos list; PRP: Platelet rich plasma

was about "hopeless infertile males and females", and had a duration of 26:21 minutes. This video had the highest number of likes (2.4K) and comments (676), and was about a medical centre in which a physician explained that stem cells can be used for the infertility issues (Table 2).

Out of the 16(47%) unique videos from Pakistan, 5(31%) were Vlogs, 4(25%) were recorded talk shows with physicians, 3(19%) were promotional, 2(12.5%) each were patient testimonials and educational.

When only the term "stem cells" was searched, no Pakistani content was found either in the most relevant or the most viewed categories. All international videos were in the English language. All the 10(25%) most relevant videos about stem cells were for medical education, like lectures, animation etc., and the information providers were science educators in all the 10(100%) videos. Of them, 8(80%) videos were animated explainer educational videos, and 2(20%) were academic lectures. The lengthiest video was a biology lecture, with a running time of 46:19 minutes. An animated video had the highest number of likes (18K) (Table 3).

Among the 10(25%) most viewed videos from around the world, 4(40%) were animated explainer educational videos, 2(20%) each were documentaries and entertainment videos, like drama and music, and 1(10%) each was a recorded conference talk and patient testimonial. Among the most viewed international videos, science educators were the information providers in 4(40%), non-physicians in 3(30%) and 1(10%) video was a recorded conference talk uploaded by a medical centre. In 2(20%) videos, researchers provided insight to new developments in stem cell research.

An animated video about 'cure for aging' was the most viewed, with a length of 07:21 minutes. It had over 7.4 million views and the greatest number of comments (14,077). A video about how the body heals itself had no likes despite being among the three most viewed videos in the category. It was uploaded by a non-profit medical organisation and was the only video in which the comment section had been turned off (Table 4).

Among the total 18(53%) unique international videos, the lengthiest one was basically an audio about staying young, with a total duration of 12 hours. Overall, 10(56%) such

Table-3: Top 10 most relevant international videos about stem cells on YouTube.

S.No.	Video Title	Format	Information Provider	Duration Hr:min:sec	Views	Comments	Likes
1.	Stem cells basics animation	Animated explainer educational video	Science educator	2:22	3:39	34	2.2 K
2.	What are stem cells?- Craig A. Kohn	Animated explainer educational video	Science educator	4:11	1,411,056	725	18 K
3.	What are stem cells? Genetics Biology Fuse School	Animated explainer educational video	Science educator	3:57	348,678	150	3.8 K
4.	23.Stem cells	Animated explainer educational video	Science educator	46:19	273,567	132	3.7 K
5.	Stem cells	Animated explainer educational video	Science educator	5:03	1,051,763	250	9.9 K
6.	Stem cells Cells MCAT Khan Academy	Animated explainer educational video	Science educator	11:54	323,690	79	4 K
7.	What are STEM CELLS? And what can they do?	Animated explainer educational video	Science educator	2:41	49,938	18	671
8.	How do stem cells work in the body?	Animated explainer educational video	Science educator	2:20	17,143	15	195
9.	GCSE Biology-What are Stem cells? Difference between Embryonic and Adult stem cells # 11	Animated explainer educational video	Science educator	4:18	44,610	39	795
10.	How Stem Cells contribute to Aging and Age-related Diseases with Rob Signer	Animated explainer educational video	Science educator	29:51	73,170	96	1.6 K

MCAT: Medical college admission test, GCSE: General Certificate of Secondary Education

uploads were animated educational videos, 2(11%) each were academic lectures, documentaries and entertainment-based, and 1(5.5%) each was patient testimonial and recorded conference talk (Figure 2).

Discussion

YouTube is the most common video-based social media used around the world, second only to Facebook. Every day, millions of people view countless videos on various topics. YouTube provides a platform to the general population to access information about diverse medical-related content. However, the reliability for the information remains questionable, as not all information providers are physicians or related to the medical field. As such, consumers should exercise caution before accepting any kind of the information presented to them.⁹⁻¹¹

Numerous studies have been conducted to analyse the quality of information uploaded to YouTube, covering medical topics, such as plastic surgery,⁵ fibromyalgia,¹² food poisoning,¹³ urinary incontinence,¹⁴ anakinra self-

injection¹⁵ and the coronavirus disease-2019 (COVID-19) pandemic etc.¹⁶

The current findings suggest people globally are interested in knowing any scientific measures that can help combat aging.

In Pakistan, 40% of the most viewed videos about stem cells were about treating infertility. The video with the most likes in Pakistan was also regarding the treatment of infertility using stem cells. In contrast, most globally viewed videos were related to medical education, like lectures, tutorials, animations or documentaries based on the recent advances about the use of stem cells in aging, burns and diabetes.

Among the 34 videos analysed, the second most-viewed video overall was the documentary, having 5.1 million views. This video was published nearly 11 years ago, introducing a new technique of isolating stem cells from healthy skin of a burns victim and spraying it on burned skin wounds. Interestingly, till date this practice has not

Table-4: Top 10 most viewed international videos about stem cells on YouTube.

S.No.	Video Title	Format	Information Provider	Duration Hr:min:sec	Views	Comments	Likes
1.	How To cure aging-during your life time?	Animated explainer educational video	Science educator	7:21	7,477,264	14,077	256 K
2.	The skin gun – National Geographic	Documentary	Researcher	3:28	5,198,540	4,869	22 K
3.	The science of how the body heals itself with William Li, M.D.	Conference talk	Medical centre	1:13:05	4,141,677	Turned off	-
4.	Joe Rogan-Mel Gibson on how stem cell therapy saved his Dad's Life	Patient testimonial	Non-physician	10:01	1,843,498	3,766	24 K
5.	Illegal injection of stem cells to cure paralysis? - Chicago Med	Medical drama/ Entertainment	Non-physician	8:34	1,550,620	689	17 K
6.	*What are stem cells?- Craig A. Kohn	Animated explainer educational video	Science educator	4:11	1,411,056	725	18 K
7.	How there could finally be a cure for Diabetes	Documentary	Researcher	20:02	1,323,507	5,365	19 K
8.	*Stem cells	Animated explainer educational video	Science educator	5:03	1,051,763	250	9.9 K
9.	Specialised cells: Significance and examples	Animated explainer educational video	Science educator	9:11	873,874	593	7 K
10.	Regenerate your telomeres: Stem cell production, Anti aging Binaural beats/ stay young forever	Live stream music/ Entertainment	Non-physician	11:55:00	746,875	1,522	19 K

* Indicates videos also present in most relevant videos list.

been established in clinical use, yet the video remains the most viewed, highlighting people's curiosity about the conservative management options for burns.

One unique and the lengthiest video was primarily an audio about how to stay young forever. Among other things, the author of the video gave the following description; "*Stay young and healthy forever listening to this stem cell production binaural beats music ... Balance hormones, restore your bones, regenerate telomeres ... beautiful tight and firm skin. Drink plenty of water to get super-fast results.*" It was streamed one year ago and had 746K views and 19K likes.

The information in the form of paid content by medical professionals is problematic due to its ability to influence the patients' trust and compliance with their primary physician. YouTube has now become a platform for promoting businesses, and various medical centres and affiliated physicians have uploaded videos advocating the usefulness of stem cells. Patients are turning to YouTube to seek information about any intervention of interest. This

leads to an ethical dilemma due to a disconnect between the physicians and patients on the use of YouTube.

Overall, the correct and unbiased information about the practical and clinical use of stem cells for numerous pathologies is lacking on YouTube. Many videos falsely depict stem cells as "*magical*" and capable of healing every condition, with deceiving information on the video thumbnails, such as in the case of Pakistan's video, claiming to 'get any organ (liver, kidney and heart etc.) made to order from stem cells'. Such thumbnails mislead the population in the absence of any authentication, although in the said video, general information about stem cells is provided by a physician with no expertise in stem cells.

Ideally, every patient who is considering stem cell treatment for any pathology should discuss it with a medical professional to obtain high-quality knowledge about the use of the stem cells in that particular disease¹⁷ and its associated risks. It is important to note that the Food and Drug Administration (FDA) has approved the use of only blood-forming stem cells for haematopoietic

disorders. The unproven use of stem cell therapy is associated with multiple safety concerns, such as local administration site reactions, tumour growth due to uncontrolled and inappropriate cell growth and failure to gain expected results.¹⁸

The current review has limitations associated with the complexity of the YouTube search algorithm, which can be influenced by various factors, such as the number of previous views and browsing history.¹⁹ The algorithm adjusts itself and displays different videos for a specific search term on various browsers, resulting in the possibility that the videos shown in accordance with their relevance may not appear in the same order for everyone.

Conclusion

YouTube's potential for sharing information with the public is incomparable to other social media applications. YouTube videos can be a powerful tool to spread knowledge and support public health decision-making, and vice versa. Misleading and wrong information about unauthorised use of stem cells can lead to local and systemic reaction with unpredictable outcomes.

Disclaimer: An earlier version of the text was presented as a poster presentation at the 8th Aga Khan University (AKU) Annual Surgical Conference, 2023, where it was awarded the third prize in the moderated poster session.

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Source of Funding: None.

Supplementary Material: List of all videos with their available URL is attached as appendix A.

References

- Haslam K, Doucette H, Hachey S, MacCallum T, Zwicker D, Smith-Brilliant M, et al. YouTube videos as health decision aids for the public: An integrative review. *Can J Dent Hyg.* 2019; 53:53-66.
- Abrahamson JA, Fisher KE, Turner AG, Durrance JC, Turner TC. Lay information mediary behaviour uncovered: exploring how nonprofessionals seek health information for themselves and others online. *J Med Libr Assoc.* 2008; 96:310-23. doi: 10.3163/1536-5050.96.4.006.
- White RW, Horvitz E. From health search to healthcare: Explorations of intention and utilization via query logs and user surveys. *J Am Med Informatics Assoc.* 2014; 21:49-55. doi: 10.1136/amiainf-2012-001473.
- Ní Ríordáin R, McCreary C. Dental patients' use of the Internet. *Br Dent J.* 2009; 207:583-6. doi: 10.1038/sj.bdj.2009.1137.
- Almarghoub MA, Alghareeb MA, Alhammad AK, Alotaibi HF, Kattan AE. Plastic Surgery on YouTube. *Plast Reconstr Surg Glob Open.* 2020; 8:e2586. doi: 10.1097/GOX.0000000000002586.
- Madathil KC, Rivera-Rodriguez AJ, Greenstein JS, Gramopadhye AK. Healthcare information on YouTube: A systematic review. *Health Informatics J.* 2015; 21:173-94. doi: 10.1177/1460458213512220.
- Behbahani S, Ward B, Montovano M, Wilson BN, Ravikumar V, Karanfilián K. The Utilization of YouTube as a Resource on Hair Loss Treatments. *Aesthetic Plast Surg.* 2020; 44:1944-6. doi: 10.1007/s00266-020-01797-w.
- Besmens IS, Uyulmaz S, Giovanoli P, Lindenblatt N. YouTube as a resource for surgical education with a focus on plastic surgery—a systematic review. *J Plast Surg Hand Surg.* 2021; 55:323-9. doi: 10.1080/2000656X.2021.1884084.
- Jamleh A, Nassar M, Alissa H, Alfadley A. Evaluation of YouTube videos for patients' education on periradicular surgery. *PLoS One.* 2021; 16:e0261309.
- Yildiz S, Toros SZ. The Quality, Reliability, and Popularity of YouTube Education Videos for Vestibular Rehabilitation: A Cross-sectional Study. *Otol Neurotol.* 2021; 42:e1077-83. doi:10.1097/MAO.0000000000003197.
- Kunze KN, Krivicich LM, Verma NN, Chahla J. Quality of online video resources concerning patient education for the meniscus: A YouTube-based quality-control study. *Arthroscopy.* 2020; 36:233-8. doi:10.1016/j.arthro.2019.07.033
- Ozsoy-Unubol T, Alanbay-Yagci E. YouTube as a source of information on fibromyalgia. *Int J Rheumatic Dis.* 2021; 24: 197-202. doi:10.1111/1756-185X.14043
- Li M, Yan S, Yang D, Li B, Cui W. YouTube™ as a source of information on food poisoning. *BMC Public Health.* 2019; 19: 952. doi:10.1186/s12889-019-7297-9
- Baran C, Baran SY. Youtube videos as an information source about urinary incontinence. *J Gynecol Obstetr Hum Reprod.* 2021; 50:102197. doi:10.1016/j.jogoh.2021.102197
- Pamukcu M, Izci Duran T. Are YouTube videos enough to learn anakinra self-injection? *Rheumatol Int.* 2021; 41:2125-31. doi:10.1007/s00296-021-04999-w
- Andika R, Kao CT, Williams C, Lee YJ, Al-Battah H, Alweis R. YouTube as a source of information on the COVID-19 pandemic. *J Community Hosp Intern Med Perspect.* 2021; 11:39-41. doi:10.1080/20009666.2020.1837412
- Hawke B, Przybylo AR, Paciulli D, Caulfield T, Zarzecny A, Master Z. How to peddle hope: An analysis of YouTube patient testimonials of unproven stem cell treatments. *Stem Cell Reports.* 2019; 12:1186-9. doi:10.1016/j.stemcr.2019.05.009
- U.S. Food and Drug Administration. (n.d.) FDA warns about stem cell therapies. [Online] [2022 October 25]. Available from: URL: <https://www.fda.gov/consumers/consumer-updates/fda-warns-about-stem-cell-therapies>.
- Abul-Fottouh D, Song MY, Gruzd A. Examining algorithmic biases in YouTube's recommendations of vaccine videos. *Int J Med Inform.* 2020; 140:104175. doi: 10.1016/j.ijmedinf.2020.104175.