YouTube as a source of public health information regarding COVID-19 vaccination: an assessment of reliability and quality of video content

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Table of Contents

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Abstract

Background: Recent emergency authorisation and rollout of COVID-19 vaccines by regulatory bodies has generated global attention. As the most popular video-sharing platform globally, YouTube is a potent medium for dissemination of key public health information. Understanding the nature of available content regarding COVID-19 vaccination on this widely used platform is of substantial public health interest.

Objective: To evaluate the reliability and quality of information of YouTube videos regarding COVID-19 vaccination.

Methods: For this cross-sectional study, the phrases ‘coronavirus vaccine’ and ‘COVID-19 vaccine’ were searched on the UK version of YouTube on December 10, 2020. The 200 most-viewed videos of each search were extracted and screened for relevance and English language. Video content and characteristics were extracted and independently rated against Health on the Net Foundation Code of Conduct (HONCode) and DISCERN quality criteria for consumer health information by two authors.

Results: Forty-eight videos, with a combined total view count of 30,100,561, were included in the analysis. Topics addressed comprised: vaccine science (58%), vaccine trials (58%), side effects (48%), efficacy (35%) and manufacturing (17%). Twenty-one percent of videos encouraged continued public health measures. Only 4.2% of videos made non-factual claims. Ninety-eight percent of video content was scored to have low (60%) or medium (38%) adherence to HONCode principles. Educational channels produced by both medical and non-medical professionals achieved significantly higher DISCERN scores than other categories. The highest DISCERN scores were achieved by educational videos produced by medical professionals (64.3 (58.5-66.3)) and the lowest scores by independent users (18 (18-20)).

Conclusions: Overall quality and reliability of information on YouTube regarding COVID-19 vaccines remains poor. Videos produced by educational channels, especially by medical professionals, were higher in quality and reliability than those produced by other sources, including health-related organisations. Collaboration between health-related organisations and established medical and educational YouTube content producers provide an opportunity for dissemination of high-quality information regarding COVID-19 vaccination. Such collaboration holds potential as a rapidly implementable public health intervention aiming to engage a wide audience and increase public awareness and knowledge.

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Keywords: COVID-19; social media; YouTube; vaccination; public health; infodemiology

Introduction

The recent emergency authorisation and rollout of vaccines against the coronavirus disease 2019 (COVID-19) by regulatory bodies has generated global media attention. Unsurprisingly, internet searches relating to COVID-19 vaccination rose dramatically during November-December 2020, as members of the public attempted to source information amid a surge in media coverage [1]. Many internet users turned to YouTube, the second-most visited website globally after Google, for further information [2].

YouTube is the most popular video-sharing platform in the world. Over one billion hours' worth of video is streamed each day on the website, and it is visited by over two billion unique users monthly [3]. It has strong penetrance globally and across all major socio-demographic groups. YouTube provides a potent means of disseminating real time information across a population; users are able to curate video content from sources varying from individual users, through celebrities, to media outlets. Aware of their central role in the dissemination of key public health information, YouTube have implemented a COVID-19 Medical Misinformation Policy which forbids COVID-19 related content that contradicts local health authorities and risks public safety [4].

There have been, however, high-profile instances of internet-propagated misinformation regarding COVID-19 including the ingestion of cleaning products as potential treatment, which have had severe consequences [5]. Despite the aforementioned measures brought in by YouTube, it is feared that the COVID-19 vaccination programmes remain an easy target for misinformation content. Previous studies have highlighted that vaccination programmes, such as the Human Papillomavirus (HPV) vaccination programme, have been a common target of high-profile YouTube videos propagated by a community of vocal users critical of vaccination programmes [6]. It is feared that anti-COVID-19 vaccination videos could (1) pose a significant threat to compliance with the vaccination programme, especially amongst those who are disproportionately affected by the illness, (2) create spill-over dissonance towards other critical COVID-19 public health measures, and (3)

displace notifications regarding other emerging time-sensitive information from official public health sources. In fact, from the beginning of the pandemic until now, COVID-19 vaccine hesitancy has been steadily increasing [7]. Understanding the nature of available content regarding the COVID-19 vaccination programme on this widely used platform is therefore of substantial public health interest and forms a foundation on which strategies for misinformation counteraction can be based.

To date, there have been no studies evaluating the quality and reliability of COVID-19 vaccination-related information available on YouTube. The objective of this study, therefore, was to evaluate the reliability and quality of information of YouTube's most prominent videos regarding COVID-19 vaccination using two validated criteria (DISCERN and HONcode).

Methods

Ethical approval for this study was waived because all gathered data was freely available in the public domain. The phrases ‘coronavirus vaccine’ and ‘COVID-19 vaccine’ were searched on the UK version of YouTube on December 10, 2020. The search was conducted in an incognito browser (Google Chrome) to avoid biased suggestions based on cookies. Search results were sorted by view count in order to identify the videos that had achieved the greatest impact and were most likely to trend, thereby reaching further viewers. The most-viewed 200 videos (10 pages) of each search were subsequently extracted.

Video titles and channels were first screened for relevance and English language before full-video screening. Videos were included if they described one or more of the following: vaccine mechanisms, clinical trial procedures, manufacturing processes, side effects/safety, and vaccine efficacy. Descriptions of the criteria are provided in Supplementary Table 1. In the event that there was uncertainty as to whether a video should be included, a consensus between authors was sought, with a predisposition to include the video for full assessment. Additionally, videos were assessed for promotion of public health measures such as handwashing, wearing masks or social distancing. Finally, instances of non-factual content in videos were noted. Non-factual information (i.e. misinformation) was defined as non-scientifically corroborated content that contradicted current local health authority or World Health Organisation medical information. Examples of misinformation are available on YouTube’s Medical Misinformation Policy [4]. Duplicate videos and non-English language videos were excluded. Video content screening was completed independently by two authors (CC and ED). Any discrepancies were resolved by discussion with a third author (VS).

Characteristics (video URL, channel, country of origin, view count, duration, age of video, number of likes, dislikes and comments) of the included videos were extracted. Videos were placed into six main categories by YouTube channel type: educational channels produced by medical professionals,

educational channels produced by non-medical individuals (e.g. science education or explanatory media), independent non-medical users (e.g. vloggers, with no obvious affiliations), internet media (e.g. newsmagazine shows or talk shows), news agencies (i.e. clips uploaded from network news) and non-profit/medical organisations (e.g. hospitals, governmental organisations or universities). Descriptions and examples of channel types are provided in Supplementary Table 2.

Reliability of video content (i.e. the extent to which the source of information and therefore information itself could be relied upon, demonstrated by clearly referenced and scientifically corroborated content) was assessed against a modified Health on the Net Foundation Code of Conduct (HONcode) checklist (adapted from Goobie *et al.*) and modified DISCERN quality criteria for consumer health information (adapted from Goobie *et al.* and Loeb *et al.*), which have previously been used to assess the quality of health information on YouTube [8,9]. Quality of video content (i.e. completeness, understandability, relevance, depth and accuracy of information provided) was also assessed using the DISCERN quality criteria. Video rating was completed independently by two authors (CC and ED).

HONcode consists of 8 principles that evaluate the reliability and credibility of health information [10]. Videos were rated with a score of 1 (adherent) or 0 (non-adherent) for each of the 8 principles. The DISCERN instrument consists of 16 questions rated from 1 to 5 that assess health content across three domains: video reliability (8 questions, 40 points), treatment information quality (7 questions, 35 points) and an overall reviewer rating (5 points); giving a maximum cumulative score of 80 (Table 1) [11]. The first 8 questions were applied to all videos, and a further 8 were applied to videos that specifically addressed vaccine science (i.e. how the treatment works).

Table 1. Modified DISCERN quality criteria for assessing reliability and quality of YouTube content regarding COVID-19 vaccination.

Section 1 - Is the video reliable?	
1	Are the aims clear?
2	Does it achieve its aims?
3	Is it relevant?
4	Is it clear what sources of information were used to compile the video?
5	Is it clear when the information used or reported in the video was produced?
6	Is it balanced and unbiased?
7	Does it provide details of additional sources of support and information?
8	Does it refer to areas of uncertainty?
Section 2 – How good is the quality of information on treatment choices?	
9	Does it describe how each treatment works?
10	Does it describe the benefits of each treatment?
11	Does it describe the risks of each treatment?
12	Does it describe what would happen if no treatment is used?
13	Does it describe how the treatment choices affect overall quality of life?
14	Is it clear that there may be more than one possible treatment choice?
15	Does it provide support for shared decision-making?
Section 3 – Overall rating of the video.	
16	Based on the answers to all of the above questions, rate the overall quality of the video as a source of information about treatment choices

Abbreviations: DISCERN = DISCERN quality criteria for consumer health information.

Note: Each question was rated from 1 (worse) to 5 (best). Section 2 and 3 only applied to videos concerning vaccine science (i.e. how the treatment (vaccination) works). Questionnaire adapted from Goobie et al. (2019) and Loeb et al. (2019) [8,9].

Statistical analysis

Statistical analysis was performed using Stata 13 (StataCorp). Inter-category differences were assessed using Kruskal-Wallis tests and post-hoc Dunn's test. Inter-rater reliability was assessed with Cohen's kappa. For DISCERN score, ±1 point was considered agreement. Associations between engagement metrics and DISCERN scores were evaluated using linear regression. Significance was set at $p<.05$. Data are presented as median (interquartile range).

Results

Video characteristics

The video review process is illustrated in Figure 1. From the 200 results of each search, 52 duplicate videos were removed, yielding 348 unique videos. After video title and channel screening followed by full video assessment, 48 videos were included for data extraction with a combined total view count of 30,100,561. Excluded videos were not in English (n=62) or did not meet the study inclusion criteria (n=225), describing topics such as vaccination priority, national distribution plans, politics, or pandemic mortality figures. Characteristics of included videos are summarised in Table 2. The majority (75%) of videos were produced by US channels. The median number of views per video was 236,064 (152,082-596,234).

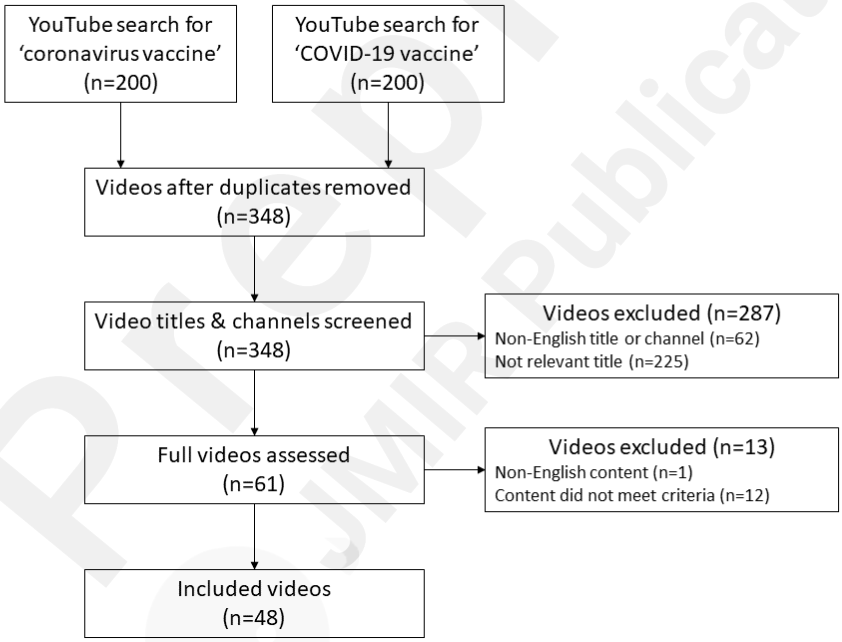

Figure 1. Flow diagram of COVID-19 vaccine video search results on YouTube and the video selection process for inclusion in the study. The two searches were performed on 10th December 2020.

Table 2. Characteristics of COVID-19 vaccine YouTube videos included in the study.

Characteristic	**No. (%) or median (IQR)**
Country of origin	
US	34 (75)
UK	6 (13)
Canada	3 (6)
Germany	2 (4)
Australia	1 (2)
Switzerland	1 (2)
Channel type	
Educational (non-medical)	10 (21)
Educational (medical)	6 (13)
Independent users	5 (10)
Internet media	10 (21)
News agencies	13 (27)
Non-profit/medical organisations	4 (8)
Video duration (minutes:seconds)	9:18 (4:42 – 11:51)
Video age (days since upload)	54 (19 – 191)
Engagement	
Views	236,064 (152,082 – 596,234)
Views per day since upload	6364 (3031 – 11717)
Likes	5600 (2300 – 9200)
Dislikes	545 (236 – 1200)
Likes/dislikes ratio	14.3 (3 – 24)

Source

The 48 videos were categorised into six categories by their YouTube channel type. The contribution of each channel type towards the total view count is detailed in Table 3. The most-viewed video (6,668,737 views, 22% of total views) described COVID-19 vaccine mechanisms and was produced by a medical organisation (JAMA Network).

Table 3. Engagement metrics, content, HONcode adherence and DISCERN score of COVID-19 vaccine videos on YouTube stratified by channel type.

	Educational (non-medical)	Educational (medical)	Independent non-medical users	Internet media	News agencies	Non-profit/ medical organisations	Overall	*P*-value
n	10 (21)	6 (13)	5 (10)	10 (21)	13 (27)	4 (8)	48	
Total views	5,473,987 (18)	1,467,003 (5)	1,766,051 (6)	4,205,972 (14)	9,798,419 (33)	7,389,129 (25)	30,100,561	
Views per video	367,560 (162,635-623,924)	213,707 (143,570-302,387)	221,299 (209,150-334,553)	197,365 (135,953-557,721)	275,615 (137,721-644,970)	247,977 (241,877-1,853,382)	236,064 (152,082-596,234)	
Views per day since upload	7604 (3681-10,802)	8309 (5179-9699)	8852 (7406-27,879)	1984 (880-5470)	5560 (4279-10,656)	11,734 (2532-37,832)	6364 (3031-11,717)	
Likes	15,050 (6050-25,250)	5600 (5000-6725)	10,000 (5800-10,000)	4200 (2000-6275)	2600 (1300-5100)	3400 (1998-15,200)	5600 (2300-9200)	
Dislikes	656 (261-1325)	268 (213-405)	557 (342-701)	651 (223-1200)	716 (404-1200)	1700 (970-5700)	545 (236-1200)	
Likes/dislikes ratio	23.8 (18-26)	20.9 (18-25)	18 (6-30)	12.3 (3-18)	4.3 (2-11)	2.8 (2-8)	14.3 (3-24)	
Comments	1633 (1047-3444)	1932 (1691-2253)	2133 (1680-6402)	1430 (622-3480)	2204 (1194-3611)	1258 (735-1858)	1891 (1059-3424)	
Content								
Vaccine science	9 (90)	6 (100)	1 (20)	5 (50)	4 (31)	3 (75)	28 (58)	
Trial process	5 (50)	5 (83)	1 (20)	7 (70)	8 (62)	2 (50)	28 (58)	
Manufacturing process	2 (20)	0 (0)	0 (0)	4 (40)	2 (15)	0 (0)	8 (17)	
Side effects & safety	3 (30)	5 (83)	5 (100)	1 (10)	7 (54)	2 (50)	23 (48)	
Vaccine efficacy	2 (20)	5 (83)	3 (60)	2 (20)	4 (31)	1 (25)	17 (35)	
Public health information	3 (30)	1 (17)	1 (20)	3 (30)	1 (8)	1 (25)	10 (21)	
HONcode adherence (/8)								
Low (0–2)	2 (20)	1 (17)	5 (100)	5 (50)	10 (77)	3 (75)	27 (56)	
Moderate (3–5)	7 (70)	5 (83)	0 (0)	4 (40)	3 (23)	1 (25)	20 (42)	
High (6-8)	1 (10)	0 (0)	0 (0)	1 (10)	0 (0)	0 (0)	1 (2)	
DISCERN score								
Reliability (/40, n=48)	28.5 (25.9-32.5)	35.5 (32-39.4)	18 (18-20)	24.8 (23.3-26.8)	23.8 (20.5-24.5)	23.5 (22.9-24.5)	25 (22.9-29.1)	**<.001**
Treatment quality (/35, n=30)	16.5 (14-18)	21.3 (20.1-25.8)	19 (19-19)	17.5 (17-18.5)	14.8 (12.6-17.4)	20.5 (16.8-21.3)	18.3 (15.1-20.5)	.052
Overall quality judgement (/5, n=30)	3 (3-4)	4.8 (4.1-5)	3.5 (3.5-3.5)	3 (2.5-4)	2.5 (2-3.1)	3 (3-3.5)	3.3 (3-4)	.072
Total score (/80, n=30)	48.5 (46.5-53)	64.3 (58.5-66.3)	43.5 (43.5-43.5)	49 (45.5-52)	40.3 (34.8-47)	52 (45.5-54.3)	50 (45.1-53.1)	**.034**

Abbreviations: DISCERN = DISCERN quality criteria for consumer health information; HONcode = Health on the Net Foundation Code of Conduct checklist.

Note: Data are displayed as median (interquartile range) or n (% of overall). P-values were produced using Kruskal-Wallis tests. Significant figures are in bold.

Content

Twenty-eight out of 48 videos (58%) addressed vaccine science and mechanisms. Twenty-eight videos also discussed vaccine trials and 23 videos discussed vaccine safety or side effects. Ten videos advocated the importance of continued traditional public health measures reducing COVID-19 transmission (e.g. hand washing, wearing face masks and social distancing).

Regarding non-factual content, two videos (1 internet media, 1 independently produced) contained unsubstantiated vaccine safety concerns, despite YouTube's aforementioned COVID-19 misinformation policy. Both videos were interviews with a single prominent anti-vaccination advocate. These two non-factual videos accounted for 390,927 views (1.3% of total viewership).

HONcode and DISCERN

There was strong inter-rater agreement for both HONcode principles (94% (93-97%), k=0.81 (0.73-0.87)) and DISCERN (88% (82-94%), k=0.83 (0.76-0.91)).

Forty-seven out of 48 videos (98%) had either low (56%), or moderate (42%) adherence to HONcode. In general, videos scored poorly regarding disclosure of financial sources and advertising (Table 4). Regarding the 'authoritative' domain, only approximately half of the videos involved input from a medical professional or relevant scientist. Additionally, only a minority of videos fulfilled criteria relating to the 'attribution', 'justifiability' and 'transparency' of the data presented.

Table 4. Description of HONCode principles and the number of COVID-19 vaccine YouTube videos that met each criteria.

Principle	Description	n (%)
Authoritative	Any medical or health advice provided in this video will only be given by medically trained and qualified professionals unless a clear statement is made that a piece of advice offered is from a non-medically qualified individual or organisation.	27 (56)
Complementary	The information provided is designed to support, not replace, the relationship that exists between a patient and his/her existing physician.	38 (79)
Privacy	The information in the video maintains the right to confidentiality and respect of the individual patient featured.	0 (0)
Attribution	Where appropriate, information contained on the video will be supported by clear references to source data and, where possible, have specific links to that data.	20 (42)
Justifiability	Any claims relating to the benefits/performance of a specific treatment, commercial product or service will be supported by appropriate, balanced evidence in the manner outlined above in Principle 4.	20 (42)
Transparency	The designers of the video will seek to provide information in the clearest possible manner and provide contact addresses for viewers that seek further information or support.	17 (35)
Financial disclosure	Support for this video will be clearly identified, including the identities of commercial and non-commercial organisations that have contributed funding, services or material for the video.	7 (15)
Advertising policy	If advertising is a source of funding it will be clearly stated. Advertising and other promotional material will be presented to viewers in a manner and context that facilitates differentiation between it and the original content.	2 (4)

Abbreviations: HONcode = Health on the Net Foundation Code of Conduct checklist.

Note: HONCode criteria adapted from Goobie et al. (2019) [8].

There were significant differences in DISCERN reliability and overall scores between different channel types (p<.001, p=.034 respectively). Educational channels produced by medical professionals attained the greatest median (IQR) DISCERN scores for reliability (35.5 (32-39.4)), quality (21.3 (20.1-25.8)), user judgement (4.8 (4.1-5)) and overall score (64.3 (58.5-66.3)). Videos produced by independent non-medical individuals achieved the lowest reliability score (18 (18-20). Post-hoc Dunn's test revealed that educational channels produced by medical professionals attained significantly higher overall DISCERN scores than non-medical educational (p=.012), independent (p=.024), internet media (p=.014) and news channels (p<.001). Additionally, both educational channels produced by medical and non-medical professionals achieved significantly higher DISCERN reliability scores than independent non-medical users (p<.001, p<.001), internet media

(p=.007, p=.04) and news channels (p<.001, p=.003).

Regression analysis revealed no significant association between engagement metrics and DISCERN or HONcode scores (p-values are provided in Supplementary Table 3). However, there was a significant positive association between DISCERN and HONcode ratings for all videos included (p<.001, r^2=.583).

Discussion

This study highlights the importance of YouTube as a medium for sharing of curated COVID-19 related information. We demonstrate growing public interest in extracting vaccine-related content from this resource, with the videos shortlisted in this study viewed over 30 million times globally so far, and an average of 1890 comments placed in the discussion thread of each video. The available content appears favourably received, with a mean 14.3 likes per dislike per video. The present study, however, demonstrates the varying quality of information provided on YouTube, with 98% of reviewed content with low to moderate adherence to HONcode principles, and DISCERN reliability scores ranging from 18 (non-medical individuals) to 35.5 (educational channels) out of 40.

Despite variable video quality, our search identified only 2 (4.2%) of videos that would constitute mis- or disinformation, which accounted for only 1.3% of viewership. In comparison, studies evaluating misinformation on YouTube published in March and June 2020 highlighted a significantly higher proportion of videos containing misleading or non-factual information [12, 13]. This is likely as a result of YouTube's COVID-19 Medical Misinformation Policy which came into effect on 14th October 2020. YouTube now operates a 'three strikes' system to prevent users uploading unsubstantiated videos, which parallels Facebook and Twitter's COVID-19 misinformation policies [14, 15]. Whilst the policy explicitly mentions videos incorporating outlandish claims such as the COVID-19 vaccines "kill people who receive them" or "contain a microchip," tackling more insidious forms of misinformation in a timely fashion has proven difficult. Recent criticism of these policies has highlighted their reliance upon scientific consensus from health authorities in order to determine what exactly constitutes misinformation [16]. In such a rapidly developing field, with limited longitudinal evidence, this consensus cannot readily be achieved, which allows time for inaccurate social media content to be shared. This is of particular concern given that previous studies on vaccine hesitancy have demonstrated that videos of a negative tone are more likely to be shared and liked, perpetuating misinformation and confirmation biases [17]. In an effort to swiftly combat

this, there has been increased governmental engagement and centralisation of initiatives to reduce and prevent the spread of misinformation. The World Health Organisation (WHO), in partnership with governmental agencies, has introduced several initiatives to improve public awareness of and to tackle vaccine misinformation (the so-called 'infodemic') on the internet [18,19]. Additionally, social media companies and the UK government have agreed to a package of measures to reduce vaccine disinformation through swift removal of flagged content and increased cooperation with public health bodies to ensure authoritative messages regarding vaccine safety are disseminated to as many individuals as possible [20].

As well as user-facing policies, several other strategies have been suggested to limit the dissemination of false health information on social media sites. These include mobilising medical professionals as advocates to counter the propagation of misinformation [21]. Amongst the videos reviewed in our study, less than a third were posted by non-profit/medical organisations or medical professionals, a lower proportion than news agencies. Furthermore, videos from established health-related organisations such as JAMA or WHO only accounted for 25% of viewership. Whilst there has been an exponential growth in medical YouTubers and despite the fact that videos produced by these individuals achieved the highest reliability and quality scores, as with other studies, we find that their current role remains limited [22]. Of note, the most viewed shortlisted video was developed by the JAMA Network, which may suggest the importance of brand recognition or marketing in attracting audiences.

In addition to the varied provenance of available vaccine content, we identified a paucity of reliable information available on YouTube. Videos produced by reputable health-related organisations were only significantly more reliable than that from non-medical individual users (p=.007) and were of similar reliability to content from all other categories. The majority also only achieved 'low adherence' to HONcode principles. Even though most of the videos produced by these non-profit/medical organisations explained vaccine concepts in a clear and approachable manner,

often utilising the ‘infographic’ format, they did not cite sources or provide links to further information, a common phenomenon in videos produced by established YouTube educational channels. Thus, these videos were unable to fulfil both DISCERN reliablity indicators (e.g. ‘referencing of information’ and ‘directing viewers to additional sources of knowledge’) and HONcode principles (e.g. attribution and transparency) and were unable to attain high scores.

Whilst non-factual claims were limited to a small minority of videos, the absence of key information, particularly regarding basic vaccinology and the importance of concurrent public health measures, currently limits the utility of YouTube videos as robust sources of public health information. These findings echo those of other studies demonstrating that reliability and quality of non-vaccine-related COVID-19 information on YouTube is unsatisfactory [13,23]. As such, viewers are provided with incomplete evidence as to how the COVID-19 vaccine fits into the larger public health effort and are not provided with curated resources that could potentially provide these pertinent details.

Limitations and future directions

There were some limitations to this study. Firstly, the subset of videos examined were limited to English language only, highlighted by the fact 88% of the videos were from the US or UK YouTube channels. Whilst this represents a language bias and limits the generalisability of findings to different languages and non-English speaking countries, we note that similar findings have been found with respect to COVID-19 information in other languages [13].

Secondly, the search strategy was limited to two search phrases (coronavirus vaccine and COVID-19 vaccine). These phrases will not encompass the various searches the public may make on this topic (e.g. covid vaccine, coronavirus vaccination or covid vaccination) which could yield different video results. Additionally, the search terms used were ‘neutral’ and may not reflect searches made by individuals who (1) have already been previously subjected to misinformation, (2) have a network who share similar misinformation content, or (3) are part of groups more likely to look for misinformation.

Thirdly, videos were first screened by title relevance and for the purposes of pragmatism, only videos that had titles relevant to five domains of vaccine information (vaccine mechanisms, clinical trial procedures, manufacturing processes, side effects/safety, and vaccine efficacy) were considered for full video analysis. However, videos with non-relevant titles may still contain relevant vaccination information and given that they are accessible by the public through neutral search terms, they could contribute towards dissemination of incorrect or low-quality information. Additionally, a large majority of search results were excluded at the screening stage, resulting in a relatively small sample size. This process may have introduced selection bias, limiting the generalisability of findings of this study. For completeness of reporting in the future, all videos in search results should be analysed for low-quality/incorrect information.

Fourthly, the search was conducted at a single timepoint (December 2020) which was relatively early in the timeline of global vaccine distribution. Given the dynamic nature of the COVID-19 pandemic and vaccine development, knowledge and attitudes regarding vaccination may evolve with increased scientific understanding and public health interventions. Moreover, the included search results included videos produced in late March and April when vaccine development was still in its early stages. Therefore, topics such as vaccine manufacturing, efficacy or safety were not discussed in this early cohort. These videos instead concentrated on explanation of vaccine science and clinical trial methodology. A cross-sectional analysis of YouTube videos through searches at multiple time points, or stratified by video age, could be conducted in the future to assess progression of video content and quality.

Fifthly, although used in previous studies assessing YouTube as a source of medical information, DISCERN and HONcode were developed and validated for assessment of written medical information. However, a strong inter-rater agreement between the scoring systems suggests they are reasonable tools to use in the absence of a validated alternative.

Finally, although efforts were made to reduce selection bias by performing the search in an incognito

window, the physical search location could still be revealed to YouTube through internet protocol (IP) address. As such, further studies should consider looking at the nature of content that users are exposed to at different locations, perhaps stratifying analysis using socioeconomic markers such as index of multiple deprivation. Additionally, routes of misinformation may vary depending on culture, education level and even at a national level. Social and ethnic determinants have been demonstrated to impact vaccine hesitancy [24, 25]. It is important to understand the drivers of vaccine hesitancy and develop high-quality, widely available educational resources to target these demographics and improve vaccine uptake. Creating videos in collaboration with medical professionals and taking advantage of YouTube's widespread reach represents one potential solution.

Conclusions

The findings of this study demonstrate that YouTube videos produced by educational channels, especially those maintained by medical professionals, achieve the highest quality and reliability metrics. Consistent with previous similar studies, this suggests that there is currently a missed opportunity in collaboration between respected health-related organisations and established educational YouTube content producers to disseminate high-quality COVID-19 vaccine information [26]. This could potentially be a rapidly implementable public health intervention to engage a wider audience and increase public awareness and knowledge.

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Not applicable

Consent for publication:

Not applicable

Availability of data and materials:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflicts of interest

None declared.

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Abbreviations

HonCODE: Health on the Net Foundation Code of Conduct

Supplementary Files

Figures

Flow of the COVID-19 vaccine video review process.